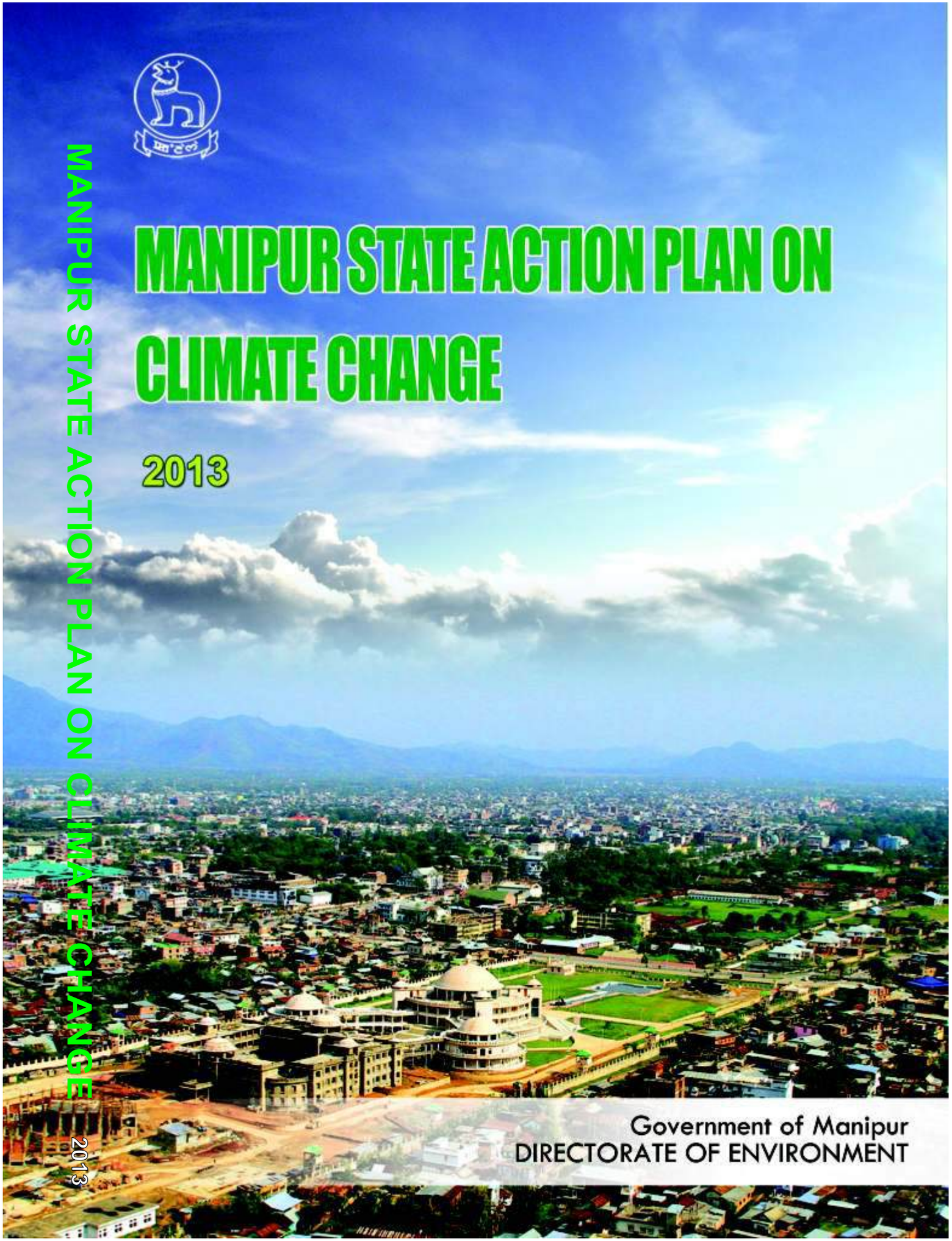
MANIPUR STATE ACTION PLAN ON CLIMATE CHANGE

2013



Government of Manipur
DIRECTORATE OF ENVIRONMENT

MANIPUR STATE ACTION PLAN ON CLIMATE CHANGE 2013

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Abbreviation :

AAP	:	Annual Action Plan
ADCs	:	Autonomous District Councils
AMC	:	American Meteorology Centre
AT&C	:	Aggregate Technical and Commercial
ATMA	:	Agriculture Technology Management Agency
BDA	:	Bamboo Development Agency
BOD	:	Bio-chemical Oxygen Demand
CAD	:	Control of Animal Diseases
CH_4	:	Methane
COD	:	Chemical Oxygen Demand
CO_2	:	Carbon dioxide
CAT	:	Catchment Area Treatment
CBFM	:	Community-Based Forest Management
CEA	:	Central Electricity Authority
CFCs	:	Chloro Floro Carbon
CGWB	:	Central Ground Water Body
CWC	:	Central Water Commission
DO	:	Dissolved Oxygen
DGVM		Dynamic Global Vegetation Model
EC	:	Energy Conservation
FC	:	Finance Commission
FDA	:	Forest Development Agency
GHG	:	Green House Gas
GIM	:	Green India Mission
GT	:	Gigatonne
HYV	:	High Yielding Varieties
IBR	:	Indo Burma Ranges
IFCD	:	Irrigation Flood Control Department
IHR	:	Indian Himalayan Region
IIS	:	Indian Institute of Sciences
NDC	:	National Data Centre
IMD	:	Indian Meteorology Department
IMR	:	Indo-Myanmar Range
INC	:	Initial Nation Communication
INCCA	:	Indian Network for Climate Change Assessment
INM	:	Integrated Nutrient Management
IPCC	:	Intergovernmental Panel on Climate Change
IPM	:	Integrated Pest Management
IREP	:	Integrated Rural Energy Programme
IT	:	Information Technology
IVR	:	Inter Village Roads
KVKs	:	Krishi Vigyan Kendras
LPC	:	Land Possession Certificates
LPG	:	Liquefied Petroleum Gas
MANIREDA	:	Manipur Renewable Energy Development Agency
MDR	:	Major District Roads
MFRDA	:	Manipur Forest Resource Development Agency
Mg/l	:	Milligram per Litre
MID	:	Minor Irrigation Department
MLD		Million Liters per Day

MNOB	:	Manipur-Nagaland Organic Belt
MSDA	:	Manipur State Designated Agency
MU	:	Million Units
NAIS	:	National Agriculture Insurance Scheme
NAP	:	National Afforestation Programme
NAPCC	:	National Action Plan on Climate Change
NBM	:	National Bamboo Mission
NER	:	North Eastern Region
NGOs	:	Non Government Organisations
NH	:	National Highway
NHPC	:	National Hydroelectric Power Corporation
NMSHE	:	National Mission for Sustaining Himalayan Eco-system
N_2O	:	Nitrogen oxide
NSDP	:	Net State Domestic Product
NTFPs	:	Non-Timber Forest Products
ODR	:	District Roads
PAN	:	Protected Area Network
PAs	:	Protected Areas
PHED	:	Public Health Engineering Department
PPP	:	Public Private Partnership
PRIs	:	Panchayati Raj Institutions
RCM	:	Regional Climate Model
SAPCC	:	State Action Plan on Climate Change
SDA	:	State Designated Agency
SH	:	State Highways
SHGs	:	Self-Help Groups
SHP	:	Small Hydel Project
SLACCC	:	State Level Advisory Committee on Climate Change
SPV	:	Solar Energy Photovoltaic
SRI	:	System of Rice Intensification
SWGC	:	Sectoral Working Group Committee
T&D	:	Transmission & Distribution
TGA	:	Total Geographical Area
TOF	:	Tress Outside Forest
ToT	:	Transfer of Technology
USFs	:	Unclassed State Forests
WDPSCA	:	Wetland Development Project in Shifting Cultivation Area

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Part A

GENERAL

Chapter 1

BACKGROUND

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Chapter 1 : BACKGROUND

Climate change may alter the ecosystem as well as biodiversity of a region in many ways. It poses a major challenge to sustainability of social and economic development especially by adversely affecting the distribution system and quality of regional natural resources thereby impacting the livelihood of communities and also the environment in developing countries. Even if Greenhouse Gas (GHG) emissions are reduced significantly in the coming years, the persisting climate change effects such as gradual temporal and spatial shifts in natural resources as well as drought, flood, severe weather events sea-level rise etc. are likely to result in food shortage, increase in vector-borne diseases, infrastructure damage and degradation of natural resources. The poor communities will be affected disproportionately. Adapting to this changing climate is a rapidly growing challenge for the dependent communities, particularly the backward & rapidly urbanized areas, in Manipur State. Hence, adaptation to climate change requires integrated solutions that simultaneously address livelihood needs and environmental sustainability. Proactive measures for adaptation to climate variability and change can substantially reduce many of the adverse impacts, and thus contribute to livelihood security of the vulnerable rural population in the state.

In a situation where climate change is likely to affect the nation's economy the consequences would be more severely felt by the poorer section of the community who has the least adaptive capacity. Subsequently, there is more emphasis on climate-sensitive sectors like ecosystem, agriculture, forests, tourism, animal husbandry, fisheries, etc. because of its relevance to the economy and population. Recognizing the importance of the climate sensitive sector, the National Action Plan on Climate Change (NAPCC) in June 2008 clearly outlined its principal objective of 'protecting the poor and vulnerable sections of the society through inclusive and sustainable development strategy, sensitive to climate change.' In this background, the Directorate of Environment, Government of Manipur, as Nodal Agency, in collaboration with 20 line government departments / agencies of Manipur Government has prepared the MANIPUR STATE ACTION PLAN ON

> Even if greenhouse gas emissions are reduced significantly in the coming years, climate change impacts, such as gradual temporal and spatial shifts in natural resources as well as drought, floods, severe weather events and sea-level rise, etc. are likely to result in food shortages, increase in vector-borne diseases, infrastructure damage and degradation of natural resources. The poor communities will be affected disproportionately.

CLIMATE CHANGE (SAPCC) with an objective to address the existing as well as future challenges of climate change and take actions to reduce the associated risks and vulnerabilities.

1.1 Principle

i. Work out a strategy and activities in consonance with the National Action Plan for Climate Change (NAPCC);

ii. Protecting the poor and vulnerable sections of society through an inclusive & sustainable development strategy, sensitive to climate change;

iii. Adapt & combat the climate change issues in the state;

1.2 Objective

To develop a State Action Plan on Climate Change (SAPCC) in Manipur based on the recommendations of the National Action Plan on Climate Change (NAPCC) for sustainable environmental management including adaptation and mitigation of the climate variable.

1.3 Approach

The SAPCC-Manipur addresses the urgent & critical concerns of the state through a directional approach including the enhancement of the existing & planned programmes with technical assessment and approach as laid down by the NAPCC.

1.4 Institutional Mechanism

Government of Manipur has put in place a comprehensive structure to deal with the threats and challenges posed by the climate change. In this regard, 3 (three) committees have been constituted during November 2010 and April 2011 respectively in the state government namely

i. State Level Advisory Committee on Climate Change (SLACCC)under the chairmanship of Hon'ble Chief Minister with concerned Ministers/ MLAs/ Representatives (Appendix-1) with the role & responsibility of

- Approving the policies and strategies determined to deal with climate change and the action plan adopted subsequently in the state; and
- Following up on decision taken by the Prime Minister's Council on Climate Change;

ii. State Level Steering Committee on Climate Change (SLSCCC) under the chairmanship of Chief Secretary, Manipur with concerned line departments / agencies (Appendix-2) with special responsibilities of

- Following up and coordinating the policy decisions of the State Level Advisory Committee;
- Co-ordinating the implementation, management, evaluation and audit of the action Plan on Climate Change Mitigation and Adaptation (CCMA) Strategies and programmes;
- Advocating and institutionalizing the Climate Change Mitigation and Adaptation policy;
- Framing of broad modalities and steering the Climate Change Mitigation and Adaptation programme; and
- Constituting an advisory body for implementation of relevant programmes

iii. Sectoral Working Group Committee (SWGC) for preparation of State Action Plan on Climate Change (SAPCC) in Manipur under the chairmanship of Addl. Chief Secretary (Forests & Environment), Manipur with concerned line departments / agencies (Appendix - 3) with responsibilities of

- Following up and co-ordinating the decisions taken by the State Level Steering Committee on climate change (SLSC CC), Manipur;
- Furnishing draft inputs on the State Action Plan on Climate Change to the Manipur State Nodal Agency on Climate Change;
- Reviewing& assessing the existing & proposed planning process and activities of the respective department / agencies with respect to the climate sensitive schemes;
- Identify the climate change adaptation and mitigation options cross cutting issues / sectors;

The Directorate of Environment, Manipur is the State Nodal Agency for overall coordination of the activities to undertake the preparation of State Action Plan on Climate Change, by soliciting inputs on relevant activities from various line departments / agencies. The State Nodal Agency has also consulted local subject experts (list at Appendix – 4). Further, State Sectoral Working Group Committee (SSWGC), held several interactive sessions with line departments / agencies in order to -

- Review & assess the existing planning process and activities with respect to the climate sensitive schemes; and
- Identification of adaptive options cutting through diverse sectors

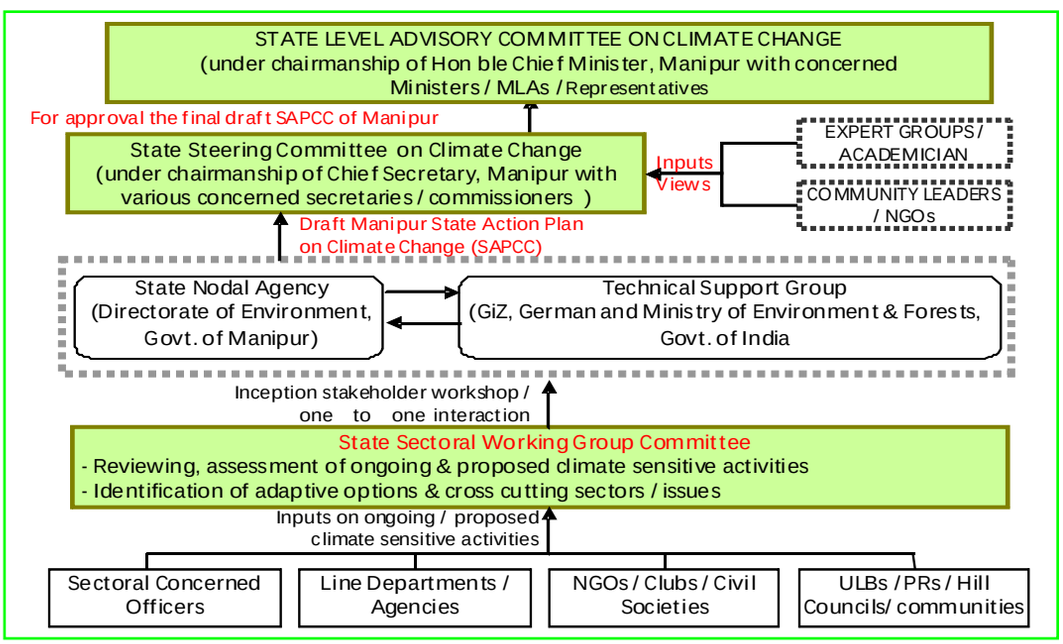

Fig. 1.1 : Institutional Mechanism for preparation of SAPCC-Manipur

1.5 Process & Activities for preparation of Manipur State Action Plan on Climate Change (SAPCC)

During the process of preparation of SAPCC, interdepartmental meetings were held for four times, followed by frequent discussions among sectoral groups and nodal departments, online interactions, one-to-one consultations, etc. (Appendix 5–7). At the district level consultation workshops were conducted two times by inviting participants from remote villages. Target groups of the workshop were district students' leaders [selective], women leaders / members of the civil society of the district, village chiefs / secretaries / religious leaders of the district, intellectuals / academicians / researchers of the district, NGOs [working for environment] of the district, other concerned individuals / citizens, etc. During the workshop, all the participants were involved in an exercise of deliberating on (1) the impact of climate change on life and livelihood (2) review& assessment of the existing planning process to address climate change and (3) the progress of existing activities with respect to the climate sensitive schemes as follows:

- identification of adaptive options through all sectors
- interaction & open discussion on district level action plans integration of all the inputs, suggestions and recommendations on action plan on climate change sensitive sectors from there spective districts into the draft Manipur State Action Plan on Climate Change, prepared by State Government;

Team from Directorate of Environ-ment, Govt. of Manipur along with local NGOs, experts and press media persons visited the vulnerable & eco-sensitive villages like Shiroi & Khankhui in Ukhrul, Dailong & Khunjao in Tamenglong etc. for ground verification of their adaptation practices in the

State level Consultative workshop for preparation of SAPCC, Manipur

Consultative workshop of academia forum on SAPCC, Manipur

District level Consultative workshop on SAPCC, Manipur

changing scenario of climate. Academia forum from different institutions were actively involved in different stages during preparation of SAPCC- Manipur.

1.6 Basic Frame-work of SAPCC in Manipur

The State Action Plan on Climate Change (SAPCC) - Manipur focuses on understanding the climate change, adaptation practices, mitigation of climate variability and natural resource conservation through eight missions viz. (1) State mission for Ecosystem, Biodiversity and Livelihood sustainability (2) State mission for Water Resources (3) State mission for Sustainable Agriculture Practices (4) State mission for Health (5) State mission for Forests Resources Conservation, (6) State mission for Enhanced Energy Efficiency & Conservation, (7) State mission for Urban Planning and (8) State mission for climate change Strategic Knowledge & Information. It provides a multi-pronged and integrated framework for addressing the climate change in the state.

Now, the SAPCC is a strategic document according to which the State Government remains the key resource in shaping the climate change policy and creating the necessary institutional mechanism for its implementation.

The SAPCC –Manipur, targets to achieve coherence between the strategies and actions on climate change policy. Address the adaptation challenges by improving the adaptability of the public through developing suitable infrastructures and preserving its eco-systems.

Besides that, the existing technological options would be included in enhancing the effectiveness of state policies for mitigation of climate change. Both adaptation and mitigation plans will be integrated into the state planning process so that the required funds may be allocated from the state budget for timely implementation of the identified prioritized activities or external funding sources may also be roped in when required. The major components of the SAPCC are listed below:

Sectoral discussion alongwith departmental heads & nodal officers with during preparation of SAPCC

Exercise & interaction amongst the departmental nodal officers of Sectoral Working Group Committee during preparation of SAPCC

Participation of peoples during preparation of SAPCC

Module 1: Vulnerability Assessment:

- Study the available climate data & projection of climate change;
- Analyse the climate change impact sectors & vulnerability assessment at the local level;
- Scientific assessment of the state's climatic variability & long term climate change vulnerability;

Module 2: Identification of options:

- Identification of most vulnerable districts, groups, sectors and adaptive capacity;
- Convergence / integration of ongoing activities, cross cutting issues;

Module 3: Prioritization of options:

- Assessment of existing national policies and state policies linked to the climate change;
- Prioritization of adaptation strategies & mitigation options based on local suitability, time factor as well as resources availability;

Module 4: Implementation & Financing options:

- Feasibility assessment for implementation of the identified options;
- Performance monitoring of ongoing climate change related activities in both adaptation & mitigation components;
- Budget analysis for the climate change related activities during current five year plan & proposed next five year plan.

1.7 State Priority Sector for SAPCC-Manipur

All the indentified 8 (eight) sectors under the SAPCC report has been priotitized and made interlinkages each other over-arching to Table 1.1: Identified State Mission of Manipur SAPCC under the ambit of NAPCC, National Action Plan on climate change.

1.8 Strategies for implementation of the State Action Plan on Climate Change

Vulnerability and Potential Assessment:

Criteria for selection of project areas under the action plan are based on the vulnerability of the area to climatic change, ecosystem sensitivity and potential for adaptation (time scale considering the existing barriers) in the sectors. Prioritization of the action plan implementation is based on the type of measures (e.g. adaptation & mitigation) and its nature of implementation (like state level, district level, particular area, etc). Nature of funding for the action plan is proposed on different basis like policy action, demonstration projects, investment projects, capacity building, research and development action etc.

Integrated cross-sectoral approach to implementation:

The action plan encourages an integrated cross-sectoral approach to improve the state of environment & the ecosystem. Especially, livelihood improvement and climate change adaptation strategies are being addressed using inter-sectoral convergence. Both the existing state sectoral working group and state steering committee on

Table 1.1 : Identified State Missions of Manipur SAPCC under the ambit of NAPCC

Sl. No.	Missions of SAPCC	Over- arching National Missions
1	Ecosystem, Biodiversity & Livelihood Sustainability	• Sustaining the Himalayan Ecosystem • Sustainable Habitat
2	Water Resources	• National Water Mission
3	Sustainable Agriculture Practices	• Sustainable Agriculture
4	Health	• Sustainable Habitat
5	Forest Resources Conservation	• Green India Mission
6	Enhanced Energy Efficiency and Conservation	• National Solar Mission • Enhanced Energy Efficiency in Industry
7	Urban Planning	• Sustainable Habitat
8	Climate Change Strategic Knowledge & Information	• Strategic Knowledge for Climate Change

Figure 1.2 Linkage between identified sectoral mission in Manipur and National Missions under NAPCC

climate change will get involved in the pre & post-implementation process with all

Chapter 2

MANIPUR STATE ENVIRONMENT PROFILE AND CLIMATE STATISTICS

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Chapter 2 : MANIPUR STATE ENVIRONMENT PROFILE AND CLIMATE STATISTICS

2.1 Overview

Bounded by Nagaland in the north, Mizoram in the south and Assam in the West, lies Manipur, one of the neighbours of the seven northeastern states. Lying at latitude of 23°83'N – 25°68'N and longitude of 93°03'E – 94°78'E, the state shares its international border with Myanmar in the east with an area of 22,347 sq. km. (i.e. 8,628 sq. mile).

According to the 2001 census, India has a population of 1027 million with approximately 28% (i.e285 million people) living in urban areas. As a result of the liberalization policies adopted by the Government of India, the share of the urban population is likely to reach up to 40 per cent of total population by the year 2021. It is estimated that by the year 2011, urban areas would contribute about 65 per cent of gross domestic product (GDP). Imphal is the only

Table 2.1 : Brief Profile of Manipur

Particulars	Manipur
Total Geographical Area (TGA)	22,327.00 sq. km. i.e. 0.7% of total geographical area of India
Population (2001 Census)	22,93,896 (34.20% ST & 2.77% SC)
Population (2011 Provisional census)	27,93,896 (34.20% ST & 2.77% SC)
Population Density	122 per Sq. Km. (2001 Census) 122 per Sq. Km. (2011 Provisional Census)
Decennial growth rate of population	30.02 % (1991-2001)
Sex ratio	987 females per 1000 males
Population below Poverty line in % (2005)	17.20
Literacy Rate in % (2001)	70.50 %
Workers in % (2001)	42.18 %
Per Capita Income (at 2001 prices)	Rs. 9,833.00
Unemployment (2001 Census)	10.74%
Index of Social & Economic Infrastructure	75.39

Class I City in the state of Manipur and is the center of economic and social activity. The city is also the Gateway to North East India. Considering the criticality of the region, development of physical infrastructure to drive the development process is essential. At the same time, the growth in population poses major challenge to the availability of urban amenities and infrastructure such as housing stock, public transport system, water supply, solid waste disposal provisions and sanitation and sewerage systems. Also, unplanned development leads to a haphazard growth and clustered settlements. As a result a large number of citizens remain deprived of the basic urban services. Urban environment is also adversely affected.

The tectonic setting of Northeast India and Indo Burman Ranges (IBR) in particular has a distinct entity in tectonic frameworks of South East Asia. It is believed that IBR is the product of an island and are type of collision between Indian and Burma plates while the eastern Himalayas evolved as result of continent-continent collision between India-Australian and Eurasian plates. Rifting and stretching of the crustal layer (lithosphere) of this region possibly initiated sometimes towards the close of the Mesozoic era and it is likely that the Manipur central valley was evolved as a result of passive rifting of the continental margins, i.e. sinking of a former plateau. Physiographically, Manipur can be characterized as two distinct physical regions: an outlying area of rugged hills and narrow valleys, and the inner area representing the features of flat plain topography with all associated landforms. The land use statistics given in TABLE 2.2 indicates that forests & agriculture are the predominant in Manipur.

Table 2.2 : Land Use Statistics

Land Use	Area	Percentage
Reporting area for land utilization	1,951,000 Ha	100.00 %
Forests	1,693,000 Ha	86.78 %
Not available for cultivation	27,000 Ha	1.38 %
Permanent pastures and other grazing lands	1,000 Ha	0.05 %
Land under misc tree crops & groves	6,000 Ha	0.31 %
Culturable wasteland	1,000 Ha	0.05 %
Fallow lands other than current fallows	0	0.00 %
Net area sown	224,000 Ha	11.48 %

Source : Wasteland Atlas 2010, National Remote Sensing Agency (NRSA), India

2.2 Climate profile of Manipur

Orographic features of Manipur such as terrain diversity, altitudinal variation and river regime plays an important role in determining the spatial variability of climate. The Barak basin and lower foothills of Manipur Western hills have a warmer climate than the central valley and surrounding hills. Similarly, the western part of the state is more humid than the eastern because of its location on the windward slope of the hills.

2.2.1 Data used

In order to understand the climate profile of Manipur and the variability in climate over the past 57 years (1954-2011), IMD published a high resolution daily gridded datasets (0.5 x 0.5 degrees). Climate Research Unit Time Series (CRU TS) 2.0 also developed a monthly 0.5 degree gridded data for both temperature and precipitation. Moreover, daily weather dataset of Manipur for the last 57 years (January 1954-December 2011) was developed by Environment Monitoring, Research & Development Laboratory, Directorate of Environment, Govt. of Manipur (Source : IMD-Pune, ICAR-Imphal and District Weather Stations of Environment Directorate) & integrated in the study. District-wise data was obtained by re-gridding the dataset to 0.1 X 0.1 degrees, and re-aggregating by districts to study the climate variability at district level.

2.2.2 Temperature Variability Trends in Manipur:

Manipur state is susceptible to anthropogenic greenhouse gas (GHG) emissions. The dataset of surface temperature variation observed during 1954 – 2011shows an increasing trend in both the minimum and maximum temperatures (Figure 2.1&2.2). When the maximum temperature has increased from 26.5 ^{0}C to 27.3 ^{0}C, the minimum temperature has increased from 13.8^{0}C to 15.3 ^{0}C. Even the night temperature has rapidly risen as compared to day time temperatures because the greenhouse gasses act as a glass house by trapping long-wave radiation radiated by earth surface.

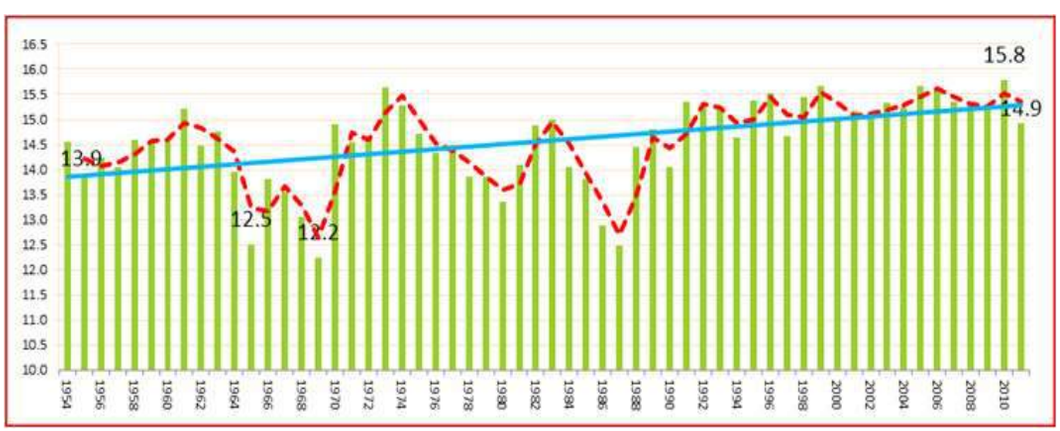


Figure 2.1: Mean Maximum Temperaturein Manipur (January 1954 – December 2011)

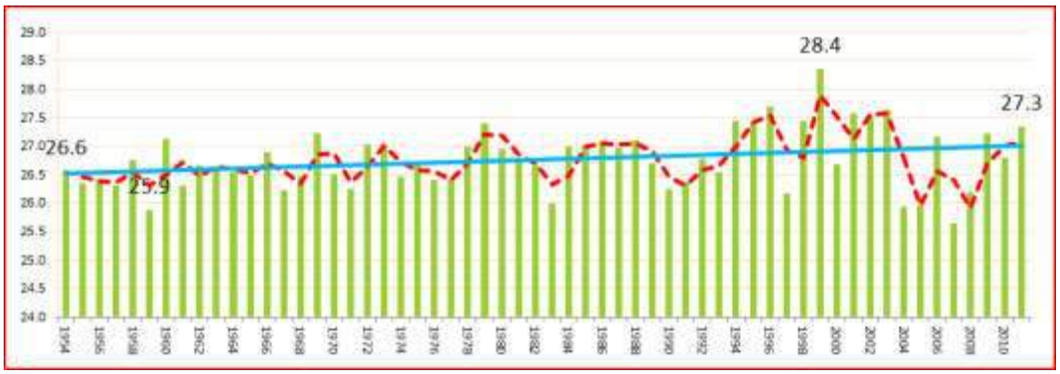


Figure 2.2: Mean Minimum Temperaturein Manipur (January 1954 – December 2011)E

Source: Directorate of Environment, Govt. of Manipur National Data Centre, Indian Meteorology Department (IMD), Pune and ICAR, Lamphel

Seasonal variability of minimum and maximum surface temperatures in Manipur was from 4 °C (January) to 21.5 °C (July) and 21.5 °C (January) to 28.9 °C (July) respectively. As per the spatial pattern of minimum temperature, an increasing trend was observed over the region. South-western parts of the state i.e. Jiribam, Churchandpur, Bishnupur, Thoubal, Imphal (east & west), Chandel, some parts of Tamenglong and Chandel have experienced an increase in both minimum and maximum temperature of ≥ 1.75°C and ≥ 1.5°C respectively in the last 100 years as displayed Figure 2.3.

2.2.3 Rainfall Variability Trends in Manipur:

To examine the current variability in precipitation over Manipur in the last 57 years (1954-2011) the daily precipitation datasets were analyzed. Annual rainfall

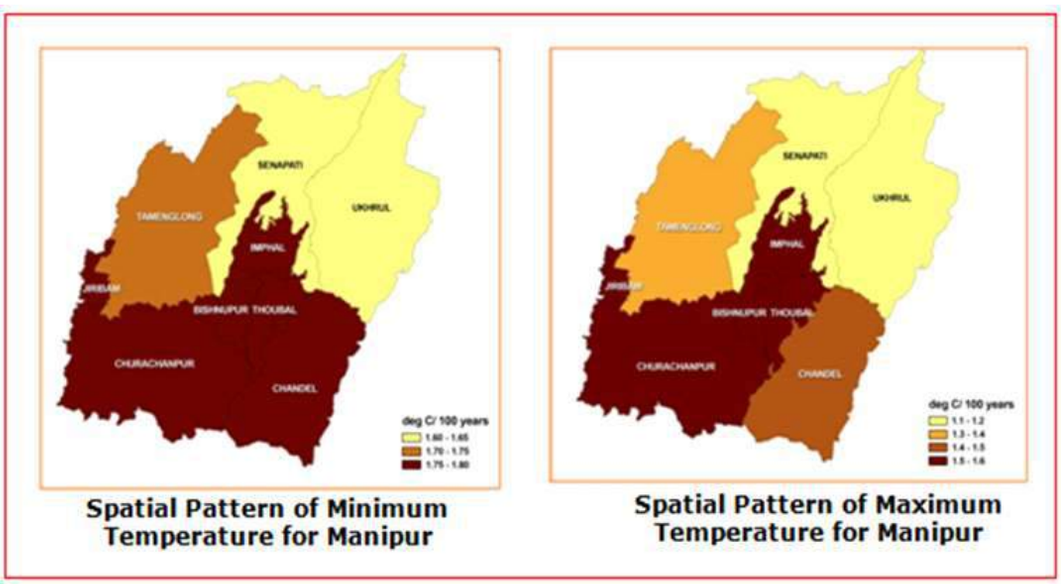


Figure 2.3: Spatial Pattern of Temperature Trends JJAS (0C per 100 year) over Manipur for the period 1901 – 2000 (Developed by INCCA)

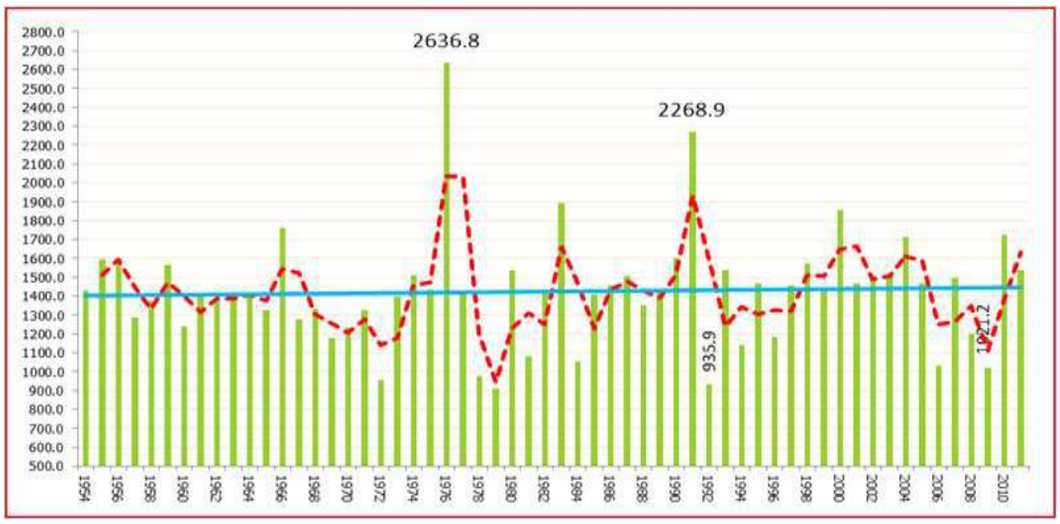


Figure 2.4: Annual precipitation at Imphal, Manipur

Figure 2.5: Average molnthly rainfall pattern over Manipur (1901- 2000)

Source: National Data Centre, Indian Meteorology Department (IMD), Pune.

quantum varies from 956.5 to 2269.9 mm over Manipur as displayed in Figure 2.4.

National Data Centre, IMD, Pune has also reported in a compiled "National Monthly mean Maximum and Minimum Temperature and Total Rainfall Dataset" that the average monthly total rainfall has varied from 12.2 mm (January) to 407.3 mm (July) as in Figure 2.5.

The decadal assessment of monthly rainfall reveals that the period of raining days in Manipur has extended from monsoon months i.e. June-October to pre-monsoon months like April and May. Few districts of central and southern Manipur experienced a marginal decrease in precipitation over Imphal (east & west), Bishnupur, Thoubal, Tamenglong, Jiribam, Chandelin the last 100 years whereas the northern districts of Manipur i.e. Senapati and Ukhrul has observed a considerable increase in precipitation as depicted in Figure 2.6.

2.2.4 Relative Humidity Variability Trends in Manipur:

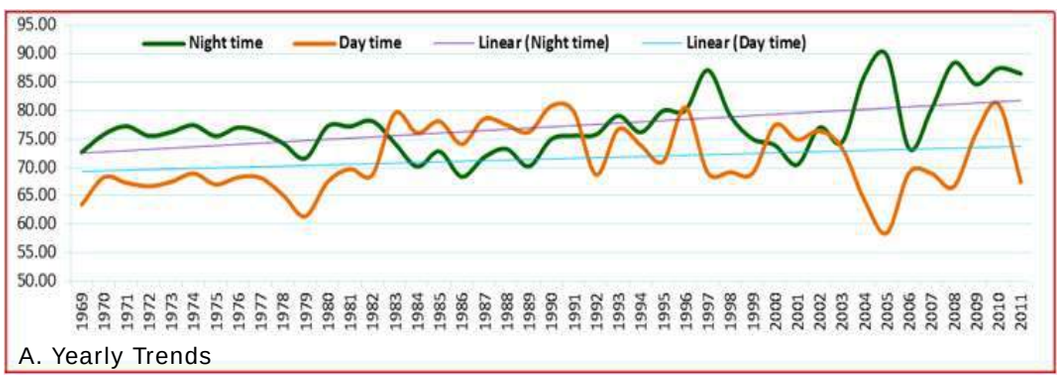
Average relative humidity (RH) in the state was 74.22% during 1969-2011. It is noticed

Figure2.6: District-wise precipitation trend (mm/day/100 years) of southwest monsoon season (June-September) for the last 100 years (1901-2000)

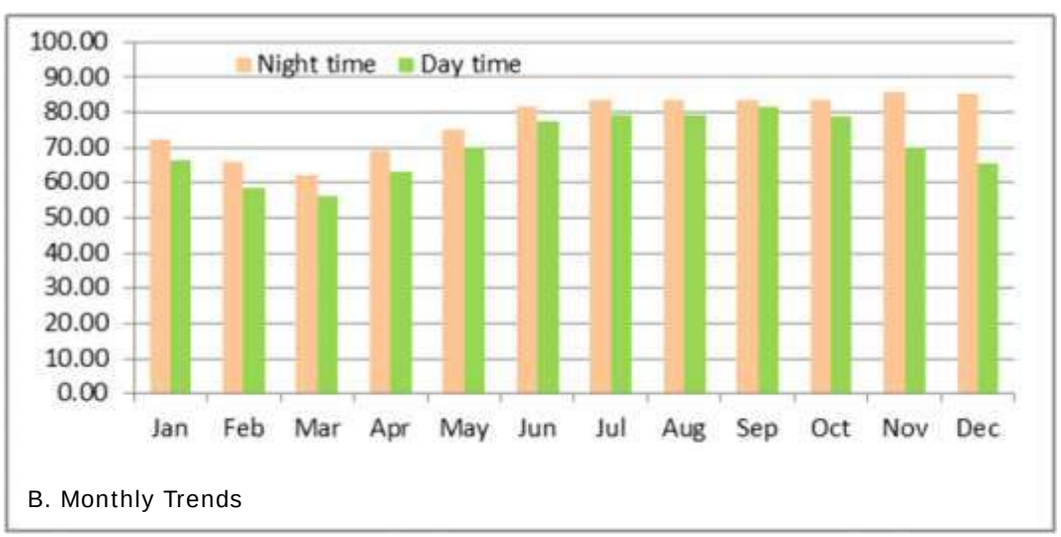
Source : Prof. Ravindranath, IIS, Banglore

that the RH is considerably increasing during night in Manipur as displayed in Figure 2.7.It has reached above 80% of RH-2 (night) especially during June to December (monsoon months) due to continuous rainfall. High RH during monsoon periods increases the incidents of people affected by vector borne diseases such as malaria, dengue etc. Optimum temperatures and high RH during monsoon periods are favorable conditions for mosquitoes, their life cycle and the development of the parasite in their body and are highly correlated with prevailing local climatic conditions.

Global climate change has emerged as an important environmental challenge due to



A. Yearly Trends



B. Monthly Trends

Figure 2.7: Observed Relative Humidity over Manipur during 1969-2011

its potential effects on the biological systems of planet Earth (Walther et al., 2002). The average surface temperature of the earth has increased during the twentieth century by about 0.6°C, and the warmest years in the previous century fell within the last decade. Eleven out of twelve years (1995-2006) rank among the warmest years in the instrumental record of global surface temperatures since 1850 (IPCC, 2007). Atmospheric CO_2 concentration has risen by more than 30% since pre-industrial times, from equilibrium level of about 280 ppm in 1880, to the current observed level of 390 ppm. This increase is the outcome of human activities, primarily fossil fuel burning, cement production and modified land-use patterns (IPCC, 2007). Current anthropogenic CO_2 emissions into the atmosphere are about 8 Gt of Carbon per year, with atmospheric levels increasing by almost 0.5% per year. If present emission pattern continue in the future, atmospheric CO_2 will be doubled by the end of the 21st century. Simulations with global climate models (GCMs) suggest that the projected increase in CO_2 will modify the global climate by increasing the surface air temperatures by altering precipitation patterns and the global hydrologic cycle and also by increasing the frequency of extreme weather events such asdrought spells and floods (IPCC, 1996). The following table 2.3 and 2.4 illustrates the current climate and the projected changes in future and its associated impacts on various vulnerable sectors.

Table 2.3 : Current Climate and Projected Changes

Climate Variables	Current Climate	Future Projected Climate
Precipitation	• Average annual rainfall varies from 935 to 2636 mm • Extreme precipitation events increasing in the last 10 years • Unpredictable monsoon onset • Frequent breaks in monsoon rainfall	• Rainfall is projected to increase by 20% • Extreme precipitation events are project to increase in frequency and intensity
Temperatures	• Average annual temperatures varied 12.2 to 15.8 °C • Extreme temperature events increasing in the last 10 years especially heat waves	• Projected an increase in temperature above 1.7^{0}C

Table 2.4 : Vulnerable Sectors and Provable Impacts

Sector	Impacts
Agriculture	• Crop yields are projected to decrease by 10% • High inter-annual variability in crop yields are projected due to increased frequency of extreme precipitation events • Incidence of pest and diseases will increase • Increased soil erosion with degradation of soil nutrients and exposing roots
Water Resources	• Increased river flow, with potential damage to river bunds • In a dry situation drying up of rivers • Increased evaporation, runoff and decreased soil moisture recharge • Water pollution, siltation and scarcity of fresh drinking water
Forestry	• Loss of bio-diversity • Invasive species • Extension of rare/threaten flora and fauna • Increased infestation of insects and pests • Increased frequency of forest fires
Health	• Increased vector borne diseases • Frequent illness from common cold and cough due to sudden varying weather • Favorable conditions for propagation of mosquitos and other vectors
Livelihood	• Decreased income from poor crop production • Lower employment rate • Food security and nutritional issues • Migration of population from rural areas to urban • Land use and change pattern
Energy	• Decreasing forest cover reduces the availability of fuel wood • Impact on power generation (hydro- power) due to vulnerability of water resources in changing climate • Increased prices of fuel wood leading to rapid degradation of forest cover
Ecosystem	• Upward movement of plant species with rise in surface temperatures • Decreased microbial population with increasing altitudes • Loss of vegetation poses potential threat for soil erosion

Part B

CLIMATE PROFILE

Chapter 3

CLIMATE CHANGE AND VULNERABILITY ASSESSMENT

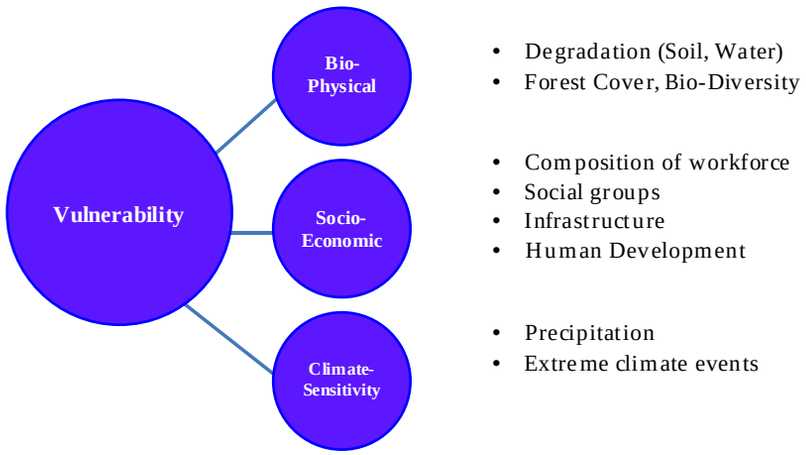
Chapter 3 : CLIMATE CHANGE AND VULNERABILITY ASSESSMENT

3.1 Introduction

Climate change and vulnerability assessment has been highlighted in some sectors under the State Action Plan on Climate Change in Manipur state. Sectors like agriculture & allied, health, water resources, ecosystem and biodiversity are reported to be highly vulnerable to human induced anthropogenic climate change. Anthropogenic climate change is primarily due to activities in different sectors like deforestation / degradation of forests, rapid burning of fossil fuels, waste disposal, etc. Economy of Manipur is closely associated with its natural-resource base and climate sensitive sectors such as agriculture, water resources and forestry. High dependency of the state on its natural resources faces potential threat from anthropogenic climate change. Crucial sectors such as agriculture, water resources, health, sanitation and forestry are likely to be affected by climate. Due to poor institutional mechanisms and lack of access to adequate resources, vulnerable population of the state is unable to cope up effectively with the adverse impacts of climate change.

Climate change is linked with multiple-sectors that are sensitive to climatic conditions, therefore the vulnerability and adaptive capacities are diverse and vary from state-to-state, several sectors and cross sectoral parameters. Sectoral parameters include key sectors of the state economy and

Box 3.1: Vulnerability assessment framework



cross sectoral factors include (a) poverty (b) inequality and social discrimination over property rights (c) access to resources (d) attrition / migration of workforce and (e) unequal and unsustainable completion for scarce natural resources.

Climate variability refers to variations from mean state of surface temperatures, precipitation, relative humidity etc. The spatial and temporal variability of climate and its associated impacts are studied in detail to develop adaptation / mitigation measures for the adverse impacts of climate change and variability on climate-sensitive sectors. Climate variability may be due to natural internal processes within the climate system (internal variability), or variations in solar hot spots and volcanic activity and external forcing (external variability).

In this section, we focus on the current mean climate and climate variability over Manipur at the district level and investigate how changes would alter Manipur's vulnerability to climate change. Precipitation and temperature are used as the key climate variables in this analysis. Climate sensitivity of the state comes from fragile-ecosystem of the region. The varied physiological features of the state and the altitudinal difference gives rise to varied types of climate ranging from near tropical to temperate and alpine.

3.2 Future climate change projections

For climate change projections over Manipur, simulated climate data from General Circulation Model HadCM3 from the Hadley Centre, UK (Collins *et al.*, 2001) has been used. Apart from that HadRM3 has been used recently for generating climate change projections for various parts of the Indian subcontinent (Kumar *et al.*, 2006).

In this report, data from the HadCM3 global climate model downscaled with HadRM3 (PRECIS) model and a regional climate model for downscaling global climate projections (Kumar *et al.*, 2006), has been used. The pathways for atmospheric greenhouse gases (e.g. CO2, CH4, N2O, CFCs) were prescribed from the SRES A1B

mid-term (2021-2050) projections. Climate change projections were made for the following:

1. For daily values of temperature (average)
2. For daily values of precipitation
3. At grid-spacing of 0.44250 latitude by 0.44250 longitude
4. For the periods of 2021-2050

Derivation of district-wise data: Data derived from the PRECIS model outputs (which had a grid spacing of 0.4425° latitude by 0.4425° longitude) was re-gridded to 0.2° in latitude and 0.2° in longitude. This ensures that enough grids fall inside each district. Then, the data is aggregated at the district-level.

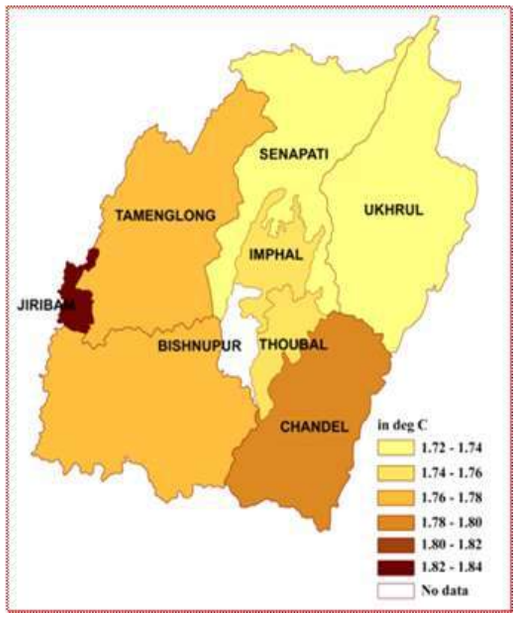


Figure 3.1: District-wise projected increase in surface annual temperature (°C) for the period 2021-2050 (A1B SRES scenario) compared with baseline scenario (1975).

Source: Prof. Ravindranath, IIS Banglore.

3.2.1 Projected change in surface temperatures

The projected increase in average temperature in the state by mid 2030's is developed during 2011 by Prof. Ravindranath, Indian Institute of Science (IIS), Bangalore, reproduced in figure 3.1

The study has reported:

- the state is projected to experience an increase in temperature above 1.7°C;
- the projected increase in annual average temperatures for the southern districts are higher than the northern districts;
- the western-most district and Imphal west is projected to experience the highest increase in temperature, 1.8°C and ° the northern part of the state is projected to have lower increase in average temperature compared to the southern part of the state.

3.2.2 Projected change in precipitation quantum and extremes

Figure 3.2 shows the projected change in total annual rainfall and for the southwest monsoon season i.e. June, July, August and September (JJAS). Similarly, Prof. Ravindranath, IIS Bangalore has worked out the changes in extreme precipitation events by 2030's in the state as

- the entire state of Manipur is projected to receive increased precipitation;
- the northern parts of the state are projected to experience an increase of ≥ 19% of rainfall. This roughly correlates with observed trends over the last 30

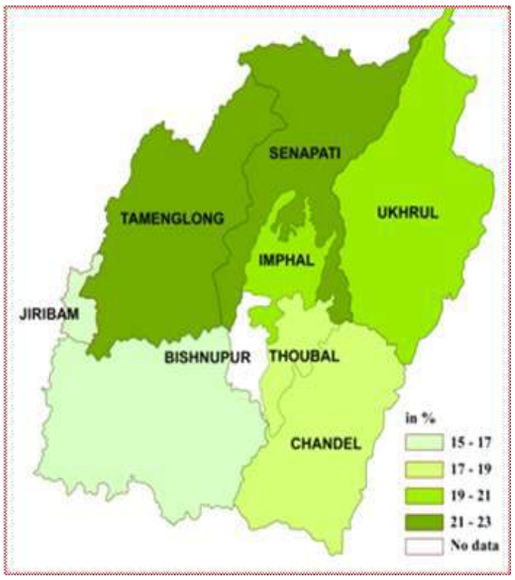


Figure3.2: District-wise projected increase in annual rainfall (%) and JJAS rainfall for the period 2021-2050 (A1B SRES scenario) compared to baseline (1975), (projected by Prof. Ravindranath, IIS, Bangalore, using the HadRM3 model)

Table 3.1: District-wise change in the number of days (in a year, on an average) when the rainfall exceeds 100 mm per day for Manipur

Sl. No.	District	Annual increase in extreme event days
1	Ukhrul, Senapati	2.0 and more**
2	Imphal East, Tamenglong, Thoubal, Chandel	1.0 – 2.0

**The value of "2.0 and more" against the district of Ukhrul and Senapati indicates that the number of heavy rainfall days per year is expected to increase by 2 or more days. A heavy rainfall day is defined as a day when the rainfall exceeds 100 mm.

years. The districts of Tamenglong and Senapati are projected to experience an increase in precipitation of ≥21%;

- The southern districts also experience an increase in precipitation of ≥15%

Further, an increase in the number of extreme rainfall (100 mm / day) conditions is projected for the state. The number of extreme rainfall events of 2 or more days was observed in Ukhrul and Senapati, the same districts which exhibited highest increase in absolute value of rainfall as well (Table 3.2). This means the danger of flood in this region is high and possible adaptation mechanisms should be examined.

3.3 Climate Change Impact on Agriculture and its allied sector of Manipur

Changes in rice yield can be attributed to the increase in temperature and CO_2 concentration coupled with the change in rainfall pattern for the region. Climate change could have positive as well as negative impacts on the rice yield in Manipur. The Indian Institute of Science (IIS), Bangalore, had studied the impacts of climate change on rice yield in Manipur by using INFOCROP (a crop growth simulation mod

- simulation using climate data averaged over the period 1975-2005 and fixed CO_2 concentration at 370 ppm; and
- simulation incorporating changes in precipitation and temperature for 2035 and with CO_2 concentration of 466 ppm.

3.4 Climate Change Impact on Health Sector in Manipur

Changing of climate and its impact may link to health directly and indirectly in many ways by propagation many diseases like increase in the number of vector borne and water borne diseases, (e.g. increase in incidence of Malaria and its related out-breaks), deterioration in nutritional health due to loss of food security and reducing cereal yields, etc. Climate change can further impact population which has a lower capacity to combat the impacts *and* their access to medical facilities.

Moreover, with projected increase in surface temperature, increase in frequency and intensity of extreme events such as increase in night temperatures, increase in number of warm days, extreme heat and heavy precipitation etc. in the future due to anthropogenic causes, human health impacts are likely to escalate with respect to their virulence and spread to hitherto disease-free areas.

3.5 Climate Change Impact on Water Resources in Manipur

The impacts of climate change on water resources have been highlighted in the IPCC's Fourth assessment report on climate change indicating an intensification of the global hydrological cycle affecting both the ground water and surface water supply. The effects of climate change on water resources in India include increased drought, river system closure, reduced flows in Himalayan river systems, extreme floods, reduced river yields and reduced ecosystem resilience. Different catchment areas are likely to respond differently to climate drivers, depending largely on catchment physio-geographical and hydro geological characteristics. The IPCC has also predicted with high confidence that the drought affected areas will increase in frequency as well as the severity of drought.

The trend in precipitation in the NER exhibits considerable spatial variability with respect to the predictions for the year 2030. According to the INCCA (November 2010) report on "Climate Change and India: a 4x4 assessment, a sectoral & regional analysis for 2030s", some part of Manipur shows an increase in evapotranspiration during 2030s . An increase in water yield is seen in Manipur with a magnitude up to about 40%.

3.6 Climate Change Impact on Forests& its ecosystem and Biodiversity

The current climate vulnerability profile for North Eastern Region of India has been developed by an assessment of the impact of projected climate change made by INCC under the sponsorship of MoeF on forest ecosystems, namely "*Climate Change and India : A 4x4 Assessment, A Sectoral and Regional Analysis for 2030*" by using different study models like

- *Climate change scenario* : A1B scenario
- *Climate impact model :* global dynamic vegetation model IBIS
- *Period of assessment*: short-term (2021-2050) and long-term (2071-2100) periods.
- *Input data:* monthly mean cloudiness (%),

monthly mean precipitation rate (mm/day), monthly mean relative humidity (%), monthly minimum, maximum and mean temperature (C) and wind speed (m/s), soil parameter (percentage of sand, silt and clay) and topography.

The dynamic global vegetation model has been validated by the report for its suitability to Indian conditions. The impacts are assessed at regional climate grid scales (about 50 km x 50km). In Manipur, no change in the forest types is projected for the short term period of 2030s. Thus the forest types in Manipur are not projected to be impacted by climate change in the short term.

Even though the forest types of Manipur are unlikely to be impacted by climate change under A1B scenario by 2030s, the forest could be vulnerable due to other factors such as forest fragmentation, forest degradation and forest conversion. The INCCA report (Climate Change and India A4×4 Assessment) has also concluded that the future climate may not be optimal for the current vegetation, for that grid. Hence, that forest grid was marked as vulnerable to climate change. Forest vulnerability index was developed considering the following indicators with equal weight:

- *Disturbance index:* An indication of the human disturbance for a particular forest patch. , For example more the disturbance index, higher the forest vulnerability.
- *Fragmentation status:* An indication of how the forest patch is fragmented for the forest vulnerability status. For example more the fragmentation status, higher the forest vulnerability.
- *Biological richness:* An indication to know the species diversity of the forest patch, a measure of the number of species of flora and fauna, per unit area. For example, h*igher* the biological richness, *lower* the forest vulnerability.

The value of each of the indicators was reduced to a scale of 1.0 (very low vulnerability) to 5.0 (very high vulnerability). A Composite Forest Vulnerability Index (CFVI), developed by the INCC (Source: Report on Climate Change India : 4x4 Assessment) for the two scenarios viz.: current CFVI and future CFVI, found that the forests of some districts of Manipur namely *Bishnupur, Churachandpur, Senapati, Imphal East, Tamenglong* and *Chandel* have high CFVI (have high overall vulnerability).

3.7 Socio-Economic Vulnerability based on source of livelihood

The state is agrarian economy with major section of population depending upon agriculture as the source of livelihood. So the impact of climate change over agricultural productivity might impose more burdens over the sector. The state is also home to more than 33 tribal groups who have a bio-mass and natural resource intensive life style and are more vulnerable to climate change. The tribals largely depend on the forest cover which is depleting over time. One of the major factors affecting forest cover is the growth of human population throughout the state and the forests are the best place to accommodate the growing pressure of additional people. Other significant drivers of the change include clearance of forests for

agriculture, tea cultivation, slash and burn mode of cultivation with ever reducing 'jhum' cycle, alteration of prime natural habitat for developmental and industrial activities (Oil and Gas, Coal mining), forest fire and other biotic interferences have led to the rapid loss of forest cover.

Increasing population and decreasing land productivity, relatively higher dependence on natural resources (e.g. forests) are also major constraints for Manipur's environmental sustainability. A high degree of vulnerability to the water and climate induced disasters will increasingly make it environmentally insecure in the future unless pragmatic interventions are made. A set of holistic policy and programmes that integrate development goals with disaster risk management for the region as a whole is the need of the hour.

The vision document 2020 prepared by DONER for North Eastern Region identifies five basic deficits for the region (a) basic needs deficit (b) infrastructure deficit (c) resource deficit (d) governance deficit (e) two-way deficit of understanding with the rest of the country. Manipur is also facing rapid urbanization its urban population is about 0.8 million in 2011 as compared to 0.5 million in 2001 and decadal growth of 43%. Urbanization is known to have negative impact on local climate and enhances unsustainable resource demand and congestion as well as pollution.

Lack of connectivity has made the population very much vulnerable and reduced their preparedness against disaster. The traditional land routes and inland waterways are lying defunct due to lack of public investment. High transportation cost has discouraged private investment in the state making it more resource starved and under developed.

Part C

CLIMATE CHANGE STRATEGIES AND ACTION PLAN OF MANIPUR

Chapter 4

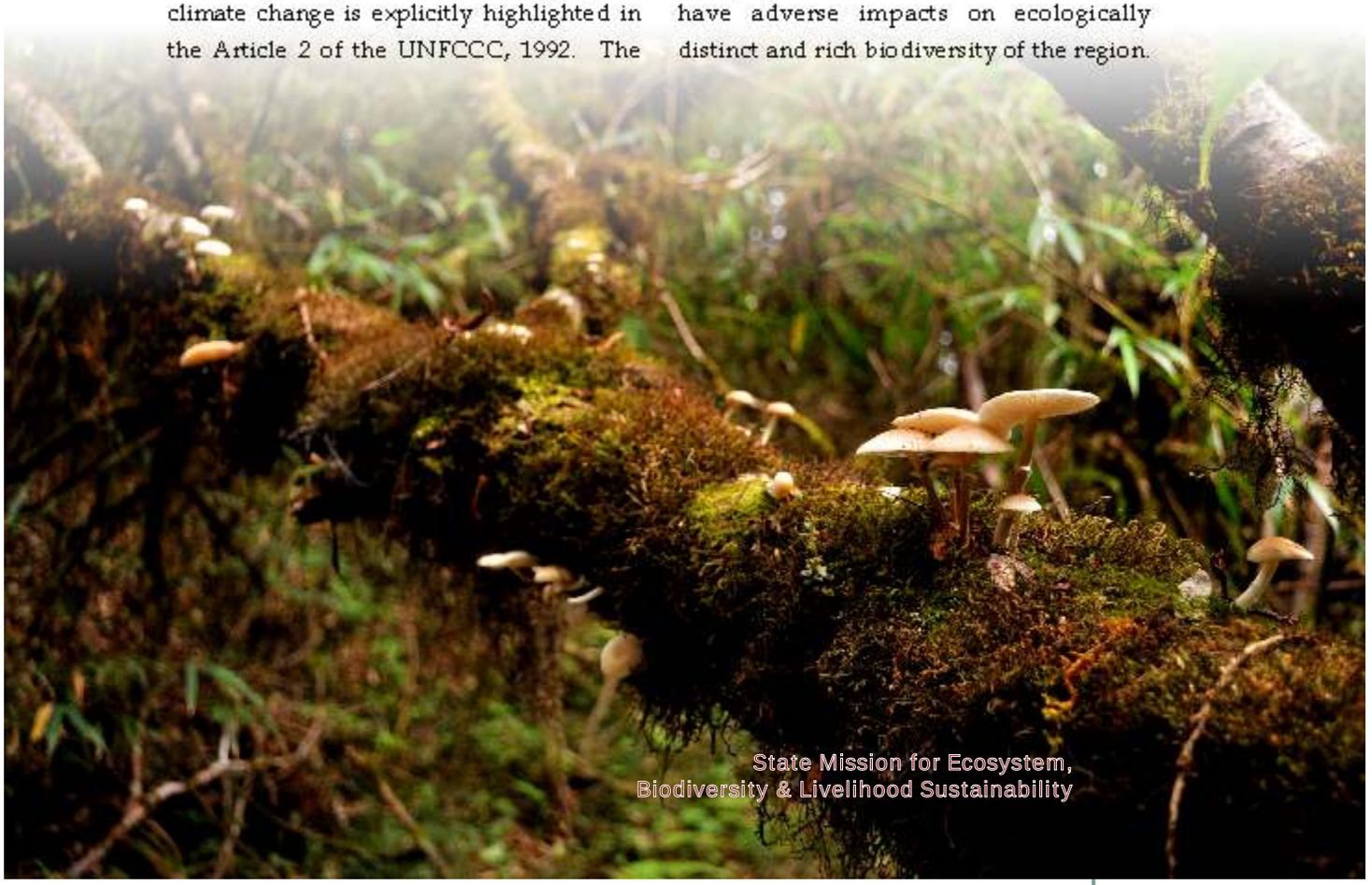
STATE MISSION FOR ECOSYSTEM, BIODIVERSITY & LIVELIHOOD SUSTAINABILITY

Chapter 4 : STATE MISSION FOR ECOSYSTEM, BIODIVERSITY & LIVELIHOOD SUSTAINABILITY

4.1. Introduction

Eco-systems have an inherent capacity to adapt and adjust to the climatic variabilities as well as to incremental changes in the landscape to a certain extent. When this capacity is exceeded, the eco-system parameters get altered in multifarious ways and become socially and environmentally unsustainable. Ecosystems are well recognized life support systems which are critical factors for human wellbeing. Hence, the importance of the conservation of ecosystem which is veritably subjected to anthropogenic climate change is explicitly highlighted in the Article 2 of the UNFCCC, 1992. The impacts on the ecosystems could lead to loss and migration of rare and endangered species and fragmentation of habitats. Though many of these are medium term impacts but they pose serious consequences especially in species extinction whether globally or locally.

Manipur comes under two of the global bio-diversity "hotspots" viz. Himalayan Biodiversity Hotspot and Indo-Burma Biodiversity Hotspot characterized by eco-systems which are rich in bio-diversity and possess rare and/or endangered species. The projected climatic variabilities could have adverse impacts on ecologically distinct and rich biodiversity of the region.



Therefore it is crucial, to be cautious about the causal links between biodiversity and ecosystem functioning in the maintenance of ecosystem services. Thus adaptation responses have to be crafted in such a manner that the endangered species are preserved and adverse impacts are minimized as species extinctions whether global or local due to climate change (natural or anthropogenic) bring about irreversible change. Moreover since both the Brahmaputra and Chindwin river systems drain Manipur, the aquatic fauna of the state embodies both Assamese and Burmese elements. Many fish species which were hitherto not recorded elsewhere in India are found only in Manipur. The Manipur River Basin is reported to be under the greatest threat - specifically for the freshwater fish. Out of the fifteen endangered fish species of Eastern Himalayas, eight fish species are reported from Manipur.

The conservation of ecosystem is vital to the ecological security of the state landscape in terms of restoring forest cover, maintaining the sources of perennial water required for drinking and irrigation purposes and sustaining agriculture which in turn is linked to the livelihood of the people. The sustainable management of ecosystem, biodiversity and livelihood requirements must go hand in hand with climate friendly practices and adaptations to the dynamic situation that may arise during execution of the programme.

4.2. Impact of Climate Change

The climate change has impacted the resilience of the eco-systems and can bring about irreversible changes to many of the parameters which are potentially harmful to the livelihoods of people. It is essential to understand the economic profile of the state, in order to assess the impact of the climate change on ecosystem and therefore on the livelihood issues. There has been a transformation in the composition of the State Domestic Product. During the last decades, there is a decrease in contribution of primary and tertiary sectors to the state GDP which is taken over by the secondary sector viz. Agriculture, Fishery and allied sectors. Manipur's population stands at 2,721,756 (2011 provisional Census) which continues to be predominantly rural, with rural population being 73.82 % of the total. Considering the large percentage people living in rural areas, livelihood of people in Manipur is heavily dependent on Agriculture, Fishery and Natural Resources including Forest and Wetland Ecosystems of the state.

Moreover an increase in the level of carbon dioxide in the atmosphere and consequent global warming may also have a profound effect on the flowering and reproduction time of plants. The impacts of climate change is likely to affect the natural ecosystem of the state in different ways, viz; reduced yield from agriculture and its allied sectors, lower production of natural resources, forest regeneration etc. which in-turn will have a negative impact on the livelihood of the people. However, due to increase in night temperature and high rainfall variability, there is a probability for reduction of yield of certain crops like rice, potato, etc. Side by side, Horticulture sector may also be affected by the extreme weather events including frost and heat stress. The Livestock and Animal Husbandry sector

will suffer from heat distress and drought like situation. Fishery & aquaculture will be impacted by changes of water level and flooding events. All the above, singularly as well as combinedly will lead to over exploitation of surrounding natural ecosystem of forests and the wetlands which are getting degraded due to anthropogenic pressures. The climate change impact in totality will put on risk the livelihood balance of the entire rural economy.

INCCA (Climate Change and India A 4×4 assessment) report has already predicted that under the climate projection for the year 2085, 77% and 68% of the forested grids and its ecosystem in India are likely to experience shift in forest types under A2 and B2 scenario, respectively. Although, there is no immediate threat to forests of Manipur from climate change point of view, one has to continuously monitor the species diversity by maintaining of its ecosystem in the state and not to allow extinction of keystone & flagship species. This task is more challenging than that of routine afforestation and reforestation.

4.3. Policy Review

The National Forest Policy, 1988 accords highest priority to the environmental role of forests and its conservation. The Policy emphasizes upon ecological balance including atmospheric equilibrium, which are vital for the sustenance of all life forms - human, animal and plant. In the hill and mountainous regions of Manipur, the aim should be to maintain two third of the area under forest cover in order to prevent erosion and land degradation and to ensure the stability of the fragile eco-system and in the valley, the emphasis should be on green and clean environment considering the population influx and demographic profile. Moreover, the Environment Directorate of Manipur is mandated to enforce the Environment (Protection) Act, 1986 and rules there under in the state. This Department has also been successfully enforcing / implementing the various Acts & Rules laid down by the Ministry of Environment & Forests, Government of India. Further, the Directorate is mandated to have a State Environment Policy & Action Plan document in the line of National Environment Policy 2006 and NAPCC. Further, the Manipur State Bio-diversity Board which is already constituted in the state has drafted the Biodiversity Policy aimed at restoration of biodiversity in the state. The state has also constituted the Manipur Medicinal Plant Board for promotion and conservation the state's medicinal plants biodiversity. The Manipur State Pollution Control Board regulates the Manipur Water (Prevention and Control of Pollution) Rules 1991 in the state. It serves to help maintaining and preservation of the state's water resources.

4.4. Key Strategies

While designing and implementing strategies and action plans for achieving the goals of the state mission for Ecosystem, Biodiversity & Livelihood Sustainability, some of the cardinal principles are being followed in tune with two national missions under NAPCC, viz. Green India Mission and Mission on Himalayan Ecosystem as follows:

- Enhancing ecological sustainability by investigating causes and consequences of disturbance regimes, promoting

conservation of native and endemic elements, and understanding river system dynamics.

- Protection of vulnerable sections of society through inclusion of participatory resource management strategies and development of livelihood options.
- There has to be heavy emphasis on green skill development, at all levels, across various sectors to enable communities become sufficiently empowered with technical know-how and mountain specific required skills, necessary for adaptation to climate change.
- Deploying technologies for hazard mitigation & disaster management, development of ideal human habitats, agriculture and forest sector innovations.
- Promoting community based management through developing mechanisms & institutionalization incentives for protection and enhancement of forested lands and conserving species diversity.

Appropriate land-use planning, sustaining traditional knowledge / practices, sustainable management of natural resources and skill development:

Assimilation of the traditional ecological knowledge of shifting cultivation into research, development and extension processes are to be developed. Further, recognition of the traditional institutions and intellectual capital generated from traditional practices relating to shifting cultivation and its protection in the legal and policy regime needs to be considered as motivational strategy. Land use classification both in hills, foothills and valley areas has to be adequately addressed.

Emphasis need to be given to develop the institutional mechanisms towards sustainable management of natural resources and capacity building of the line department as well a civil societies. Sensitization and skill development of the community leaders is needed so that they can effectively collaborate in joint initiatives and extend support. Both autonomous community efforts (preservation of sacred groves, etc.) and assisted ones by JFM and autonomous district councils and other traditional bodies need to be encouraged.

Promote sustainable livelihood through promotion of eco-tourism and non-timber forest products [NTFPs].

There is an urgent need to develop enterprise-based livelihoods and raising of living standards of the communities through better management of NTFPs including Medicinal and Aromatic Plants and other cash crops. Ecotourism and agro-forestry based development models and biodiversity linked enterprise development initiatives need up-scaling.

Promotion of traditional knowledge:

To address the gaps in available information on Traditional Knowledge (TK) and climate change adaptation and mitigation, and to promote respect for TK and the role of indigenous peoples in policy development it is essential to undertake consultation programme through community level participation to ensure that the experience of indigenous and traditional peoples of climate change impacts and their adaptation

and mitigation strategies are fully integrated in the state action plan for climate change.

Development of market strategies to improve the livelihood and increase climate change adaptive capacity

Movement of goods and services within the state in an orderly fashion reduces over exploitation and under utilization of any specific eco-system. This needs to be supported with regulated-marketing systems and infrastructure for people and further to support the communities in interior areas of Manipur with proper and environment friendly communication and transportation systems.

Restoration of Ecosystem Structure and Functions:

It is essential to recognize the biodiversity values and ecosystem services rendered by the State and incorporate them appropriately into 'the national accounting' systems, thus encouraging the local people to conserve the natural forests and other ecosystems. This may include, for example, providing cooking gas at a subsidized rate to the people living in the mountains, or governmental support to generate sufficient hydroelectricity in the hills to meet the people's energy need for cooking and heating.

Table 4.1: Key priorities for State Mission for Ecosystem Biodiversity & Livelihood Sustainability

S. No.	Sector Thematic Area	Strategies	Status	Type	Nature	Priority	Actors / Agencies	Proposed Budget Estimate 12th FYP (2012-17) Rs. in Cr	Available under Budget Estimate (2012-13) Rs. in Cr	Proposed budget Estimate during 2013-14 Rs. In Cr
1	Appropriate land-use planning, sustaining indigenous traditional practices (hill & valley) for sustainable habitate and sustaining hill ecosystem	Appropriate policy / planning for mountain farming, usewise practice at mountain, conservation & protection of mountain ecosystem including integrated farming, conservation of native varieties, market institutionalization, paddy-cum-pisciculture, medicinal plants, farm production, etc.	Proposed	MI	PA	High	Forest, Agriculture, Horticulture, Fishery, Environment	12.50	0.00	2.50
2	Promotion of Indigenous Traditional Knowledge (ITK)	Natural resources Management (Forests, Land and Water), Promote traditional knowledge with micro-finance, skill development, human resource development, etc.	Proposed	MI, AD	PA, CB	High	Agriculture, Horticulture, Planning	27.50	0.00	4.50
3	Promote sustainable livelihood through promotion of eco-tourism and non-timber forest products [NTFPs]	Creation / setting up of eco-model village (Climate Change adaptive model) and Mini Eco-model parks at Shirui, Kangkhui, Dailong, Khunjao, Dzuko, Liyai, Tungjoi & Thangal (Senapati)	Proposed	AD	IP	High	Environment	40.00	0.00	8.00
4	Development of market strategies for vegetations to improve the livelihood and increase climate change adaptive capacity.	Establishment of district level food park, cold storage & food processing units, Marketing policy for local floral varieties like medicinal plants, orchids, etc.	Proposed	AD	IP	High	Commerce & Industries, Planning	13.50	0.00	2.70
	Total budget							93.50	0.00	17.70

Note :
Type : MI-Mitigation; AD – Adaptation;
Nature : PA – Policy Action, RD – Research & Development, DP – Demonstration Project, IP- Investment Project, CB – Capacity Building
Priority : H – High, M – Medium, L – Low

Table 4.2: Comprehensive List of Actions for Ecosystem Biodiversity & Livelihood Sustainability Sector

S. No.	Activities	Criteria for prioritization	Priority	Type	Scale	Nature	Time Frame
1	Appropriate land-use planning & best traditional practices (hill & valley)	Easy to Implement but Time taking process	M	AD / MI	S	IP	LT
2	Appropriate policies on mountain farming especially integrated pest management, mixed farming, conservation of native crop varieties and promotion of cooperative institutions for organic products, certification etc. will be evolved.	Easy to Implement but Time taking process	M	AD	S	CB	LT
3	Farmers need better functioning markets for both outputs and inputs. Also, better rural infrastructure, including storage and food processing.	Implementation not Easy but Time taking process	M	MI	S	CB	LT
4	• Forest revival through empowering women: • Controlled collection of forest products including economically important wild plants. • Use of forest produce for value addition, like use of pine needles for making of bio-briquettes. • Promote initiatives of value addition in traditional technology/knowledge such as handicraft, fermented food/beverages, apiculture and cattle breeding to upgrade the income of local inhabitants.	Easy to Implement but Time taking process	M	AD	S	CB	LT
5	Conservation of sacred groves/landscapes.	Easy to Implement	M	AD	S	IP	LT

Note :
Type : MI-Mitigation; AD – Adaptation;
Nature : PA – Policy Action, RD – Research & Development, DP – Demonstration Project, IP- Investment Project, CB – Capacity Building
Priority : H – High, M – Medium, L – Low
Scale : S – State, D – District, B – Block
Time Frame : LT – Long Term, MT – Mid Term, ST – Short Term

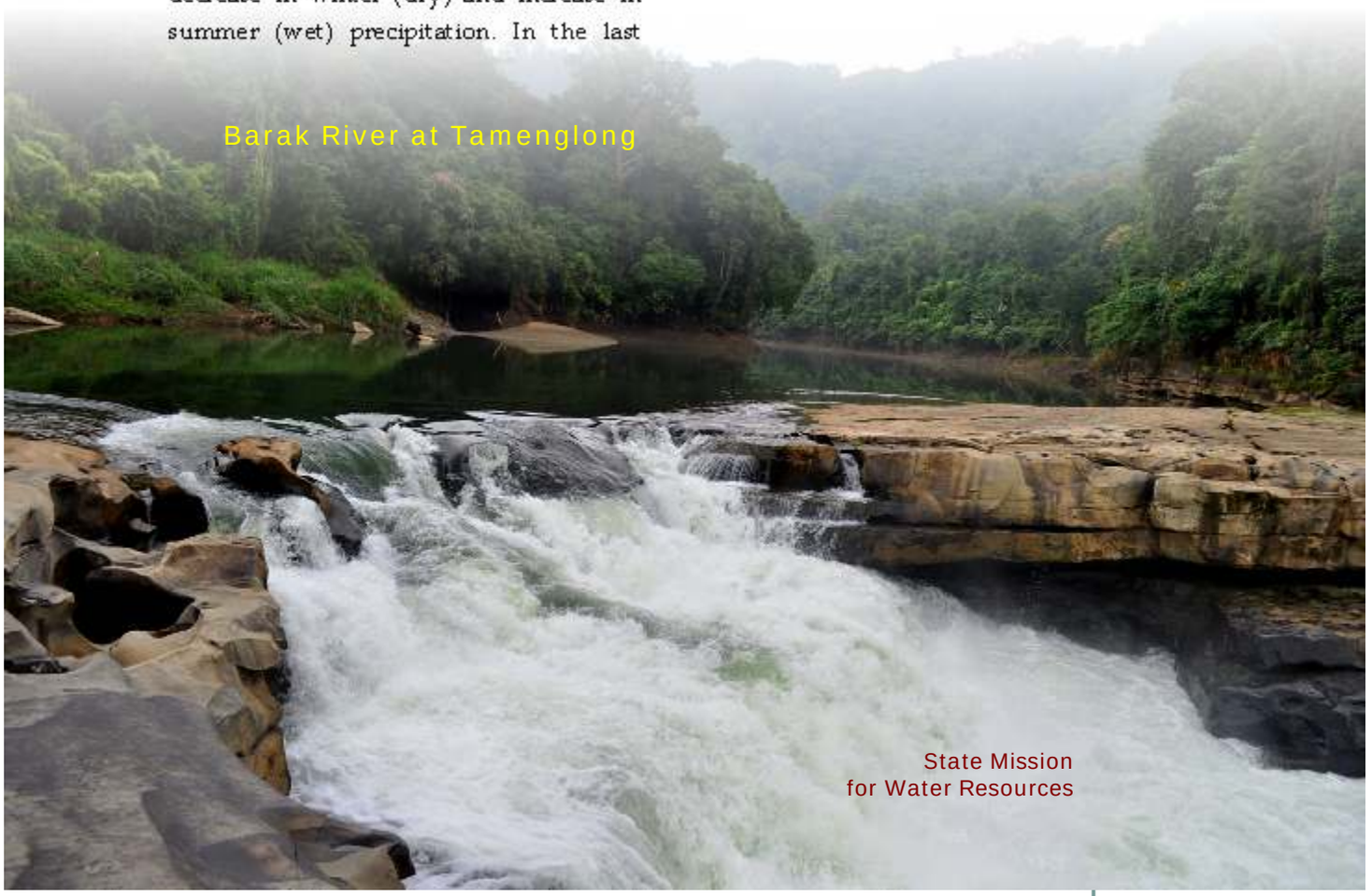
Chapter 5

STATE MISSION FOR WATER RESOURCES

Chapter 5 : STATE MISSION FOR WATER RESOURCES

5.1 Introduction

The impact of climate change and global warming on hydrological cycles are well documented. It is associated with increasing atmospheric water vapour content, changing precipitation patterns, extreme weather events etc. The state has also witnessed substantial spatial and inter-decadal variability of rainfall pattern. The recorded average rainfall in the last 5 decades (1961-2010) was 1435 mm. Climate data of the recent past along with the modeling results for the future predict decrease in winter (dry) and increase in summer (wet) precipitation. In the last decade, the state has seen increased in extreme precipitation events. Growing human habitation and the consequent human pressure has altered the state's hydrological system. Although rivers, streams, wetlands and lakes cut across the state there is a need for appropriate water management measures, in order to mitigate adverse impacts on climate change on agriculture and water security for the people. Therefore, it is essential that Manipur formulates a coherent adaptation strategy that can protect its citizens from these climate risks.



Barak River at Tamenglong

5.2 Climate Change Impact on Water Resources:

According to India's first climate change science assessment report from INCC (Source: 4x4 Climate Change Assessment report 2010, INCCA), Manipur is vulnerable to the water-induced disasters because of its location in the eastern Himalayan periphery, fragile geo-environmental setting and economic under-development. Most of the surface water resources in the state are currently witnessing threats from heavy siltation rate, uncontrolled quarrying activities in the catchment areas, increasing pH at wetlands, etc. which are leading to water quality deterioration.

The trend in precipitation in the north eastern region including Manipur and the projected patterns of precipitation and evaporation predict considerable spatial variability in water yield in the 2030s. The state is in one of the rain fed regions of the country and receives appreciable amount of unevenly distributed precipitation throughout the year with peak rainfall during monsoon period. However, because of the hilly topography, water does not get to recharge over a long period of time.

The valley areas witnessed frequent floods recently even after short spell of storm due to various reasons like: manmade ecological changes in the catchment areas, the high intensity rainfall during the rainy season in the hilly areas i.e., the upper catchments of the rivers and heavy runoff and low infiltration in degraded watersheds in the upper reaches of the rivers resulting in flash floods. As a result, the available agricultural lands and habitats are damaged by such floods. Flash floods are frequent also within the urban settlement areas during rainy season. The damages due to flood comprise of breach of bunds, overflowing, landslides, erosion and depression of river banks at the vulnerable areas. Heavy siltation occurs during the monsoon season in the rivers and streams. Several perennial streams and natural springs have disappeared gradually due to siltation.

Drinking water supplied through Public Health Engineering Department is not adequate to meet the increasing demands of the people. Acute shortage of safe drinking water has been a prominent problem being faced by the people during the past few decades. Such situation may worsen in the context of already induced climate change scenario.

Pollution of water sources poses risks for health and ecosystem. All these issues mark the need of a mitigation policy that incorporates 'polluter- pays' type principle and implement strict strategies with the same.

5.3 Current Policy Review

There is abundance of water resources in the state. If used properly, this can help in mitigating many other problems accentuated due to climate change. The full hydrological potential is yet to be realized

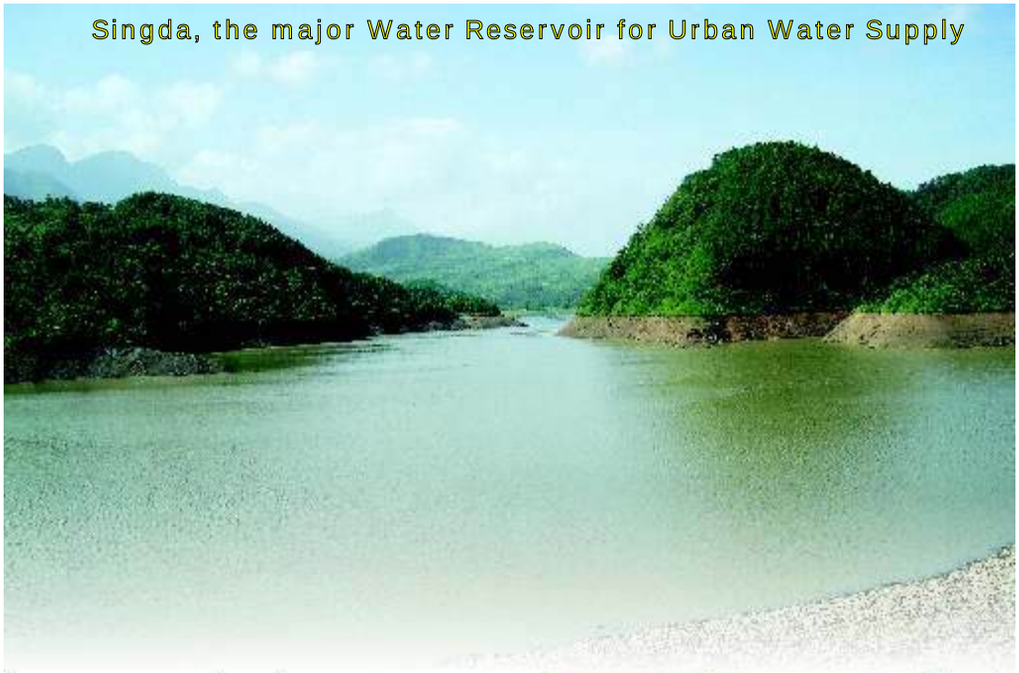
for sufficient and safe drinking water supply, generation of hydro-power, irrigation facilities, fishery, eco-tourism etc. Since Manipur receives huge amount of rainfall, there is immense scope for rain water harvesting and ground water recharging.

The state has taken initiatives for effective implementation of the existing irrigation projects which has constantly followed up during the subsequent financial plan. Many of such schemes have been summarized as follows:

The major and medium irrigation projects have covered 67,546 ha of cultivated area out of the total of 2, 30,000 ha by the end of the 8th. Plan period. 28,150 ha. (29.38%) was under the major and medium irrigation projects whereas minor irrigation projects cover 39,396 ha. At present, three major & medium irrigation projects having large irrigation potential are under construction. Subsequently the state has taken into consideration these projects & has included in the 12th Five years period Plan as: i) Completion of the ongoing projects viz, potential of 43,640 ha. over the existing irrigation potential of 6,550 ha. The DPR for the ERM of the above projects have been submitted to Central Water Commission (CWC) and scrutiny is in progress for onward submission for the approval of TAC. After the TAC approval proposal for funding under AIBP will be put up. iii) To start two New Projects viz Chakpi Multipurpose Project and Jiri Irrigation Project to create irrigation potential of 22,150ha, water supply of 4.20MGD and power of 12.50MW are under pipeline. Khuga Multipurpose Project, Thoubal Multipurpose Project and Dolaithabi Barrage Project are under progress. The projects would create an additional irrigation potential of 26,085 ha., additional utilisation of 26.085 ha, power potential of 9.75 MW and water supply potential of 15 MGD in the state. ii) Extension, renovation and modernization(ERM) of the some completed projects likes LLLI Project, Singda Dam Project, Khoupum Dam Project, Imphal Barrage Project &Sekmai Barrage Project with revised irrigation purpose.

Imphal River, the main source for drinking water in Imphal

Command Area Development Agency (CADA) of Manipur operates the Centrally Sponsored Command Area Development and Water Management Programme (CADWMP). The programmes focusses on scientific irrigation management, on farm development, formation of water user association and management of command area and recaharge of underground water about 70 per cent irrigation efficiency has been achieved through this programme. Unless the ongoing projects are completed, the desired level of irrigation facilities required for the desired agricultural output cannot be provided. Hence, the priority of


Singda, the major Water Reservoir for Urban Water Supply

the state is to complete the ongoing projects, which will minimize the time and cost overrun and also help to terminate the economic stagnancy.

Eight medium and multipurpose river valley projects are under progress at present. On completion of the ongoing projects with improvement of the completed projects the estimated annual irrigation would cover 99,590.00 ha. This will sufficiently improve the water availability in the state as well as improve the hydel generation making North Eastern Grid more sustainable (low fossil fuel dependent).

Flood control projects/schemes cleared by the Planning Commission, State Technical Advisory Committee (T.A.C.), Ministry of Water Resources (MOWR), North Eastern Council (NEC) were taken up during Ninth and Tenth plans. However, some of them could not be completed due to shortage of funds during those five year plans. Those

Water Supply at Singhat, Churachandpur District

schemes have been continued in Eleventh Plan. Some of the schemes have now been continued further and proposed for completion during XIIth Five Year Plan period under joint funding pattern of central and the state. These schemes will reduce risk to agriculture and allied sector as well as human lives during flood.

Wetlands act as a natural carbon sink and air-cooler. For better wetland management, Government of Manipur has employed a comprehensive structure for conservation &

management of the wetlands including the major water bodies in the state. In Manipur state, 167 wetlands (≥ 2.25 Ha) and 541 wetlands (<2.25 Ha) covering 63,616 ha i.e. 2.85% of total geographic area under different types of wetlands like lake / pond (61.5%), river / stream (26.2%), waterlogged area (5.5%) and aquaculture pond has been reported by the National Wetland Atlas, 2010. Out of that, 19 major wetlands covering 317.6Sq Km of area has been identified and started conservation works at some wetlands by the Directorate of Environment, Government of Manipur as State Nodal Agency for its conservation and management action plan in the state.

The lakes spread across the state have lately suffered from heavy siltation. The Government of Manipur thus has constituted Loktak Development Authority (LDA) in 1986 as a nodal agency for conservation and management of the Loktak lake. The focus of the Authority was initially on de-siltation and ensuring availability of water for hydropower and irrigation from the Loktak Lake. With the financial support through Finance Commission and Ministry of Environment and Forests (MoEF), LDA also undertook afforestation in critical micro-watersheds, horticulture plantation, small scale engineering measure for erosion control, limited desiltation and dredging of channels, removal of *phoomdis* from selected pockets of lake. A project on Sustainable Development and Water Resources Management of Loktak Lake (SDWRML) was initiated in 1997 with the main objective of developing and implementing technical know-how for conservation and management of Loktak Lake involving local communities, NGOs, research organizations and government agencies. Further, the Loktak Development Authority (LDA) is concerned with management and conservation of the ecosystem and biodiversity of Loktak Lake (a Ramsar site) under the provisions of the Manipur Loktak lake (Protection) Act, 2006 and the Loktak lake (Protection) Rules, 2008. With the financial assistance under SPA, implementation of the Short Term Action Plan (STAP) for conservation and management of Loktak Lake integrating Manipur River Basin was initiated in March 2009, following a review and reprioritization of project activities of the Management Action Plan (which strted in 2007-08 with a budgetary allocation of Rs. 50 crores) at the instance of the Planning Commission.

For Integrated Watershed Development Project, IWMP Projects are implemented in the state on funding pattern 90: 10 between Centre and State. Duration of the project will be 4 to 7 years , depending upon the nature of activities. Under Pre-IWMP, 43 projects were sanctioned and 27 projects have been completed. Watershed programs provide much needed drought proofing for the water deficit areas of the state.

The table below summarises the key issues relating to the water sector due to climate change impacts and possible adaptation options (Table 5.1).

Table 5.1 : Adaptation Option for Water Resource sector.

Issues	Climate Change Impact	Adaptation Options
Inadequate Water quantity	• Average mean annual rainfall is projected by INCCA to vary from a minimum of 940±149 mm to a maximum of 1330±174.5mm, with increase from 0.3% to 3% by 2030s with respect to the 1970s. • As intensity of rainy days increases in a more warming scenario, number of rainy days is likely to decrease by 1–10 days in Manipur. The intensity of rainfall in the region is likely to increase by 1-6 mm/day. • Entire state of Manipur is projected to receive increased precipitation. • Northern parts of the State are projected to experi-ence an increase of ≥19% rainfall to the last 30 years.	• Augmentation of water resources in rainy seasons by developing ponds and reservoirs, • Watershed management, water harvesting [including rainwater] • Protection and augmentation of floating vegetative mass (phumdi) for conservation of lacustrine ecosystem and dependent species and humans, • Updation of infrastructure [storage & distribution system] & expanding hydrometry network: • Dredging of rivers
Inadequate Water quality	• Water-logging, uneven hydrology and vector born diseases and pest incidence	• Plantation on river banks to create a buffer zone wherever feasible and Maintenance of riparian buffer strip / corridor to improve stream health wherever feasible. • Survey and mapping of groundwater resources including arsenic affected areas • Monitoring of water quality especially in arsenic prone areas • Recharge of groundwater through rainwater harvesting to address arsenic contamination and control of pollutants of groundwater resources
Flood	• The available agricultural lands and habitats are damaged by such floods. Flash floods are quite frequent within the urban settlement areas during rainy season due to poor drainage conditions.	Structural adaptation measures: • Strengthen & build embankments, channel improvement, canals and retention ponds to control flood, protect river bank, erosion control, drainage clearance, silt management. • Geo-textile fabric tube technology for enduring protection against floods and erosion. Non-structural adaptation: Efficient management of flood plains and contingency planning for disaster preparedness and response Regulatory Measures: • Strict regulation of urban land use in the valley, find a way out of the inundation at the barrage and treatment of upper catchment areas. • Follow up National Flood Policy to support rehabilititation, resettlement and compensation.

Groundwater management	• Changes in precipitation and evapo-transpiration may influence ground water recharge; • Increased rainfall intensity leading to higher run-off and less recharge; • Increased flood events affecting groundwater quality in alluvial aquifers.	Sustainable use of ground water resources: • Safeguard the groundwater reserves • Focus on harnessing surface water resources in view of projected increase in precipitation

5.4 Key Strategies to tackle the impact of climate change

Enhancement of water resources, catchment treatment & improvement of basin health though augmentation of other water infrastructure both for conservation and use

Sustainable management of basins is critical for achieving water use efficiency. There are two major basins, viz., the Barak Basin and the Manipur river basin. The precipitation flowing as surface water into the rivers and lakes forms surface water resources of the state of Manipur. Average availability of surface water of these two river basins and the lakes has been assessed at 18487 million cum per annum (Barak Basin- 3295 million cum against a total catchment area of 9042 Sq. km and Manipur Basin – 5192 million cum against a total catchment area of 6332 Sq. km) as per CWC's report, 1983.

It is important to increase the efficiency of water use, explore options to augment water supply in critical areas and ensure more effective water resource management. New regulatory structures with appropriate entitlements, pricing and incentives to adopt water-neutral and water positive technologies may be required. Integrated water policies would help to cope with the variability in rainfall and river flow at the basins. Blending of proper water positive or water-neutral technology with appropriate institutional framework that enhance community participation and sustainable in the long run should be the main plank of integrated water management strategy (that deals with rainfall variability from basin level to household level (that deals with efficient use and demand management).

The integrated water management framework can be modelled around national water policy under NAPCC within the ambit of overall management goal of ensuring conservation and sustainable utilization of the wetland complex for ecological security, livelihood improvement of local communities, enhancing hydrological connectivity within wetland systems with the Manipur River system and improve water quality through waste management and minimizing nutrient runoff from agricultural fields.

Structural reform for both urban & rural water sector management

Structural reforms for both urban & rural water sector have to deal with related issues of climate change, water scarcity and quality along with institutional factors, which are also decisive in explaining the capabilities of water users to accomplish self-organization, equity, efficiency and sustainability and takes into the diversified socio-economic character of state water systems.

Institutionalizing Monitoring & Evaluation system for both water quality and impact of Climate Change

There should be co-ordination among the programs aimed at addressing the impacts of climate change on water resources and other public policies exerting influence on water scarcity and quality. The outcomes of the water management measures are uncertain in the context of climate change adaptation because of the complexity of the schemes / programmes to be implemented and uncertainties in the environmental and socioeconomic developments that affect the performance of the chosen management

strategies. As a result, robust M & E system that performs well under a wide range of uncertain but possible future developments might be chosen over strategies that perform best under certain conditions.

Identifying new water harvesting scheme (ponds) and Rain water harvesting and small check dams at community lands:

In water deficient areas, there is possibility of acute water scarcity due to climate change. There should be proper identification of areas for new creation as well as renovation and protection of water bodies. Ground water recharge options should take care of both domestic and agriculture options in the region.

Restoration, conservation and management plan for all the lakes and wetlands including Catchment Area Treatment plan:

As already brought out in para 5.3 the state is endowed with 708 wetlands covering an area of 63,616 ha (2.8% of TGA). However in the absence of a holistic Management plan coupled with acute anthropognic pressures, majority of the lakes are in varying degree of degradation. Excepting Loktak lake, the biggest water body in the state which is being treated by the Loktak Development Authority, no other water body is supported by any approved management plan. It is imperative for the newly created High Level Committees to activate the management action plans within a reasonable time frame for restoration, conservation of all the wetlands. Further, encroachment is a major threat to the existence of wetlands of Manipur. Increase in number of phoomdi dwellers, filling of lake boundaries by earth filling for settlement purpose, encroachment for farming purpose etc. are common practices that affect the wetland management. The State Government should take up various steps for developing a comprehensive strategy and policy support to inventorization, institutional development (wetland management committee with community participation), and capacity building. Necessary steps being taken for catchment area treatment need to be further strengthened for addressing all the wetlands.

Developing ground water models for different agro-climatic zones

There is high probability of acute water deficiency due to climate change in the water scarce areas. Thus there should be proper identification of areas for new creation as well as renovation and protection of water bodies. Ground water recharge options should take care of both domestic and agriculture options in the region. Following are some of the suggested action points-

- Ground water recharge-position / scenario for the last 30 years in Manipur and ground water modelling.
- Impact of recent climatic change on groundwater condition in Manipur: Monitoring and geo- electrical mapping for sustainable agriculture development.

Quality monitoring of ground water in arsenic affected areas and adaptation measures

As indicated in the National water Mission, promotion of integrated water resource

management will get an additional focus as an effective response to climate change. In this context, research and studies especially projection of impact of climate change on surface and ground water including water quality will be emphasized more and strategic protection measures will be adopted accordingly. Following are the actions pointed out:

- Setting up Surface Water Treatment Plant for supplying of Quality Water
- Proper management of rural Solid Wastes and liquid wastes
- Assessment of arsenic contaminated water areas /bodies/ground water sources
- Extensive Awareness Generation Programme about Safe use of drinking water & sanitation.
- Setting up of Block level water testing laboratory for drinking water parameters
- Setting up of Scientific Research Laboratory for drinking water& waste water parameters

Preparation of contingency plan for the both at state/district level

Climate change would have a direct impact on the type, scale and frequency of disasters, emergencies and incidents. The state of Manipur is likely to face increased flooding and more frequent drought like situations. This will lead to severe economic consequences. Forecasting models are required to assist in preparedness and response actions. Under this initiative, a prototype information system will be developed, demonstrated and validated for effective near-real time flood and drought forecasting, warning and management. The state should initiate disaster-specific vulnerability assessments and sectoral impact assessments at the state and district level for preparing contingency plans before implementing any such water management programme.

WATER RESOURCES

Table 5.2: Key priorities for State Mission for Water Resources

S. No.	Sector Thematic Area	Strategies	Status	Type	Nature	Priority	Actors / Agencies	Proposed Budget Estimate 12th FYP (2012-17) Rs. in Cr	Available under Budget Estimate (2012-13) Rs. in Cr	Proposed budget Estimate during 2013-14 Rs. In Cr
1	Enhancement of water sources catchment & improvement of river / stream basin health on priority basis	Catchment area treatment & conservation of water sources through river basin care & development [Nambul, Imphal, Thoubal, Kongba & Iril river]	Ongoing	MT	PA	H	Forest	23.00		5.00
							PHED			
							Environment	2.00	0.40	0.60
		Maintenance of riparian buffer strip / corridor and water resources to improve stream health	Proposed	AD	PA	H	PHED	5.00		1.00
		Artificial water recharge in & around the spring heads for maintaining perennial flow through afforestation & renovation	Proposed	AD	PA	H	PHED	9.00		0.90
		Assessment of the likely recurrence, magnitude and location of floods, draughts, landslides in the climate change scenario, detailed assessment of water demand in current & climate change scenario	Proposed	AD, MT	RD	H	PHED, IFCD, Environment	2.00		0.50
2	Averting disasters due to heavy precipitation and increase in extreme events like flood , draught, etc.	Embankment / river front development at eroded / hazard zones at (i) Jiri, (ii) Lanva, (iii) Khujairok, (iv) Sekmai, (v) Nambul, (vi) Langathel, (vii) Potshangbam, (viii) Imphal, (ix) Barak, (x) Chakpi, (xi) Thoubal, (xii) Chowkidarkhong, (xiii) Koite, (xiv) Kongba, (xv) Iril	Ongoing	AD	PA	H	IFCD	15.00	0.25	0.75

WATER RESOURCES

WATER RESOURCES

S. No.	Sector Thematic Area	Strategies	Status	Type	Nature	Priority	Actors / Agencies	Proposed Budget Estimate 12th FYP (2012-17) Rs. in Cr	Available under Budget Estimate (2012-13) Rs. in Cr	Proposed budget Estimate during 2013-14 Rs. In Cr
3	Policy, regulatory, delivery options, technologies, R & D & HRD, Survey & monitoring for adapting the impacts of higher or shortage annual rainfall	Preparation of long term management action Plan for wetlands conservation of Manipur, establishment of monitoring station / infrastructure to study the impact of climate change on water quality in the state, documenting natural water resources across the state [by using remote sensing technique & ground verification]	Ongoing	AD, MT	PA	H	Environment	1.00	0.10	0.40
		Preparation of State Water Policy	Proposed	AD, MT	RD	H	PHED	0.50		0.50
		Assessment of the likely recurrence, magnitude and location of floods, draughts, landslides in the climate change scenario, detailed assessment of water demand in current & climate change scenario	Proposed	AD, MT	RD	H	PHED, IFCD, Environment	2.00		0.50
4	Watershed management, water harvesting [including rainwater]	Rain water harvesting at community lands, roof top harvesting, etc. for collection of water sources [integrate to the building by laws]	Proposed	AD, MT	PA	H	PHED	23.00		9.00
		Construction of small check dams	Proposed	AD	PA	H	IFCD	22.50		4.50
5	Conservation of water resources [Wetland, lakes, rivers, major water bodies] and encouragement of indigenous & community pond / lake	Conservation of water bodies, wetlands (hill & velley), major urban water bodies	Ongoing	AD, MT	PA	H	Environment	85.00	5.00	10.00

S. No.	Sector Thematic Area	Strategies	Status	Type	Nature	Priority	Actors / Agencies	Proposed Budget Estimate 12th FYP (2012-17) Rs. in Cr	Available under Budget Estimate (2012-13) Rs. in Cr	Proposed budget Estimate during 2013-14 Rs. In Cr
		Encourage & development of community water harvesting as mini water reservoir at hill ridges, Minor / integrated Irrigation Tanks/ Community Ponds, Water harvesting in terms of digging / extension of ponds	Proposed	AD, MT	PA	H	PHED, MDS, Environment	100.00		9.00
		Conservation and Management of Loktak and Associated Wetlands Integrating Manipur River Basin (Short Term Action Plan)	Ongoing	AD, MT	PA	H	LDA	45.00		
		Management for Loktak Lake (long term action plan)	Proposed	AD, MT	PA	H	LDA	600.00		
		Flushing of Phumdi from Pumlen Lake through Maramba Maril Wetland conservation	Ongoing	AD, MT	PA	H	LDA	5.00		
		Comprehensive coverage of ecologically safe sanitation in villages adjoining Pumlen, Ikop, Kharung and Khoidum	Ongoing	AD, MT	PA	H	LDA	20.00		
	Sub Total							958.00	5.75	42.15

Note :
Type : MI-Mitigation; AD – Adaptation;
Nature : PA – Policy Action, RD – Research & Development, DP – Demonstration Project, IP- Investment Project, CB – Capacity Building
Priority : H – High, M – Medium, L – Low

WATER RESOURCES

Table 5.3: Medium & Low Priority List of Actions for Water Resources Sector

S. No.	Sector Thematic Area	Strategies	Status	Type	Nature	Priority	Scale	Time Frame	Actors / Agencies
1	Reduction / minimization of distribution loss of water supply and efficient demand side management	Updation of infrastructure [storage & distribution] & expanding hydrometry network	Ongoing	AD	PA	M	S	LT	PHED
		Enhance water use efficiency in urban households	Ongoing	AD	PA	M	S	LT	PHED
		Re-utilization of domestic waste water for urban housholds and agriculture	Proposed	MT	PA	M	S	LT	PHED
2	Drilling of 750 Nos tube wells (375 for State and 375 for Central) @ Rs. 2.00 lakhs / well	Medium implementation constraint and medium importance	Ongoing	AD	PA	L	S	LT	PHED

Note :

Type : MI-Mitigation; AD – Adaptation;

Nature : PA – Policy Action, RD – Research & Development, DP – Demonstration Project, IP- Investment Project, CB – Capacity Building

Priority : H – High, M – Medium, L – Low

Scale : S – State, D – District, B – Block

Time Frame : LT – Long Term, MT – Mid Term, ST – Short Term

Chapter 6

STATE MISSION FOR SUSTAINABLE AGRICULTURE PRACTICES

Chapter 6 : STATE MISSION FOR SUSTAINABLE AGRICULTURE PRACTICES

6.1. Introduction

Agricultural production is highly sensitive to climate change and weather variability. Extreme weather events such as droughts, floods, tropical cyclones, heavy precipitation events, heat and cold waves have significant negative impacts on agricultural production and livelihood of the farmers as agriculture forms the backbone of state economy. IPCC (Intergovernmental Panel for Climate Change) and many other scientific researches have predicted 10-40% loss in crop production in India by end of 21st century due to anthropogenic climate change. Crop simulation analysis performed by INCCA suggests that irrigated rice yields would vary from –10% to 5%, while the impacts on rain-fed rice are likely to be in the range of –35% to 5% in A1B 2030 climate scenarios across the region. Study carried out by IISc Bangalore also substantiates the INCCA'c claim of decrease of rice yield under the possible impact of climate change in the range between 0.1 to 4 percent across six states.

The agricultural practices in the states can broadly be categorized into two distinct types, viz., settled farming practiced in the plains, valleys, foothills, terraced slopes, *etc.* and shifting cultivation (Jhum) practiced on the hill slopes. The shifting cultivation leads to possible forest degradation in the foot hills

Agriculture at hills of Manipur

and reduce the total sink potential across the state.

The State is marginally lacking in the production of food grains. The requirement of food grains for the year 2012-13 is estimated as 720.17 thousand MT against the production target of 688 thousand MT[1]. This gap may further increase under the observed and projected impact of climate change. Therefore, the state government has prioritized to develop strategy towards delinking the agricultural productivity from the impact of climate change to the best possible extent and to ensure the food and nutritional security issues as well as to address economic sustainability of the 70% of agrarian population.

6.2. Impact of Climate Change

Importance of the climate change to agriculture is now explicit, but the exact magnitude is uncertain because of complex interactions and interrelationships between the ecosystem and the economy. As climatic patterns change, so do the spatial distribution of agro-ecological zones, habitats, distribution patterns of plant diseases and pests entailing significant impact on agriculture and food production which is speculated by the year 2050. According to estimation by Sinha S.K. and Swaminathan M.S. (1991), a 2°C increase in mean air temperature could decrease rice yield by about 0.75 ton/hectare in the high yield areas and by about 0.06 ton/hectare in the low yield regions. A large number of high-value crops are grown during the rabi season, so the negative impact on farmers' economy would possibly be higher.

As per the study by IISc Bangalore rice yield is projected to decrease in seven out of nine districts of Manipur *viz.* Chandel and Thoubal by 3% and between 0.4 to 0.1% in Imphal (East & West), Senapati, Ukhrul and Tamenglong by the year 2050. Further rice yield is projected to increase in only two districts *viz.* Bishnupur and Churachandpur (Table 6.1).

Impact of Climate Change A1B Scenario on Rice Yields by 2010s in Manipur

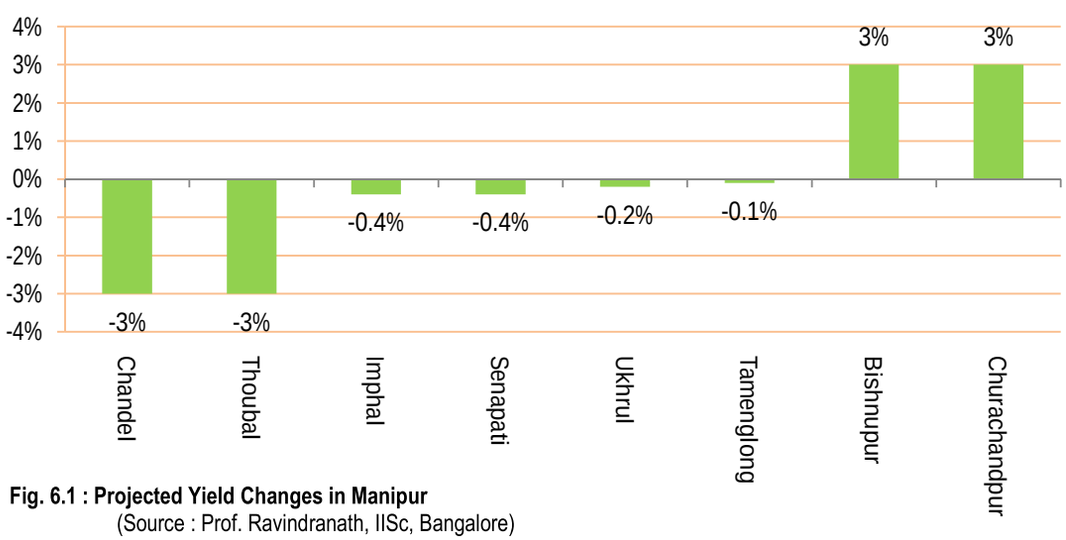


Fig. 6.1 : Projected Yield Changes in Manipur
(Source : Prof. Ravindranath, IISc, Bangalore)

1. 12th five year Plan of the state

In a parallel study by IISc, the district level vulnerability index for Manipur has also been brought out. As per the study out of the 9 (nine) districts 5 (five) districts *viz.* Bishnupur, Churachandpur, Imphal west, Imphal East and Thoubal fall in the highly vulnerable to moderately vulnerable category.

The Projected impact of climate change on the agriculture and its allied sectors are as follows:

Agriculture:

- Decreased crop production as well as shortening of crop growing period
- Crop failure due to high rainfall variability
- Increased incidence of pests and diseases
- Occurrence of late monsoon, unpredictable seasonal rainfall and drought resulting into delay in rice seedling and transplanting;
- Water inundation due to heavy rainfall during the Panicle Initiation (PI) Stage of Rice;
- Natural occurrence of extreme events like flood, drought, etc.
- Creeping soil acidity problems

In this context it is worthwhile to note that the agricultural sector also contributes to climate change through release of GHG in the atmospheres.

Horticulture:

- Increased crop water needs
- Reduced water availability
- Greater crop damage due to frosts and heat stress
- Increased pest and disease activity
- Increased damage from extreme weather events, and
- Changing production regions (where the crops grow) or cropping cycles

Livestock:

- Heat distress suffered by animals will reduce the rate of animal feed intake and result in poor growth performance (Rowlinson, 2008)
- Lack of water and increased frequency of drought will lead to a loss of resources. Consequently, food insecurity and conflict over scarce resources will be exacerbated

Fisheries:

Climate change represents a threat to the sustainability of capture fisheries and aquaculture development.

- Fisheries will be impacted by changing water levels and flooding events
- Temperature changes will cause a shift in the range of fish species (in different geographical areas) and a disruption to the reproductive patterns of fish
- River dependent fishers are more vulnerable due to their comparatively small or weak economies and low capacity to adapt to change

6.3. Sectoral Policy and Programme

There are 18 (eighteen) main crops which are cultivated during the 2 (two) seasons in

the state. Rice continues to dominate in all the other crops with 1,69,370 ha *i.e.* 64.82% of total crop land in the state during 2009-10. The adoption of high yielding varieties (HYV) of rice has been growing in Manipur in comparison to other crops. Agro-ecologically the state has both sub temperate and high altitude sub regions. Hence, the state has ample scope and potential to grow various horticultural crops *viz.* pineapple, lemon, orange, banana, guava, peaches, seasonal vegetables, *etc.*

The main categories of livestock reared in Manipur are cattle, buffalo, sheep, goat, pig *etc.* With a view of sustainable development & self sufficiency in livestock products, the state government focuses on some issues like *Animal Health Care* for protecting the valuable livestock and poultry from deadly diseases, *Cattle and Buffalo Development* for upgradation of local cattle, *Poultry Development and Piggery Development*.

The state Fishery Department has a vision to attain self sufficiency in table fish production with a target of 35,000 tonnes against the total requirement of 30,000 MT and generate self-employment of 10,000 educated unemployed youth by 2017. Upliftment of socio-economic condition of the fishers by enhancing productivity level of their ponds / catch per unit effort through local Cooperative Societies / NGO's are also targeted by the department. In order to attain self-sufficiency in Agriculture and its allied sectors the following National programs are also implemented in the State like,

National Agricultural Insurance Scheme

Agricultural insurance scheme will provide protection to the agricultural farmer over the lower productivity due to the incidents of weather variability and extreme climate change events.

Rashtriya Krishi Vikash Yojana (RKVY)

The flagship program aims at enhancing the agricultural productivity and address the issues of climate change through crop diversification, introduction of water and pest resilient variety. Introduction of System of Rice Intensification (SRI) system of rice cultivation will address green house gas accumulation in the atmosphere.

6.4. Key Strategies

The Climate Change impact assessment and related vulnerability profiles of Agriculture and allied sectors necessitates the need for adaptation strategies and practices to enable the stakeholders to cope with climate risks both under current climate variability as well as projected climate change. The adaptation options are given in Table 6.1.

Table No. 6.1 : Sectoral Impacts and Adaptation options.

Sector	Impacts	Potential adaptation options
Agriculture and Horticulture	Changes in crop productivity, phenology and morphology, moisture stress, diminishing soil productivity	• Develop new crop varieties including hybrids to increase the tolerance and suitability of plants to temperature, moisture and other relevant climatic conditions • Diversify crop types and varieties, including crop substitution, to address the environmental variations and economic risks associated with climate change • Soil and moisture conservation practices through activities like: contour ploughing, check dams and bunding, organic manuring, mulching etc. • Develop water management and conservation innovations, including irrigation, to address the risk of moisture deficiencies and increasing frequency of droughts • Develop early warning systems that provide daily weather predictions and seasonal forecasts • Change timing of farm operations like sowing and harvesting to address the changing duration of growing seasons and associated changes in temperature and moisture • Encourage organic farming practices • Conservation of agro-biodiversity to provide specific gene pools for crop and livestock adaptation to climate change.
	Increased insect outburst	Selection of crops and cultivars with tolerance to pests and diseases to generate greater genetic variability
	Rice production and grain quality is expected to decrease	• Developing rice crops resilient to heat stress • Use of genetic markers for speeding up breeding process • Geographical analysis of vulnerable regions • Site-specific adjustment in crop management (e.g. shifting planting dates and improved water management) • Regional climate modeling to identify future "tilting points" of rice production (e.g. the temperature level or CO_2 levels above which major yield losses are experienced) • Developing newer crop management trends (e.g. diversification from rice-rice to rice-maize systems) to alter crops' budgets of carbon and nitrogen and thus significantly attempt to reduce greenhouse gas emissions
Livestock	Increased incidences of diseases in livestock	Breeding livestock for greater tolerance and productivity. Changes in livestock practices may influence future spread/distribution of vector borne diseases
	Changes in productivity of forage crops affecting livestock productivity	• Breeding livestock for greater tolerance and productivity • Improving pastures and grazing lands management
	Conversion from a mixed crop-livestock system to a rangeland-based system, as farmers leading to changes in animal diets thus affecting animal productivity	Preservation and conservation (in-situ and ex-situ) of existing animal genetic diversity
	Substitution of fodder providing crops/change in distributions of these crops can alter availability of feedstock for livestock	Technological developments, such as the development and promotion of new crop varieties, improvements in water and soil management, and improved animal health technology
	Changes in species combination in grasslands/grazing lands thus affecting livestock productivity	Planting species with higher tolerance to changing climate

Besides the adaptation measures dealt in the Table 6.1. Some further utilization measures can be taken to address the climate change issue.

Rapid screening and strategy assessment of State agriculture policy

Short term as well as long term agriculture policies related to the inputs for the production of crops such as cereals, pulses and oil seeds along with irrigation and fertilizers need to be screened in view of the possible climate change scenario along with strategic assessment.

Climate Change Impact studies on Orange and other Citrus fruits Production.

An understanding of the impact of climate change on horticulture crops especially coconut and orange and other citrus fruits in the state is likely to be critical for the distributional effects of climate change. Extensive research is necessary on the assessment of impact of climate change on horticultural crops.

Risk management in agriculture and allied sectors

New credit and insurance mechanism might be devised to facilitate adoption of desired practices.

Breeding studies on major crops for climate resilient agriculture

To combat the climate change impacts, breeding strategies are to be undertaken for development of genotypes of different major crops having climate resistant characteristics to these multiples tresses.

Establishing an effective institutional delivery mechanism to promote best Practices on climate change

This will be transferred to the farmers through cluster level training and in this way farmers will be able to make suitable decision about their cropping patterns. System of Rice Intensification (SRI) method of rice cultivation can reduce methane emissions from traditionally irrigated rice.

Utilization of Bio-resources (Organic wastes, plant wastes, leaf fall drop pings etc.) towards preparation of organic manure

Small scale decentralized mechanism including vermi-compost will help in preparation of organic manure and also help in mitigating the unavoidable methane emission to the atmosphere.

Developing livelihood–focused, people-centric integrated watershed development in rain-fed areas

Livelihoods interventions are to be implemented in the form of cropping system strategy, Pisciculture, livestock promotion, non-Timber Forest Produce (NTFP) collection, marketing and various other land based income generating activities.

Development of water use-efficient micro irrigation methods and individual/ community farm ponds.

For sustained availability of water for irrigation, it is imparative to develop of water-use efficient micro-irrigation methods such as different drip irrigation

systems and individual/ community farm ponds to cater to their water requirements.

Developing sustainable soil, water and crop management practices

Popularization and implementation of Integrated Nutrient Management (INM) along with soil amelioration, improved methods to conserve the soil and water regime and preparation of soil fertility map for the state is required to be undertaken from time to time.

Improving pest monitoring and surveillance technique

To combat the impact of Climate Change, monitoring and pest surveillance is required.

Research study on the Climate Change Impacts on their production of Cattle, worm infestation, milk Production and vector borne diseases for domestic Animals

To minimize the impact of climate change on animal health and reduce the adverse effect of vector borne diseases, the state has to carry out a study on impact of climate change in livestock and poultry population, ensure vaccination of farm animals against contagious diseases, de worming and early disease warning system, develop a breeding policy and use biotechnology to breed genetically climate resilient breeds of farm animals and increase the availability of vaccines.

Table 6.2: Key priorities for State Mission for Sustainable Agriculture Practices Sector

S. No.	Sector Thematic Area	Strategies	Status	Type	Nature	Priority	Actors / Agencies	Proposed Budget Estimate 12th FYP (2012-17) Rs. in Cr	Available under Budget Estimate (2012-13) Rs. in Cr	Proposed budget Estimate during 2013-14 Rs. In Cr
	Rainfed agriculture with climate [flood, drought] & pest resistant crops varieties	Risk management, crop insurance and contingency crop planning, develop-pment of Spices, encoura-gement of high yielding variety (HYV) seeds, Maize development, etc.	On going	AD	PA	H	Horticulture, Agriculture	45.40	1.74	7.26
		Pest surveillance and rodent management	On going	AD	PA	H	Agriculture, Horticulture	9.00	0.05	0.85
		Surveillance of diseases and pest on horticulture crops	Proposed	AD	DP	H	Horticulture	5.00		1.50
		Agricultural Technology Management Agency and setting up of Plant Health Clinic (at district level)	Ongoing &Proposed	AD	PA	H	Agriculture	9.00	0.50	4.00
	Application of modern scie-ntific approach in agriculture & horticulture with different crop varieties & organic farming / Macro Management mode of Agriculture;	Promote canals system in agricultural fields for multiple cropping	Proposed	AD	PA	H	Minor Irrigation	22.50		4.50
		Introduction and popularization of System of Rice Intensification (SRI), ICM (integrated crop management), INM (integrated Nutrient Management), non-IPM (non-integrated pest management) etc.]	Proposed	AD	PA	H	Agriculture	22.50		4.50
		Development of organic farming for sustainable agriculture / horticulture including multiple farming / relay cropping, etc.	Proposed	MT	PA	H	Horticulture	5.00		1.50
			On going	MT	PA	H	Agriculture	5.00	0.02	0.98

S. No.	Sector Thematic Area	Strategies	Status	Type	Nature	Priority	Actors / Agencies	Proposed Budget Estimate 12th FYP (2012-17) Rs. in Cr	Available under Budget Estimate (2012-13) Rs. in Cr	Proposed budget Estimate during 2013-14 Rs. In Cr
			Ongoing	MT	PA	H	Agriculture	5.00	0.02	0.98
		Development of aquatic vegetables on shallow lake areas of Manipur (*Euryale farox, Neptunia olerecia, Oenanthe javanica, Trapa natana*)	Proposed	AD	DP	H	Horticulture	2.00		1.00
	Encouragement of indigenous fish culture, climate resistant breed and climate related diseases on animals	Conservation and development of flood plain lakes for Pisciculture	Proposed	AD	CB	H	Fishery	22.50		4.50
		Conservation of declining indigenous endangered fish species of the state	On going	AD	PA	H	Fishery	22.50	0.03	4.47
		Development of cold water fishery and running water fish culture in hill districts	Proposed	AD	PA	H	Fishery	12.50		2.50
		Control of Animal Diseases (CAD)	On going	AD	PA	H	Vet. & A.H.	3.08	0.74	0.34
	Encouragement of indigenous & climate resistant species, R & D, HRD, more information, new technology including monitoring on agriculture & allied	State Policy for Agricultural and its allied sectors with land use policy / land capability classification [supportive of traditional land rights of communities, especially for hill]	Proposed	AD, MT	RD	H	Agriculture, Horticulture, Fishery, Vet. & AH	18.00		9.00
		Fishery research extension & transfer of Technology	On going	AD	CB	H	Fishery	2.50	0.22	2.28
		Re-organization of agricultural information unit & crop statistics	Proposed	AD	PA	H	Agriculture, Horticulture, Fishery, Vet. & AH	5.00		5.00
		Survey, Investigation and development of agricultural activities at foothills & shallow lake	Proposed	AD	RD	H	Agriculture	0.90		0.90
		Plantation of indigenous fruit plants like wild Apple, Walnut, Chestnut, Amla, Black berry, wild mango, Jack fruit, etc. on hill slops above 30% in 6 hill districts of the state	Proposed	AD	PA	H	Horticulture	36.00		7.20
	Total Budget							253.38	3.32	63.26

Table 6.3: Medium Priority List of Actions for Sustainable Agriculture Practices Sector

S. No.	Activities	Criteria for Prioritization	Priority	Type	Scale	Nature	Time Frame
1	Research study on supply of animal feedstock and feasibility of rubber seed cake as feedstock in drought seasons	Minimal	M	AD	S	RS	MT
2	Integrated watershed management for Fodder and nutritional security	None	M	AD	S	IP	LT
3	Development of water use-efficient micro irrigation methods and individual/community farm ponds	None	M	Mi	S	IP	MT
4	Developing sustainable soil, water and crop management practices: (4000 Ha drip irrigation & Demonstration)	None	M	AD	S	PA	MT
5	Increasing Cropping Intensity in Traditional Conventional Land (To achieve 300% Cropping Intensity)	Minimal	M	AD	S	IP	LT
6	Modernization of Agricultural practices through agronomic practice, agro-forestry, dry-land horticulture plantation	Minimal	M	Mi	M	PA	MT
7	Procurement & distribution of chemical fertilizer & compost	None	M	Mi	L	PA	LT

Note :
Type : MI-Mitigation; AD – Adaptation;
Nature : PA – Policy Action, RD – Research & Development, DP – Demonstration Project, IP- Investment Project, CB – Capacity Building
Priority : H – High, M – Medium, L – Low
Scale : S – State, D – District, B – Block
Time Frame : LT – Long Term, MT – Mid Term, ST – Short Term

Chapter 7

STATE MISSION FOR HEALTH

Chapter 7 : STATE MISSION FOR HEALTH

7.1. Introduction

Manipur is a landlocked state cozily nestled in the lap of nature, blessed with hitherto salubrious climatic conditions. The projected climatic variability in terms of rise in the average surface temperature and change in precipitation pattern are likely to enhance incidence of infectious diseases and escalate the impact on human health in terms of increased virulence and spread of diseases in hitherto disease-free areas caused by pathogens transmitted by vectors. These include diseases like malaria, japanese encephalitis, dengue, kalaazar, chikungunya etc. The transmission patterns of vector bionomics are highly influenced by the weather variability. Thus it is crucial to have an in-depth knowledge of impact of climate change on the vector causative agents and the related hosts in order to formulate an appropriate adaptation strategy and also timely mitigation actions. The situation is equally grave as far as water borne diseases like diarrhoea are concerned which might proliferate in flood and water logged conditions.

As per the scientific consensus weather variability due to climate change may proliferate some of the sensitive diseases and other health related risks envisioned as follows:

- Increase incidence of vector borne (malaria, japanese encephalitis, dengue, kalaazar, Chikungunya etc.) diseases due to increase in temperature, relative humidity and change in the rainfall pattern.
- Increased risks of water borne diseases like diarrhoea, generally incident from water contamination after flooding.
- Heat strokes and associated mortality from heat waves.
- Higher risk of mortality from the impact of large-scale loss of livelihoods, deterioration in nutritional health arising due to loss of rain fed crops and reduced cereal yields from temporary droughts or erratic rainfall, high temperatures during night etc. Even though the state has not witnessed severe drought events, number of dry-days have increased leading to crop failure.

7.2. Impact of Climate Change

The incidence of the malaria is climate sensitive largely because of the carrier mosquito whose gonotrophic cycle and sporogony is largely linked to surface temperature, rainfall, relative humidity and wind velocity. The determination of transmission window is carried out both on the basis of the surface temperature as well as the surface temperature coupled with relative humidity (RH). As per the projection (across seven districts amongst nine districts in the state based on the available information) in 2030's, one district in the state is likely to get an increased transmission window of 10-12 month as compared to the baseline scenario (1960-1990) while it remains unaltered for 7-9 months for most of the other districts (Table 7.1). This 7-9 month open transmission window demands adaptation measures to completely eradicate the malarial incidence.

During the last 57 years (i.e. 1954-2011) in Manipur, the mean minimum and maximum temperature have risen from 13.9 to 14.9^{0}C and 26.6 to 27.3^{0}C respectively and the average relative humidity has increased from 70% to 80%. The increased current mean temperature and the relative humidity is likely to favor the reduced sporogony of the vector mosquito. Moreover at increased temperature the rate of digestion of blood meal increases this in turn accelerates the ovarian development, egg laying, reduction in duration of genotrophic cycle and higher frequency of feeding on host amongst the

Table 7.1: Transmission Windows (TWs) of Malaria in the state based on temperature (A1B Baseline and projected scenario by 2030)

No. of months open for Malaria Transmission								
No. of Districts		0 month	1-2 months	3 months	4-6 months	7-9 months	10-12 months	Data Not available
9 (nine) Districts	Baseline	0	0	0	1	6	0	2
	Projection	0	0	0	0	6	1	2

Health

Table 7.2: District wise percentage contribution of malaria cases to the State

Sl. No.	Name of District	2006	2007	2008	2009	2010	2011
1.	Tamenglong	42	26	18	24	35	52
2.	Churachandpur	11	8	16	19	23	24
3.	Imphal East	7	17	28	14	17	5
4.	Ukhrul	14	10	8	9	3	6
5.	Chandel	10	13	12	9	4	6
6.	Other districts (Bishnupur, Thoubal, Imphal West & Senapati)	7	23	16	23	18	7

vectors, thus increasing the probability of malarial transmission.

District-wise distribution of percentage of malaria cases in the state indicates increasing trends of incidence in Tamenglong and Churachandpur (Table 7.2).

Disease profile of malaria in 2010 reveals that Tamenglong district contributes 32% of total 947 malaria cases in the state, followed by Churachandpur district (22%), Imphal East including Jiribam SD (16%) and other remaining districts contributing in the range of 1% to 8% respectively. Although the Malaria cases presented in the table above refers towards a downward trend in the incidence of the vector borne diseases but the same is largely due to the better health infrastructure, preparedness and awareness amongst the people of the state as well as departmental intervention.

As per the report of Health Department, incidence of the cases of Japanese encephalitis & Dengue are on the rise in the state (Table 7.3).

Health

Table 7.3: Profile on Climate Change Sensitive Disease in Manipur

Year	Malaria		Dengue		Japanese Encephalitis	
	Cases	Death	Cases	Death	Cases	Death
2001	943	5	Nil	Nil	Nil	Nil
2002	1268	9	Nil	Nil	Nil	Nil
2003	2589	17	Nil	Nil	2	1
2004	2736	8	Nil	Nil	1	Nil
2005	2071	0	Nil	Nil	Nil	Nil
2006	2709	8	Nil	Nil	Nil	Nil
2007	1194	4	5	1	65	Nil
2008	708	2	Nil	Nil	4	Nil
2009	1069	1	Nil	Nil	64	Nil
2010	947	4	7	Nil	118	15

Disease and epidemiological profile points towards the relationship between the occurrence of Dengue and Japanese Encephalitis to subtle change in climatic conditions that favor the breeding and proliferation of their vectors. Adoption of preventive measures of Japanese Encephalitis and Dengue are critical as these diseases have caused serious morbidity and mortality in recent times across the state. Based on the above projection of increased incidence of vector and water borne diseases it is imperative that the climate change issues, particularly in A1B scenario need to be integrated in to health sector planning of the state.

The changes in climate parameters, their possible impacts and the consequent health issues are summarized as follows (Table 7.4).

The impacts of climate change summarized above are expected to increase the disease burden in the state. As a result the constraints & barriers to adaptation need to be reassessed to address the problem in future. Major issues of concern related to the sector are described below. Further, these are correlated to the impacts of climate change and identified as thrust areas for proposed actions. Some of the major issues are:

i. Lack of surveillance programme for new climate change related diseases in remote villages that could not be achieved due to shortage of manpower and early warning signal system of impending outbreaks of epidemic prone diseases.

ii. Lack of facilities for high tech entomological research laboratory in the state.

Table 7.4: Potential impacts of climate change on human health in the state

Climate parameters	Probable impacts	Emerging Impacts on health
• Surface air temperature is projected to increase between 0.8ºC to 2.10ºC • Decrease in winter precipitation • Increase in intensity of summer precipitation • Change in precipitation pattern • Increase in night-temperatures	• Increased breeding of mosquito because of reduced sporogony, ovarian development, egg laying, reduction in duration of genotrophic cycle and higher frequency of feeding on host • Cereal production likely to be benefited, but yield of paddy will be negatively affected due to projected increase of night-time temperature • Decrease in yields in winters • Increase runoff , flash flood and landslides ,during summer precipitation	• Expected to face an increased incidence of vector borne diseases like malaria, dengue and chikungunya. • Malnutrition • Increased incidence of water borne diseases. • Occurrence of extreme weather events might cause loss of life, infrastructure and human resources.

iii. Lack of infrastructure, connectivity to the remote high risk areas, emergency equipment including wireless communication device, proper waste disposal facility, etc.

7.3. Policy Review

Health services in the state are being provided both by government and private sectors. The institutional functioning of the health system under the State Health Department is organized at three levels and comprises of Primary care level comprising of Primary Health Sub-Centres (PHSC), Primary Health Centers (PHC) and Community Health Centres (CHC), Secondary care level comprising of CHCs and District Hospital and finally the Tertiary care level where specialist and super specialist care are provided.

The vector borne disease control programme in Manipur state is emphasizing on six diseases viz. malaria, kala-azar, dengue, chikungunya, Japanese encephalitis and filariasis. This is one of the most important ongoing activities to adapt to the challenge imposed by climate change. The State Health Department targets vector control in 527 villages i.e. about 2, 60,000 populations of high risk areas.

Analysis of health issues, impacts, programmes & policies require further interventions:

1. Changes in climate may alter the distribution of important vector species (for example, mosquitoes) and may increase the spread of diseases to new areas that lack a strong public health infrastructure.
2. High altitude populations that fall outside the areas of stable endemic malaria transmission may be particularly vulnerable to malaria due to warming of climate.
3. The seasonal transmission and distribution of many other diseases by mosquitoes (dengue, yellow fever) and by ticks (Lyme disease, tick-borne encephalitis) may also be affected by climate change.

7.4. Key Strategies

The key elements for the multi -pronged strategies for adaptation measures were identified after detailed deliberation in the working groups and are as follows:

Uncertainties and limitations of climate change related health secondary data

Researches on health impact of climate change are nascent in the state but are essential to develop a state specific short term projection model for the climate sensitive vector borne diseases. It is therefore imperative that a research organization is to be appointed and provided with adequate infra structural facilities to undertake collection of information so as to map the impact of climate change over the health scenario throughout the plan period across the state demography and ecological zones. The major information required is as follows:

- Relationship between surface temperature, precipitation and RH over the proliferation of vector borne diseases like malaria, kala-azar, dengue, chikungunya, Japanese encephalitis at the district level.

- Relationship between Agricul-tural practices, urban habitat, water scarcity and socio economic scenario with incidence of vector borne diseases.
- Assessment of possibility of emergence of new pathogens.

Knowledge and research gaps

Following are the knowledge gaps identified

- In some geographic areas, transmission windows depicts suitability for less number of months based on weather parameter while the occurrence of malarial incidence reflects transmission for longer periods. This suggests for detailed micro level studies.
- Based on the outputs of open months for malaria transmission, validation is needed at the district level to determine cut-off limits of transmission for temperature, relative humidity and rainfall.
- The study may be expanded to other vector borne diseases also. Malaria and dengue are two important climate change related diseases that have to be extensively studied for understanding the relationship between climate parameters and disease incidence, and their future spread in the future context. The seasonal transmission and distribution of many other diseases, transmitted by mosquitoes (dengue, yellow fever) and ticks may also be affected by climate change.
- The outcome of projections is based only on climatic parameters, which if integrated with intervention measures, socio-economic and immunity of the population would provide a holistic projection.
- R&D especially, ecological study of pollens & pollutants need to be studied further in the context of climate change in Manipur.

A number of thrust areas have been identified by the state, which will assist in integrating climate change in the health sector. These areas are given below.

Outbreak investigation and response (early warning signals of impending outbreaks of epidemic prone diseases and help initiate an effective response in timely manner)

Climate change is associated with changing weather patterns and due to severe weather events but till now there is major uncertainty about the timing, location, and severity of these changes. Adaptation to climate change is a structural process of decision making and can help in proper planning to reduce health risks due to climate change in the state.

The World Bank funded Integrated Disease Surveillance Project (IDSP) has investigated and contained 7 (seven) outbreak / epidemic in specific locations in the state since its implementation. The lessons learnt need to be integrated in the planning.

Therefore the present public health facility structure needs to be stronger with better observation, better early warning system and control mechanism for climate related outbreaks with major focus on vulnerable and fragile groups.

Integrated Diseases Surveillance Programme (IDSP), nutrient survey for base line nutritional status and subsequent impact & its mitigation

Human health is suffering from short and long term health risks due to climate variability and change. Current levels of vulnerability in the state are due to lack of performance of traditional public-health services. Implementation of surveillance programmes and nutrient baseline survey is necessary to categorize and take action to control outbreaks of malaria and other infectious diseases.

Control of malaria and other climate variability related vector born diseases including sentinel Survillance of Dengue, Japanese Encephalitis, Chicken Guniea, Scrub Typhus, Rabies, host agents, water born diseases, air born diseases

Variability in surface temperature and rain fall might enhance the chances of incidence of infectious diseases (vector borne, water borne and air borne) including malaria which was never endemic in Manipur.

Likewise, other malaria prone area, in the state need to be identified and prioritized for holistic health care programmes to prevent the disease spread & adapt to the possible impacts of climate change. The state mission on health under SAPCC-Manipur is targeted to align the national programmes for health, which comprises two main components, namely provision of enhanced public health care services and assessment of increased burden of disease due to climate change. The mission targets to enhance health care services in the state by focusing on the following:

- Provide high-resolution climate data to study the district wise projection and change in pattern of disease;
- Development of a high-resolution health impact model at the district level;
- GIS mapping of access routes to health facilities in areas prone to climatic extremes;
- Prioritization of geographic areas based on epidemiological data and the extent of vulnerability to adverse impacts of climate change;
- Ecological study of air pollutants and related issues with climate change;
- Studies on the response of disease vectors to climate change;
- Enhanced provision of primary, secondary and tertiary health care facilities; and
- Implementation of public health measures, including vector control, sanitation and clean drinking water supply.

In order to reduce the burden of climate-sensitive health problems, determinants and outcomes may need to be revised, reoriented and in some regions and should be expanded to address the additional pressures of climate change.

Diarrhoeal Diseases Control Programme

Extreme weather events like excess rainfall and flooding, drought, are the major contributors to water-borne infectious diseases. Diarrhoea creates severe dehydra-

tion and poor absorption of nutrients, which affects individuals and makes one vulnerable to infectious diseases. During childhood, diarrhoea is associated with improper growth, physical fitness, and cognitive development, which would lead to diminished future activity and lower energy level to earn livelihood. Access to clean drinking water and improved sanitation will help to reduce the water borne diseases. The state desires to introduce a comprehensive Diarrhoea control programme as climate resilient adaptation strategy.

Setting up of State level High tech entomological research laboratory, operational research on geographical areas based on epidemiological data, extent of vulnerability to adverse impacts of climate change, high resolution health impact model, etc

To control the impact of climate change and extent of vulnerability, the state wants to develop district level and regional assessments on burden of disease studies, identification of adaptation strategies for the health sector, dissemination of current scientific findings, guidelines and training materials, research and reviews on early warning systems. The State also wants to promote interdisciplinary research, through the leading academic institutions in the State as well as in the country.

The State is willing to prioritize geographical areas based on epidemiological data and the extent of vulnerability to measure the adverse impacts of climate change on health impact model & GIS mapping to be correlated for vulnerability assessment & prioritization of geographic areas.

Develop climate friendly State Health Policy

Climate related health risks are not incorporated in the present State Health Policy. The state wants to incorporate all the climate related health risks in the policy to mitigate vector borne, water borne and air borne diseases on human health. After the incorporation at the policy level, the implementation of the plan in a mission mode will be easier at different levels of the district.

Table 7.5: Key priorities for State Mission for Health Sector

S. No.	Sector Thematic Area	Strategies	Status	Type Nature	Priority	Actors / Agencies	Proposed Budget Estimate 12th FYP (2012-17) Rs. in Cr	Available under Budget Estimate (2012-13) Rs. in Cr	Proposed budget Estimate during 2013-14 Rs. In Cr
1	Health security, hygiene, nutrition surveillance and food safety	Outbreak investigation and response (early warning signals of impending outbreaks of epidemic prone diseases and help initiate an effective response in timely manner)	Proposed	AD PA	H	Health	22.50		4.50
		Integrated Diseases Surveillance Programme (IDSP), nutrient survey for base line nutritional status and subsequent impact & its mitigation	Ongoing	AD IP	H	Health	4.50	1.19	7.81
2	Management emergence of climate change related new diseases and its outbreaks	Control of malaria and other climate variability related vector borne diseases including sentinel Survillance of Dengue, Japanese Encephalitis, Chicken Guniea, Scrub Typhus, Rabies, host agents, water borne diseases, air borne diseases	Ongoing	AD PA, RD	H	Health	22.50	7.98	3.27
		Diarrhea Diseases Control Programme	Proposed	AD PA	H	Health	13.50		2.70
		Setting up of State level High tech entomological research laboratory, operational research on geographical areas based on epidemiological data, extent of vulnerability to adverse impacts of climate change, high resolution health impact model, etc.	Proposed	AD RD	H	Health	20.00		10.00
		Develop climate friendly State Health Policy	Proposed	AD PA	H	Health	0.50		0.50
	Total Budget						83.50	9.17	28.78

Health

Chapter 8

STATE MISSION FOR FOREST RESOURCES CONSERVATION

Chapter 8 : STATE MISSION FOR FOREST RESOURCES CONSERVATION

8.1. Introduction

Forests of Manipur are rich in biological & genetic diversity, and are reported to possess about 2192 species of plants belonging to over 213 families, out of which about 523 plant species are reported as ethno botanically important. Moreover the state has many endemic species like *Lilium mackliniae*, *Schoenorchis manipurensis* etc. There are at-least 100 species of mammals and over 400 species of avi-fauna found in the state. Manipur is home to *Recervus eldieldi* (endangered deer species), Hoolock gibbon, Slow Loris, Serow, Malayan Sun Bear, Hog-badger and host of such rare & endangered denizens of the forests. This rich flora and fauna of the state forest might be at risk under the long term projection of variability of the climate on temporal and spatial scales or deforestation due to natural or anthropogenic pressure.

As per the sectoral vulnerability analysis no change in the forest type is projected for the short term period in the state however few of the districts are demarcated to have high composite forest vulnerability index. In addition the study also depicts an increasing trend towards deforestation largely due to lack of definition of rights or ownership over forests, lack of survey and settlement operations, soil erosion resulting from shifting cultivation, illegal logging of forest produce and wildlife products and the absence of estimates of the encroached areas.

Forests of Manipur
(Dailong, Tamenglong District)

As per the analysis carried out by INCCA about 8% of (or 6 out of 73) forested grids are projected to undergo changes under the projected climate change scenario with possibilities of shifting forest boundaries in the region. Even under the projected scenario the state forest profile is concluded to be comparatively least vulnerable as compared to other north eastern states. Although there may not be a substantial impact over the forestry sector but focus should not be diluted on conservation to maintain species diversity as Manipur being a bio-diversity hotspot there may be a likelihood of species extinction. Moreover the forestry sector acts as a carbon sink so conservation and expansion of forest cover is expected to reduce the green house gas accumulation in the atmosphere and contribute positively towards reducing the climate change impact and improve microclimatic condition in the region.

In the context of the aforesaid issue it can be indicated that conservation of forest resources is equally important from the point of view of reducing green house gas concentration as well as conserve the endemic flora and fauna as well as livelihood of the forest dependent people in the region. The objective of State Mission on Forest Resource Conservation under SAPCC Manipur is to achieve the national goal of increased afforestation under Green India Mission (GIM) & reduce the possible impact of climate change and anthropogenic pressure to its flora and fauna.

8.2. Impact of climate Change

As per the study carried out by INCCA it is reported that the climate change is likely to have multiple effects on individuals, species and ecosystem due to increase in surface temperature and changes in rainfall pattern. As per the study carried out by IISC no change in the forest types is projected for the short term period of 2030s but districts like Bishnupur, Churachandpur, Senapati, Imphal East, Tamenglong and Chandel is likely to have high composite forest vulnerability index. Moreover, climate change impacts on forests might have some implications on livelihood of the people dependent on forest resources.

Vegetation modeling studies by IPCC 2007 suggests potential forest dieback towards the end of this century and beyond, especially in tropics, boreal and mountain areas (Miles 2002; Mc Clean et al. 2005) as long term climate change impact. While there is no state specific data available for Manipur the likely impact projected by IPCC for mountain areas would apply to Manipur in varying degrees like net primary productivity change in western Himalayas is likely to be more affected than eastern himalayan region where Manipur is situated.

The forests ecosystem might be vulnerable on account of the altitudinal and latitudinal shift of the species of the forest ecosystems and also on account of increased occurrences of fire, pests/ diseases, invasive species, change in species assemblage / forest type, forest die-back and loss of biodiversity. The dynamic global vegetation model has been validated by a study of Indian Institute of Science (IISC) for its suitability to Indian conditions. The impacts are assessed at regional climate grid scales (about 50 km X 50 km). As per this study in Manipur, no major change in the forest types has been projected over a short term period. However, the loss of forest cover during the last few years as reported by FSI need to be addressed diligently as the same might impact ecologically distinctive and

rich biodiversity, having many endemic flora and fauna and a number of sacred groves.

The anthropogenic pressure on the forests of Manipur cannot be ignored. The swelling population, demographic resettlements, developmental projects, consumerism, illicit felling together with the pernicious practice of Shifting Cultivation is likely to pose a serious threat to the conservation of this invaluable resource. Even though the forest types of Manipur are not likely to be impacted much by the climate change under A1B scenario through 2030s, the forests could be vulnerable to other factors such as forest fragmentation, forest degradation and forest conversion.

As highlighted in the report of IISC Bangalore the vulnerability of the forest ecosystem is linked to several natural and anthropogenic issues highlighted as follows:

Loss of Forest Cover

The destruction of forests and biodiversity in Manipur can also be attributed to exces-

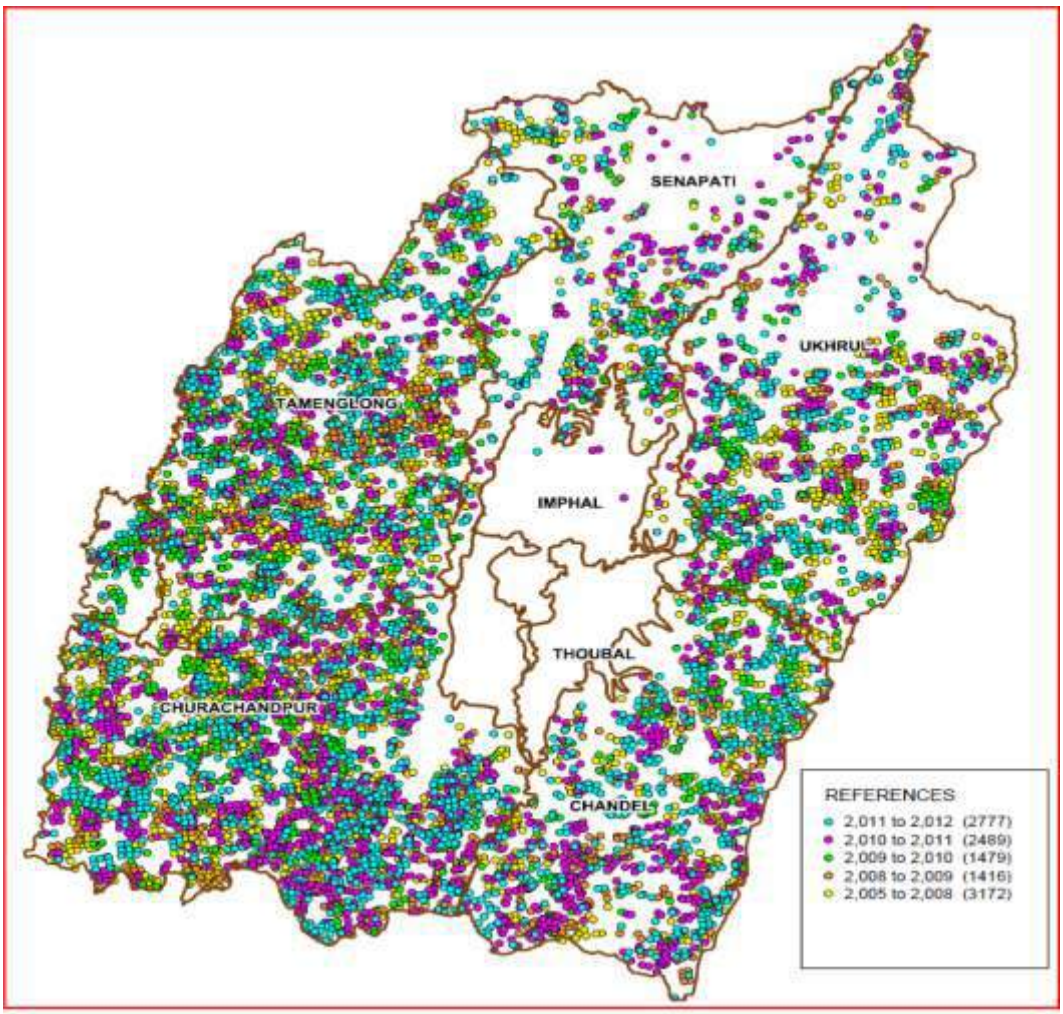


Fig. 8.1 Forests Fire area in Manipur during 2004-2012

sive exploitation for firewood, timber, encroachment of forest land, multifarious developmental works like establishment of housing colony, road and dam construction, etc. A comparison of current forest cover assessment with the previous assessment (satellite data of Dec 2006 – Jan 2007) shows a loss of 190 sq. km of forest cover in Manipur (ISFR, FSI 2011). Maximum decrease has been reported in open forest area i.e. to the extent of 896 sq. km. as compared to that of 2009 assessment.

Forest Fire:

Manipur has a history of using fire to clear land for agriculture and other needs. Rapid occurrence of forest fire is also one of the contributing factors to the loss of biodiversity having direct impact on the livelihood of forest dependent communities. Forest clearing and burning releases huge amounts of GHG especially CO_2, accelerates soil erosion, causing a decline in soil fertility, exacerbation of downstream flooding and sedimentation. The incidence of forest fire is more in the forest areas adjoining the valley where, villagers set fire to forests / small vegetation to get a flush of new grass for their cattle. Regeneration (natural as well as artificial) in these areas is completely wiped out and wildlife including rare plants is severely damaged. The extent of area affected by forest fire is estimated to be about 2000 sq. km annually. Incidence in various districts of Manipur during fire season of 2005 – 2011 is presented in Fig 8.2 &Fig 8.3. Most of the incidents have been reported during February to May every year. In March, more than 2200 incidence in Manipur have been reported in 2010.

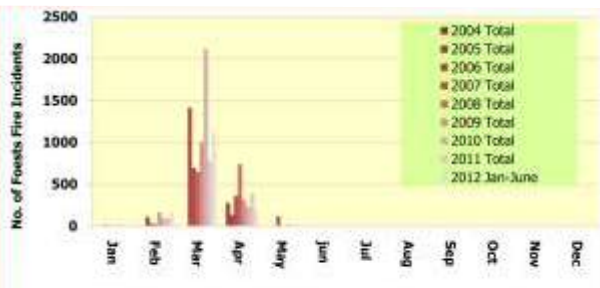


Fig. 8.2 Monthwise Forest Fire Incidence in Manipur [2004-June 2012] (FSI, Govt. of India]

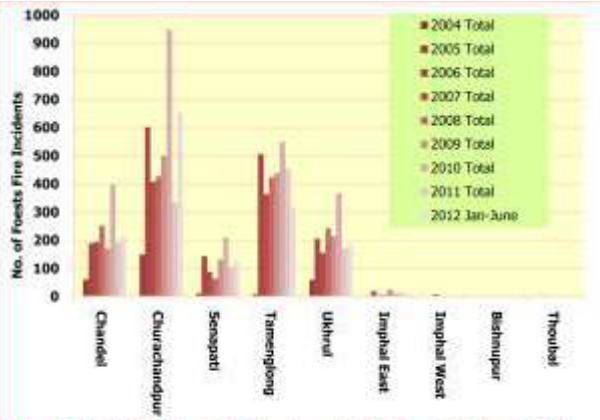


Fig. 8.3 Districtwise Forest Fire Incidence in Manipur [2004-June 2012] (FSI, Govt. of India)

The data indicate that Churachandpur reports maximum forest fire incidence i.e. 949 incidence in 2010 followed by Tamenglong, Ukhrul, Chandel, Senapati, Imphal East and Imphal West. The forest fire in both way impacts climate change the first one being release of the green house gas to the atmosphere and second by reducing the total volume of sink.

Practices of Shifting Cultivation:

The Wasteland Atlas Report of Manipur (2010) prepared by Indian Institute of Remote Sensing records 7027.47 sq. km. of wasteland (i.e. 31.48% of the TGA). Of which, an estimated 90% of the wasteland area falls under degraded forest category viz. 66% under land with scrub, 22% under land with degraded forest and 12% under shifting cultivated area of the state.

Shifting cultivation which is widely practiced in the state is reported as the main reason for the change in forest cover of Manipur. The traditional practices of jhumming in the hills cause maximum loss to the forests of Manipur. Therefore, focus on the practices of sustainable livelihood and climate resilient modern agricultural are highly needed to eradicate jhumming in the state.

Encroachment:

There has been a steady rise in encroachment of the forests as there are thickly populated areas adjoining the state reserved forests (RF) and protected forests (PF). Villagers most often encroach upon forest lands not only out of dire necessity but also in anticipation of more fertile land inside RF and PF which can be regularized in their names later on. The extent of encroachment in forests (Annual Administrative Report 2010-11), Forest Department, Government of Manipur) is 1,844.63 ha. Western Forest Division, Tamenglong has the maximum area under encroachment (816 ha) followed by Yangoupokpi Lokchao wild life Sanctuary (305 ha), Northern Forest Division, Kangpokpi (292.75 ha), Central Forest Division, Imphal (168.96), Thoubal Forest Division (130.73), Tengnoupal Forest Division, Chandel (82.00 ha) and Southern Forest Division, Churachandpur (49.19 ha). Bishnupur Forest Division, Eastern Forest Division, Senapati Forest Division and Jiribam Forest Division are free from encroachments. Issue of encroachment can be tackled with the help of appropriate land-use policy and land reforms.

8.3. Policy Review

Key Focus

The12th Five Year Plan (2012-17) of the Forest Department of Manipur gives priority on:

- Research on the non-cash contribution of forests;
- Development of NTFPs inventory, improvement of linkages between NTFPs collection by local people and market and formulation of effective NTFP policy to ensure that NTFPs are not over-exploited
- Development and inventories of food items that were collected from forests by local people for food security;
- Development and inventories of medicinal plants and traditional medicine systems;

Thrust Areas during the 12th Five Year Plan [2012-17]:

i. Sustainable management of forests by implementation of Working Plans;

ii. Establishment/creation of Manipur Forest Resource Development Agency (MFRDA) and facilitating natural resource access by way of departmental extraction;

iii. Ensuring food security through supply of NTFPs (Non-timber forest produces) and making 'non-cash' contributions to subsistence livelihoods;

iv. Development of NTFPs inventory including inventory of food items which are collected from forests by local people for food security, and inventory of medicinal plants and traditional medicine systems;

v. Research on the non-cash contribution of forests, commercial production of medicinal plants and fast growing and fire-tolerant tree species;

vi. Ushering in congenial environment for frequent interactions between buyers and sellers, and exploration of competitive markets;

vii. Ensuring long-term forest rights and tenure;

viii. Protection of State Forest Resources and creation of State Forest Protection Force;

ix. Achievement of the national target of covering 5% of the total geographical area of the State under Protected Area Network (PAN);

x. Development of Community Based Forest Management (CBFM) and Small and Medium Forest Enterprises (SMFEs);

xi. Making available information and support for producer networks; and

xii. Adoption of good practices to ensure transparent delivery of services.

State Plan Scheme:

Soil conservation:

(a) Afforestation : The scheme of Afforestation has been taken up with the objective of protecting land against erosion, restoration of degraded land / abandoned jhum land to productive use, better soil and moisture conservation for improving productivity; reduce siltation in reservoirs and finally generation of employment opportunities.

(b) Rehabilitation of Jhumias: The scheme aims to prevent jhumias from the faulty and unproductive practice of shifting cultivation through an integrated approach for cultivation and management of forests coupled with other economic development activities.

Social forestry plantation:

The scheme aims to ensure adequate and sustainable supply of fuel-wood for cooking and heating purposes, facilitate supply of bamboo and small timber for agricultural and commercial purposes, ensure supply of fodder for cattle, generate employment in villages, reclaim degraded forests and wastelands, soil and moisture conservation particularly in hills, creation of aesthetic value and improve environmental conditions in villages.

Restocking of reserved forests (Economic Plantation):

With a view to convert and improve the poorly stocked degraded Reserved forests into a high-quality forests with better vegetation density and to meet the future requirements of timber for commercial purpose, plantation of locally important economic species viz. Gmelina arborea, Pinus kesiya, Schima wallichi,, Tectona grandis, Quercus spp., Castanopsis spp., Terminalia myriocarpa, Cedrela toona, etc. are taken up under the scheme.

Rubber plantation:

The sub-tropical climate in and around Jiribam, is conducive and suitable for rubber plantations. The scheme aims at rehabilitating wastelands by raising rubber plantations and produce natural rubber on one hand and uplifting the economy of the local

poor people by providing employment on the other hand.

Centrally Sponsored Schemes:

i. National Afforestation Programme

ii. National Bamboo Mission

iii. Integrated Forest Management Scheme (IFMS)

iv. Scientific management of Forests (under 13th FC) (rendered State Plan)

All the above schemes aim at enhancing the total forest cover in the state which can act as a sink for Green house gas removal from the atmosphere. The above policies are directed at both conservation or restoration of the existing forest cover, as well as introduce afforestation schemes for increasing the total sink.

8.4. Key Strategies

Enabling adaptation of forest dependent communities to climatic variability:

Any possible impact of the climate change or deforestation of forest due to natural or anthropogenic causes will have direct effect on the forest resources of the State which might in-turn badly affect the livelihood and income generation activities of the local people. The employment potential of the people can be improved by imparting training in nursery techniques & raising of seedlings, NTFP cultivation / harvesting & trade, etc. Emphasis should be planned on the capacity building of people, to take up alternate employment opportunities by providing awareness and exposure through audio-visual aids, trainings and meetings under various rural development programmes. The aim will be to reduce the dependence of the people on the natural resources for livelihood options.

Schemes need to be formulated for the forest dependent communities in order to produce industrial raw materials as a source & input, and to maintain the desired percentage of forest cover. The indigenous population may be encouraged to undertake cultivation of cash crops like pineapple, ginger and rubber, etc. The planned distribution of rubber saplings / seedlings and other planting material as well as the implementation / utilization / absorption for forest dependent communities should have the priority. A close liaison between the forest development and the PRIs can be established to treat those forest areas which have the potential of income and livelihood generation. The forest and natural resources dependent communities can be made aware of the climate change impacts and its consequences. Linkages between concerned Department and the organizations like Krishi Vigyan Kendra (KVK),Village Forest Community's (VFCs) and extension wing of state Forest Department are very important. Therefore, the extension activity in areas of agriculture, forestry and horticulture has to be coordinated by providing technical guidance on management of all natural resources and likely adverse climatic effects in this State.

Promoting Green India Mission and National Afforestation Programme

The state has formulated several adaptation and mitigation measures proposed under SAPCC for the forest sector in conjunction with Green India Mission under NAPCC and National Afforestation programme.

The objectives of the Mission under SAPCC-Manipur are:

i. Increasing forest/tree cover and improved quality of forest cover on both forest/ non forest lands;

ii. Improving ecosystem services including biodiversity, hydrological services and carbon sequestration as a result of treatment;

iii. Increasing forest-based livelihood income of forest dependent communities living in and around the forests; and

iv. Enhancing annual CO2 sequestration

Promotion of Urban Forestry:

Urban forests have emerged as an exciting & new opportunity to mitigate climate change, ameliorate the environmental hazards and a way to reduce the air pollution, which in the process helps in improving the overall water regime and nurture biodiversity in the urban environment. Urban tree plantation (avenue as well as city suburbs plantation) reduce atmospheric carbon dioxide (CO_2) through sequestration and reducing GHG emissions by conserving the energy used for space heating and cooling. Tree shade reduces summer air conditioning requirement demand, and at the same time can increase heating energy use by intercepting winter sunshine. Lowered air temperatures and wind speeds from increased tree cover can decrease both cooling and heating demand. Air conditioning and heating savings result in reduced GHG emissions from power plants & other industrial units.

Agro Forestry & Social Forestry Promotion in Manipur to enhance Carbon Sinks:

Proper design and management of agro-forestry practices can make them act as effective carbon sinks and they can also protect biodiversity resources to great extent. Being the next best alternative to the shifting cultivation, Agro-forestry is in a position to satisfy a large diversity of socioeconomic needs in a sustainable way and shall have a direct impact on the micro-climate of the area. Agro-forestry may contribute to human well-being in Manipur through a number of ways: by providing additional income, by increasing food security through a higher diversity of agricultural products (e.g. fruits, nuts, medicinal plants and edible oils), by providing fuel wood and construction material, thus, reducing deforestation and controlling the adverse impacts of the climate change. Intervention of site specific Agro-forestry systems in Manipur is necessary to reduce the deleterious effects of the shifting cultivation practices which will also help in controlling the level of emission of GHGs.

Rehabilitation of shifting cultivators & restoration of shifting cultivated areas:

Shifting cultivation is one of the most destructive systems of cultivation practiced in Manipur. A very large part of the forest areas are burnt every year for preparation of jhum fields. This practice not only degrades the soil, vegetation and other life forms but also increases the GHG content in the environment. Exploitation of forests beyond their sustainable capacity has resulted in

degradation and thereby severely impairs its ability to sustain itself and recoil to a position to provide the environmental goods and services. The effects of degradation of forests are already evident in the forms of drying up of perennial water sources across many places in Manipur. It has accelerated the intensity of soil erosion, flash floods, silting up of reservoirs, loss of biodiversity and forest productivity. The destructed sites are required to be rejuvenated on priority basis. Shifting cultivation practices have to be replaced by suitable agro-forestry systems which can provide wide range of benefits in addition to environmental & social, values & services. The adoption of crop rotation to raise wild varieties of short as well as long duration crops at the same time would be helpful in recovering a substantial percentage of crop yields even in the adverse climatic conditions.

Promoting rural households to adopt fuel wood efficiency and improved Chulhas (stoves) Biogas Etc.:

The state is rich in bio-resources and energy derived from these resources is of low emission as well as sustainable in nature. Major source of cooking fuel in the state is still the fuel wood. This is used in traditional chullahs having an efficiency level of 10-12%. According to estimates of the World Health Organization, more than 1.6 million deaths and over 38.5 million disability-adjusted life-years can be attributable to indoor smoke from solid fuels affecting mainly children and women. Significant improvement in efficiency in this sector can be achieved through use of improved challahs thus saving the forest resources in one hand and reducing the emission level on the other. The State will take suitable action plan at policy level for introduction of improved stoves for use in the family / community level or through subsidized cost. These interventions to suppress or reduce indoor exposure to smoke shall also impact the behavior changes, improvements of household ventilation, improvements of stoves, and outstandingly, transitions to better and cleaner fuels.

Strengthening of Forest Department (Infrastructure & Capacity Building):

Capacity building measures shall be undertaken for personnel in forest and environment sector to improve their skills and professional competence keeping in view the arduous nature of their duties, often in remote and inhospitable places. For effective implementation of forest and environmental laws, GIS & remote sensing, carbon forestry as well as regular trainings on legal aspects of forest and environmental issues needs to be conducted for the forest personnel. Adequate infrastructure and professional needs are to be fulfilled and provided with to meet the training requirements at all levels of Forest Officers & staff keeping in view the current needs and future trends in forestry management and administration in the State.

Forest Fire management:

Management of forest fires is an important aspect of forest protection. Forest Survey of India (1993) has estimated that forest fire has led to heavy to moderate degradation of around 6.16% of the forests. The forests atop all the hills in the State get burnt due to Jhum fire which spreads in the nearby forest areas. This causes immense harm to the forests, the

catchments in the hills become barren & denuded, and it completely wipes out the regeneration (natural as well as artificial) process. It ravages all life forms and adversely affects the already threatened wildlife species. The main constraints in control of forest fires are lack of communication facility for early detection of forest fire, motivation and will of the concerned staff and also the lack of fire-fighting equipment. Proper equipment and trained manpower shall be needed for effective management of forest fires in vulnerable areas. Involvement of local communities in prevention and control of forest fires need to be further strengthened through incentive based mechanism.

Removing fire hazards, creating fire lines, improving fire monitoring systems and quick identification and reporting systems are the important steps needed for prevention and management of the forest fires in the state. This action will help in protecting the forest areas which will lead to better GHG sequestration in near future.

Livelihood improvement Activities:

Climate change impacts are already being observed and felt, signaling an urgent need for response measures that minimizes the current vulnerabilities. By protecting and enhancing the natural services that support livelihoods, vulnerable communities can be brought under through maintenance of local safety nets and expansion of the range of options for coping with disruptive shocks and trends. The forest dependent communities are mainly economically fragile and they rely on forest resources for a wide range of basic needs like food, shelter, clothing and heating. Promotion of alternate livelihood improvement activities such as Rubber plantation, Horticulture, Bee Keeping, Poultry, duckery, creation of check dams etc and engagement in protection activities will motivate the communities to protect the forest resources and to gain economic benefits. The people get gainful employment in collection of bamboo and minor forest produce and selling them in the market and other ancillary activities such as value additions. This adaptive measure will help in improvement of livelihood of the forest dependent communities and also encourage forest conservation which will ultimately result in GHG sequestration.

The interventions needed for the State include Assisted Natural Regeneration, Artificial Regeneration, Pasture Development, Bamboo Plantation, Mixed plantation of NTFP species and Energy Plantation on lands outside the forest land in the Social Forestry Model.

Enhancement of community livelihood through Biomass and NTFPs:

The economic development of forest dwellers is heavily dependent on generation of biomass and NTFPs, as the forest fringe areas where people live are rather inhospitable and agricultural yield is not only low but also uncertain. Training and information related to cultivation, non-destructive harvesting, value addition and new marketing channels must be provided to the target groups. Package of practices for cultivation of medicinal plants will be developed and farmers will be encouraged to undertake cultivation of such medicinal plants and tree species on non-forestlands and private lands which are indigenous but profitable. Value addition and processing of non-

timber forest produce within the State need to be encouraged along with development of market linkages and trade related information so that these are not exported in raw form, and producers get remunerative prices for their produces. Therefore, importance will be accorded to making forest policies and strategies for the sustainable management and marketing of NTFP and the development of the forest fringe dwellers, in particular, the marginalized sections viz. scheduled tribes, other backward classes & scheduled castes whose livelihood is closely related to sustainable production.

Sustainability of Afforestation activities using carbon financing options

The carbon financing option can be used to take up afforestation as well as reforestation activity in the state or even restoration of existing forest. Clean Development Mechanism (CDM) and Reducing the Emission from Deforestation and Degradation (REDD) and other voluntary standard could be thought of to incentivize similar initiatives.

Table 8.1: Key priorities for State Mission for Forest Resources Conservation Sector

S. No.	Sector Thematic Area	Strategies	Status	Type Nature	Priority	Actors / Agencies	Proposed Budget Estimate 12th FYP (2012-17) Rs. in Cr	Available under Budget Estimate (2012-13) Rs. in Cr	Proposed budget Estimate during 2013-14 Rs. In Cr
1	Enhancing improvement of state forests quality and ecological restoration;	Accelerated programme for restoration and regeneration of degraded forests, including increase in forests coverage & density including economic plantation, eco-restoration, monitoring & assessment system of carbon stock in forests	Proposed	MI PA	H	Forest	259.00	99.10	150.00
		Encouragement & adoption of forests protection villages as best model for climate change adaptation like Dailong & Khunjao Village of Tamenglong and Kangkhui Village of Ukhrul	Proposed	AD, PA MI	H	Environment	3.00		1.00
		Rehabilitation of shifting cultivation areas at 20,000 Ha	Proposed	AD, PA MI	H	Forests	60.00		5.00
		Problem lands Ravine reclamation at 1,500 Ha	Proposed	AD, PA MI	M	Forests	10.50		1.00
		Restoration of mining area at 500 Ha	Proposed	AD, PA MI	M	Forests	5.00		1.00
2	Green city in Manipur concept and increasing of tree coverage outside forests	Mass plantation at industrial sites/ urban area & recreational forestry (settlement area & road side plantation);	Ongoing	MI PA	M	Environment	22.50	0.05	4.45
						Forests	5.00		1.00
		Encouragement of market linkage of minor forests produce (MFPs) and medicinal plants in sustainable limits	Proposed	MI PA	H	Forests	10.00		2.00
3	Increasing biomass and creating carbon sink through agro-forestry & social forestry	Development of monitoring and assessment system of carbon foot print in forests	Proposed	MI PA	H	Forests	10.00		2.00

		Framing of State Policy of REDD+ incorporating micro financing approach & skilled development	Proposed	MI	RD	H	Forest	5.00		1.00
		Promote private social forestry plantation, farm lands, current fallow, identification of varieties to be planted, community participation of Afforestation & reforestation at degra-ded forest for comm.-unity forests users	Proposed	MI	PA	H	Forest	24.00		5.00
		Agro forestry at Shelter-belt plantation social forestry at 30,000 Ha	Ongoing	AD, MI	PA	M	Forests	160.00	18.00	100.00
		Agro forestry at Highway / canal / road / bunds	Proposed	AD, MI	PA	M	Forests	8.50		2.00
4	Biodiversity conservation [in-situ and ex-situ conserva-tion of flora & fauna at the possible]	Biodiversity park at Jiribam, Moreh, Luwangsangbam, Churachandpur,	Ongoing	AD, MI	IP	M	Environment	53.00	0.40	10.00
		State Botanical Garden at Khonghampat, Imphal East	Ongoing	AD, MI	IP	M	Environment	10.00	0.25	2.00
		Eco Park at Shirui, Tamenglong, Kakching	Ongoing	AD, MI	IP	M	Environment	43.00	0.20	8.00
		Integrated development of wildlife habitat	Ongoing	AD, MI	PA	H	Forests	50.00	1.00	10.00
		Development of Orchidorium and Arboratum at Khonghampat	Ongoing	AD, MI	PA	H	Forests	20.00	0.50	4.00
		Implementation of Economics of Ecosystems and Biodiversity (TEEB)	Ongoing	AD, MI	PA	H	Forests	5.00	0.50	1.00
5	Restoration, conservation & protection of scared groves /landscapes	Identification of keystone species and use in restoration activities	Proposed	AD, MI	PA	M	Environment	22.50		4.50
6	Reduction of Fuel wood & Carbon emission	Promoting alternate Energy Biogas, Solar, LPG, Improved Stove	Proposed	AD, MI	PA	M	Forests	14.00		3.00
	Total							800.00	120.00	318.00

Note :

Type : MI-Mitigation; AD – Adaptation;
Nature : PA – Policy Action, RD – Research & Development, DP – Demonstration Project, IP- Investment Project, CB – Capacity Building
Priority : H – High, M – Medium, L – Low
Scale : S – State, D – District, B – Block
Time Frame : LT – Long Term, MT – Mid Term, ST – Short Term

Table 8.2: Medium Priority List of Actions for Forest Resources Conservation Sector

S. No.	Activities	Criteria for Prioritization	Priority	Type	Scale	Nature	Time Frame
1	Enhancing resilience & ability of vulnerable species / ecosystems to adapt to climate change	Implementation not Easy and Time taking process	M	AD	S	RS	ST
2	Enhancing adaptation of forest dependent local communities in the face of climatic variability	Implementation not Easy and Time taking process	M	AD	S	RS	ST

Note :

Type : MI-Mitigation; AD – Adaptation;
Nature : PA – Policy Action, RD – Research & Development, DP – Demonstration Project, IP- Investment Project, CB – Capacity Building
Priority : H – High, M – Medium, L – Low
Scale : S – State, D – District, B – Block
Time Frame : LT – Long Term, MT – Mid Term, ST – Short Term

Chapter 9

STATE MISSION FOR ENHANCED ENERGY EFFICIENCY AND CONSERVATION

Chapter 9 : STATE MISSION FOR ENHANCED ENERGY EFFICIENCY AND CONSERVATION

9.1. Introduction

There is a clear consensus amongst the scientific community that fossil fuel combustion for thermal, mechanical or electrical energy is one of the major contributors of Green House Gases (GHGs) the emission of which abates climate change. The projected economic growth, urbanization, rise in per capita energy consumption and spread of energy access are all likely to substantially increase the total energy consumption and exacerbate the green house gas concentration. With this in view, the mission of Energy Efficiency and Conservation is formulated so as to mitigate the overall impacts of Climate change. Increased concentration of green house gases and the projected variations in climate change-as a result thereof, including changes in the rainfall pattern, increased frequency of extreme events and disruption in hydrological cycle might impact the power sector in the state. The power sector in Manipur state is largely vulnerable to climatic variability due to higher dependency over hydel power generation. This sector also contributes to methane emission, one of the GHGs.

9.2. Impact of Climate Change

The power supply in the state is heavily dependent on the Central Sector Generating

Stations located in the North Eastern Region. Against a peak demand of 184 MW during 2010-11, the maximum availability of power was around 105 MW from all the Central Sector Generating Stations including the unallocated shares along with 1 MW of power generated from states own sources, leaving a peak shortfall in tune of 43%. The level of vulnerability of the state energy sector (characterized by its demand supply gap) will be further exacerbated by the climate extremes. The projected impacts due to climate change are envisioned as follows.

Impact over power sector

1. The power generation sector in the state (as well as at the regional level) is mainly hydro dominated which is likely to be affected under the projected climate change impact. The hydel power sector in Manipur is crucially dependent on rainfalls, which may be erratic in coming years. This scenario might disrupt the power generation and intensify power deficit.
2. Increased intensity and frequency of severe weather event may adversely impact the existing energy infrastructure, for instance power plants, transmission lines, power lines, etc. and thus cause asset loss and service disruption.
3. Regions that would face warmer summer, cold winter and lower precipitation level will have an increased demand for electricity from gadget use. Higher energy demand will enhance the pressure on electricity distribution network through increased seasonal demand.

Impact over the Rural Energy Resources

Fire wood forms the main energy source for household cooking. About 67% of population in rural areas is dependent on fire wood followed by LPG. The climate extremes are likely to impact the natural forest vegetation with a shift in forest types with consequent change in forest produce. The reduction in yields of forest biomass will enhance the dependency on the other GHG emitting sources of power causing adverse impact to climate change scenario.

Contribution of GHG from transport sector

The state has been experiencing rise in the number of diesel vehicles, old public vehicles etc. including 2- & 3- wheelers which is contributing to GHGs emissions in an alarming rate.

9.3. Policy Review

The state energy sector is administered and managed through the Power Department, which is responsible for generation, transmission and distribution networks. Manipur Renewable Energy Development Agency (MANIREDA) managing the renewable energy portfolio and Manipur State Designated Agency (MSDA) are responsible for implementation of the energy conservation measures and the regulatory aspects under the ambit of Energy Conservation Act, 2001.

Policies and programmes in the energy sector are framed with an objective of providing energy access to all citizens including enhancing renewable energy generation portfolio and initiating energy efficiency alongwith adoption of risk measures envisioned from power shortage

due to climate variability and vulnerabilities. The major state policies are:

i. The Electricity Act, 2003 providing a comprehensive framework for the development of renewable power and promoting private sector investment through preferential tariff for renewable-based electricity and a mandatory Renewable Purchase Obligation (RPO).

ii. Manipur Hydro Power Policy, 2012, framed to promote Hydro Power Projects having capacities more than 5 MW in the state through Independent Power Producers (IPPs), Central Public Sector Undertakings (CPSUs) and State Public Sector Undertakings (SPSUs) routes.

iii. Vision 2020 in North East aimed at promoting decentralized renewable power generation options.

iv. The state 12th Plan opting for energy loss reduction in the transmission and distribution sector as a measure to reduce the carbon footprint/ GHG emission encountered from the fossil fuel based power generation.

v. The Government of India under the 12th Plan Programme has introduced the concept of Nationally Appropriate Mitigation Actions (NAMAs) to finance the mitigation options.

vi. Fossil fuel consumed by the transport sector contributes substantially to the green house gas emissions. The Manipur State Designated Agency (MSDA) has framed policies towards promoting fuel conservation in transport sector through efficiency improvement which will help mitigation of climate change scenario.

9.4. Key Strategies

The strategic approach of Manipur is aimed at meeting the existing challenges of the energy sector taking into consideration the possible vulnerability projection and promoting low carbon inclusive growth. As a part of the planning process highest priority is being accorded to development of power generation based on diversified renewable energy sources with specific emphasis on solar energy. Thrust is also accorded towards maximizing energy efficiency in the entire power sector as well as transportation sector for minimizing the green house gas emission.

The key elements of the multi -pronged strategies for adaptation and mitigation measures were identified after detailed deliberation in Manipur State. The priorities are in line with the concerns raised over the impact of the energy sector towards enhancing climate variability as well as impact of the climate change to the sector. The priorities are as follows:

Promotion of grid interactive and off-grid intervention in power generation options using renewable energy technology:

The state government has planned to promote solar energy (as part of JNNSM target) and other renewable energy based (wind and biomass) power generation option as a part low carbon growth strategy. The objective of the action is to harness renewable energy potential in the state including solar resources, creating and enabling policy interventions for diffusion of the technologies across the state in near future.

The implementation of the action will be undertaken through

- Incorporating the strategic approach of enhancing and promoting the option of grid interactive power generation using renewable energy sources in state energy policy.
- Formulating preferential tariff structure for renewable energy option.
- Attracting private sector investors in solar power projects under Jawaharlal Nehru National Solar Mission (JNNSM) and / or other schemes of Govt. of India in PPP mode
- Submission of proposal for higher budgetary allocation from MNRE for the subsidy disbursement.

Promoting small and medium hydro power project

Manipur has hydro power potential of about 2190 MW (assessed at 60% Load Factor by the Departments the total realizable potential is 1350 MW) which is sufficient not only to meet the local requirement for domestic and industrial purposes but leave surplus for marketing outside. Initiatives in this direction will enhance the renewable energy generation and reduce the share of conventional power supplied to the grid leading to reduction of associated GHG emissions.

Drafting of State Energy Policy

To meet the current and projected future energy demand, to attend energy self sufficiency and for providing energy access to all, it is essential to frame the State Energy Policy. The Energy Policy will broadly incorporate the possible mitigation options to reduce the impact of climate change over the energy sector as an indirect adaptive measure.

Reduction of AT&C losses

The state owned energy sector is suffering from significantly high Transmission and Distribution (T&D) losses (varying between 30% and 50%), while the Aggregate Technical and Commercial (AT&C) losses are even higher, estimated at 62.56% during 2010-11. Reduction of T&D loss is the prime focus for the energy sector as reduction of loss will directly result in increased energy availability, reduction of green house gas emission (power obtained from the regional grid are also fed from fossil fuel based power plant) and reduced pressure on generating station to meet the existing demand.

Promoting Energy Efficiency Practices in the State

The objective of the priority is to create awareness among the different category of consumers (domestic, commercial and public works) on the benefit and necessity of taking up energy efficiency measures.

Promoting Demand side energy efficiency and management measures

Demand side management is an effective energy conservation tool that can not only reduce the energy losses but can also reduce the peak power requirement.

Capacity Building of the agencies in Energy Sector towards promotion of EC measures

Capacity building of the State Nodal Department of energy sector along with convergence with other line departments like Energy Corporation and Regulatory Department is necessary to achieve efficient functioning and implementation of energy

conservation, promotion of renewable energy generation capacity and energy efficiency measures, improved transmission and distribution network, etc.

Table 9.1: Key priorities for State Mission for Enhanced Energy Efficiency and Conservation Sector

S. No.	Sector Thematic Area	Strategies	Status	Type	Nature	Priority	Actors / Agencies	Proposed Budget Estimate 12th FYP (2012-17) Rs. in Cr	Available under Budget Estimate (2012-13) Rs. in Cr	Proposed budget Estimate during 2013-14 Rs. In Cr
1	Promotion of grid interactive power generation, off-grid intervention of solar energy technology option using renewable energy technology, power plants from Solar / Wind / Hydel/ Biomass, etc.	Installation Stand alone type SPV Power Plant (of 1 - 40 kWp), Wind Solar Hybrid system (40 kW), solar street & home lighting system, home solar water heaters (at 9 DC offices, 399 CSCs, 46 Sub-Divn. Offices, 6900 solar street lights, 3340 sq. m. solar water heating system, 5 kW Micro Hydel Projects, etc.)	Ongoing	MI	DP	H	MANIREDA	21.50	20.50	1.00
2		Installation of Solar Power Packs/inverters (10,000 Nos.) and high intensity solar LED Street lights (10,000 Nos.)	Proposed	MI	DP	H	MANIREDA	123.21		10.00
		Installation of 50,000 sq. m. of solar water heating system	Proposed	MI	DP	H	MANIREDA	75.00		5.00
	Promoting small and medium hydro power project	Survey & Investigation of Irang and Tuivai Hydroelectric Projects, Maklang-Tuyungbi HE Project etc.	Proposed & Ongoing	MI	RD	H	Power	20.00	0.25	0.45
		Generation of 5 MW	Proposed	MI	RD	H	MANIREDA	125.00		5.00
3	Drafting of State Energy Policy	Preparation of State Energy Policy	Proposed	MI	PA	H	MANIREDA, Transport	0.50	0.00	0.50
			Ongoing	MI	PA	H	Power	4.00	1.20	2.50
4	Reduction of transmission & distribution (T&D) losses, reduction of aggregate technical and commercial (AT & C) losses	Strengthening of transmission, sub-transmission and distribution systems	Ongoing	MI	IP	H	Power	996.71	50.90	124.60
		Enactment of revenue collection under APDRP / R-APDRP and introduction of pre-paid system on power supply ;	Ongoing	MI	IP	H	Power	88.10	8.50	27.00

Enhanced Energy

S. No.	Sector Thematic Area	Strategies	Status	Type	Nature	Priority	Actors / Agencies	Proposed Budget Estimate 12th FYP (2012-17) Rs. in Cr	Available under Budget Estimate (2012-13) Rs. in Cr	Proposed budget Estimate during 2013-14 Rs. In Cr
		Energy auditing of all Government buildings	Proposed	MI	PA	H	Power			
5	Facilitating development and propagation of non-conventional renewable energy usage	Concerted efforts for development and propagation of non-conventional renewable energy generation system.	Proposed	MI	PA, RD	H	MANIREDA, Power	11.00	0.00	9.00
6	Promoting Energy Efficiency Practices in the State	Awareness for conservation of energy through adaptation of newly introduced CFL, LED, Star labeled appliances of TFL, AC, Frost free Refrigerator, Transformer, etc.	Ongoing	MI	PA, CB	H	Power	0.30		0.10
7	Promoting fuel conservation in transport sector	Conversion of CNG (Compressed Natural Gas) as transport fuel and introduction of green [CNG / solar] public transport [bus] services / system	Proposed	MI	PA, IP	H	Transport	18.00	0.00	9.00
		Phasing out of the old & expired vehicle	Proposed	MI	PA, IP	H	Transport	9.00	0.00	4.50
8	Promoting Demand side energy efficiency and management measures	Providing of electricity access under Bharat Nirman {(Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY)}.	Ongoing	MI	IP	H	Power	11.55	5.00	7.00
9	Capacity Building of the Energy Sector towards promotion of EC measures	Training, Advance Communication System, Relay & Testing Laboratory, works related to Energy Conservation;	Proposed	MI	CB, RD	H	Power	32.50	0.00	1.10
	Total Budget Energy							1,536.37	86.35	206.75

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Table 9.2: Medium Priority List of Actions for Enhanced Energy Efficiency and Conservation Sector

S. No.	Activities	Criteria for Prioritization	Priority	Type	Scale	Nature	Time Frame
1	Increase more rooftop solar heat collectors to provide hot water to the households, and space heating to a growing numbers of home;	Medium implementation constraint and medium importance	M	MI	S	PA	MT
2	Make more subsidies to the entire solar lighting facilities of the individual household including public buildings & government offices.	Medium implementation constraint and lower importance	M	MI	S	PA	MT
3	Incentives / punitive measures to prevent abuse & promote the use of energy efficient devices (both production and distribution)	Medium implementation constraint and lower importance	M	MI	S	PA	MT
4	Choice of practicable clean technologies for energy generation and processes including bio gas, phumdi energy cake	Medium implementation constraint and lower importance	M	MI	S	PA, IP	LT
5	Decentralization of energy application and its state side networking system	Medium implementation constraint and lower importance	M	MI	S	PA, IP	LT
6	Pre- & Post-Environmental Impact Assessment and proper environmental appraisal of the energy generated sources	Medium implementation constraint and lower importance	M	MI	S	PA, IP	LT

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Chapter 10

STATE MISSION FOR URBAN PLANNING AND SUSTAINABLE HABITAT

Chapter 10 : STATE MISSION FOR URBAN PLANNING AND SUSTAINABLE HABITAT

10.1. Introduction

Projected increase in temperature and precipitation will affect certain components of human settlement especially in urban sectors. The likely scenario will be shortage in safe drinking water, repeated flash floods, increase in prices of food commodities, health risks, etc. Urban habitation is highly dependent upon the availability of good infrastructure - such as power, roads, water supply, mass transportation, alongwith civic amenities (like sanitation and solid waste management). In the projected climate extreme scenarios all the major urban sectors mentioned above are likely be adversely affected. It is also worthwhile to mention that energy consumption for domestic heating and lighting, accumulation of solid waste, use of old vehicles with adulterated fuel, etc. are major contributors of Green House Gas (GHG) emission to the atmosphere. Thus, in the above context, it can be brought out that not only the climate change adversely impacts the urban settlement with the level of vulnerability depending upon the population density and urban infrastructure, but urbanization also *per se* impacts the climate.

During recent years, Manipur has experienced higher growth of urbanization (Table 10.1) in comparison to figures for all India and North Eastern Region. The percentage

Table 10.1 : Urbanization Trends of Towns & its Population in Manipur (1901 – 2011)

Year	Total No. of UAs / Towns	Total Population		% of Urban Population to the total population
		State	Urban	
1961	1 No.	780,037	67,717	8. 68
1971	8 Nos.	1,072,753	141,492	13. 19
1981	32 Nos.	1,420,953	375,460	26. 42
1991	31 Nos.	1,837,149	505,645	27. 52
2001	33 Nos.	2,388,634	570,410	23. 88
2011	33 Nos.	2,721,756	822,132	30. 21

Source : Census of India, 2011 (Provisional)

of urban population in Manipur i.e. 27.69% is substantially higher than the average for north-eastern region i.e. 12% and slightly higher than the all India average of 25.72% (*Source: Provisional Census of India, 2011*). About 42.54 % of the total urban population of the state is found settled in the two districts of Imphal East and Imphal West. Most of the urban settlements outside the central valley of Manipur are mainly coming up along the highways with a weak economic base and very poor road linkages to the rural hinterland.

10.2. Impact of Climate Change

The average annual rainfall of Manipur is about 1436 mm and is projected (by INCC) to increase in the coming years with higher intensity of rainfall in certain regions of the state. Frequent flash floods may occur every year during the rainy seasons due to causes like heavy runoff with less infiltration in degraded upper catchment of the rivers, poor drainage condition, etc. The projected increases in precipitation and incidence of extreme events may further increase the vulnerability of the urban population.

The urban poor sanitation facilities like old septic tanks, dry / wet latrines, etc. may cause severe health impact under the occurrences of extreme events i.e. frequent flash flood situation might impact the drinking water and result in outbreak of water borne diseases in the flood scenario. Further, disposal of the waste in the state as landfill is one of the major sources for emission of GHGs in the atmosphere.

The total number of registered motor vehicles has increased with the two wheeler segment comprising of motorcycles, scooters and mopeds growing most rapidly amongst personalized modes of transportation which is emitting maximum Carbon Dioxide (CO_2) and Carbon Monoxide (CO) which add to the pool of GHG in atmonsphere.

10.3. Policy Review

The Department of Municipal Administration, Housing and Urban Development (MAHUD) looks after the urban settlements and the Department of Transport is concerned about the transport system of the state. The following are the key policies in place that will be able to address the impacts of climate change as well to reduce the sectoral contributions to climate change *per se*.

State Policy for Urban Development:

Revision of the existing Master Plans and the state Urban Policy is desirable in the context of contemporary standards and issues. As a rule the urban areas are to be categorized into 5 (five) zones/land use categories viz.[1] Residential zone (low density, medium density, high medium density and high density)[2], Commercial & Industrial zones[3], Public & semi-public zones[4], Recreational & open spaces zone and[5] Agricultural zone. Clear regulations are to be laid down for each of the zones, so that the growth projection and climate change impact must be incorporated at the planning stage.

State Transportation Sector:

In Manipur, the vehicular population has been increasing day by day. Planning is therefore being initiated to promote energy efficient vehicles, use of mass transport, pedestrianism and cycling.

Solid Wastes Management (SWM) Policy :

The Municipal Solid Wastes (Management & Handling) Rule 2000 has been implemented in the state. The Imphal Municipality Council (IMC) has been taking care of the solid waste management within the Imphal Municipal area. However, the existing policy for waste management of the state is to be improved to include the features of scientific management on a sustainable basis.

10.4. Key Strategies

The SAPCC Manipur targets to enhance adaptive capacity for climate change impacts in urban sector as well to create sustainable habitat under the state mission on Urban Planning and Sustainable Habitat as follows (Table 10.2).

Moreover, this mission also targets to enhance adaptive capacity for climate change impacts in urban sector like integrated rain water harvesting, recycling and reuse of waste water, waste recovery and disaster management, etc. as well as create sustainable habitat under the state mission.

Improvement of waste management including waste to bio-energy

This strategy is conceived both as an adaptation and mitigation option. On one hand effective waste management will reduce the risk of water borne diseases caused from weather extremes (like flash floods). Its effective management will reduce the GHG gas emission to the atmosphere. A comprehensive plan for power generation and manure production from Municipal Solid Waste in the state is encouraged under this mission.

Encourage climate sensitive architectural urban infrastructures [water distribution and lighting system at street and public transport system including green and low carbon foot-print pathway

More frequent rainstorms will overload the capacity of sewer systems and wastewater treatment plants more often. Thus, the plans like installation of liquid waste treatment facilities, provision of new sewerage system with treatment plant, collection network, outfalls and sewer cleaning equipment, both rehabilitation of the existing water supply and distribution systems, constitution of water use societies for regular monitoring of services, leak detection and water quality monitoring, etc. are to be encouraged. Shift

Table 10.2 : Pathway for adaptation in urban areas.

Issues	Impact	Pathways
Warm and Humid summer and cold winters	Increased demand for air conditioning	Create awareness to retrofit building with green design; policy incentive for usage star rated Heating, Ventilation and Air-conditioning (HVAC) systems
Heavy and aberrant precipitation	Increased storm-water runoff	Development of storm water management plan and investment in sewerage; re-assessment of master plans/land use plans of urban agglomerations, policy incentive use of permeable surfaces and incorporation in the building codes
Enhanced waste generation due to urban agglomeration by population influx	Health hazards, soil contamination through leaching, odour pollution, methane gas emission	Awareness for waste segregation and policies for environmental management in a sustainable way
Transport system congestion and ageing	Congestion and higher GHG emission	Promotion of Mass Rapid Transit systems, Phase out of old vehicles, integrated traffic study and congestion reduction plan
Energy Usage	Higher concentration and higher use	Utility Demand Side Management (DSM) measures in street lighting, solar water heating
Decline in the Tree in urban areas (TOF)	Decrease in bio-sequestration of atmospheric carbon dioxide, incur significant adverse soil erosion and frequently degrade into wasteland.	Planting heat tolerant trees, city wide programmes for tree watering and maintenance, roadside plantation programme, development of parks and green belts

towards public transport or Mass Rapid Transit system, improved urban infrastructure, , low emission vehicles, electric vehicles in Imphal and other small Town and appropriate urban planning are essential steps to go towards low carbon economy including conversion into CNG as transport fuel.

Encourage green buildings - Leadership in Energy and Environmental Design (LEED) in the line of India Green Building Rating System for Construction

The concept of Green Building and LEED certification by using eco-friendly construction materials like sustainably available wood / bamboo, solar energy both in active and passive manner is encouraged through change of Building bye laws, specially in Governmental buildings.

Implementation of Rain water harvesting as part of building by-laws

Rain water harvesting is a vital alternative source to provide the urban population with safe drinking water. There is need to introduce rain water harvesting programmes as an alternative to provide a solution to scarcity of drinking water for domestic dwellers in the region.

Decentralized policy for urban development

Increased climate hazards coupled with rapid urbanization are likely to put increased strain on local governments as they attempt to respond to the vulnerabili-

ties of the urban poor. The impact of climate change in urban areas is likely to disproportionately affect the poorest and most vulnerable. Their integration in decision-making and policy processes is crucial for building climate resilience.

Capacity building & HRD of ULBs on climate change strategies, CDPs (City Development Plan), CSP (City Sanitation Plan), existing master plans for urban development, etc

The state emphasizes on the need to enhance capacity of the officials on climate change implications and possible adaptive and mitigating measures so that they could include climatic considerations in their departmental planning as well as day to day operational and monitoring activities. Climate friendly master plans for selected cities / towns is to be developed considering the disaster risk of the zones. Understanding the function of the land management and revenue department to protect land from encroachment; land revenue code, ownership titles as provided in the present Land Law of Manipur and reformulation of land tenure policy to enable sustainable urban development is necessary.

Development of green belts in the cities

Urban green belts are considered as lungs of the cities because they act as a sink for some of the harmful gases released by vehicles and industries operating in the city area. Over the years rising population has led to a decrease in open spaces and green belts in the cities. Hence, development of more green belts within the urban areas are suggested.

Table 10.3: Key priorities for State Mission for Urban Planning Sector

S. No.	Sector Thematic Area	Strategies	Status	Type	Nature	Priority	Actors / Agencies	Proposed Budget Estimate 12th FYP (2012-17) Rs. in Cr	Available under Budget Estimate (2012-13) Rs. in Cr	Proposed budget Estimate during 2013-14 Rs. In Cr
1	Clean Development technology	Improvement of waste management including waste to bio-energy like domestic waste to bio-gas, electricity, etc.	Ongoing &Proposed	MT	IP	H	MAHUD	45.00		
							Environment	2.00	0.15	0.65
2	Green urban Infrastructure	Encourage of climate sensitive architectural urban infrastructures	Proposed	MT	PA	H	MAHUD, Transport, PWD	22.50		4.50
		Encourage of green buildings - Leadership in Energy and Environmental Design (LEED) in the line of India Green Building Rating System for Construction	Proposed	MT	PA	H	MAHUD, PWD	22.50		4.50
		Implementation of Rain water harvesting as part of building by-laws	Proposed	MT, AD	PA, IP	H	MAHUD, PHED, Environment	22.50		4.50
3	Decentralization of urban planning & expansion for better environmental management	Decentralized policy for urban development	Proposed	AD	PA	H	MAHUD	5.00		5.00
		Capacity building & HRD of ULBs on climate change strategies, CDPs (City Development Plan), existing master plans, etc	Proposed	AD	CB	H	MAHUD	5.00		5.00
		Improvement of drainage system	Ongoing	MT, AD	IP	H	PHED	20.00		4.00
4	Green urban Infrastructure	Encouragement of public transport system, non-motorized transport system & cycle tracks	Proposed	MT, AD	PA	H	Transport Environment	18.00		9.00
		Development of green belts in the cities	Proposed	MT	IP	H	Environment Forest	20.00		4.00
	Total Urban							182.50	0.15	41.15

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Table 10.4: Medium Priority List of Actions for Urban Planning Sector

Sl. No.	Activities	Criteria for Prioritisation	Priority	Type	Scale	Nature	Time frame
1	Alteration of conventional fuel & blending of bio-fuel in automobile;	Implementation not easy and time taking	M	MT	S	PA	LT
2	Benchmark survey for urban development;	Implementation not easy and time taking	M	MT, AD	S	RD	LT
3	Vulnerability assessment in context of global warming and climate change to address the issue of sustainability of cities.	Implementation not easy and time taking	M	AD	S	RS	MT, LT
4	Strengthening of environmental clearance process and synergizing with other mandatory/voluntary approaches that aim to achieve similar objectives (e.g. synergizing with voluntary rating systems and ensuring due diligence)	Implementation not easy and time taking	M	AD	S	PA	MT
5	Integration of climate change strategies in City Development Plan, existing master plans by MAHUD/Department of Town Planning/Urban Local Bodies, etc.	Implementation not easy and time taking	M	AD	S	PA	MT
6	Rooftop gardens, greening of building surroundings for cooling	Implementation not easy	L	MI	S	IP	LT
7	Formulate and implement local environmental codes/ bye-laws need to be given greater importance to account for city-specific environmental concerns.	Implementation not easy and time taking	M	AD	A	PA	LT
8	Increase office recycling, e.g. paper, cardboard, cans, glass bottles, toner and cartridges	Implementation not easy	L	MI	A	OM	MT
9	Establishment of centres for reusing salvageable goods	Implementation not easy	L	MI	A	DP	MT
10	Purchasing preferences for recycled materials	Less cost effective	L	AD	S	PA	LT
11	Home composting education programme	Implementation not easy and time taking	M	AD, MI	S	PA	LT
12	Consideration of waiving off VAT on bicycles, to encourage these zero emitting vehicles	Less cost effective	L	AD	S	PA	LT
13	Implement policy shifting funding away from roads and highways to alternative transport	Implementation not easy	L	AD	S	PA	LT
14	Consideration of tax on diesel-run vehicles by 25 percent at the time of registration	Implementation not easy	L	AD	S	PA	LT
15	Funding for facility, system and/or infrastructure improvements	Implementation not easy and time taking	M	AD	S	PA	LT
16	Dedicated lanes for transit/ High Occupancy Vehicles (HOV)	Less cost effective, Implementation not easy and time taking	L	MI	S	IP	LT
17	Establish or facilitate road tolls to decrease motor vehicle use	Implementation not easy and time taking	L	AD	S	PA	LT

18	Impose a congestion tax to discourage the use of private cars in cities/towns where "sufficient public transport capacity" has been created.	Implementation not easy	L	AD	S	PA	LT
19	Fiscal incentives and production grants for fuel ethanol and biodiesel	Implementation not easy and time taking	M	AD	S	PA	LT
20	Programmes to provide discounts and other incentives for using public transportation system	Less cost effective	L	AD	S	PA	LT
21	Improve scheduling and route efficiency	Implementation not easy	L	AD	S	PA	LT
22	Change procurement policy to specify high fuel efficiency for each vehicle class.	Less cost effective	L	AD	S	PA	LT
23	Programme to enforce energy labelling with fuel efficiency standards of all new cars and other vehicles sold	Implementation not easy	L	AD	S	PA	LT
24	Set up clean-vehicle quotas for government vehicle procurement programmes	Implementation not easy	M	AD	A	DP	MT
25	Programmes to phase out leaded gasoline, where used	Implementation not easy and time taking	M	AD, MI	S	PA, DP	MT
26	Improve maintenance regime for increased efficiency, e.g. regularly check tyre pressure	Implementation not easy	L	AD	A	OM	MT
27	Tax incentives to promote the use of natural gas	Implementation not easy and time taking	M	AD	S	PA	MT
28	Establish solar PV or other electric vehicle charging station	Implementation not easy and time taking	M	AD	S	PA	LT
29	Subsidies for purchase and use of electric vehicles	Implementation not easy and time taking	M	AD	S	PA	LT
30	Retire old polluting vehicles	Implementation not easy	L	AD, MI	S	PA	LT

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Chapter 11

STATE MISSION FOR CLIMATE CHANGE STRATEGIC KNOWLEDGE AND INFORMATION

Chapter 11 : STATE MISSION FOR CLIMATE CHANGE STRATEGIC KNOWLEDGE AND INFORMATION

11.1 Introduction

The strategic knowledge on Climate Change is to assimilate and upgrade the information of climate change to determine the variability and vulnerability of livelihood. The impact of the climate variations depend on the coping capacity of the people and intensity of conditions arising out of anthropogenic and natural changes which are likely to influence the determinants of climate. It proposes a coordinated mechanism and process with a view to further enhance the effectiveness and impact of the various existing intra- and extra-mural knowledge generating systems. Hence, data sharing among various data sources is necessary for building strategic actions based on knowledge-led paths.

The mission will have an information system on climate science of the state specific modeling, an assessment of various technology scenarios and alternatives, development of new technologies for adaptation and mitigation and ensuring that knowledge gaps, etc. It will be able to access as well as integrate data, information and assessments originating from a large number of interconnected sources.

11.2 Issues and Challenges

There are a number of constraints that limit at present the ability of the national knowl-

edge system to deliver the required and expected outcomes for effective response. Some of the major issues and challenges of the sector are

- Knowledge gaps in key underlying scientific areas
- Insufficient observational and scientific information data base
- Inadequate knowledge on the impacts of climate change in different sectors e.g. water resources, forests resources, biodiversity, agriculture, natural ecosystem, health, etc.
- Fragmented knowledge base in terms of people, institutions and capabilities
- Poor connectivity between and within knowledge generating communities and user communities at various levels
- Lack of a systemic institutional mechanism for collating, synthesizing and delivering knowledge products for decision-making
- Absence of a strong and vibrant global technology watch system
- A knowledge system to relate technology choices with time evolved climate responses
- Absence of a knowledge system to develop various scenario for disaggregated impact assessment, and
- Absence of a knowledge system to make risk-minimized selection of technology choices for meeting the developmental goals.

Further, the Mission will address two important cross-cutting issues as an integral part of the Mission design and implementation, as

- Building human and institutional capacity at various levels, and
- Engaging and benefitting from global collaboration in scientific research & technology development

11.3 Key Strategies to tackle the impact of climate change

Relevant competencies of the sectoral concerned officers, line department, NGOs, clubs and civil societies, ULBs, PRs, Hill councils and communities on the ongoing and proposed climate sensitive activities have to be integrated with the accumulated local knowledge for drawing the mission document and mobilize in a preliminary way. Some of the priority strategies of the mission may be highlighted as

i. Institutional Framework : Development of an institutional network system on regional Climate Change Science knowledge to act as the repository of knowledge about the sectoral demands and needs. This will serve as an effective mechanism for data sharing amongst the climate change researchers. Moreover, this network will play watch dog role during implementation and monitoring of the identified action plan for all the mission.

ii. Vulnerability and Potential as criteria for intervention: Criteria for selection of project areas for all the identified Missions will include projected vulnerability to climate change, potential areas for enhancing carbon sinks (mitigate Green House Gas emission) and the significance of the area from ecosystem services angle.

iii. Robust and effective monitoring mechanism: The proposed institutional network will also help during the implementation of the identified action plan for all the mission and monitoring mechanism will frame at four different levels, like

- Self-monitoring including communities,
- Monitoring by external/ multiple agencies,
- Monitoring by using modern technology like Remote Sensing with GPS mapping of plot boundaries etc. for monitoring at the input/ output/ outcome level.
- The village Council/ Authorities will carry out the social audit of the Mission activities at the village level. The Mission will identify research priorities in support of the Mission aim and objectives.

Table 11.1: Key priorities for State Mission for C limate Change Strategic Knowledge & Information Sector

S. No.	Sector Thematic Area	Strategies	Status	Type	Nature	Priority	Actors / Agencies	Proposed Budget Estimate 12th FYP (2012-17) Rs. in Cr	Available under Budget Estimate (2012-13) Rs. in Cr	Proposed budget Estimate during 2013-14 Rs. In Cr
1	Enhancing stratigic knowledge and sensitization of climate change information network	Activities aimed at mapping of the knowledge base and data resources relevant to climate change for the mobilization of state specific strategic knowledge, institutional support to be provided for the formation of state wide knowledge network and networking of the state level institutions	Proposed	AD	PA, CB	H	Environment	1.00	0.00	0.00
		Performance monitoring of ongoing related / climate change sensitive activities for feasibility assessment and also the budget analysis	Proposed	AD	PA, CB	H	All the line Department	0.50	0.00	0.00
		Research on identified state mission for climate change action plan and different climate change sensitive sectors	Ongoing	AD	RD	H	Environment	2.50	0.50	0.50
		Preparation of mission paper for all the identified state mission under SAPCC Manipur	Proposed	AD	PA, CB	H	Environment	0.80	0.00	0.00
2	Climate change monitoring infrastructure development	Augment the existing climate change monitoring stations / infrastructure (automated weather stations, Green house gas monitoring, etc.)	Ongoing	AD / MT	PA / RD	H	Environment	2.50	0.40	1.60
		Total						7.30	0.90	2.10

Note :
Type : MI-Mitigation; AD – Adaptation;
Nature : PA – Policy Action, RD – Research & Development, DP – Demonstration Project, IP- Investment Project, CB – Capacity Building
Priority : H – High, M – Medium, L – Low

Table 11.2: Medium Priority List of Actions for Climate Change Strategic Knowledge & Information Sector

Sl. No.	Activities	Criteria for Prioritisation	Priority	Type	Scale	Nature	Time frame
1	Study the climate data and the project the climate changes for the vulnerability assessment at the regional and local level	Medium implementation constraint and medium importance	M	AD	S	PA, CB	LT
2	Identification of research gap in each identified sectors with review of existing sectoral policies and strategies	Medium implementation constraint and medium importance	M	AD	S	PA, CB	LT
3	Prioritisation of all the national and state policies and for climate change on local suitability and time factor as well as resource availability	Medium implementation constraint and medium importance	M	AD	S	PA , CB	LT
4	Tasks related to managing surface and ground water resources. Also updating the water harvest, storage, distribution of infrastructure and conservation of water bodies especially wetlands, lakes, rivers etc	Medium implementation constraint and medium importance	M	AD	S	PA, CB	LT
5	Promote sustainable agricultural practices with application of scientifically advanced technologies in agriculture and horticulture through macro management mode of agriculture, encourage of indigenous fish culture and climate resistant breed, encouragement of indigenous and climate resistant livestock, R & D, HRD	Medium implementation constraint and medium importance	M	AD	S	PA, CB	LT

Note :
Type : MI-Mitigation; AD – Adaptation;
Nature : PA – Policy Action, RD – Research & Development, DP – Demonstration Project, IP- Investment Project, CB – Capacity Building
Priority : H – High, M – Medium, L – Low
Scale : S – State, D – District, B – Block
Time Frame : LT – Long Term, MT – Mid Term, ST – Short Term

Chapter 12

ANALYSIS AND SYNTHESIS

Chapter 12 : ANALYSIS AND SYNTHESIS

12.1. Introduction

The set of key adaption and mitigation actions planned under each identified sector are analyzed to arrive at a set of key priorities. Certain cross cutting areas are also identified. These were synthesized to arrive at findings, which describe what the state climate change action plan will achieve. A new institutional arrangement is proposed for implementation of the proposed initiatives. The independent monitoring and evaluation framework is required to ensure effective implementation of the actions proposed under the climate change action plan.

12.2 Findings

Some of the key findings from the discussion with various stakeholders may be described as:

Changes in policies and practices:

Analyzing the key priorities revealed that orientation on climate change and its impact needs to be provided at different sectors in different levels like policy, organizational, practices, etc. Policies need to integrate climate change considerations. At an organizational level, awareness, skills and capacity has to be built. And, at the practice level, implementation of programmes will have to shift towards a more climate-friendly, low carbon and sustainable developmental path. Marginal/incremental actions will not suffice and there are significant actions required at all these levels to move on a climate-friendly and sustainable development path.

Awareness generation and capacity building:

Considering that the issues of climate change related impacts are a relatively new challenge, the focus should be on generating awareness and building capacity at all levels of the society. Similar actions should be planned to be carried out across all levels of the government departments and external stakeholders involved in the different sectors including the residents of the state. This strong drive towards building capacity will result in empowering people and organizations to be able to address, manage and respond to climate change concerns.

Action implemented across the economy:

Given the all-pervading nature of climate change, action will be taken across the state economy. The inter-connectedness of issues pertaining to climate change necessitates this approach. Selecting and initiating work only in some of the sectors will undermine the effectiveness in an overall sense.

Therefore, progress is to be planned across all the identified sectors in a parallel and simultaneous manner.

Climate-intrinsic sectors distinguished:

Broadly, the different sectors can be classified as climate-intrinsic and climate add-on sectors. Climate-intrinsic are sectors that are so heavily associated with climate change that every action within these sectors have a strong bearing or related to climate change. These include eco system, forest, water and agriculture. Climate add-on sectors are those wherein the climate dimension is additional, e.g. energy, health, transport and urban. While the key priorities across all these sectors is required to be met, the nodal department along with the government should recognize that every activity – particularly any new policies, organizations and initiatives - in the climate-intrinsic sectors should have a strong association with climate change.

Integrated perspective imperative:

To be effective in implementing initiatives pertaining to the key priorities, it is important to have an integrated outlook and not work in isolation. This will be required to address the climate change adaptation and mitigation actions in a holistic manner.

Carbon-conscious development:

Various mitigation initiatives are identified and planned across different sectors to ensure that the state of Manipur proceeds on a carbon-conscious development path.

Biodiversity in addressing livelihoods:

The key adaptive strategy being envisaged in the climate change action plan will facilitate conservation of biodiversity including restoration and rehabilitation which will help vulnerable people, mostly those are forest and natural resource dependent and from economically backward strata, to cope with climate change. Biodiversity plays a central role in ensuring livelihoods especially amongst forest fringe and indigenous communities. The climate change adaptation so planned will aim at integrated management of biodiversity, thus immensely facilitating the poverty reduction and food security planning in the state.

Building climate resilience:

It is important to note that policy and planning must sync to have climate resilient outcome. The different adaptation initiatives being planned will ensure better preparedness of the state to climate-induced changes, including extreme events as climate change adaptation is an integral part of good development.

12.3. Cross cutting issues

Every sectoral chapter deliberated on the relevance of climate change concerns and identified key priorities. After the identification of the key priorities it was realized that implementing many of the activities pertaining to the key priorities have cross cutting relevance. Various activities proposed under the climate change action plan have cross cutting relevance. Implementation of activities pertaining to these cross cutting issues will require intervention of the government at the highest level to ensure that there is inter-department co-ordination.

Multi stakeholders co-ordination

Managing climate change requires multi-sectoral coordination and commitment of the stakeholders. The stakeholders should consider the vulnerability, priorities and inter-sectoral coordination and indicators for tracking the climate change phenomenon and its impact as well the resultant effect of their interventions at all levels. Although not new, the collaboration across the sectors — private, public and civil society— has traditionally been defined by a single issue. 'Convergence' is a rather complex form of collaboration involving multi-stakeholder coalitions, seeking to effect systemic change on wide-ranging issues, focused on outcomes rather than inputs to deliver tangible and sustainable change. The multi sectoral approach will also address the issue of complementarities and avoid duplication of efforts or resource deployment. The table outlines idea about crosses sectoral relevance and contemplated action:

Table 12.1: Cross Sectoral Issues

Sl. No.	Cross sectoral issues	Description
1	Promoting water use efficiency	Requires technologies, methods and mindset change in practices. Important both from a climate change adaptation as well as a mitigation (e.g. energy-efficient water supply) perspective. Water resources, agriculture, urban and rural are main sectors that are concerned with water.
2	Institutionalizing Energy-use efficiency	Requires technologies, methods and mindset change. Important from a climate change mitigation perspective as it leads to reduced carbon emissions. Energy-use efficiency needs to be promoted across all sectors that include energy, urban, water, agriculture, rural and transport.
3	Transport and urban planning	Reducing transport emissions is best achieved by addressing the source, i.e. the need for transportation. Through integrated urban and transport planning, this can be achieved involving transport, urban and works.
4	Rural development planning	Water is an important factor in development planning. With climate change induced variability to water availability, rural development planning will need to be suitably strengthened. This will involve different sectors – agriculture, water, rural development and energy.
5	Biodiversity – forests, agriculture	This pertains to biodiversity relevant to forests and agriculture that can be maintained to have a better adaptability to climate change.
6	Basin management/flood plain management	Basin-level water resource planning is an integrated approach to determine how the water available should get apportioned to various applications. Flood management is a part of this basin-level planning. With the climate change inducing precipitation variability, the basin level planning will need to be further strengthened. Involves all sectors that need and use water, primarily agriculture, rural and urban.
6	Livelihoods support	Climate change impacts are likely to be borne by the most vulnerable, i.e. the poor. All community based livelihoods support programme in the different sectors, e.g. agriculture, health and rural development programmes, will have to consider climate change dimensions as this has the potential to aggravate an existing problem.

Planning Process

Under the Climate Change programme, sectoral programs are planned and under sectoral programs key priorities are framed. The projects/ subprojects are broadly categorized as:

a. Investment projects that need to be planned in a participatory manner involving community, line departments, NGOs, academicians or other groups integrating climate change concerns. However, wherever possible the so called "stand-alone" projects could also be executed; these interventions should eventually be integrated at district level planning processes and shall be used as entry level activities to kick-start climate change adaptation measures. A multi-stakeholder involvement at the planning stage (including private sector and policy makers) is therefore highly recommended.

b. Regular Operational and Maintenance: Efforts shall be made to identify the O&M budget in the existing projects to find out how these can be made climate resilient.

c. Policy research: This kind of actions shall be targeted and carefully chosen with simple criteria that it should have short to medium term effect as well in the line of least resistance and fully targeted and tied to a specific climate linked result.

d. Training & Capacity Building type of projects shall include: Sponsorship for training needs (GIS, accounting, micro planning, Carbon monitoring training, Climate modeling), Exposure visit and extension.

Cross cutting requirement

Apart from the cross cutting relevance, there are also cross cutting needs. In other words, these are required across all the individual sectors. The following table lists these requirements/needs which are required to be addressed towards effective planning and implementation of its overall response towards climate change.

12.4. Institutional Arrangement

The Climate Change Action Plan revealed the inter-sectoral and inter-departmental nature of climate change response action. In preparing the Climate Change Action Plan, different groups have been constituted through representation from various departments. These deliberations revealed that implementation also requires strong inter-sectoral and inter-department co-ordination. To meet this need, a dedicated Climate Change Agency is to be put in place to facilitate and monitor the implementation. This will have an advisory and coordinating role on climate change issues. This Agency will be a single-window contact for dealing with the state government and other external funding agencies in issues pertaining to uptake of climate change related proposed actions. The agency will be with the Environment & Forest Department of the state. However, the agency's role will include and involve all sectors and all departments. It is envisaged that this agency will function in an independent and autonomous manner so that it can execute its various roles, responsibilities and duties in a smooth, quick and effective manner.

The Agency will be equipped with appropriate quality manpower, resources and infrastructure that are commensurate with the requirements and challenges faced. The Agency's functioning style will be collaborative and inclusive, not only within Departments of the Government but also with the different external stakeholders. The climate change institutional structure is illustrated as follows:

Table 12.2: Monitoring and Evaluation Framework

Sl. No.	Title	Description
1	Awareness	• Climate change is a relatively new issue. Awareness within the government departments and civil society associated with the different sectors needs to be strengthened. • Local Level: Creating local level awareness is first step, e.g. barefoot workers, framers, field schools may promote descaled climate change Concerns. • State Level: Building awareness of legislators, policy, makers on socioeconomic and socio-political cost of climate change • Linkages to national programmes/missions: Participation in national networks, interface with the national knowledge network and research systems
2	Capacity building And community empowerment	• Awareness is the first step. The next is to build the capacity – knowledge, skills and resources – to be able to address climate change concerns. This is again a need across all the individual sectors. • *Local:* Monitoring, observation, Awareness/assessment at state/ district/community levels. • *State:* Scientific assessment, measurement, models, with state level technical institutions like state pollution control board, biodiversity board, wet land authority , Regional Centres of National Institution, Universities • Linkages to national programmes/missions: Special regional modelling and assessments, best practices study and resource leveraging from various missions and mission resource centres and technical secretariats.
3	Information needs	• Information on the climate change impacts/implications of different sectors is not readily available. Both top-down (from climate projections) as well as bottoms-up (from collecting empirical data / information) approach is required for all sectors that are impacted due to climate change, e.g. water resources, agriculture, forest and disasters. • *Local:* Local specific databases, scenarios and assessment, local monitoring networks, rapid assessment for input to state inventory • *State:* Research networks, Compilation of state level GHG inventory and input to National databases(e.g. NATCOM), scientific and policy models, state wide and area specific scenarios, technology inventory • Linkages to national programmes/missions: Interface with IPCC assessments, interfacing with regional/global databases, scenarios and assessments, technology inventory
4	Estimation of extent of emissions and impacts	• While all individual sectors recognize the climatechange relevance, there is no data / information to the extent to their sector contributes to the overall emissions. There is also no data / information to the extent the sector has to adapt to climate change impacts. Such estimation is a common need.
5	Integration with state planning processes, Institution Partnership	• Climate change is relevant across a number of activities within each individual sector. As these activities are planned as a part of the overall annual state planning, it is required for each sector to integrate climate change concerns into their respective planning. Development planning needs to integrate climate change concerns. • Local: Community initiatives, Early warning networks, Disaster management teams. • State: Stakeholders networks, public/private programs • Linkages to national programmes/missions: Standardised Climate impacts assessment both academic as well more applied ones for result based management and programming

6	Policy/ Instrument	• Policy level intervention is highly essential for both planning and implementation of the action plan under climate change. • Local: Locality specific adaptation plans, community based adaptation programs • State: Scientific evidence and policy linkage, mainstreaming climate change agenda in sectoral policies of the state (agriculture, energy, water, forestry, etc.) economic instruments (e.g. insurance, R&D funds), integration with national development/ planning process. • Linkages to national programmes/missions: Adaptation funds, Interface with private sector participants for fund under market mechanisms like CDM, REDD+, scientific exchange, technology transfer

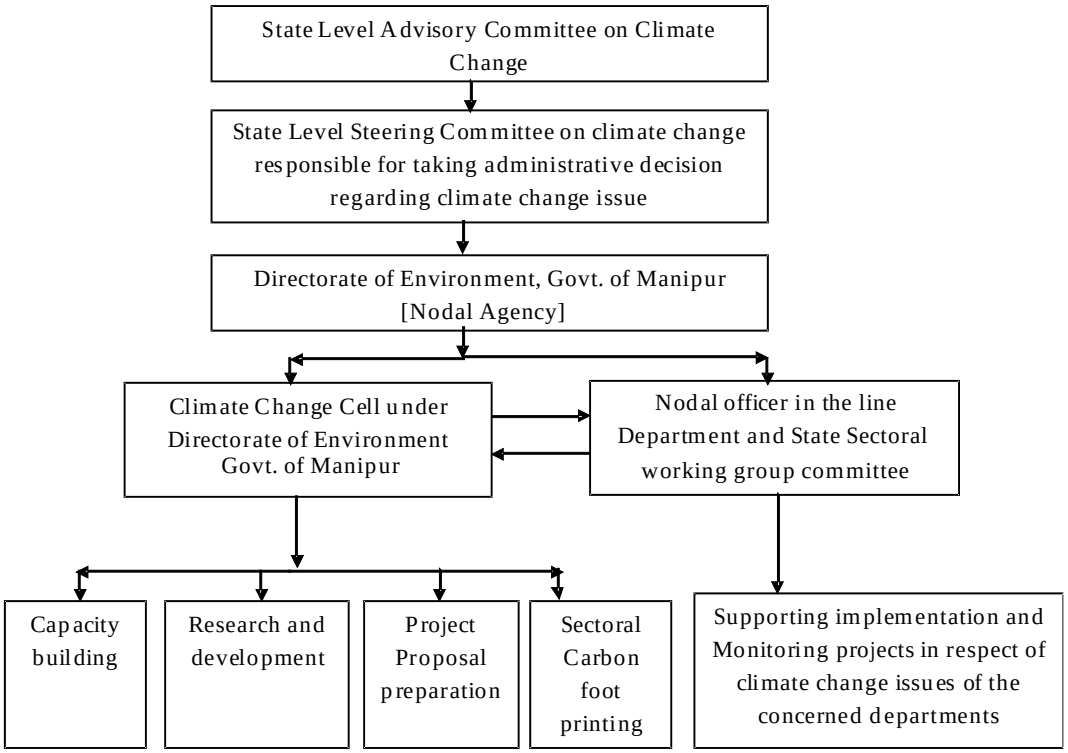


Fig. 12.1 : Proposed climate change institutional structure

As part of the institutional arrangement a climate change cell will be formed and housed within the environmental and forest department. The cell (project management unit) under supervision of the environment and forest department will have an advisory, supervisory and coordinating role in climate change issues. The cell will be nodal point facilitation centre to coordinate with Government of India, state departments and external funding agencies. The cell will also undertake the following tasks

1. Preparing working documents - Manual for design and Implementation of sub-projects, baseline establishment, O&M concepts, monitoring of subprojects, performance based incentive schemes.

2. Preparation of decision making - Prescreen of sub-project applications; screening criteria; sanctioning of sub-projects, etc.

3. Project management – Activity schedule, indicators in a participative manner with stakeholders and implementing agencies & administration.

12.5. Financial Budget

Each sectoral chapter put together a budget for the initiatives proposed to meet the key priorities. There are a number of ongoing initiatives, which are also relevant to climate change; these budgets have also been included in determining the overall budget for the climate change action plan. The additional resources required in each sector has also been estimated and resources for these will be planned by the nodal agency in association with the state planning department and concerned depart-

ment. The following table provides the budget estimate of the climate change action plan:

Table 12.3: Budget Estimate for the SAPCC, Manipur

Sl. No.	Particulars	Approx. Amount (Rs. Crore)
A	Sectors	
1	State Mission for Ecosystem Biodiversity & Livelihood Sustainability	93.50
2	State Mission for Water Resources	958.00
3	State Mission for Sustainable Agriculture Practices	253.38
4	State Mission for Health	83.50
5	State Mission for Forest Resources Conservation	800.00
6	State Mission for Enhanced Energy Efficiency and Conservation	1,536.37
7	State Mission for Urban Planning	182.50
8	State Mission for Climate Change Strategic Knowledge & Information	7.30.00
	Sub-total:	*3,914.55*
B	Institutional Arrangements	
1	Establishing new State Climate Change Agency	TBD
2	Independent external Monitoring & Evaluation	TBD
	Sub-total:	TBD
	Grand Total (Approx)	3,914.55

Note : TBD = To be decided

12.6. Monitoring and evaluation framework

A key part of a climate change action plan has to be:

- The monitoring of impacts of climate change and of progress in achieving key targets proposed under state climate change action plan and
- The evaluation of programs undertaken to mitigate the green house gas emission to atmosphere as well as to adapt to its consequences.

Both the monitoring and evaluation have to be done regularly and a feedback loop should be established so that corrective action can be taken in the case of:

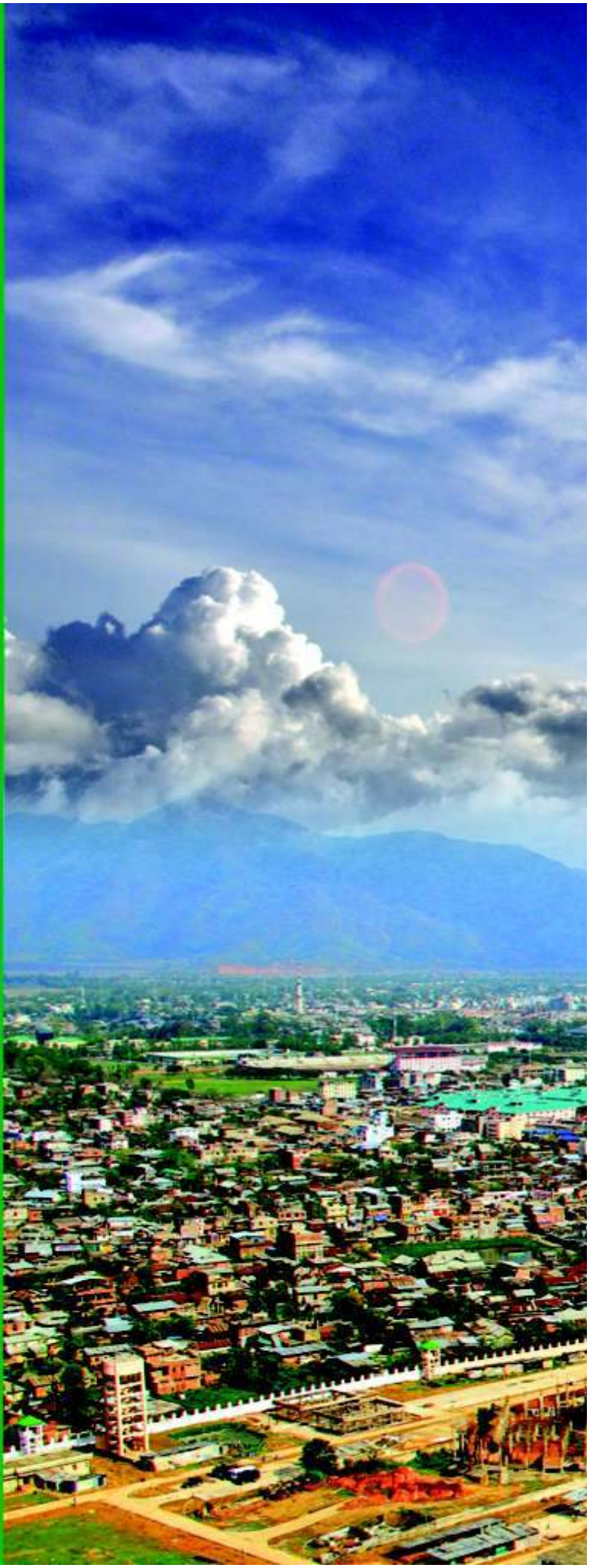
- Impacts being more or less severe than originally anticipated,
- Key targets not being attained in a timely manner and
- Programs underperforming.

In the case of Manipur climate change action plan, the main areas where monitoring will

12.4. Monitoring and Evaluation Framework

Area	Key Impacts to Monitor	Targets to Monitor	Key Programs to Evaluate	Frequency	Feedback Loop (if any)
Agriculture	Changes in yields for key crops, Frequency of crop failures	Irrigational facility, Addition to areas under perennial plantation. Adoption of improved seed varieties	Micro irrigation and farm ponds Perennial plantation program	3 years	Adjust budgets. Modify programs.
Energy	Emissions of CO_2. Emissions intensity	No of renewable power project implemented Losses in T&D in state systems Installation of solar power Generation of energy from biogas	Wind and solar programs Biogas promotion program Energy department capacity building program T&D Loss Program Energy saving/demand management program.	3-5 years depending on program	Adjust programs if not successful. Tighten or loosen targets based on experience.
Forests	Loss rates for forest biomass, flora , fauna and endangered species	Reforestation rates Reduction in loss of forests Losses from fires	Reforestation / afforestation program Forest conservation program Fire management program Capacity building in forest fringe area	5 years	If programs do not meet targets modify allocation of budgets

Area	Key Impacts to Monitor	Targets to Monitor	Key Programs to Evaluate	Frequency	Feedback Loop (if any)
Health	Incidence of vector borne diseases Incidence of water borne diseases	Vector borne disease impacts relative to baseline Water borne disease impacts relative to baseline	Vector borne disease program Water borne disease program	3 years	Modify programs according to evaluation
Transport		Bulk transport Use of biofuels Trees planted on highways No of electric operated vehicles	Bulk transport promotion program Biofuels program Tree plantation program Emission check up program	3 years	Modify funding for programs failing to meet targets.
Urban		Water use efficiency indicators Waste collection rates No of energy efficient street light installed Average energy efficiency in buildings	Water use efficiency programme Waste collection program Water supply connection program Energy efficient lighting program Promotion of energy efficiency in buildings		Modify funding for programs failing to meet targets.
Water	Frequency of rainfall in different seasons, water level in the river	Accuracy of flood forecasting Water use efficiency rates No of harvesting structures built Drainage of water indicator	Flood forecasting program Water use efficiency program Water harvesting structures investment program Improvement of drainage program Environmental flow in wetlands program	3-5 years depending on program	Modify funding for programs failing to meet targets.



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