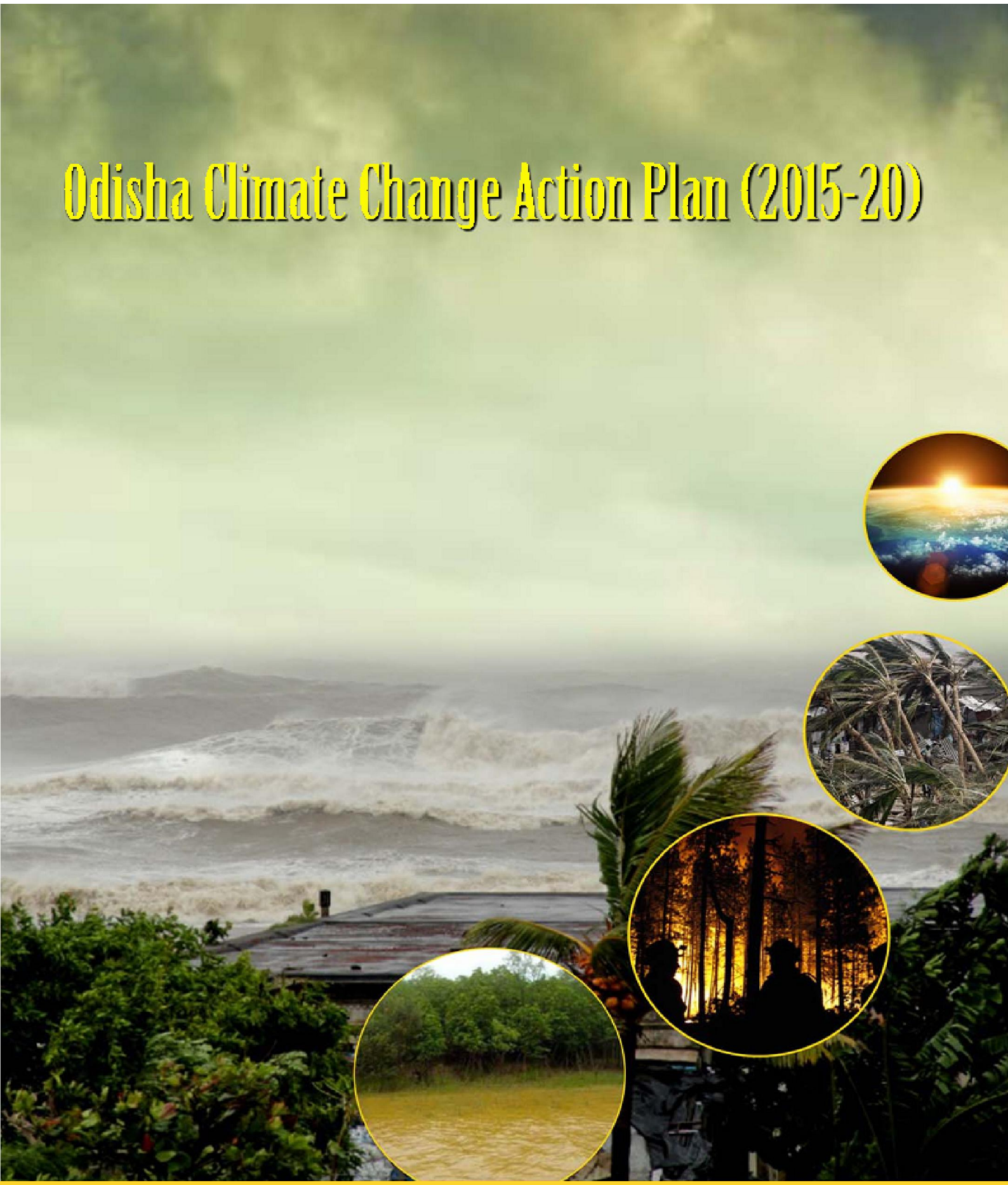
Odisha Climate Change Action Plan (2015-20)



Climate Change Cell
Forest and Environment Department, Government of Odisha

2015

Odisha State Action Plan on Climate Change (2015-20)

DRAFT REPORT

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Tables

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Abbreviations

ANR	Assisted Natural Regeneration
ARD	Animal Resources Development
AR5	Fifth Assessment Report
BPL	below poverty line
BRTS	bus rapid transport system
CAMPA	Compensatory Afforestation Fund Management and Planning Authority
CARS	U.S. Consumer Assistance to Recycle and Save
CBDR	Common But Differential Responsibility
CBDRF	Community-Based Disaster Risk Reduction Framework
CDM	clean development mechanism
CDP	comprehensive development plan/city development plan
CER	certified emissions reduction
CESR	Central Electrical Supply Undertaking
CFM	community forest management
CII	Confederation of Indian Industry
CNG	compressed natural gas
CRZ	Coastal Regulation Zone
CSR	corporate social responsibility
CVI	coastal vulnerability index
DFE	Department of Forest and Environment (Odisha)
DFID	Department for International Development (United Kingdom)
DPR	detailed project report
DRM	disaster risk management
DRR	disaster risk reduction
ECBVC	Energy Conservation Building Code
ENSO	El Niño Southern Oscillation
ENVIS	Environmental Information System
ETP	effluent treatment plant
GCM	global climate model
GEDCOL	Green Energy Development Corporation of Odisha Limited
GHG	greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GMAC	Green Manufacturing Committee
ICZM	Integrated Coastal Zone Management
IEC	information, education, and communication
IFC	International Finance Corporation
IITM	Indian Institute of Tropical Meteorology
IMD	Indian Meteorological Department
INCOIS	Indian National Centre for Ocean Information Services
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IPICOL	Industrial Promotion and Investment Corporation Limited
ITK	indigenous technical knowledge
IWRM	Integrated Water Resources Management
JFM	joint forestry management
JICA	Japan International Cooperation Agency
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
KVIC	Khadi and Village Industry Commission
KVK	Krishi Vigyan Kendras
LAC	livestock assistance centre
LIP	life irrigation project

LPG	liquefied petroleum gas
LULUCF	land use, land use change, and forestry
MCL	Mahanadi Coal Fields Ltd
MCS	multipurpose flood and cyclone shelter
MDGs	Millennium Development Goals
MJO	Madden Julian Oscillation
MNRE	Ministry of New and Renewable Energy
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MoEF	Ministry of Environment and Forests
MRP	mixed recall period
MRTS	mass rapid transit system
MRV	monitoring, reporting, and verification
MSME	micro, small, and medium enterprises
MSW	municipal solid waste
MT	million Tonnes
NABARD	National Bank for Agriculture and Rural Development
NALCO	National Aluminium Company
NAMA	Nationally Appropriate Mitigation Action
NAPCC	national action plan on climate change
NCRMP	National Cyclone Risk Management Project
NFHS	National Family Health Survey
NICRA	National Initiative on Climate Resilient Agriculture
NLTA	non-lending technical assistance
NMEE	National Mission on Energy Efficiency
NMSA	National Mission on Sustainable Agriculture
NSSO	National Sample Survey Organisation
OBDA	Odisha Bamboo Development Agency
OCTMP	Odisha Community Tank Management Project
ODRP	Odisha Disaster Recovery Project
OECBC	Odisha Energy Conservation Building Code
OHPC	Odisha Hydropower Corporation
OLIC	Odisha Lift Irrigation Corporation
OMFED	Orissa State Cooperative Milk Producers' Federation Limited
OREDA	Orissa Renewable Energy Development Agency
OSDMA	Odisha State Disaster Mitigation Agency
OSPCB	Odisha State Pollution Control Board
OUAT	Odisha University of Agriculture and Technology
PAT	perform, achieve, and trade
PFM	participatory forestry management
PHEO	Public Health Engineering Organisation
PLF	plant load factor
PML	probable maximum loss
PPP	public-private partnership
PSU	public sector undertaking
R-APDRP	Redesigned Accelerated Power Development and Reform Programme
RCP	Representative Concentration Pathway
REDD	Reduction in Deforestation and Degradation
RPO	Renewable Power Obligation
RTDAS	real-time data acquisition system
SAAQM	State Ambient Air Quality Monitoring Network
SAPCC	state action plan on climate change
SC	scheduled caste
SDG	Sustainable Development Goal

SME	small and medium enterprise
SPCB	State Pollution Control Board
SRI	system of rice intensification
ST	scheduled tribe
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention for Climate Change
UNISDR	United Nations Office for Disaster Risk Reduction
VSS	Vana Surakhya Samities
WUA	water users association

EXECUTIVE SUMMARY

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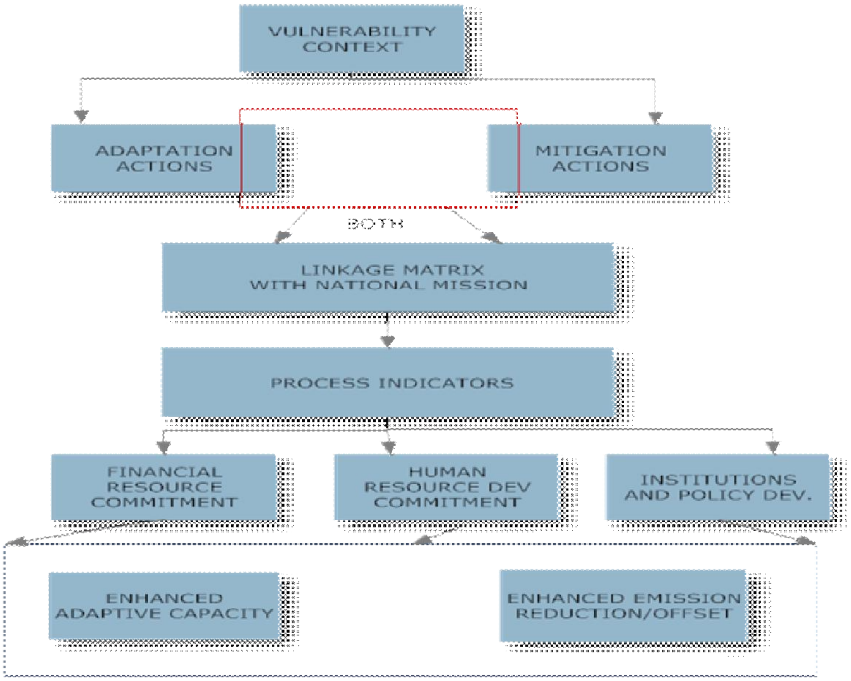
Odiha has 480 kilometres of coastline stretching from West Bengal to Andhra Pradesh, and it is a hotbed of climatic events. Odisha is India's eighth largest state, comprising 4.7 percent of India's land mass, 3.37 percent of its population (some 42 million people), and over 5 percent of its poor. Although poverty levels fell from 57 percent in 2004/05 to around 33 percent in 2011/12 (Government of Odisha 2014), the proportion of poor in Odisha remains well above the national average of around 22 percent. As clearly stated in every climate change discourse, high poverty level, high percentage of indigenous communities with high natural resource dependency make the state extremely vulnerable to climate change. Its rapidly growing economy (above national average) and rapid urbanisation of many agglomerations too pose a challenge for mitigation. On September 4, 2014, the Chief Secretary of Odisha convened a meeting to review the progress of State Action Plan on Climate Change (2010-2015). The presentations and discussions resulted in the announcement of the need to develop the second State Climate Change Action Plan for 2015-2020 to address the drivers of climate change, to prepare for its likely impacts in Odisha, and to establish goals and timetables for implementation of a sound operational action plan for the next five years.

The announcement emphasized Odisha's particular vulnerability to climate change impacts of sea level rise, increased storm intensity, extreme droughts and heat waves, and increased wind and rainfall events. It once again recognized that human activities such as coastal development, burning of fossil fuels, and increasing greenhouse gas (GHG) emissions are contributing to the causes and consequences of climate change. The Chief Secretary noted Odisha's ongoing climate change related initiatives, and emphasized that continued leadership by the State and local governments was imperative.

The State Action Plan on Climate Change Cell (Climate Change Cell) functioning within the Department of Forest and Environment (DoFE) was assigned to document the progress made by the state, identify where gaps were from the Phase 1 (2010-2015), and to coordinate the development of a sound operational action plan for 2015 and 2020. The SAPCC 2015-2020 follows the format of the first plan and it is structured using the Monitoring Framework of the progress report and also refers to the co-benefits. Therefore, the SAPCC 2015-2020 must be viewed in conjunction of these reports and not in isolation.

The Structure of SAPCC 2015-2020

The report has close linkage with the national action plan and associated missions, an important foundation for the State Action Plan on Climate Change (SAPCC). The report delineates state-level assessment of the likely consequences of the changing global climate on Odisha's agriculture, industry, forest resources, environmental priorities, energy requirements, fisheries resources, freshwater supply, aquatic and terrestrial ecosystems, and human health. The Cell coordinated with a working group of department nodal officers, consultants and experts for peer review, to conduct assessments, extensive literature review and model projections.



State Climate Vulnerabilities

The SAPCC 2015-2020 highlights the current and future vulnerabilities of Odisha under different scenarios based on scientific assessments. It also summarizes some major climatic events and their impacts as well as exposure to such events that likely to happen in future.

Rainfall patterns in Odisha have been more erratic since the 1960s, with below-normal rainfall across all districts being recorded for most years. The "normal" 120 days of monsoon rain has shrunk to 60–70 days, and unusual spikes in rainfall, with torrential rainfall of over 200–250 millimetres/day, are more frequent during the monsoon, frequently resulting in floods. This situation has had a strong influence on agriculture, especially during rabi season, because of the reduced residual moisture.

By 2100, the mean annual temperature globally is projected to increase by one to five degrees Celsius (24.5°C in 1970 to 28.5°C in 2080), depending on the A2 scenario in IPCC AR5 and location. Coastal Odisha will remain relatively less warm than the rest of the state, even though it clearly breaches the 2°C barrier. North-western, western, and south-western Odisha show the highest rise in temperature. This temperature rise is certainly at an unsustainable level, assuming the current

challenges of global warming are not mitigated. This factor will have an increasingly larger impact on terrestrial and marine ecosystems.

According to the costal vulnerability index (CVI) study by the Indian National Centre for Ocean Information Services (INCOIS), vulnerability, loss and damage from sea level rise, coastal geomorphology, tidal range, and elevation in the area of Odisha coastline varied from "low" in about 76 kilometres of the coastal stretch of Odisha state, covering parts of Ganjam, Chilka, southern Puri, and Kendrapara, and to "medium" in about 297 kilometres, covering northern Ganjam, Chilka, central Puri, Jagatsinghpur, Kendrapara, southern Bhadrak, and northern Balasore, and to "high" in about 107 kilometres, covering northern Puri, parts of Jagatsinghpur, Kendrapara, northern and southern Bhadrak, and southern Balasore. Chapter 2 provides details of some of the other Key Vulnerabilities including aspects that stem form urbanization and changing socioeconomic factors.

Greenhouse Gas Inventory - Odisha

A GHG inventory mapping exercise was undertaken by the state during preparation of the SAPCC in 2011 and to review the changes in state's carbon footprint, a second study was conducted in 2014 with support of the Confederation of Indian Industries (CII). This emissions inventory was carried out using IPCC guidelines and it is aligned with the "India Greenhouse Gas Emissions Report 2007."

The carbon footprint study indicates that the state has emissions of 98.525 mega tonnes of CO2-equivalent (baseline year 2012). The per capita emissions of the state are 2.35 metric tonnes, which is higher than the national average of 1.7 metric tonnes (estimated as per 2007 baseline as presented in 2010-15 SAPCC.

To reduce emissions and follow a low-emissions growth strategy CII has made 11 specific recommendations many of which are listed as a part of the SAPCC 2015-2020 planned actions.

Table: Comparison of GHG Emissions in Last Five Years, Odisha

Sector	CO_2 – equivalent (megatonnes)		
	As per SAPCC I (2010-15)	As per SAPCC II (2015-20)	Change
Industry, Transport, Energy Sector	82.68	109.77	6.0%
Agriculture[a]	-	25.07	
Waste[b]	0.56	0.66	42.4%
Subtotal (a)	83.24	135.49	
Forest (LULUCF) (b)	- 4.56	-36.9	1.8%
Total (a+b)	78.68	98.52	11.4%
Per capita emission	1.88	2.35	11.4%

Adaptation Measures

With over 485 kilometres of coastline, Odisha is in a precarious position when it comes to the impacts of climate change. Odisha's coast is particularly vulnerable to both episodic storm events, such as cyclones, as well as chronic problems associated with shore erosion, coastal flooding, storm surge, and inundation. Odisha also has 10 climatic zones each of which require development of distinct adaptation strategies for various sectors.

Mitigation Measures

While the Climate Change Cell has assembled a listing of investments that will help the state mitigate effects of climate change, there is still a need to develop a Comprehensive GHG and Carbon Footprint Reduction Strategy. As part of the implementation plan the Cell also analyzes the science-based GHG emission scenarios with different level of mitigation targets and measures in the long term.

Actions and Budget

The SAPCC 2015-20 includes about 56 specific actions that will enable the state design investments that will enable adapt to changes in climate. The action plan also recommends Odisha to implement 35 GHG reduction strategies to begin reducing global warming. SAPCC 2016-20 includes 11 actions that have both resilience/mitigative and adaptive features. The total estimated budget required to implement all 102 actions will be about Rs 31,663.58 Crores. Based on current state budgetary allocations and using best estimate of projections the state will have about 20,357 Crores available for investing into these actions. There will be a shortfall of about 11,306 Crores to be mobilised from other sources.

Implementation

The implementation of the actions will be the responsibility of the various departments. The plan outlines a comprehensive coordination and knowledge management role for the Cell to be provided to departments in a way that ensures quality implementation by using robust monitoring, evaluation and verification systems. As a part of the state's funding strategy, various climate financing options are identified in order to possibly fill the financial gaps in addition to the budgetary sources of the state or central sector schemes.

Some of the actions listed in SAPCC 2015-2020 will require enabling legislations/policy framework that must be developed and adapted to ensure that climate change related investments are mainstreamed into annual and long-term plans.

The action plans provides opportunity to develop policy/legislations in the following areas:

- Adopting energy efficiency standards based on performance

- Amending state building codes and development codes to improve land use, transport, and energy efficiencies
- Strengthening Odisha's renewable energy policy, portfolio and related standards
- Strengthen multi sector initiatives that cater to challenges related to poverty reduction and enhance adaptive capacity

Action plan matrix (2015–20)

Agriculture

Odisha is an agrarian state with 70 percent of the state's population depending on agriculture and allied sector. Of the total geographical area of the state, about 39.69 percent consists of land under cultivation. Increasing agricultural production and productivity is necessary for ensuring food security, livelihood security, and nutritional security.

Even though the quantum of rainfall in Odisha is quite high, its distribution during the monsoon period is turning out to be highly uneven and erratic. As a result, flood and drought occur regularly with varying intensity. During extreme weather events, the damage to crops has been significant. The frequent occurrences of natural calamities are impacting the production of kharif rice. In drought years, there is a considerable loss in production of pulses and oilseeds both during kharif and rabi. This in turn is likely to impacts the state's food security. The prioritised activities proposed by the agricultural departments are outlined as follows.

Agriculture – Key Priorities

1. Continue the livelihood-focused, people-centric integrated watershed development programmes in rain-fed areas vulnerable to climatic variations.
2. Establish an institutional delivery mechanism to promote best practices on climate change
3. Capacity building of extension personnel
4. Increase the area under fruit crops to help cope with uncertain weather patterns
5. Develop water-efficient micro-irrigation methods: individual and community farm ponds
6. Ensure coordination by the National Mission on Sustainable Agriculture (NMSA) of climate change adaptation initiatives
7. Create awareness among farmers of climate change adaptation.
8. Establish an automated weather station
9. Establish a seed bank at the village level.
10. Promote SRI.
11. Encourage the adoption of climate-resilient cropping techniques.
12. Document Indigenous Technical Knowledge (ITK) in agriculture.
13. Green energy efficient models for farmers

Coast and Disaster Risk Management

Coasts & Disasters – Key Priorities

1. Undertake a micro-level vulnerability assessment of state resources in coastal areas (construction of saline embankments under the National Cyclone Risk Management Project, NCRMP).
2. Construct multipurpose flood and cyclone shelters (MCS) and provide shelter-level equipment.
3. Develop a techno-legal regime for the construction of disaster-resilient public infrastructure (construction of approach roads to MCS buildings under the NCRMP) and include Odisha Disaster Recovery Project (ODRP) project for housing, etc.
4. Set up an integrated capacity-building protocol covering shelter and a self-help group under the Community-Based Disaster Risk Reduction Framework (CBDRF), including college and school volunteers and officials at the state and district levels

Odisha has a coastline spanning 480 kilometres that covers six districts: Balasore, Bhadrak, Kendrapada, Jagatsinghpur, Puri, and Ganjam. The coastal and marine environment plays a critical role in the socioeconomic, cultural, and environmental well-being of the state. It has strong linkages to industrial development, agriculture, aquaculture, recreation, and port-related transport and commerce.

The loss of land to the sea has become a more recurrent phenomenon. Ocean dynamics and coastal processes have a strong link to climate change. They also have strong links to various disasters that are likely to confront the state quite often. The prioritised activities proposed by the Coast and Disaster Management sector are outlined as follows.

Energy

Odisha has reasonable water resources for hydropower and substantive coal for thermal power. This unique combination has helped the state to remain a balanced and surplus power producer for the nation. The vulnerability here has a dualism. The enhanced demand from within and outside the state for thermal power production would certainly increase emissions. This will in turn increase the state's contribution to global warming and also result in significant environmental pollution. The sector itself is also vulnerable to climate change. Generation of hydropower will be directly affected by the erratic monsoon seasons and conflict with agricultural and industrial water uses. In the long term, there does not seem to be a major change in the precipitation level at the aggregate level. The temperature increase might affect the plant load factor (PLF) of the power plants. It will also increase the cooling demands of consumers and add stress to the already overloaded distribution network of the state.

Energy – Key Priorities

1. Generate power through clean coal approaches
2. Undertake institutional development
3. Reduce T&D losses and improve the distribution system
4. Improve energy efficiency
5. Utilise fly ash
6. Promote small and medium hydel (hydroelectric) plants
7. Promote biomass and wind generation
8. Maximise solar energy generation potential (GEDCOL).
9. Promote biogas and manure management
10. Effective Fly-ash utilisation
11. Promotion of small and medium hydel plants
12. Maximising and harnessing bio-mass potential
13. Promotion of grid connected wind power
14. Maximising solar energy generation potential (GEDCOL)
15. Bio-gas and manure management

Very severe Cyclone Phailin recently exposed the vulnerability of the power network of the state. Immediately after the cyclone, the power demand in Odisha dipped to as low as 600 megawatts, 22 percent of the 2,800 megawatts normally registered in the state, bringing the regional grid under stress. Up to seven lines of 400 kilovolts, 17 lines of 220 kilovolts, and 19 lines of 132 kilovolts were affected in the state. It also affected several 11-kilovolt lines and 3.8 million consumers.

The state has an ambitious target for the integration of renewable energy. However, wind installations along the coasts are not fully cyclone-proof, and the

cloud cover and prolonged rainy days may negatively affect the state's solar power generation. The prioritised activities proposed in the energy sector are as follows:

Fishery and Animal Resources Development

Fishery and animal resources are fully integrated into the agriculture system of the country and more so in several parts of Odisha. Unlike in many other parts of the country, livestock holding in Odisha is equitable; over 80 percent of all livestock are owned by the marginal/small holders and the landless. Small ruminants, poultry birds, and aquaculture are highly vulnerable to climate change.

Fisheries & ARD – Key Priorities

1. Scientific Animal Health Management
2. Improved feeding management
3. Capacity building of livestock keepers
4. Breeding Management
5. Better Waste Management
6. Research on easy Methane Harvest Technology
7. Research on Disease Early Warning System
8. Loss of livelihood due to ban and climate change related implications on the fishery livelihood
9. Study on climate change and catch of marine fish
10. Impact of exuberated extreme climatic events due to climate change
11. Protection of Fisheries infrastructure and assets
12. Finishing methods and gears
13. Health and sanitation in the coastal area
14. Fishermen welfare activities

The rise in the surface temperature of the water is likely to result in sifting of species and a smaller catch in traditional areas. It will also boost the operating costs in the ponds for increasing the aeration and de-silting the river mouth. Major carp such as rohu, katla, and mirgal, are likely to show early maturity (before monsoon) and have lower survival rates because of more predators and infestation. For livestock, higher temperatures mean reduced dead storage. And poor water quality means more diseases, reduced milk production, and higher mortality in small ruminants and poultry. Floods and cyclonic weather alter the salinity of the water; damage spawns in the breeding season. High tidal surges in coastal areas are likely to inundate landmass and affect the mangroves. These are likely to damage freshwater, freshwater exchange, and several brackish water species. Loss of estuarine areas are likely to affects the quality and quantity of fish. The prioritised activities proposed in the Fishery and animal resources development sector are as follows:

Forestry

Forests are not just about flora and fauna; they also support a large number of forest-dependent communities (especially scheduled tribes) in the states. In Odisha, forests cover about 37.34 percent of the state's geographic area. According to the Forest Survey of India (FSI), there has been an increase in the forest cover in the state. This improvement has been possible because of the enhanced conservation and plantation drive. In view of the high diversity, tree density, and low fragmentation of the Odisha forest, if protected properly it is likely to be the resource least vulnerable to climate change under the A1 and B2 scenarios. However, the temperature rise might affect micro-flora and fauna in northern Odisha and the south-western part of Odisha and adversely affect the biodiversity. The prioritised activities proposed in the forestry and environment sector are as follows:

Forestry – Key Priorities

1. Increase the forest cover of the state by undertaking afforestation and reforestation measures
2. Enhance the density of forests by undertaking assisted natural regeneration (ANR) and protecting existing forest stocks to act as a carbon sink with stronger conservation
3. Increase planting on non-forest land
4. Cover bald hills with suitable species mix
5. Increase and protect existing mangrove cover and coastal biodiversity along the coast.
6. Fire protection
7. Conserve and regenerate bamboo forest
8. Undertake sustainable management of forests and maximisation of forest productivity, preparation of management plans, and scientific forest management through annual coupe working
9. Undertake research studies on indigenous flora and fauna and their vulnerability to climate change
10. Conserve wildlife and its habitat, assessing the threats to biodiversity and wildlife.
11. Implement joint forest management so that people can participate in conservation, management, and regeneration
12. Build the capacity of the department staff in the field to tackle climate change related issues
13. Procure and build communication infrastructure

Health

Natural disasters are common in Odisha because of its specific geo-climatic condition, which makes the state more vulnerable to cyclones, floods, tornados, drought, and heat waves. These climate-induced events result in epidemics that have the potential to cause mass casualties and suffering within a short period of time. From March to October, Odisha experiences calamities such as floods, cyclones, droughts, or heat waves. Floods were experienced in 2003, 2004, 2007, 2011, 2013, and 2014. Eighteen of the state's 30 districts are prone to flood or flash flood. Experiences with the super cyclone of 1999, Super Cyclone "Phailin" of 2013, and frequent floods in the state have resulted in the prevalence of both water-borne and vector-borne diseases in the immediate aftermath. And between March and June, the recorded temperature is above 45°C in 30–40 percent of districts. All 30 districts of Odisha are prone to experiencing heat stress disorders. The prioritised activities proposed in the health sector are as follows:

Health – Key Priorities

1. Build the capacity of health sector personnel on issues relating to climate change.
2. Integrate climate change concerns into the state health policy.
3. Strengthen approaches to managing the vector-borne diseases that worsen because of climate change
4. Strengthen approaches to dealing with heat wave conditions in the state.
5. Undertake measures to manage water-borne diseases that have worsened because of climate change impacts

Industries

The industry and services sectors have emerged as the main drivers of growth during the past decade. The industry sector contributes more than one-third of the state's GDP. A climate change–induced rise in temperature rise reduces industrial activity, increasing down time. Similarly, water scarcity severely affects many industrial processes. Floods and cyclones damage industrial infrastructure and also affect industrial productivity. Industries along the coast such as food processing (aquaculture), chemical, and fertiliser are more vulnerable. The prioritised activities proposed in the industry sector are as follows:

Industries – Key Priorities

1. Devise a mechanism for green belt development and maintenance for industrial clusters
2. Study the feasibility of establishing and operating a bio-methanation process for a food processing cluster in public-private partnership (PPP) mode.
3. Incorporate climate change concerns in the draft SEZ Policy and PCPIR master plan
4. Install a centralised solar heating system in a food processing cluster for supplying hot water
5. Prepare regional environmental management plans for major industrial clusters.
6. Prepare a GHG profile of major industrial clusters and introduce a system of GHG auditing for these sectors
7. Undertake a heat island study of the Angul-Talcher and Jharsuguda-Ib valley areas.
8. Train officials in the Industries Department, Directorate of Industries, IPICOL, SPCB, etc. on various aspects of climate change
9. Devise a mechanism to implement a system of compensatory water harvesting

Mining

Of India's total mineral deposits, Odisha's mineral reserves constitute 28 percent of its iron ore, 24 percent if its coal, 59 percent of its bauxite, and 98 percent of its chromite. The mining sector contributed an average of 7.4 percent of the gross state domestic product in the 11th plan (2007–12), which declined to 6.67 percent in 2013–14, and is likely to decline to 6.31 percent in 2014–15 (the first two years of the 12th plan period). The high level of precipitation will increase the rainwater infiltration on spoil piles, resulting in aquifer-level contamination in coal-bearing areas. The water quality of nearby streams may be affected. Concentrated rainfall will also increase the risk of mining operations and damage the outbound transport infrastructure. Changes in the frequency and intensity of storm events could affect mining operations (e.g., tailing dams, sediment and erosion control). Similarly, the excessive heat that is likely to prevail in the summer months in the northern and western parts of the state would contribute to workers' heat strokes, cause more mining accidents and shorter working hours and lower productivity. The prioritised activities proposed in the mining sector are as follows:

Mining – Key Priorities

1. Prepare regional sustainable mining plans
2. Devise a mechanism for green belt development and maintenance in mining clusters
3. Create an environmental restoration fund supported by contributions from mining companies
4. Prepare an action plan for reclamation and rehabilitation of old abandoned mines.
5. Construct rest shelters with plantations in mining areas to provide shelter during heat wave conditions
6. Supply drinking water in the vicinity of mining clusters
7. Explore cleaner technologies and best practices in coal mining.
8. Conduct a study to determine the potential of coal bed methane in the coal fields of Odisha
9. Develop a methodology to measure, monitor, and verify the amount of carbon sequestered by plantation programmes in the mining sector.

Transport

The transport sector is reliant on oil. Economic growth spurs the sector and consequently both oil consumption and CO2 emissions. This sector is also responsible for the air pollution contributed by ozone, nitrous oxides, and particulates. In 2010, 53 percent of global primary oil consumption was used to meet 94 percent of transport energy demand. In 2007 the Transport Policy of Odisha outlined the following objectives: to increase the competition, efficiency, transparency, accessibility, and availability of transport services in the state. Rising temperatures and extended heat wave periods expedite damage to roads and pavements. In addition, to increase their comfort vehicle users tend to turn on their air conditioning more than before. The use of air-conditioning is further amplified in urban areas as the temperature in those areas is a few degrees higher than in rural areas because of the heat island effects. Higher temperatures also affect rail networks through thermal expansion. The new rail network expanding to Angul and Kalinganagar (Jajpur) is likely to be affected because of the rise in temperatures in these areas. Rising temperatures and extended heat wave periods expedite damage to roads and pavements. In addition, to increase their comfort vehicle users tend to turn on their air conditioning more than before. The use of air-conditioning is further amplified in urban areas as the temperature in those areas is a few degrees higher than in rural areas because of the heat island effects. Higher temperatures also affect rail networks through thermal expansion. The new rail network expanding to Angul and Kalinganagar (Jajpur) is likely to be affected because of the rise in temperatures in these areas. The prioritised activities proposed in the transport sector are as follows:

Transport – Key Priorities

1. Enact policy changes for phasing out old vehicles in order to reduce emissions
2. Ensure fuel efficiency through driver training
3. Strengthen the enforcement and emission check-up system
4. Use liquefied petroleum gas (LPG)
5. Use electric rickshaws (e-rickshaws)

Urban Development

About 17 percent of Odisha's population resides in urban areas. The state has registered remarkable urban growth (about 26.8 percent) during the last decade. The urbanisation trend over the last five decades in the state reveals that the smaller towns (Classes IV, V, and VI) are growing at a faster rate than the bigger towns. The urban centres of Odisha experiencing fast growth are also vulnerable to natural hazards.

Urban – Key Priorities

1. Augmentation of integrated sewerage project for Bhubaneswar and Cuttack municipality
2. Update building byelaws and development control regulations to incorporate CC and DRR considerations
3. Incorporate risk-sensitive land use planning in city's Master Plan
4. Introduce BRTS and MRTS
5. Revise the guidelines for preparation of a master plan, community design plan (CDP), etc. incorporating climate change concerns.
6. Rejuvenate water bodies
7. Promote urban storm water and drainage management for urban flood control

The urban assets and life are exposed increasingly to the risk of cyclone, heat wave, urban flood, health, and earthquake. Urban centres, mainly Class I cities of the state, are also facing the rapid growth of the slum population living in poor building types in environmentally vulnerable pockets. The fast growth of these urban centres leads in turn to the build-up of the surrounding areas, thereby encroaching on low-lying areas and increasing the flood risk. The encroachment of low-lying areas and the clogging of drainage due to the increase in solid waste in the city has led to unhygienic conditions and in turn a high incidence of water- and vector-borne diseases. The prioritised activities proposed in the urban sector are as follows:

Water Resources

The movement of water in the climate system is essential to life on land because much of the water that falls on land as precipitation and supplies the soil moisture and river flow has been evaporated from the ocean and transported to land by the atmosphere. The world is increasingly confronted with mounting evidence of significant alterations in climate patterns stemming from anthropogenic emissions. They cause frequent extreme events such as floods and droughts and are responsible for a rising sea level, leading to submergence of the coastal area and its erosion, quite apart from other consequences. Indirect evidence from scientific data and sea salinity studies show that the pattern of evaporation-precipitation over the oceans has been enhanced since the 1950s. This is likely to have adverse impacts on the spatial and temporal scales in several regions, including India and Odisha. Because the monsoon contributes more than three-fourths of the water in the state's water reserve, any change in monsoon behaviour affects the state's flood- and drought-related vulnerability. The other vulnerability is on the demand side. The bigger problem seems to be the water supply for the rapidly forming urban agglomerations in the state, especially around the industrial clusters. Aquaculture (fresh and brackish) is the other area of the economy affected by the water sector. As per the Odisha State Water Plan, the total water requirement as estimated in 2011 was in the range of 1,085,158.59 million litres. This requirement is likely to be affected if there is a shortfall in rainfall. In the case of floods, the fish escape, and the predatory species damage the aquaculture. The prioritised activities proposed in the water sector are as follows:

Water Resources – Key Priorities

1. Increase water use efficiency in the irrigation sector
2. Conserve water resources
3. Improve flood control and drainage
4. Assess the impact of climate change on the state's water resources.

Waste Management

With rapid growth of industrialization, mining as well as urbanization the waste generation in Odisha has also seen a sharp growth. As per Odisha State Pollution Control Board, The average MSW generation in Odisha has been found to be around 2293.3 tons per day in all ULB across the state in 2014. If waste generated is not properly managed, especially faecal matters and other liquid and solid waste from households then it may lead to serious health hazard and spread of infectious diseases. Unattended waste lying around attracts flies, rats, and other creatures that in turn spread disease. Normally it is the wet waste that decomposes and releases a bad odour. This leads to unhygienic conditions and thereby gives rise to health problems. The prioritised activities proposed in the waste sector are as follows:

Waste Management – Key Priorities

1. Awareness generation for management of various kinds of waste
2. Waste to energy projects in PPP mode
3. Management Municipal Solid Waste
4. Fly ash utilisation

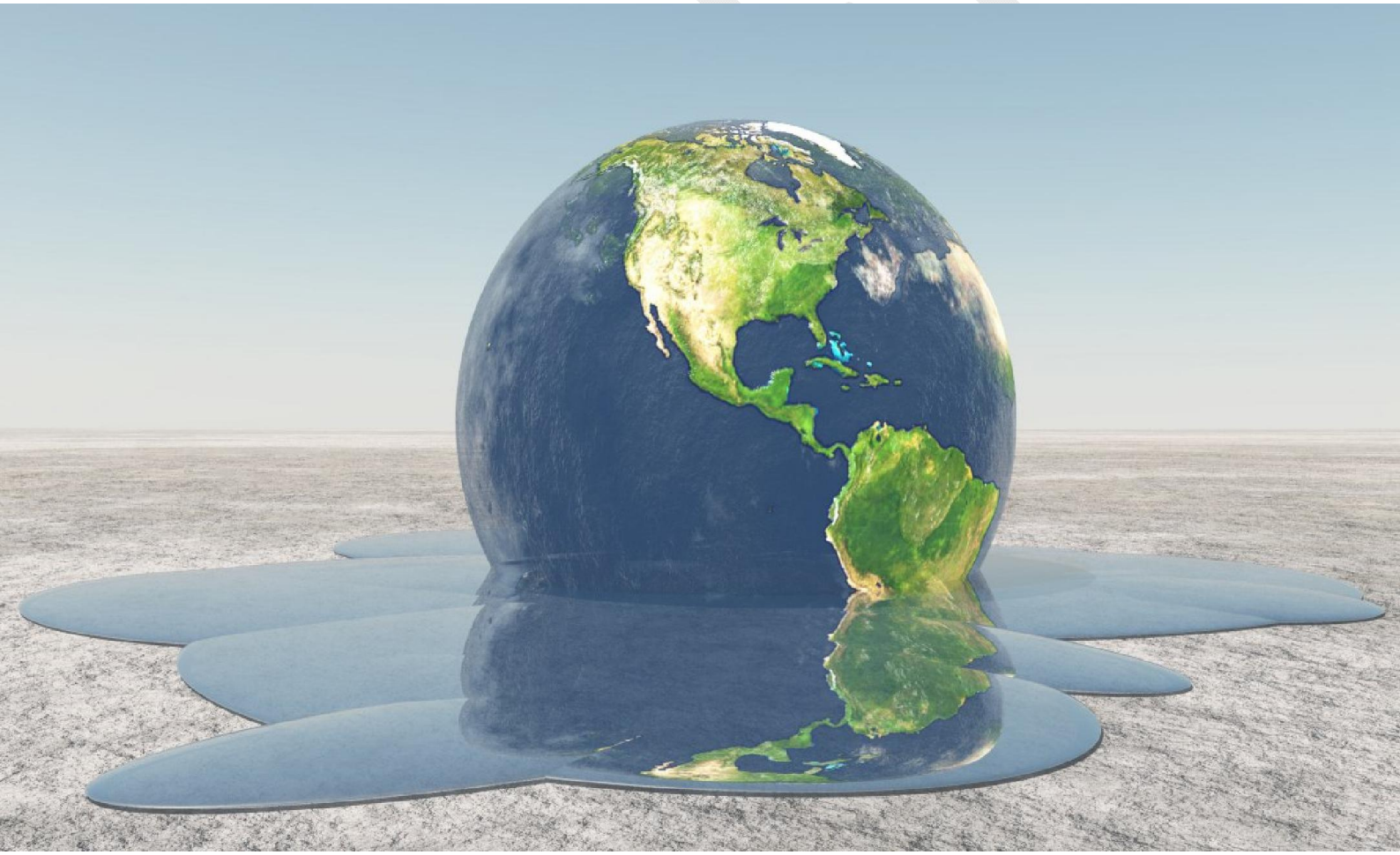
Conclusions and Recommendations

The formulation of SAPCC 2015-2020 highlighted some of the key lessons learned since formulation of the first SAPCC. Despite the limitation and uncertainty in climate models at state level, it has been clearly understood in the context of Odisha that climate change has both a socioeconomic cost and a socio-political cost. A broad vision that factors in sustainable development is pragmatic; factoring climate change concerns into the developmental planning process, has progressed with more understanding and assimilation of the planning process of SAPCC. The action plan is aligning new missions being added at the national level (e.g., coast and disaster risk management, health, waste to energy; out of which Odisha already highlighted these state specific missions on health and disaster risk reduction in its first SAPCC). Climate Change cell is coordinating with departments to meet the mission targets by close monitoring the SAPCC implementation on a regular basis.

It is heartening to note that the state has had consistently higher allocations to climate change in its budget and has reported the progress in a transparent manner. About Rs 6000 crore per year has been designated for climate-related activities. Thus clearly the state has taken the climate change issue seriously and is taking action on it. In contrast, it was also revealed that climate financing should be mobilized more aggressively so that pressure is reduced on the state budget.

Chapter 1

INTRODUCTION



INTRODUCTION

1.1 India's scenario

The United Nations Framework Convention for Climate Change (UNFCCC) is engaging both developed and developing countries in reaching a global agreement on a work plan beyond 2020 at the Paris Conference of Parties (COP) scheduled for December 2015. By October 2015, all the participating countries, including India, have to declare their Intended Nationally Determined Contribution (INDC). India is also preparing Nationally Appropriate Mitigation Actions (NAMAs) in time for the Paris COP. In other developments, in 2015 a set of Sustainable Development Goals (SDGs) will replace the UN's Millennium Development Goals (MDGs). The SDGs will largely shape the policy landscape on climate change adaptation and mitigation.

India has already engaged in intense deliberations on giving equal emphasis to adaptation and mitigation and on establishing targets and mobilizing funds for both. The country also has initiated several domestic actions on the energy efficiency and renewable energy fronts. And it was one of the earliest adopters, in 2008, of a national action plan on climate change (NAPCC).

Meanwhile, India has voluntarily agreed to reduce the emission intensity of its gross domestic product (GDP) by 25–30 percent by 2020, and the recent United Nations Environment Programme (UNEP) emissions gap report (2014) envisages that India is on track to achieve its emissions reduction pledge. India is now revisiting national missions under the NAPCC in light of the new scientific information in the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5), and it is placing a great deal of emphasis on adaptation measures in agriculture, water resources, and urban resilience. Several states have also prepared state action plans on climate change (SAPCCs). According to the Economic Survey of India, 2014, an estimated Rs 11,33,692 crore will be needed for implementation of the 31 SAPCCs. This amount is not entirely an addition to the budget.

Odisha is one of the first states in India to prepare a comprehensive state action plan on climate change. This report, the second iteration of that plan, is for the period 2015–20.

1.2 Scientific Assessment

Released in 2014, the Fifth Assessment Report of the IPCC observed that the period 1983–2012 was the warmest 30-year period in the last 1,400 years, largely due to the higher quantum of burning fossil fuel. AR5 estimates that for the temperature increase to remain two degrees Celsius below pre-industrial levels, the world can emit only about 2,900 gigatonnes of CO_2 from all sources from the Industrial Revolution until 2100. As of 2011, the world had emitted 1,900 gigatonnes of CO_2, thereby already consuming about two-thirds of its budget.

Global warming has been responsible for certain irreversible damage to ecosystems around the world. The effects have been manifested in the enhanced frequency and intensity of extreme weather events. The rise in sea level is likely to be 15–20 percent larger in the tropics than the global mean (World Bank 2012). Increases in the intensity of tropical cyclones are likely to be felt disproportionately in low-latitude regions.

Global warming has an adverse impact on the world's economy, livelihoods, cropping patterns, and food security. Major food grains (rice and wheat) and certain kinds of fish are likely to be negatively affected. Health problems will be exacerbated, and in developing countries such as India the frequency of disasters will affect the poverty reduction goals.

The lack of carbon space would also leave India with very little choice but to engage in political brinksmanship over the issue. India's stance in the climate change negotiations has been guided by the principle of common but differentiated responsibility (CBDR). The country thus believes that the climate change agreement of 2015 should take into consideration a whole gamut of issues, including adaptation, finance, technology development and transfer, capacity building, transparency of action and support in a balanced manner, and loss and damage, in addition to mitigation.

1.3 State Scenario

Odisha has 480 kilometres of coastline stretching from West Bengal to Andhra Pradesh, and it is a hotbed of climatic events. Odisha is India's eighth largest state, comprising 4.7 percent of India's land mass, 3.37 percent of its population (some 42 million people), and over 5 percent of its poor. Odisha contributes about 2.5 percent of India's national income. Although poverty levels fell from 57 percent in 2004/05 to around 33 percent in 2011/12 (Government of Odisha 2014), the proportion of poor in Odisha remains well above the national average of around 22 percent, and it is considered a low-income (lagging) state.

However, Odisha has grown quickly over the last few years. It has recovered from a slow growth rate of 2.21 percent in 2013–14 and is expected to grow at a rate of 8.78 percent in 2014–15. Interestingly, the downturn in the state economy in 2013–14 could be attributed to a climatic event. The –9.78 percent growth (at factor cost) in the state's broad agriculture sector stemmed from the effects of a severe cyclone, Phailin, followed by flash floods in October 2013. Agricultural production and procurement, along with yield rates (paddy in particular), fell sharply in 2013–14 as compared with the bumper production in 2012–13. The large-scale damage to power lines and roads reduced growth as well. The manufacturing sector recorded a very low growth rate of 2.16 percent (at factor cost) in 2013–14 (first revised estimate) after a growth rate of –3.47 percent (at factor cost) in 2012–13 (second revised estimate). Stagnant growth rates in the construction subsector (–0.04 percent) and trade, hotel, and restaurant subsector (0.17 percent) and a negative growth rate in the public administration subsector (–1.98 percent) in 2013–14 added to the downswing of the overall growth rate of Odisha during the year. However, the fishery and transport sectors have grown.

According to the Odisha State Disaster Management Authority (OSDMA), for 95 of the last 105 years Odisha has been affected by disasters brought on by heat waves, cyclones, droughts, and floods. Since 1965, these calamities have become more frequent and widespread. Natural calamities have seriously affected household income and set back the state's economy. Odisha is susceptible to cyclones and drought, and its 480 kilometres of coastline also make its coastal communities and infrastructure vulnerable to the rising sea level. A majority of the districts of the state are also affected by heat waves. The rural poor in Odisha depend mostly on agriculture and forest resources (especially the scheduled castes and tribes). The high level of poverty in Odisha is closely tied to the state's low productivity in agriculture.

The National Sample Survey Organisation (NSSO) divides Odisha into three regions: coastal, northern, and southern. From 1993/94 to 2004/05, the incidence of poor fell by 18 percentage points (from 45 percent to 27 percent) in the coastal region, but increased by 4 percentage points (from 68.8 percent to 72.7 percent) in the southern region and 13 percent (from 46 percent to 59 percent) in the northern region. The incidence of poor and calorie-poor is highest in the southern region (73 percent and 91 percent, respectively), followed by the northern and coastal regions. The share of poor is the highest in the northern region (44 percent), but the share of calorie-poor is the highest in the coastal region at 40 percent.

Odisha was among the first states to recognise the threat posed by climate change. Its vulnerability stems from its high poverty levels (43 percent) and its higher than the national average (21 percent) of natural resource dependency, particularly by its large population of indigenous communities. In response, it developed a strategic SAPCC to address this issue. Odisha is also the first state in the country to monitor and report the progress made by its various departments in the areas of adaptation and mitigation. The state's climate change cell has carried out these tasks.

1.3.1 Preparation of the first SAPCC

Odisha was one of the first states in the India to prepare a comprehensive and truly consultative state action plan involving diverse stakeholders. The climate change missions were formulated in 2008 at the national level. However, the states are required to plan actions in different sectors for adaptation and mitigation. The adaptation strategy is aimed at reducing vulnerability and achieving resilience. The mitigation actions are aimed at reducing the energy intensity of the state GDP through a variety of low carbon options in increasing the renewable component of the energy mix, enhancing energy efficiency in several sectors, and reducing emissions. The process of preparation is described in this section. The state-created climate change cell in the Department of Forest and Environment (DFE) coordinates with other line departments to track the progress on proposed actions. The salient milestones appear in figure 1.1.

Figure 1.1 Key Milestones in SAPCC Development in Odisha

Nov 09	• Climate change (CC) scoping study
Feb 10	• Completion of the scoping study
Mar 10	• Establishment of high-level Inter departmental steering committee and working groups
April 10	• Preparation of the draft climate action plan (CAP)
May 10	• Stakeholder consultation
June 10	• Web hosting of the draft CAP
July 10	• Finalization and release after taking into consideration comments
Sept 11	• Appraisal by Expert Committee of the Ministry of Environment and Forestry (MoEF) (CC)
Dec 12	• Endorsement by MoEF
Mar 14	• Monitoring of progress of the climate action plan
July 14	• Completion of the progress monitoring
June 2015	• Second iteration of the SAPCC for 2015-20

1.3.2 Progress summary during the period 2010–15

The climate change cell in the Department of Forest and Environment has produced a detailed progress report on actions taken by state departments in the areas of adaptation and mitigation.

During 2011, 121 priority actions in 11 departments were identified. These actions were considered highly relevant from a public expenditure review standpoint. How the state allocated budgets in these areas of action reflected its level of ambition and commitment to tackling the challenges of climate change.

The state has been sensitive to the need to invest in climate change mitigation and adaptation actions. The budget allocation for climate change–related activities as a percentage of the total budget increased from 3.3 percent in 2012–13 to 3.6 percent in 2013–14 and to 4 percent in 2014–15. These increases largely reflect the highly relevant priorities identified in the first SAPCC.

In addition to benefiting from the non-lending technical assistance offered by the World Bank, the state has undertaken the following activities:

- Implemented a tool for rapid assessment of the energy profiles of the cities of Cuttack, Puri, and Bhubaneswar in order to prioritise areas in which to reduce energy consumption. Key areas are the building sector, street lighting, water pumping, and

transport. The progress made in these areas has been summarised in city background reports, which have been compiled from various sources.

- Local resilience action plans have been developed for the so-called twin cities of Cuttack and Bhubaneswar so they can face the challenges of disaster based on risk and vulnerability assessments and the climate change scenario at the state level.
- A vulnerability assessment has been carried out in the agriculture sector. Pilot programs are being planned in the degraded area of Sundargarh to balance post-mining livelihood restoration using the agroforestry system, in Bhadrak for mangrove restoration, in Balasore to balance the fishing ecosystem, in the Phulbani area for diversification of the cropping system, and in the Bolangir area on a watershed-based livelihood for drought management.
- A voluntary environmental management disclosure programme for the industry and mining sector has been initiated in association with the State Pollution Control Board.
- In the energy sector, a draft integrated renewable energy policy has been prepared, and a concept note to operationalize the Odisha Energy Conservation Building Code has been drafted.

1.3.3 Rationale for this phase (2015–20)

Several changes have been made in the strategy for addressing the evolving challenges in the climate change discourse. The main purpose of preparation of the second SAPCC is

- To understand where gaps are
- To develop a sound operational action plan for the next five years.

The state has taken several initiatives that have strong positive links to both climate change adaptation and mitigation. These activities have been largely financed through the state budget.

The state needs to showcase these initiatives. Some of these are described in the progress report. The new initiatives proposed by the departments for the next phase (2015–20) would be noted in that report as well.

The state has not been able to mobilise the new sources of climate finance that are available globally such as the Adaptation Fund, Green Climate Fund, and Clean Technology Fund, and so it needs to propose investment projects for reducing climate risk and emissions. These would be captured in this phase.

Each state department has been asked to provide a list of measures that are likely to reduce vulnerability, mitigate greenhouse gas (GHG) emissions, and enhance resilience. Stakeholders have been asked to evaluate these measures and prioritise among them, taking into consideration the likely impacts per measure, the resources needed, the co- benefits generated, the timeline, as well as roles and responsibilities. The proposed actions by the departments will serve as the basis for mainstreaming the climate change agenda in their development planning process.

A strong monitoring, reporting, and verification (MRV) system will help not only track the progress but also support project development for climate financing.

The second SAPCC is a continuation of the first SAPCC (June 2011) and its progress monitoring report released in May 2015. It should therefore be seen in conjunction with these documents and not in isolation.

1.4 International discourse on the SAPCC at the Odisha, national, and international levels

Odisha started developing a climate change action plan soon after announcement of the national action plan on climate change. The various missions and their objectives were highlighted in the previous SAPCC. At the national level, the prime minister's council on climate change is the main body for planning. The Ministry of Environment, Forest and Climate Change (MoEFCC) is the nodal department for coordination, and sectoral departments are the partners. At the state level, Odisha links its relevant partner departments to their respective missions, and it adds its state-specific missions based on the perceived needs. Eight missions are currently in operation in the country:

- Mitigation-focused missions aiming to reduce India's GHG emissions
  - National Mission on Energy Efficiency
  - National Solar Mission
  - Green India Mission
- Adaptation-focused missions to build resilience
  - Sustainable Agriculture Mission
  - National Water Mission
  - Himalayan Mission
- Missions common to mitigation and adaptation
  - Sustainable Habitat Mission, which aims at both adaptation and mitigation; considered a service mission
  - Strategic Knowledge Mission to improve the understanding of climate change dissemination.

Recently, the Prime Minister's Council on Climate Change formulated four new missions:

- *Wind Mission*. Modelled on the National Solar Mission, it will improve the renewable share in the energy basket. The Wind Mission may have an initial target of producing about 50,000–60,000 megawatts of power by 2022, the year the 13th five-year plan comes to an end. India already has about 22,000 megawatts of installed capacity in wind energy.
- *Mission on Coastal Ecosystem*. This mission for coastal areas will prepare an integrated coastal resource management plan and map vulnerabilities along India's nearly 7,000 kilometres of shoreline.
- *National Health Mission*. This mission will deal with the effects of climate on human health and build up capacities to respond to these and to health emergencies arising out of natural disasters.
- *Waste to Energy Mission.* This mission will incentivise efforts to harness energy from all

kinds of waste and is again aimed at lowering India's dependence on coal, oil, and gas for power production.

1.4.1 National and state mission linkages

Table 1.1 shows the linkages of the missions under the SAPCC to the national mission.

Table 1.1 Linkages between National and State Missions

Sl no.	Mission	National	Odisha	Remark
1	Sustainable Agriculture Mission	Yes	Yes	Several components are being implemented.
2	Coastal and disaster management	For coastal ecosystems, vulnerability formulation is now under way.	Already formulated	Odisha has undertaken this mission since 2010 and has taken a pioneering role.
3	Energy	National Mission on Energy Efficiency (NMEE), Solar Mission	Currently links NMEE and the National Solar Mission	Will link with the national Wind Mission and the Waste to Energy Mission
4	Fishery and animal resources development (ARD)	Covered under Sustainable Agriculture Mission	Separate mission considering the nature of the mixed cropping system	Already formulated; strong linkages to be built up within the framework of the national mission
5	Green India Mission	Yes	Yes	Aligned with national mission
6	Health	Is now being formulated	Has already been developed	Some implemented since 2010; more detailing will be needed.
7	Industry	No specific mission included under National Mission on	Has gone beyond energy efficiency and also tries to	Odisha mission is even more broad-based.

Sl no.	Mission	National	Odisha	Remark
		Energy Efficiency	address other impacts	
8	Mining	No specific mission	Specific to state	Requires integration and alignment with some components of other mission
9	Transport	No specific mission linked to sustainable habitat	Specific to state	Requires integration and alignment with some components of other missions, especially the Sustainable Habitat Mission
10	Urban	Sustainable Habitat Mission (yes)	Yes	Aligned
11	Water	National Water Mission	Yes	Aligned
12	Strategic Knowledge Mission	Yes	State does not have separate mission but links up.	In the process of alignment

1.4.2 Fiscal instruments

The fiscal instruments, which include carbon finance, are intended to address market failures in the public policy context. With the support of the British Council and the Confederation of Indian Industry (CII), the government of Odisha has undertaken a study to identify the fiscal instruments that can aid low carbon development in the state.

Table 1.2 illustrates the nature of market failures and how the fiscal instruments address them.

Table 1.2 Fiscal and Regulatory Instruments Relevant to Climate Change

Nature of market failure	Relevant sectors in the state	Potential policy response
Environmental externalities (such as when positive and negative consequences are not recognised in the marketplace and are not duly priced)	Coastal zone, industry, mining, forest	Regulations (Coastal Regulation Zone; perform achieve, and trade; Renewable Power Obligations, Feed in Tariff), Compensatory Afforestation Fund Management and Planning Authority (CAMPA)
Climate equity (when the principles such as Common But Differential Responsibility(CBDR), peaking year, etc. are highly contested and common ground is not established)	Energy, industry, agriculture, forestry	Carbon pricing (tradable permits and certified emissions reduction units (CERs) under the Kyoto mechanism and voluntary standards)
Information asymmetry/search costs (ignorance of value and search costs, hoarding, etc.)	Industry, mining, energy, transport, urban development	State-of-the-art low carbon technology, recycle-reuse zero discharge initiatives, clean production systems (subsidies linked to green process, clean production), building codes and higher floor area ratio (FAR) for green building, holding tax reduction
Transaction costs (when unencumbered transactions are a cost to one or the other party) such as in the auction process in the coal and power value chain	Industry, energy, mining	Sector-specific exemption on clean products and technologies, priority tax holidays, export and import concession, VAT exemption, etc.
Property rights (when access is reduced and curtailed by market and nonmarket forces, intellectual property rights for technologies are not respected or protected)	Energy, water, urban development	Pay for use; reduction in nonrevenue water loss through metering, proper metering, and collection system for transmission and distribution (T&D) loss reduction; time-demand–based tariff for transport and incentivising mass transport; parking space management;

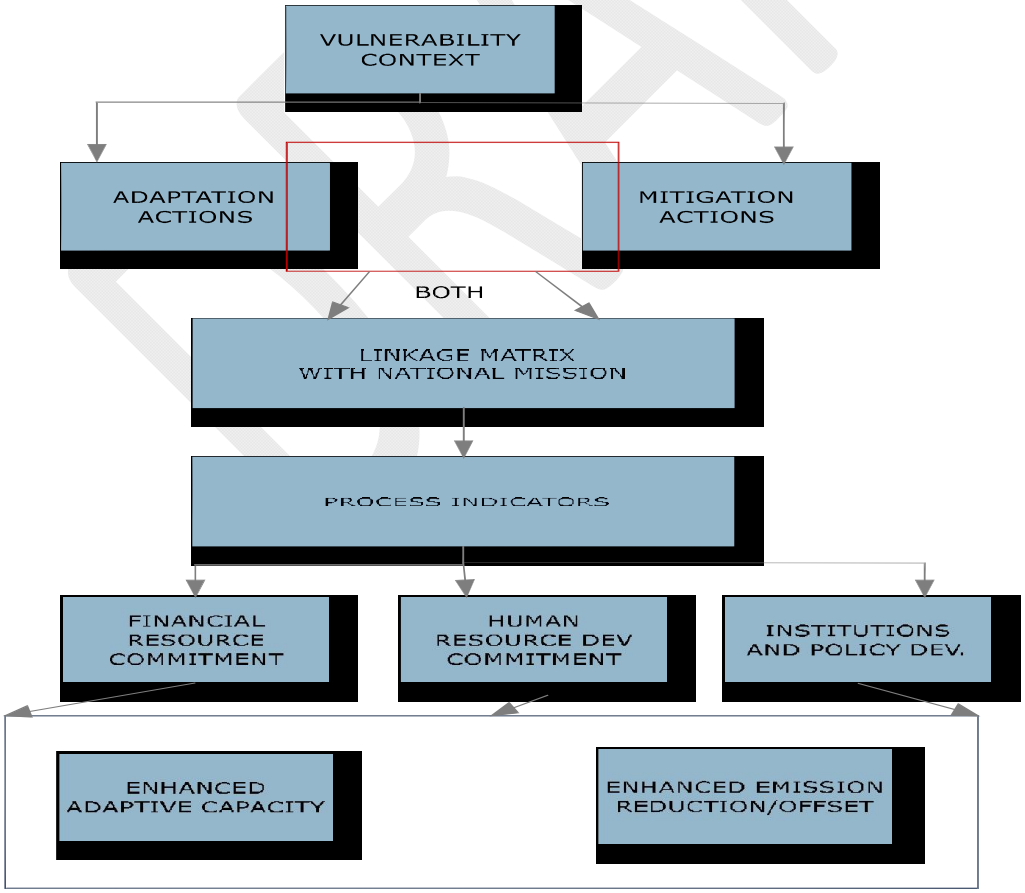
Nature of market failure	Relevant sectors in the state	Potential policy response
		water audit and benchmarking for accountability; supercritical power plant technology and carbon capture and storage technology

1.4.3 Monitoring system

As highlighted in a separate monitoring report, each department covered under the SAPCC is fully conversant in tracking the key priorities they are undertaking. The climate change cell tasked with compiling the information sends the formats from time to time to line departments.

The typical framework used in monitoring and evaluation appears in figure 1.2.

Figure 1.2 Monitoring and Evaluation Framework, SAPCC



So far, each department has identified sectoral vulnerability and developed actions pertaining to both adaptation and mitigation. Indicators from national missions have been used if needed for reporting purposes in order to ensure alignment with those missions.

Some of the process indicators such as pre-investment and policy actions are tracked as well. Financial allocations to the key activities are also tracked, along with the physical process. However, ex post analysis of actions has not yet been undertaken. This will be gradually built up in the departments, and the climate change cell will periodically report the outcomes of climate-related investments in the key priorities.

1.4.4 Institutional development: the climate change cell

The climate change cell was formed via Letter No. 22271, dated December 3, 2011, in the Department of Forest and Environment of the government of Odisha. The DFE functions as the nodal department. Based on the state notification, the DFE has appointed the director of forest and environment to head this cell until a formal institutional arrangement is established. A senior DFE scientist is currently looking after the day-to-day activities related to climate change. The DFE has also hired a two-person team to conduct the initial activities of the climate change cell.

The key functions of the cell are as follows:

- Coordinate with technical agencies to help departments develop design-specific policies and establish implementation pathways for carbon-conscious development
- Assist in developing mechanisms to evaluate progress toward the state's goals in order to adjust strategies and action plans accordingly
- Communicate the benefits of programs to mitigate climate change and engage with stakeholders proactively.

1.5 Co-benefits framework and prioritisation of actions

The planning commission of India formulated the country's low carbon development plan using a central theme that revolved around co- benefits. It is often argued that growth and climate change mitigation run counter to each other, and adaptation is something of a middle path. However, if it is defined within a problem context in which

CO-BENEFITS

Co-benefits refers to the multiple benefits for different fields resulting from one policy, strategy, or action plan.

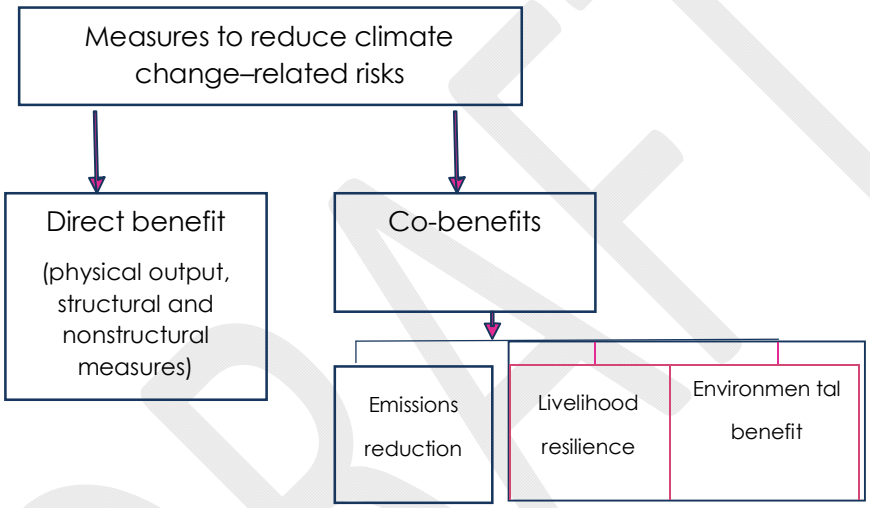
Co-beneficial approaches to climate change mitigation are those that also promote positive outcomes in other areas such as concerns relating to the environment (e.g., air quality management, health, agriculture, forestry, and biodiversity), energy (e.g., renewable energy, alternative fuels, and energy efficiency), and economics (e.g., long-term economic sustainability, industrial competitiveness, income distribution).

Similarly, in the adaptation pathway, one could achieve mitigation co-benefits (e.g., health- related adaptation investment and links to air quality or water quality).

socioeconomic development and environmental problems are key issues at both the national and state levels, then the Indian climate change agenda is driven by the philosophy that measures should be prioritised in the action plan that promote India's development objectives while addressing climate change effectively. Thus by implementing projects that are designed to address climate change risks, India can promote sustainable development.

The types of benefits from a climate change programme can be classified as in figure 1.3.

Figure 1.3 Co-benefits of a Climate Change Programme



In India, the national action plan on climate change inverts the prioritisation development benefits are direct, and climate gains are supplementary or "co-benefits" (Dubash 2014). In other words, a co-benefits approach is a win-win strategy aimed at capturing both development and climate benefits through its various initiatives.

However, the term *co-benefits* tends to be used differently in different contexts. In a development plan, climate benefits are co-benefits, whereas in a climate plan development benefits are co-benefits. In certain other instances, the term *co-benefits* is used to refer collectively to all the benefits (development co-benefits, climate co-benefits, and environmental co-benefits) arising from an initiative. Odisha's SAPCC 2015–20 follows the direction given in the 2008 national action plan on climate change (NAPCC) and uses the term *co-benefits* in what is most appropriate in the Odisha context.

As well-established, NAPCC 2008 focuses on measures that "promote our development objectives while also yielding co-benefits for addressing climate change effectively." In the Indian context, development objectives are paramount, whereas those yielding co-benefits

will be implemented through the action plans on climate change. The same is true and relevant in the Odisha context as well.

In this document, the primary development gains are referred to as the direct benefits, whereas emissions reduction, livelihood resilience building, or local environmental benefits are referred to as the co-benefits.

Emissions reduction mitigation under various sectoral scopes was very clearly demonstrated in the clean development mechanism (CDM) projects. The direct benefit in a solar energy project may be energy supply and the resultant certified emissions reduction (CER). Other sustainable development outcomes would be co-benefits. However, because of the uncertainty in the post-Kyoto Protocol market, this project-based mechanism has been stagnant. This was the most internationally-recognized form of co-benefits in mitigation with verifiability and additionally.

Livelihood resilience outcomes in mitigation projects are direct in nature and related to the investments made. In adaptation projects, they are visible in two forms: (1) the people who are experiencing livelihood resilience benefits and (2) those whose lives are saved through the nullification of the impact of climate change. The latter enhances resilience.

As for *environmental and health benefits*, a variety of actions both climatic and anthropogenic affect air quality and water quality, which in turn affect the health of flora, fauna, and humans. Some actions may have strong environmental benefits for example, improved cook stoves reduce fossil fuel dependence, black carbon, and the chances of respiratory problems from the partial biomass burning and smoke.

In this action plan process, actions have been prioritised, taking into account co-benefits as well as the prioritisation matrix used in the first SAPCC. The steps are as follows:

- Check the inventory of actions and develop an understanding of further actions to be taken.
- Ensure that the list of actions include a preliminary estimate of co-benefits and direct benefits.
- Generate estimates with departments through assisted facilitation.
- Gather inputs from stakeholders.
- Prioritise, with the support of an expert group, using the Delphi technique and based on urgency, irreversibility of damage, and low barriers (including financial capacity, technology availability, and policy).

The various sectoral measures were prioritised based on their exposure (impact frame), urgency and barrier (time frame), resilience, and emissions and environmental benefits (co-benefits). The respective departments conducted the prioritisation exercise through an internal consultative process. This will be validated through the wider consultative process with external stakeholders (see appendix B).

1.6 Inclusive stakeholder consultation

Intense deliberations were undertaken with sectoral departments while preparing and prioritising the actions that are relevant and urgent.

A consultation workshop was held on September 23, 2015 to familiarise stakeholders from the media, civil society, and academic institutions with the draft action plan and to get feedback on the relevant issues and concerns.

For wider consultation, the draft has been also posted on the website of the cell on climate change.

1.7 Limitations

It is important to acknowledge the fact that climate change–induced events are uncertain. Assessing both the co-benefits and probable maladaptation of any specific intervention presents policy dilemmas.

Attempts have been made to mainstream many climate change issues in the development planning, but limited resources are available for many activities. However, a lot more can be done, provided the climate-related budgets are available from any mechanism that can contribute to sustainable development. Therefore, only highly relevant activities with strong environmental and livelihood resilience–related co-benefits have been identified.

Chapter 2

KEY VULNERABILITIES

KEY VULNERABILITIES

This section deals with the current and likely vulnerabilities of the state of Odisha under different scenarios based on scientific assessments. It also summarises some of the major climatic events and their impacts as well as the exposure to such events the state is likely to have in future. It seeks to sensitise stakeholders to the need to build up the adaptive capacity of the state and its resilience. This section also looks at the state's low carbon development options while meeting its growth aspirations and it suggests several mitigation actions to reduce emissions.

Finally, this section includes a discussion of the successful management of disasters in the context of rising risk exposure from climate change and natural disasters (some of which will be climate-driven). The successful management of Cyclone Phailin and preparedness for the very severe Cyclone Hudhud have been discussed elsewhere in the context of adaptive capacity. This section also deals with how various state agencies are gradually addressing climate vulnerability in their development planning. The state has implemented several adaptation and mitigation measures in different sectors to enhance resilience.

2.1 Hydro-met vulnerability

2.1.1 Monsoon variability

According to the Indian Meteorological Department (IMD), the Madden Julian Oscillation (MJO) is an important tropical variability that modulates India's summer monsoon on an intra-seasonal scale. This is strongly associated with Odisha's recent monsoon in which 20 districts had deficient rainfall and 10 districts had excessive rainfall. Indian Ocean disturbances that used to significantly affect the state's monsoon variability because of various global circulation events have not in recent times had a strong influence on the state's monsoon rainfall. It is too early to say that this is a pattern.

Rainfall has been more erratic since the 1960s, with below-normal rainfall across all districts being recorded for most years. Figure 4 analyzes the last 100-year trend in the summer monsoon (relevant for the state) as of 2008.

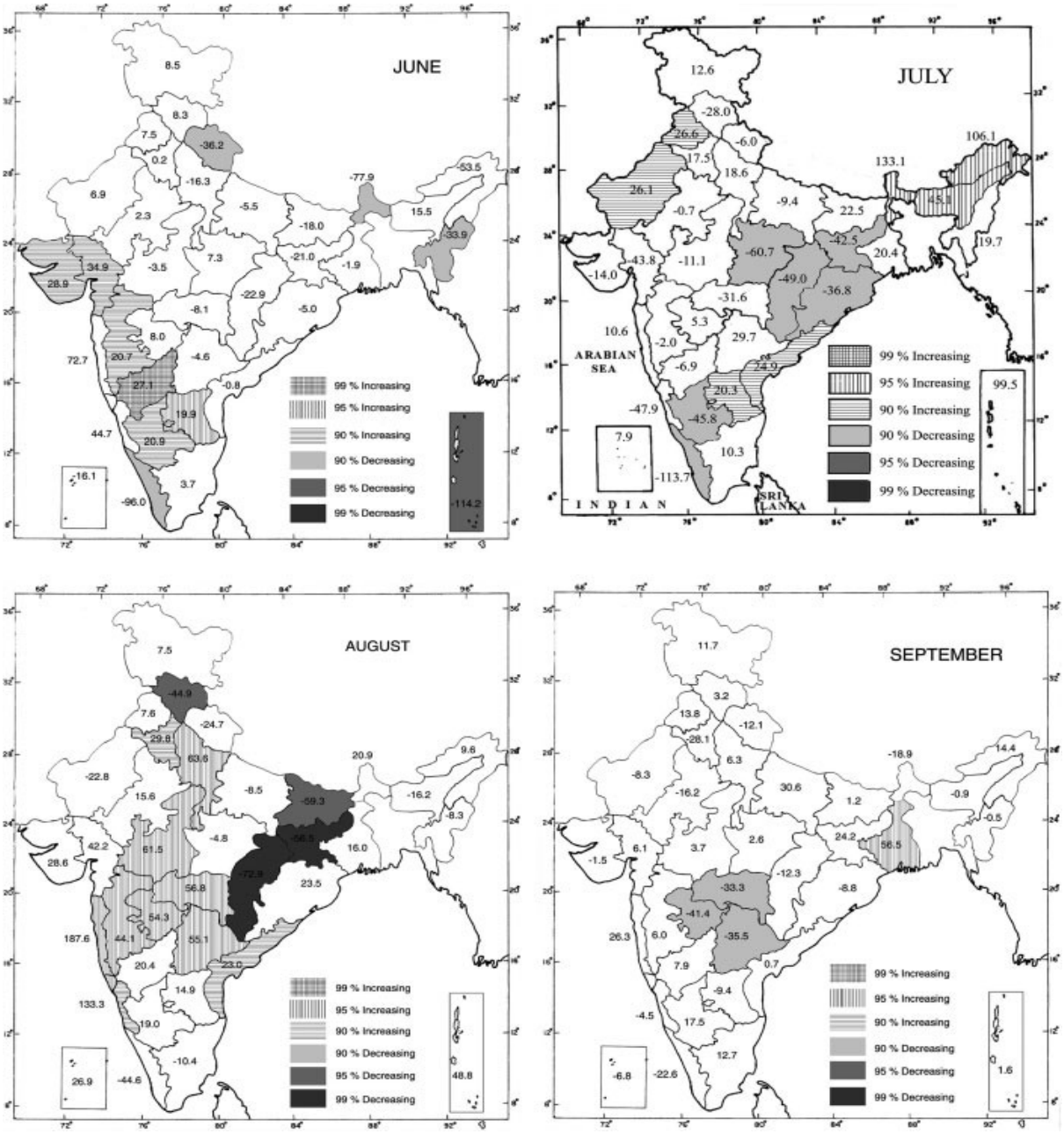
The state's average annual rainfall from 1901 to 1950 was 1,503 millimetres. It is now 1,451 millimetres, with about 84 percent of rainfall received between June and September (State Disaster Management Plan, Odisha, August 2013). The "normal" 120 days of monsoon rain has shrunk to 60–70 days, and unusual spikes in rainfall, with torrential rainfall of over 200–250 millimetres day, are more frequent during the monsoon, frequently resulting in floods. This situation has had a strong influence on agricultural crops, especially during rabi season,[1] because of the reduced residual moisture. Pulses and cereals have been affected, in that order.

Although the increasing weather variability has important implications for understanding the current vulnerabilities, weather trends in the last 100 years generally do not reveal the extent of climate change requiring adaptation by humans in the future.

[1] September-sown crops.

The development of both a long-term plan as well as short-term contingency planning based on the past experience with cropping systems, habitat, etc. will help in turn with the development of both policy and standard operating procedures.

Figure 2.1 Trend over Last 100 Years in the Summer Monsoon, India (rainfall in millimetres)



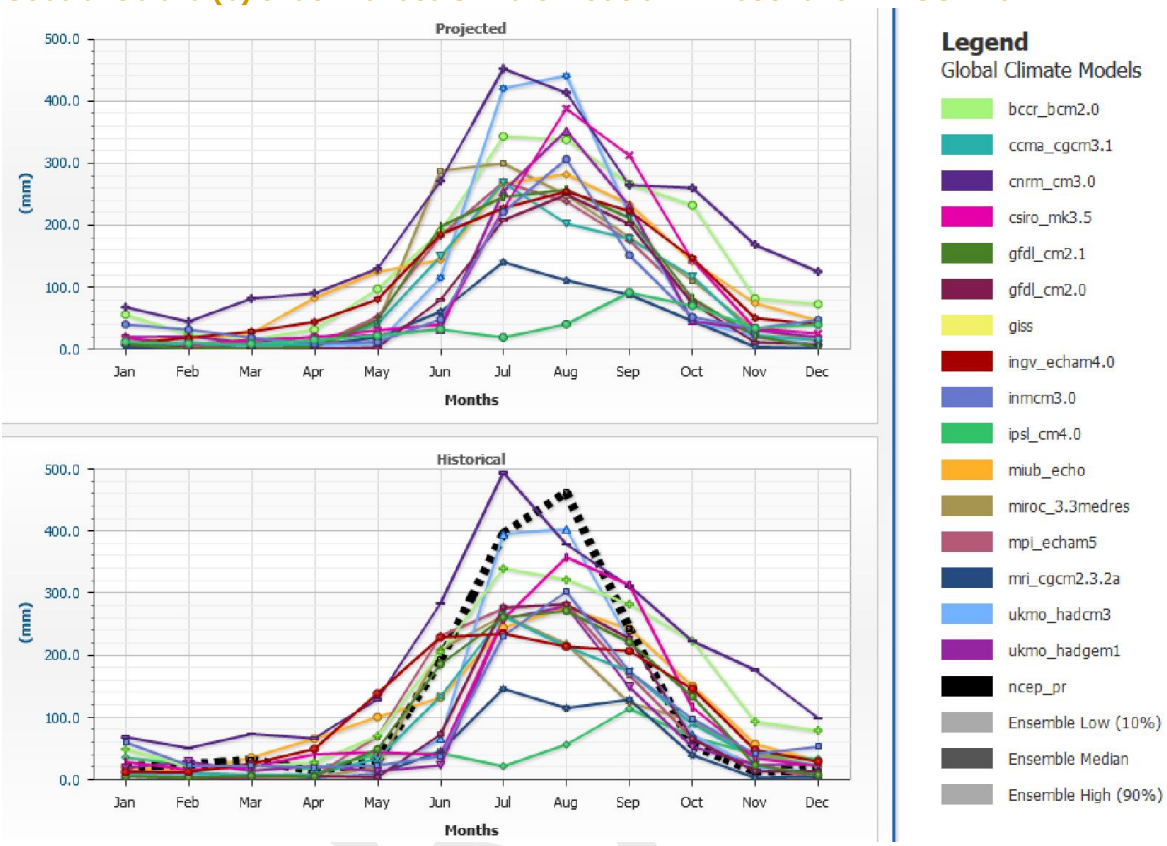
Source: Guhathakurta-Rajeevan 2007.

The rainfall variations in coastal Odisha and western Odisha from several global climate models (GCMs) appear in figure 5. These historical figures (1980–99) have been used as a baseline, and the global model has been downscaled to the regional scale from the Indian scenario. Analysis using the PRECIS tool reveals that the mean annual precipitation is likely to increase by 15 percent in north-western Odisha, by about 10 percent in western Odisha, and by 5–10 percent in coastal Odisha under the A2 scenario in the IPCC AR5.[2] Overall, it may vary from 1,327 millimetres (1970) to 1,638 millimetres (2080). For the downscaling, the following limitation has to be considered. This information takes the values of a 2 degree (about 450 square kilometres) climate model at the selected site and returns the average for the region. Planning for a particular district or sub region of the state is only possible when the microclimate data and other biophysical data parameters are available. Given the limitations, this is the best that can be projected with the available information.

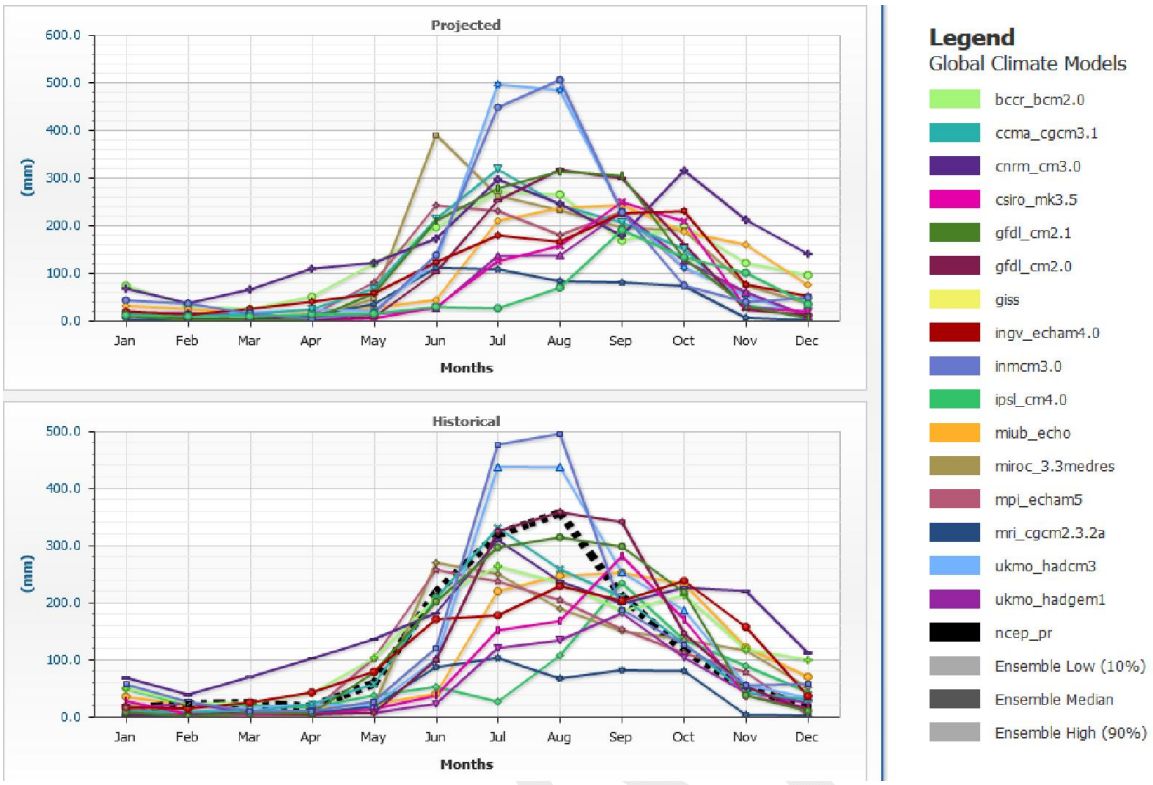
Any downscaling from GCMs for such state-level analysis suffers from the uncertainty of climate projections. For rainfall, the projections are generally very different for the different GCMs (ranging from huge increases to huge decreases in the same area). The state-level analysis indicates less divergence in the projections for this region. Even so, it is difficult to conclude that one area will be more or less affected. This analysis thus depicts only the order of magnitude of likely rainfall projections.

[2] The A2 scenario was used because the A2 storyline and scenario family describe the very heterogeneous world used in the AR5. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population. Economic development is primarily regionally oriented. Per capita economic growth and technological change are more fragmented and slower than in other storylines.

Figure 2.2 Medium-Term Prediction (2020–39) of Rainfall Variation for Western Odisha (a) and Coastal Odisha (b) under Various Climate Models in A2 Scenario in IPCC AR5



(a)

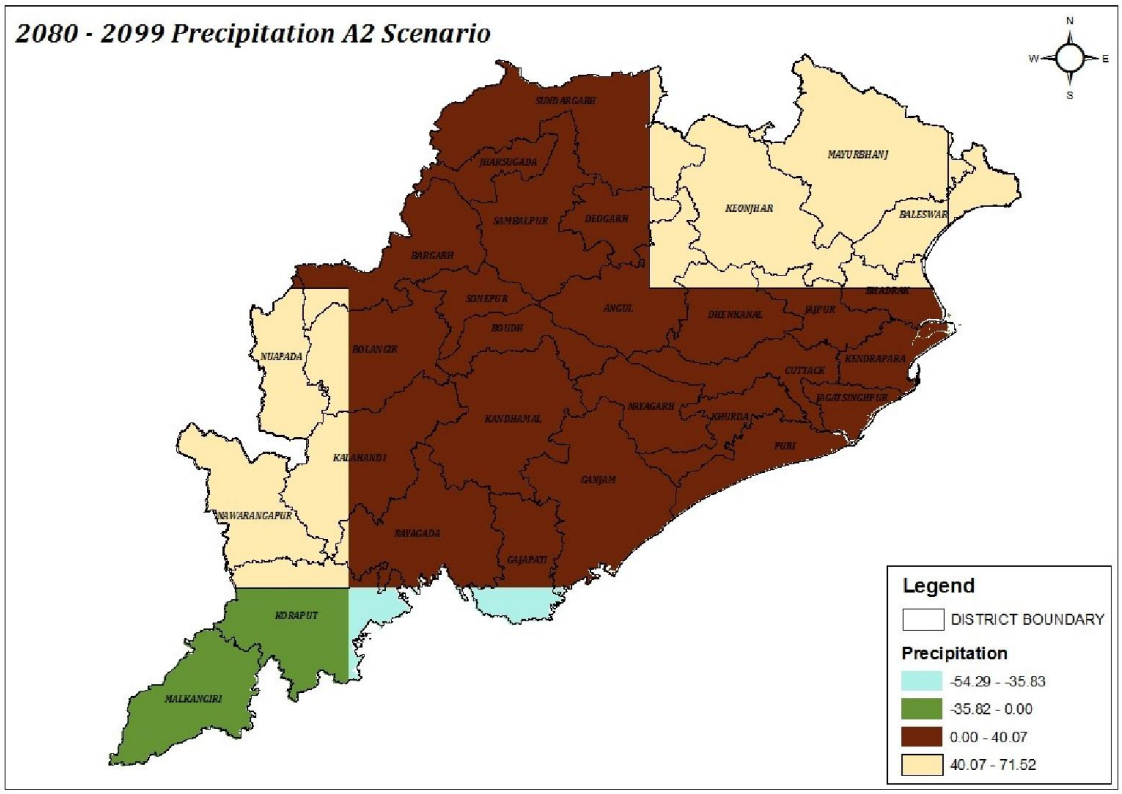


(b)

Source: Computed from climate data from the World Bank database

A further long-term projection up to the 21st century (mean annual rainfall) downscaled from the global climate models for Odisha appears in figure 2.3. This gridded map was downscaled from high-resolution maps based on an aggregated model run by the World Bank. It is based on the A2 scenario in IPCC AR5, which reflects the current policy regime.

Figure 2.3 Long-Term Prediction (by 2100) of Projected Change in Total Annual Precipitation under A2 Scenario in IPCC AR5, Odisha (millimetres)



Source: Computed from climate data from the World Bank database.

This figure shows no change in the +40 millimetres of excess annual average rainfall during the 21st century in several parts of coastal and western Odisha. Southern Odisha will have less rainfall (–35 millimetres to no change). The northwest and southwest would have to have higher rainfall annually, ranging from +40 millimetres to +72 millimetres. According to the IMD and the Indian Institute of Tropical Meteorology (IITM), this may be due to the shifting trough line and the enhanced forest stock. Studies commissioned by the Department for International Development (DFID) in the United Kingdom of plantations along the watershed shows low climate variability as compared with the control area/bald area. Most of these areas are Schedule VI areas, and the undulating terrain together with excess rainfall may enhance the risk of flash floods and sand casting of fields. Such events may even enable people to change the cropping system from coarse grain to cereals and pursue more animal husbandry and fisheries. Some river courses are likely to be affected.

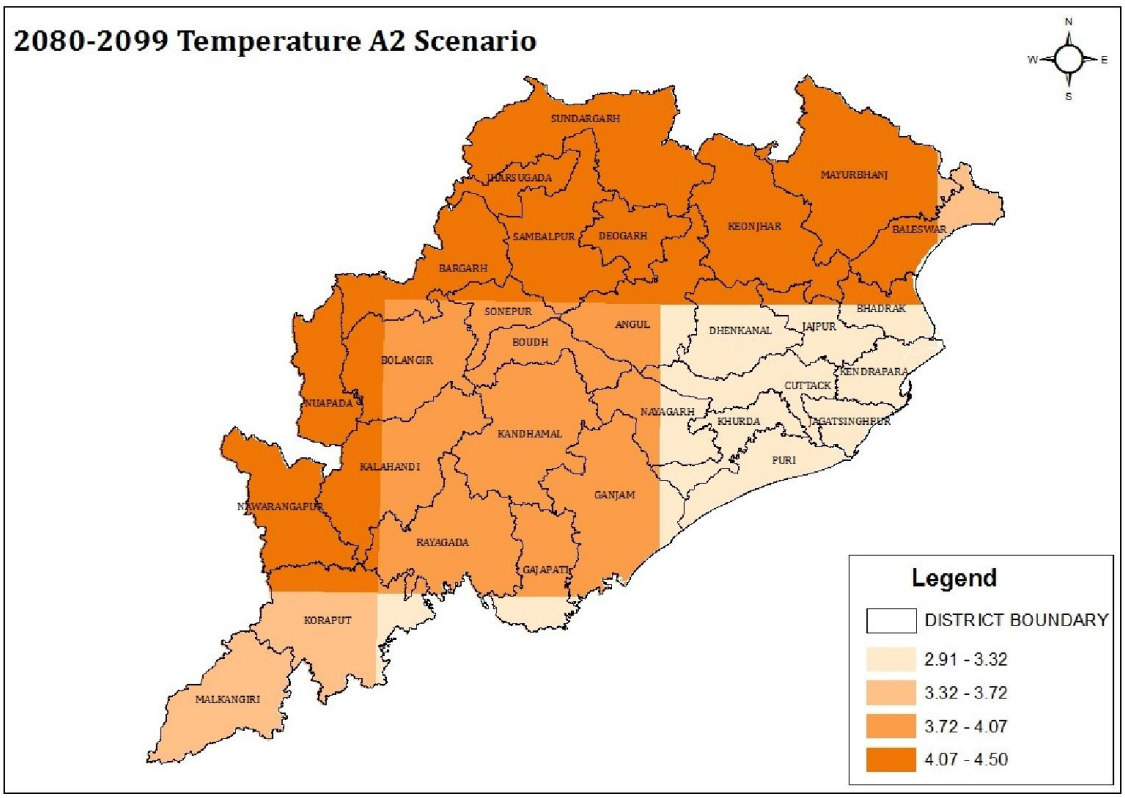
2.1.2 Temperature

Odisha has both a sea side and a hinterland effect (for central Odisha districts) when it comes to intraday and seasonal variations in temperature.

In the medium term, a *Kala Baisakhi*, known elsewhere as a nor'easter, is more likely to occur in the state. According to the Odisha State Disaster Management Authority, this phenomenon occurs in the state because of the strong heating of land mass during midday. This heating initiates convection over the Jharkhand Plateau that moves southeast and is intensified by mixing with warm moist air mass from the Bay of Bengal. This phenomenon not only damages several horticultural crops but also affects slum dwellers. Thunderstorm activity progresses from March onward as the season advances. According to the IMD, the mean number of days of thunderstorms is not more than eight in any part of the country.

By 2100, the mean annual temperature globally is projected to increase by one to five degrees Celsius (24.5°C in 1970 to 28.5°C in 2080), depending on the A2 scenario in IPCC AR5 and location. In figure 2.4, the long-term projection up to 2100 for Odisha shows some disturbing pictures.

Figure 2.4 Long-Term Prediction (by 2100) of Projected Change in Mean Annual Temperature under A2 Scenario in IPCC AR5, Odisha (degrees Celsius)



Source: Computed from climate data from the World Bank database.

According to figure 2.4, coastal Odisha will remain relatively less warm than the rest of the state, even though it clearly breaches the 2°C barrier. North-western, western, and south-western Odisha show the highest rise in temperature. This temperature rise is certainly at an unsustainable level, assuming the current challenges of global warming are not mitigated. This factor will have an increasingly larger impact on ecosystems.

2.1.3 Heat wave

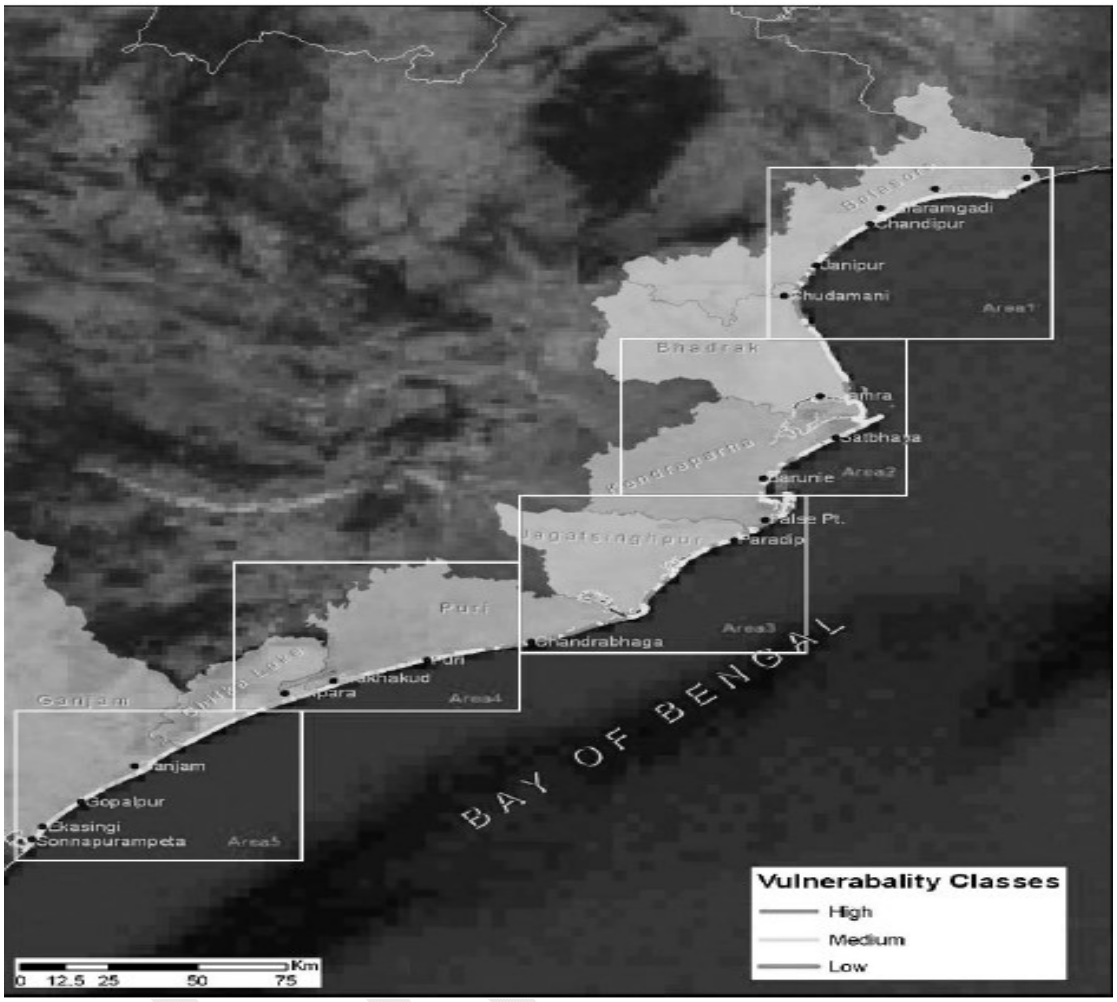
A heat wave is a condition of atmospheric temperature that leads to physiological stress, which sometimes can claim human life. The normal temperature is less than 40°C. When the temperature exceeds that level it is called a heat wave. When it reaches five or six degrees above the normal temperature, it is called a moderate heat wave, and at seven degrees or more it is called a severe heat wave. In 1998 the state of Odisha faced an unprecedented heat wave situation in which 2,042 persons lost their lives. Although extensive awareness campaigns have largely reduced the number of casualties since1998, a good number of casualties are still being reported each year. Meanwhile, preparedness has increased significantly. For example, the state government announces changes in working hours and school timings, places water fountains along the roadside, and issues advisories from time to time.

2.1.4 Sea level rise and coastal vulnerability

According to the IPCC's Fifth Assessment Report, future rates of sea level rise are expected to exceed those of recent decades, thereby increasing coastal flooding, erosion, and saltwater intrusion into surface and groundwater. The report predicts cyclone frequency, intensity, and sea level rise. In turn, these would increase coastal flooding and the loss of coral reefs and mangrove forests and would exacerbate wave damage. Individual fish species are projected to shift their ranges northward in response to rising sea surface temperatures, and the body size of certain marine fish is likely to shrink, which will affect the fishing community.

A study by the Indian National Centre for Ocean Information Services (INCOIS) estimated the coastal vulnerability index (CVI) of Odisha by dividing the entire coastline into grids of 1 kilometre by 1 kilometre. Eight risk variables such as sea level rise, coastal geomorphology, tidal range, and elevation were assigned appropriate risk classes (1, 2, 3) based on their ability to cause low, medium, and high damage, respectively, for a particular area of the coastline. The vulnerable points along the coastline identified by the study appear in figure 2.5.

Figure 2.5 Coastal Vulnerability, Odisha



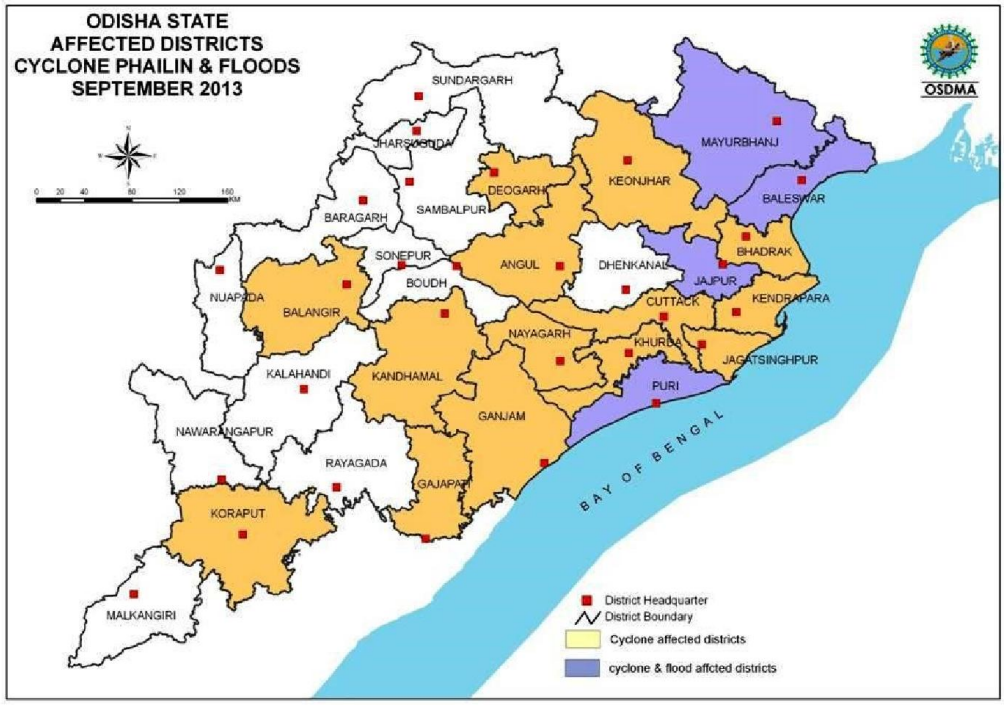
Source: Kumar et al. 2010.

The CVI value in the study area of Odisha coastline varied from 2.1 to 1.9 (Kumar et al. 2010). The 25th and 50th percentiles of CVI value are 4.75 and 9.5, respectively. In vulnerability to damage, those parts of the coastline having CVI values ranging from 2.1 to 4.75 are considered to be in the low class; those ranging from 4.75 to 9.5 in the medium class; and the remaining parts with CVI values of over 9.5 in the high class. Accordingly, in vulnerability to damage, about 76 kilometres of the coastal stretch of Odisha state, covering parts of Ganjam, Chilka, southern Puri, and Kendrapara, are in the low class; about 297 kilometres, covering northern Ganjam, Chilka, central Puri, Jagatsinghpur, Kendrapara, southern Bhadrak, and northern Balasore, are in the medium class; and about 107 kilometres, covering northern Puri, parts of Jagatsinghpur, Kendrapara, northern and southern Bhadrak, and southern Balasore, are in the high class.

2.1.5 Flood

With a flood-prone area of 33,400 square kilometres, Odisha is the fifth most flood-prone state in India after Uttar Pradesh, Bihar, Assam, and West Bengal. Odisha's entire coastline of 480 kilometres is exposed to frequent floods and water logging. In addition to heavy rainfall, cyclonic winds and tidal flows also cause flooding in coastal areas. Flooding lasts for 5–15 days along the coastal belt. It causes loss of life and damage to property and crops, thereby affecting food security and livelihoods (Mishra et al. 2010). Agriculturally, the fertile coastal regions with paddy fields are vulnerable to inundation and salinization. Experts warn that Odisha should brace itself for more severe flooding in the future due to deforestation, faulty flood control planning, and climate change. Such conditions are likely to displace large numbers of people, leading to rapid urbanisation and pressure on civic amenities and resources. The flood-affected area in 2013 is depicted in figure 2.6. One of the interesting observations in figure 2.6 is that new areas are being affected by flood and cyclone, beyond the traditional flood zone of the state.

Figure 2.6 Areas Affected by Flood and Cyclone: Odisha, 2013



Source: OSDMA.

In Odisha, normal flood damage occurs mainly in areas surround the Mahanadi, Brahmani, and Baitarani Rivers. These rivers have a common delta where flood waters intermingle, and when they are in spate simultaneously, they wreak considerable havoc. This problem becomes even more acute when floods coincide with high tide. The water level rises

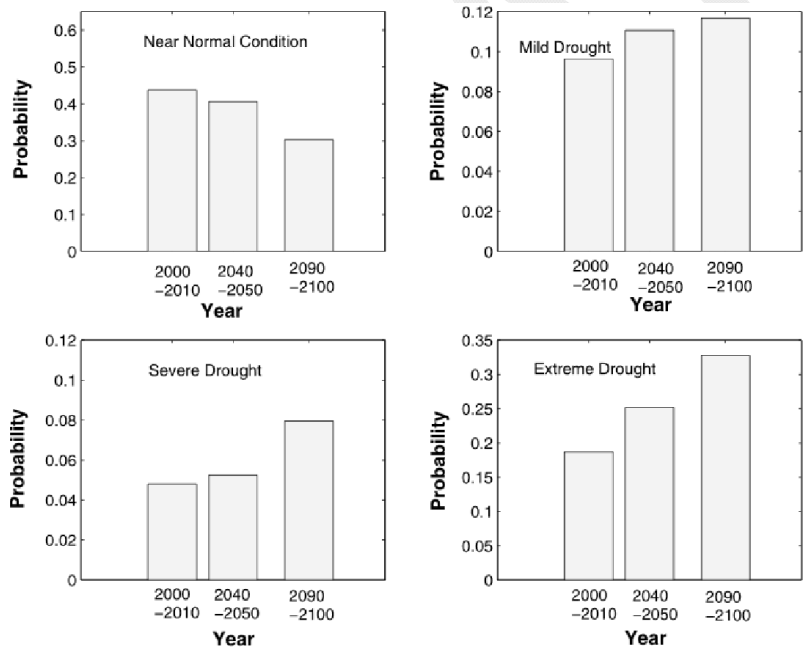
because of the deposits of silt on the riverbed. The floods of 1980, 1982, 2001, 2003, 2011, and 2013 in the state were particularly severe; property worth tens of millions of rupees was destroyed in the floods.

2.1.6 Drought

Recent studies show that drought-prone areas over the world have more than doubled since 1970s. It has been established that drought severity has increased along with the enhanced warming of both the sea surface and land mass. Evidence exists of a climatic link between the El Niño Southern Oscillation (ENSO)[3] and India's rainfall (Maity and Nagesh Kumar 2006). The impact is thus more severe in India, especially in the Odisha region because of its coastal position. Therefore, global warming with high surface warming in Odisha, the sensitivity of its precipitation to ENSO, and the coastal position are the possible reasons for the greater probability of drought in this region.

Downscaled from the global circulation model, the probability of occurrence of various categories of drought in Odisha is presented in figure 2.7.

Figure 2.7 Probability of Occurrence of Drought: Odisha, 2000–2100



Source: Ghosh and Majumdar 2007.

[3] The Madden Julian Oscillation is recognised in both excess and deficit rainfall scenarios, whereas it is associated solely with deficit or drought scenarios in the Indian context.

According to the methodology adopted by Ghosh and Majumdar (2007), there is an increasing trend in the probability of severe and extreme droughts for Odisha toward the end of the 21st century, with a modest decrease in the probability of near-normal conditions.

2.1.7 Cyclone

According to the Fifth Assessment Report, the frequency and intensity of tropical cyclones in Odisha are likely to rise. Even past data compiled by the United Nations Office for Disaster Risk Reduction (UNISDR) reveal that from 1970 to 2010, the Asia-Pacific population living in cyclone-prone areas increased from 71.8 million to 120.7 million, expanding the magnitude of vulnerability to disasters. Odisha did improve its disaster preparedness based on the lessons learned from the super cyclone episode in 1999. The cyclone-prone areas of the state are shown figures 2.6 and 2.8.

Figure 2.8 Wind- and Cyclone-Prone Areas, Odisha

Source: OSDMA.

The local area resilience plan prepared for Cuttack, Puri, and Bhubaneswar under the World Bank's NLTA programme estimates that the probable maximum loss (PML) from cyclonic wind is highest for the residential sector on the order of Rs 223 crore with substantial increases in the climate change scenarios for the 2040s and 2080s. The losses in the commercial and industrial sectors would be about Rs 115 crore and Rs 11 crore, respectively, with substantial increases in the 2040s and 2080s in Bhubaneswar. The estimated PML in Cuttack for the residential sector would be Rs 215 crore, with projected losses of Rs 322 crore and Rs 430 crore in the scenarios for the 2040s and 2080s, respectively. Losses for the commercial sector, also significant, are on the order of Rs 39 crore, which would double in 2080s scenario.

MANAGING DISASTER

In October 2013, Cyclone Phailin, with a wind speed of more than 200 kilometres per hour, lashed out at the coastal region of the state of Odisha. The cyclone affected 13.2 million people in five districts. The Indian Meteorology Department, four days ahead of the cyclone, cautioned the state administration to evacuate nearly 1.2 million people. In the largest single-day evacuation on October 11 (the day before landfall), 0.5 million people were shifted to safe locations. Only 21 lives were lost. Later, however, another 22 lives were lost due to flash floods, snake bite, and mud wall collapse. The fact that in a 1999 cyclone 10,000 lives were lost shows the resilience attained in the structure and processes of disaster management in the state.

In 2014 Cyclone Hudhud headed toward s the Odisha coast. Landfall was expected to be on October 11. This time, too, the state remained alert and cancelled the leaves of officers and kept officers available in the non-affected areas to meet any eventuality. Meanwhile, the cyclone changed course, largely affecting the southern districts of Odisha. However, not taking any chances, the state evacuated close to 0.4 million people from the vulnerable areas. Six teams of the National Disaster Response Force (NDRF) and 10 teams of the Odisha Disaster Rapid Action Force (ODRAF) were engaged in rescue operations, and 17 satellite phones provided by the central government were used for uninterrupted communication. Two thousand shelter homes were erected in the districts of Gajapati, Ganjam, Koraput, Malkangiri, Puri, Rayagada, Nabarangpur, Kendrapara, Kalahandi, and Khurda.

2.1.8 Hydro-met challenges: key sectoral measures taken

Table 2.1 summarises the measures Odisha has taken to meet the hydro-meteorological challenges described in the preceding sections.

Table 2.1 Key Sectoral Measures Taken to Meet Hydro-Meteorological Challenges, Odisha

Event	Sector	Adaptation measures adopted by the state
Flood and cyclone	Agriculture Water Coastal and disaster management	Early warning Flood-tolerant varieties Structural modification Insurance Construction of artificial reefs, riffraff structures Water regulation in basin, main delta
Drought	Agriculture Water Fishery and animal resources development	Drought-resistant varieties Tank de-silting Runoff management Rainwater harvesting Watershed management
		Crop insurance Livestock management with forage stock and dead water storage for wildlife Establish wooded riparian areas/buffer strips along water bodies
Heat wave	Health Agriculture Housing and urban development Industry	Health advisory Water fountains Electricity and water supply Timing of work for labourers, especially construction labourers

2.2 Other vulnerabilities

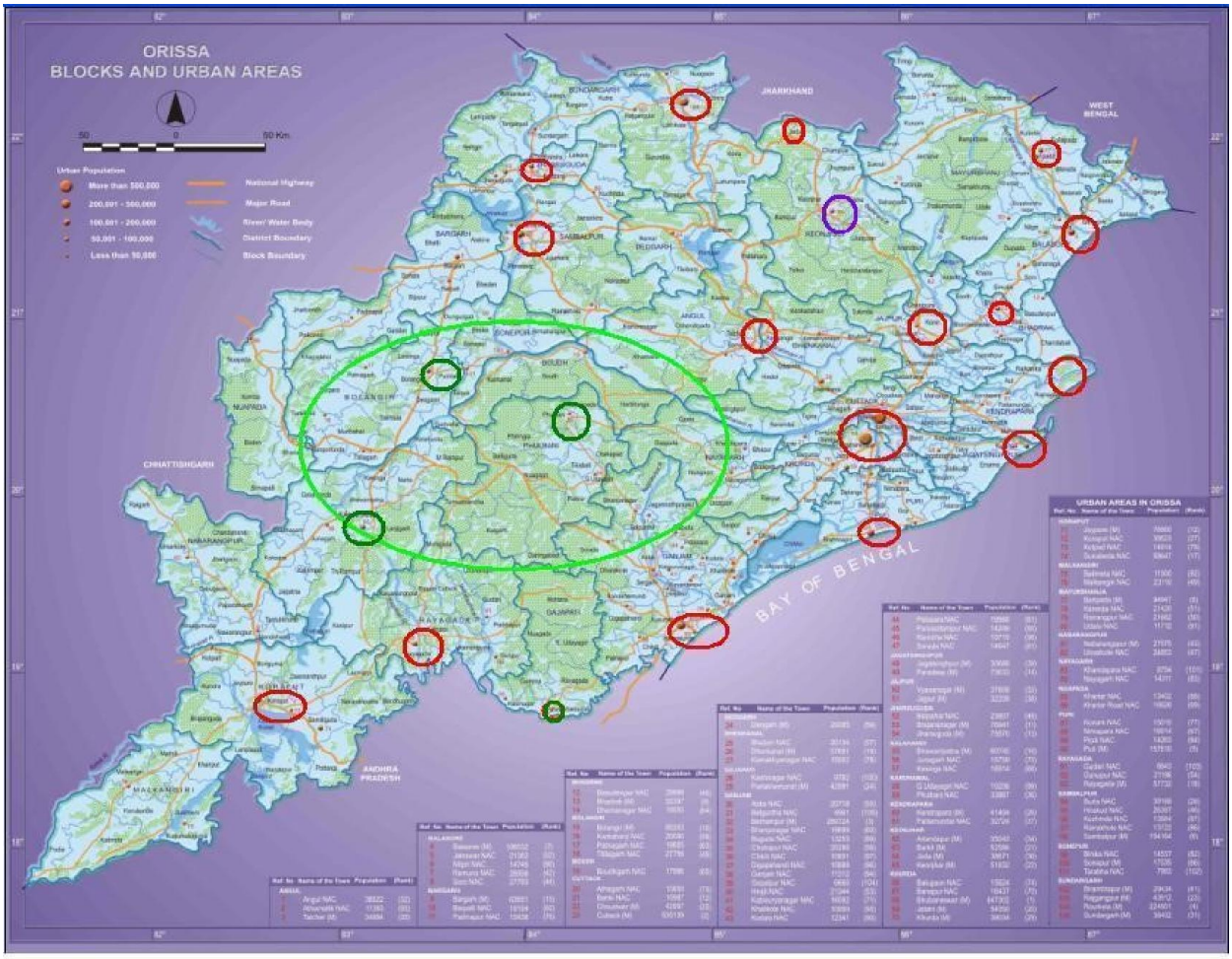
2.2.1 Growth and urbanisation

In India, economic growth and opportunities are likely to add about 500 million people in an estimated 7,000–12,000 urban settlements by 2060. This situation will put a lot of pressure on the urban infrastructure, leading to congestion, higher emissions per unit area, and degradation of the environment, with long-lasting effects on human health and urban biodiversity. Urbanisation and development not only are important for mitigation, but also determine vulnerability (e.g., more people will live in high-risk areas) and adaptive capacity (i.e., more resources/assets will be needed to respond).

Odisha has projected its urbanisation rate to be 20 percent as per the 2011 census. Even though Odisha is 24th in terms of overall urbanisation in the country, five or six major cities in Odisha are growing much faster than the other urban pockets. Bhubaneswar, Cuttack, Puri, Rourkela, Berhampur, Jharsuguda, and the Jajpur Road-Keonjhar belt are witnessing a maximum growth spurt. Both pull and push factors are responsible for the migration of lakhs of rural folks to the urban centres of the state. It is not only the poor but also the rich and the semi-rich who are settling in these big cities for better amenities and opportunities.

Based on the close relationship between urbanisation and other developmental indicators, Odisha may have at least five metropolitan areas other than Bhubaneswar with populations of 10 lakhs within the next 25 years. These clusters are shown in figure 2.9.

Figure 2.9 Urban Growth over Next 25 Years, Odisha



Source: Compiled from Census of India, 2011.

Note: The following rapidly urbanising clusters likely to emerge in the future are as follows:

- Rourkela-Kansbahal-Rajgangpur (within 5 years)
- Berhampur-Chhatrapur-Hinjilicut (within 10 years)
- Sambalpur-Jharsuguda-Belpahar-Brajarajnagar (within 10 years)
- Baripada-Balasore (within 20 years)
- Koraput-Jeypore-Sunabeda (within 25 years).

Each of these clusters has varied degrees of vulnerability because of its population composition. In those areas where the population of scheduled castes and tribes are higher, the inequity increases because of rapid urbanisation. One of the major challenges in these areas is inclusive development. Vulnerability is also associated with the nature of the migrants in and out of these clusters.

Examples are street vendors and their exposure to climate events, brick kiln workers, scavengers, etc. The nature of vulnerability may be as follows:

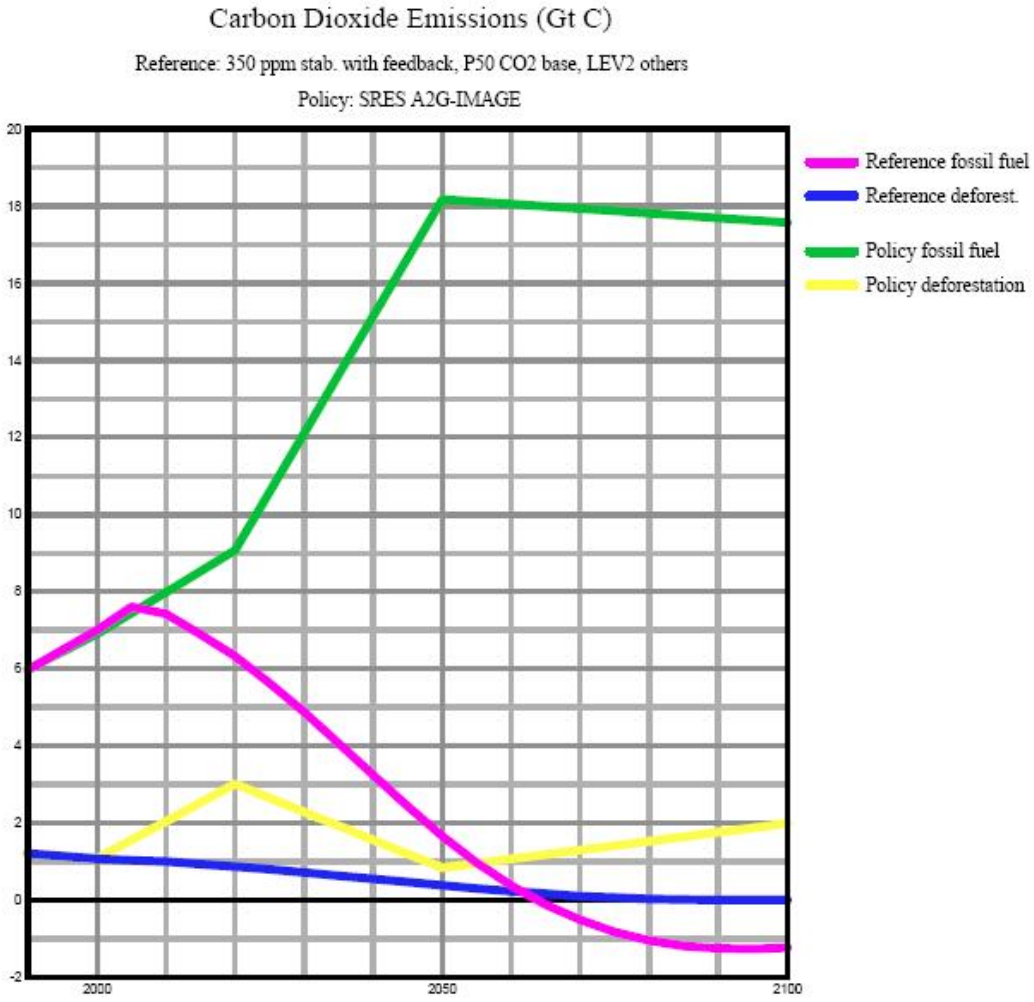
- Large, unplanned dense settlements
- Overloading of infrastructure such as the energy supply system, leading to the disruption of the water supply system because of the limited availability of potable water, contamination of water due to inadequate sewerage, and waste disposal.
- Degradation of air quality because of vehicular and transport-related congestion apart from construction-related emissions,

Other exposure-related vulnerability includes the heat island effect and heat stress. The warmer areas in cities stem from the increase in high rises, decrease in space for avenue planting, depletion of rice fields and wetlands, and overexploitation of groundwater.

2.2.2 Emissions scenario

A CO_2 emissions scenario has been computed for India using baseline SRES 3 (year baseline is 1990) and a policy scenario of the A2 image from 1990 to 2100 (figure 2.10). This output is for the entire country of India and is from a global model. It therefore gives only an order of magnitude.

Figure 2.10 Carbon Dioxide Emissions Scenario: India, 2000–2100

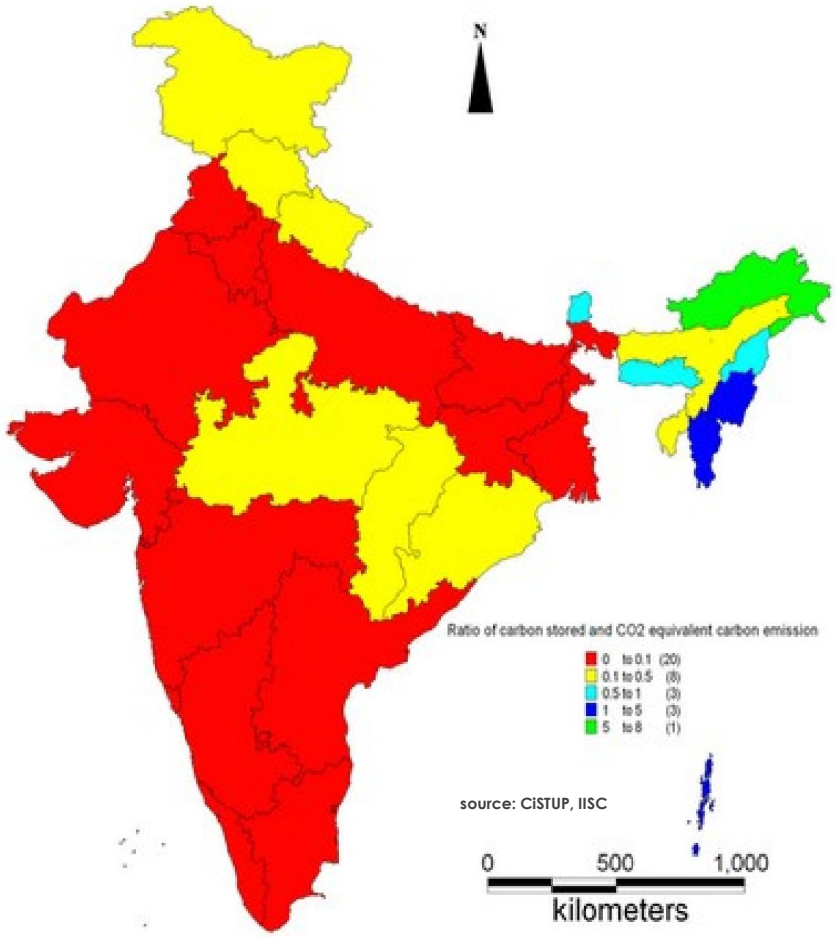


Source: Computed from the Model for the Green House Induced Climate Change (Meinshausen et al. 2011).

Note: The scenario (350 parts per million) depicted in this figure is used in subsequent sections to understand the vulnerability caused by emissions in sectors such as agriculture and the socioeconomic impact of climate change in the state.

If the ratio of carbon sequestration to CO_2 emissions is considered, the scenario in figure 2.11 emerges.

Figure 2.11 Carbon Status Map, India



Source: Ministry of Environment and Forests, Indian Institute of Science study, August 2009, http://moef.nic.in/modules/about-the-ministry/CCD/Contri_carbon_sink.pdf.

In figure 2.11, Odisha appears in second-risk category of carbon status, whereas most of India is in the high-risk red zone. The north-eastern region has a favourable carbon status. Odisha owes its lower risk status to better forest cover.

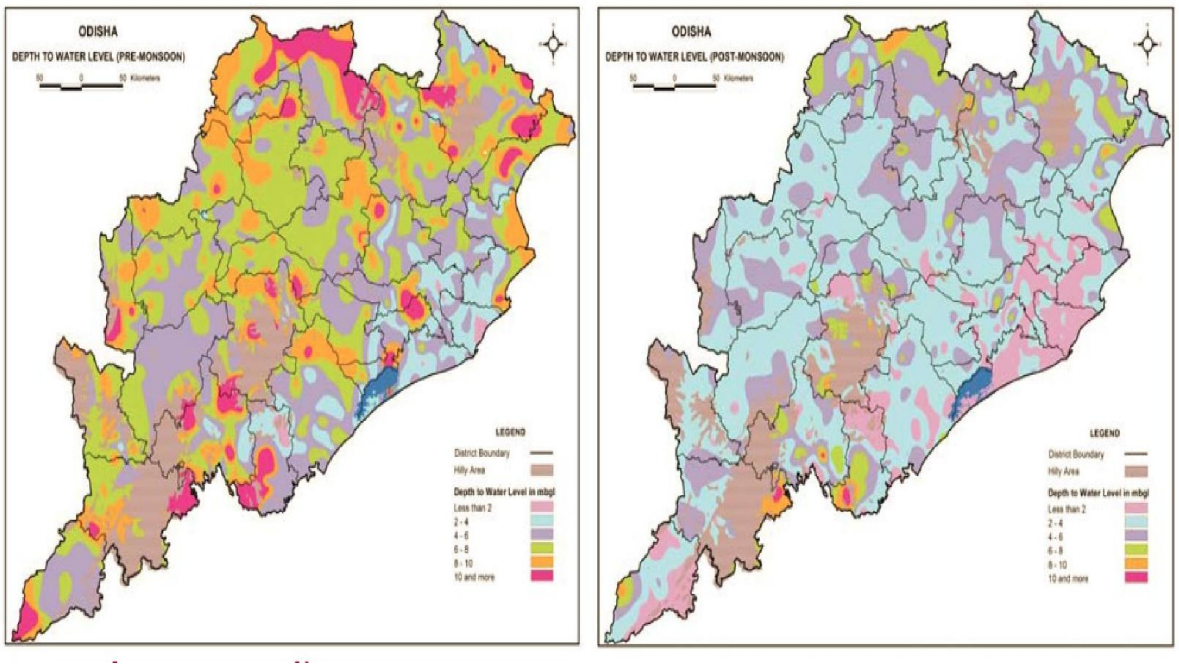
2.2.3 Water availability and pollution

A higher ambient temperature places a greater demand on groundwater and also increases energy use for water pumping. The turbidity of water also increases with an increase in the ambient temperature.

The main sources of water in Odisha are the Bay of Bengal, lakes such as Chilika and Ansupa, and 11 rivers (Mahanadi, Subarnarekha, Baitarani, Rushikulya, Budhabalanga, Brahmani, Salandi, Kathajodi, Birupa, Kusabhadra, and Daya) and many rivulets. Other forms of water sources are groundwater, tanks, ponds, open wells, and tube wells. According to National Family Health Survey (NFHS) I data,[4] about one-third of the population of Odisha has access to piped water, and about 20 percent use a non-improved (risky) source of groundwater. More than 52 percent use untreated water in rural areas.

According to the Environmental Information System (ENVIS) report, in urban areas people use about 335 litres of water daily for different domestic purposes. About 70–80 percent of this water flows to nearby ponds, tanks, or rivers through the drains or *nalas* of the municipality, thereby polluting those ponds, tanks, and rivers. Municipal sewage is the main pollutant of water. In all cities of Odisha, most sewage receives no treatment before discharge. Cities such as Bhubaneswar, Cuttack, Rourkela, Sambalpur, and Berhampur generate approximately 10, 7.5, 6,3, and 5 lakh[5] litres of sewage effluents, respectively, every day. These effluents are discharged into these rivers: the Mahanadi and Kathajodi in Cuttack, Kuakhai and Daya in Bhubaneswar, Brahmani in Rourkela, Mahanadi in Sambalpur, and Rushikulya in Berhampur. The effluents contain heavy metals such as lead, chromium, cadmium, zinc, and mercury, together with harmful bacteria and viruses.

Figure 2.12 Groundwater Profile, Odisha



Source: Central Ground Water Board.

[4] *dhsprogram.com/pubs/pdf/frind3/frind3-vol2.pdf*
[5] 1 lakh = 0.1 million.

According to the groundwater quality report of the Central Ground Water Board, 11 districts of Odisha have a fluoride problem in the water; 20 districts have water with an iron content of more than 1 milligram per litre; and most districts have nitrate levels of greater than 43 milligrams per litre. In the recent past, the state has seen several cases of jaundice arising from contamination of water. Open defecation is another reason for the contamination of groundwater. A groundwater profile of Odisha appears in figure 2.12.

The Odisha State Pollution Control Board (OSPCB) monitors critical parameters (pH, DO, BOD) of water quality in major river basins of the state. It is recommended that the Mahanadi river basin (covering 10 rivers and 32 sites) undergo conventional treatment and disinfection in order to comply with class C water quality criteria. In the Brahmani river basin, of 25 monitoring stations only the Dharmasala and Patamundai areas are suitable for outdoor bathing (class B compliant); others are class C. Two sites in the Rushikulya river basin are class C as well.

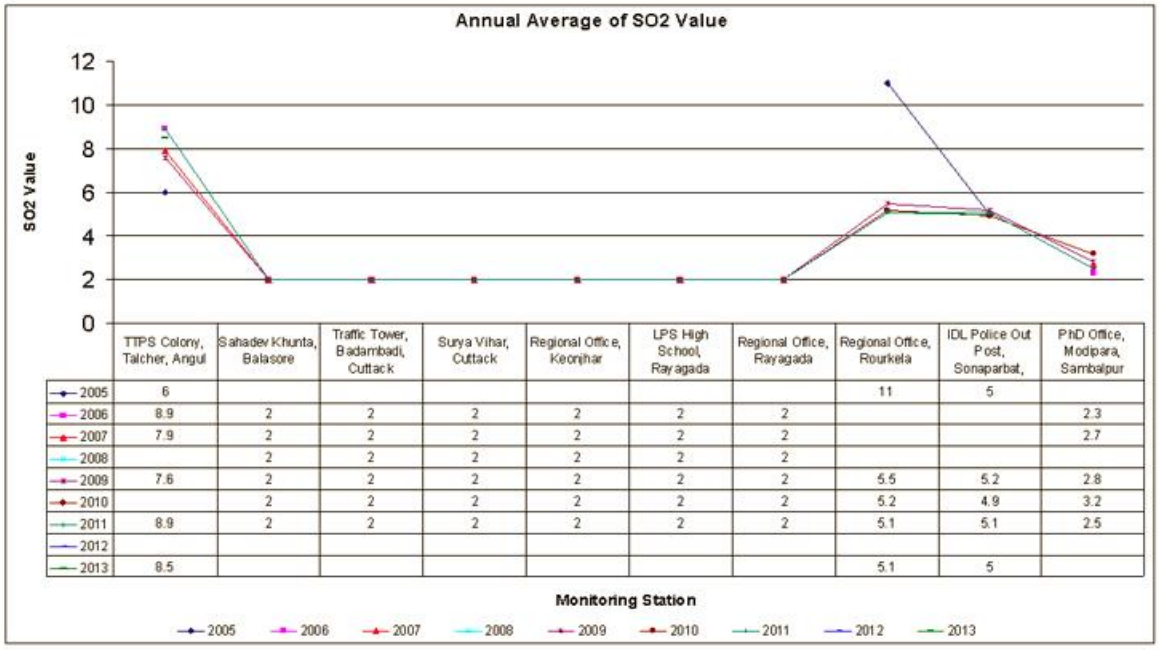
2.2.4 Air pollution

Growing emissions will further deteriorate air quality in the state of Odisha. Population growth combined with the growth of the state economy (which is growing more than the national average) will multiply the current levels of energy use, traffic, and industrial production, and have serious impacts on human health and vegetation.

Air pollution has become a major health hazard in many parts of the state. Factors contributing to it include unplanned development, rapid industrialisation, obsolete technology, and poor awareness in micro and small industries. The main primary pollutants released into the atmosphere are carbon dioxide, carbon monoxide, sulphur dioxide, oxides of nitrogen, and un-burnt hydrocarbons. Carbon monoxide and carbon dioxide are products of the oxidation of carbon. Sulphur dioxide comes from the burning of sulphur, which is invariably present in coal and oil. In addition, black carbon is present in rural areas; the results of un-burnt biomass and briquettes affect urban areas; and suspended particulate matter is generated in various industrial processes and activities.

Air quality is being monitored by the State Pollution Control Board in all eight stations under the State Ambient Air Quality Monitoring Network (SAAQM). The data from these centres for sulphur dioxide are shown in figure 2.13.

Figure 2.13 SO_2 Values, Odisha Monitoring Stations



	TTPS Colony, Talcher, Angul	Sahadev Khunta, Balasore	Traffic Tower, Badambadi, Cuttack	Surya Vihar, Cuttack	Regional Office, Keonjhar	LPS High School, Rayagada	Regional Office, Rayagada	Regional Office, Rourkela	IDL Police Out Post, Sonaparbat,	PhD Office, Modipara, Sambalpur
2005	6							11	5	
2006	8.9	2	2	2	2	2	2			2.3
2007	7.9	2	2	2	2	2	2			2.7
2008		2	2	2	2	2	2			
2009	7.6	2	2	2	2	2	2	5.5	5.2	2.8
2010		2	2	2	2	2	2	5.2	4.9	3.2
2011	8.9	2	2	2	2	2	2	5.1	5.1	2.5
2012										
2013	8.5							5.1	5	

Source: Odisha State Pollution Control Board.

The air quality data for various parameters based on the exceedance factor (EF) values appear in table 2.2.

Table 2.2 Air Quality on the Basis of EF Values: Odisha, 2012

Area with location points	Type	SO_2 ($\mu g/m^3$)	NO_X ($\mu g/m^3$)	RSPM ($\mu g/m^3$)	SPM ($\mu g/m^3$)
Angul					
1. Regional office building, industrial estate, Angul	I	L	M	C	M
2. NALCO Township, NALCO Nagar	R	L	L	C	H
3. TTPS, Talcher	I	L	L	C	M
Rourkela					
1. Regional office building, premises, Sector 5	R	L	L	C	H
2. IDL outpost, Sonaparbat	R	L	L	C	H
Rayagada					
1. Regional office building, Indra Nagar	R	L	M	M	L
2. Jaykaypur	I	L	M	M	L
Bhubaneswar					
1. SPCB office building, H.O. Nayapalli	R	L	L	H	M
2. IRC Village	R	L	L	H	M
3. Capital police station	R	L	L	C	H
4. Palasuni	R	L	M	H	H
5. Patrapada	R	L	L	H	H
Cuttack					
1. Traffic tower, Badambadi	R	L	L	H	H
2. Regional office building, Surya Vihar	R	L	L	H	H
Sambalpur					
1. PHD office building, Modipara	R	L	L	M	M
Balasore					
1. Regional office building, Sahadevkhunta	R	L	L	H	H
2. DIC office, Angaragadia	R	L	L	H	H
Berhampur					
1. Regional office building , Berhampur	R	L	L	H	H
Keonjhar					
1.Regional office building ,Baniapat	R	L	L	H	M

Source: OSPCB.

Note: R = residential areas; I = industrial areas; SPM = suspended particulate matter; RSPM = respirable suspended particulate matter; L = low pollution, M = moderate pollution, H = high pollution; C = critical pollution.

2.2.5 Key sectoral measures for other vulnerabilities

Table 2.3 is a snapshot of the key mitigation possibilities for reducing emissions.

Table 2.3 Key Mitigation Possibilities for Reducing Emissions, Odisha

	Mitigation measures	Likely impact
Agriculture	Water use efficiency drip irrigation, demand-side management, solar pumps Methane management	CO_2 emissions reduction due to less fossil fuel use Methane emissions reduction
Coastal ecosystem	Mangrove restoration	Carbon sequestration—– blue carbon
Energy	Integrated renewable energy policy to ramp up renewable generation: solar, wind, biomass Renewable Power Obligation (RPO), building codes, energy	Reduction in fossil fuels Avoided generation Behavioural change for a low carbon lifestyle
Fishery and animal resources development	Methane management using advance techniques for enteric fermentation, biogas	Methane emissions reduction
Forestry	Planting in degraded areas, bald hills; Reduction in Deforestation and	Carbon sequestration
Industry	Enhanced energy efficiency in industrial processes; perform, achieve, and trade	Emissions reduction, energy efficiency
Mining	Sustainable mining, planting, coal bed methane tapping, shale gas, coal to liquid	Carbon management and sequestration and improved fuel mix
Transport	Transport demand management, dedicated corridor for	CO_2 emissions reduction

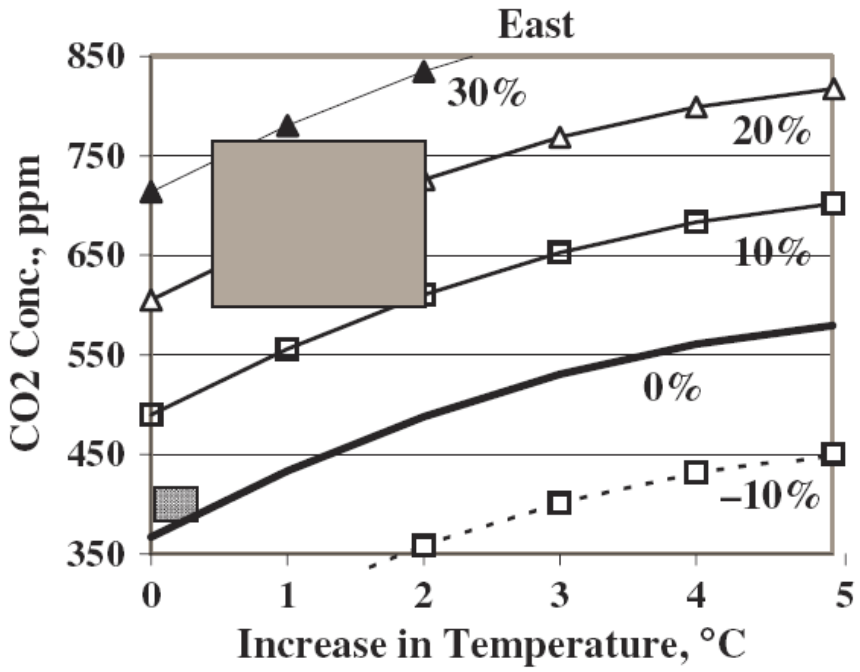
Sector	Mitigation measures	Likely impact
	inland waterway, mass and rapid transit systems, compressed natural gas (CNG) ecosystem,	
Urban development	Building energy efficiency, water supply/pumping efficiency, urban plantation, building codes, land use plan Waste management; effluent treatment	CO_2 emissions reduction Methane management
Water	Irrigation and water use efficiency, solar energy integration	CO_2 emissions reduction

2.3 Socioeconomic factors

2.3.1 Agrarian nature of the economy

Agriculture is the mainstay of the economy of Odisha; about 70 percent of its citizens depend on agriculture for their livelihood. Agriculture is highly vulnerable to climate change (see figure 2.14). Paddy is the main agricultural crop of the state, and the majority of the people are rice eaters.

Figure 2.14 Simulation of Cereal Yield Change Due to Temperature and CO_2 Interaction, Eastern Odisha



Source: Khan et al. 2009.

Note: The figure shows the effects of an increase in temperature and CO_2 on the simulated grain yields of irrigated rice with improved nitrogen management (allowing no nitrogen stress) in different regions of India. Lines refer to the change in grain yield (percentage change is indicated) at different values of CO_2 and increases in temperature. The large box represents 2070 and the small box 2010, the baseline.

Figure 2.14 indicates that climate change is likely to enhance rice yields under different models in an optimistic scenario, but it would reduce the rice yield in the eastern region of Odisha when the four degrees Celsius threshold is crossed. However, yields of coarse grains and maize are likely to fall in Odisha in the medium term even within an optimistic scenario. Coarse grains are staples of the tribes, and so a reduction in yields is likely to increase their vulnerability and worsen their economic condition.

Unseasonal rains and intense tropical cyclones also would affect the socioeconomic conditions of the poor in the state.

2.3.2 Dimensions of poverty

Odisha is a disaster-prone state that has repeatedly suffered from the vagaries of monsoons, cyclonic disturbances, and heat waves, which have affected people at the margin. The impact of disasters on Odisha's economy is evident. The state's per capita income declined rapidly in the second half of the 1990s, which was fraught with disasters. Indeed, its per capita income is now half the national average. An average 900,000 hectares of agricultural production are lost every year due to disasters. Similarly, between 1980 and 2000 agriculture's contribution to the state's GDP fell by 16 percent. Under these conditions, people are unable to cross the poverty margin regardless of the economic gains the state has made in other sectors in the recent past.

Under the non-lending technical assistance programme of the World Bank, poverty and various climate risks have been mapped in the state.

Odisha is one of India's poorest states. Although poverty levels fell from 57 percent in 2004/05 to about 33 percent in 2011/12, the proportion of poor in Odisha remains well above the national average of 22 percent. Odisha, along with Madhya Pradesh, has the highest percentage of rural poor in the country (Odisha Economic Survey, 2013–14).

The 2011–12 poverty estimates for Odisha are based on poverty lines of Rs 695 and Rs 861 per month for rural and urban areas, respectively. Odisha recorded the highest reduction in poverty among all major states between 2004/05 and 2011/12; poverty fell by about 25 percent in rural areas and 20 percent in urban areas. The northern region registered the highest reduction of poverty (30 percent) followed by the southern region (25 percent) and the coastal region (20 percent). Poverty among the scheduled tribe (ST) and scheduled caste (SC) communities has been falling at a faster rate; however, the ST communities remain poorer than other social classes (Odisha Economic Survey Report, 2013–14).

The National Sample Survey Organisation divides Odisha into three regions: coastal, northern, and southern. Table 2.5 shows that poverty reduction (for those below the poverty line, BPL) has been sharper in the southern region for STs but has increased in the northern region. For SCs, in s both southern Odisha and northern Odisha it has increased, whereas in coastal Odisha it has decreased by 2 percent. Even though coastal Odisha repeatedly faces cyclones and floods, it has recovered relatively better than other regions. Whether this is due to higher public investment and better adaptive capacity is not clear.

Table 2.4 Spatial Distribution of Poverty across Social Groups, Odisha

NSSO round	Social	Head count ratio (HCR)				Share of BPL population			
		Coast	Souther	Norther	All	Coast	Souther	Norther	All
66th (MRP)	ST	57.15	72.52	34.25	54.01	14.85	49.80	52.63	43.30
	SC	22.69	49.80	28.28	34.46	27.48	24.16	23.26	24.63
	OBC	10.48	30.77	15.56	18.79	23.05	21.59	18.63	21.18
	Other	14.63	17.61	12.67	14.93	34.62	4.44	5.48	10.89
	Total	16.57	47.03	25.07	29.65	100.00	100.00	100.00	100.00

NSSO round	Social	Head count ratio (HCR)				Share of BPL population			
61st (MRP)	ST	50.63	76.42	59.39	64.32	19.62	56.84	49.70	44.88
	SC	26.99	59.52	42.85	38.55	29.65	20.06	15.89	20.59
	OBC	13.52	45.26	33.58	24.48	33.00	18.83	30.55	27.20
	Other	11.71	41.38	22.52	15.57	17.73	4.27	3.85	7.33
	Total	18.38	62.50	43.69	35.54	100.00	100.00	100.0	100.00

Source: Odisha Economic Survey, 2011–12.

Note: BPL = below poverty line; MRP = mixed recall period. Based on poverty estimates by the National Sample Survey Organisation (NSSO) in its 66th (July 2009–June 2010) and 61st (July 2004–June 2005) National Sample Survey (NSS) rounds.

Sectoral links to poverty and vulnerability are presented in table 2.5:

Table 2.5 Socioeconomic Dimensions and Climate Vulnerability, Odisha

Sector	Poverty/livelihood links
Agriculture	• 80–85 percent of the rural population is dependent on agriculture. • 60 percent of land is rain-fed agriculture, and water-dependent rice is the main crop. Climate change in Odisha has the potential to tremendously aggravate water stress and enhance food insecurity.
Coastal zones disasters	• 36 percent of the population lives in nine coastal districts and is vulnerable to cyclones.
Energy	• Off-grid hydroelectric potential important for energy access • Identification of land for biofuel crops
Fishery and animal resources developme	• Animal resources support a large part of rural livelihoods. • Fisheries contribute to the food and nutritional security of coastal communities.
Forestry	• Cover 31 percent of state • Provide important ecological functions, including carbon mitigation • Provide important livelihoods to rural poor/tribal populations
Health	• Reduced food production could create pockets of hunger and malnutrition • Aggravation of vector-, water-, and food-borne diseases
Mining	• Many mineral resources are on forest land with tribal/indigenous populations.

Sector	Poverty/livelihood links
	• Forest loss increases climate risks for vulnerable (forest- dependent) communities.
Transport	• Inland waterways can provide transport links for the inhabitants of inaccessible riverine areas.
Urban development	• Rural-urban migration will increase the pressure on urban resources and can exacerbate urban poverty issues.
Water	• Water shortages in certain parts of Odisha affect domestic and agricultural supplies. • Saline water intrusion in some coastal districts

2.3.3 Key sectoral measures relevant to socioeconomic factors

Sector	Key socioeconomic vulnerability	Issue addressed in SAPCC
Agriculture	Mono-cropping, hydro-met risks	Livelihood diversification, watershed and livelihood, crop insurance
Coastal zones and disasters	Livelihood risk, asset loss	Early warning, timely relief and response
Fishery and animal resources development	Livelihood risk, asset loss	Insurance, fodder bank
Forestry	Access to non-timber forest products (NTFPs), human- wildlife conflict	Strengthening joint forest management groups, assisted natural resource generation
Industry	Employment disruption	Climate proofing
Mining	Employment disruption	Climate proofing
Water	Livelihood improvement, access	Enhancing water use efficiency and availability

Chapter 3

GREENHOUSE GAS (GHG) INVENTORY

GREENHOUSE GAS (GHG) INVENTORY

A GHG inventory exercise was undertaken by the government of Odisha during preparation of the SAPCC in 2011. Subsequently, to review the changes in state's carbon footprint, a second study was conducted in 2014–15 with the support of the Confederation of Indian Industry.

The state's emissions inventory was carried out on the basis of the IPCC guidelines. It includes various sources and removal sinks that fall under provincial boundaries. Much ensued because of the peculiar nature of the coal-bearing states where thermal power plants are scheduled to be built. However, a small percentage of such generated power will be used in the state and rest will be used in other parts of the country, contributing to the overall development of the nation. Therefore, the "India Greenhouse Gas Emissions Report 2007"[6] was used as reference to define the emissions inventory boundaries for the state. This approach was adopted to avoid uncertainties and to ensure that the report on the emissions inventory for Odisha state is aligned with the "India Greenhouse Gas Emissions Report 2007." The emission factors used in this study were a mix of country-specific emissions factors and default factors from the IPCC. Default factors were used only in the absence of country-specific factors.

3.1 Sectoral inventory

The carbon footprint study indicates that the state has emissions of 98.525 megatons of CO_2-equivalent. The per capita emissions of the state are 2.35 metric tonnes, which is higher than the national average of 1.7 metric tonnes (estimated as per 2007 baseline as presented in 2010-15 SAPCC)

Table 3. 1 Sectoral GHG Emissions, Odisha

Emission source	CO_2-equivalent (megatonnes)	Percentage of total
Energy	**61,307,42**	**62%**
Power generation	50,770,10	83%
Transport	6,077,75	10%
Residential/commercial	1,573,31	3%
Other energy	907,64	1%
Fugitive emissions	1,978,59	3%
Agriculture	**25,067,054**	**25%**
Enteric fermentation	10,112,31	41%
Manure management	543,37	2%
Rice cultivation	9,359,55	38%
Agricultural soils	4,896,18	20%
Burning of crop residue	155,62	1%
Waste	**659,01**	**1%**
Municipal solid waste	170,37	26%

[6] http://www.moef.nic.in/sites/default/files/GHG_report_2.pdf.

Emission source	CO_2-equivalent (megatons)	Percentage of total
Domestic wastewater	224,45	34%
Industrial wastewater	264,19	40%
Land use, land use change, and forestry (LULUCF)	**-36,969,07**	**-38%**
Forest land	-	77%
Crop land	-	21%
Grassland	520,533.48	-1%
Wetland	-	5%
Fuel wood usage	289,769.35	-1%
Industrial sector	**48,461,45**	**49%**
Cement Industry	2,683,80	5.5%
Ceramic Industry	83,839	0.2%
Chemical Industry	93,954	0.2%
Iron & Steel Industry	11,759,56	24.3%
Aluminium Industry (Smelter & Refinery)	29,751,73	61.4%
Ferro Alloys Industry	1,792,36	3.7%
Pulp & Paper	989,23	2.0%
Other Energy Usage	1,306,96	2.7%
Total emissions in baseline year 2011–12 (MT)		**98,525,876**

Source: Compiled from GHG Inventory prepared by Confederation of Indian Industry, 2015, and SAPCC, 2010–15.

Table 3.1 clearly shows that the energy sector is the main emitting sector in the state, largely because of the large number of coal-based thermal power plants built in the state in recent years. The 23 power projects in the state represent a potential investment of about Rs 136,501crore.

Some power-intensive industries such as cement, aluminium, and steel also have a large presence in the state because of the strong mineral base.

Finally, Odisha is a predominantly paddy-growing state. Rice field methane emissions are also quite significant because of the accumulated cow-dung in the field and flooding method of irrigation.

3.2 Comparisons

This section highlights how have sectoral emissions changed since the last computation. Because of the different methodologies used in some sectoral computations (the LULUCF COMAP model was used in 2011), such a comparison may yield only an order of magnitude (see table 3.2).

Table 3. 2 Comparison of GHG Emissions in Last Five Years, Odisha

Sector	CO_2-equivalent (megatonnes)			
	As per SAPCC I (2010–15)	As per SAPCC II (2015–20)	% share in SAPCC (2015–20)	CAGR (%)
Industry, transport, energy sector	82.68	109.7689	81.0	6.0
Agriculture[a]	—	25.06705	18.5	
Waste[b]	0.56	0.659	0.5	42.4
Subtotal (a)	83.24	135.4949		
Forest (LULUCF) (b)	–4.56	–36.969	-38	1.8
Total (a+b)	78.68	98.525		11.4
Per capita emission	1.88	2.35		11.4

Source: SAPCC 2010-5 and CII GHG inventory study , 2015

Note: CAGR = compound annual growth rate; LULUCF = land use, land use change, and forestry.

a. Agricultural emissions were not computed in the last SAPCC in line with the Indian government's position of excluding the agriculture sector from the national communication.
b. Industrial waste was not included in the last SAPCC computation.

3.3 Recommendations for reducing Odisha's carbon footprint

To reduce emissions and follow a low-emissions growth strategy (to reduce emission intensity by 25–30 percent), the Confederation of Indian Industry has made several recommendations that are listed here. Many of these are part of the approved SAPCC planned activities, which are in brackets in italics at the end of the recommendations that follow:

1. Adopt voluntary Renewable Purchase Obligation (RPO) targets, significantly exceeding any mandatory values that the central government may impose. RPOs should be gradually increased from the current levels to 25 percent by 2020. Investments in renewable energy should be aggressively pursued and results achieved to help significantly reduce carbon emission intensity. *[A part of the energy sector action plan and the regulator have already specified the current RPO level. The state is coming out with an integrated renewable energy policy to spur renewable investment in the state.]*

2. Create a Green Fund and support the state's climate mitigation efforts through funds raised from the larger emissions sources (e.g., the power sector). This could be a viable alternative for resolving environmental concerns to a certain extent without compromising citizens' fundamental requirements. *[The state has already set up a fund.]*

3. Consider allowing land use, land use change, and forestry (LULUCF) to significantly act as a carbon sink in the state's efforts to minimise its overall carbon footprint. *[CAMPA and the Green India Fund would cater to this objective.]*

4. Establish a Power Plant Refurbishment Fund to create a source of funds for the Odisha electricity board so that it can gradually refurbish and modernise its power stations. *[It is proposed that industrial and commercial consumers be charged at a rate of Rs 0.10 per kilowatt-hour.]*

5. Charge a fuel cess of Rs 0.50 per litre on both diesel and petrol, with the funds generated from it utilised for funding biofuel research and supporting technology absorption. Based on baseline year data, the proposed fuel cess (at the rate of Rs 0.50 per litre) will result in substantial funding for research and implementation of low carbon fuels.

6. Consider a green tax on new vehicles at 1 percent of the vehicle cost. This green tax can be channelled toward developing a public transportation system and intercity transportation across the state.

7. Consider a clean energy cess (at a rate of Rs 100 per ton of coal) to be made available to non-fossil fuel–based energy such as energy plantations, biomass, waste

to energy, etc. (The Union Government is planning to announce such a cess, and currently the coal cess has been doubled to Rs 100 per tonne). India is the first developing country to levy a carbon tax of this nature.

8. Consider that co-processing of industrial, municipal, and other combustible wastes in cement kilns could be another viable alternative for partially meeting the cement industries' energy requirements and addressing the waste management issues of the state. *[This has been proposed in the industry sector action plan.]*

9. Utilise cleaner production and industry symbiosis to improve the productive use of energy, materials, and water; reduce the generation of waste and emissions (including GHGs); and strengthen the sound management of chemicals for small and medium enterprises (SMEs). *[This has been proposed in the industry sector action plan.]*

10. Promote adoption of green buildings in the residential and commercial space. The government of Odisha could lead by example. *[Operationalization of the Energy Conservation Building Code (ECBC) is being supported under the NLTA initiative of the World Bank.]*

11. Explore demand-side management in agricultural pump sets, water and crop management, and the system of rice intensification (SRI) technique as potential emissions reduction opportunities in the agriculture sector. *[Both of these initiatives are part of the SAPCC in the energy and agriculture sector action plans.]*

Chapter 4

PROGRESS ON SAPCC IMPLEMENTATION (2010-15)

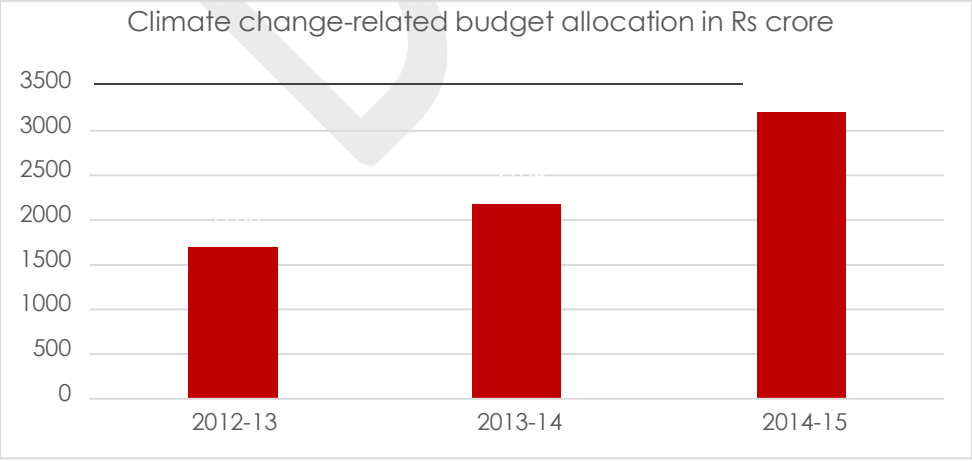
PROGRESS ON SAPCC IMPLEMENTATION (2010-15)

The first SAPCC has been in effect for almost four years, and several activities have been taken up. The DFE's climate change cell was mandated to coordinate with the various line departments in order to track the progress made in the priorities identified in the first SAPCC. This section summarises the actions taken by the state in implementing the 2010–15 climate change action plan. It is the first report card of any state in India that openly describes what has been done in the identified sectoral areas to address the adaptation and mitigation of climate change concerns.

4.1 Overall budget allocation

The state without having any recourse to any climate finance has used funds from its own sources to support high-priority activities in 11 sectors. An analysis clearly shows that the climate investment commitment (allocation) by the state increased from 3.3 percent of the total budget in 2012–13 to 4 percent in 2014–15. As a percentage of the planned budget, the allocation is at 8.5 percent in 2014–15. The climate budget increased from Rs 1,700 crore in 2012–13 and Rs 2,184 crore in 2013–14 to Rs 3,207 crore in 2014–15 (figure 4.1). These numbers could be higher because they do not take into account cross-sectoral investment in the Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA), etc. with climate benefits. In 2014–15, the total investment stands at Rs 3,207.26 crore, of which 51 percent are for mitigation, 41 percent for adaptation, and the remaining 8 percent for both.

Figure 4.1 Climate Change–Related Investment: Odisha, 2012–15



Source: "Progress Report on Implementation of Climate Change in Odisha," 2015.

In terms of type of investment, table 10 shows the breakdown for 2014–15. It shows that the largest amount has been spent on investment projects, followed by 5.9 percent on pre-investment pilots or detailed project reports (DPRs) and then 3.6 percent on capacity building.

Table 4.1 Investment Breakdown: Odisha, 2014–15

Category	Investment amount (Rs crore,	% of total
Capacity building	114.7	3.6
Investment	2,779.1	86.7
Pilot/demo	19.66	0.6
Policy action	48.24	1.5
Preinvestment	189.8	5.9
Research study	55.69	1.7
Total	3,207.2	100.0

Source: "Progress Report on Implementation of Climate Change in Odisha," 2015.

4.2 Sectoral allocations to key activities

The state has identified 121 high-priority climate change activities in 11 sectors (the sectoral allocations for these activities are shown in table 4.2). The Water Resource Department and the Revenue and Disaster Management Department lead in adaptation-related allocations, and the Forest and Environment, Coastal and Disaster Management, and Agriculture departments contribute to both sides (adaptation and mitigation).

Table 4.2 Sectoral Allocations to Key Climate Change–Related Activities, Odisha

In Rs crore

Sector	Climate budget (2014–15)	Climate budget (2013–14)	Climate budget (2012–13)
Agriculture	556.2	631.4	218.4
Coastal zones and disasters	319.4	208.0	36.1
Energy	509.4	367.4	274.3
Fishery and animal resources	28.33	27.6	15.4

Forestry and	554.59	310.05	246.30
Health and family welfare	36.10	30.03	0.00
Housing and urban development	502.10	0.00	0.00
Industry	70.50	0.18	0.00
Steel and mines	0.00	0.00	0.00
Transport	0.00	4.22	1.16
Water resources	630.47	605.00	908.27
Total	**3,207.26**	**2,184.35**	**1,700.17**

Source: "Progress Report on Implementation of Climate Change in Odisha," 2015.

From the data, it is clear that the large emitting sectors– energy, urban development, forestry and environment, and agriculture- have higher levels of allocations than the other sectors. Allocations for the Energy Department include higher allocations for climate change–related actions in part because of the massive transmission and distribution (T&D) loss reduction initiative funded by both government and distribution companies and financed by a loan. This is 16 percent of the total allocation that was proposed for the entire five-year period in the SAPCC. The same is the case for the Department of Urban Development. Therefore, the investments in climate change adaptation and mitigation seem to be on track.

Some of the departments such as Steel and Mines, Transport, and Industry work with the State Pollution Control Board and the Department of Forest and Environment on climate change–related activities and place funds with them. Therefore, these investments have not been segregated to avoid duplication. Out of the total allocation for all the sectors, 51 percent is for mitigation-related actions, 41 percent for adaptation, and 8 percent contributes to both adaptation and mitigation.

4.3 Offset estimates

Several mitigation actions have contributed to the offset benefits (emissions reduction benefits through the creation of a carbon sink). These benefits are associated with the creation of a carbon sink through plantation-related actions by the Department of Forest and Environment, the promotion of the system of rice intensification (SRI) and agroforestry- related activities by the Agriculture Department, and coastal mangrove protection and renewable energy generation through the Energy and Science and Technology Departments, respectively. The combined emissions offset from the proposed actions are estimated to be 6.23 megatons by 2014–15. This has been calculated using IPCC default values and country/state-specific values, if available. Unlike mitigation, adaptation outcomes are difficult to estimate in a short span of time.

4.4 Key sectoral policies implemented as a part of the first SAPCC

One of the key benefits of the climate change action planning is the mainstreaming of the climate change agenda in the development planning process (see table 4.3).

Table 4.3 Key Sectoral Policies Implemented as Part of First SAPCC, Odisha

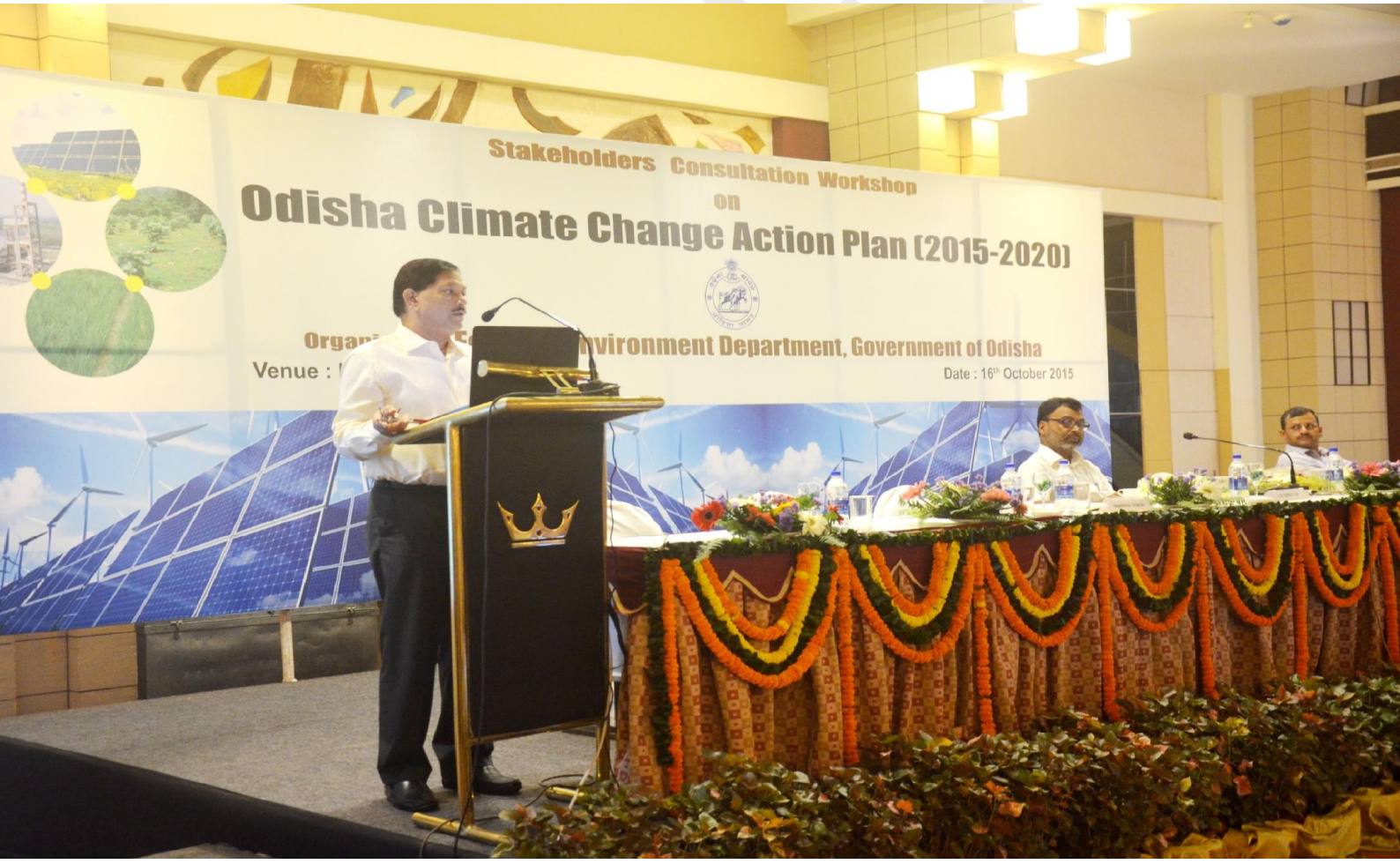
Sector	Policy	Remark
Agriculture	Climate concerns in the state agriculture policy and crop contingency planning and seed	Is operational and has a strong climate change linkage.
Coast and disaster management	Compliance with Coastal Regulation Zone (CRZ), disaster risk reduction policy, district-level disaster risk management (DRM) plan, plan for vulnerable	Is operational and has a strong climate change linkage.
Energy	Integrated renewable energy policy Energy Conservation	Draft policy, once approved, will spur renewable energy investment in the state.
Fishery and animal resources development (ARD)	Perspective plan in the ARD sector	Has some linkages to climate-related stress.
Industry	Industrial Policy Resolution, 2015	Has some linkages to issues relating to climate change and
Water	Water policy and groundwater legislation Rooftop rainwater	Has linkages to climate change.

ACTION PLAN MATRIX (2015-20)

ACTION PLAN MATRIX

The key objective of the second SAPCC is to revisit actions that help in adaptation and mitigation to reduce vulnerability and emissions, respectively. The departments identify various activities relevant to climate change. These are then prioritised based on the urgency, barriers, continuity, and co-benefits (emissions, livelihood resilience, and environmental benefits). In the matrix, the time frame is three to five years and more; impact is categorised as high, medium, and low; and co-benefits are identified as additional benefits to the environment, livelihood resilience outcomes, and emissions reduction wherever applicable.

Basing on prioritized activities the sectors are categorized as follows:



AGRICULTURE

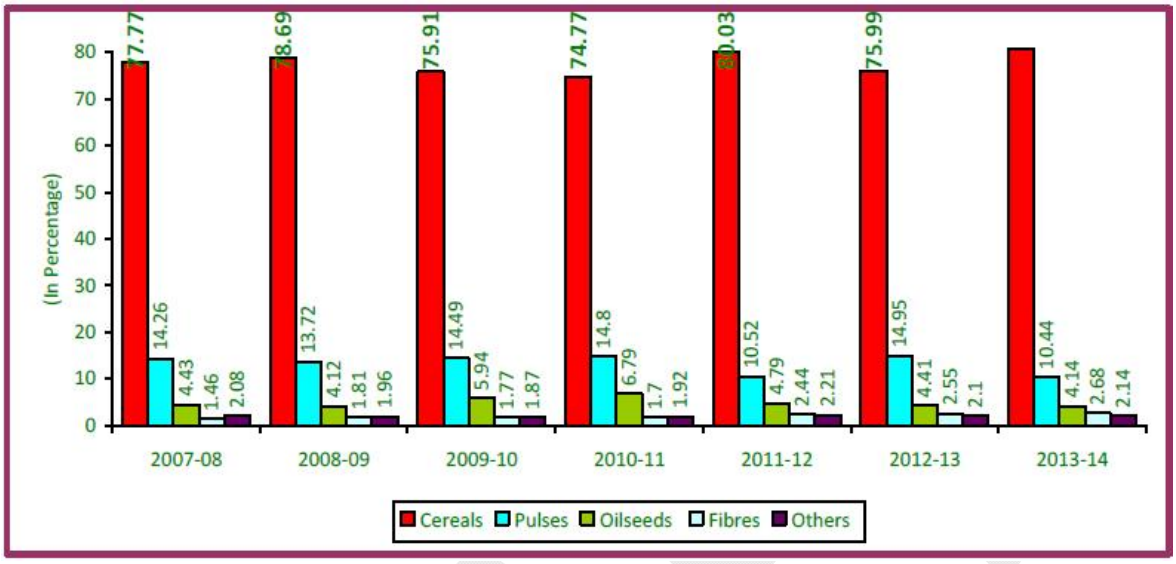
5.1 Agriculture

5.1.1 Overview

Agriculture is key to food security of millions in India. The sector is highly vulnerable to climate change. Odisha is an agrarian state in which about 70 percent of the population is dependent on agriculture. The agriculture sector of Odisha broadly comprises agriculture, horticulture, and related activities. Of the total geographical area of the state, about 39.69 percent consists of land under cultivation. Increasing agricultural production and productivity is necessary for ensuring food security, livelihood security, and nutritional security. Agricultural production and productivity can be improved through better land and water management, a greater reliance on rain-fed agriculture, expansion of agricultural markets, better technology, higher public and private investments, and effective implementation of the ongoing programs in agriculture and allied sectors such as for crop and weather insurance.

The state's key agricultural output trend is shown in figure 5.1.1. According to the figure, most outputs have been relatively stable over the last five years without any major fluctuations. The frequent occurrence of natural calamities badly affects the production of kharif rice. In drought years, there is a considerable loss in production of pulses and oilseeds both during kharif and rabi.

Figure 5.1.1 Key Agricultural Outputs, Odisha



Source: Odisha Economic Survey, 2014.

The agro-climatic diversity in the state, with its high rainfall distributed over a four-month monsoon and a reasonably moderate winter, allows cultivation of a variety of horticultural crops. The normal rainfall from June to September from the southwest monsoon is immensely suitable for growing perennial fruit crops such as mango, litchi, guava, oranges, and limes; annual fruit crops such as banana, pineapple, and papaya; spices such as ginger, turmeric, and chilli; a variety of roots and tubers; and a whole range of vegetables. Among all states, Odisha is ranked fourth in the production of vegetables. The total production of vegetables was 9,433.65 thousand tonnes in 2013–14, compared with 9,913 thousand tonnes in 2012–13. From 2010–11 to 2013–14, the production of major fruit crops increased: mango from 33.78 thousand tonnes to 38.02 thousand tonnes; papaya from 214.36 thousand tonnes to 220.06 thousand tonnes; and banana from 181.93 thousand tonnes to 190.18 thousand tonnes. The production of ginger and turmeric has increased significantly. Odisha also accounts for about 3 percent of India's total flower production and 4 percent of spice production.

5.1.2 Sector vulnerability due to climate change

Even though the quantum of rainfall in Odisha is quite high, its distribution during the monsoon period is highly uneven and erratic. As a result, flood and drought occur regularly with varying intensity. During extreme weather events, the damage to crops has been significant.

The agriculture sector is also a major contributor to non-CO_2 such as methane emissions. Rapid mechanisation of agriculture and fossil fuel use lead to CO_2 emissions. Increases in the number of ruminants and food wastes as well as expansion of the rice-growing area are

the major sources of methane emissions. According to the IPCC AR5, there is scientific evidence that the CH_4 concentration in the atmosphere began growing after 2007. Odisha, as a major rice-growing area, is also a contributor to this phenomenon.

Farmers in developing countries such as India are little able to cope with climate change. Various climate events such as drought, cyclone, and flood have significantly affected Odisha's agriculture. About 70 percent of the total cultivated area in the state is drought- prone. Historically, Bolangir and Boudh were the most drought-affected districts. The government has, however, identified contiguous patches comprising 47 blocs as a chronic drought-prone zone.

Even though human casualties were minimal because of the deft handling of Cyclones Phailin and Hudhud, the damage to crops and livestock could not be prevented. Severe cyclonic storm and post cyclonic floods damaged standing crops in 6.71 lakh hectares in the state. Heavy rains and surging seawater destroyed more than 500,000 hectares (1.23 million acres) of crops worth an estimated Rs 24 billion (US$395 million), according to official sources (Revenue and Disaster Management).

Beyond the temperature rise of two degrees Celsius, yields of cereals and even coarse grains and maize are likely to be adversely affected, affecting in turn the state's food security.

Finally, the pest problem is likely to worsen because of climate change, although strong causality has not yet been established in Odisha.

5.1.3 Key activities taken up during 2010–15

Table 5.1.1 lists the key climate change activities implemented in Odisha from 2010 to 2015.

Table 5.1.1 Key Climate Change Activities, Agriculture Sector: Odisha, 2010–15

Sl no.	Activity	Linkage	Progress in 2010–15
1	Expand 25,954 hectare area under perennial fruit crops.	Adaptation and mitigation	Implemented as a key priority (KP)
2	Promote SRI (system of rice intensification) rice cultivation for methane management.	Mitigation	Implemented but not a KP
3	E-pest surveillance in all districts	Adaptation	Implemented as a KP
4	Water use efficiency through micro-irrigation	Mitigation	Implemented as a KP
5	Undertake livelihood-focused, people-centric integrated watershed development programmes in rain-fed areas.	Adaptation and mitigation	Implemented as a KP
6	Conduct research on climate resilience and cropping system adaptation.	Adaptation	Initiated pilots as a KP
7	Promote organic agriculture and nutrient management	Adaptation	Implemented but not a KP
8	Identify suitable varieties for flood and drought (crop contingency planning).	Adaptation	Implemented but not a KP
9	Build capacity of extension personnel and farmers in aspects of climate change (vulnerability and adaptation).	Adaptation	Implemented as a KP
10	Build community capacity for disaster preparedness.	Adaptation	Implemented as a KP
11	Emphasise poly houses, net houses, and mulching.	Adaptation	Implemented but not a KP

5.1.4 Proposed activities for 2015–20

The Agriculture Department proposes continuing some of the key priorities that were undertaken during 2010–15.

AG/KP/1- Continue the livelihood-focused, people-centric integrated watershed development programmes in rain-fed areas vulnerable to climatic variations.

This activity was undertaken during the last phase (2010–15). Out of the targeted Rs 1,000 crore, Rs 827 crore has been spent, and another 600,000 hectares will be developed in the next five years, with an allocation of Rs 720 crore split equally between centre and state. The implementing agency, Odisha Watershed Development Mission, will follow the watershed-plus approach already mainstreamed in the state.

AG/KP/2- Establish an institutional delivery mechanism to promote best practices on climate change.

This is a new activity and a network of centres of excellence will be established in the state based on the climate-smart principles. About 9000 extension personnel across all grades (A, B and C) are planned to be trained.

AG/KP/3- Capacity building of extension personnel

It is important to train extension personnel on climate smart agricultural practices so that they can motivate the farmers.

AG/KP/4- Increase the area under fruit crops to help cope with uncertain weather patterns.

This proposal will help in crop diversification and provide nutrition. Also, fruit crops, when planted in degraded areas, would help in carbon sequestration. The state has already developed an AR-CDM[7] project, which is under validation. The total area to be covered under this phase (2015–20) is 75,000 hectares, with an outlay of about Rs 560 crore.

AG/KP/5- Develop water-efficient micro-irrigation methods: individual and community farm ponds.

This activity will enhance both demand-side and supply-side efficiency and aid in the mitigation effort. It will also help in water use efficiency and reduce the risk of crop failure, especially in the rabi crops. Total outlay is expected to be Rs 280 crore in 75,000 hectares over five years.

[7] A methodology under the clean development mechanism in the forestry sector.

AG/KP/6- Create awareness among farmers of climate change adaptation.

This initiative would sensitise farmers to climate change adaptation in rural areas. The initiative is being supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).

AG/KP/7- Establish an automated weather station.

Establishment of such a weather station and linking it to KVK network would yield better microclimate data. It will also help in modelling and risk management and will deepen the weather insurance in the state.

AG/KP/ 8- Establish a seed bank at the village level.

This initiative enhances adaptability by managing climate variability and seeding at the local level.

AG/KP/9- Promote SRI.

The system of rice intensification (SRI) can help to reduce methane emissions by use of an alternate wetting and drying method, can reduce water use, and can lead to higher outputs. SRI has been successfully incorporated into production in Odisha and will be continued during 2015–20.

AG/KP/10- Encourage the adoption of climate-resilient cropping techniques.

Climate-resilient cropping techniques will be a major extension challenge. They will be applied in in the four climate risk areas.

AG/KP/11- Document indigenous technical knowledge (ITK) in agriculture.

Some traditional agricultural practices are supposed to be climate adaptive, and they have withstood climate shocks. Documentation of ITK is a useful initiative that is supported by GIZ.

AG/KP/12- Green energy efficient models for farmers

More widespread use of this model will help in carbon sequestration as well as enhance productivity. Use of solar pumps and other efficient pump sets can be used for this.

5.1.5 Co-benefits

Resilience-related: In Odisha, about 70 percent of the total population is dependent on agriculture and allied activities. Therefore, any activity that would improve the resilience of agriculture will positively affect this population.

Mitigation-related: Initiatives such as SRI will help to reduce methane emissions while the agroforestry system helps in carbon sequestration. Planting fruit trees in degraded areas has provided this benefit as well as livelihood diversification and nutrition.

5.1.6 Implementation schedule and budget

Sl no.	Activity	Time frame (years)	Impact	Co-benefits	Required budget (Rs crore, (2015–20)	State budget (RS crore)	Other sources (centre, bilateral/ multilateral (Rs crore)
1	Continue the livelihood-focused, people-centric integrated watershed development programmes in rain fed areas vulnerable to climatic variations	5	H	H	72.00	36.00	36.00
2	Increase knowledge and capacity.	5	M	M	21.70		21.70
3	Build capacity of extension personnel (Gr. A/B/C) and farmers.	5	M	H			
4	Continue liaison work with the NCCP and NMSA.	5	M	M		1.00	1.00
5	Create awareness among farmers.	5	M	M			
6	Establish automated weather station.	3	L	L	0.30		0.30
7	Establish seed bank at village level.	5	M	L	15.70		15.70
8	Promote SRI.	5	H	H		1.00	
9	Promote crop diversification.	5	H	H			
10	Develop efficient micro and drip irrigation.	5	H	M	280.00	59.50	220.50
11	Increase the area under perennial fruit crops.	5	H	H	562.50	21.88	540.63

Sl no.	Activity	Time frame (years)	Impact	Co-benefits	Required budget (Rs crore,	State budget (RS crore)	Other sources (centre, bilateral/ multilateral (Rs crore)
12	Document ITK helping in adaption of climate	3	M	M			1.00
13	Promote green energy-efficient models for	3	M	M	15.7	0.70	15.00

Note: L = low; M = medium; H = high.

COAST & DISASTER RISK MANAGEMENT

5.2 Coast and disaster risk management

5.2.1 Overview

Odisha has a coastline spanning 480 kilometres that covers six districts: Balasore, Bhadrak, Kendrapada, Jagatsinghpur, Puri, and Ganjam. According to the 2011 census, the total population of these six coastal districts is 10,112,048, and it is distributed over an area of 21,887 square kilometres with a population density of 462 persons per square kilometre. The coastal area and hinterlands along the coast are rich in biodiversity. They include Chilka, Asia's largest brackish water lagoon, which includes a 672-square kilometer mangrove forest and wetland. Odisha also has a large nesting beach of Olive Ridley turtles along its southern coast.

The coastal and marine environment plays a critical role in the socioeconomic, cultural, and environmental well-being of the state. It has strong linkages to industrial development, agriculture, aquaculture, recreation, and port-related transport and commerce. Some of these activities compete for space along the coast, and management of the coastal zone is vital for the state's development. The loss of land to the sea has become a more recurrent phenomenon. Ocean dynamics and coastal processes have a strong link to climate change. They also have strong links to various disasters that confront the state quite often.

5.2.2 Coastal vulnerability due to climate change

According to the IPCC Fifth Assessment Report's Representative Concentration Pathway (RCP), the 2.6 scenario coincides with global warming of 1.5 degrees Celsius, and in this scenario the sea level is projected to rise by 0.36 meters (range of 0.20 meters to 0.60 meters). And for the four degrees Celsius world for the period by 2100, the sea level is projected to rise by 0.58 meters (range of 0.40 meters to 1.01 meters).

Coastal vulnerability is strongly correlated with elevation and the exposure. Regional coastal process modelling undertaken by the Integrated Coastal Zone Management (ICZM) project supported by the World Bank has identified the vulnerable areas along the coast. Structural and non-structural measures have been undertaken to mitigate the risks. Of the coast length of 480 kilometres, nearly 187 kilometres are exposed to erosion and are considered accreting or stable; 39.3 kilometres are a high erosion zone; and 51.96 kilometres have been designated at medium erosion zone. Coasts subjected to accretion are considered less vulnerable areas as they move toward the ocean and result in the addition of land areas, whereas areas of coastal erosion are considered more vulnerable because of the resultant loss of private and public property and important natural habitats such as beaches, dunes, and marshes.

Global warming is also likely to affect the brackish water fishery, which is a major revenue earner in the state. This type of fishery is expected to undergo significant physiological change during the larval stage because of higher acidification.

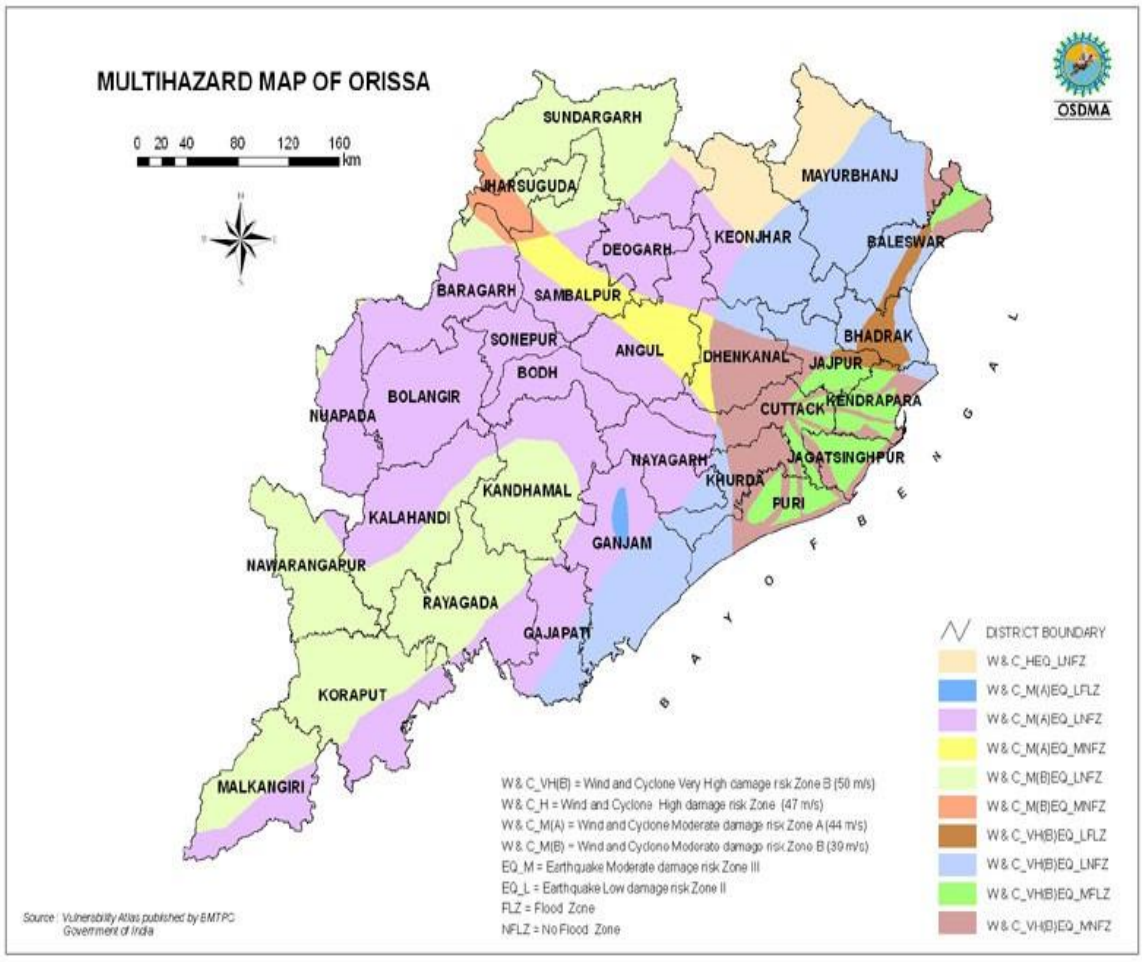
Saline water ingress and poor water discharge due to high tide would affect the crop productivity and food security in this region.

Coastal cities such as Paradeep, Gopalpur, and Dhamara have ports and are also highly populated. Enhanced storm surge will inundate the coastal infrastructure and affect the lives and livelihoods of people in these cities.

5.2.3 Disaster-related vulnerability

The disaster proneness of the coastal areas from storm surge, erosion, and periodic cyclones raises the overall disaster risk for the state. A multi hazard analysis of Odisha is shown in figure
5.2.1.

Figure 5.2.1 Multihazard Analysis, Odisha



Source: OSDMA.

Table 5.2.1 indicates the types of disasters to which the state has been vulnerable.

Table 5.2.1 Types of Disasters, Odisha

Sl no	Type of disaster	Frequency	Intensity
1	Flood	Regular feature	High
2	Cyclone	2–3 year interval	High
3	Tsunami	Rare	High
4	Drought	3–5 years	Moderate
5	Heat wave	Less	Low
6	Earthquake	Less	Low

Source: OSDMA

5.2.4 Key activities taken up during 2010–15

Table 5.2.2 is a snapshot of climate change activities undertaken by the state for disaster risk reduction.

Table 5.2.2 Key Climate Change Activities, Coast and Disaster Risk Management Sector: Odisha, 2010–15

Sl	Activity	Linkage	Progress in 2010–15
1	Coastal biodiversity conservation and livelihood security	Adaptation	Implemented but not a key priority (KP)
2	Mangrove restoration	Mitigation	Implemented as a KP
3	Multipurpose cyclone shelter construction	Adaptation	Implemented as a KP
4	Solid waste management in Paradeep	Mitigation	Implemented but not a KP in this sector; done in association with Housing and Urban Development
5	Coastal protection measures in a high erosion zone (Pentha, Kendrapara), including saline embankment construction under National Cyclone Risk Management	Adaptation	Implemented a pilot under a generic KP
6	Construction and restoration of climate- resilient public infrastructure under Odisha Disaster Recovery Project	Adaptation	Implemented as a KP (started after Cyclone Phailin)
7	Regional Coastal Process Study[a]	Adaptation	Implemented as a KP for better scientific assessment of coastal
8	Hydrological intervention for lake restoration in	Adaptation	Implemented but not a KP
9	Research study on bioprospecting, water bird movement, macrophyte biodiversity	Adaptation	Implemented but not a KP
10	Hazard mapping zones for flood and cyclone	Adaptation	Implemented as a KP
11	Community capacity building for disaster preparedness	Adaptation	Implemented as a KP
12	Multipurpose cyclone shelter building and food assistance	Adaptation	Implemented as a KP
13	Streamlining the standard operating procedure (SOP) based on the Early Warning	Adaptation	Implemented as a KP

[a]. Study undertaken by Indian National Centre for Ocean Information Services (INCOIS) under the Integrated Coastal Zone Management (ICZM) programme at the World Bank.

5.2.5 Proposed activities for 2015–20

CD/KP/1- Undertake a micro-level vulnerability assessment of state resources in coastal areas (construction of saline embankments under the National Cyclone Risk Management Project, NCRMP).

After undertaking a micro-level vulnerability assessment, the state planned 12 embankments measuring 57.77 kilometres in coastal areas, and 60 percent of the work has been completed at a cost of Rs 121.17 crore. These embankments will help protect agricultural land and fishing ponds from saline water ingress. The balance of this work will be completed during 2105–20.

CD/KP/2- Construct multipurpose flood and cyclone shelters (MCS) and provide shelter-level equipment.

Several multipurpose flood and cyclone shelters with shelter-level facilities and equipment have been built in the state. These shelters have been extremely useful for evacuating people in response to hydro-met events. Food assistance is provided during a temporary stay. Of 319 planned flood shelters, only 12 have yet to be completed during 2015–20. However, new construction may be needed in newly flooded areas. As for cyclone shelters, 378 have been built, and the remaining 212 are scheduled to be completed by 2015–20. Planned investment is Rs 292 crore.

CD/KP/3- Develop a techno-legal regime for the construction of disaster-resilient public infrastructure (construction of approach roads to MCS buildings under the NCRMP) and include Odisha Disaster Recovery Project (ODRP) project for housing, etc.

Several approach roads to cyclone and flood shelters will be completed during 2015–-20. Of the 100 roads (169.44 kilometres) planned, only 10 roads have been completed. The balance will be completed.

Under the Odisha Disaster Recovery Project supported by the World Bank, 15,980 houses and 113 habitation developments with climate-resilient infrastructure are planned. The project is expected be completed by 2018–19 and has an allocation of about Rs 700 crore, of which Rs 265 crore have

already been spent. For the balance of the work, the state government will spend Rs 135 crore, and a loan of Rs 316.65 crore is being provided by the World Bank. These projects will help restore the livelihood of the affected people and also follow norms and technologies that make them disaster-resilient.

CD/KP/4- Set up an integrated capacity-building protocol covering shelter and a self-help group under the Community-Based Disaster Risk Reduction Framework (CBDRF), including college and school volunteers and officials at the state and district levels.

The role of capacity development in disaster risk reduction has been well proven in the context of Odisha. The investment in institutions and processes to manage disasters has helped reduce casualties and also aided in quick recovery. Therefore, plans are under way to build the capacity of the community from the shelter level to the decision-making members of the Panchayats, teachers and students in schools and colleges, and district and state officials through an integrated framework. The capacity building will be attempted in areas such as early warning, precautions related to health and hygiene, and livelihood restoration. Provision has been made for an allocation of Rs 29.50 crore.

5.2.6 Co-benefits

Coastal zone management has several co-benefits that protect the life and livelihood of fishermen. Mangroves and coastal vegetation, referred to as "blue carbon," sequester carbon far more effectively (up to 100 times faster) and more permanently than terrestrial forests. There is strong evidence of water balance allowing the proper exchange of water between land and sea. Investment in climate-smart disaster management has helped create resilient community, institutions, and networks. This in turn has helped reduce climate risk and protect livelihoods.

5.2.7 Implementation schedule and budget

Sl no.	Activity	Time frame (years)	Impact frame	Co-benefits	Required budget (Rs crore, (2015–20)	State budget (Rs crore)	Other sources (centre, bilateral/multilateral (Rs crore)
1	Undertake a micro-level vulnerability assessment of state resources in coastal areas (construction of saline	5	H	M	Ongoing	Ongoing	
2	Construct multipurpose flood and cyclone shelters and provide	5	H	M	292.00	292.00	—
3	Develop a techno-legal regime for construction of disaster-resilient public infrastructure (construction of approach roads to MCS	3	H	H	451.65	135.00	316.65
4	Set up an integrated capacity- building protocol covering shelter and a self-help group under the CBDRF, including	5	H	M	29.50	29.50	29.50

Note: L = low; M = medium; H = high.

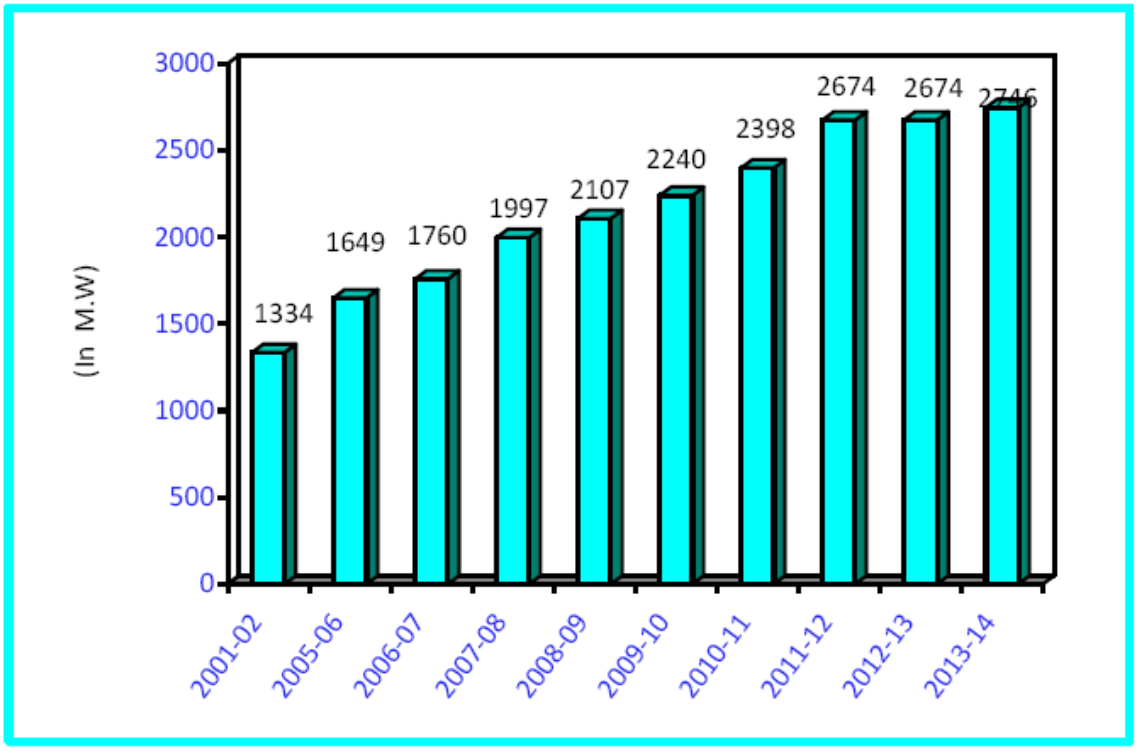
ENERGY

5.3 Energy

5.3.1 Overview

Odisha has reasonable water resources for hydropower and substantive coal for thermal power. This unique combination has helped the state to remain a balanced and surplus power producer for the nation. Installed capacity of power in the state was 5,054 megawatts in 2013–14. The installed capacity of the state doubled from 2005–06 to 2011–12. The state's demand for power from 2001 to 2014 is shown in figure 5.3.1.

Figure 5.3.1 Power Demand: Odisha, 2001–14



Source: Odisha Economic Survey, 2014.

Even though the state has surplus power, it experiences shortages during peak demand. The peak demand is 3,300 net megawatts, and the amount met during peak is 2,600 net megawatts.

Out of the total power supply from the state sector in 2013–14, 18 percent was from thermal sources, 49.7 percent was from hydro sources, and the balance, 32.3 percent, was purchased from captive power plants (CPPs) and other sources. Most of the thermal power plants that contribute to emissions actually cater to the needs of the nation, including

different industrialised parts of India. Solar and biomass power generation has not been fully developed. By 2013–14, only 13 megawatts of solar power has been commissioned in the state.

In terms of rural energy access, the state has done well. Out of 47,529 villages in Odisha, 93.4 percent of villages had been electrified by the end of March 31, 2014, as opposed to 95.7 percent for all of India. Only nine states in India have achieved 100 percent electrification.

5.3.2 Sector vulnerability due to climate change

The vulnerability here has a dualism. The enhanced demand from within and outside the state for thermal power production would certainly increase emissions. This will in turn increase the state's contribution to global warming and also result in significant environmental pollution. The sector itself is also vulnerable to climate change.

Generation of hydropower will be directly affected by the erratic monsoon seasons and conflict with agricultural and industrial water uses. In the long term, there does not seem to be a major change in the precipitation level at the aggregate level.

The temperature increase might affect the plant load factor (PLF) of the power plants. It will also increase the cooling demands of consumers and add stress to the already overloaded distribution network of the state.

Very severe Cyclone Phailin recently exposed the vulnerability of the power network of the state. Immediately after the cyclone, the power demand in Odisha dipped to as low as 600 megawatts, 22 percent of the 2,800 megawatts normally registered in the state, bringing the regional grid under stress. Up to seven lines of 400 kilovolts, 17 lines of 220 kilovolts, and 19 lines of 132 kilovolts were affected in the state. It also affected several 11-kilovolt lines and 3.8 million consumers.

The state has an ambitious target for the integration of renewable energy. However, wind installations along the coasts are not fully cyclone-proof, and the cloud cover and prolonged rainy days may negatively affect the state's solar power generation.

5.3.3 Key activities taken up during 2010–15

The activities shown in table 5.3.1 were undertaken during 2010–15 in the state's energy sector.

Table 5.3.1 Key Climate Change Activities, Energy Sector: Odisha, 2010–15

Sl	Activity	Linkage	Progress in 2010–15
1	Institutional development and policy (Green Energy Development Corporation Limited, GEDCOL, was formed for on-grid renewable); renewable energy policy for the state has been formulated.	Adaptation	Implemented as a key priority (KP)
2	Ambitious Capital Expenditure (CAPEX) programme was launched to improve distribution infrastructure and reduce transmission and distribution (T&D) losses in Central Electrical Supply Undertaking (CESU) areas.	Mitigation	Implemented as a KP
3	Energy efficiency measures in government buildings, public sector undertakings (PSUs), and water supply system as specified in Odisha Energy Conservation Building Code (OECBC) and as required by state-designated agencies	Mitigation	Implemented as a KP
4	Area-based programmes in upgrading 33 11- kilovolt substations to improve system efficiency and reduce transformer overloading and burn-out	Mitigation	Implemented but not a KP
5	Underground cabling to make power lines disaster-proof (Puri and now in	Adaptation	Implemented but not a KP
6	Commissioning of 13 megawatts of solar power	Mitigation	Implemented as a KP
7	Biogas and biomass power generation enhancement through the Orissa Renewable Energy Development Agency	Mitigation	Implemented as a KP

5.3.4 Proposed activities for 2015–20

The energy sector has an ambitious plan to harness the potential in the state. It aims to shed its image as a generator of dirty power and invest in clean coal, clean generation, and renewables in a big way.

Energy/KP/1- Generate power through clean coal approaches.

The state is now promoting super-critical technologies that will reduce coal consumption from 1 MT to 0.88 MT per megawatt-hour. Some activities such as coal washery and improved boiler efficiency contribute to low emissions. Adani Power is also planning to set up a power plant with washery-rejected coal.

Energy/KP/2- Undertake institutional development.

From its own resources, the state has undertaken capacity building and restructuring of the Energy Department. Formation of the Green Energy Development Corporation Limited (GEDCOL) is an important milestone toward a coherent approach for grid-connected renewable energy generation in the state. Simultaneously, capacity development of OREDA would ensure off-grid renewable generation. The government is also working with regulators for operationalization of RPO, net metering, etc. Feasibility studies on clean technology in generation and T&D loss reduction have been undertaken as well.

Energy/KP/3- Reduce T&D losses and improve the distribution system.

Reductions in T&D loss are a top priority of the Energy Department after the franchisees failed to control the losses and did not invest in the distribution infrastructure. The department has undertaken a CAPEX programme of about Rs 135 crore for this purpose.

The state after large-scale damage to the power infrastructure during Cyclone Phailin plans to invest in a disaster-resilient power system along the coastal area in which transformers and towers can withstand wind speeds of 300 kilometres per hour.

To manage the increasing load in the state's capital region, Rs 50 core have been invested in distribution network up gradation and Rs 20 crore have been proposed for the ambitious SMART grid project, and Rs 67 crore are being provided for improving the power infrastructure during the Nabakalebar festival in Puri.

In addition, the state has made a token provision for a Redesigned Accelerated Power Development and Reform Programme (R-APDRP) in anticipation of central government funding.

Energy/KP/4- Improve energy efficiency (Energy/CAP 23, 29, 30, 31).

Energy efficiency measures are a reflection of avoided generation. The state wants to strengthen the designated agency through building the capacity of energy auditors, working with utilities in promoting energy-efficient use, and working with the Public Health Engineering Organisation (PHEO) and the Odisha Lift Irrigation Corporation (OLIC) to improve the efficiency of the water pumping system. It also is working toward operationalizing the Odisha Energy Conservation Building Code.

Energy/KP/5- Utilise fly ash.

Because of a large number of power plants, fly ash generation is high, almost 100 megatons per year. The state has constituted a fly ash mission to coordinate with various agencies and industry on improving its utilisation in areas such as road construction and brick making.

Energy/KP/6- Promote small and medium hydel (hydroelectric) plants.

A prefeasibility report and a detailed project report are under preparation for more than 20 sites in the state to boost hydel generation. This is the responsibility of the Odisha Hydropower Corporation (OHPC).

Energy/KP/7- Promote biomass and wind generation.

The Orissa Renewable Development Agency (OREDA) acts as the technical agency for promoting these two renewable energy technologies in the state. So far, a few demonstration wind energy plants have been built in Odisha, and more sites are being identified with the Centre for Wind Energy Technology (C-WET). Biomass generation started in the Angul district, and rice husk–based power generation has also begun in some of the rice mills.

Energy/KP/8- Maximise solar energy generation potential (GEDCOL).

The solar energy generation initiative received a boost after an infusion of Rs 35 crore equity into GEDCOL. The DPR preparation for the Mukhiguda site has begun, and 1,250 hectares of land have been identified by the Industrial Development Corporation (IDCO) to serve as the site of a solar park. In Manmunda, a 20-megawatt solar plant is being commissioned with viability gap funding from the Solar Energy Corporation of India.

Energy/KP/9- Promote biogas and manure management.

OREDA is implementing an ambitious plan to work with the Orissa State Cooperative Milk Producers' Federation Limited (OMFED) and others to promote a large-scale biogas programme in the state. They have already installed more than 2.25 lakh of domestic biogas systems.

5.3.5 Co-benefits

Renewable energy generation will help to improve the energy mix in the state and also create green jobs in the sector. Reducing emissions in the energy sector yields a global impact, but the co-benefits will be experienced in the state as well. Mitigation policies relating to the energy efficiency of plants, fuel switching from coal to biomass and other renewable energy uptake policies may have several objectives that imply a diverse range of co-benefits such as a reduction in air pollution (an environmental co-benefit) and increased energy diversity that enhances livelihood resilience as well. Investment in hydel will also help in some flood control measures, as well as bring about a more efficient use of water, especially in the run-off-the-river projects. Decoupling economic growth from emissions will have strong implications for capital allocation. Capital-intensive projects in wind and megawatt-scale solar projects, especially in areas such as Manmunda (Boudh district), a backward area, will spur growth and reduce disparity.

5.3.6 Implementation schedule and budget

Sl no.	Activity	Time frame (years)	Impact	Co-benefits	Required budget (Rs crore, (2015–20)	State budget (Rs crore)	Other sources (centre, bilateral/multilateral/PSU, Rs crore)
1	Generate power through clean coal approaches (where coal consumption will be reduced						
	Pursue coal washery, improved boiler efficiency in (OPGC plant) for low emissions	3	M	M	5.02		5.02
2	Develop a state-level energy efficiency standard through ECBC, PAT, etc. and through	5	M	H	0.30	0.20	0.10
3	Engage in institutional development (capacity building and restructuring of Energy Department, formation of GEDCOL, capacity development of OREDA,	5	M	H			
4	Reduce T&D Losses (CAPEX, ODSSP, Disaster Resilient Power System, SCRIPS, radial to ring conversion, Smart Grid, Nabakalebar in Puri,	3	H	H	577.99	577.99	
5	DSM and EE (utility level)	5	H	M	11.00	11.00	
6	Generate awareness of energy efficiency.	5	H	H	2.10	1.85	0.25
7	Implement OECBC.	5	M	M	4.00	3.50	0.50
8	Build capacity of energy auditors, strengthen the energy conservation cell.	5	M	M	4.70	3.20	1.50
9	Increase energy efficiency in drinking water pumping system and lift irrigation system.	5	H	H	84.20		84.20

10	Use fly ash effectively.	5	H	H			
11	Promote small and medium hydel plants.	5	H	H	15.70		15.70
12	Maximise and harness biomass potential.	5	H	M			
13	Promote grid-connected wind power.	5	M	M			
14	Maximise solar energy generation potential	5	H	M	44.45		44.45
15	Promote biogas and manure management.	5	M	M			

Note: L = low; M = medium; H = high.

FISHERIES & ARD

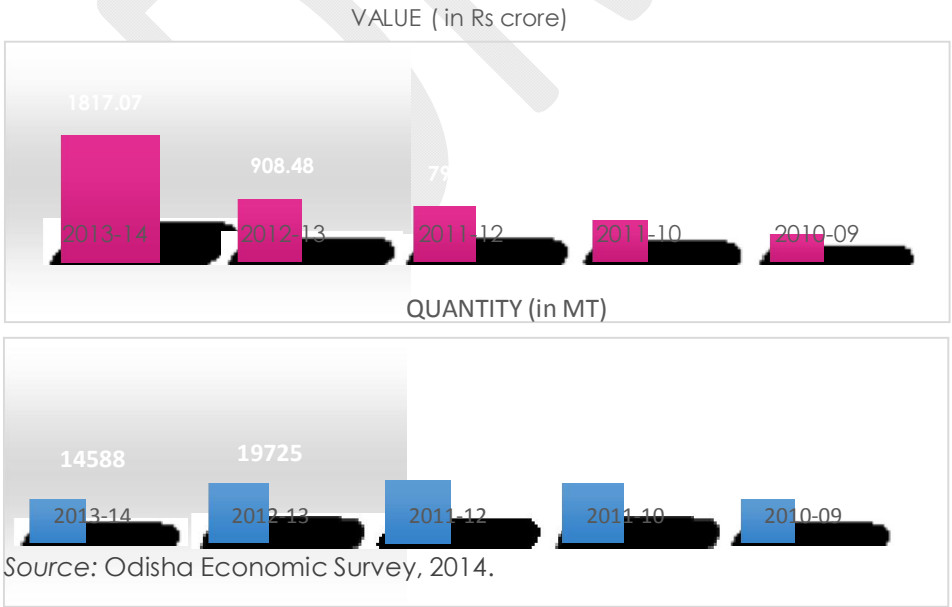
5.4 Fishery and animal resources development

5.4.1 Overview

Fishery and animal resources are fully integrated into the agriculture system of the country and more so in several parts of Odisha. The predominant farming system in Odisha is the mixed crop-livestock farming system, and over 90 percent of farms of all categories conform to this farming system. Unlike in many other parts of the country, livestock holding in Odisha is equitable; over 80 percent of all livestock are owned by the marginal/small holders and the landless. Some 80 percent of all rural households own livestock of one species or the other, or a combination of some of them, cattle being the most popular. The state has an ambitious target of having 20 lakh of cross-bred cows by 2020. One million breed able goats and 0.2 million sheep will be upgraded through the supply of an improved variety of buck/ram by 2020. Poultry has also grown in several parts of southern and central Odisha in recent years, whereas indigenous species are predominant in northern and western Odisha. By means of a poultry breeding programme, a target of 2,000 broiler units (bird capacity of 1,000–10,000 birds per week) has been set in the state. On 1,000 hectares, green fodder will be developed.

Freshwater tanks and ponds are spread over 1.21 lakh hectares in the state. The total production of freshwater fish in Odisha is about 264,000 megatonnes per year, which is consumed largely in the state itself. The marine fishery is a major contributor to the state economy. Even though the catch is smaller, the value has been increasing every year (see figure 5.4.1).

Figure 5.4.1 Marine Fish Production: Odisha, 2009–14



Source: Odisha Economic Survey, 2014.

Potential brackish water fishing areas in the state total almost 32,587 hectares in seven coastal districts, and these areas produce delicious shrimp, which is a major export item for the state.

According to the Fishery and ARD Department, fish production has increased by 13 percent since 2013–14, to 333,86 MT, and an additional 4,000 hectares were also brought under aquaculture. Export earnings increased from Rs 421 crore in 2009–10 to Rs 2,300 crore in 2014–15.

5.4.2 Sector vulnerability due to climate change

Small ruminants, poultry birds, and aquaculture are highly vulnerable to climate change. Some of the vulnerabilities are listed here.

Impacts of temperature rise. As shown in section 2, under the A2 scenario in AR5 several parts of coastal Odisha are likely to breach the two degrees Celsius temperature rise barrier, while hinterlands are likely to be warmer. The rise in the surface temperature of the water will result in sifting of species and a smaller catch in traditional areas. It will also boost the operating costs in the ponds for increasing the aeration and de-silting the river mouth. Major carp such as rohu, katla, and mirkal, which are popular in this region, are likely to show early maturity (before monsoon) and have lower survival rates because of more predators and infestation.

For livestock, higher temperatures mean reduced dead storage. And poor water quality means more diseases, reduced milk production, and higher mortality in small ruminants and poultry.

Impacts of monsoon variability and flooding. According to the IMD, Odisha is receiving the same quantity of rainfall in fewer days during the monsoon. This has resulted in several floods in the state. Floods and cyclonic weather alter the salinity of the water, damage spawns in the breeding season, and result in the escape of species. They also have an economic impact because of the higher investment in creating flood-resistant structures.

For livestock, damage from floods and cyclones is estimated to be quite high because of mud wall collapse, snake bite, etc.

Sea level rise and storm surge. High tidal surges in coastal areas inundate landmass and affect the mangroves. They also damage freshwater, freshwater exchange, and several brackish water species. Loss of estuarine areas also affects the quality and quantity of fish.

Drought incidence. Drought affects water quality and fodder availability, reducing the efficiency of the livestock and their productivity.

5.4.3 Key activities taken up during 2010–15

The activities listed in table 5.4.1 were undertaken during 2010–15 in the state's fishery and animal resources development sector.

Table 5.4.1 Key Climate Change Activities, Fishery and Animal Resources Development Sector: Odisha, 2010–15

Sl no.	Activity	Linkage	Progress in 2010–15
1	Provide routine deworming and vaccination tasks in a planned manner to minimise the mortality of small animals.	Adaptation	Implemented as a key priority (KP)
2	Conserve and selectively breed native species of cattle, buffalo, small ruminants, and poultry.	Adaptation	Implemented as a KP
3	Utilise all departmental fodder farms optimally to produce quality planting materials for fodder development.	Adaptation	Implemented as a KP
4	Revive genetic up gradation of small animals.	Adaptation	Implemented but not a KP
5	Promote insurance in the livestock sector.	Adaptation	Implemented but not a KP
6	Promote insurance for fishermen (mostly marine).	Adaptation	Implemented as a KP

5.4.4 Proposed activities for 2015–20

FARD/KP/1- Engage in scientific animal health management.

Climate change increases the disease burden for animals and aquatic species. Because of irregular precipitation, flooding, or reductions in groundwater, the infestation of worms and pests are higher. Therefore, it has been proposed that 100 veterinary institutions be strengthened, and 8,140 health check-up and de-worming camps be established.
Lifesaving drugs would be made available to 540 veterinary dispensaries and 3,040 livestock assistance centres (LACs) over five years.

FARD/KP/2- Pursue capacity building of livestock keepers.

In the training curriculum, a module of climate change concerns will be used to sensitise livestock keepers to those concerns. A total of 31,400 farmers will be covered under this programme over five years.

FARD/KP/3- Improve fodder management.

Providing green fodder during a period of lower precipitation or a drought-like situation is crucial for animal productivity. Therefore, 110 lakh minikits will be provided to 30,000 farmers to produce 12.5 quintal of certified fodder seed.

FARD/KP/4- Undertake breeding management

Some of the breeds that better adapt to the adverse impacts of climate change have been identified. In the regular artificial insemination (AI) programmes, some climate- stressed areas will be prioritised. Ninety lakh AI programmes will be undertaken over five years, and the Frozen Semen Bank will be strengthened.

FARD/KP/5- Promote biogas and manure management.

The development of industrial-scale biogas infrastructure along potential clusters will be explored. Using the OMFED livestock, a network for aggregation and other aggregating points for achieving the scale will be undertaken.

FARD/KP/6- Undertake research on a disease early warning system.

In this initiative, 314 block-level disease reporting nodes will be connected to the integrated disease surveillance system. This system will be converted to early warning and preparedness.

5.4.5 Co-benefits

The key co-benefits of these proposals for the fishery and animal resources development sector include the diversification of livelihoods through animal husbandry and fisheries, which leads to more resilient livelihoods. About 70 percent of the population of Odisha is dependent on agriculture and allied activities.

Initiatives such as biogas and manure management enrich soil health and also help to reduce methane emissions.

5.4.6 Implementation schedule and budget

Sl no.	Activity	Time frame (years)	Impact	Co-benefits	Required budget (Rs crore, (2015–20)	State budget (Rs crore)	Other sources (centre, bilateral/multilateral, Rs crore)
1	Scientific animal health management	5	H	H	259.1	237.3	21.8
2	Improved feeding management	5	H	H	25.0	18.0	7.0
3	Capacity building of livestock keepers	5	M	H	3.14	3.14	
4	Breeding management	5	L	M	109.35	50.0	59.35
5	Research on disease early warning system	5	H	M	0.42		0.42

Note: L = low; M = medium; H = high.

FORESTRY

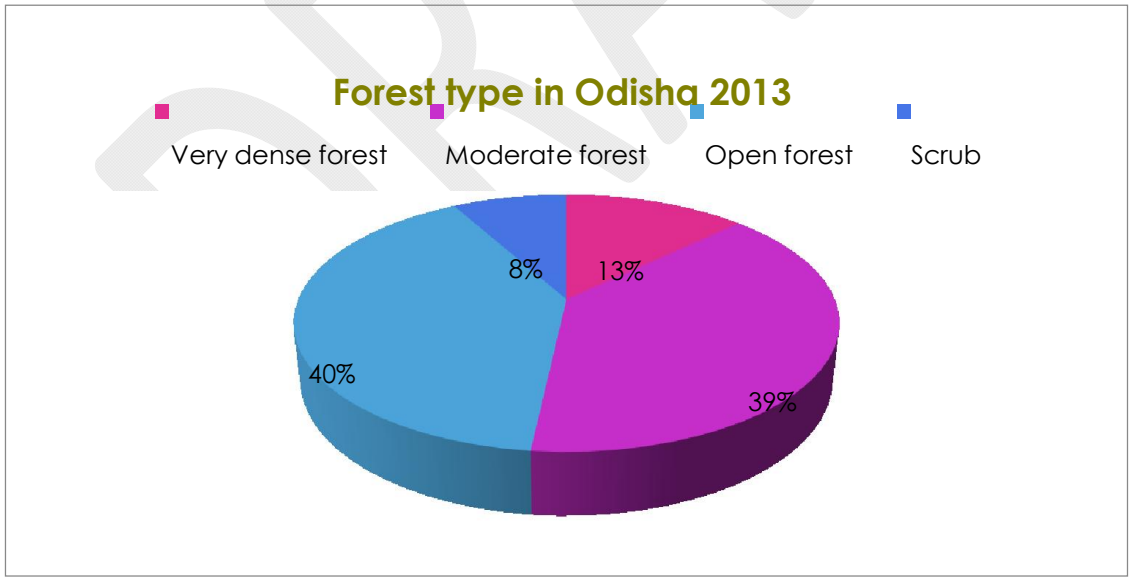
5.5 Forestry

5.5.1 Overview

Forests are not just about flora and fauna; they also support a large number of forest-dependent communities (especially scheduled tribes). It is estimated that a little less than one-third of the increase in CO_2 in the atmosphere is a result of the deforestation over the last 150 years. Currently, India has a dominant forest cover of the tropical dry forest type (37.2 percent), followed by dry savannah type (33 percent) and moist savannah type (32.5 percent). This mix is projected to change, with tropical dry forest and tropical seasonal forest (28.4 percent) becoming dominant. Xeric scrubland, to a smaller extent, is set to decrease in area, and xeric woodland is expected to increase in the drier regions.

In Odisha, forests cover about 37.34 percent (about 58,140 square kilometres) of the state's geographic area. According to the Forest Survey of India (FSI), which was released in 2013, forest covers about 48,903 square kilometres of Odisha, or about 31.41 percent of state's geographical area. The state's coverage includes 7,060 square kilometres of dense forest, 21,366 square kilometres of moderate forest, 20,477 square kilometres of open forest, and 4,734 square kilometres of scrub. The latest survey data on various forest types appear in figure 5.5.1, and a map of the forest mix appears in figure 5.5.2.

Figure 5.5.1 Forest Types: Odisha, 2013



Source: Forest Survey of India, 2013.

Figure 5.5.2 Forest Mix: Odisha, 2013

Source: Forest Survey of India, 2013.

The changes in the state's forest cover are presented in table 5.5.1. The table shows a net increase in forest cover in the state and expansion of the forest carbon sink. This improvement has been possible because of the enhanced conservation and plantation drive.

Table 5.5.1 Change in Forest Cover: Odisha, 2011 and 2013

Year	VDF (km^2)	MDF (km^2)	Open forest (km^2)	Scrub (km^2)	Total (km^2)	% of forest	Change of forest (%)	Trend of forest
2011	7060	21366	20477	4734	48903	31.41	0.93	Increasing
2013	7042	21298	22007	4427	50347	32.33		

Source: Forest Survey of India, 2013.

Note: VDF = very dense forest; MDF = moderately dense forest.

5.5.2 Forest sector vulnerability due to climate change

In view of the high diversity, tree density, and low fragmentation of the Odisha forest, if protected properly it is likely to be the resource least vulnerable to climate change under the A1 and B2 scenarios. The early intervention in community-based forest management and robust implementation of the Forest Right Act are likely to maintain the carbon sink in

the 21st century for the state. Some of the major species such as teak in the forest grids are not likely to be much affected and might even gain under both emissions scenarios. However, even within this overall scenario, of the 2,564 (2.5 x 2.5 minutes) forest grids that fall within Odisha state, 9.71 percent are projected to undergo change by 2035 and 13.53 percent by 2085 (Gopalakrishnan et al. 2011). This will affect the carbon flux and may affect the sink.

However, the temperature rise, as projected under the A2 scenario in IPCC AR5, would affect micro flora and fauna in northern Odisha and the south-western part of Odisha and adversely affect the biodiversity. There is a likelihood of an increase in forest area because of the higher temperature and the dry deciduous nature of the state's forest.

Mining and industrial activity beyond the carrying capacity, if affected during this period, would cause irreversible damage to the ecosystem. There is also likely to be intensification of the conflict between humans and wild animals (elephants, monkeys) in the adjacent areas.

5.5.3 Key activities taken up during 2010–15

The activities listed in table 5.5.2 were undertaken during 2010–15 in the state's forest and environment sector.

Table 5.5.2 Key Climate Change Activities, Forest and Environment Sector: Odisha, 2010–15

Sl	Activity	Linkage	Progress in 2010–15
1	Increase reforestation/afforestation activities in degraded forest areas (392,759 hectares) and avenue plantings (8,382 route kilometres).	Both	Implemented as a key priority (KP)
2	Protect existing forest stocks to act as carbon sink with stronger conservation.	Both	Implemented as a KP
3	Cover bald hills with suitable species mix.	Both	Implemented as a KP
4	Increase and protect existing mangrove cover and coastal biodiversity.	Both	Implemented as a KP
7	Assess fire management strategies.	Adaptation	Implemented as a KP
8	Improve tree planting and forest management to integrate with watershed and water resource management.	Both	Implemented as a KP
9	Work to establish new systems to support community forest management (CFM), joint forestry management (JFM), and REDD+ activities.	Adaptation	Implemented as a KP
10	Undertake studies on indigenous tree species to assess their vulnerability to climate change.	Adaptation	Implemented as a KP
11	Assess additional threats to biodiversity and wildlife.	Adaptation	Implemented as a KP
12	Obtain access to updated knowledge on climate change science and policy development.	Adaptation	Implemented as a KP
13	Build capacity of CFM committees and Panchayati Raj institutions to adapt to climate change.	Adaptation	Implemented as a KP
14	Monitor carbon stock and biodiversity at regular intervals.	Adaptation	Implemented as a KP

5.5.4 Proposed activities for 2015–20

FOR/KP/1- Increase the forest cover of the state by undertaking afforestation and reforestation measures.

There is tremendous potential to increase the carbon stock within the state. The canopy density of open and degraded forest of about 22,007 square kilometres (according to the Forest Survey of India Report, 2013) can be increased through assisted natural regeneration. Such land can be identified and brought under forest cover. Reforestation and afforestation can be achieved through economic plantations (2,300 hectares per year) and plantations under the Green India Mission and MNREGA convergence (20,000 hectares per year). Plantations under compensatory afforestation (1,000 hectares per year) have been targeted for coverage under this programme. Economic planting will be undertaken in designated and notified forest areas in suitable pockets to convert the lower-value growing stock to forest stand of higher value.

FOR/KP/2- Enhance the density of forests by undertaking assisted natural regeneration (ANR) and protecting existing forest stocks to act as a carbon sink with stronger conservation.

Assisted natural regeneration plantation under the National Afforestation Programme (5,080 hectares per year), MNREGA (30,000 hectares per year), the Compensatory Afforestation Programme, CAMPA (9,700 hectares per year), and the Odisha Forestry Sector Development Project (OFSDP) under Ama Jungala Yojana (22,000 hectares per year) will be undertaken in the state. Protecting existing forest cover and carbon stocks is as important as undertaking reforestation and afforestation. Recent Forest Survey of India statistics reveal an increase of 1,444 square kilometres of forest cover from 2011 to 2013 (50,347 square kilometres in 2013 and 48,903 square kilometres in 2011). This is the result of stronger protection measures and people participation in forest conservation. These activities are to be continued with renewed vigour. Planting inside and outside of working plan areas (5,500 hectares per year) will be undertaken (about 2 lakh ha and 32 crore saplings). Emphasis will be put on mixed and qualitative forest, so that it will be a carbon sink and not a carbon source. Procedures for stronger protection measures and community participation will be formulated.

FOR/KP/3- Increase planting on non-forest land.

There is vast scope for increasing the carbon stock by increasing planting on non-forest land such as orchards, trees on farm lands, roadside plantations, canal banks, and irrigation projects. Urban and periurban plantation programmes will be undertaken to reduce the adverse impact of climate change in urban areas. Planting about 17,00,000 seedlings a year has been proposed under these initiatives. To increase the green cover outside forests in both urban and rural areas, including on the premises of public institutions in the state, seedlings will be distributed free of charge to the beneficiaries—30 million seedlings to beneficiaries and 25 million seedlings under the agroforestry programme alone. Furthermore, to create a green belt along roads (national highways, state highways, express ways, district roads, and Panchayat roads) and to provide environmental services and shelters, avenue plantation of 4,000 route kilometres per year (about 25,000 route KM) will be undertaken. In summary, under this initiative trees will be planted on these non-forest lands. As per the plan for urban Plantation - 97.00 lakh seedlings and 2950 lakh seedlings to be distributed in other areas.

FOR/KP/4- Cover bald hills with suitable species mix.

Scrublands across Odisha are mostly bald hills devoid of any appreciable forest growth. Such lands can be found in the districts of Ganjam, Koraput, Rayagada, Kalahandi, Kandhamal, Gajapati, Nayagarh, Bolangir, and Khurda, among others. These are very difficult sites for plantations. The scrub forest of 4,734 square kilometres in the state is mainly in the form of bald hills, which can be used for planting at the rate of 1,000 hectares per year after filling the pits with external soil. However, mixed species instead of a monoculture will be used for normal and compensatory plantings in order to increase green cover.

FOR/KP/5- Increase and protect existing mangrove cover and coastal biodiversity along the coast.

Mangroves can serve as excellent barriers against climate-induced extreme weather events such as cyclonic storms. They also can act as a blue carbon stock, and they have proven to be most effective for carbon sequestration. Odisha has 221 square kilometres of mangroves in the districts of Kendrapara, Bhadrak, Jagatsinghpur, Balasore, and Puri. Under this initiative, the area under plantation will be increased, and potential mangrove areas will be protected. Rs 1.52 crore under central sector plan scheme, Rs 0.92 crore under Integrated Coastal Zone Management Programme and rest would be met from state budget for this activity.

FOR/KP/6- Fire protection

Forest fire is a major cause of degradation of forests. With the change in climate, forest fires will increase because a warmer climate means more fires. Thus a strategy of fire forecasting, fire prevention and fire fighting will be developed. Modern technologies will be used to locate fires and forecast fires. Based on satellite images, fire-prone zones will be prioritised and monitored. Community participation in fire prevention and fire fighting will be encouraged through incentives.

An improved communication network through equipment such as VHF radios /mobiles, vehicles, as well as camp sheds and watchtowers are needed to facilitate the protection and conservation of forests and wildlife. It has been proposed that 100 VHF radios be purchased, an additional 20 watchtowers be constructed, and 1,792 kilometres of road network be maintained during this five-year period.

FOR/KP/7- Conserve and regenerate bamboo forest.

The state government has constituted the Odisha Bamboo Development Agency (OBDA) to address all aspects of bamboo development in the state. Planting under the Odisha Bamboo Development Project (1,000 hectares per year) and under the National Bamboo

Mission (700 hectares per year) and regeneration under CAMPA (1,00,000 hectares per year) will be undertaken.

FOR/KP/8- Undertake sustainable management of forests and maximisation of forest productivity, preparation of management plans, and scientific forest management through annual coupe working.

Climate change will make weather more uncertain and less predictable. Soil and water conservation measures in watersheds will be undertaken to control runoff, to conserve water, and to harvest (excess) water. This is discussed in detail in the agriculture section of this chapter. This activity will be under taken by Odisha Forest Development Corporation. (Timber coupe-296520 ha; subsidiary sylvicultural operations for timber coupe-398692 ha, bamboo coupe-492358 ha, simultaneous sylvicultural operations for bamboo coupe-499913 ha)

FOR/KP/9- Undertake research studies on indigenous flora and fauna and their vulnerability to climate change

Climate change is expected to have a significant impact on the forest ecosystem, thereby affecting wildlife because many species may be unable to tolerate the weather changes. Study of the long-term effects of climate change on plant species and wildlife is needed. Ex situ conservation of threatened/endangered species will be undertaken through captive breeding programmes.

FOR/KP/10- Conserve wildlife and its habitat, assessing the threats to biodiversity and wildlife.

Effective implementation of management plans is needed to conserve and improve the status of wildlife and biodiversity in the state. Steps will be taken to develop meadows in interior forest areas to meet the food requirement of herbivores and delimit their movement in forest areas.

To augment the water available to wild animals, more water bodies will be created in forest and protected areas. The existing water bodies will also be renovated regularly. The fragmented forest landscapes will be linked through corridor development measures in order to maintain their connectivity to facilitate movement of long-ranging wild animals. An improved communication network through equipment such as VHF radios /mobiles, vehicles, as well as camp sheds and watchtowers are needed to facilitate the protection and conservation of forests and wildlife. It has been

proposed that 100 VHF radios be purchased, an additional 20 watchtowers be constructed, and 1,792 kilometres of road network be maintained during this five-year period.

FOR/KP/11- Implement joint forest management so that people can participate in conservation, management, and regeneration.

Climate change will exacerbate the pressures on the forest. In that context, the pressures must be reduced through formation of Vana Surakhya Samities (VSS) and Eco Development Committees (EDCs). Under this initiative, it is proposed that the capacity of communities to manage through the sustainable forest management plan be enhanced. VSS committees will be convened under the Ama Jungala Programme. An Eco Development Committee
will be mobilised for protection and management of the forests.

FOR/KP/12- Build the capacity of the department staff in the field to tackle climate change related issues.

Staffs of the department especially at all levels in the field will be sensitised through various capacity-building programmes related to the climate change action plan. The capacity building of the staff will also be carried out to develop a strategy for adapting to climate change as part of sustainable forest and wildlife management. Sensitising and building the capacity of the JFM/Eco Development Committees and Panchayati Raj institutions is also needed through training and awareness generation programmes.

5.5.5 Co-benefits

Forest sector has both adaptation and mitigation co-benefit. promoting plantation activity in large scale facilitates the creation of an economic alternative (both for the state) and also for private owners of degraded land, mainly small and marginal farmers, which in turn will result in a new impetus to the forestry activity in the state. This would increase rates of afforestation and restoration of natural forests and make the livelihood of forest dependent communities resilient. It will also enhance bio-diversity and eco-system balance. At the same time, the establishment and enhancement of forest cover in the state will result in the generation of an environmental asset that will be a key part of the national strategies of mitigation of GHG emissions.

5.5.6 Implementation schedule and budget

Sl no.	Activity	Time frame (years)	Impact	Co-benefits	Required budget (Rs crore, (2015–20)	State budget (Rs crore)	Other sources (centre, bilateral/multi-lateral (Rs crore)
1	Increasing the forest cover of the State by taking up massive plantation programme	5	H	H	1259.20	818.48	440.72
2	Enhance the density of forest by taking up Assisted Natural Regeneration and Protecting existing forest stocks to act as carbon sink with stronger conservation	5	M	H	991.00	644.15	346.85
3	Increasing planting on non-forest land	5	M	H	1004.41	753.31	251.10
4	Covering bald-hills with suitable species mix	5	M	H	109.874	109.874	
5	Mangrove cover and coastal biodiversity along the coast	5	H	H	8.28	5.84	2.44
6	Conserve and regenerate bamboo forest	5	M	M	165.48	65.41	100.07
7	Sustainable management of forest and maximising forest productivity, preparation of management plans and scientific forest	5	H	M	99.96		99.96
8	Implementation of joint forest management for people participation in conservation, management and regeneration	5	H	H			
9	Conserve wildlife and its habitat	5	H	H			
10	Capacity building	5	H	H	1.00	1.00	
11	Research Activities	5	H	M	1.00		1.00
12	Procurement of equipment	3	M	M	1.00	1.00	
13	Communication infrastructures	3	M	M	5.00	5.00	

Note: L = low; M = medium; H = high.

HEALTH

5.6 Health

5.6.1 Overview

The Health and Family Welfare Department of the government of Odisha has been making an ongoing, concentrated effort to formulate and implement schemes to ensure that the people of the state have adequate health care services in line with national health policy. Special care is also being taken to meet the needs of people living in the tribal area and backward region.

The objectives are as follows:

- To provide the people of the state with affordable health care and adequate curative and preventive facilities
- To eliminate diseases such as polio and leprosy and to prevent as well as control communicable diseases
- To reduce maternal, infant, and neomortality rates
- To improve hospital services at the primary and secondary levels.

5.6.2 Sector vulnerability due to climate change

Natural disasters are common in Odisha because of its specific geo-climatic condition, which makes the state more vulnerable to cyclones, floods, tornados, drought, and heat waves. These climate-induced events result in epidemics that have the potential to cause mass casualties and suffering within a short period of time. From March to October, Odisha experiences calamities such as floods, cyclones, droughts, or heat waves. Floods were experienced in 2003, 2004, 2007, 2011, 2013, and 2014. Eighteen of the state's 30 districts are prone to flood or flash flood. Experiences with the super cyclone of 1999, Super Cyclone "Phailin" of 2013, and frequent floods in the state have resulted in the prevalence of both water-borne and vector-borne diseases in the immediate aftermath. And between March and June, the recorded temperature is above 45°C in 30–40 percent of districts. All 30 districts of Odisha are prone to experiencing heat stress disorders.

The following are the impacts of extreme climate-induced changes on air, water, and food:

- Heat waves lead directly to heat stress disorders such as heat stroke, heat exhaustion, heat cramps, and heat syncope.
- Heavy rainfall (flood and cyclone) leads directly and indirectly to mass casualty incidents, population displacement or migration, and water- and vector-borne diseases.
- Food scarcity during a drought leads to malnutrition and psychosocial disorders.
- Air pollution leads directly to respiratory diseases and other health consequences.

5.6.3 Key activities taken up during 2010–15

The activities listed in table 5.6.1 were undertaken during 2010–15 in the state's health sector.

Table 5.6.1 Key Climate Change Activities, Health Sector: Odisha, 2010–15

Sl	Activity	Linkage	Progress in 2010–15
1	Strengthen approaches (e.g., integrated vector management; information, education, and communication (IEC); behaviour change communication; and capacity building) to manage vector-borne diseases that have worsened because of climate change impacts	Adaptation	Implemented as a key priority (KP)
2	Strengthen approaches to deal with heat wave conditions exacerbated by climate change	Adaptation	Implemented as a KP
3	Undertake measures (e.g., improved disease surveillance and IEC) to manage water-borne diseases that have worsened because of climate change impacts (to be carried out by the Public Health Engineering Organisation, PHEO)	Adaptation	Implemented as a KP

5.6.4 Proposed activities for 2015–20

H/KP/1- Build the capacity of health sector personnel on issues relating to climate change.

Plans are under way to sensitise 1,749 hospital staff, rapid response teams, and the five- member quick reaction team from each village to the issue of disaster response and climate change. Plans are also under way to train staff in the use of renewable energy such as solar water heating, rainwater harvesting, and energy efficiency measures to reduce the carbon footprint of hospitals. It is proposed that Rs 3 crore be earmarked to be spent in three years on these measures.

H/KP/2- Integrate climate change concerns into the state health policy.

This activity includes a compressive review of state health policy and assessment of climate-stressed areas to make provisions of a dedicated trained staff and labs, as well as the placement of buffer resources. The policy would ensure to have

judicious placement of the staff needed for diagnostic, referral, and transport services in the stressed areas. They must be equipped with adequate consumables to enable them to undertake early detection, prevention, and recovery measures.

H/KP/3- Strengthen approaches to managing the vector- borne diseases that worsen because of climate change.

This activity would expedite disease surveillance, entomological study, vendor control measures, and environmental engineering. Eleven interventions are proposed to reduce vector density and parasite loads in endemic communities.

H/KP/4- Strengthen approaches to dealing with heat wave conditions in the state.

This activity would continuously sensitise the staff of control rooms on treatment protocols from March to June to deal with heat stress and provide sufficient drugs, consumables, and facilities to deal with heat stress. It is also proposed that the targeted communication effort be supplemented. A proposed Rs 5 crore would be spent in three years.

H/KP/5- Undertake measures to manage water-borne diseases that have worsened because of climate change impacts.

This approach would strengthen disease surveillance units for early detection and control of water-borne diseases and periodic and monitoring of water quality, and it would include a review and feedback mechanism. Provision would be made for separate diarrhoea and herpetology units, dedicated wards, and free drugs and isolation wards. Case management and referral units should be strengthened to deal with the large-scale epidemiological situations aggravated by climate change. An intensive IEC campaign also should be mounted. The budget for this activity will be Rs 15 crore

5.6.5 Co-benefits

One of the co-benefits of these health sector activities is enhanced life expectancy. The improved air and water quality needed to boost health would have environmental benefits as well. Mitigation co-benefits would result when renewable energy (such as solar water heaters) is integrated into hospital infrastructure, and energy efficiency measures are undertaken.

5.6.6 Implementation schedule and budget

Sl no.	Activity	Time frame (years)	Impact frame	Co-benefits	Required budget (Rs crore, (2015–20)	State budget (Rs crore)	Other sources (centre, bilateral/multilateral (Rs crore)
1	Build the capacity of the health sector to deal with the adaptation and mitigation aspects of climate change.	3	H	M	2.0	2.0	
2	Integrate climate change considerations into the state health policy.	3	H	M	30.0	30.0	
3	Strengthen the approaches to managing vector-borne diseases that have worsened because of the impacts of climate change.	3	H	H	90.0	90.0	
4	Strengthen the approaches to dealing with the heat wave conditions exacerbated by the impacts of climate change.	3	M	M	5.0	5.0	
5	Undertake measures to manage water-borne diseases that have worsened because of the impacts of climate change.	3	H	H	15.0	15.0	

Note: L = low; M = medium; H = high.

INDUSTRIES

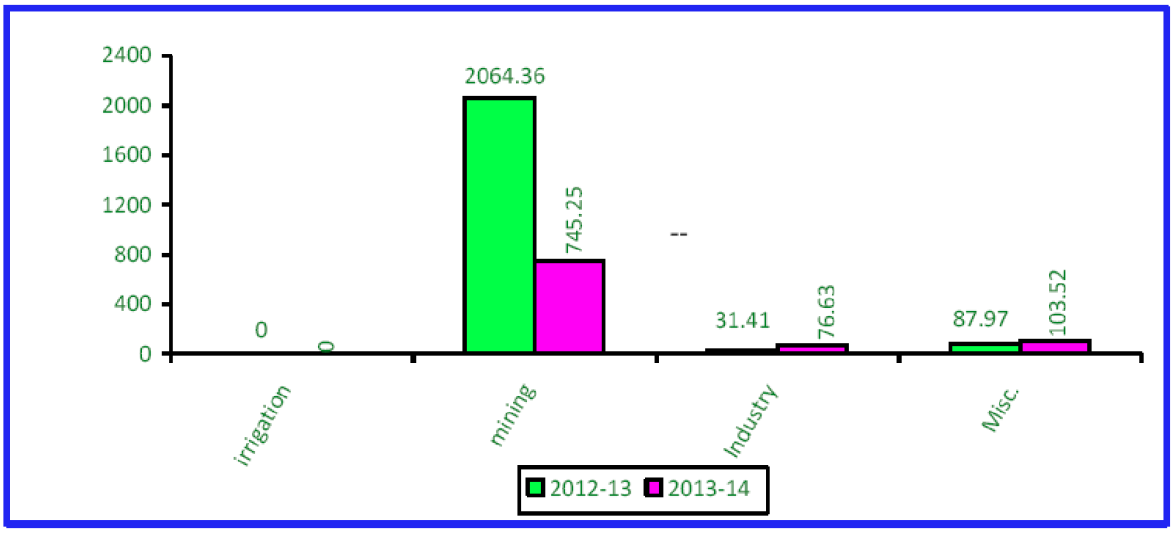
5.7 Industries

5.7.1 Overview

The national goal of India is described in its National Manufacturing Policy (2011). This policy seeks to increase the contribution of manufacturing to GDP to 25 percent (from the current 15 percent) within the next decade and help create 100 million jobs. Among the priorities outlined in the policy is its focus on "greener and cleaner" technologies. The policy recommends that a Green Manufacturing Committee (GMAC) be established to work with industries in developing low emissions strategies for production and supply chains. The Industrial Policy Resolution of Odisha also emphasises cleaner production. The major industries in Odisha are steel, aluminium (covered by the Steel and Mines Department), power (Energy Department), food processing, and ancillary industries, including the clean Khadi and Village Industry Commission (KVIC) pattern industries under the Micro, Small, and Medium Enterprises Department.

The industry and services sectors have emerged as the main drivers of growth during the past decade. In real terms at 2004–05 prices, Odisha's economy exhibited an average annual growth rate of 8.82 percent during the 10th Plan (2002–07), exceeding the target of 6.20 percent. The industry sector contributes more than one-third of the state's GDP. In aluminium, Odisha occupies first place in the country in terms of production capacity and actual output. For several mineral-based industries, forests must be diverted to production, which sometimes has a negative effect on the environment if not mitigated. According to the Odisha Economic Survey, by the end of January 2014, 394 diversion proposals covering 42,371.86 hectares of forest land were approved by MoEF for non-forest use. Figure 5.7.1 shows some examples of how forest land is diverted to industrial uses.

Figure 5.7.1 Forest Area Diversion by Category: Odisha, 2012–14 (hectares)



Source: Odisha Economic Survey, 2014.

The number of micro, small, and medium enterprises (MSMEs) in the state has been increasing over time. Most of these are set up as ancillary industries near Rourkela and in the metals sector, engaged in maintenance and repair. The second most important category is the food processing sector. Both of these sectors have high potential in energy conservation.

5.7.2 Sector vulnerability due to climate change

The vulnerability in the industrial sector, especially in manufacturing, can be analysed in two different ways. First, many thermal power industries contribute to emissions. Aluminium, paper, and cement are power-intensive industries that place demands on thermal generation. As described in the mining sector study, most of these industries use world-class technologies and are almost on a par with developed countries in energy consumption. Having additional such industries in the state would definitely contribute to emissions and to climate vulnerability.

Most of the MSME sector in metals and food processing has far to go in reducing emissions by improving energy use and reducing waste. Thus clean production is necessary to reduce vulnerability.

A climate change–induced rise in temperature rise reduces industrial activity, increasing down time. Similarly, water scarcity severely affects many industrial processes.

Floods and cyclones damage industrial infrastructure and also affect industrial productivity. Industries along the coast such as food processing (aquaculture), chemical, and fertiliser are more vulnerable.

5.7.3 Key activities taken up during 2010–15

The activities listed in table 5.7.1 were undertaken during 2010–15 in the state's fishery and animal resources development sector.

Table 5.7.1 Key Climate Change Activities, Industry Sector: Odisha, 2010–15

Sl	Activity	Linkage	Progress in 2010–15
1	Integrate climate concerns in policies and plans for industrial development and related areas.	Mitigation	Implemented as a key priority (KP)
2	Prepare GHG profile of major industrial	Mitigation	Implemented as a KP
3	Undertake a heat island study for Talcher and	Mitigation	Implemented as a KP
4	Train various stakeholders on climate change issues.	Both	Implemented as a KP
7	Implement a system of compensatory water harvesting.	Adaptation	Implemented as a KP

Sl	Activity	Linkage	Progress in 2010–15
8	Streamline an institutional arrangement and strengthen OSDMA to tackle extreme climate events in coastal areas.	Adaptation	Implemented as a KP
9	Carry out an energy efficiency study of the iron and steel, thermal power, cement, and aluminium sectors.	Mitigation	Implemented as a KP
10	Promote use of bulk waste material such as fly ash, dolo char, slag, etc.	Mitigation	Implemented as a KP

5.7.4 Proposed activities for 2015–20

IND/KP/1- Devise a mechanism for green belt development and maintenance for industrial clusters.

The purpose of this activity is to internalise green belt development and maintenance in all industrial clusters within the state. This initiative should move away from being funded and maintained through government funds. Industrial clusters and their organisations need to develop a mechanism to define green belts and expand and maintain them on a continual basis.

IND/KP/2- Study the feasibility of establishing and operating a biomethanation process for a food processing cluster in public-private partnership (PPP) mode.

Because food processing waste has a high organic content, the potential for generating energy from such wastes and residues is high. This potential needs to be captured in a structured and systematic manner. The technology and financing lie in the environmental sector, whereas the waste and residue are in the food processing sector. Therefore, the PPP mode is the best way forward to convert these wastes and residues into an energy source. Prior to making it operational, a feasibility study will be required.

IND/KP/3- Install a centralised solar heating system in a food processing cluster for supplying hot water.

Odisha is uniquely placed to use solar power for various applications. In the food processing sector, significant financial savings can be accrued through the use of solar heating for hot water requirement in preheating processes.

IND/KP/4- Prepare regional environmental management plans for major industrial clusters.

Regional environmental management plans are required to identify the priority environmental actions needed in each of the major industrial clusters. Resources both financial and human are scarce. Thus regional environmental plans can be used to determine where the focus should be in order to maximise effectiveness.

IND/KP/5- Prepare a GHG profile of major industrial clusters and introduce a system of GHG auditing for these sectors.

Establishing a GHG profile and periodically conducting GHG auditing in order to determine industry performance will need to be streamlined. A GHG profile at the state level has been developed by Confederation of Indian Industry. However, in each cluster a carbon footprint study will be undertaken to prioritise the categories of industries where more action on emissions education can be pursued.

IND/KP/6- Undertake a heat island study of the Angul-Talcher and Jharsuguda-Ib valley areas.

The two industrial clusters have been identified as heat islands in the state. Various factors contribute to the heat island effect. To manage these heat islands, a study is required to determine what initiatives will be required. Once identified, those initiatives that would be a priority will be short-listed for focused implementation.

IND/KP/7- Train officials in the Industries Department, Directorate of Industries, Industrial Promotion and Investment Corporation Limited (IPICOL), State Pollution Control Board (SPCB), etc. on various aspects of climate change.

In the area of climate change, awareness, knowledge, and skills must be constantly updated, especially in view of the turnover of officials within key departments and agencies, and the constantly evolving science of climate change and best practices needs to be communicated.

IND/KP/8- Devise a mechanism to implement a system of compensatory water harvesting and storage around industries/industrial clusters by the

concerned industries.

As the vagaries of weather continue to rise, particularly precipitation, water harvesting is becoming increasingly necessary. On the one hand, it serves as a containment device in cases of intense precipitation. On the other hand, it caters to the water requirements during extreme drought. In order to control the excessive extraction of groundwater during times of need, industries must increasingly rely on water from harvested sources. This is particularly true of industries and industrial clusters that consume significant quantities of water for their production and manufacturing. Through this initiative, a mechanism would be devised in order to encourage industrial clusters either singly or collectively to plan and implement water harvesting structures.

IND/KP/9- Establish and monitor pollution prevention plans in industrial clusters.

Pollution prevention using top-of-the-pipe and through-the-pipe solutions rather than end- of-pipe solutions are effective at the industrial unit level and cluster level. The reduced energy/water consumption also results in financial benefits at the industrial unit level.

5.7.5 Co-benefits

Green manufacturing using renewables (covered under energy sector), perform, achieve, trade (PAT)–compliant industries, and industries using recycling and reuse processes for waste beyond the legal requirements are strong environmental co-benefits of the proposed climate change activities in the industry sector.

The other co-benefits include the employment that green manufacturing generates. Table 5.7.2 shows employment in the various categories of industry.

Table 5.7.2 Employment related co-benefit in Industry Sector: Odisha

Sector	(MoU + non-MoU)	Within-state	Outside-state	Total
Steel	113	77,83	41,23	118,404
Power	28	7,83	2,11	9,944
Aluminium	3	10,34	2,63	1,2981
Cement	4	1,71	349	2,059
Others (auto ancillary, oil refinery,	8			725
Total	156			144,113

Note: MoU = memorandum of understanding.

Although power sector co-benefits in employment would be provided by thermal sources, the growing investment in renewable power will also add to employment, especially in terms of the human resources required for solar installations and the trade and commerce in solar devices.

The environmental and emissions co-benefits are as follows:

- Creation of a green belt will improve the environmental aesthetics of industrial clusters, reducing the local heat and expanding the carbon sinks within the state.
- Treatment of food waste will result in ways to convert waste, reducing a local environmental problem and reducing or avoiding methane emissions by capturing them for use.
- Centralised solar heating will reduce heating needs for conventional power and thus reduce carbon emissions.
- Water harvesting will include better climate adaptation and reduced groundwater/ surface water use as the stored runoff water is gainfully utilised.
- Implementation of pollution prevention plans will bring about a reduction in energy and water consumption, which will translate into emissions reduction as well.

5.7.6 Implementation schedule and budget

Sl no.	Activity	Time frame (years)	Impact	Co-benefits	Required budget (Rs crore, 2015–20)	State budget (Rs crore)	Other sources (centre, bilateral/multilateral, Rs crore)
1	Devise a mechanism for green belt development and maintenance for industrial clusters.	5	M	H			
2	Study the feasibility of establishing and operating biomethanation process for food processing cluster in PPP mode.	5	H	M	15.00	5.00	10.00
3	Install a centralised solar heating system in the food processing cluster for supplying hot water.	5	H	M	10.00	0.00	10.00
4	Prepare regional environmental management plans for major industrial clusters.	3	M	M	1.00	0.00	1.00
5	Prepare GHG profiles of major industrial clusters and introduce a system of GHG auditing for those sectors.	5	H	H			
6	Conduct a heat island study for Angul-Talcher and the Jharsuguda -ib valley area.	3	M	M	0.50		0.50
7	Study the feasibility of establishing and operating biomethanation process for food processing cluster in PPP mode.	5	H	H			
8	Train officials of the Industries Department, Directorate of Industries, IPICOL, SPCB, etc. on various aspects of climate change.				1.00	0.50	0.50
9	Establish a training and research institute on climate change.	5	H	H			

Sl no.	Activity	Time frame (years)	Impact	Co-benefits	Required budget (Rs crore, 2015–20)	State budget (Rs crore)	Other sources (centre, bilateral/multilateral, Rs crore)
10	Devise a mechanism to implement a system of compensatory water harvesting and storage around industries/industrial clusters by the concerned industries.	5	H	H			
11	Establish and monitor pollution prevention plans in industrial clusters.	5	H	H			

Note: L = low; M = medium; H = high.

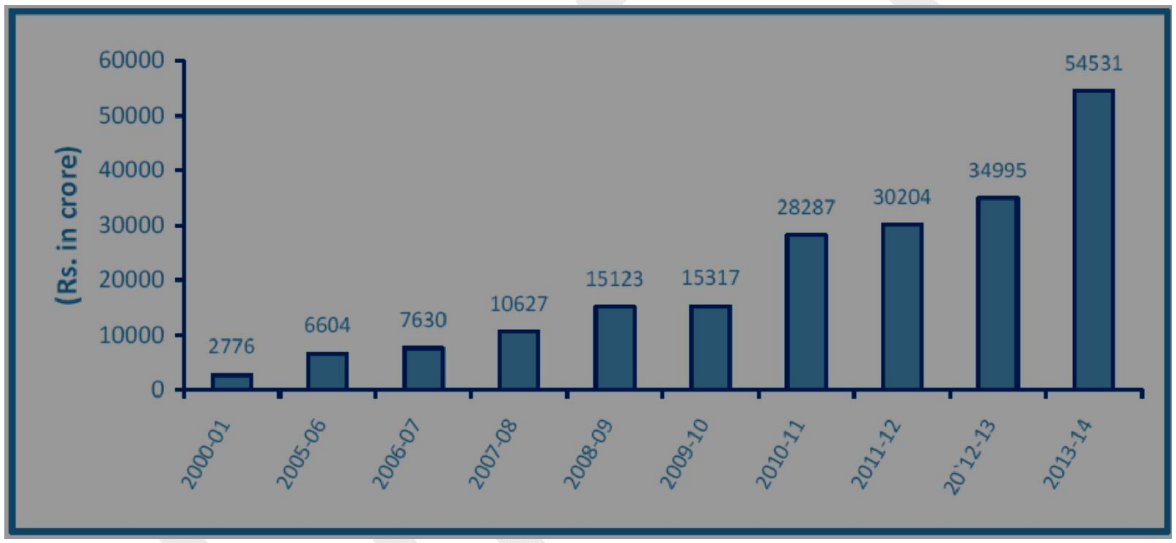
MINING

5.8 Mining

5.8.1 Overview

Of India's total mineral deposits, Odisha's mineral reserves constitute 28 percent of its iron ore, 24 percent if its coal, 59 percent of its bauxite, and 98 percent of its chromite. The mining sector contributed an average of 7.4 percent of the gross state domestic product in the 11th plan (2007–12), which declined to 6.67 percent in 2013–14, and is likely to decline to 6.31 percent in 2014–15 (the first two years of the 12th plan period). In terms of total value of mineral output, Odisha ranks highest in the country, and its share is increasing (figure 5.8.1).

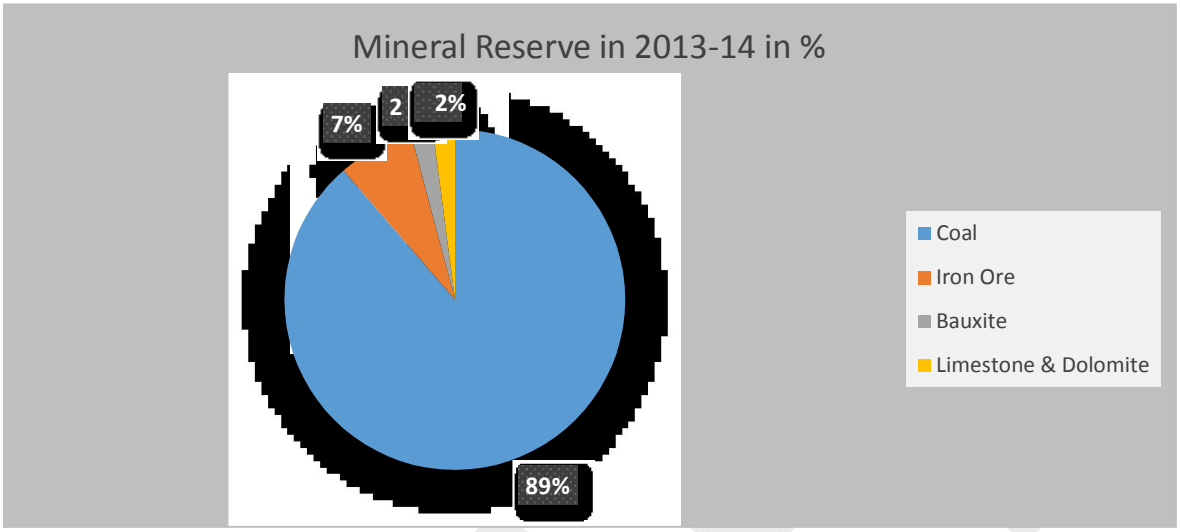
Figure 5.8.1 Value of Mineral Production: Odisha, 2000–2014



Source: Economic survey, 2014

Odisha's share of mineral reserves are shown in figure 5.8.2.

Figure 5.8.2 Share of Mineral Reserves: Odisha, 2013–14



Source: Odisha Economic Survey, 2014.

From figure 27 it is clear that the state will need to address many climate change issues related to the coal sector. This may include emissions reduction in thermal power plants, fly ash management, coal washery, and coal bed methane management and exploration both from an energy security standpoint as well as from a climate change standpoint.

5.8.2 Sector vulnerability due to climate change

According to IPCC's Fifth Assessment Report and subsequent observations of the climate change network in the country, the following events may affect mining activity in the state.

The high level of precipitation will increase the rainwater infiltration on spoil piles, resulting in aquifer-level contamination in coal-bearing areas. The water quality of nearby streams may be affected. Concentrated rainfall will also increase the risk of mining operations and damage the outbound transport infrastructure.

Changes in the frequency and intensity of storm events could affect mining operations (e.g., tailing dams, sediment and erosion control). However, these impacts have to be addressed as a part of a mine's water management plan in a changing climate scenario.

CARBON FOOTPRINT REDUCTION IN MCL

In Odisha, 68.44 percent of Mahanadi Coal Field Limited (MCL) production (73.84 MT) is conducted using surface mining technology. This eco-friendly, blast less mining technology completely eliminates the dust-generating operations such as drilling, blasting, and crushing while sprinkling water at the same time. The total CO_2 reduction by using this technology in 27 surface mines is about 619,410.5 MT.

The atmospheric pollutants from primary aluminium production also produce acid rain when they mix with water vapour. Aluminium poses no danger of environmental toxicity when the soil pH remains at or above 5.0. However, acid rain lowers the pH of soil and forces aluminium into solution. This causes it to leach into the water supply where it can damage root systems.

Similarly, the excessive heat that is likely to prevail in the summer months in the northern and western parts of the state would contribute to workers' heat strokes, cause more mining accidents and shorter working hours and lower productivity.

The greenhouse gases resulting from primary production include perfluorocarbons (PFCs), polycyclic aromatic hydrocarbons (PAHs), fluoride, sulphur dioxide ($S0_2$), and carbon dioxide (CO_2). Of these gases, PFCs resulting from the smelting process are the most potent. PFC emissions from primary aluminium smelting can be reduced by controlling the frequency and duration of anode effects (AEs). It is possible to reduce AEs by as much as 70 percent. The reduction can be achieved by computerised process controls, but also by increasing employee awareness and training. The major aluminium plants in the state already have state-of-the-art technology.

5.8.3 Key activities taken up during 2010–15

The activities listed in table 5.8.1 were undertaken during 2010–15 in the state's mining sector.

Table 5.8.1 Key Climate Change Activities, Mining Sector: Odisha, 2010–15

Sl no.	Activity	Linkage	Progress in 2010–15
1	Institute robust system of environmental monitoring and disclosure for mines	Adaptation	Implemented as a key priority (KP)
2	Create and maintain green zones	Adaptation	Implemented as a KP
3	Offer training on clean development mechanisms and climate change awareness programmes	Mitigation and adaptation	Implemented as a KP
4	Conduct heat island study	Adaptation	Implemented but not a KP

5.8.4 Adaptation and mitigation measures planned for 2015–20

5.8.4.1 Adaptation measures

MIN/KP/1- Prepare regional sustainable mining plans.

The regional management plan for Joda-Barbil (iron and manganese area), Mayurbhanj (iron ore zone), the Talcher-Angul–Ib valley area and Sukinda (chromite belt), Sundergarh (lime stone and dolomite belt), and the eastern Ghats (bauxite zone) will help in estimating the carrying capacity and sustainable extraction of minerals from the region, along with the proper mine closure plans. This measure will also have a mitigation co-benefit.

MIN/KP/2- Devise a mechanism for green belt development and maintenance in mining clusters.

Green belt development helps to reduce emissions and also helps to lower the ambient temperature in the region and improve biodiversity.

MIN/KP/3- Create an environmental restoration fund supported by contributions from mining companies.

The Department of Forest and Environment and the Department of Steel and Mines are planning to develop an environmental restoration fund supported by contributions from the mining companies. This fund will help in mitigating several environmental problems (air quality, water quality, waste management) in the region.

MIN/KP/4- Prepare an action plan for reclamation and rehabilitation of old abandoned mines.

A proper plan is essential to close and reclaim the area under closed and abandoned mines because such areas often create environmental and health disasters. A mechanism for proper scrutiny has been established to address this issue.

MIN/KP/5- Construct rest shelters with plantations in mining areas to provide shelter during heat wave conditions.

Most of the mining areas are suffering from heat wave conditions. It is essential to provide workers with shelter as well as their families in the area. This can be achieved by proper use of corporate social responsibility (CSR) funds.

MIN/KP/6- Supply drinking water in the vicinity of mining clusters.

Provide clean drinking water not only in the worker colonies but also along the roadside and in market places and village clusters. Mining companies and government will join hands to make water available to all in the mining areas.

5.8.4.2 Mitigation measures

Some of the following mitigation measures can reduce emissions by 40–50 percent if integrated into some of the existing mines:

- New pollution control devices such as advanced scrubbers that clean pollutants from flue gases before they exit a plant's smokestack (mandated by OSPCB)
- Chemical looping combustion technology to concentrate CO_2 levels in the exhaust
- Production of ultraclean coal, which reduces ash from the coal, allowing it to be directly fired in gas turbines at higher efficiency and lower emissions
- Efficiency upgrades and co-firing with fewer greenhouse-intensive fuels in coal-fired power stations
- Low–NO_x burners, which allow coal-fired plants to reduce nitrogen oxide emissions
- High-temperature solar thermal applications integrated into coal-fired power generation
- Stack gas treatment, applied to gaseous emissions from pulverised fuel combustion.

The PFC reduction and energy efficiency issues remain a challenge in the aluminium industry. Mitigation measures have been implemented. Some companies operating in the state are using slotted anodes. This technology is useful in expelling gas bubbles out of the pot easily and reduces the ohmic voltage drop to the tune of 50–100 megavolts, thereby reducing direct current (DC) energy consumption. The Indian aluminium industry is among the lowest users of electricity in aluminium smelters in the world. By adopting prebaked anode technology, it also has one of the lowest perfluorocarbon emissions in the world (0.14 MT of CO_2- equivalent per MT of aluminium). But because of the very low efficiency of coal-based captive power production, the sector's carbon intensity is well above the global average.

Energy efficiency opportunities for the iron and steel sector include improved heat and energy recovery from process gases and waste streams. Improved fuel delivery through coal injection is also a possibility. Emission-related efficiency gains are possible through beneficiation of coal ash and the substitution of a cleaner fuel such as natural gas or waste plastics for coal injection. The Paradip region is likely to have a plastic park and can therefore enhance the waste plastic supply. The Perform, Achieve and Trade (PAT) target (a domestic energy efficiency trading measure) covers most of the iron and steel industry in the state.

MIN/CAP/6- Explore cleaner technologies and best practices in coal mining.

Many advanced technologies are now available for sustainable mining of coal. The public sector Mahanadi Coal Fields Limited (MCL) has already adopted some of the best practices, and others should follow suit.

MIN/CAP/8- Conduct a study to determine the potential of coal bed methane in the coal fields of Odisha.

A detailed study is needed to estimate the state's coal bed methane potential and the commercial viability of such exploration. The exploration rights will be granted following the due procedures, and this effort will help enhance the energy security of the state and nation.

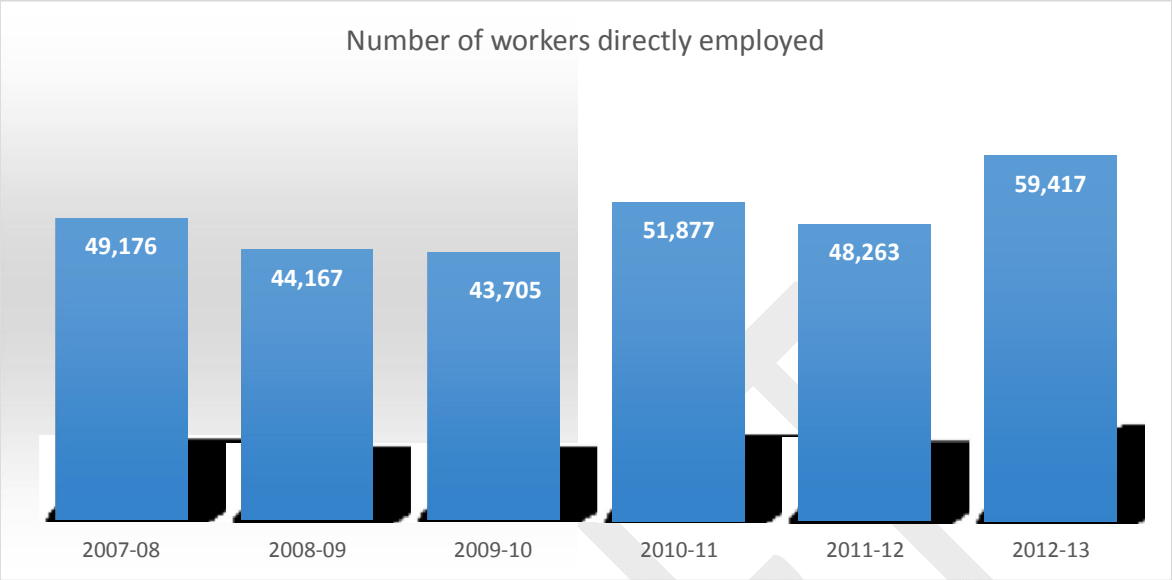
MIN/CAP/34- Develop a methodology to measure, monitor, and verify the amount of carbon sequestered by plantation programmes in the mining sector.

It is important to track the carbon stock in mining areas where planting has been undertaken on a massive scale. A transparent methodology will be developed for this purpose and routinely made available at various sites.

5.8.5 Co-benefits

The workers directly employed in this sector are shown in figure 5.8.3. However, the direct employment in this sector is almost stagnant because most mines now operate with capital- intensive and labour-saving technology to compete on a global scale. The indirect employment benefits in this sector are huge.

Figure 5.8.3 Workers Directly Employed in Mining Sector: Odisha, 2007–13



Source: Department of Steel and Mines, Government of Odisha, 2014–15.

Many mines (coal, iron ore, and bauxite) in the state operate with the same global environmental standards as followed by developed countries. The violators are penalised through the regulatory mechanism, and notices have been issued.

Recycling of aluminium (as practiced by the National Aluminium Company (NALCO), thereby closing the supply chain loop, reduces energy consumption and minimises waste.

With globally available technologies, the manufacturing and mining processes are almost comparable, and their products are competitive. This situation helps create jobs and improve livelihoods. The mandatory CSR expenditure also enables companies to invest in social infrastructure (health, education, and skill development)

5.8.6 Implementation schedule and budget

Sl no.	Activity	Time frame (years)	Impact	Co-benefits	Required budget (Rs crore, (2015–20)	State budget (Rs crore)	Other sources (centre, bilateral/multilateral (Rs crore)
1	Prepare regional sustainable mining plans for the Joda-Barbil iron and manganese area, Mayurbhanj iron ore zone, Talcher-Angul–Ib valley area, Sukinda chromite belt, Sundergarh lime stone and dolomite belt, eastern Ghats bauxite zone.	5	M	H	1.00	1.00	
2	Devise a mechanism for green belt development and maintenance in mining clusters.	5	H	M	15.00	5.00	10.00
3	Explore cleaner technologies and best practices in coal mining.	5	H	M	10.00	0.00	10.00
4	Conduct a study to determine the potential of coal bed methane in the coal fields of Odisha.	3	M	M	1.00	0.00	1.00
5	Create and maintain green zones in major mining	5	H	H			
6	Develop a methodology to measure, monitor, and verify the amount of carbon sequestered by plantation	3	M	L	0.50		0.50
7	Create an environmental restoration fund supported by contributions from the mining	5	H	H			
8	Prepare an action plan for reclamation and rehabilitation of old abandoned mines	5	H	H			
9	Construct rest shelters with plantations in mining areas to	5	H	H			

Sl no.	Activity	Time frame (years)	Impact	Co-benefits	Required budget (Rs crore, (2015–20)	State budget (Rs crore)	Other sources (centre, bilateral/multilateral (Rs crore)
	during heat wave conditions.						
10	Plan for supplies of drinking water in the vicinity of mining clusters,	5	H	H			

Note: L = low; M = medium; H = high.

TRANSPORT

5.9 Transport

5.9.1 Overview

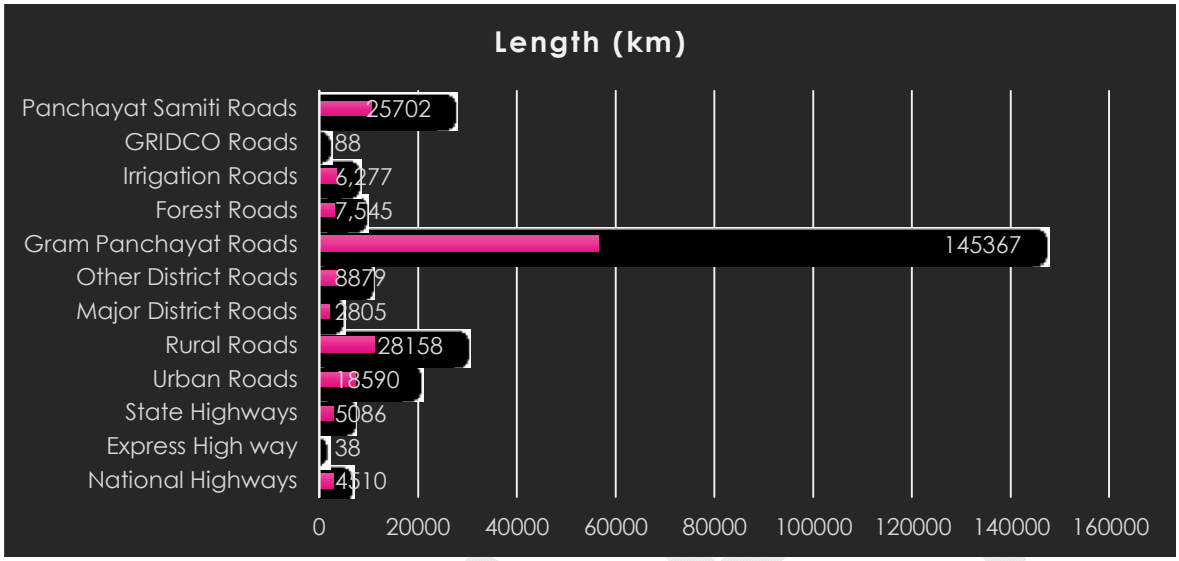
The transport sector is reliant on oil. Economic growth spurs the sector and consequently both oil consumption and CO_2 emissions. This sector is also responsible for the air pollution contributed by ozone, nitrous oxides, and particulates. In 2010, 53 percent of global primary oil consumption was used to meet 94 percent of transport energy demand.

In 2007 the Transport Policy of Odisha outlined the following objectives: to increase the competition, efficiency, transparency, accessibility, and availability of transport services in the state. An ultramodern and well-designed transport network enhances the productivity and profitability of various socioeconomic activities. The state government has placed much emphasis on infrastructure development in roads and transport in both urban and rural areas for the effective utilisation of resources. However, from the climate change perspective there is a need to understand the impact of transportation on GHGs and other emissions. The transport sector therefore has two main aspects that must be analysed to develop measures that address climate change adaptation and mitigation: (1) roads and related infrastructure and (2) vehicular modes of transportation.

Transportation: roads and related infrastructure. Of the urban roads infrastructure in Odisha, only 27.3 percent is blacktop; 17.8 percent is cement concrete, and 16.8 percent is metal (see figure 5.9.1 for types of roads). The state had 28,159 kilometres of rural roads by the end of 2014. Of these roads, 17,430 kilometres (61.9 percent) are blacktop and 2,365 kilometres (8.0 percent) are cement/concrete. The quality of a roadway affects commuting time. The amount of time spent on the road is as important as the distance travelled. The quality and optimal design of roads play a key role in achieving travel efficiencies and in reducing maintenance costs.

Traffic smoothing studies have shown that reductions in constant acceleration and deceleration result in fuel efficiencies. Such studies have also demonstrated that smoothing of traffic flow has been accomplished through controlled traffic signals and with modified lanes as a part of traffic flow management.

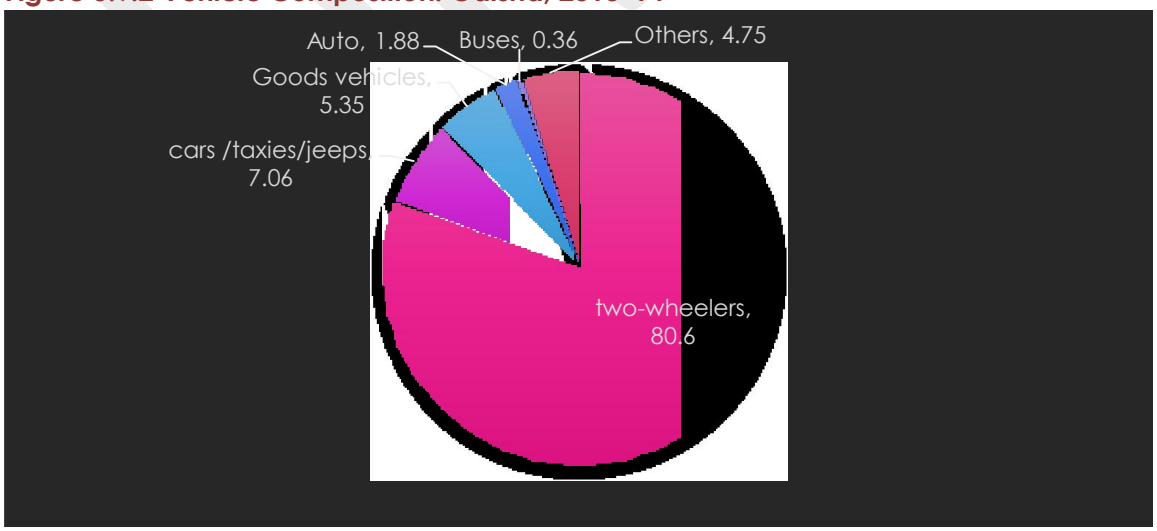
Figure 5.9.1 Types of Roads, Odisha



Source: Odisha Economic Survey, 2014.

Composition of the vehicular mode of transport. In Odisha, two-wheeler motorised vehicles are still a huge part of the transport system (see figure 5.9.2). However, the growing trend in Odisha is new car ownership, which is estimated to be increasing at a rate of 15 percent a year. Similarly, new auto rickshaws sales are also expected to grow at 17 percent a year. Although new cars are fuel-efficient, the auto rickshaw segment requires major regulatory changes to ensure that these new vehicles conform to the emissions standards.

Figure 5.9.2 Vehicle Composition: Odisha, 2013–14



Source: Odisha Economic Survey, 2014.

5.9.2 Sector vulnerability due to climate change

The transport sector is itself a major contributor of emissions that contribute to climate change and global warming. Globally, the transport sector produced 7.0 gigatonnes of CO_2-equivalent of direct emissions in 2010 (or, including non-CO_2 gases, about 20 percent of the total). Emissions from transport are projected to reach 46 percent of global emissions by 2035.

The number of vehicle miles travelled by passenger cars and light-duty trucks increased 35 percent from 1990 to 2013. The increase in travel miles is attributed to several factors, including population growth, economic growth, urban sprawl, and low fuel prices during the beginning of this period.

Rising temperatures and extended heat wave periods expedite damage to roads and pavements. In addition, to increase their comfort vehicle users tend to turn on their air conditioning more than before. The use of air-conditioning is further amplified in urban areas as the temperature in those areas is a few degrees higher than in rural areas because of the heat island effects.

Higher temperatures also affect rail networks through thermal expansion. The new rail network expanding to Angul and Kalinganagar (Jajpur) is likely to be affected because of the rise in temperatures in these areas.

Movement of dirty cargo, especially from mining areas, and constant road congestion increase emissions and cause air pollution.

Floods damage roads in rural areas, and increased precipitation and storm water weaken the road infrastructure. Cyclones and hurricanes also damage roads and the avenue plantations.

Roads and rail near the coast will become more vulnerable to flooding and erosion as a result of the rise in sea level and extreme weather events. Ports such as Gopalpur, Dhamra, and Paradeep are in cyclone paths and repeatedly suffer from extreme weather events.

Older vehicles and overloaded vehicles emit more CO_2 than newly arrived modern vehicles or lightly loaded vehicles.

5.9.3 Activities planned for 2010–15

The activities that were planned for the transport sector in 2010–15 are listed in table 5.9.1.

Table 5.9.1 Key Climate Change Activities Planned, Transport Sector: Odisha, 2010–15

Sl	Activity	Linkage	Progress in 2010–15
1	Expand road network, flyovers, and bypasses in major cities for decongestion	Mitigation	Implemented but not a key priority (KP)
2	Develop plan for inland waterways	Mitigation	Implemented as a KP
3	Introduce mass rapid transport system (MRTS)	Mitigation	Implemented as a KP

5.9.4 Proposed activities for 2015–20

Good opportunities exist for both structural and technological changes around low carbon transport. Policy changes in the transport sector have the potential to institute practices that can improve the prospects for mitigation through reductions in carbon.

C&T /KP/1- Enact policy changes for phasing out old vehicles in order to reduce emissions.

Several global best practices such as a scrappage programme and vehicle emissions standards are available in this sector both incentive programmes and regulations. Such practices will entail changes in transport policy and regulations.

However, this would require strong political will. As a start, the programme will be implemented in all of the state's municipalities over the next five years. No budget provision has yet been made for this initiative.

If this programme is incentive-driven, an effort to phase out 12-year-old cars/taxis/autos, including disposal/deposition, needs to be in place. In a five-year programme, it may cost Rs 20 crore to retire 50,000 vehicles.

CASH FOR CLUNKERS

The U.S. Consumer Assistance to Recycle and Save (CARS) Act of 2009, more commonly known as "Cash for Clunkers," was intended to improve the fuel efficiency of the U.S. vehicle fleet by removing old and inefficient vehicles from use. As a result, CARS had a one-time effect of preventing 4.4 megatonnes of CO_2-equivalent emissions.

C&T/KP/2- Ensure fuel efficiency through driver training.

Training drivers to better manage vehicle control and road and traffic signage will enhance fuel efficiency in the transport sector. Plans call for training about 1 lakh drivers over the next five years, at an outlay of Rs 20 crore.

C&T /KP/3- Strengthen the enforcement and emission check-up system.

If the current high court order on road safety is implemented, high security number plates will be installed on cars, and emission standards will be included in the transport policy and regulations. Forceful implementation would require an integrated transport management policy with proper urban planning (an important component of the smart city). The funds needed for this initiative are as follows: travel signal redesign/smart sensor implementation, Rs 20 crore (1,200 signals), and lane widening and traffic management, Rs 250 crore (250 nodes or choke points in urban areas). Some of these measures can be implemented in the public-private partnership mode.

C&T/KP/4- Use liquefied petroleum gas (LPG).

The use of LPG would certainly reduce CO_2 emission levels. However, before enacting such policy the state would have to wait until the LPG infrastructure is in place.

C&T/KP/5- Use electric rickshaws (e-rickshaws).

The central government is enacting legislation that prescribes the standards for battery- powered e-rickshaws. They will reduce the ever-increasing growth of CO_2-emitting normal autos. The government may provide for this initiative either as a back-ended subsidy or as loans offered to the operators under the priority sector.

5.9.5 Co-benefits

A low-carbon transport system with trained drivers not only provides such drivers (about 1 lakh) with a livelihood, but also provides the poor who earn their livelihoods in different parts of the state with mobility services. It also aids in the movement of goods and services. An efficient transport system saves time, reduces particulate emissions, and ensures long- term energy security.

5.9.6 Implementation schedule and budget

Sl no.	Activity	Time frame (years)	Impact	Co-benefits	Required budget (Rs crore, (2015–20)	State budget (Rs crore)	Other sources (centre, biiateral/multilateral, Rs crore)
1	Enact policy changes for phasing out old vehicles in order to reduce	5	H	M	20.00		20.00
2	Ensure fuel efficiency through driver	5	H	H	20.00	20.00	10.00
3	Strengthen the enforcement and emissions check up	5	H	H	250.00	0.00	250.00
4	Use LPG.	5	M	M			
5	Use e-rickshaws.	5	M	H	0.50		0.50

Note: L = low; M = medium; H = high.

URBAN DEVELOPMENT

5.10 Urban development

5.10.1 Overview

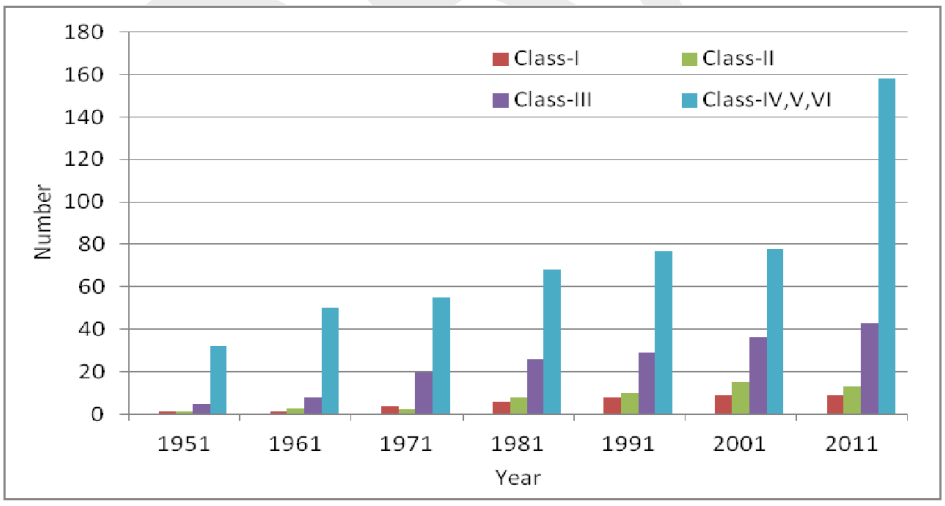
About 17 percent of Odisha's population resides in urban areas. The state has registered remarkable urban growth (about 26.8 percent) during the last decade (2001–11), and the urban population has grown from 37 million to 42 million during this period. Considering the pace of the economic growth in the urban centres in the state, even these growth figures appear to be high and pose challenges in terms of services and secure living conditions for the urban community.

There is significant inter district variation in the urban-rural composition in the state, with Khordha district reporting an urbanisation rate of 48 percent (highest), whereas Boudh in south central Odisha has an urbanisation rate of only 5 percent. Khordha district has the highest urbanisation in terms of both the spatial extent and growth in urban population.

The urbanisation trend over the last five decades in the state reveals that the smaller towns (Classes IV, V, and VI) are growing at a faster rate than the bigger towns (see figure 5.10.1). Also, these small towns are more in number and spread over different parts of the state, whereas the larger cities are fewer in number and concentrated in specific advantageous locations attracting more urban population with a higher grade of opportunities.

Figure 5.10.1 Trends in Urban Growth: Odisha, 1951–2011

Population in million



Source: Economic survey, 2014

Note: Classes are the standard classification used in India's census.

5.10.2 Sector vulnerability due to climate change

The urban centres of Odisha experiencing fast growth are also vulnerable to natural hazards. The urban assets and life are exposed increasingly to the risk of cyclone, heat wave, urban flood, health, and earthquake. Urban centres, mainly Class I cities of the state, are also facing the rapid growth of the slum population living in poor building types in environmentally vulnerable pockets.

The fast growth of these urban centres leads in turn to the build-up of the surrounding areas, thereby encroaching on low-lying areas and increasing the flood risk. The encroachment of low-lying areas and the clogging of drainage due to the increase in solid waste in the city has led to unhygienic conditions and in turn a high incidence of water- and vector-borne diseases.

5.10.3 Key activities taken up during 2010–15

The activities listed in table 5.10.1 were taken up during 2010–15 in the state's urban development sector.

Table 5.10.1 Key Climate Change Activities, Urban Development Sector: Odisha, 2010–15

Sl	Activity	Linkage	Progress in 2010–15
1	Conduct training programmes for the staff covering aspects of the challenges and combating the issues in climate change and their respective roles and responsibilities.	Adaptation	Implemented as a key priority (KP)
2	"To sensitise city dwellers on non-revenue water loss and orient them towards water conservation measures. To introduce water metering system and ensure water assessment and audit."	Both	Implemented as a KP
3	Develop and implement an ideal municipal solid waste (MSW) management plan in a selected city and prepare such plans for state-wide	Mitigation	Implemented as a KP
4	Orient city dwellers to energy-efficient street lighting and pilot the same through a clean development mechanism (CDM) proposal.	Mitigation	Implemented as a KP
5	Develop models of urban storm water flows and based on assessment of the capacities of existing drainage systems in a selected city with climate change	Adaptation	Implemented as a KP
6	Strengthen the existing guidelines for preparation of a master plan/comprehensive development plan (CDP) by incorporating measures to combat climate change and prepare and implement such a master	Adaptation	Implemented as a KP

Sl	Activity	Linkage	Progress in 2010–15
	plan/CDP for a selected city. The activity will be outsourced through a technical organisation.		
7	Improve urban infrastructure by making non-motorised transport feasible throughout the city. The activity will involve survey of the transport network of the city and development of a plan for improvement along with policy-level decisions	Mitigation	Implemented as a KP
8	Rejuvenate ponds and tanks.	Adaptation	Implemented but not a KP

Several city-level projects have been implemented under the city developmental fund and also through external funds, and they overlap with adaptation and mitigation activities. For example, the preservation of ponds in the cities of Bhubaneswar and Cuttack will benefit efforts to regulate urban flooding if the project has a component aimed at maintaining the drains feeding the ponds.

5.10.4 Proposed activities for 2015–20

HUD/KP/1- Introduce municipal solid waste (MSW) composting and conversion of waste to energy.

The cities of Bhuhaneswar and Cuttack are developing strategies for effective solid waste management because the present services are inadequate to meet the cities' requirements. Portions of the services in both cities are being handled by private agencies. Strategies are required for effective waste management that is hygienic and safe. This will also be linked to the upcoming waste-to-energy mission proposed by government of India.

HUD/KP/2- Introduce BRTS and MRTS.

City bus services will be expanded to Rourkela, Sambalpur, and a few more cities in order to reduce congestion and discourage private motorised transport. Detailed project reports for a mass rapid transit system (MRTS) and bus rapid transport system (BRTS) are also being prepared and will be operational in PPP mode.

HUD/KP/3- Revise the guidelines for preparation of a master plan, Community Design Plan (CDP), etc. incorporating climate change concerns.

Building and development codes are needed to address the challenges arising from climate change and natural disasters. The current building bylaw and development regulations do not address some of the newer challenges that must be deliberated and legislated. New building codes, effective development control, upgrading of informal settlements, and retrofitting of existing housing stock are also essential. Changes in storm water policy, preparation of master drainage plans, use of attenuation facilities, and calculation of new flood lines are also needed. Promotion of higher densities to reduce pressure on the ecological infrastructure also should be incorporated into the CDP.

As for the redevelopment and rehabilitation of slum communities, plans call for investing in developing affordable models for the delivery of basic services (water, toilets, roads, pathways, electricity, and waste management) for slum inhabitants and developing models for the redevelopment of slums into formal settlements that adhere to new building codes. Another proposal is the development of city-specific rehabilitation schemes to ensure that environmentally sensitive areas are left alone.

HUD/KP/4- Rejuvenate water bodies.

Water bodies require redesign and improved maintenance because they are one of the root causes of water logging. More efficient water bodies will help increase the water- holding capacities of urban areas, thereby reducing the impact of urban flooding. These areas also include the ponds that surround temples, which, although considered sacred, also act as natural reservoirs to reduce urban floods.

HUD/KP/5- Promote urban storm-water and drainage management for urban flood control.

Learning from the on-going investments in drainage in Bhubaneswar and Cuttack, strategies will be developed to cover all areas, including new ones that become part of the urban centre.

5.10.5 Co-benefits

Many of the city development projects that are part of city's regular services have co-benefits in terms of climate and urban resilience. Solid waste management will help reduce the urban flood risk and could possibly generate energy through effective disintegration of waste. The amendment of building bylaws to address the hazard risk and climate change impact will also accommodate design for energy savings include lighting, heating, and cooling. Augmentation of an integrated sewerage project for Bhubaneswar and Cuttack will help reduce urban flooding and improve the health condition of the people.

5.10.6 Implementation schedule and budget

Sl no.	Activity	Time frame (years)	Impact frame	Co-benefits	Required budget (Rs crore, 2015–20)	State budget (Rs crore)	Other sources (centre, bilateral/ multilateral, Rs. crore)
1	Restore urban water bodies in Berhampur and Bhubaneswar (Bindusagar).	5	M	M	70.00	28.00	42.00
2	Introduce city bus services in Bhubaneswar, Puri, and other cities	5	H	M	336.60	79.20	316.80
3	Update building bylaws and develop control regulations to incorporate climate change and disaster risk reduction considerations.	3	H	H	2.00		
4	Incorporate risk-sensitive land use planning in cities' master plans.	3	M	H	2.00		
5	Incorporate policy framework to encourage non-polluting or "green" economic activities in cities' master plans.	3	M	M	1.00		
6	Develop effective techno-legal enforcement mechanisms for bylaws and development control regulation	3	M	H	4.00		
7	Augment the integrated sewerage project for Bhubaneswar and Cuttack municipalities.	5	H	H	1,000.00		

Note: L = low; M = medium; H = high.

WATER RESOURCES

5.11 Water

5.11.1 Overview

The movement of water in the climate system is essential to life on land because much of the water that falls on land as precipitation and supplies the soil moisture and river flow has been evaporated from the ocean and transported to land by the atmosphere. The world is increasingly confronted with mounting evidence of significant alterations in climate patterns stemming from anthropogenic emissions. They cause frequent extreme events such as floods and droughts and are responsible for a rising sea level, leading to submergence of the coastal area and its erosion, quite apart from other consequences. The present agricultural practices are also having uncertain and adverse effects linked to the changing climatic conditions. Many of these effects are due to the direct or indirect impacts of climate change on hydro-met systems, leading to excesses or shortages of water. The IPCC's Fifth Assessment Report also shows fairly widespread decreases in relative humidity near the surface of the land in recent years. Indirect evidence from scientific data and sea salinity studies show that the pattern of evaporation-precipitation over the oceans has been enhanced since the 1950s. This is likely to have adverse impacts on the spatial and temporal scales in several regions, including India and Odisha.

The long-term average rainfall in the state is about 1,452 millimetres. According to a 2009 assessment, the net annual groundwater availability is about 16.69 billion cubic meters. The 2005 and current annual groundwater draft for Odisha is shown in table 5.11.1.

Table 5.11.1 Annual Groundwater Draft, Current and Projected: Odisha

billion cubic meters

Usage level	Current level	2025 level
Irrigation	3.47	Available 11.94
Domestic and industrial uses	0.89	1.27

Source: State water policy

The availability of water in the future from basins is presented in table 5.11.2.

Table 5.11.2 Basin Water Availability, Odisha

Basin Name	Average Annual flow (in BCM)			75% dependable flow (in BCM)		
	Own	Outside State	Total	Own	Outside State	Total
Mahanadi	29.90	21.039	50.939	25.508	16.702	42.210
Brahmani	11.391	3.118	14.509	8.849	2.395	10.884
Baitarani	7.568	-	7.568	5.434	-	5.434
Rushikulya	3.949	-	3.949	2.782	-	2.782
Vamsadhara	5.083	-	5.083	3.881	-	3.881
Budhabalanga	3.111	-	3.111	2.521	-	2.521
Kolab	11.089	-	11.089	8.885	-	8.885
Indravati	6.265	-	6.265	4.451	-	4.451
Bahuda	0.438	-	0.438	0.213	-	0.213
Nagavali	2.853	-	2.853	2.322	-	2.322
Subernarekha	1.193	1.115	2.308	1.193	1.115	2.308
Total	**82.841**	**25.272**	**108.113**	**65.679**	**20.212**	**85.891**

Source - State Water Plan

Source: Odisha State Water Plan, 2007.

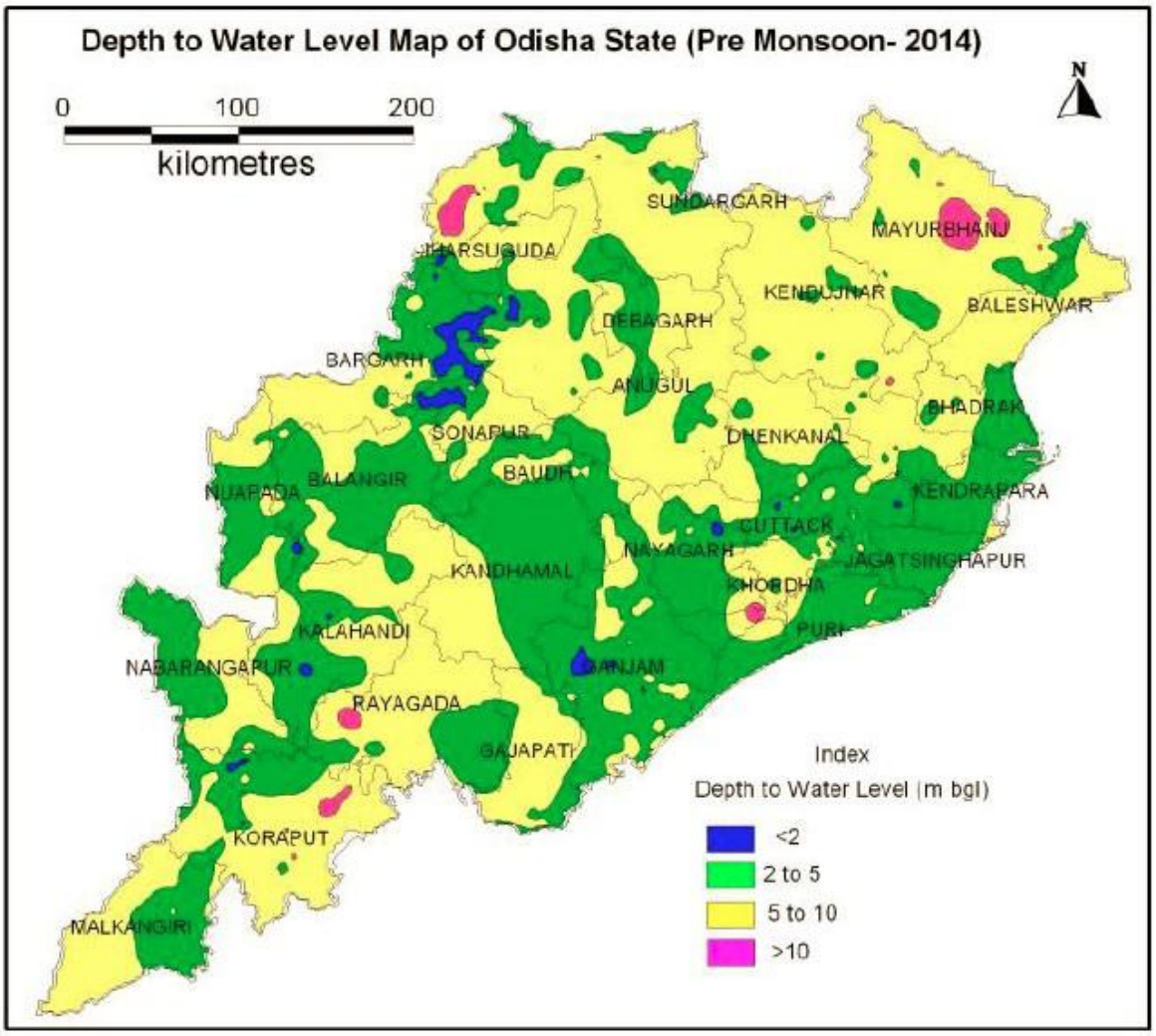
5.11.2 Sector vulnerability due to climate change

In Odisha, the per capita water availability is about 3,359 cubic meters per year. However, this might be drastically less in some areas, especially in southern and south-western Odisha. It is likely to fall to 2,218 cubic meters by 2051 (this is still more than 1,700 cubic meters, which is a water-stressed condition).

Because the monsoon contributes more than three-fourths of the water in the state's water reserve, any change in monsoon behaviour affects the state's flood- and drought-related vulnerability.

Groundwater levels in Odisha, pre-monsoon in 2014, are shown in figure 5.11.1.

Figure 5.11.1 Groundwater Level: Odisha, Pre-monsoon, 2014



Source: Central Ground Water Board.

The pre- and post monsoon assessment by the Central Ground Water Board in 2014 observed that in 8 percent of wells, water level ranges were 0–2 meters below ground level; about 45 percent of the wells analysed had water levels in the range of 2–5 meters below ground level; and about 45 percent of monitoring stations showed a depth to water level range of 5–10 meters below ground level. Less than 2 percent of the wells analysed had a water level in the range of 10–0 meters below ground level. It was also observed that the decadal mean (pre-monsoon 2004–13) fluctuation of water level in about 62 percent of the analysed wells showed a rise in water level, and, of those, 51 percent of wells showed a rise in the range of 0–2 meters, 9 percent in the range of 2–4 meters, and 2 percent in the range of more than 4 meters. About 37 percent of wells showed a fall in water level, mostly in the range of 0–2 meters (34 percent of the wells). About 1 percent of wells showed no change. Therefore, water is still not a strong vulnerability from an availability point of view. Rather, it is a management challenge in view of the spatial variability.

The hydro-met vulnerability is discussed in section 2.1. The other vulnerability is on the demand side. The bigger problem seems to be the water supply for the rapidly forming urban agglomerations in the state, especially around the industrial clusters. For Class I towns, the domestic water demand is about 291.333 cubic meters at the 2051 level; for Class II towns, 92.733 cubic meters; and for Class III towns, 51.115 cubic meters. The contamination of groundwater and the increased turbidity due to the temperature rise has raised the disease burden in some areas, largely because of the poor drainage or the release of wastewater to rivers without adequate treatment.

The state has a power surplus (with a demand in excess of 3,500 megawatts) because of the normal monsoon. If there is below-normal rainfall, hydropower generation falls below 400 megawatts. This, coupled with the poor supply of coal to thermal power plants, puts enormous pressure on the demand-supply power situation in the state.

Aquaculture (fresh and brackish) is the other area of the economy affected by the water sector. As per the Odisha State Water Plan, the total water requirement as estimated in 2011 was in the range of 1,085,158.59 million litres. This requirement is likely to be affected if there is a shortfall in rainfall. In the case of floods, the fish escape, and the predatory species damage the aquaculture.

Flood- and drought-related vulnerability is discussed in section 2. Management of flood and water management is a critical task of the Water Resource Department in its effort to achieve the balanced growth of agriculture and its allied sector, energy, as well as make quality water available to each citizen of the state in an adequate quantity.

5.11.3 Key activities taken up during 2010-15

The activities listed in table 5.11.3 were undertaken during 2010–15 in the state's water sector.

Table 5.11.3 Key Climate Change Activities, Water Sector: Odisha, 2010–15

Sl	Activity	Linkage	Progress in 2010–15
1	Expand the hydrometry network at 107 stations across the state.	Adaptation	Implemented as a key priority (KP)
2	Increase water use efficiency in irrigation projects. Includes water audit, benchmarking,	Adaptation and mitigation	Implemented as a KP
3	Construct and protect water harvesting structures through 6,000 check dams and restoration of 1,121 ponds.	Adaptation	Implemented as a KP
4	Improve the drainage system through de-silting and expanding the network.	Adaptation	Implemented as a KP
5	Raise awareness with Pani Panchayat through farmers' training programme.	Adaptation	Implemented as a KP

5.11.4 Proposed activities for 2015–20

The Water Resource Department wanted to follow the climate outcome approach by recombining some activities and sub activities. The key proposed activities for 2015–20 are described below.

WR/KP/1- Increase water use efficiency in the irrigation sector.

The National Water Mission on Climate Change proposes enhancing water use efficiency in the irrigation command area by 20 percent. The state government has proposed lining canals and undertaking canal rehabilitation work under the rehabilitation of canal networks, including lining/construction of the field channel.

Bore wells, community lift irrigation projects (LIPs), micro river lifts, shallow tube wells, a mega lift scheme, and an Indravati lift scheme (WR CAP 13) under the priority area would enhance the availability of water and reduce the agricultural vulnerability stemming from climate change.

Operation and maintenance by Pani Panchayats (WR-CAP 9) and incentives for Pani Panchayats and water users associations (WUAs) would improve participatory irrigation management. A good capacity-building effort would be to undertake climate-linked crop planning based on water availability and efficient distribution.

Systematic collection and analysis of data will help water auditing and benchmarking of irrigation projects.

All these activities will contribute to increased water use efficiency that can later be verified against the investments made.

WR/KP/2- Conserve water resources

The rivers in Odisha are seasonal. There is little flow in them during the non-monsoon period. It is essential to conserve the surplus monsoon water for utilisation during the dry period. Thus the following projects are under consideration for pursuit over the next five years under conservation of water resources: expediting completion of major and medium reservoir projects (14); constructing check dams (WR CAP 6 and 11) (10,000); de-silting minor

irrigation tanks Odisha Community Tank Management Project (OCTMP) (192); and pursuing Repair, Renovation and Restoration (RRR) (1,170). as well as rooftop rainwater harvesting and artificial recharge of groundwater.

WR/KP/3- Improve flood control and drainage.

One of the major climate change impacts is flooding. For the real time, flood forecasting models are needed to assist in preparedness. Expansion of the hydrometry network is essential to a better flood forecasting model. It is necessary to facilitate measurement and to process, store, and disseminate hydrological and meteorological data both qualitatively and quantitatively. A real-time data acquisition system (RTDAS) was set up during phase 2 of the World Bank–supported River Hydrology Project.

During this phase, 107 hydro- metrological stations were installed. In the priority area of flood management, the following projects are under consideration for the next five years: river and saline embankments (raising and strengthening), embankment construction, renovation or construction of spurs/ launching aprons, identification of a flood hazard zonation map, extension of the flood forecasting network, real-time operation of the Rengali and Hirakud reservoir, preparation of a basin flood control master plan, excavation and resectioning of drainage channels, and construction of field drains in the command area of irrigation projects.

WR/KP/4- Assess the impact of climate change on the state's water resources.

A detailed assessment of the impact of climate change on water resources is needed to take the necessary preventive measures. For this, development of a water database for the state through the Integrated Water Resources Management (IWRM) study is being contemplated. The basic principle of IWRM is that the river basin should be recognised as a basic unit in water planning. Increasing demands on water, leading to scarcity, have forced the state to adopt IWRM as the basic approach to water resource management. All water-related activities in the basin are to be planned, managed, and overseen by a single multidisciplinary organisation, the River Basin Organisation (RBO), in partnership with the Department of Water Resources. Thus there is a need for reassessment of the basin water situation, review of the network of hydrological observation stations and the establishment of additional stations, development of a state water resources information system, and implementation of advance technology for the collection and analysis of data. This information will be used to develop climate-sensitive groundwater legislation, including the development of a groundwater data system for monitoring the consumptive use of groundwater.

5.11.5 Co-benefits

Some of the major co-benefits include increasing water availability for crops (especially rabi and summer crops) in a climate-stressed situation and improving water use efficiency. Fewer crop failures enhance livelihood security and food security.

The mitigation co-benefits include more clean power through enhanced hydro generation, reduced energy demand from more efficient use of groundwater and pumping systems, and the integration of solar pump sets and generation along canals.

The livelihood resilience co-benefits are indirect and linked to the investment in the development and conservation of water resources.

Finally, improving water quality by means of less turbidity, managing salinity, and improving drainage and sewerage has environmental co-benefits.

5.11.6 Implementation schedule and budget

Sl no.	Key climate outcome	Activity	Time frame (years)	Impact frame	Co-benefit	Required budget (Rs crore, 2015-20)	State budget (Rs crore)	Other sources (centre, biiateral/multilateral, Rs crore)
1	2	3	4	5	6	7	8	9
WRN1	Increased water use efficiency in the Irrigation sector (CAP-4) Old	Rehabilitation of canal networks, including	5	H	H	2,334.98	50.00	2,284.98
		Operations and maintenance by Pani Panchayats/water users	3–5	H	M	20.00	20.00	
		Incentives for WUAs to adopt better water management	3–5	M	M	50.00	50.00	
		Water auditing and benchmarking of	3–5	H	M	0.50	0.50	
		Increasing water availability and use	5	H	H	11,164.50	8,764.50	2,400.00
		Command area						
		Use of sprinkler, drip, and						
		Mega lift irrigation						
		Revival of lift irrigation projects (LIPs)						
		Subtotal (A)				13,569.98	8,885.00	4,684.98
2	Conservation of water resources	Expediting completion of major and medium reservoir projects	5	H	H			
		Constructing check dams	3–5	M	M			
		De-silting minor irrigation	5	H	H			
		Roof top rainwater harvesting and artificial recharge	3–5	H	M			

Sl no.	Key climate outcome	Activity	Time frame (years)	Impact frame	Co-benefit	Required budget (Rs crore, 2015–20)	State budget (Rs crore)	Other sources (centre, biiateral/multilateral, Rs crore)
1	2	3	4	5	6	7	8	9
		Generating community awareness for water	3–5	H	M			
		Subtotal (B)				3,548.35	2,348.35	1,200.00
3	Flood control, river training, and drainage	Flood protection and anti-erosion works	5	H	H			
		Non-structural works	3–5	M	H			
		Drainage system improvement and	5	H	H			
		Subtotal (C)				4522.25	2348.35	2173.90
4	Assessment of impact of climate change on water resources of the state	Reassessment of basin water situation	5	H	M			
		Review of network of hydrological observation stations and establishment of additional stations expansion of hydrometry network	3–5	H	M			
		Development of state water resources information system	3–5	H	M			
		Implementation of modern technology for collection and analysis of data	3–5	H	M			
		Groundwater legislation	3–5	H	H			
		Creation of database for groundwater	3–5	H	M			
		Consumptive use of surface and groundwater resources	5	M	H			
		Subtotal (D)				42.55	42.55	
		TOTAL				22,714.08	15,283.02	7,430.88

Note: L = low; M = medium; H = high.

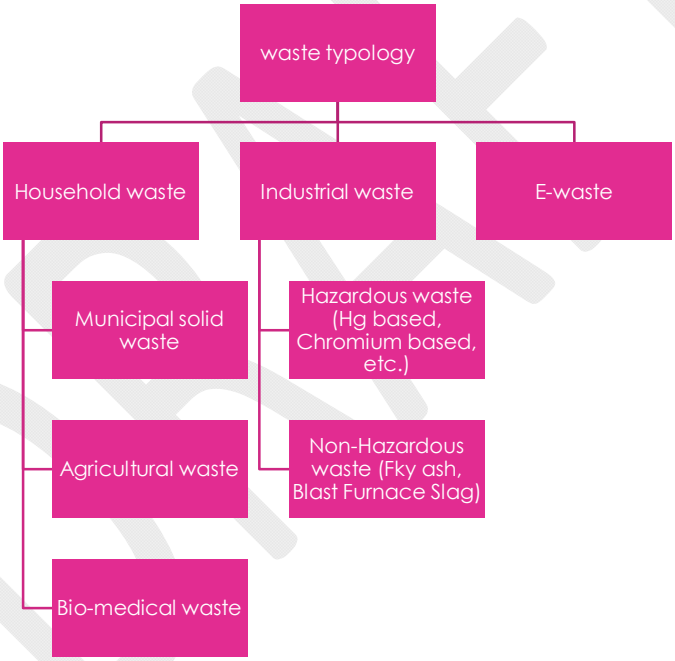
WASTE MANAGEMENT

5.12 Waste Management

5.12.1 Overview

Indian Government has launched "Swachh Bharat Mission" or "Clean India Mission" which aims to mobilize masses and seeks to create a clean India. The aim of this mission is to motivate Indian citizens to devote at least hundred hours every year i.e. two hours every week to keep their homes and neighbourhood clean. Waste management market is expected to be worth US$ 13.62 billion by 2025. Indian municipal solid waste (MSW) management market is expected to grow at a CAGR of 7.14% by 2025 while e-waste management market is expected to grow at a CAGR of 10.03% during the same period. India has planned to achieve a capacity of 2.9 million hospital beds by 2025 which will help bio medical waste management market to grow at a CAGR of 8.41%.

The characterisation of waste has been given below:



With rapid growth of industrialization, mining as well as urbanization the waste generation in Odisha has also seen a sharp growth. As per Odisha State Pollution Control Board, The average MSW generation in Odisha has been found to be around 2293.3 tons per day in all ULB across the state in 2014.

5.12.2 Sector Vulnerability

If waste generated is not properly managed, especially faecal matters and other liquid and solid waste from households then it may lead to serious health hazard and spread of infectious diseases. Unattended waste lying around attracts flies, rats, and other creatures that in turn spread disease. Normally it is the wet waste that decomposes and releases a bad odour. This leads to unhygienic conditions and thereby gives rise to health problems.

The group at risk from the unscientific disposal of solid waste include – the population in areas where there is no proper waste disposal method, especially the pre-school children; waste workers; and workers in facilities producing toxic and infectious material. Other high-risk group include population living close to a waste dump and those, whose water supply has become contaminated either due to waste dumping or leakage from landfill sites. Uncollected solid waste also increases risk of injury, and infection. In particular, organic domestic waste poses a serious threat, since they ferment, creating conditions favourable to the survival and growth of microbial pathogens. Direct handling of solid waste can result in various types of infectious and chronic diseases with the waste workers and the rag pickers being the most vulnerable. Occupational hazards associated with waste handling infections, skin and blood infections resulting from direct contact with waste, and from infected wounds. Eye and respiratory infections resulting from exposure to infected dust, especially during landfill operations. Different diseases that results from the bites of animals feeding on the waste. Intestinal infections that are transmitted by flies feeding on the waste.

Disposal of hospital and other bio-medical waste requires special attention since this can create major health hazards. This waste generated from the hospitals, health care centres, medical laboratories, and research centres such as discarded syringe needles, bandages, swabs, plasters, and other types of infectious waste are often disposed with the regular non- infectious waste.

Waste treatment and disposal sites can also create health hazards for the neighbourhood. Improperly operated incineration plants cause air pollution and improperly managed and designed landfills attract all types of insects and rodents that spread disease. Ideally these sites should be located at a safe distance from all human settlement. Landfill sites should be well lined and walled to ensure that there is no leakage into the nearby ground water sources.

Recycling too carries health risks if proper precautions are not taken. Workers working with waste containing chemical and metals may experience toxic exposure. Disposal of health- care wastes require special attention since it can create major health hazards, such as Hepatitis B and C, through wounds caused by discarded syringes. Rag pickers and others who are involved in scavenging in the waste dumps for items that can be recycled, may sustain injuries and come into direct contact with these infectious items.

5.12.3 Proposed Activities 2015-20

This is a new missions mainly aimed at sanitary land fill of solid waste and wherever possible to attempt waste to energy projects.

WS/KP/1- Awareness generation for management of various kinds of waste

Considering the food habit and culture, massive effort is needed to create awareness about waste segregation at the household level. This has to be done in urban areas with housing societies and also schools and slum committees. OSPCB would also work with relevant industry associations through workshops and seminars about handling of hazardous waste and E-waste.

WS/KP/2- Waste to energy projects in PPP mode

Nowadays, waste-to-energy plants based on combustion technologies are highly efficient power plants that utilize municipal solid waste as their fuel rather than coal, oil or natural gas. Far better than expending energy to explore, recover, process and transport the fuel from some distant source, waste-to-energy plants find value in what others consider garbage. Waste-to-energy plants recover the thermal energy contained in the trash in highly efficient boilers that generate steam that can then be sold directly to industrial customers, or used on-site to drive turbines for electricity production. WTE plants are highly efficient in harnessing the untapped energy potential of organic waste by converting the biodegradable fraction of the waste into high calorific value gases like methane. The digested portion of the waste is highly rich in nutrients and is widely used as bio-fertilizer in many parts of the world.

WS/KP/3- Management Municipal Solid Waste

Government of Odisha would work with Urban Local Bodies and private sector for the management of municipal solid waste. The ULBs will identify landfill sites and sign concession agreement with private sector. A viability gap funding mechanism has been proposed for this. The activity would include effective source segregation, transfer station management and quality landfill and compaction wherever possible.

WS/KP/4- Fly ash utilisation

The fly ash mission is managed with the support of OSPCB and specific budget provisions have been made under Energy sector.

5.12.4 Implementation schedule and budget

Sl no.	Activity	Time frame (years)	Impact frame	Co-benefits	Required budget (Rs crore, 2015–20)	State budget (Rs crore)	Other sources (centre, bilateral/ multilateral, Rs. crore)
1	Awareness generation for management of various kinds of waste	5	H	H	15.00	10.00	5.00
2	Waste to energy projects in PPP mode	3	H	H	25.00	25.00	From Private sector
3	Management Municipal Solid Waste	3	H	H	40.00	40.00	

Chapter 6

FUNDING STRATEGY

6 Funding strategy

Climate finance refers to funding that is above the business-as-usual investment from budgetary sources of the state or central sector schemes. However, so far no concrete allocation mechanism has been forthcoming from the centre. The state has allocated budgets for many identified activities from its own sources or existing schemes of the centre and the state.

Table 6.1 shows the volume of global climate finance flows.

Table 6.1 Global Climate Finance Flows to Developing Countries

	Finance flow (US$ billions, annualised)
All financial flows (public and private) from developed nations to developing nations	40–175
Amount of all above financial flows that flow through public institutions in developing countries	35–50
Rest of the flows are overlapping multilateral development bank flows, official development assistance (ODA), other official flows, climate development policy loans (DPLs), etc.	100–125

Source: United Nations Framework Convention on Climate Change (UNFCCC) Climate Finance Assessment, 2014.

Adaptation finance is a little less than a quarter of the allocation, mitigation finance is a little less than 50 percent, and the rest contributes to multiple objectives.

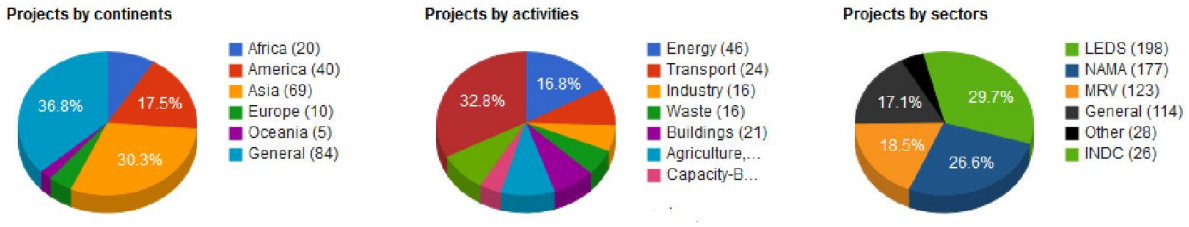
6.1 Nationally Appropriate Mitigation Actions (NAMAs)

According to Article 12, paragraph 1(b), Article 12, paragraph 4 and Article 10, paragraph 2(a), of the United Nations Framework Convention on Climate Change, in October 2010 India communicated that by 2020 it would endeavour to reduce the emission intensity of its GDP by 20–25 percent from the 2005 level.

NAMAs are the vehicles for the low carbon development strategy that the state has envisaged. On this front, the state proposes to work with the government of India and bilateral and multilateral organisations to obtain funds and technical support on policy- and project-based NAMAs at the state level. It will also involve the private sector and urge agencies to fund credited NAMAs.

Based on a NAMA registry analysis, the breakdown of NAMAs appears in figure 6.1.

Figure 6.1 Breakdown of NAMAs in Operation



Source: NAMA Registry, 2015.

India features in 15 NAMAs, some at national level and some as partnerships with other countries.

Some of the actions initiated under the different sectors are listed in table 6.2. These actions will help contribute to the NAMA requirement if duly structured during 2015–20.

Table 6.2 Activities with Possible Linkages to Proposed NAMAs, India

No.	Sector	Objective	Type of NAMA	Status	Duration (years)
AG/KP/5	Agriculture	Increase area under perennial fruit plants in degraded areas of the state (enhances carbon	Project	Under implementation	5
FOR/KP/2	Forestry	Enhance the carbon sink through protection of forest stock and enhanced conservation.	Programme	Under implementation	> 5
FOR/KP/12	Forestry	Build the capacity of joint forestry management (JFM)/participatory forestry management (PFM) communities to	Programme	Under implementation	5
TRANSPORT /KP/3	Transport	Introduce a mass rapid transport system (MRTS), including electric-operated vehicles as per the low	Programme	Under implementation	5
HUD/KP/4	Urban	Develop and implement an ideal municipal solid waste (MSW) management plan and go for state-wide	Programme	Under implementation	5

Currently, GIZ is assisting the Ministry of Environment, Forest and Climate Change (MoEFCC) with the waste management and forestry NAMA. The low carbon transport NAMA study was completed by the Energy Research Institute (TERI) with support from the government of the Netherlands.

6.2 Adaptation finance

Globally, as of May 2015, 48 projects were eligible for adaptation funding, and a US$318 million grant had been approved.

To date in India, three projects have secured adaptation funding overseen by the National Bank for Agriculture and Rural Development (NABARD) under the overall aegis of MoEFCC, the designated national agency. Of these projects, two are in the water sector and one is in the agriculture sector. The total grant volume sanctioned is US$5 million. Projects in agriculture, coastal and disaster risk management, forestry, and water are well positioned to receive adaptation funding for Odisha.

6.3 Way forward to implement the SAPCC

As described in section 1, the government of Odisha has been providing funds largely from its own sources and leveraging some of the central schemes for implementation of high-priority actions identified during 2010–15. Its climate-related allocation increased from Rs 1,700 crore in 2012–13 to Rs 3,207 crore in 2014–15. Possible funding sources include:

- The state budget, the state Public Sector Undertaking (PSU) budget, and the budgets of the parastatals in the state (e.g., OMFED, which is implementing fodder development and biogas programmes)
- Mission-related allocations (e.g., solar mission–related subsidy and subventions)
- Central sector schemes and centrally sponsored schemes (e.g., components of the Jawaharlal Nehru National Urban Renewal Mission, JNNURM)
- Possible project submissions: at least one Rs 10 crore project to the Adaptation Fund Board; a US$10–25 million project to the Green Climate Fund; and an Rs10 crore project to the National Adaptation Fund or National Clean Environment Fund.

In addition, the state is working with the World Bank on a climate-related development finance loan, with GIZ and DFID on implementation of a climate change–related activity, and with the Japan International Cooperation Agency on major programmes in forestry, energy, and urban development. It is also seeking assistance for its water sector programme from the Asian Development Bank.

Chapter 7

IMPLEMENTATION STATUS

7 Implementation process

The Odisha State Action Plan on Climate Change is anchored by the Department of Forest and Environment as a nodal department. It interfaces with 11 partner departments and implementing agencies to coordinate the implementation. It is also the focal point for stakeholder interface.

7.1 Climate change cell

The state has been proactive in the creation of a climate change cell, and an interim budget was approved for FY 2013 to enable the Department of Forest and Environment to take the first steps toward instituting the cell. Based on the state notification, the DFE has appointed the director of forest and environment to head this cell until a formal institutional arrangement is determined. A senior scientist of the DFE is currently looking after the day-to-day work related to climate change. The DFE has also hired a two-person team to conduct the initial activities for the climate change cell. The DFE's medium-term plan is to formalise in a document the structure of the cell within the department and the state. This document will provide guidance on the setting up and functioning of the climate change cell.

Although the current climate change action plan has developed a sector-based classification of actions, the longer-term plan is to develop technical aspects and guidelines that address the following:

- Regional and local climate risks and vulnerabilities
- Baseline emissions
- Goals and targets for each department
- Alternative policy options and recommendations for their development
- Identification and screening of mitigation/adaption actions
- Documentation and forecasting of the impacts of mitigation/adaption actions
- Recommendations and strategy for implementation.

The institutional arrangement of the climate change cell is based on the following assumptions:

- Odisha will undertake reforms aimed at mainstreaming investments related to climate change adaptation/mitigation within each department. This includes mandating departments to structure budgetary allocations and to maintain optimal expenditure rates based on the detailed actions outlined in the SAPCC.
- Odisha will develop governance and implementation mechanisms to incentivise the departments to scale up implementation and their internal capacities for successful implementation of the climate change actions.
- Odisha will oversee the functioning and growth of the climate change cell so that it serves as a centre in the medium term and perhaps a stand-alone department in the long term.

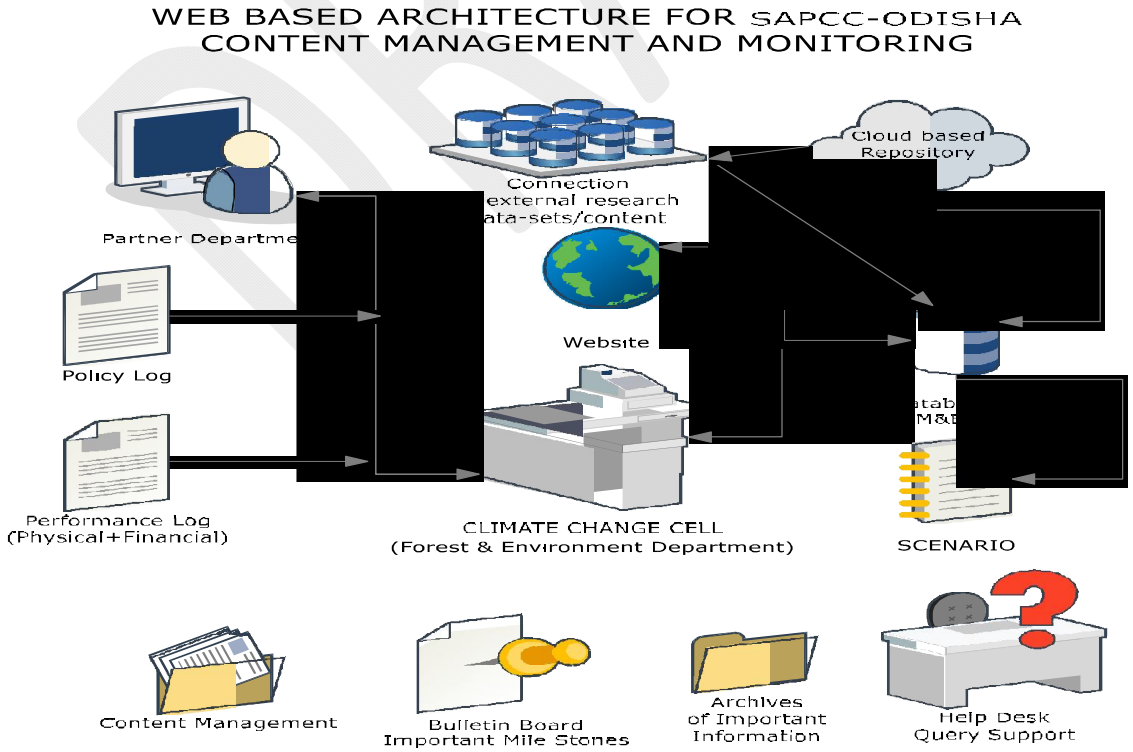
The objectives of the climate change cell will be the following:

- *Design and implement policies.* The climate change cell will coordinate with the technical agencies to assist departments in developing design-specific policies and establishing implementation pathways.
- *Monitor, measure, and evaluate.* The climate change cell will assist in developing mechanisms to evaluate progress toward the state's goals in order to adjust strategies and action plans accordingly. Planning for monitoring, measurement, and evaluation will be included in the design of policy implementation.
- *Communication.* Citizens and stakeholders have important roles in implementation of the SAPCC. Communicating the benefits of programmes to mitigate climate change can help gain continued support for state policies and programmes.

7.2 Technology-assisted progress on monitoring and knowledge management

The climate change cell will act as the interface and repository of the state's climate change–related activities. It already has a website. It plans to regularly issue knowledge products and progress reports. The IT-enabled framework appears in figure 7.1.

Figure 7.1 Proposed Information Technology–Enabled Knowledge Management Platform for Climate Change Cell



The climate change cell will draw inputs primarily from the various state agencies implementing the climate change–related activities as well as inputs from the departments. It will also endeavour to tap into the external knowledge resources available nationally and internationally and provide links to such contents and data. It will access the cloud (data) from the Indian Meteorological Department and other relevant departments for conducting analysis.

Eventually, various standardised environment indicators from OSPCB, climate indicators, hydro-met indicators from IMD, disaster risk reduction indicators from the Odisha State Disaster Management Agency, socioeconomic indicators from Planning and Coordination (P&C), and forest-related indicators from MoEF (ENVIS) will be integrated.

Content management will include categorisation, analysis, and policy briefs/logs. The climate change cell will also have a help desk for resolving queries and accessing the archives of important documents related to climate change.

Chapter 8

MONITORING & EVALUATION

8 Monitoring and evaluation system

The Odisha State Action Plan on Climate Change is accompanied by a mutually agreed-on system of monitoring, evaluating, and verifying the actions outlined in section 1.4.3 of this report. Developing such a system is critical because the state has to create its own protocols based on the context, and especially because many of the tasks are multidisciplinary in nature. In the context of climate change, it is important to understand the definitions to be used and the process that must be undertaken for monitoring, evaluation, and verification.

Monitoring is a process that has taken the form of a state-developed mechanism to capture emissions reductions and other associated economic, social, and environmental benefits and activities that actually occur as a result of the implementation of each action within the SAPCC. By itself, monitoring does not involve the calculation of specific impacts (e.g., a reduction in emissions), nor does it involve comparisons with previous baseline measurements. For example, monitoring would involve measuring the kilowatts produced by a solar energy project, or the number of hectares of land reforested by the Department of Forest and Environment. Therefore the objectives of monitoring are to use the assessments to

- Inform stakeholders and interested parties about the project
- Propose modifications
- Propose measures to improve impact
- Achieve cost-effectiveness
- Enhance the knowledge of all stakeholders.

Evaluation is often referred to as the process by which the impact of a particular investment or project is measured. Process evaluations of a particular project through more detailed and in-depth analysis are also a part of the evaluation processes, which makes it more rigorous than the process used for monitoring. Evaluations of projects or investments usually involve conducting a comparative assessment using information from outside sources and context—for example, the calculation of emissions reductions will be a part of the evaluation process. Therefore, in the context of climate change, project evaluation would include the GHG impacts, environmental impacts, economic and social impacts, and estimation of losses. The main purpose of the evaluation of projects is to understand the SAPCC actions as implemented over a period of time and not just the proposed actions.

Verification is a process by which it is established whether the measured impacts actually occurred. This process is similar to an audit performed by a certified entity. Verification activities may have different objectives and timing and therefore the state must develop a system that is acceptable to all stakeholders.

For the state of Odisha, the goal of the climate change monitoring, evaluation, and verification (MEV) system is:

- To understand the current levels of emissions in the state
- To measure and verify the impact of mitigation programmes on emissions at the project, sector, or state level
- To develop a system of accountability for emissions-reducing and climate change adaptation activities.

Because the MEV process is interdisciplinary, the state will have to draw on the knowledge of climate change adaptation and mitigation policies, accounting methods for emissions sources, technology options, and natural resources management. Implementing such a system will ensure that the state's policy makers, donors, and private investors are able to incorporate MEV protocols into their policy development, programme design, and implementation. This will enable the state to attract public and private funds to invest in climate change mitigation and adaptation.

Recommended MEV systems. The state will customise and internalise the MEV processes (see figure 2 in section 2). Such a process will require apportioning responsibilities to an independent entity so that knowledge and unbiased services are transferred to the various departments in a timely manner. This need reaffirms in turn the need to develop a robust climate change cell as the internal arm of the state to deliver the following aspects of the MEV systems:

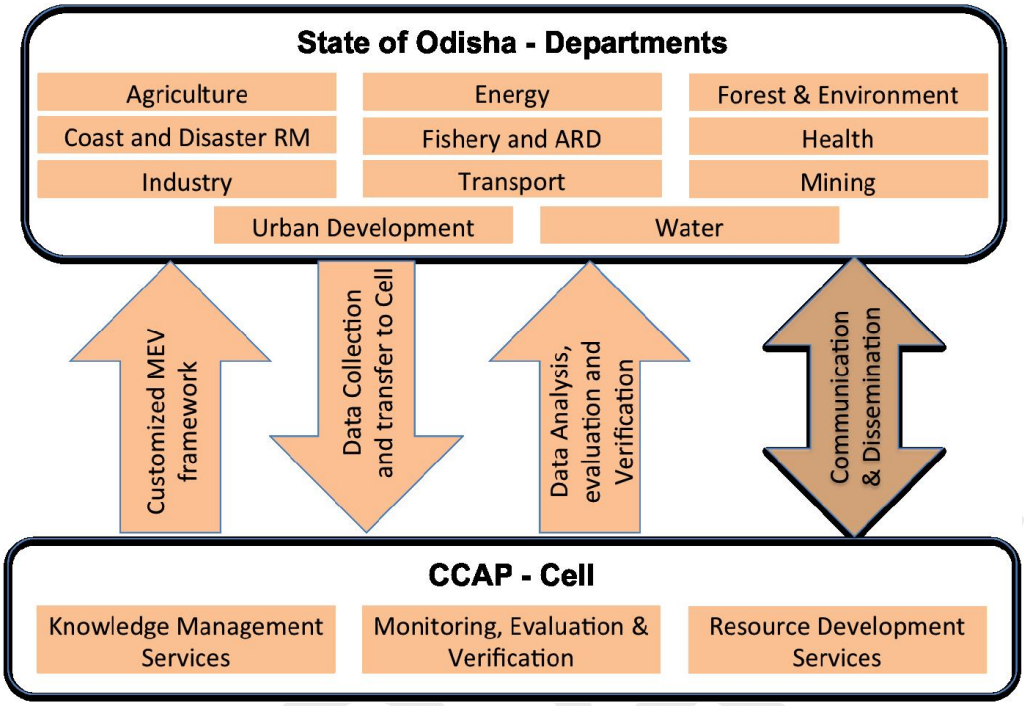
- Design and publish an MEV framework that will address the scopes, objectives, principles, roles, and responsibilities of the institutional structures that will take part in the state's climate change action plan implementation system.
- Provide services to departments that will range from developing emissions accounting methods and baselines at all levels within the state to analysing the impacts of projects in all sectors, including energy, transport, water, waste, industry, forestry, agriculture, water, and urban development.
- Develop tools and methods that can be used to capture carbon counts and other related metrics that can be used internally for measuring targets and externally to validate the effectiveness of investments.
- Establish (1) a credible baseline; (2) methods to ensure the precision of measurement; (3) MEV frequency; (4) reporting frameworks; (5) uncertainty and risk; (6) institutional capacity in conducting MEV; and (7) the cost of undertaking MEV for the state.
- Develop online tools to publish progress and generate real-time reports.

Managing climate change cell MEV systems. MEV will be the responsibility of the climate change cell. Using the action plans and implementation schedules from various departments, the climate change cell will develop a customised MEV framework that will be provided for setting up reporting protocols. Using this framework, the departments will provide the climate change cell with investment and implementation data on an annual basis (see figure 8.1).

The climate change cell will develop collaborative mechanisms with each department to verify data and develop a mechanism to monitor results. On a need basis, the cell will

recommend evaluations of investments, which could have a significant impact by showcasing gains on issues related to climate change.

Figure 8.1 Relationship of State of Odisha Departments to Climate Change Cell



MEV reporting and communication. The climate change cell will develop monitoring reports on investments by departments on an annual basis. These reports will enable the chief secretary's office to conduct assessments of actions undertaken by the departments. The climate change cell will also develop research and evaluation documents to enable the state to showcase its investments.

The climate change cell will develop as well a customised, interactive, web-based tool that will provide updates on the state's investments (levels that can be made public) in issues related to climate change. This tool will also provide a schematic on iterative measurements of emissions and carbon footprint reductions for each department.

The project timeline for the MEV system is as follows:

CCAP 2015-2020
Monitoring, Evaluaiton and Verification Schedule

			2016				2017				2018				2019				2020			
	MEV Actions	**Responsibility**	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct
1	Customized MEV Framework	Cell																				
2	Data Collection/Transfer	Departments																				
3	Data Verification & Analysis (Cell)	Cell																				
4	Evaluations	Cell																				
5	Website Update & Manintenance	Cell																				
6	Documentation and Reporting	Cell																				
7	Dessimination	Cell and depts																				
8	State wide Assessment	CS's office																				

Chapter 9

CONCLUSION & RECOMMENDATION

9 Conclusions and recommendations

Since preparation of the first SAPCC, the state has committed itself to a carbon-conscious growth strategy.

9.1 Key lessons learned

Some of the key lessons learned since formulation of the first SAPCC are the following:

- Climate science is a science of uncertainty. Thus it is important to moderate the expectations of naysayers and climate fanatics.
- It has been clearly understood in the context of Odisha that climate change has both a socioeconomic cost and a socio-political cost, and a broad vision that factors in sustainable development is pragmatic.
- The departments have been closely involved in the process of formulating the SAPCC and are factoring climate change issues into the developmental planning process.
- It is clear that many development issues need to be in sync with addressing climate change concerns:
    - Agriculture and allied sectors require activities subject to both long-term planning (seed and varietal development, breed development, green fodder zone, agroforestry system, water use efficiency) and short-term contingency planning (sowing date adjustment, weather advice, insurance, pest surveillance, etc.).
    - Coastal dynamics plays a larger role in Odisha than in other states because of its long coastline. Therefore, understanding coastal processes, coastal biodiversity, aquatic flora and fauna, and water exchange regimes would play an important role in protecting coastal infrastructure and livelihoods from the adverse impacts of climate change. Although such an understanding would help the state better plan for the future in the short term, investment in institutional development and capacity building on issues relating to climate change along the coast would help to minimise the immediate risks during extreme weather events.
    - Sustainable development in certain sectors (industrial corridor with green cover and renewable energy integration), proper land use planning, integrating long-term climate change scenarios into habitat development and transportation, a thrust on renewable energy policy to spur such investment in the state, efforts to address the issues surrounding water use efficiency and energy efficiency, and a fiscal instrument to aid low carbon growth require holistic thinking to enable the state to achieve low carbon growth.
- Formulation of the first SAPCC took almost a year. It turned out to be the de facto template for many states for such planning. The draft of the second SAPCC has

taken less than four months. This demonstrates a much higher level of understanding and assimilation of the process by the partner departments.

- In future SAPCCs, it probably would be wise to integrate as many departments and implementing agencies as possible into the planning stage itself.
- New missions are being added at the national level (e.g., coast and disaster risk management, health), and many inputs have gone into such a step since Odisha's first SAPCC. Odisha is formulating an integrated renewable energy policy that would cover a modified solar mission, a wind mission, and the upcoming hydel mission. This will go a long way in changing the energy mix in the state.

9.2 Budget and funding

Any estimation of the cost of climate change adaptation activities and even some mitigation activities is difficult because of the externalities and uncertainties associated with their implementation. The prioritised activities in 12 sectors for the period 2015–20 is expected to be Rs 31,664 crore, which is about Rs 14,000 crore more than estimated in the previous SAPCC. If inflation of about 5–6 percent is assumed, the amount seems to be on the same order of magnitude. The total budget breakdown by sector appears in table 9.1.

Table 9.1 Summary Budget, Climate Change Activities, 2015–20

Sl No	Sector	Reported spending (2011-15) in	Budget for 2015-20 in INR Crore	Source: State Budget In INR Crore	Source from (National Missions, from external aid, etc.) in INR Crore
1	Agriculture	1,466.15	1,633.60	961.83	671.78
2	Coast and DRM	889.19	773.15	456.50	316.65
3	Energy	455.14	749.46	597.74	151.72
4	Fishery & ARD	21.38	396.59	308.44	88.15
5	Forest	1,636.88	3,646.20	2,404.06	1,242.14
6	Health	96.20	142.00	142.00	-
7	Industry	0.15	5.00	2.60	2.40
8	Mining	-	27.50	6.00	21.50
9	Transport	10.29	21.00	11.00	10.00
10	Urban Development	224.03	1,475.00	109.20	1,365.80
11	Waste Mgmt.		80.00	75.00	5.00
12	Water	2,928.58	22,714.08	15,283.20	7,430.88
	TOTAL	7,727.98	31,663.58	20,357.57	11,306.02

It is proposed that climate financing be mobilised aggressively so that pressure is reduced on the state budget. It is presumed that two third of the climate budget will be from state sources and balance one third will be mobilised from centre and other climate funds. This is in line with many central sector plan schemes either getting devolved to states or having higher state share.

It is heartening to note that the state has had consistently higher allocations to climate change in its budget and has reported the progress in a transparent manner. About Rs 6000 crore per year has been designated for climate-related activities. Thus clearly the state has taken the climate change issue seriously and is taking action on it.

APPENDIX

Appendix A: Sectoral budget

Appendix B: Stakeholder comments and suggestions

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