GOVERNMENT OF NAGALAND

Nagaland State Action Plan on Climate Change

Achieving a Low Carbon Development Trajectory

Version 2012.2

Supported by GIZ

Table of Contents

List of Figures

List of Tables

List of Boxes

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FOREWORD

The hilly topography, the high dependence of its population on natural resources, and the lesser developed status of the state makes Nagaland highly vulnerable to impacts of climate change. The projected increase, during the period 2020-2050, in annual average temperature by 1.6 – 1.8 degree Celsius, annual rainfall by 15-20 per cent, increase in extreme events poses a massive challenge, but also provides the State with opportunities to change its development trajectory towards better management of environment and resources while providing for the livelihoods of its communities.

Climate Change is likely to have adverse impacts on climate sensitive sectors of water resources, agriculture and allied services, biodiversity and forests. Human health is another area of concern. A threat such as climate change thus calls for timely and coherent policy response and action that will help reduce vulnerability and build resilience of the State to projected climate impacts.The State Government has already initiated number of activities to meet the challenge of adapting to climate change in these sectors. The National Action Plan for Climate Change (NAPCC) and the eight missions provide the State Government with an opportunity to upscale its adaptation efforts, and while engaging with national policies and programmes, develop well-researched mitigation and adaptation strategies to respond effectively to the possible impacts of climate change.

The State Government has approached the task of preparing the Nagaland State Action Plan for Climate Change (NSAPCC) through a consultative process involving all stakeholders, and in addition to a core team of senior officers, working groups were constituted in the identified key sectors of water resources, integrated agriculture, biodiversity and forests, human health, urban habitats, energy as well as to look into the cross –cutting issues of livelihoods, and research and development. The team was also assisted by consultancy services provided by GIZ and aided by earlier work done by Indian Institute of Science and KfW, and has come out with a well-researched action document.

In addition to identifying the strategies and actions thereof, the process of preparation of NSAPCC has also helped in familiarisation and capacity building of the involved stakeholders on climate change. Capacity building, re-engineering of delivery systems, and finding the necessary financial resources for the identified activities will be a challenge and key to ensuring that the NSAPCC is implemented in its full. As the knowledge base and experience in handling climate change issue evolve in the state, the country and the rest of the world, the strategies and actions will be further fine-tuned in sync with the requirements.

1.9.12

(LALTHARA)

Acknowledgments

The National Action Plan on Climate Change (NAPCC) recommends that each State develops its own Action Plan for Climate Change (SAPCC), which captures the State specific vulnerabilities due to climate change, and addresses these through State specific adaptation strategies while contributing to the national mitigation efforts. This approach addresses the geographic diversity in the country and also takes into account the many initiatives that have been taken up by the States, and the communities.

The task of bringing together the diversity of traditional practices of the Naga tribes, the policies and programs of twenty five departments, and the State specific climate change projections into the Nagaland State Action Plan for Climate Change (NSAPCC) was not easy. It involved contributions from a large number of stakeholders. This would not have been possible without the support and valuable contributions provided by a cross-section of officers, and the assistance provided by consultants appointed by GIZ. This group not only brought in their own experiences, but also undertook an extensive exercise of consultations with ground level officials, farmers, workers and civil society. They also undertook desk reviews of government plan documents, interacted with officials and simultaneously learnt new tools and methods to analyze the existing policies and programs to cull out the adaptation and mitigation components, as well as highlight the gaps. The nodal officers from each of the twenty five departments/organisations very enthusiastically spared their time, despite being involved in their departments own activities, and were always available for discussions, brainstorming and fine-tuning of the sectoral papers undertaken as part of the preparation exercise. The names of the officers are listed at Annexure 1.

Ministry of Environment & Forests, Government of India and GIZ India, the German Technical Aid agency provided financial resources and support by appointing International Resources Group Systems South Asia Pvt. Ltd (IRG SA), who helped in sensitizing the officers, doing the initial field visits and analysis of government programs and policies. Smt. Sumana Bhattacharya, Shri Srinivas Krishnaswamy, Shri C.K. Rao and Shri Sanjay Vashisht, recruited by GIZ India, thereafter took over and aided in preparing the sectoral papers. Shri Sunder Subramanian, with his vast experience of working in Nagaland came in towards the last part to provide his incisive edits. Shri Sanjay Tomar, Senior Advisor of the Natural Resources Management Programme of GIZ was steadfast in his support throughout the preparatory exercise.

Late Raj K Verma was a passionate advocate of climate change and his invaluable contributions till his untimely death was a huge support. The task force members Shri Albert Solo, Shri Elusing Meru, Shri Temjenyapang and Shri Vengota Nakro were the constants who were there during all the brainstorming sessions, editing, organizing numerous meetings and workshops.

Last but not the least, the NSAPCC wouldn't have been possible without the constant support and encouragement provided by Shri M.C. Konyak, Minister (Forests & Environment) Nagaland, Shri Lalthara, Chief Secretary, Shri Alemtemshi Jamir, Additional Chief Secretary & Development Commissioner and Shri Temjen Toy, Commissioner & Secretary, Works & Housing, Nagaland.

Amardeep S Bhatia, IAS
Commissioner & Secretary, Government of Nagaland
and Task Force Chairman

Abbreviations/Acronyms

Acronym	Expanded Form
ACA	Additional Central Assistance
ADB:	Asian Development Bank
AIBP	Accelerated Irrigation benefits Programme
AT&C	Aggregate Technical and Commercial
AUWSP	Accelerated Urban Water Supply Programme
BDP	Block Development Officer
BNP	Bharat Nirman Programme
BSNL	Bharat Sanchar Nigam Limited
CADWMP	Command Area Development and Water Management Programme
CAGR	Compounded Annual Growth Rate
CCAPN	Climate Change Action Plan for Nagaland
CCL	Climate Change Leader
CDM:	Clean Development Mechanism
CEA	Central Electricity Authority
CEO	Chief Executive Officer
CFVI	Composite Forest Vulnerability Index
CGWB	Central Ground Water Board
CHC:	Community Health Centre
CIC	Community Information Centres
CIDA	Canadian International Development Agency
DIFC	Department of Irrigation and Flood Control
DOEACC	Department of Electronics Accreditation of Computer Courses
DoEI	Department of electrical Inspectorate
DoHFW	Department of Health and Family Welfare
DoIC	Department of Industries and Commerce
DoNRE	Department of New and Renewable Energy
DoP	Department of Power
DPDB	District Planning and Development Board
DRDA	District Rural Development Agency
DSWC	Department of Soil and Water Conservation
EH	Eastern Himalaya
ENPO	Eastern Naga People's Organisation
EPIP	Export Promotion Industrial Park
ESI	Environmental Sustainability Index

Acronym	Expanded Form
FDA	Forest Development Agency
FDI	Foreign Direct Investment
FMP	Flood Management Programme
GoI:	Government of India
GoN	Government of Nagaland
GSDP:	Gross State Domestic Product
GSI	Geological Survey of India
HKH:	Hindu Kush Himalaya
HYV:	High Yielding Varieties
ICAR:	Indian Council for Agriculture Research
ICEF	India-Canada Environment Facility
ICFRE:	Indian Council for Forestry Research & Education
IDSP	Integrated Disease surveillance Programme
IFMR	Institute for Financial Management and Research
IGC	Industrial Growth Centre
IGNOU	Indira Gandhi National Open University
IHDMS	Integrated Health Data Management System
IHR:	Indian Himalayan Region
IIDC	Integrated Infrastructure Development Centre
IISc	Indian Institute of Science
IMD:	India Meteorological Department
IMR:	Infant Mortality Rate
INCCA:	Indian Network for Climate Change Assessment
IPCC:	Intergovernmental Panel on Climate Change
IT	Information Technology
IUCN	International Union for Conservation of Nature
IWMP	Integrated Water Management Programme
JE	Japanese Encephalitis
JFM	Joint Forest Management
JNNURM:	Jawaharlal Nehru National Urban Renewal Mission
KfW:	Kreditanstalt für Wiederaufbau
KVK:	Krishi Vikas Kendra
LAPA:	Local Action Plan on Adaptation
LEAD	Leadership for Environment and Development
LPG	Liquefied Petroleum gas
MDONER	Ministry of Department of North East Region
MLA	Member of Legislative Assembly

Acronym	Expanded Form
MoEF:	Ministry of Environment and Forest
MoUD	Ministry of Urban Development
MoWR	Ministry of Water Resources
NABARD:	National Bank for Agricultural and Rural Development
NAP	National Afforestation Programme
NAPCC:	National Action Plan for Climate Change
NBCC	Nagaland Baptist Church Council
NBDA	Nagaland Bamboo Development Agency
NBHM	Nagaland Beekeeping and Honey Mission
NBRC	Nagaland Bamboo Resource Centre
NBSAP	National Biodiversity Strategy and Action Plan
NCDC	National Centre for Disease Control
NDMA	National Disaster Management Agency
NEC	North East Council
NECCAP	North East Climate Change Adaptation Programme
NEDFI	North East Development Finance Corporation Limited
NEPED	Nagaland Empowerment of People through Economic Development
NEPeD	Nagaland Empowerment of People through Energy Development
NER	North East Region
NERC	Nagaland Electricity Regulatory Commission
NERCCDIP	North East Region Capital Cities Investment Development Programme
NERLP	North East Rural Livelihoods Programme
NERUDP	North East Region Urban Development Programme
NGO:	Non-Governmental Organisation
NH:	National Highway
NIDC	Nagaland Industrial Development Corporation
NLCPR	Non-Lapsable Pool of Central Resources
NMA	Naga Mothers Association
NPCB	Nagaland Pollution Control Board
NRCD	National Rivers Conservation Directorate
NREGA	National Rural Employment Guarantee Act
NRLM	National Rural Livelihoods Mission
NSDP	Net State Domestic Product
NSS	National Sample Survey
NTFP:	Non-Timber Forest Produce
NVBDCP	National Vector Borne Disease Control Programme
NWMP	National Water Quality Management Programme

Acronym	Expanded Form
ONGC	Oil and Natural gas Commission
PHC:	Primary Health Centre
PHED	Public Health Engineering Department
PoU	Programme Operations Unit
PPP:	Private Public Partnership
PRI:	Panchayati Raj Institutions
PWD:	Public Works Department
REDD:	Reducing Emissions from Deforestation and Forest Degradation
RKVY	Rashtriya Kisan Vikas Yojana
RKVY:	Rashtriya Krishi Vikas Yojna
RNTCP	Revised national Tuberculosis Control Programme
RRT	Rapid Response Team
RSPM	Respirable Suspended Particulate Matter
SAC:	Space Applications Centre
SAPCC:	State Action Plan on Climate Change
SARS	State Agricultural Research Station
SEZ:	Special Economic Zone
SGSY	Swarna Jayanti Gram Swarozgar Yojana
SPM	Suspended Particulate Matter
SSC	State Steering Committee
ST	Scheduled Tribe
T&D	Transmission and Distribution
THI	Temperature-Humidity Index
TRC	Terrace Rice Cultivation
UDD:	Urban Development Directorate
UNFCCC:	United Nations Framework Convention on Climate Change
VC	Village Council
VDB	Village Development Board

Chapter 1

Introduction

1.1 Background and Context

Climate change is arguably the most urgent global challenge today. The future of the environment and the life it supports rests on the decisions we take over the coming years. This represents an enormous responsibility on our shoulders, which is not only a burden—but also a tremendous opportunity for us all. Climate change is expected to hit developing countries the hardest. Its effects—higher temperatures, changes in precipitation patterns, rising sea levels, and more frequent weather-related disasters—pose risks for agriculture, food, and water supplies.

Though all possible consequences of climate change are yet to be understood, it is now established that adverse impacts are likely from increased frequency of extreme weather, floods and droughts, and submergence of coastal areas due to sea level rise and extreme climate variability. Impacts of climate change are also likely to be iniquitous -- the poor, women, the aged, and the very young – especially in underdeveloped or developing area contexts are relatively more vulnerable due to their greater dependence on climate-sensitive sectors like agriculture, fisheries, and forestry for their livelihoods or their limited adaptive capacity. The poor status of infrastructure and essential services in most of the poverty-affected areas also limits their ability to cope with adverse impacts of climate change. At stake are recent gains in the fight against poverty, hunger and disease, and the lives and livelihoods of billions of people in developing countries.

Climate change no longer remains a distant theoretical possibility or an academic rhetoric; but is an unconcealed reality. The deep interconnections between the vulnerability of natural and human systems to climate change calls for expeditious coping strategies and response measures. Climate proofing of vulnerable sectors, programmes, natural systems and communities by integrating adaptation and mitigation options into planning process and interventions are increasingly becoming an integral part of development/environment lexicon and action worldwide.

1.2 The National Context

Climate change is expected to manifest quite significantly in India[1]. India is considered highly vulnerable to climate change, not only because of high physical exposure to climate-related disasters (65 percent of India is drought prone, 12 percent flood prone, and 8 percent susceptible to cyclones), but also because of the dependency of its economy and majority of population on climate-sensitive sectors (e.g. agriculture, forests, tourism, animal husbandry and fisheries). Climate change shall induce changes in the complexion, distribution, quality and functionality of natural resource base. Further, it will result in 'insecure livelihoods' due to disruptions in the social, cultural, economic, ecological systems, physical infrastructure and human assets; increasing health risks, and crippling or even negating the developmental gains and opportunities.

Addressing climate change calls for a wide array of policy responses and strategic actions at local, sub-national, national and global levels. Recognizing that climate change is a global challenge, India has engaged actively in multilateral negotiations in the United Nations Framework Convention on Climate Change (UNFCCC). The objective is to establish an effective, cooperative and equitable global approach based on the principle of 'common but differentiated responsibilities and respective capabilities'. India's immense geographic diversity adds to the complexity of developing and implementing a climate response strategy. As the impacts will vary across states, sectors, locations and populations, there can be no 'one-size-fits-all' climate change strategy. Approaches will need to be tailored to fit specific sub-national contexts and conditions.

India's National Action Plan on Climate Change, 2008 (NAPCC), with its eight national missions, is designed to achieve sustainable development with co-benefit of climate change. The focus of NAPCC is

[1] A Framework for preparation of the State Level Action Plans on Climate Change, MoEF, 2010.

on promoting understanding of climate change, adaptation, mitigation, energy efficiency and natural resource conservation while pursuing overall economic growth – i.e., measures that promote development objectives which also result in co-benefits for addressing climate change. There are eight National Missions (see Box 1), which form the core of the NAPCC, representing a "multi-pronged, long-term and integrated strategies for achieving key goals in the context of climate change:"

Box 1: The Eight National Missions

- **National Solar Mission** (renamed as Jawaharlal Nehru National Solar Mission) aims to promote the development and use of solar energy for power generation and other uses with the ultimate objective of making solar energy competitive with fossil based energy options.
- **National Mission for Enhanced Energy Efficiency** recommends mandating specific energy consumption decreases in large energy consuming industries. It also recommends financing for public-private participants to reduce energy consumption through demand side management programs
- **National Mission on Sustainable Habitat** aims to promote energy efficiency as a core competent for urban planning. The plan calls for a greater emphasis on urban waste management and recycling including production of power from waste.
- **National Water Mission** sets a goal of 20 percent improvement in water use efficiency through pricing and other measures
- **National Mission for Sustaining the Himalayan Ecosystem** aims to conserve biodiversity, forest cover and other ecological values in the Himalayan region
- **National Mission for a Green India** aims at Increased forest/tree cover on 5 m ha of forest/non-forest lands and improved quality of forest cover on another 5 m ha (a total of 10 m ha), improved ecosystem services including biodiversity, hydrological services, and carbon sequestration as a result of treatment of 10 m ha.
- **National Mission for Sustainable Agriculture** aims to support climate adaptation in agriculture through the development of climate resilient crops and appropriate agricultural practices
- **National Mission on Strategic Knowledge for Climate Change** is for gaining a better understanding of climate science, impacts and challenges. It envisions improved climate modelling and increased international collaboration to develop adaptation and mitigation technologies.

All Indian States have been asked to prepare State Action Plans for Climate Change (SAPCCs) in line the NAPCC.

1.3 The Mountains, the North East Hills and the Eastern Himalayas Context

Mountains are among the most fragile environments on Earth. They are also rich repositories of biodiversity and water and providers of ecosystem goods and services on which downstream communities (both regional and global) rely. Mountains are home to some of the world's most threatened and endemic species, as well as to some of the poorest people, who are dependent on the biological resources. Realising the importance of mountains as ecosystems of crucial significance, the Convention on Biological Diversity specifically developed a Programme of Work on Mountain Biodiversity in 2004 aimed at reducing the loss of mountain biological diversity at global, regional, and national levels by 2010. Despite these activities, mountains are still facing enormous pressure from

various drivers of global change, including climate change. Under the influence of climate change, mountains are likely to experience wide ranging effects on the environment, natural resources including biodiversity, and socioeconomic conditions.

Little is known in detail about the vulnerability of mountain ecosystems to climate change. Intuitively it seems plausible that these regions, where the varying topography and relief lead to rapid changes in climatic zones over small distances, will show marked impacts in terms of biodiversity, water availability, agriculture, and hazards, and that this will have an impact on general human well-being. But the nature of the mountains, fragile and poorly accessible landscapes with sparsely scattered settlements and poor infrastructure, means that research and assessment are least just where they are needed most.

The Eastern Himalayas (EH) lie between 82.700E and 100.310E longitude and 21.950N to 29.450N latitude, covering a total area of 524,190 sq.km. The region extends from the Kaligandaki Valley in central Nepal to northwest Yunnan in China, and includes Bhutan, parts of India (North East Indian states, and the Darjeeling hills of West Bengal), southeast Tibet, and parts of Yunnan in China, and northern Myanmar. These five countries have different geo-political and socioeconomic systems, as well as diverse cultures and ethnic groups. Various studies have showed the critical linkages between biodiversity, ecosystem functioning, ecosystem services, drivers of change, and human wellbeing. These studies highlight the region's vulnerability to climate change as a result of its ecological fragility and economic marginality. This is in line with the broad consensus on climate change vulnerability, and need for adaptation of conservation policy at national and regional levels.

The North Eastern Hills of India – comprising the northeastern states fall within the overall EH region and shares its characteristics. As in the case of the EH, for the North Eastern Hills, many factors contribute to the loss of biodiversity such as habitat degradation (loss and fragmentation), colonisation by invasive species, overexploitation of resources, pollution, nutrient loading, and global climate change. The threats to biodiversity arising from climate change are very acute in the area as it is rich in threatened and endemic species with restricted distributions. Fragmentation and loss of habitat directly impinge on the survival of species, especially those that are endemic to the region. Species in high altitude areas – especially in the transition zone between sub-alpine and alpine – are more vulnerable to climate change. In addition, the region's wetlands are being affected by the erratic weather observed in many parts of the region.

People in the region too see climate change as a big threat and challenge. They perceive climate change to be a result of excessive human activity and, to a certain extent, natural cyclical climatic variation. Various studies have shown that people from the region associated climate change with landslides, increases in temperature, land degradation, the drying of water sources, pest outbreaks, and food shortages. Studies have also revealed gaps in our knowledge on the climate change vulnerability of mountain ecosystems in the EH and the inadequacy of human resources and institutional setups, as well as a lack of policy imperatives to address the issues. The region also lacks adequate scientific evidence to determine the impact of climate change on human wellbeing with any certainty. Equally, the majority of available research focuses on the adverse impacts of climate change and overlooks both the adaptation mechanisms adopted by the local people and the new opportunities presented. The enormous challenge for the region is to adapt to the impacts of climate change by integrating responses and adaptation measures into local level poverty reduction strategies.

On a sub-national entities level, the state, acts as the focal point of climate change response. Preparation and implementation of SAPCCs thus forms a crucial cog in the strategy to address climate change, as most of the interventions aimed at improving the climate resilience/adaptation ability of the communities, public or private infrastructures and preserving the eco-systems are undertaken and implemented at the state level. Besides, technology improvements in production, consumption and other related sectors at the state level are also critical in enhancing the effectiveness of national policies for mitigation. The process of preparation of the Nagaland State Action Plan for Climate Change Action Plan (NSAPCC) stems from these imperatives.

1.4 The Nagaland Context

Nagaland, one of the eight north eastern states of India is situated in the North East Hills and forms the extended part of the Eastern Himalayas. The state is most vulnerable to climate-mediated risks conforming to the EH context described above. The natural resources of the State provide life supporting, provisioning, regulating, and cultural 'eco-system' services to millions of local as well as downstream people. The economy as a whole is characterized by low levels of development with high dependence of livelihoods on natural resources - water, forest, agriculture, etc. *A detailed introduction to the State is given in the following chapter.*

Climate change escalates the already existing vulnerabilities of Nagaland and could manifest disastrously if not addressed adequately. At the same time, the State has already been undertaking a range of initiatives across various sectors that are supportive of building adaptive resilience and to climate change (*these have been described in the respective chapters addressing the vulnerable sectors*). As such, this offers unique opportunities for the state to holistically converge these existing initiatives and make additional efforts to integrate climate concerns and response measures into all aspects of the development process, from policy and planning to implementation. As such, the State has adopted this as the underlying principle in the formulation of the NSAPCC.

1.5 Process Adopted for NSAPCC Preparation

The Government of Nagaland (GoN) has taken a very systematic and proactive approach towards the formulation of the NSAPCC. A State Steering Committee (SSC) was formed in early 2011 comprising 15 senior GoN officials (*see* Box 2 *below*), and chaired by the Chief Secretary. The SSC first met on 01.02.2011. Considering the cross sectoral nature of climate change issues it was decided that the process of preparation of NSAPCC will follow a consultative approach with active involvement of representatives of all climate sensitive sectors as well as civil society. Some key sectors which are highly sensitive to climate change were prioritized as areas where detailed sector plans were required – these include agriculture and allied sectors, forest and bio-diversity, health, energy, urban habitats, water, sustaining livelihoods in mountain eco-systems and climate Studies. A Working Group comprising of officials from various concerned departments was formed for each of the above sectors, with the Forest Department as the coordinating/Nodal Department for NSAPCC preparation. Constitution of each of the Working Groups may be seen at Annexure 1.

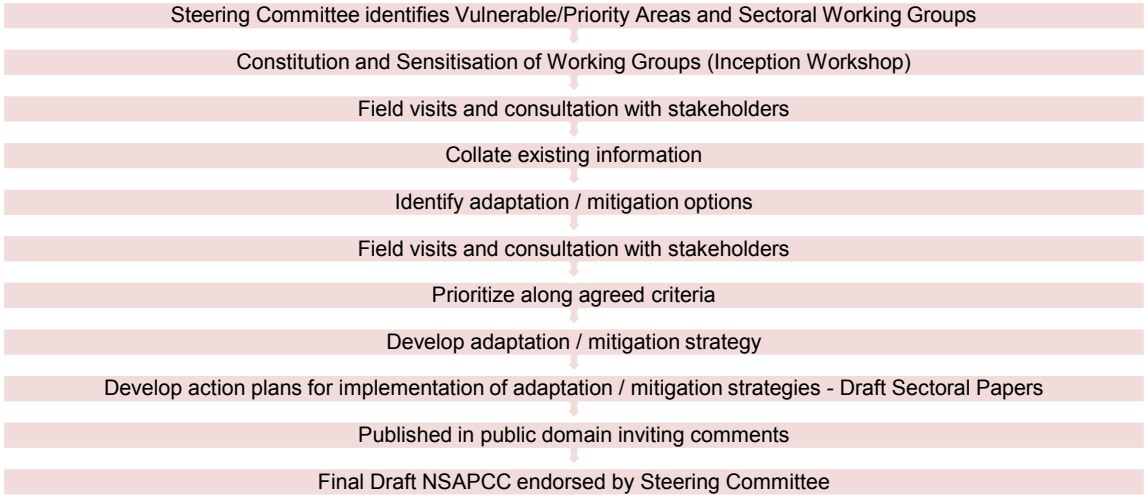
Box 2: Composition of the State Steering Committee

Composition of the State Steering Committee

1. Chairman-Chief Secretary
2. Member -Development Commissioner
3. Member-Finance Commissioner
4. Member- Agricultural Production Commissioner
5. Member- Commissioner & Secretary (Power)
6. Member- Commissioner & Secretary (Transport)
7. Member- Commissioner & Secretary (Rural Development)
8. Member- Commissioner & Secretary (Urban Development)
9. Member- Team Leader, NEPED
10. Member- Commissioner & Secretary (PHED)
11. Member- Commissioner & Secretary (Health & Family Welfare)
12. Member- Member Secretary, State Biodiversity Board
13. Member- Principal Chief Conservator of Forest.
14. Member- Commissioner & Secretary (Industries & Commerce)
15. Member Secretary- Commissioner & Secretary (Forests)

An inception workshop was organized on 18th February 2011. The purpose of the workshop was to introduce the NAPCC and the NSAPCC concept to representatives of prioritized sectors. A series of extensive interactions with various stakeholders from government departments, scientific institutions, NGOs and village level functionaries and other stakeholders, further substantiated through field visits by members of the sectoral working groups were conducted during the drafting of the NSAPCC. *The overall approach adopted is shown in* Figure 1.

Figure 1: Steps followed in preparation of the NSAPCC



Desk reviews of plan documents and reports of identified departments of each sector were carried out to highlight current sectoral concerns and analysis of on-going developmental plans. These were additionally contextualised with reference to studies conducted by Indian Institute of Science (IISc), Bangalore in Nagaland to identify the climate drivers and vulnerability and their impacts on the various sectors as part of the on-going North East Climate Change Adaptation Programme (NECCAP)[2] supported by Kreditanstaldt für Wiederaufbau (KfW). The findings of the interactions, the desk studies, and the IISc studies were used to develop strategies and action that will help the State adapt to projected climate variability. Each of the sectoral working groups developed a sector paper, which was refined over a series of consultative meetings, and put in the public domain for comments (on www.nagaland.nic.in) as well as circulated to all concerned departments. Comments received were further factored in. The contents of the final sectoral papers has been distilled and synthesized into this report.

A timeline of processes undertaken in the NSAPCC drafting process is given in Table 1 below:

Table 1: Important dates for NSAPCC drafting process/activities

Month/Dates	Process/Activity
1.02.2011	First meeting of the SSC
18.02.2011	First Inception workshop
8.03.2011-10.03.2011	Field tour for stakeholder consultations: • Forestry Group -- 8th March - 10th March, Mokokchung, Longleng, Tuensang

[2] This has been described under Part A to this report

	• Urban Planning Group -- 8th March, Kohima, Dimapur
	• Energy Group -- 9th March, Peren (Old Chalkot & Athibung)
	• Agriculture Group -- 8th & 9th March, Wokha, Kohima
	• Water Resources Group -- 9th March, Kohima (Rusoma, Dihoma, Kijumetouma)
	• Health Group -- 10th March, Dimapur
	• Climate Change Group -- 9th March, 10th March, Kohima & Dimapur, Zunheboto
	• Livelihood Group -- 9th March, Kohima (Tseminyu), Wokha (Longsa)
19.07.11- 21.07.11	Field visit for stakeholder consultation (Kohima – Tuensang – Kiphire)

1.6 Future Reviews and Revisions

This document is intended to be a "live" document and shall undergo periodic review, revisions and will be updated on an on-going basis as the knowledge base broadens and as more data and evidence become available. As such, this NSAPCC has to be perceived as an evolving document, with ample flexibility to internalize changes and developments happening at the national, regional and local levels over time.

Chapter 2

Nagaland - A Profile

2.1 Location and Physiography

Nagaland is one of the eight North-Eastern states in India, located between 25°10′ N and 27°4′N Latitude and 93°15′E and 95°20′E Longitude with a total geographical area of 16,579 km² in the northern extension of the Arakan Yoma ranges. The state shares a long international border with Myanmar in the East and is bounded by state of Assam in the west and north, Arunachal Pradesh the North and Manipur in the south. Currently Nagaland has 11 districts, namely, Kohima, Dimapur, Kiphire, Longleng, Mokokchung, Mon, Peren, Phek, Tuensang, Wokha and Zunheboto, 114 sub-divisions, 26 towns (19 statutory and 7 census towns) and 1428 villages.

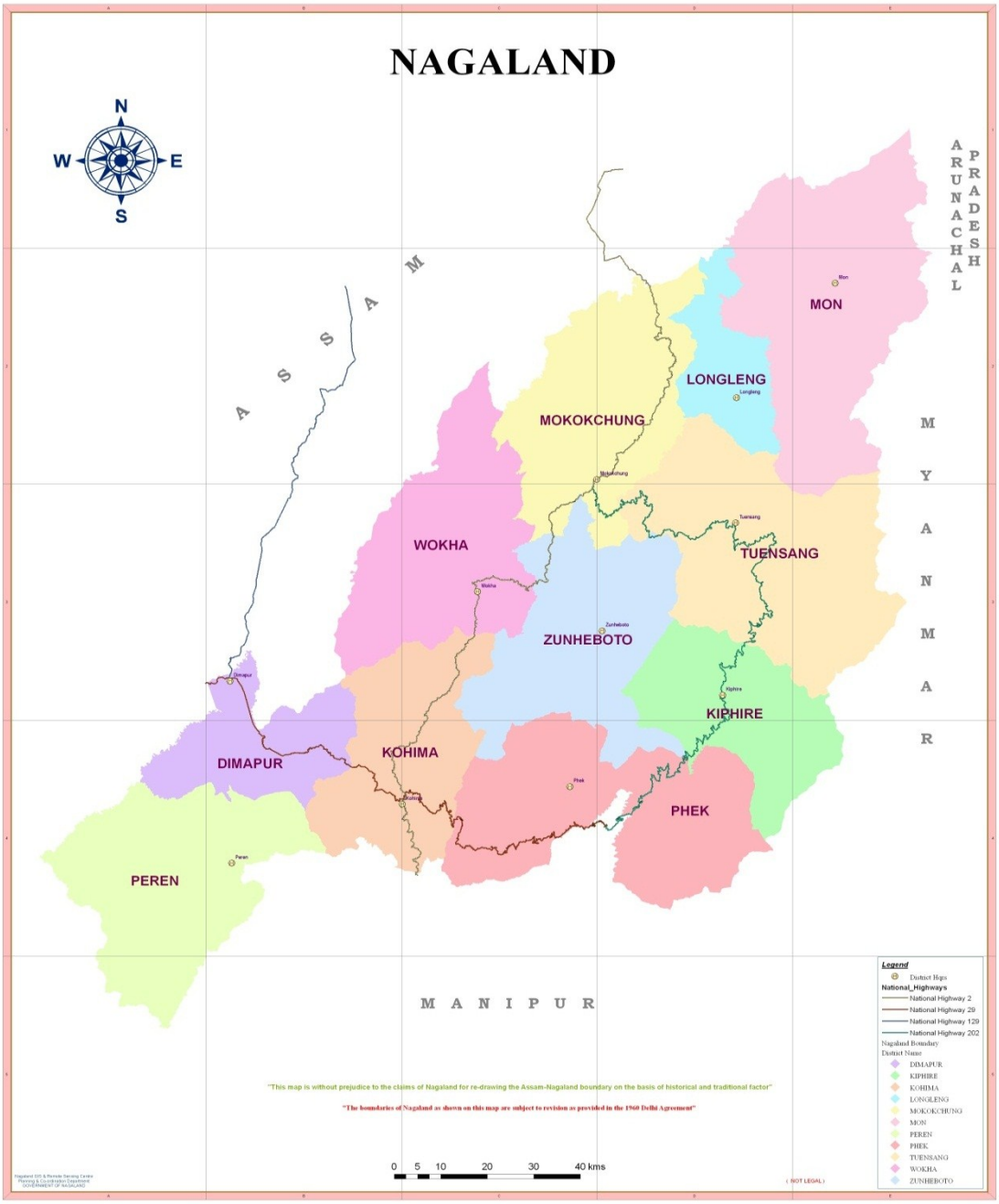


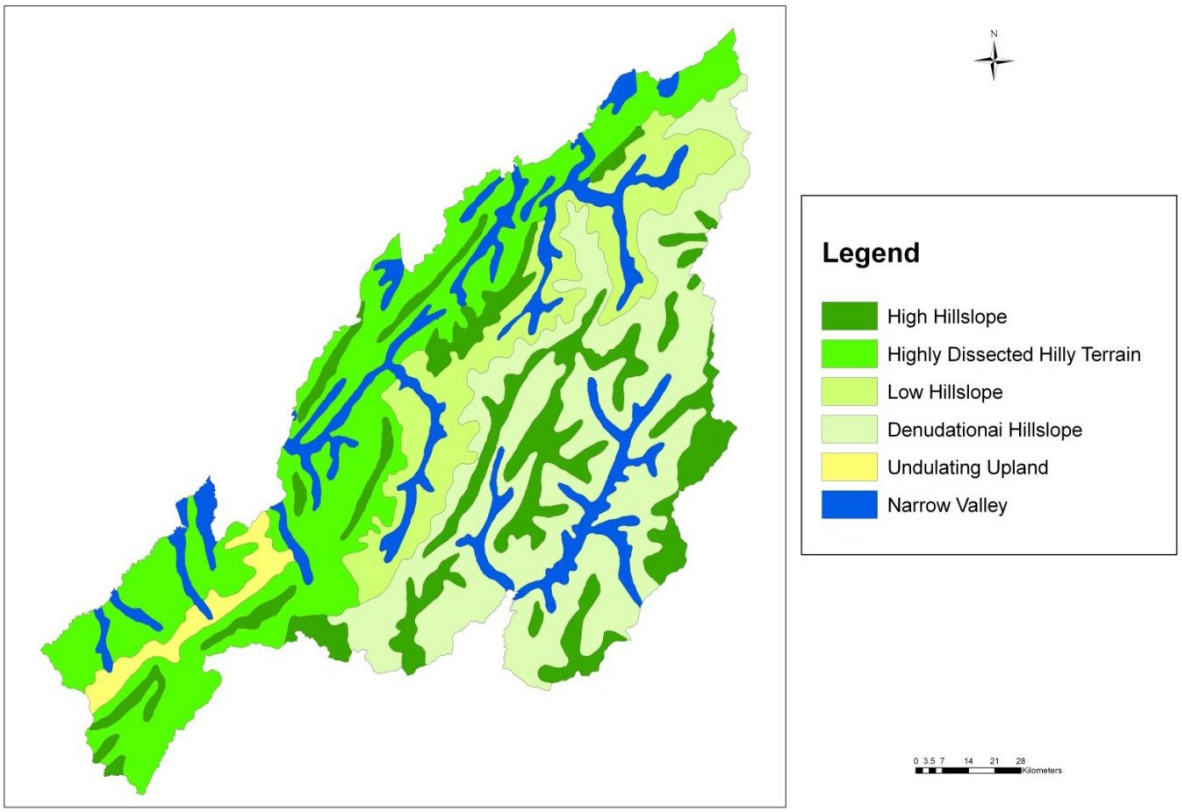
Figure 2 : Nagaland – boundaries and districts

Nagaland is almost entirely hilly, except along the foothills bordering Assam plains. The Naga Hills are located in the northern extension of the Arakan – Yoma ranges. The general elevation of the Naga Hills increases towards the east, the highest peak Saramati (3826.15 metres) belongs to the easternmost hill ranges of the state, bordering Myanmar where it merges with the Patkai ranges of the Arakan mountain

system. The Barail hill range, in the southwest corner of the state runs approximately due northeast almost upto Kohima, which has a height of 1465 metres. Near Kohima, it merges with the hill ranges extending up to Manipur border which swings northerly. Between Mao and Kohima, there are several high peaks including Japfu. Barail and Japfu ranges of the Naga Hills and their extensions in Mokokchung and Tuensang mark a prominent water divide separating Brahmaputra and the Chindwin River systems[3]. The hills of Nagaland, and the North-East India, are also sometimes taken as part of the Eastern Himalayas[4].

Geomorphologically, the terrain can be broadly grouped into four topographic units - alluvial plains (150 to 200 meters above m.s.l.), low to moderate linear hills (200 to 500 meters above m.s.l.), moderate hills (500 to 800 meters above m.s.l.) and high hills (800 meters and above). The main rivers that flow through the state are Dhansiri, Doyang, Dikhu, Tizu and Melak. The narrow valleys of the many streams and rivers, the varying climate and the rich forest cover in the state provide a profusion of habitats, supporting rich biodiversity with high degree of endemism (see Figure 3).

Figure 3: Nagaland physiography[5]



2.2 Climate

Climate of Nagaland is humid tropical type and minor variations are caused by change in physiography. Plain area experience warm and subtropical climate. The foothill areas with rolling to undulatory topography experience subtropical climate. Low to moderate ranges with varying degree of slopes have submontane climate[6]. Monsoon is the longest lasting for five months from May to September with May,

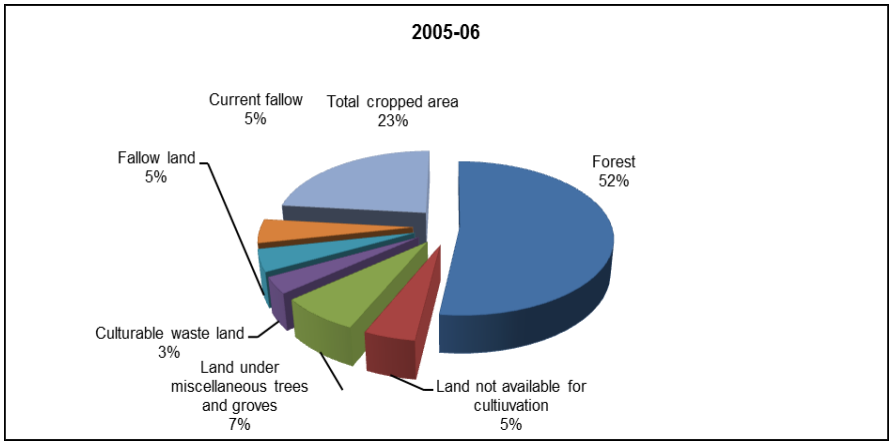
[3] Geology and Mineral Resources of Manipur, Mizoram, Nagaland and Tripura, geological Survey of India, 2011
[4] INCCA 4X4 Assessment, 2010
[5] Nagaland Science and Technology Council
[6] Geology and Mineral Resources of Manipur, Mizoram, Nagaland and Tripura, geological Survey of India, 2011

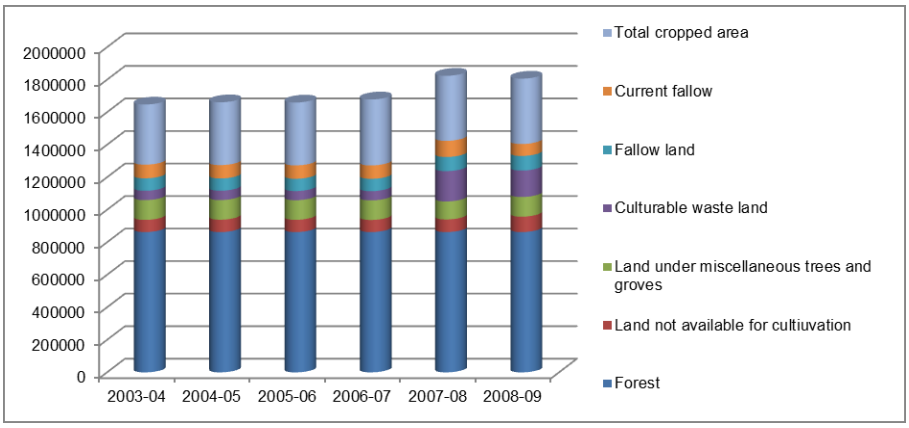
June, and July being the wettest months. Owing to varied topography and relief annual rainfall varies from 1000 mm to over 3000 mm at different places with an average of 2000 mm.

2.3 Land Use and Ownership

The majority of land, over 90 percent, in Nagaland is either community or privately owned. Forest area in Nagaland has remained at 1.5 million ha since 2003 up till 2008, and it constitutes 52 percent of the total area reported for different land utilization in the state[7]. Total cropped area has grown from 0.36 million ha to 0.4 million ha from 2003-04 to 2008-09 and is around 23 percent of the total land utilization reported. Total fallow including current fallow is 10 percent and it has grown from 76.2 thousand ha top 89.4 thousand ha from 2003-04 to 2008-09. The total cultivable waste island has grown from 57.75 thousand ha to 162.8 thousand ha between the two years and is 3 percent and land area reported in 2008-09. Area under trees and groves constituted 7 percent of the land reported under different utilization. The trend and distribution of land utilization in the state is shown in Figure 4[8].

Figure 4: Nagaland land-use, trends, and distribution





7 Statistical handbook, Nagaland 2009. http://db.nedfi.com/content/land-resources-Nagaland
8 ibid

2.4 Population and Socioeconomic Profile

The population of Nagaland as per the provisional census of 2011 is 19,80,602 (0.2 percent of the country's population). The State is predominantly rural, with 71.03 percent (2011 census) of the population living in villages, totalling to 14,06,861 people, while the urban population stands at 5,73,741. The population density is 119 persons per sq. km. with a sex ratio of 931. Nagaland's literacy rate is around 80 percent. English is the official language and the medium of education. Sixty different dialects of Sino-Tibetan language are spoken in the state. Dimapur, Mokokchung, Tuensang, Wokha, Mon and Zunheboto are some of the key cities in the state. Nagaland has a high literacy rate of 80.1 per cent. Majority of the population in the state speaks English, which is the official language of the state.

Table 2: Basic data on Nagaland

Parameters	Nagaland
Capital	Kohima
Geographical area (sq km)	16,579
Administrative districts (No)	11
Population density (persons per sq km)*	119
Total population (million)*	1.9
Male population (million)*	1.0
Female population (million)*	0.9
Sex ratio (females per 1,000 males)*	931
Literacy rate (%)*	80.1
Birth rate (per 1,000 population)	17.2

At current prices, the Gross State Domestic Product (GSDP) of Nagaland was about Rs. 8,891.8 crore in 2007-08. Its GSDP grew at a compound annual growth rate (CAGR) of 13.1 percent between 2004-05 and 2007-08. At current prices, the Net State Domestic Product (NSDP) of Nagaland was about Rs. 8146.1 crore in 2007-08. Nagaland's NSDP grew at a CAGR of 12.8 per cent between 2004-05 and 2007-08. The state's per capita GSDP in 2007-08 was Rs. 32,229 as compared to Rs. 25,842 in 2004-05. Per capita GSDP increased at a CAGR of 7.6 percent between 2004-05 and 2007-08.

Table 3: Select economic and infrastructure data, Nagaland[9]

Parameter	Nagaland	All-States	Source
GSDP as a percentage of all states' GSDP	0.15	100	CMIE, as of 2007-08, current prices
Average GSDP growth rate (%)*	9.0	15.9	CMIE, 2004-05 to 2007-08, current prices
Per capita GSDP (Rs.)	32,229	63,255	CMIE, as of 2007-08, current prices

[9] *Calculated in Indian Rupee Terms; ^Figures for the northeastern region comprising Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura; #Figures for the northeastern region comprising Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura

Physical Infrastructure			
Installed power capacity (MW)	103.2	173,626.4	Central Electricity Authority, as of March 2011
GSM cellular subscribers (No)	7,088,382^	618,284,322	Cellular Operators Association of India, as of September 2011
Broadband subscribers (No)	37,605	10,737,850	Ministry of Communications & Information Technology, as of November 2010
National Highway length (km)	494	70,934	Ministry of Road Transport & Highways, Annual Report 2010-11
Airports (No)	1	133	Airport Authority of India

The state's per capita NSDP in 2007-08 was Rs. 29,526 as compared to Rs. 23,855 in 2004-05. The per capita NSDP increased at an average rate of 7.3 percent between 2004-05 and 2007-08. The secondary sector has been the fastest growing sector, at a CAGR of 16.7 per cent from 2004-05 to 2007-08. It was driven by construction, manufacturing and electricity, gas & water supply. The tertiary sector grew at a CAGR of 10.9 percent from 2004-05 to 2007-08, driven by trade, real estate, banking, insurance, transport, and communications. In 2007-08, the tertiary sector contributed 53.9 percent to the state's GSDP at current prices. It was followed by the primary sector at 28.5 percent and secondary sector at 17.6 percent. Majority of the state's population, at 68% of the total workforce (2001 Census), is engaged in agriculture and allied activities. Services sector, led by the Government is the other major employment avenue for the state's workforce. The state government employs has more than one lakh employees.

Figure 5: GSDP and NSDP, Nagaland

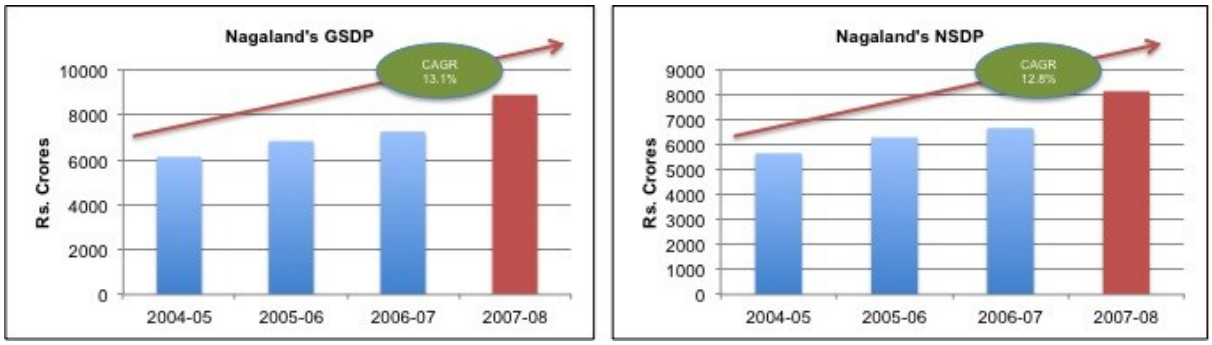


Figure 6: Per capita GSDP and NSDP, Nagaland

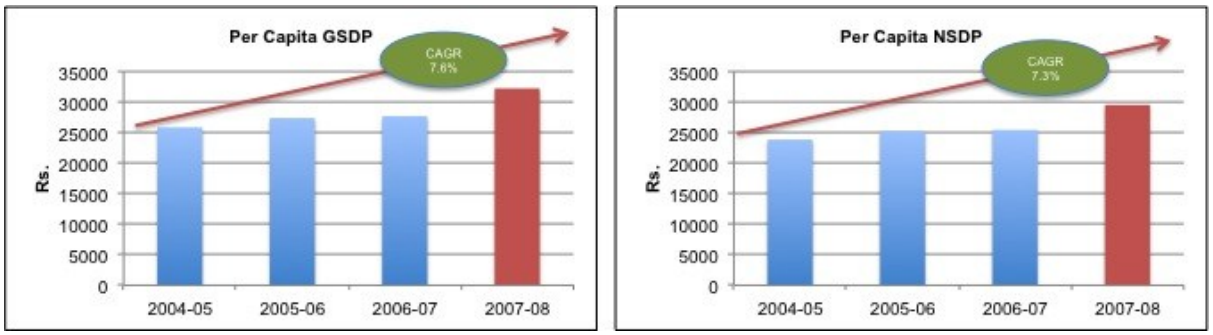
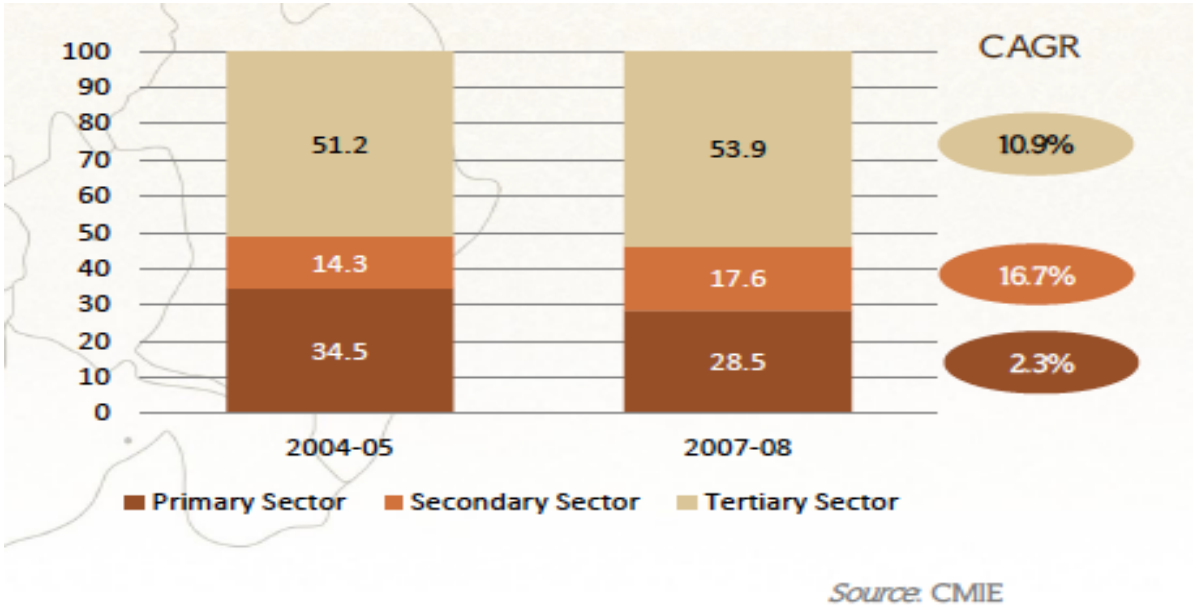


Figure 7: Percentage distribution of GSDP, Nagaland



2.5 Human Development

Nagaland was one of the first States in the northeast to produce a State Human Development Report, in 1994. The State remains committed to tracking and monitoring human development, and has published the District Human Development Reports for three districts – Kohima, Phek, and Mon. The State's HDI rank among the Indian states has remained at a consistently high 8 in 1996 and in 2006, whereas its GDI rank has gone up by one place, from 8 in 1996 to 7 in 2006. Likewise, Nagaland's GEM score has remained unchanged -- 35 in 1996 and in 2006. A comparison of HDI, GDI, and GEM values and ranks for the NE States are given below, for 1996 and 2006. The table shows that Nagaland was the best HDI and GDI performer among the NE States in 1996, to be overtaken only by Manipur in 2006.

Table 4: HDI, GDI, and GEM data for the NE States, 1996 and 2006[10]

State	Human Development Index (HDI)				Gender Development Index (GDI)				Gender Empowerment Measure (GEM)			
	1996		2006		1996		2006		1996		2006	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank
Arunachal Pradesh	.549	24	.647	20	.544	23	.642	18	.307	30	.469	17
Assam	.543	25	.595	26	.523	26	.585	26	.313	28	.417	26
Manipur	.610	12	.702	7	.600	12	.699	6	.380	21	.418	27
Meghalaya	.595	13	.629	24	.592	13	.624	23	.231	34	.346	34
Mizoram	.618	11	.688	12	.612	10	.687	9	.312	29	.374	32
Nagaland	.653	8	.700	8	.626	8	.697	7	.165	35	.289	35
Sikkim	.582	16	.665	17	.556	17	.659	15	.300	31	.447	23
Tripura	.579	17	.663	18	.546	21	.626	21	.335	23	.382	30

[10] Source: Ministry of Women and Child Development, 2009.

2.6 Infrastructure – Airports, Railways, Roads, Telecommunication

Nagaland has 494 km of National Highways and around 1,094 km of State Highways. The state is well connected with Assam and Manipur through National Highway (NH)-61, NH-39, NH-36, NH-150 and NH-155. Agencies maintaining roads in the state include the Public Works Department (PWD) and SEWAK (Border Roads Organisation of the Government of India [GoI]). The Nagaland State Transport provides road transport across Nagaland, covering 112 routes and 21,300 km daily. The railway station at Dimapur connects Nagaland to rest of the country via Assam. Nagaland has one operational airport at Dimapur. A second airport is being planned for Kohima.

As of December 2010, Nagaland has 62 telephone exchanges. The service is provided through the Northeast-II circle of Bharat Sanchar Nigam Limited (BSNL). As of December 2010, total mobile phone connections provided by BSNL were 325,778. Mobile and Broadband service in the state is provided by several private operators, in addition to BSNL. The Department of Telecommunications is implementing the scheme for augmentation, creation, and management of infra-district optical fibre connectivity network in the state.

Under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), Rs. 89.5 crore has been allocated for road transport development in Kohima. The City Development Plan of Kohima city has been approved by the GoI and development works are under way. Infrastructure development of Kohima city is under way with a funding of Rs. 331.2 crore from the Asian Development Bank (ADB). It is to be implemented during the period 2008-2017 and will cover projects such as water supply, sewerage, solid waste management, drainage and landslip protection, transportation, slum and community up-gradation. Rs. 10.5 crore has been earmarked for the development of 71 towns under the "Development of Small and Medium Towns" programme of the GoI. Solid waste management programmes are being implemented across the state.

2.7 Industries and Economic Sectors

Nagaland Industrial Development Corporation (NIDC) is responsible for the development of industrial infrastructure in the state. Promoted by NIDC, the Export Promotion Industrial Park (EPIP) at Dimapur has received formal approval as a Special Economic Zone (SEZ) for agro and food processing in view of the vast potential in meat processing, and a proposed multi-product SEZ spread across 400 acres in Dimapur has received formal approval. An Industrial Growth Centre (IGC) has been developed in Dimapur. Kiruphema in Kohima has been identified for development as an Integrated Infrastructure Development Centre (IIDC). The Longnak valley in the Mokokchung district is being considered for similar development. Urban haats have been set up in Dimapur, providing market outlets for various trades. Additionally, a mini tool-room and training centre has been set up at Dimapur. Other promising sectors in the state include paper and pulp processing, minerals and mining, and petrochemicals.

The natural resources, climatic conditions and policy incentives in Nagaland support investments in industries related to bamboo, beekeeping and honey, horticulture, sericulture, tourism and agro-processing. Nagaland's bamboo growing stock, covering 448,000 ha of land and comprising 22 species is about 5 per cent of the total stock in the country. Considering the potential and importance of this resource, development of Bamboo in Nagaland has set up the Nagaland Bamboo Development Agency (NBDA) as the nodal office that coordinates with other offices for all bamboo-related research, development, and business applications. Bamboo processing enterprise is promoted, covering various applications such as food-based, medicinal usage, handicraft, art, tiles, and flooring. Nagaland has a rich wealth of flora and fauna. Favourable climatic and geographical conditions in the state offer tremendous scope for floriculture and cultivation of medicinal plants. Another area with significant potential is beekeeping – the State has the potential to keep at least 3 million colonies and can produce at least 15,000 MT of honey & 100 MT wax annually, and generate an income of Rs. 500 crores (US$ 100 Million) per annum. Keeping this potential in mind, the Nagaland Beekeeping and Honey Mission (NBHM) was

launched in 2007-08 to implement programs and policies for promotion and development of beekeeping in the state. The current production of honey stands at approximately 500 MT per annum.

Nagaland has vast, untapped natural resource reserves of limestone and marble (1,000 million tonnes), petroleum and natural gas (600 million tonnes), coal (50 million tonnes) and substantial reserves of slate sandstones, basalt, chert, dunite, gabbro, granodiorite, serpentine, spilite, pyroxenite, and quartzite. This presents a huge untapped potential in the minerals and petrochemicals industries. Explorations are being carried out by Geology & Mining Department, Geological Survey of India (GSI), Oil and Natural Gas Corporation Limited (ONGC), Atomic Minerals Division and Central Ground Water Board (CGWB).

Nagaland's information technology (IT) policy aims to increase the use of IT in the industrial and government sectors. With a high literacy rate, affordable cost, strong English-speaking population, improved telecommunications connectivity, and favourable climate, Nagaland is well poised to serve the IT industry. In order to develop skilled work force in IT, education, and certifications from Department of Electronics Accreditation of Computer Courses (DOEACC), Indira Gandhi National Open University (IGNOU) are provided through Community Information Centres (CICs). The IT policy also provides various incentives and concessions for investments in IT.

Tourism is another sector that has significant potential in Nagaland. With salubrious climate, green hills, criss-crossing rivers, interspersed lakes, vibrant culture, colourful handicrafts and weavings, and numerous festivals make Nagaland a tourist's paradise. More than 30,000 tourists, from India and abroad, visited the state during 2011. The Ministry of Tourism, GoI has included 12 villages in Nagaland under rural tourism scheme in order to promote traditional rural art, craft, Textile, and culture.

2.8 Governance, Traditional Institutions and Civil Society

The structural framework of the administrative system in Nagaland is largely similar to that of other states in the country. However, the distinction with the rest of the country arises owing to the distinct sanction given by Article 371 (A) of the constitution, giving the Naga customary law and procedure, including with regard to ownership of land and its resources, an overriding supremacy over the national statutes.

2.8.1. Decentralized Governance

The Village Council[11]

Traditionally, a Naga village was an independent entity having its own governance systems and laws, with varying traditions across villages and tribes. Given that such functional traditional systems existed in each Naga village, the government built upon it and enacted the Nagaland Village and Area Councils Act 1978 to give it legitimacy and recognition as a local self governance institute. Every recognized village in Nagaland is required to have a Village Council (VC). The Village Councils are empowered for carrying out administration, and administration of justice as per local customs and traditions. VC Members are chosen by villagers in accordance with the prevailing customary practices and usages and as approved by the State Government. Hereditary village chiefs, Anghs and Gaonburas (GB) as per usage and customary practices of the community are to be ex-officio members with voting rights of the VCs. The VC is required to meet at least once every three months or as and when the situation requires. It is also required to form the Village Development Board (VDB) for the overall development of the village.

[11] Source: Understanding Local Self Governance in Nagaland, India: An essence of local institutions and activities, Amba Jamir, January 2011, Decentralization Community Solution Exchange United Nations India

The power bestowed upon the VCs to establish VDBs in Nagaland dramatically changed the functions and outlook of VCs across the state. As socially embedded institutions VCs have always been people centred delivery mechanisms that responded effectively to the needs of the community. Over the years, VCs through the VDBs have become an important implementation arm for governmental development programs and have started to play an important role in facilitating livelihood and economic development of the community and the village as a whole.

The Village Development Boards

A separate VDB, without displacing the traditional VC was first experimented and adopted in Phek District, in 1976 and later in 1980-81 extended to other villages across the state. As is provided for in the Nagaland VCs Act, it is the VC, which forms the VDBs. The VDBs are involved in all phases of developmental activities as a part of their responsibilities. These include receipt of allocation of funds, selection of beneficiaries or schemes, monitoring of progress of works & expenditure and completion of schemes. The book keeping of accounts of all VDB is mandatory, open, and subject to any audit of its account, including by an independent committee appointed by the VC on a regular basis.

Funds for development flow to the VDBs of the recognized 1083 villages from the State Plan as grant, as well as from the various Rural Development schemes of the Government of India implemented through the DRDAs. Funds transferred are proportioned as per the recognized households in the village and also as per particular scheme's laid down criteria. The VDBs implement schemes under the supervision of General Body of the village. Funds from the grants are also earmarked for women and youth.

District Planning and Development Boards

Area Councils were established in the erstwhile Nagaland Village and Area Council Act, 1978, to act as link between the village and state authorities at the district levels and to oversee development and to resolve disputes. Area Councils were however abolished and the DPDBs introduced to provide the much-needed linkage to the grassroots and to ensure a responsive and holistic approach towards development. The DPDB consists of Members of Legislative Assembly (MLAs) and district heads of departments. A Chairman is appointed by the government from amongst the members and the Deputy Commissioner of the district is the Vice Chairman and District Planning Officer the Member Secretary of the Board. The DPDB however remains a pure government agency to basically oversees the implementation of the Local Area Development projects.

Communitization of Public Institutions and Services

Building upon the strong traditional institutions and governance systems, the Nagaland government initiated "Communitization of Public Institutions and Services Act" which fosters a strategic partnership between the government and the communities. The Act to improve services and ensure peoples' buy-in to public assets as stakeholders further delegates management responsibilities for essential services such as health, primary education, power, rural tourism, rural water supply, etc. to the community.

This Act institutionalized a process of going to the community beyond the VDBs. The law provides for ownership of public resources and assets and control over service delivery to be transferred to the community directly. To start with this has been done in elementary education, grassroots health services and power utilities. Communitization is basically a contract between the government and the community. In this contract, the community becomes the owner of the government institutions and assets and is granted powers and resources to manage the employees and maintain institutions. In other words, it is empowerment, delegation, decentralisation and privatisation at the same time. The move has in many ways become an effective instrument to ensure that the institutions and services set up for the benefit of the community operate efficiently and that the authorities are accountable to the beneficiaries and not only to the government. The decision of the State Government to declare the VC and its committees as 'local authority' within the meaning of the Communitization of Public Institutions and Services Act further legitimizes the institutions under the local self-governments. As such, Communitization has effectively handed over the management and maintenance of infrastructure and

management of power, rural tourism, elementary education, public health engineering, and health and family welfare to the VC under different committees in the departments.

2.8.2. Civil Society

Nagaland has a vibrant civil society, characterised by a range of organisations and networks. A few of these are briefly outlined below:

Naga Hoho and Eastern Naga Peoples' Organisation

The Naga Hoho is the apex body of the different tribal organisations. Its constituent tribes in Nagaland are from the districts of Dimapur, Kohima, Mokokchung, Phek, Peren, Wokha, and Zunheboto. Several Naga tribes from neighbouring states and Myanmar are also member of the Naga Hoho. The executive body of Naga Hoho consists of representatives nominated by the constituent tribal organisations. Eastern Naga Peoples' Organisation (ENPO) is the apex body of its constituent tribal organisation. Its constituent members in Nagaland are the tribe from the districts of Mon, Longleng, Tuensang and Kiphire. The executive body of ENPO consists of representatives nominated by the constituent tribal organisations.

The Officer Bearers of both these apex bodies are elected in a general body meeting or executive meeting. The organisations are headed by the President. For all practical purposes they represent the Nagas in the region (Nagas of neighbouring states and Myanmar). The functions of Naga Hoho and ENPO are among others; to voice the views of its constituent communities, arbitration on inter tribal conflicts, etc.

Naga Student Federation and Eastern Naga Student Federation

These two apex bodies are the prominent student organisations in Nagaland. Their federating unit members are similar to that of Naga Hoho and ENPO respectively. For all practical purposes they represent the youth of the Nagas in the region (Naga students of neighbouring states and Myanmar).

Naga Mothers Association (NMA)

Like the NH and ENPO, the NMA has units in all the villages of Nagaland. In general, all Mothers regardless of tribe, religion and age, are members of NMA. The major thrusts areas of the NMA social justice, morality, and asserting women's right. It had been the major force along with the Nagaland Baptist Church Council (NBCC) in declaring Nagaland a 'dry state'.

Nagaland Baptist Church Council

Christianity is the predominant religion of Nagaland. The state's population is 1.988 million, out of which 90.02 percent are Christians. Among Christians, Baptists are the predominant group, constituting more than 75 percent of the state's population. The membership of the NBCC consists of 20 Baptist Associations and Organizations and 4 Associate members. The total number of Churches as on February 2012 was 1553. While the goal of the NBCC is for unity of the Baptist Churches in and outside of Nagaland and for effective and proper running of the Council's ministry, it has departments to address the present pressing issues. Among others NBCC has Department for Youth, Women, Development and Children Ministry.

The NBCC is perhaps the widest broad base organisation and most vibrant, the message that it would like to be conveyed are announced in 1553 Churches and heard by over 5, 20, 000 members. On top of the spiritual message it preaches to its followers, it has sounded strongly on climate change concerns and biodiversity conservations. In its annual general sessions it passes important resolutions addressing current social, religious, political and environmental concerns. The most recent one being the Platinum Jubilee celebrations in Kohima from 19th to 21st April 2012, reproduced below.

"*Resolution III On environment reaffirm the Rotomi Resolution No. 8 of February 2011 that:*

1. *Baptist Churches will initiate Climate Change adaptation strategies and other Eco-Biological friendly actions, Sensitise on Conservation of Forest and preservation of wild life, and work closely with the community leaders and concerned Departments for addressing the Environment alarm.*
2. *Abstain from using jungle meat during NBCC and Churches gatherings.*
3. *Discourage Churches from offering wild animals during its Thanksgiving service."*

Chapter 3

Observed Climate and Climate Change Projections

3.1 India and the North-Eastern region

The Indian Network for Climate Change Assessment in its report 'Climate Change and India: A 4X4 Assessment' for the purpose of observed climate and climate change projections classifies the country into four regions – the Himalayan region, the North-Eastern region, the Coastal region and the Western Ghats. Nagaland state, with most of its landmass part of the North-Eastern Hills, falls within the Himalayan and the North Eastern region. The trend of projections for both the regions is similar, as indicated in Table 5.

Table 5: Project climate change parameters in 2030s with respect to 1970s – 4x4 Assessment

Features		Himalayan/North Eastern Region
Temperature		Increase
Precipitation		Increase
Extreme Temperature		Increase
Extreme Precipitation	Intensity	Increase
	Number of Rainy Days	Increase

Specifically, the projections for climate change for the North-Eastern region by the Indian Network for Climate Change Assessment in its report 'Climate Change and India: A 4X4 Assessment', are summarised below:

a. Precipitation: The projected mean annual rainfall is varying from a minimum of 940±149mm to 1330 ±174.5 mm. The increase with respect to 1970's is by 0.3% to 3%. The north-east also show a substantial decrease in rainfall in the winter months of January and February in 2030's with respect to 1970's with no additional rain projected to be available during the period March to May and October to December. In fact, recent data indicates the same pattern. However, the monsoon rainfall during June, July and August is likely to increase by 5 mm in 2030's with reference to 1970's. A rise of 0.6%.
b. Annual Surface Temperature: Surface air temperature is projected to rise by 25.8 to 26.8 °C in 2030's with a standard deviation ranging from 0.8 to 0.9. The rise in temperature with respect to 1970's is ranging from 1.8 to 2.1 °C.
c. Extreme Precipitation: The frequency of rainy days are projected to be more and there will be an increase in intensity of rainy days by 2-12 % in 2030s.

3.2 Climate Profile for Nagaland

3.2.1. Observed Trends in Climate

Indian Institute of Science, Bangalore12 has analysed the climate change trends at district level, using temperature and rainfall as the key climate variables for analysis. A summary of this study is presented in the following sections.

[12] Prof. Ravindranath of Indian Institute of Science and his team carried out this study, and were sponsored by the GIZ/KfW.

As part of the study, the high resolution (0.5° x 0.5° lat. and long.) daily gridded rainfall dataset for a period of 35 years (1971–2005) provided by Indian Meteorological Department (IMD) was analysed to understand the precipitation trends. The analysis focused on the monsoon season as more than 95 percent of precipitation falls over Nagaland during that period. For temperature trends, the Climatic Research Unit Time Series (CRU TS) version 2.10 on a 0.5° lat x 0.5° l long resolution monthly dataset spanning 102 years (1901-2002) were used. District-wise data was obtained by re-gridding the dataset to 0.1° lat. x 0.1° long and re-aggregating by the districts to study the climate variability at district level.

Observed Precipitation Trends

Majority of districts of Nagaland experienced an increase in monsoon precipitation in the past 100 years (see Figure 8). However Wokha showed a decrease in precipitation of 0.26 mm/day. The precipitation trend shows high variability with Zunheboto (4.67 mm/day) and Tuensang (3.96 mm/day) showing a high increase in precipitation.

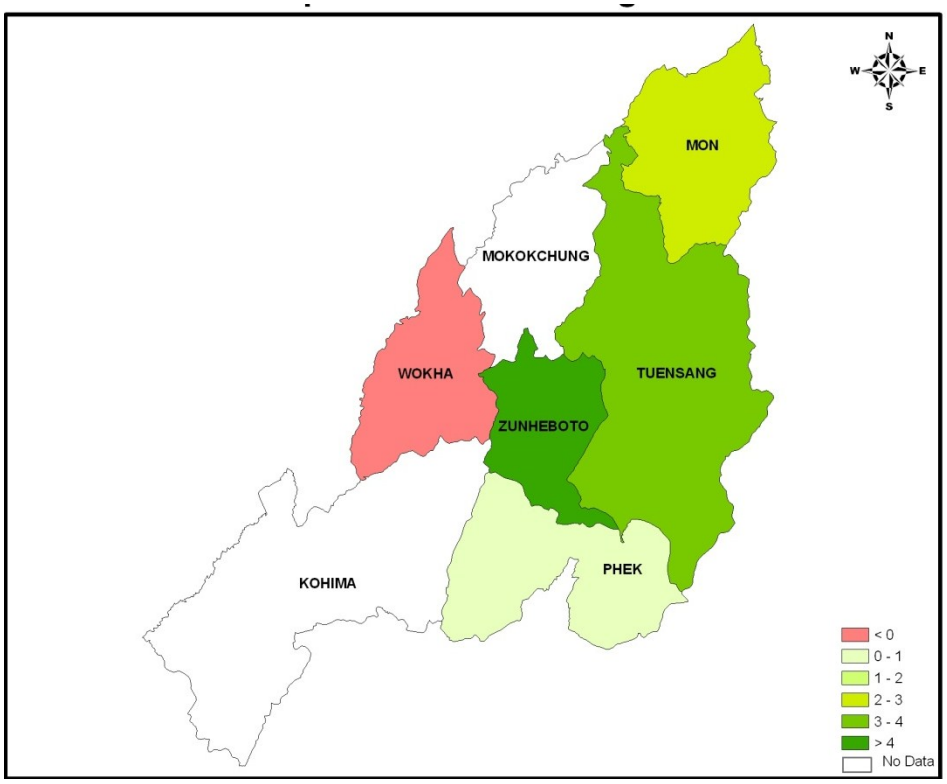


Figure 8: District-wise precipitation trend (mm/day per 100 yr) of southwest monsoon season (June-September) for the period 1971-2005. The districts of Dimapur, Kohima and Mokokchung have no observations

Observed Temperature Trends

The analysis of temperature records for Nagaland shows a steady warming trend in both the minimum and maximum temperatures over the past 100 years shows. The districts of Wokha, Zunheboto, Tuensang and Phek have registered an increase in minimum temperature of more than 1.6°C. The minimum temperature in Mon has increased by about 1.4°C (see Figure 9, Upper Panel). The maximum temperature also shows an increasing trend all across Nagaland (see Figure 9, Lower Panel). The maximum temperature in the district of Wokha has increased by 1.17°C, and in Phek the increase in maximum temperature is of the order of 1.1°C. The northern districts, in comparison, have experienced a smaller increase in absolute value of maximum temperature. For example in Mon the maximum temperature has increased by 0.57°C, in Zunheboto by 0.69°C, and in Tuensang the maximum

temperature has increased by 0.77°C respectively. Overall, the trend of last 100 years shows that increase in minimum temperature is slightly higher in absolute terms than the increase in maximum temperature.

The observed district wise trends in minimum and maximum temperature during the period 1901 and 2002 and precipitation during the period 1971 and 2005 are summarised in the table below. As can be seen, information for Kohima (which includes Peren and Dimapur district, carved out of it during the past decade and a half) and Mokokchung is not available for the period, and is, therefore, a limitation.

Table 6: Summary of the observed trends in temperature and precipitation

District	Change in precipitation (1971-2005)	Change in Minimum Temperature (1901-2002)	Change in Maximum Temperature (1901-2002)
Mon	+2 - 3 mm/day	+1.4°C	+0.57°C
Tuensang^	+3 -4 mm/day	+1.6°C	+0.77°C
Mokokchung	No data	No data	No data
Wokha	Negative change	+1.6°C	+1.17°C
Zunheboto	>4mm/day	+1.6°C	+0.69°C
Phek	1-2 mm/day	+1.6°C	1.1°C
Kohima	No data	No data	No data
Note: ^ Includes Longleng, Kiphire			

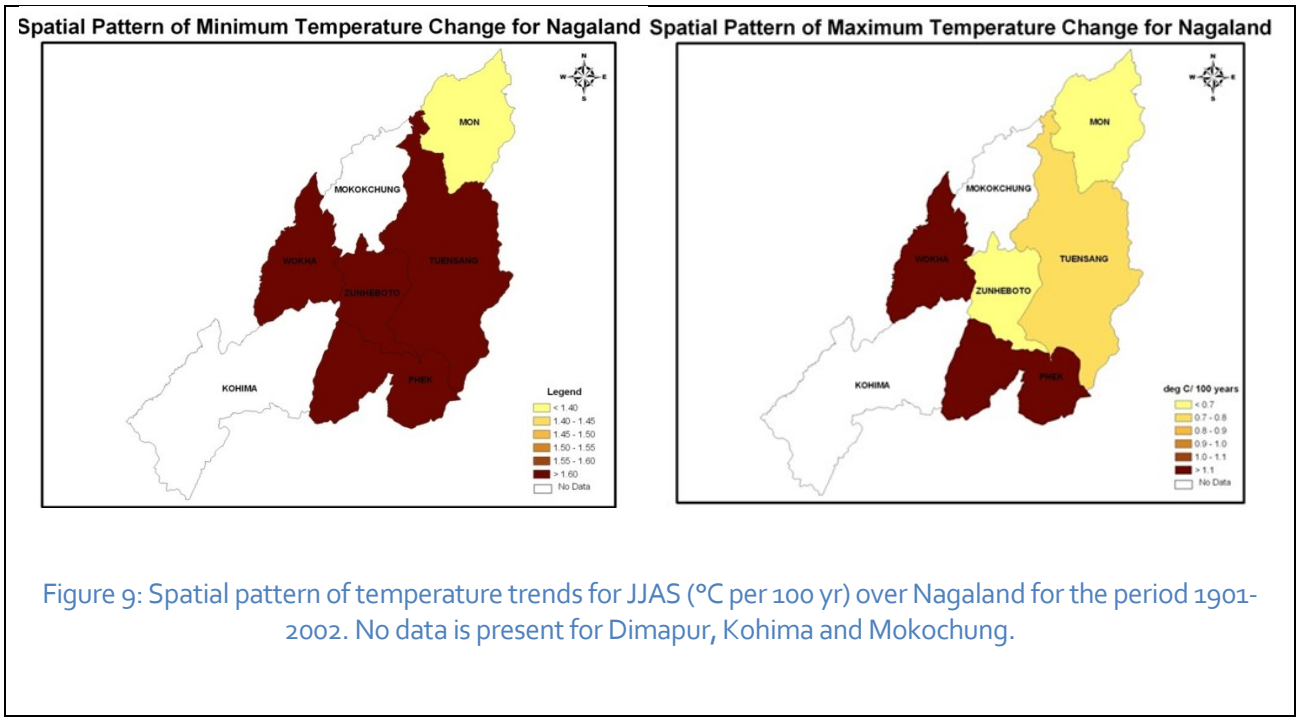


Figure 9: Spatial pattern of temperature trends for JJAS (°C per 100 yr) over Nagaland for the period 1901-2002. No data is present for Dimapur, Kohima and Mokochung.

3.2.2. Climate Change projections

Temperature

In the mid century (2020-2050), the state is projected to experience an increase in annual average temperature between 1.6°C and 1.8°C (*Figure* 10 *a)*. Southern districts show higher increase in temperature, with Kohima, Wokha, Phek, Zunheboto and Tuensang showing an increase in temperature between 1.7°C and 1.8°C. The Northern districts of Mon and Mokokchung are projected to have an increase in average temperature of between 1.6°C and 1.7°C.

Box 3: Deriving climate change scenarios for Nagaland

For climate change base line simulation and projections into 2021-2050s, PRECIS- a regional climate change model has been used for entire India including Nagaland. PRECIS down scales at 0.44x0.44 resolution (50 km^2) the outputs of the HadCM3 (Hadley Centre Climate Model ver. 3), a global climate model, whose outputs are at a resolution of $2.5^{o}x3.75^{o}$ ~ 280km^2. Both PRECIS and HadCM3 have been developed by Hadley centre UKMO. The combination of HadCM3 and PRECIS models is known as the HadRM3 model. The pathways for atmospheric greenhouse gases (e.g. CO_2, CH_4, N_2O, CFCs) were prescribed from the SRES A1B mid-term (2021-2050) projections.

The IPCC A1B SRES scenario has been chosen from a bouquet of socio-economic scenarios developed by the IPCC (IPCC SRES, 2001) representing the developmental aspiration of India. The A1B scenario assumes significant innovations in energy technologies, which improve energy efficiency and reduce the cost of energy supply. Such improvements occur across the board and neither favor, nor penalize, particular groups of technologies. A1B assumes, in particular, drastic reductions in power-generations costs, through the use of solar, wind, and other modern renewable energies and significant progress in gas exploration, production and transport. This results in a balanced mix of technologies and supply sources with technology improvements and resource assumptions such that no single source of energy is overly dominant. The assumptions are in line with a low carbon world.

Climate change projections were made for daily values of temperature (average), for daily values of precipitation, at grid-spacing of 0.44250 latitude by 0.44250 longitude, and for periods of 2021-2050. District wise data have been derived by re-gridding the PRECIS model outputs at 0.2° x 0.2° resolution ensuring enough number of grids are available in each district fall inside each district for a statistically sound projections. The grids are again re-aggregated to provide average district-level projections of climate parameters.

(Source: Krishna Kumar et al., 2006. Current Science, INCCA 4X4 Report)

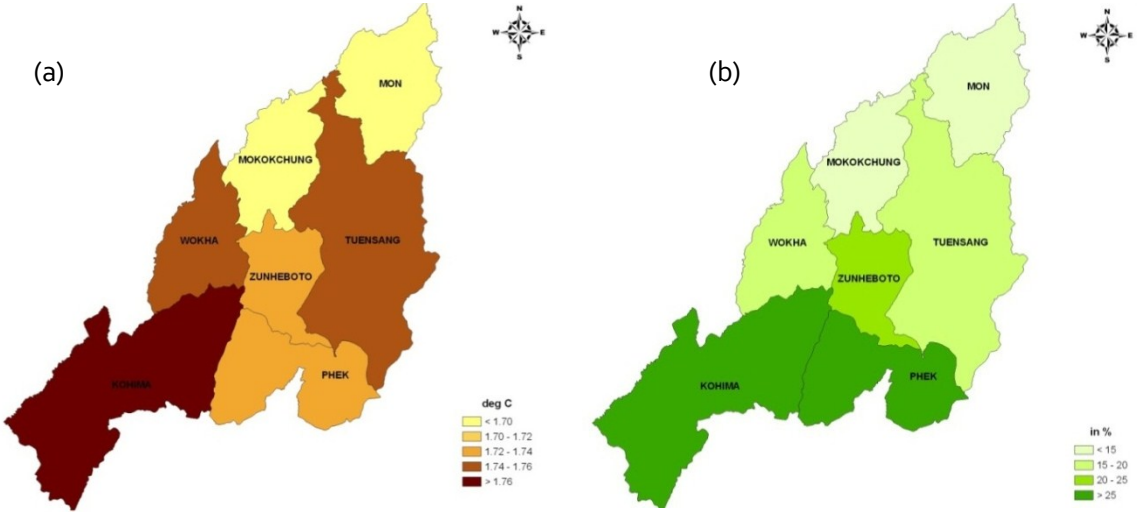
Precipitation

The total annual rainfall in Nagaland within the same period is projected to increase state-wide (*Figure* 10 b). The southern districts of Nagaland are likely to receive higher rainfall with respect to the northern districts. The southern districts of Kohima, Zunheboto, and Phek are projected to obtain more than 20 percent increase in rainfall with respect to base line. Wokha and Tuensang are projected to receive an increase in precipitation by 15 percent and 20 percent. The northern most districts of Mon and Mokokchung are projected to receive an increase in precipitation of between 10 percent and 20 percent. A gradient decrease in precipitation is projected as the latitude increases.

Extreme Precipitation

Increase in extreme rainfall events (100 mm/day) is projected in some districts of the state. Phek, Tuensang, and Kohima are projected to experience an increase in extreme rainfall events of 2 or more days per year. These are the same districts that exhibited an increase in absolute value of rainfall as well. The northern districts of Zunheboto, Wokha, Mon, Mokokchung all exhibit less than 2 days increase in extreme events per year.

Figure 10: (a) District-wise projected increase in annual average temperature (°C) for the period 2021-2050 (A1B SRES scenario) compared to baseline (1975), projected by the HadRM3 model. (b) District-wise projected increase in annual rainfall and JJAS rainfall for the period 2021-2050 (A1B SRES scenario) compared to baseline (1975).



Droughts and Floods

Increase in moderate drought like condition (onset of drought) is projected for Nagaland during 2021-2050s, with northern states facing more drought weeks than the southern states. The drought weeks across Nagaland are likely to increase by 25-50 percent in 2021-2050s with respect to current base line scenario. The projections also indicate higher flood discharge in the southern districts of Phek and Kohima, an increase of 10 - 25 percent more flood discharge is likely to take place with respect to current discharge rates in these districts.

The climate projections for the state are summarized in *Table 7*.

Table 7: Climate projections for Nagaland in 2021-2050

Climate parameter	Districts	Projected Change in 2021-2050s with respect to base line (1961-1990)
Temperature	Kohima, Wokha, Phek, Zunheboto and Tuensang,	+ 1.7 -1.8°C
	Mon, Longleng and Mokokchung	+1.6°C-1.7°C
Precipitation	Kohima, Zunheboto, and Phek	+20%
	Wokha and Tuensang	+15-20%
	Mon, Longleng and Mokokchung	+10 -20%
Extreme rainfall (>100 mm/day)	Phek, Tuensang, Kohima	≥2 or more days
	Zunheboto, Wokha	1.0 – 2.0 days
	Mon, Mokokchung	0– 1.0 days

Chapter 4

Sectoral Interventions - Overall Approach and Framework

4.1 Existing Initiatives Related to Climate Change

Nagaland has been ranked 4th on the Environment Sustainability Index (ESI) for Indian States in study13 conducted by the Centre for Development Finance, of the Institute for Financial Management and Research (IFMR). As will be seen in the succeeding sections, Nagaland is already on a development pathway that is relatively climate friendly. In addition to this, several initiatives have been undertaken or are underway in the State that are supportive of or will foster climate friendly development and adaptive resilience building. Some of these include the first and second phase projects undertaken by NEPED aimed at improving jhum through agro-forestry and introducing a micro-credit structure at the village level through the VDBs respectively. The State is also currently implementing the World Bank funded North East Rural Livelihoods Project (NERLP) to improve rural livelihoods in the state. Nagaland University, Departments of Geology & Mining, Science & Technology, Soil and Water Conservation, and Kohima Science College are already conducting research and studies on impacts of varying rainfall on landslides, etc. In collaboration with LEAD India, eight Climate Change Leaders have already been trained and embedded in the society to do advocacy and awareness on climate change. The Detailed Project Report for the North East Climate Change Adaptation Program (NECCAP), with NEPED as the state nodal agency, and to be funded by KfW- MoDoNER has already been prepared and the project is likely to start from 2013. Details of these initiatives may be seen at Annexure 2

4.2 State Vision and Commitment

Through the NSAPCC, the GoN commits itself to help the state achieve its developmental goals through a path that will enable conserve its natural resources without compromising on livelihood and food security. The state visualizes the Action Plan to serve the dual purpose of integrating climate concerns in its developmental plans into the future and achieve a *low carbon* inclusive growth, while ensuring complementarity with and contributing to the national agenda on climate change. The strategies and actions developed in the NSAPCC also addresses the capacity building requirements *vis a vis* the institutional, technological, policy, risk sharing and the financial needs for climate proofing vulnerable sectors.

4.3 Overall Approach, Principles, and Strategies

The Overall approach of the NSAPCC will be to create and define an overarching climate response framework at the State Government level, as also develop flexible sector specific response strategies and actions, while keeping in mind the overall Vision as articulated above. Climate change escalates the already existing vulnerabilities (social, ecological, economic and cultural) of Nagaland and could manifest severely if not addressed adequately. Therefore the climate response strategy of Nagaland has key elements such as accelerating inclusive economic growth, promoting sustainable development, securing and diversifying livelihoods, and safeguarding ecosystem services. Further, the strategy is not to be viewed as a standalone action; instead it will be integrated into the regular developmental planning process.

Climate change adaptation is the predominant philosophy and component of the climate response strategy of Nagaland, while at the same time leveraging opportunities for mitigation. The state lays equal emphasis on both 'hard' and 'soft' adaptation approaches – where 'hard adaptation options' include options that have physical attributes (e.g. infrastructure and engineering structures) and 'soft adaptation options' include the development of skills, processes, institutions, social systems, policies and programmes. The key elements of the climate response strategy for Nagaland also involves

[13] Environment Sustainability Index for Indian States: Informing Environmental Action, IFMR, 2008

flexibility (within livelihoods, economic, social, cultural, ecological and institutional systems), diversification (involving multiple independent flows to livelihood and natural systems), learning and education (from events at both individual and institutional levels and knowledge base required to develop new systems when existing ones are disrupted), mobility (an attribute of flexibility), operational techniques (for risk reduction before and following disruptions), convertible asset and innovation (designing new systems and options).

Specific elements of the overarching climate response framework at the State Government level are articulated below (and additional elements will be added as and when necessary). **It has also been ensured that all actions to be undertaken as part of the NSAPCC have broad conformity to the NAPCC and the eight National Missions under it**.

4.3.1. Scientific Knowledge, Evidence Base, and Understanding of Climate Change

The NSAPCC recognises that the currently available evidence base vis-à-vis climate change and its impacts on the State, its economy, and its various sectors and communities is limited. On this front, the NSAPCC seeks to fulfil the following outcomes (which are linked to the overall Knowledge Management Strategy under the NSAPCC):

- Development of detailed climate vulnerability and risk analyses covering all districts, as well as specific analyses pertaining each of the sectors addressed in the NSAPCC;
- Improved scientific evidence base and coordination mechanisms between scientific research and academic institutions (including both national and state level agencies) for building scientific data and evidence base for the State; and
- Collation of available scientific information and data on climate change pertaining to the State
- Documentation (on an on-going basis) of people's perceptions on community change and its impacts, and where appropriate, establish if these have scientific bases and validity.

To fulfil the above outcomes, the State will take all necessary steps including initiating (as one of the highest priority agendas) processes for carrying out detailed climate sector studies, vulnerability analyses and developing a climate vulnerability atlas, which will be updated on an on-going basis. Dialogue between scientific research and academic institutions will also be fostered and coordinated on an on-going basis. The NSAPCC also recognises that scientific knowledge and evidence base is also limited and scattered and there is no single clearing house mechanism that aggregates the available evidence base and tracks all on-going and planned research programmes that may have relevance to the State. An institutional mechanism has been proposed in the NSAPCC to oversee Research and Development specific to the state. This will then be used to foster processes for specific basic and applied research initiatives that may be required to support the implementation of this NSAPCC. The State will also foster dialogue between scientific and academic research organisations as part of the above processes.

4.3.2. Governance Mechanisms, Institutional Decision Making, and Convergence

As indicated above, Nagaland is already implementing a range of steps/programmes that are climate-friendly/neutral. While continuing to foster such initiatives, the State will seek to fulfil a range of outcomes including:

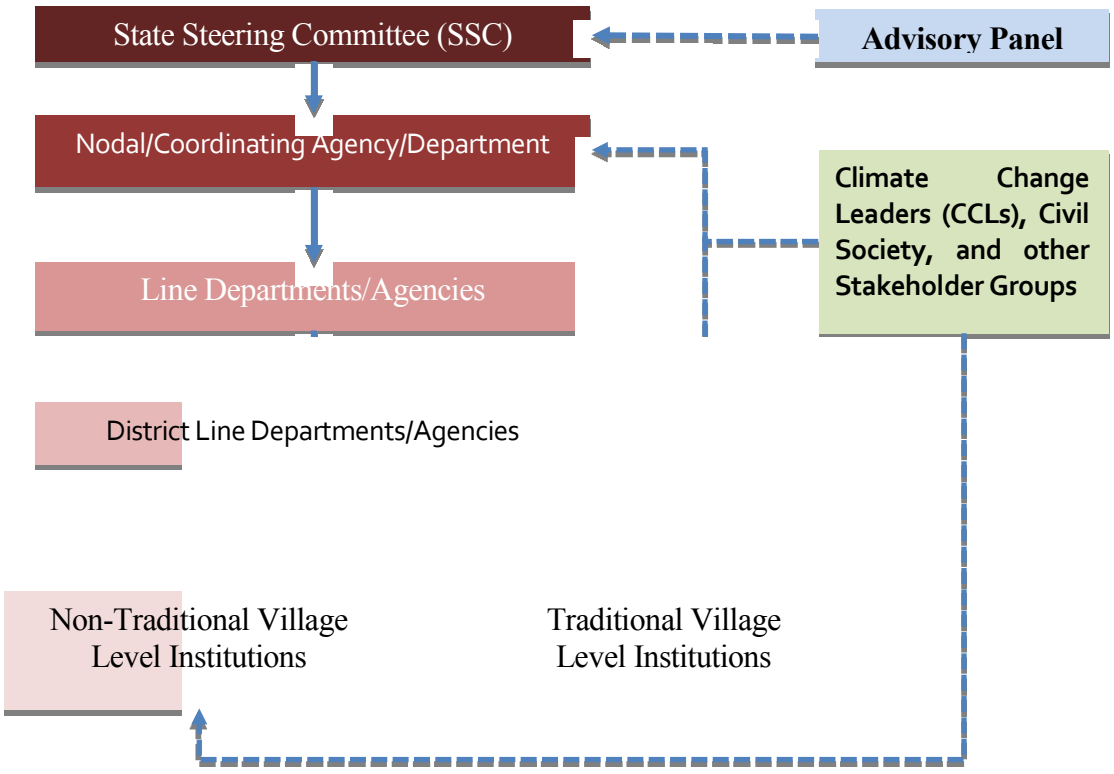
- Developing and putting into place overarching institutional and governance mechanisms at the State level to oversee and implement the NSAPCC;
- Review of all state policies and revise these as necessary to articulate and integrate climate concerns
- Articulation and integration of climate change considerations into development strategies, plans and programmes;
- Strengthening of institutional decision-making mechanisms and processes (including monitoring and evaluation) to ensure cross-sectoral coordination related to climate change;

- Development and adoption of appropriate management approaches including regulatory, incentive, and innovation based approaches to encourage appropriate adaptation and mitigation measures; and
- Development and strengthening of institutional capacity for climate related disaster risk reduction and management.

In order to provide an overarching governance framework and guidance to the State's climate agenda, the State has already constituted the SSC under the Chairmanship of the Chief Secretary and comprising 15 members including Commissioner & Secretaries in-charge of various line departments as well as other senior government personnel. The SSC, which was mandated the apex role of overseeing all aspects of the State's preparations and initiatives to address climate change and its impacts, will also oversee implementation of this Plan. The overarching State level institutional framework is given in **Error! Reference source not found.**. An Advisory Panel, comprising of 4-5 sector experts will be constituted, and be tasked with assisting the State Steering Committee in its role. The composition of the Advisory Panel will be flexible, and new members can be co-opted from time to time as required.

The nodal agency/department (currently Forest department) overseeing the operational aspects of NSAPCC implementation will be supported closely by other State level departments/agencies whose work is crosscutting, as appropriate, and close coordination with all such departments will also be ensured. While this NSAPCC focuses on sectoral interventions across a selected set of government line departments/agencies, this will by no means exclude the role of other line departments/agencies, and these will be co-opted to support NSAPCC implementation processes from time to time.

Figure 11: State level architecture for NSAPCC implementation



4.3.3. Capacity Development, Education, and Awareness

The State recognises that overall awareness of climate change and its impacts in Nagaland is limited. Therefore, the NSAPCC seeks the fulfilment of the following outcomes:

- Significantly improved awareness of climate change and its impacts in government at all levels as well as in communities, civil society and the private sector in the State; and

- Capacities of government line departments and agencies at all levels to analyse, plan, converge, implement and monitor programmes addressing climate change and its impacts;

Therefore, the State will initiate and foster a range of on-going awareness and capacity building measures aimed at targeting government departments and agencies at various levels, to improve overall awareness levels. It is envisaged that each sectoral line department and State level agency will develop and activate Climate Change Cells, and actively seek and foster climate champions.

The State will also put into motion a process of building awareness on climate change and its impacts among the population and communities in general and also develop and widely disseminate sets of actions that the citizens of the State can take to support the NSAPCC. In addition, the State will examine the possibility of incorporating climate change related modules into the educational curriculum across various levels, including the development of specific academic programmes on climate change at University levels. Appropriate non-governmental agencies will be co-opted as necessary to support the awareness and capacity building processes.

Nagaland will also explore the scope for expansion and revitalisation of the CCL network, and develop a cadre of committed Climate Change Leaders across the State.

4.3.4. Private Sector

As has been outlined in Part A, Section 1 of this NSAPCC, the private sector already plays a significant role in contributing to the State's economy in the secondary and tertiary sectors. Additionally, PPP initiatives and projects are beginning to be fostered in the State. Such models can be useful for pooling resources and expertise and for up-scaling climate change adaptation (especially in terms of climate resilient infrastructure and low carbon goods and services) and mitigation initiatives by way of explicit incorporation of climate concerns into project frameworks. Private Sector has great potential and competency for bringing innovative solutions and scale to the various models for climate change adaptation shaped by the government or other non-governmental actors.

Increasingly, there is a huge potential and need private sector to play critical roles sectoral initiatives in the primary sectors as well – bringing in new management practices, technologies and technology transfer, innovation, capital and investments, capacity building, etc. In this direction, the NSAPCC will additionally seek to fulfil the following outcomes:

- Developing a roadmap for exploring the potential role of private sector across the various focus sectors of the NSAPCC especially in the primary sectors such as agriculture (with special emphasis on rain-fed mountain agriculture and extension), forestry, etc.;
- Review of existing policy frameworks governing the private sector with the objective of exploring the incorporation of climate change concerns into private sector and/or PPP projects in the state; and
- Outlining of necessary enabling frameworks and regulatory mechanisms for involvement of the private sector.

4.3.5. Role of Civil Society

Civil society and voluntary organizations have played critical roles in shaping the development landscape of not only Nagaland, but also across the nation. These will continue to have vital roles in the context of climate change, and have the potential to deliver programmes and services to communities and to bridge the roles of not only the government and community but also bridge the roles of scientific research institutions and the private sector with government and the community.

As such, the NSAPCC envisages the following outcomes relating to the role of civil society:

- Identifying civil society organisations and developing their capacities towards preparing society, for adapting to climate change impacts.

4.3.6. Monitoring Framework

The state is committed to ensuring that NSAPCC implementation is complemented by a robust framework and mechanisms for monitoring and evaluation not only as a means of ensuring that the detailed operational plans that will be developed under the NSAPCC are implemented as planned, but more importantly, as a tool for systematic review and programme improvement as the needs of the State evolve with implementation. It is tentatively expected that reporting will take place on a quarterly basis at all levels, internal reviews of implementation progress and performance on a half-yearly basis. Likewise, considering that this NSAPCC broadly covers implementation plans over a five year period, implementation of the, an external third-party evaluation during mid-2014 to critically examine implementation and recommend course corrections, and another similar external evaluation will be carried out during end 2017.

A detailed and robust monitoring framework will be developed including specific methodologies, protocols, and templates for monitoring and reporting as part of the process of developing detailed work plans under the NSAPCC.

4.3.7. Knowledge Management, Sharing, Learning, and Dialogue Across the IHR and Beyond

The NSAPCC recognises that knowledge creation, management, and dissemination and exchange will be critical and central to the successful implementation of the SAPCC. The NSAPCC also recognises that Nagaland does not exist in an independent developmental vacuum; it exists in the developmental context of the North Eastern Hills, IHR and also in the larger context of the Hindu Kush Himalaya (HKH). Therefore the NSAPCC will seek to fulfil the following outcomes in this regard. It will strive to develop and deploy mechanisms for collating and sharing the existing knowledge base on climate change and its impacts as relevant to the State, emerging experiences including best practice with other member states of the IHR.

4.4 Overall Common Implementation Framework

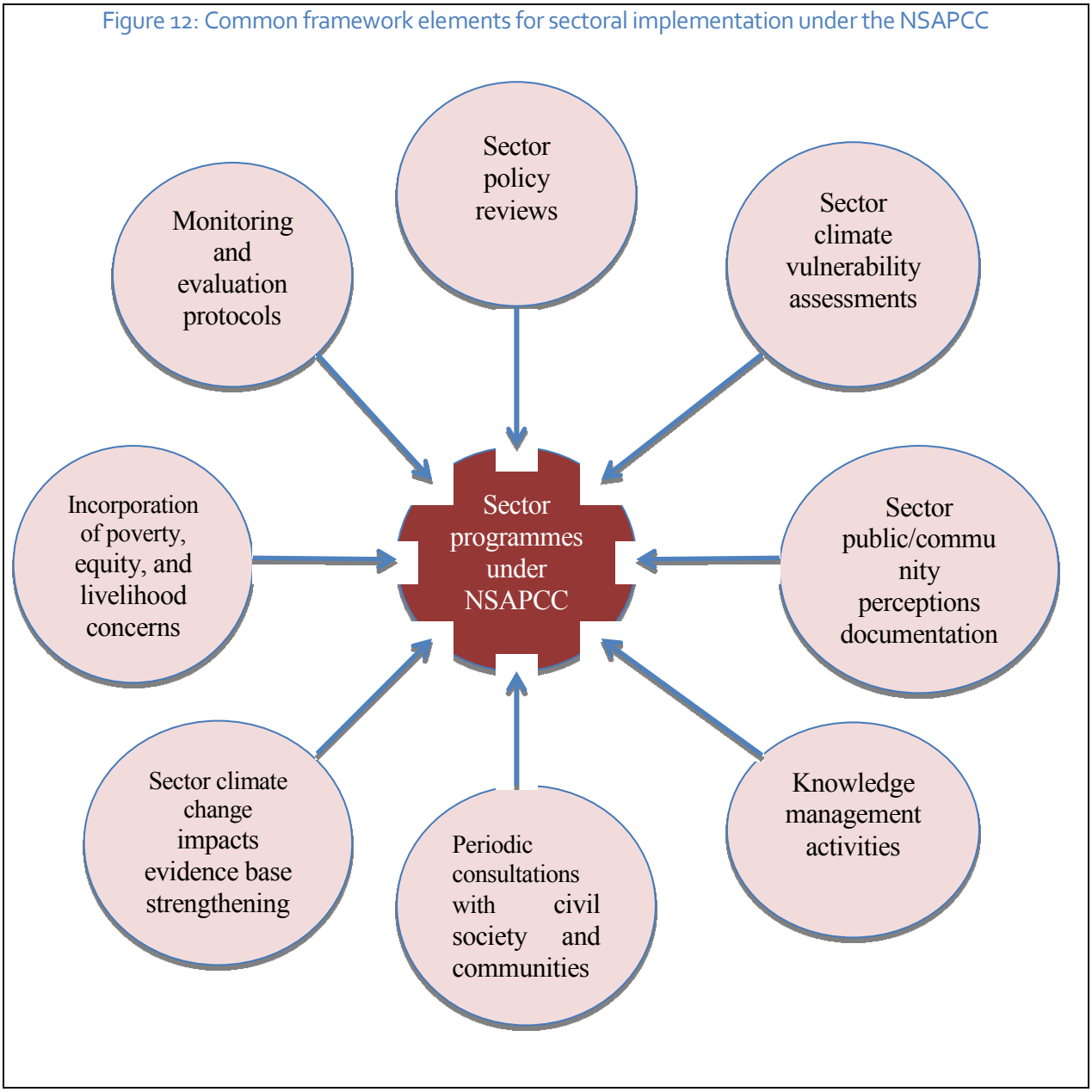
It is envisaged the NSAPCC implementation under the various sectors of the State will be governed by a common implementation framework[14] as in the Figure 12 below.

The common elements will include:

- *Sector policy reviews*: Each sector will undergo a policy review, and where appropriate, explicit articulation of climate change concerns and sectoral responses will be articulated;
- *Sector climate vulnerability assessments:* Sectoral climate vulnerability and risk assessments will be carried out as part of a larger vulnerability and risk assessment for the State, and where appropriate, sectoral programme elements will be re-framed based on the findings;
- *Sector climate change impacts evidence base strengthening:* Each sector will put into motion a process of building the evidence base on climate change and impacts to the sector;
- *Sector public/community perceptions documentation:* Each sector will carry out periodic documentation of public/community perceptions on climate change and its impacts relevant to the sector;
- *Periodic consultations with civil society and communities:* Each sector will carry out periodic consultations with civil society and communities to gauge adaptive resilience needs;
- *Incorporation of poverty, equity and livelihood concerns:* Each sector will, where appropriate, incorporate and explicitly articulate poverty, equity and livelihood concerns in their policies, plans and budgetary processes;

[14] Since these will be common across sectors, in order to avoid repetitiveness, will not appear in the descriptions of each sectoral programme

Figure 12: Common framework elements for sectoral implementation under the NSAPCC



- *Monitoring and evaluation protocols:* Each sector will, in line with the overarching State level framework, develop and deploy monitoring and evaluation processes and protocols to guide effective programme implementation; and
- *Knowledge management activities:* Each sector will, in line with the overarching State level framework, carry out KM activities, and contribute to the State level processes on an on-going basis. As indicated in an earlier sub-section, under the NSAPCC, an appropriate agency will carry out the role of a knowledge aggregator, and become a clearinghouse of all data/information on existing and planned research projects and initiatives relating to climate change in the Nagaland context. Towards this, the proposed inputs by the chosen/nominated will be:
  - Hosting of geo-portal on climate change;
  - Host-hub for knowledge/information sharing related to climate change;
  - Knowledge repository;
  - Identification of potential research and development domains concerned with climate change issues in the state; and

- Technical demonstration, research and development, extension and transfer of technology protocols, relating to climate change.

Additionally, efforts will be made to explore the options for participation of and leveraging the private sector and financial institutions in each sectoral programme. Likewise, where appropriate, suitable external support agencies will be leveraged/sought to bring in additional implementation support or technical assistance.

Chapter 5

Integrated Agriculture

5.1 Overview, Characteristics and Status

Agriculture is the main occupation in Nagaland, with over 70 percent of population living in rural areas and dependent on agriculture and allied activities. Nearly 28 percent of the total area of the state is under cultivation, with another 6 per cent under various agro-forestry practices. Of this, 70 percent is located in the hilly region and only 30 percent in the plain areas of the foothills. The state is classified into four agro climatic zones, namely High Hills, Low Hills, Foot Hills, and Plain areas. These zones have distinct characteristics with regard to soils, crops, rainfall, and biodiversity. Jhum, or traditional shifting agriculture is practiced in over 80 per cent of the cultivable area. Rice is the main crop grown in all zones. 80 per cent of the gross cropped area is under rice cultivation. Rice is mostly single cropped but sometimes other crops like maize, millets, and vegetables are taken along with rice. The cropping pattern across different agro climatic zones is presented in **Table** 8 below.

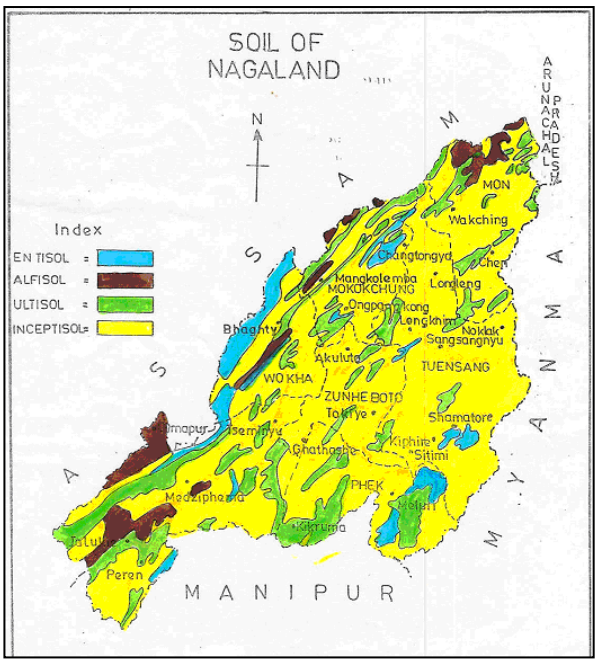
Table 8: Cropping system (paddy dominated) under different agro-climatic conditions of Nagaland[15]

Agro climatic zones	Cropping systems
High hills	Rice-Potato/vegetable Rice/maize-mustard Rice
Low hills	Rice-wheat +mustard; Rice – potato
Foot hills	Rice- potato; Rice- vegetable
Plain areas	Rice-groundnut, rice-rice- cowpea, Rice-wheat-rice, Rice-pulses, rice-linseed.

5.1.1. Soils of Nagaland

Soils in Nagaland are derived mainly from shales and sandstones and range from highly fertile to highly weathered and infertile. The four soil orders found in the state (National Bureau of Soil Survey & Land Use Planning) are Alfisols, Entisols, Inceptisols, and Ultisols. Inceptisols (66 percent) dominate the soils of the state with followed by ultisols (23.8 percent), Entisols (7.3 percent) and Alfisols (2.9 percent). The soils developed on moderately steep to steep slopes of low altitudinal hill ranges are moderately deep to deep, well to somewhat exclusively drained, loamy skeletal, fine-loamy to fine and moderate to severely eroded. In general, the soils are acidic in nature with PH ranging from 4.20 to 5.70. The soils are rich in organic carbon which may be as high as 3 percent but very poor in base saturation. Due to acidic nature of soils the available phosphate and potash content of the soils are usually poor or low. The heavy monsoonal rains, and traditional agriculture practice of jhum leading to severe soil erosion, followed by increased acidity of soils, affecting an estimated 13,33,000 Ha of land in the state.

Figure 13: Soils of Nagaland



[15] Source: ICAR Research Complex for NEH Region, Nagaland Centre, Nagaland

5.1.2. Irrigation

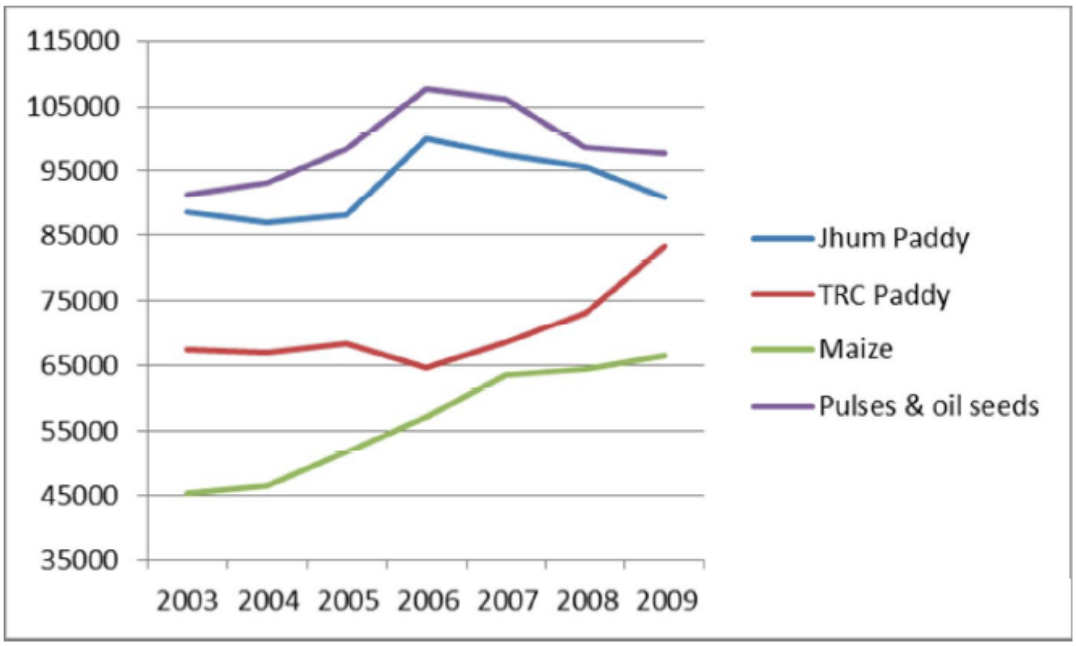
The rainfall in the state is highly seasonal, with 80 per cent of the heavy annual receipt of 1500 - 2500 mm rain received during the monsoons. Further, due to hilly terrain, the rainwater is not optimally utilized due to high runoff. The traditional and primary agricultural practice of jhum in the state is, therefore, built around utilising the heavy monsoonal rainfall. Scanty rainfall and inadequate natural or artificial storage/harvesting facilities for rain water imply that the cultivation during the Rabi season is insignificant.

Until 2006-07, a total irrigation potential of 103217 ha had been created, only 60963 ha have been developed. Crops are irrigated in Nagaland mainly through diversion channels leading directly to agricultural fields and occasionally through pipelines conveying system leading to a storage structure for using in subsequent lean season.

5.1.3. Traditional Farming Systems

About 86 percent of the cultivable area in Nagaland is under traditional Jhum and terrace rice cultivation system and rest under commercial and other crops. Jhum is a traditional process that involves clearing a patch of forest land by slash and burn method but retaining useful trees and plant varieties, cultivating it for two to three years and then moving on to another patch of land. The previously cultivated land is abandoned for 8-20 years to allow the fallow forest to grow back and the soil to regain its fertility. The cycle of cultivation -- leaving fallows and coming back to it for cultivation -- is called the Jhum cycle. Jhum supports production of rice, maize, pulses, and oil seeds in the state. Area under Jhum rice cultivation and pulses and oil seeds peaked in 2006 but it has gradually decreased (See Figure 14).

Figure 14: Trends in area under traditional agriculture in Nagaland[16]



[16] Source: Traditional Agriculture Practice- Practice and sustainable livelihoods- A thematic Report, 2009, A GoI-UNDP Project - strengthening of State Plans for Human Development, GoN, Department of Planning

In rice production, traditional rice varieties occupy an important place; in Nagaland out of total production, 70 percent of rice is produced from traditional varieties while remaining 30 per cent through improved varieties from foothills. These traditional rice varieties grown in altitude ranging from 300-2500 meters do not respond well to modern technology and thrives well under low management practices. The State Agriculture Research Station (SARS) has broadly categorized these varieties into glutinous rice, brown rice, and aromatic rice; the institute has identified 867 traditional varieties from the state.

Box 3: Indigenous varieties of rice grown in Nagaland[17]

Some of the indigenous varieties of rice grown in Nagaland are Nagaland Sinsatsu, Henigido, Akatan, Kemehyasopa, Kemenhya, Ngoba, Mikotchuwakelu, Mikudep, Sarang, Sarengma, Misarengma, Khulong, Misokmil, Mitonging, Yaribatsuk, Moyatsuk, Maikutsuk, Pangnakla, Geartsuk, Mamen, Yirnontsuk, Makuktanakla, Meserong, Kiyirtsuk, Maikumapuk, and Nagaland special. These have potential of being adapted in the climate change scenario, as generally the indigenous varieties are more resilient to warming and water stress conditions.

The traditional varieties are generally tall, medium to long duration; although they are mostly poor to medium yielders they are resistant to pests and diseases, tolerant to cold and stress environment. The performance of some indigenous crops is presented in ***Table*** 9. Improved varieties introduced in the state during 1990 performed better than traditional varieties but require additional inputs; and since farmers cannot afford to purchase high inputs they prefer local varieties.

Table 9: Traditional varieties performance and seasons

Class of Rice	Sowing season	Harvesting season	Average Yield (MT/ha)
Glutinous Rice	Jhum: March - April	Jhum: August - September	1.5-20
Brown Rice	TRC: June-July	TRC: November-December for	1.6-2.5
Aromatic Rice			1.6-2.5

5.1.4. Agricultural Production and Productivity

The total area under food grain production has increased from 257.5 thousand ha in 2001-02 to 283.9 thousand ha in 2008-09 – a rise of about 10 percent. Correspondingly the food grain production has increased by 44 percent during the same period, with yields growing from 1380 kg/ha in 2001-02 to 1811 kg/ha in 2008-09 (*See* Figure 15). Ninety percent of cereals and commercial crops are produced in the Kharif season in Nagaland. Rabi is the main season for pulses and oil seed production. The productivity of crops grown in both seasons when compared is higher in Kharif than Rabi. There is a gradual shift in cropping pattern from mono cropping to mixed cropping due to increase in population and

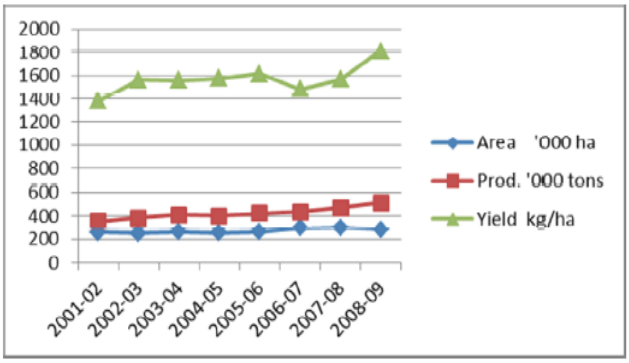


Figure 15: Trends of cropped area, food grain production and yields in Nagaland[18]

[17] Source: Rice resource book of Nagaland 2007

[18] Constituting total cropped area and land under different trees and other crops. Source: Statistical Handbook, 2009

improvement in the basic agricultural infrastructural facility. Since most crops are rain fed, any anomaly in rainfall patterns affect productivity of crops.

During last fifty years, the Kharif cropped area increased from 90,480 ha to 3,26,620 ha resulting in production augmentation of all crops from 103240 MT to 909400 Mts. In the past, cereals were main crops grown in Kharif but gradually the trend has changed to other crops. Analysis of data provided by agriculture department shows that percentage of cereal cropped area declined from 93.67 to 78 percent in 2010, while during the same period the percentage of cropped area of pulses, oil seeds and commercial crops increased in the state. Subsequent to decrease in crop area, the share of cereal production has decreased while pulses and oil seeds share has increased. In case of commercial crops despite increase of cropped area, its share in production has declined marginally (*see* Table 10).

Table 10: Kharif Crop Wise Trends and Changes in Nagaland

Crops	Area (percentage)		Production (percentage)	
	1960-61	2010-2011	1960-61	2010-2011
Cereals	93.67	77.79	60.52	56.34
Pulses	1.38	4.72	0.50	1.87
Oil seeds	0.64	9.56	0.56	3.43
Commercial crops	4.31	7.93	38.42	38.35
	100	100	100	100
Source: Analysis of data provided by Department of Agriculture				

The productivity trend analysis of Kharif crops (Yield in kilos/ha) for the period 1960-61 to 2010-11 indicates a steady increase of cereal crops, variance in pulses and oil seeds and decrease in commercial crops. On further analysis on annual growth rates of crop productivity during the period 1960-61 to 2010-11 showed that cereal, had higher annual growth rate (3.47 percent), followed by pulses (3.36 percent), oil seeds (2.80 percent) and lastly commercial crops (0.64 percent).

An area 67,440 ha of land as compared to 3350 ha in 1960 has been gradually brought under Rabi cultivation resulting in increase of Rabi crop production from 2580 MT to 1,14,850 MT by 2010. Cereal crop production was introduced during Rabi season in the 80s. Subsequent to this, the share of pulses and commercial crops has declined whereas oil seed share has increased. A steady increase in productivity of oil seeds, pulses, and commercial crops has been observed during the period.. The analysis of annual growth rates of crops shows that cereal crop productivity during the period 1980-81 to 2010-11 was about 0.9 percent whereas higher annual growth rates were observed in case of oil seeds (3.37 percent), pulses (4.07 percent) and commercial crops (12 percent). Considering productivity as a key indicator sensitive to climate change, from above data it is difficult to arrive at a conclusion that climate change has had an impact on agriculture productivity.

5.1.5. Horticulture

The agro-climatic conditions in Nagaland are quite conducive for cultivation of various fruits, vegetables, plantation crops, flowers, and spices. Horticultural crops are cultivated by almost all rural households in Nagaland; however, it has typically been considered as a backyard activity since farmers' main focus was on agriculture -- in general, farmers preferred field crops over orchards because gestation period of horticultural crop cycles are longer than the agriculture.

In Nagaland the total horticultural crop area in the year 2010-11 was 33,274 ha with 2,09,538 metric tons of fruit production .The main fruit crops are pear, plum, peach, orange, lemon, pomelo, pomegranate, papaya, banana, guava, jack fruit, pineapple, cardamom and passion fruit. Farmers produce vegetables

mainly for self-consumption, and as supplemental income generating activity. The total vegetable production of the state in the year 2010-11 was 3,30,391 MTs in a total area of 43, 325 ha. Principal vegetable grown in the state are cabbage, potato, beans, sweet potato, cauliflower, brinjal, chillies, bean, tomato, ginger, garlic, radish, onion, Naga cucumber, and leafy vegetables. Since the vegetable production does not meet local demand, the state depends on outside and imports about 20 -30 percent of state vegetable requirement.

Nagaland produces high quality tea in the hills and foothill areas adjoining Assam state. About 9800 ha of land has been identified for the development of tea on a commercial scale. At present, about 750 ha land is under tea cultivation. At present tea is produced mostly in Mokokchung and Mon districts but Wokha also has potential areas for producing tea. The state also has the potential to produce medicinal plants, which have essential oil bearing properties. The department has identified Citronella, Patchouli, Lemon grass, Geranium, Agar, and Ginseng as medicinal and aromatic plants for commercial development.

Elevation range and climate are two factors on which horticultural crop production system is based. Based on altitude, the horticultural crop production zones could be classified into three agro climatic zones. Within these zones farmers follow standard cropping pattern. Horticultural crops are sensitive to climatic variations and according to different climate the horticultural area is divided into two climatic zones (*see* Table 11).

Table 11: Agro-climatic zones and horticulture cropping pattern

Crop zones	Elevation range	Important horticulture crops grown
Foothills & Lower hills (Sub Temperate)	<800 m Temperature: (8-38)	Fruits: Pineapple, Mango Papaya, Guava, Citrus, Banana, Litchi, Jack fruit, Coconut, Cashew nut Flowers: Anjuriuim, Gerbera, Orchid Vegetables: Cabbage, Cauliflower, Pea, Bean, Brinjal, Tomato, Potato, root crops, Cucumber etc. Spices: Naga Mircha, Turmeric, Black pepper, Ginger
Mid- and High Hills Sub Temperate	800 >1500 m, Temperature: 3-240C	Plum, Pear, Kiwi, Mango, Banana, Passion fruit, Apple, Cherry, Walnut, Chestnut, Pear, Plum, Kiwi, Peach Flowers: Rose, Lilium, Alstroaemeris, dry flowers, Carnicium Vegetables: Broccoli, Chow-chow and Cabbage, Cauliflower, Pea, Bean, Brinjal, Tomato, Potato, root crops, Cucumber Spices: Large cardamom, Ginger, Naga Mircha, Naga garlic

5.1.6. Livestock

Livestock is considered as subsidiary income by most rural households in the State. Along with agriculture, backyard pig and poultry rearing is integral to the livelihoods of farmers. Pig rearing in Nagaland is traditional and very common, provides additional income to households, and helps rural households diversify their risks. The stocking rate of pigs in Nagaland ranges between 1 - 3 per household but some households from Dimapur district rear up to 15 pigs at a time. Pig rearing is easy since they are fed on by-products of paddy, maize, taro, vegetables and other gathered forages and is an excellent source of subsidiary income for the poor because of high local demand for pork, consumption in Nagaland being the highest among all the NER states. While crossbred pigs have significantly better

productivity value, many rural households prefer to keep indigenous scavenging pigs because they produce better tasting pork. Dairying is not generally practiced by farmers except in some small pockets of Kohima and Dimapur districts, as Nagas are not primarily milk consuming people. Rearing cows and mithun for meat is also a common traditional practice; however, they are free grazing and not stall-fed.

The stocking rate of all species is, however, declining mainly because of increased management costs, lack of feed resources, increased risks due to disease and lack of market stimulus. The livestock sector growth rate of 6.63 percent in the state was, however, higher than NER (2.37) and India (3.51). The livestock population trends of Nagaland showed that the people are shifting mainly towards meat animals than for milk production. Very high growth rates were observed in ducks (47.79 percent), followed by sheep (17.39 percent), poultry 10.46 percent), mithun (8.03 percent), goat (7.34 percent), cattle (6.57 percent), pigs (6.11 percent) and buffalo 6.10 percent). The contribution of livestock sector to the state's GSDP has, however, declined as compared to the increase observed in the national GDP figures.

5.1.7. Fisheries

In Nagaland, pond culture is commonly practiced in foothills whereas in hill areas, especially Kohima and Phek districts, farmers practice paddy cum fish culture. In all there are 68 fish varieties in Nagaland and data available with the Department of Fisheries, GoN shows that fish production has been steadily growing, and currently stands at 6585 MT, with 6557 farmers engaged in fishery. Fish production is reported throughout the year and maximum production is recorded during March and least in June. The common species of fish grown in Nagaland are Catla, Rohu, Mrigal and Silver carp, Grass carp, cat fishes and Common carp (exotic). Ponds and tanks comprising 31 percent of total area produce 80 percent of total fish. Paddy cum fish culture with 32 percent contributes 15 percent, and Doyang reservoir with 26 percent of total area produces only 5 percent of fish production.

Table 12: Fish production trends in Nagaland

Year	Production of Fish (in MT)
2004 – 2005	4900
2005 – 2006	5500
2006 – 2007	5800
2007 – 2008	5975
2008 – 2009	6175
2009 – 2010	6358
2010 – 2011	6585

District-wise data on number of ponds and production fish during the period 2001- 02 to 2008 - 09 showed that number of ponds increased almost three times whereas the production has not increased accordingly. The average productivity of fish in the state is about 1.74 MT per ha. Fish productivity is higher in Kohima, Dimapur, Mokokchung, and Wokha whereas all other district productivity is below the average. Tuensang and Phek performance is very low compared to all districts. However, lack of longer time series data is a constraint to draw any conclusions with regard to productivity.

5.2 Institutional Arrangements and Existing Initiatives

The state Vision for the Agriculture and allied sectors is 'Food for All by 2025', which it aims to achieve by increased production and productivity in a sustainable way. The departments of Agriculture, Veterinary

and Animal Husbandry, Horticulture, and Fisheries are the departments in charge of the respective sectors described above. In addition, the Soil and Water Conservation Department as well as the Irrigation and Flood Control Departments also play key roles across the agriculture and its allied sectors. ***Nagaland Bio Resources Mission*** and the ***Nagaland Honeybee Mission*** are also important players promoting livelihoods based on harvesting the rich bio-resources of the state and increasing honey production respectively. The major thrust areas and main programme of each of these departments are summarised below.

5.2.1. Department of Agriculture

Towards achieving the state vision, the department implements a bouquet of programs, mainly funded under various centrally sponsored schemes. The department is implementing totally 17 programmes in the state (See Annexure 4). The focus is to increase cropped area and improving inputs, including irrigation, technology, and increase the value addition at or close to the farm as well as conservation of local varieties, strengthening of human capacities. The department also aims to transform subsistence agriculture to organic agriculture, and promote commercial agriculture in a sustainable manner.

5.2.2. Department of Horticulture

With the objective of increasing production and productivity of vegetable, fruits, flowers and other horticulture crops in the state, the Department of Horticulture aims at promoting low volume, high value, and less perishable horticulture crops, improving post-harvest management and providing marketing linkages, receives support and funding from the *Horticulture Technology Mission and the Rashtriya Kisan Vikas Yojana (RKVY) in addition to the State Plan and NEC.*

5.2.3. Department of Veterinary & Animal Husbandry

The Department of Veterinary and Animal Husbandry's vision is to attain self-sufficiency in meat, milk and eggs by creating self-employment opportunities for farmers living in villages. The department aims to intensify the provision of animal health care service at farmers' doorstep. Towards this vision, the department is implementing ten programmes sourcing funds from state government and central government (see Annexure 5). In addition, ***NEPED*** is also implementing a piggery based livelihood project aimed at improving pig rearing practices in the state.

5.2.4. Department of Fisheries

The primary objective of the Department of Fisheries is to strengthen the state economy through aquaculture. It aims at maximizing fish production and enhancing productivity to the level of self-sufficiency. In all there are nine programmes being implemented by the department in the state to achieve the overall objective (see Annexure 6). These have contributed to increased production from 5500 MT in 2005-06 to 6585 Mt in 2010-11. Research and development still seems to be not receiving much attention in the state and all the efforts of the department was mainly focused on area expansion.

5.2.5. Department of Soil and Water Conservation

The Department policy is to put land to optimum use according to its capability, with priority being to optimize crop production and to protect arable land by adopting appropriate scientific soil and water conservation measures. The department is implementing six schemes that are contributing o increased access to water, better management of soils and contributing to increased productivity (see Annexure 7).

5.2.6. Department of Irrigation and Flood Control

The main programme being implemented by the department is minor irrigation programme, which is aimed at irrigating small command area to a larger area and improve drinking water facilities where its scarcity was severe. The minor irrigation programme includes digging shallow wells for a command area of 1-2 ha, deep tube wells in plain areas of Dimapur, shallow dug wells for drinking water purpose, reservoir/irrigation tank for conservation of spring water and store rainwater reservoir for irrigation purpose, surface lift irrigation for irrigating fields located at higher level and cannot be irrigated by flow

irrigation, sprinkler/drip irrigation for irrigating those Rabi cash crops/horticultural crops which require minimum water during the acute scarcity; and construction of diversion structures by identifying potential irrigation projects to increase the irrigations.

Command area development and water management programmes are implemented with the objective to bridge the gap between potential created and potential utilized. Flood Management Programme (FMP) implemented to protect threatened infrastructures, township, communications, human habitations, etc. to due to heavy erosion of riverbank. It is also implemented to mitigate the floods in the rivers and drainage system. Under the financial assistance from the GoI's Ministry of Department of North East (MDoNER) programme, the Department is implementing Tsurang Irrigation and Integrated Nguiki Irrigation Projects. A hydrology programme is under implementation to collect hydrological data from 27 new gauge and discharge site on Major River across the State and set up five new.

5.2.7. Extension, Outreach, Research and Development

To bring awareness among farmers on improved agricultural practices the Agriculture department has extensive network of field level officers. There are nine KVKs established at Dimapur, Kohima, Mokokchung, Mon, Phek, Tuensang, Wokha, Longleng, and Zunheboto with the purpose of increasing productivity by conducting field demonstrations and improve awareness among farmers to transform from subsistence agriculture. One Integrated Extension Training Centre is located at Medziphema with a purpose of training of field staff and farmers. ICAR located at Jarnapani works on conservation, propagation, and improving species in the NER. State Agriculture Research Station (SARS) located in Yisemyong, Mokokchung. The major activities of the Station are maintenance and preservation of crop germplasm, agro forestry, soil chemistry, development of watershed models and crop research. One Soil Conservation Training and Research Centre is located at Sechu to impart training on soil conservation measures to field staff before they are deputed to their field stations.

Central Institute of Horticulture, Medziphema, Nagaland was established by GoI in 2006 also provide institutional support for development of horticulture in the state and north-east. Horticulture Progeny-cum-research Farm, Pfutsero conducts field-required research.

Nagaland Empowerment of People through Economic Development (NEPED) is a GoN programme, which has contributed substantially, since its establishment in 1993, through its intensive extension activities at augmenting the Jhum cycle through agro-forestry activities and creating micro-credit mechanisms at the village level. NEPED is the nodal agency for carrying out the KfW funded climate change adaptation project in the state.

5.3 Key Issues and Challenges

5.3.1. Water

Eighty percent of the rainfall is received during the pre-monsoons and monsoons. The heavy rains during the monsoons, coupled with the hilly topography of the state lead to high surface runoff. Lack of adequate water storage – natural as well as artificial, and the scanty rainfall received during post-monsoon and winter season, is not favourable for Rabi cultivation.

Irrigation potential created in the state, due to lack of developed land in the command area and mono cropping pattern followed by many farmers, and is also not adequately utilized. Erratic and heavy rains also lead to frequent landslides and damages to Irrigation infrastructure affecting agricultural activities in the command area.

5.3.2. Soils

The hilly topography, heavy seasonal rains, and the traditional farming practices lead to heavy soil erosion. Soil erosion due to heavy rain leads to increased acidity of soils because Calcium, Magnesium, and Sodium minerals are washed out from soils and at the same time mineral like Iron, Copper and

Aluminium in the soil becomes toxic to plants. The mineral imbalance leads to reduced Phosphorus availability to the plant affecting the growth of rice plant. ICAR in 2008 has estimated that without any soil conservation measures the soil loss in jhum cultivation area will be about 40-90 tonnes per hectare (ICAR Complex, NER, Shillong). As pointed out above, 13,13,000 ha. is affected by soil erosion, affecting productivity.

5.3.3. Livestock related issues

Swine fever among pigs is a major cause of concern and the state lacks facilities for confirmatory diagnosis and providing timely vaccines. The department has not so far developed systematic disease reporting system like many other states in the country leading to inaccurate assessment of disease status of the state. Among pig rearing households, farmers lack knowledge on care of sows during pregnancy and lactation, and efficient usage of household crop by-products, as well as general health care management (medication and vaccination). Although the state has a high percentage of crossbred population among large ruminants, the feeding systems are still traditional, and poor management of cattle sheds increases the risks of parasitic diseases and mastitis especially in crossbreds. Also, fodder availability is a concern, since most farmers do not allocate fields for sufficient fodder cultivation as the priority is for crop production. Heavy loss of soil nutrients due to heavy rainfall in turn affects fodder quality, which in turn impacts the health of ruminants.

5.3.4. Fisheries related issues

Management of ponds is a serious concern in the state. Most of the ponds in the state are rainfed and all of them would dry during summer months impacting the productivity of fish. Also poor maintenance of water bodies results in growth of weeds and heavy siltation affecting the fish production. Increase in weeds and deterioration of water quality in ponds lead to stress to the fish and suppress the immune system resulting in reduction in resistance of the fish and consequently fish become susceptible to pathogens present in water. Most of the water bodies are deficient in nutrients and depleted oxygen levels impact productivity. In Dimapur district the decline of water level is seen in most of the ponds during summer. Lack of technical knowhow in fish farming among farmers is also an area of concern.

5.3.5. Institutional and other issues

Availability of appropriate productivity enhancing technology and level of its adoption in the state, Non-usage of inorganic fertilizers which can be a blessing in disguise, timely receipt of quality inputs, increased incidence of natural calamities viz. landslides, flash floods, etc. and degradation of prime agricultural land, weak extension services, weak institutional credit delivery system (per hectare credit disbursement is one-fifth of the national average), negligible agro-processing and post-harvest management, poor transport and market infrastructure, lack of research in developing high yield varieties suitable to local needs, etc. are some of the other issues facing the agriculture and the horticulture sector in the state.

5.4 Projected Impacts of Climate Change

Agriculture in the state is largely rain-fed. The behaviour of monsoon, including the intensity, frequency and the seasonality will potentially impact agriculture systems in the state negatively. Projected temperature changes coupled with the hilly terrain and the large variability in climate within the state, would also likely impact the crop yields and may require altitudinal movement of species. New pests and diseases are also likely due to climate variability. Anecdotal evidence is already being received with regard to crop failures, better results from seeds used in plains of Assam, etc. However, climate resilient varieties may be found from within the local varieties preserved and used in traditional farming practices.

The losses on account of post-harvest could increase for horticultural crops with the rise in temperature. Erratic heavy rainfall during flowering time of orchard crops reducing production had been reported by

farmers. Longer dry spell is resulting is scourging and dying of cash crops, this phenomenon had been more prominent in the case cardamom.

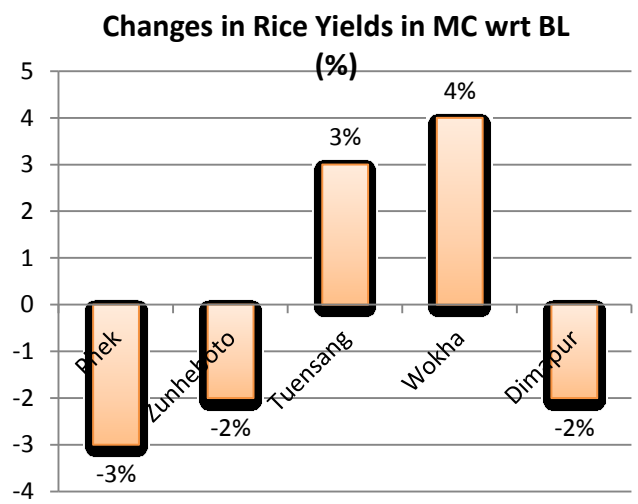
Nagaland falls within a zone where the temperature and humidity combination is favourable for animals, but with likely increase in temperature and humidity, the productivity of animals may be negatively affected due to mild heat stress. Vector borne diseases and other diseases are also likely to be more prevalent, again adversely affecting the health of livestock. Projected increase in temperature may also lead to an adverse impact on fish population, while indirectly due to increase sediment loads due to increased rainfall, again adversely impact fish populations.

The results of projects carried out by Indian Institute of Science for agricultural productivity in the state in a separate study are reproduced below.

5.4.1. Results of Modelled CC Impacts

Indian Institute of Science has used INFOCROP, a crop growth simulation model, to simulate the impacts of climate change on rice production in Nagaland. INFOCROP is a generic dynamic crop model developed to simulate the effects of weather, soils, agronomic management practices (including planting, nitrogen, residues and irrigation) and major pests on crop growth, yield, soil carbon, water and nitrogen, and the associated environmental impacts. It can be used for a variety of applications at field, farm and regional levels. The various inputs required by the model include information on rice variety sown, location, soil type, type of sowing, irrigation, fertilizer application, climate data, pest type and diseases. Two model runs were performed-the first simulation called "baseline" using climate data averaged over the period 1975-2005 and fixed CO_2 concentration at 370 ppm and the second simulation incorporating changes in precipitation and temperature for 2035 and with a CO_2 concentration of 466 ppm.

Figure 16 : District wise changes projected in rice yields in Nagaland in MC (2021-2050) with respect to base line (1975-2005). Source: Ravindranath et al., 2011

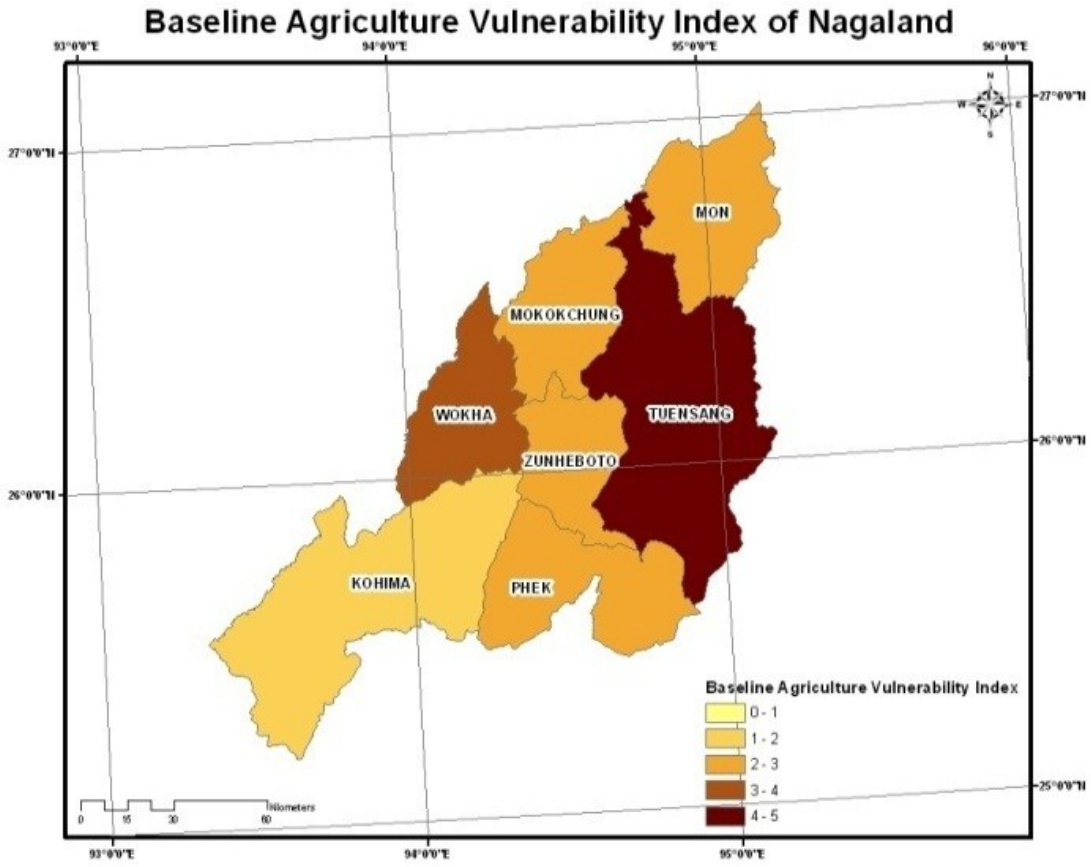


Changes in rice yield can be attributed to the increase in temperature and CO_2 concentration coupled with changes in rainfall pattern for the region. Figure 12 shows district-wise impacts of climate change on the rice yield in Nagaland. The state of Nagaland shows mixed results in the rice yields projection for the 2030s scenario. Phek district is projected to show a decrease in rice yields by 3%. The districts of Zunheboto and Dimapur exhibit a decrease in rice yields by 2%. However the districts of Tuensang and Wokha exhibit increase in rice yields of 3% and 4% respectively. The results represent the output of only one crop model. Different crop models give different outputs depending on the input parameters used.

Maize is another important crop in the state. It is expected that with increase in CO_2 concentration in the background and rising temperatures in Nagaland, the state will benefit in Maize production. Maize, however, is also very sensitive to water availability. Irrigated conditions lead to more crop yield, and excess rainfall, leading to more run off in the hilly terrains may short-charge the expected rise in yields with increase in temperature.

5.4.2. Agricultural vulnerability profile

Agricultural vulnerability assessment is an important pre-requisite for undertaking any planning work or developmental project aimed at climate resilient sustainable agricultural development. Indicators for agricultural vulnerability assessment were selected based on the dynamics of the region and data availability such as rainfall variability, area under rainfed crops, rural population density, net sown area, area under high yielding crop varieties, amount of fertilizers and manure used, groundwater availability, mean crop yields, etc. These indicators were quantified mostly with data from secondary sources across districts and at the state level. Further, for the future scenario, the same set of indicators was estimated, incorporating simulation trials for crop yield function. The assessment representing the year 2010 has been referred to as the 'baseline'. With the same set of indicators, impact projections for the short-term (2021-2030) incorporating the outputs of climate model projections are assessed. The vulnerability profiles for the agricultural sector are developed for the two scenarios namely baseline/current scenario and A1B scenario, a moderate climate scenario. Figure 17 shows district-wise agricultural vulnerability profile of Nagaland for baseline as well as A1B scenario. Out of the 8 districts considered, Tuensang, Wokha, Mon, Mokokchung, Phek and Zunheboto districts fall in the highly vulnerable to moderately vulnerable category. For climate impacted scenario, the district Tuensang is very highly vulnerable.



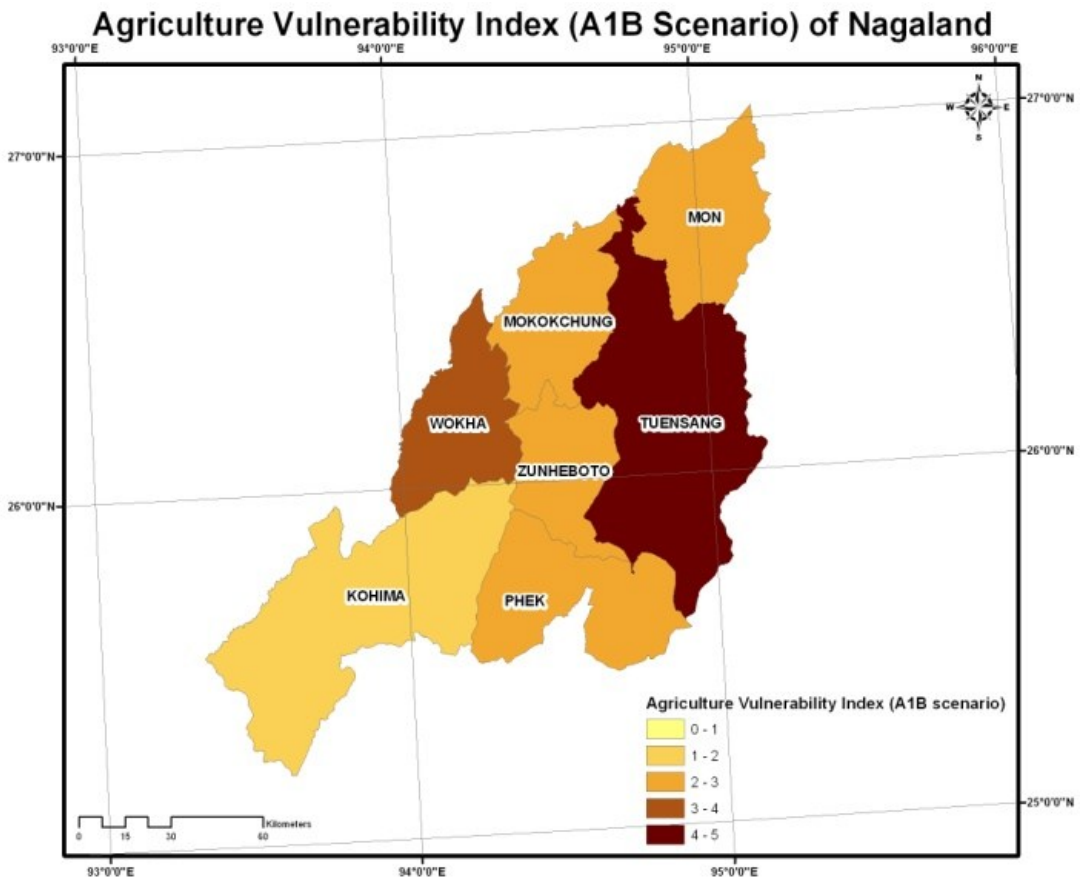


Figure 17 : District wise agricultural vulnerability profile of Nagaland for baseline and A1B scenario(where 0-1 represents very low vulnerability, 1-2 represents low vulnerability, 2-3 represents moderate vulnerability, 3-4 represents high vulnerability and 4-5 represents very high vulnerability) *The district Dimapur, Longlegs, Kip hire and Preen have not been depicted in the map

5.5 Sectoral Strategies: Integrated Agriculture

The departments involved are already implementing a number of programs with in-built adaptation strategies. There is a need to strengthen the adaptation components of these programs. These are given in detail below. Further, despite having strong network of institutions with qualified professionals in the field, better access to services is a challenge. As such, the current service delivery system needs to be appropriately strengthened to improve responses to farmers' needs for quality inputs and timely services. Department personnel working at various levels currently lack understanding of impacts of climate change on their sector. As such, the strategy therefore will be to strengthen capacities among extension staff appropriately along with up-scaling the adaptive components of the existing programs and policies. A few new interventions have also been proposed, especially in the Research and Development area..

5.5.1. Research and Development

Enhancing Research and Coordination

Capacities of research institutes in the State will be enhanced for better understanding on climate change-context, projections and impacts of climate change on existing programmes. The coordination between research institutes and the department will be strengthened to bring climate change concerns

in to research agenda and undertake research for introducing temperature tolerant and water stress resistant varieties and promoting indigenous strains to cope with the climate change.

Introducing New Varieties

The department is currently implementing a programme on introduction of new crop varieties for increasing productivity. While introducing new varieties research and development will play a vital role in identification of new cultivars resilient to higher temperatures, water stress and higher CO_2 concentrations. Special emphasis will be given to research on rice (including traditional rice cultivation), which is a staple food of the Naga people, to identifying suitable cultivars best suited to the state and resilient to changing climatic conditions. Additional emphasis will also be given to the system of rice intensification, especially in Phek and Zunheboto districts.

Promotion of Indigenous Cultivars

As mentioned above, increased temperature by 2030 is likely to reduce irrigated rice between 5-10 percent, dry rice by 35 percent and maize by 40 percent. Therefore the performance of traditional rice, maize along with indigenous fruit varieties will be studied in the research centres and characterized. Cataloguing and preservation of these indigenous varieties via gene banks and other methods will be examined as possible strategies to cope with the threat of climate change.

Crop Intensification

Under crop intensification programmes, the department is implementing supply of seeds to farmers for sowing after the rice harvest. However due to moisture stress, productivity of some crops is not high. Therefore studies will be conducted to know which crop suits well for moisture stress during Rabi

Organic Farming

Considering that much of the agriculture in the State is de facto organic, and that the policy of the state too support organic cultivation, studies on impact of climate change on productivity of crops grown as organic and also to identify suitable bio control agents in collaboration with Department of Biotechnology, GoI will be undertaken to control reduced risks from climate change. The State will also examine the prospect of setting up an Organic Commodities Board to further support organic cultivation in the state, including certification, value addition, marketing, etc.

Study on Status of Riverine Fishes and Identification of Resilient Varieties

Mapping of riverine fish existing in the state will be conducted, and measures for improving productivity will be done in participatory discussions with fish producing farmers. The researchers will analyse the cause of low productivity on account of temperature rise and other climate change factors. Based on the study, types of fish that are more resilient will be identified and trial runs are conducted in government farms.

5.5.2. Upscaling No Regret Interventions

Seed Production and Certification for Producing Drought Resistant, HY local Varieties

At present the state is procuring high yielding varieties (HYV) seeds from outside for distributing to farmers. The strategy of the state in this regard will be to become self-reliant. System should be developed to identify seed growers from the farming community and encourage them to grow drought resistant high yielding varieties and create facilities for its procurement and seed certification, and to establish seed banks at strategic locations for storing the seeds that are procured from the villages for further distribution.

Protected Cultivation

Production of high value flowers in the state is slowly growing. With change in climate floriculture, which is climate sensitive, is likely to be impacted. The strategy is therefore to intensify protected cultivation of

high value commercial flowers initiated by the department. The State will however ensure that any pest control mechanisms used do not adversely impact honeybees and the apiculture industry in the State.

Land Resource Inventory

The department will set-up an inventory of land resource for proper land use by strengthening soil survey, soil testing laboratories and cartography so as to establish land capability for land use plans, soil maps etc. For improving health of the soil, regular soil testing at farmers' fields will be carried out and based on soil test reports, suitable soil amendment programmes will be undertaken.

Watershed Development Programmes

Activities for contour trenching, gully control structures, conservation forestry, agrostology etc. to reduce soil erosion and to conserve non arable land especially those catchment areas having potential to cause natural hazards to productive cultivable land will be enhanced. Water resources development and water conservation measures such as water harvesting embankments, dams, de-silting structures, rain water structures, farm ponds, dugout ponds etc. for multiple purposes like irrigation, fishery etc. and for re-cycling of water resources and ground water recharges will be taken up.

Reclamation and Amendments of Soils

Reclamation and amendments of soils in developed land for more productivity per unit area by carrying out pre-treatment soil test and application of soil amendments in required doses will be carried out. Reclamation of acid soil with lime application will be a priority to counteract since soil minerals leeching.

Creation of Irrigation Potential

The department will take up activities to create irrigation potential in the state by conserving rainwater through constructing irrigation structures thereby bridging the gap between irrigation potential created and its utilization in command areas.

Promotion of Drip Irrigation

Productivity of horticultural crops grown in Rabi season is likely to be impacted due to water stress. Scaling up of drip irrigation systems initiated by the department to efficiently utilize meagre quantities of water for irrigating horticultural crops will be undertaken.

Preventive Health Measures for Livestock

To control and contain existing epidemics, the department will prepare long-term strategies where by 100 percent of the livestock population get regularly vaccinated. Beside this, animal health camps will be set up periodically to make people aware of adopting different control measures.

Genetic Improvement of Livestock

As demand for small meat animals is high in the state, their genetic improvement is very important. Local pig performance is not very high and also it is difficult for farmers to manage crossbred pigs. Hence a selective breeding programme will be carried by identifying superior germplasm. Similar approaches will be followed in case of poultry and for distributing superior quality chicks establishing small hatcheries.

Production of Quality Fish Seeds

Breeding centres will be established in the districts to produce quality fish. In these centres mostly those fish breeds adapted to high temperature will be introduced in phased manner.

Reclamation of Derelict Water Bodies for Fisheries Development

Mapping of all derelict water bodies will be conducted. Once mapping is done, their renovation will be taken with an aim to increase productivity based on prioritisation.

5.5.3. Enhancing Extension Services

Institutional Strengthening

Capacities within the agricultural and allied departments will be developed to gain knowledge on climate change and advise farmers on right adaptation practices. A Climate Change Cell will be created covering all sectors. One of the mandates of the cell will be to critically look into climate change aspects of all department programmes and propose suggestions to government for revising programmes to include climate change concerns.

As part of HRD policy, the cell will also review all existing training curriculum and revise them by incorporating climate change concerns. A set of master trainers will be developed to train field staff, who in turn can train farmers. For sensitizing farmers on climate change issues, extension material will be developed and used in the field.

Crop Diversification

Crop diversification will be taken to cope with productivity losses from crops that are sensitive to climate change, and where farmers have long experience. Crop diversification will be taken by developing packages of practices, providing timely inputs and regular training of field staff and farmers.

Awareness Creation

Farmers will be sensitized on climate change impacts and accordingly advised to change cropping pattern wherever appropriate. The NEPED experience in this regard will be optimally utilized for awareness creation. The training material developed in the training centre will be used in all training programmes. All trainings will be crop specific, region specific, and animal specific. VCs and VDBs will be sensitised and assist in all trainings to have incremental impact.

Reduction in Weather Related Risks

Farmers relay upon rain for agriculture and timely weather related information is essential for them to manage their crops properly. As variations in climate are different within short distances it is necessary that farmers receive timely information on weather and make adjustment with crop management. The strategy will therefore be to establish small weather stations (at least four to five per district) for data collection and interpretation of these data to enhance risk reduction. This initiative will be linked to the Agriculture University. The mechanism of dissemination of information will include:

- Identification of young educated unemployed person from community as weather manager to collect daily data and send to university
- Dissemination of weather related messages received from University by displaying at common place

Planning Agriculture According to Crop Zones

Crop zones have already been developed in the state, which identify suitable zones for different crops. Information on these will be disseminated, and participatory technology development processes will be followed which will involve farmers, scientists, and the department for appropriate cultivation methods and technologies.

Risk Management to Address Crop Failures

Automatic insurance of crops through Kisan Credit Cards and crop loans will be developed. Contingency plans for crop production will be drawn, and buffer stocks of quality seeds will be maintained.

Jhum Optimization

As *Jhum* cycles shorten, productivity is likely to be impacted. To augment the productivity, introduction of new agricultural activities/practices will be taken involving farmers experiences. The NEPED experience in this regard will be drawn upon, and enhanced as appropriate.

Post Harvest Technology and Value Addition

Horticultural products are sold in local market at a lower price due to lack of post harvesting facilities to store them. The proposed strategy in this regard is to establish processing units at multiple locations to procure and process horticultural crop products and produce value added products to improve economy. Developing market linkages with commercial players from the country to participate in improving horticultural market value of products will also be undertaken.

Mineral Mixture Mapping

Mineral deficiency is likely to happen due to leaching off minerals due to continuous soil erosion. The animal husbandry department therefore will coordinate with soil and water conservation department to map micronutrients deficiency in soils accordingly supply mineral mixture for farmers for increasing productivity.

Feed and Fodder

Fodder banks will be planned and established to address fodder problems during the fodder deficit period and measures to conserve and promote local fodder species will be carried out. Through location-specific programs for ethnic and social groups, participatory methods and action research will be used to improve feeding management of livestock.

Production of Quality Fish Seeds and Infrastructure Improvement

Breeding centre and hatchery infrastructure will be established for production of quality fish seed of resilient varieties to meet the demand of fish farmers. Stocking of all water bodies in the state with quality fish seeds viz., bheels, lakes, ponds, swamps, reservoirs etc. to enhance fish production will also be carried out in conjunction with the mapping programme as articulated above. Connections between rivers and water bodies through necessary changes in the embankments along the river will also be undertaken to enhance auto stocking of fish in water bodies.

5.6 Action Plan and Budget

(₹ In Lakh)

Sl. No.	Activities	Budget (2012-17)	Funding Source	Implementing Agency
Strategy 1: Research and Development				
1.1	Introducing climate resilient varieties			
1.1.1	Conduct research to know temperature resistant varieties in rice, maize, mustard and colocassia	100	GoN, ICAR, GoI	ICAR, SARS, Agriculture and NU
1.2	Documentation and Promotion of indigenous cultivars			
1.2.1	Conduct research on Rice, Maize, Millets and Colocassia crops	200	GoN, ICAR, GoI	ICAR, SARS, Agriculture and NU
1.3	Crop intensification			
1.3.1	Conduct research to assess short duration Rice Maize, Kholar, Millet, Soybean, Pea, Mustard Linseed for growing in less moisture immediately after Kharif harvest and promote	400	GoN, ICAR, GoI	ICAR, SARS, Agriculture and NU

1.4	Study Riverine fisheries			
1.4.1	Conduct studies on status of current riverine fisheries of the state	500	GoN, GoI	Fisheries Research Institute, Fisheries Deptt and NU
1.4.2	Identification of breeds that could thrive to increased temperature			
1.5	Strengthening Research Institutions & Undertaking Research			
1.5.1	Strengthening of SASRD in NU to take up plant breeding, genetics, and specific research topics	700	GoN, ICAR, GoI	ICAR, SARS Agriculture, Horticulture and NU
1.5.2	Strengthening of SARS, Yisemyong and conduct of action research in organic farming, adaptability trials, etc.	700		
1.5.3	Action Research by Departments - adaptability trials, etc.	200		
Strategy 2: Upscaling No Regret Interventions				
2.1	Seed Production and Certification for producing drought resistant, HY local varieties			
2.1.1	Set norms for producing quality Rice, potato, Maize, Millets and Mustard seeds by identifying suitable locations	1000	GoN, GoI	Agriculture, Horticulture KVK, NU
2.1.2	Supply seed bank material for storing seeds. Piloting in farmers' fields			
2.1.3	Pilot in 10 farmers' fields 4 villages each in each of the 52 Blocks			
2.2	Protected cultivation to reduce losses due to increases in temperature			
2.2.1	Expansion of activities by contracting more green houses in select districts where floriculture is promising	200	GoN, GoI	Horticulture, KVK
2.3	Land Resources inventory for moisture conservation			
2.3.1	Establishing an inventory of soil resource for proper land use through Soil Survey & Testing; remote Sensing	400	GoN, GoI	Soil & Water Conservation
2.4	Watershed development programmes			
2.4.1	Land development by Bench Terracing; Contour Bunding & trenching; Mechanized Land Development, Afforestation, Providing livelihood options	2500	GoI	S & WC, Forest and Environment
2.5	Reclamation and amendments of soils to improve land for productivity enhancement			
2.5.1	Use the land inventory data and identify methods for improving soil strength.	200	GoN, GoI	Soil & Water Conservation, Agriculture
2.5.2	Monitor the productivity data of key crops grown in the area			

2.6	Strengthening creation of Irrigation potential (Budgeted in Water Resources chapter)			
2.6.1	Surveys	0	GoN, GoI	Irrigation and flood control
2.6.2	Construction of Diversion Weirs, Check Dams			
2.6.3	Providing Conduit Pipes wherever applicable			
2.6.4	Providing Rain Water Harvesting Ponds			S & WC
2.7	Promotion of drip irrigation			
2.7.1	Establish 1000 drip irrigation units in farmer filed with cost sharing system to enhance access to water during water stress period.	1000	GoN, GoI	Horticulture and Irrigation and Flood Control
2.8	Improve livestock health service delivery system			
2.8.1	Provide preventive health services to reduce risks from epidemics	2500	GoN, GoI	Veterinary and Animal Husbandry
2.9	Genetic Improvement of pigs and poultry			
2.9.1	Upgrade local pigs and poultry through selective breeding in pigs	1000	GoN, GoI	Veterinary and Animal Husbandry
2.9.2	Establishing small poultry hatcheries and supply chicks to farmers			
2.10	Production of quality fish seeds			
2.10.1	Establish breeding centre units to produce fish ling resistant to temperature and supply to farmers @ 5 units	250	GoN, GoI	
2.11	Reclamation of derelict water bodies for fisheries development			
2.11.1	To develop 200 ha of derelict water bodies	200	GoN, GoI	Fisheries Deptt
Strategy 3: Enhancing Extension Services				
3.1	Institutional strengthening			
3.1.1	Strengthening of training centres, development of curriculum integrating CC concerns	1000	GoN, GoI	Deptts of Agri, Horti, Vety and Animal Husbandry, S & WC and Fisheries
3.1.2	Develop CC cell within the sector and develop HRD policy			
3.1.3	Training master trainers			
3.2	Crop diversification			
3.2.1	Timely supply of inputs to farmers	50	GoN, GoI	Agriculture and Horticulture
3.2.2	Development of package of practices			
3.2.3	Farmer trainings			
3.3	Resurgent and Promotion of millets			

3.3.1	Consolidation of seeds and its exchange, providing seeds, providing improved milling technology, germplasm collection and characterisation and establish market linkage.	100	GoN, GoI	Agriculture
3.4	Awareness creation among farmers on technologies to adapt to climate change			
3.4.1	Production of extension and training material on CC issues and impacts on crops	100	GoN, GoI	Agri, Horti, S & WC and NEPED
3.4.2	Conduct farmer trainings			
3.5	Reduce weather related risks			
3.5.1	Organise village groups	600	GoN, GoI	Agriculture, Horticulture, S & WC and NEPED
3.5.2	Training weather managers			
3.5.3	Supply of 100 weather stations (budgeted in water chapter)	0	GoN, GoI	S&WC
3.6	Risk Management to address crop failures			
3.6.1	Implementation of Modified National Agriculture Insurance Scheme	400	GoN, GoI, Banks	Agriculture, Horticulture, S & WC and NEPED
3.7	Crop zones			
3.7.1	Intensification of existing crop zones programme	200	GoN, GoI	Agriculture and Horticulture
3.7.2	Cultivation of drought resistant crops			
3.8	Jhum optimization			
3.8.1	Conversion of Jhum into permanent agriculture and promote integrated farming of converted lands	1500	GoN, GoI	Agri, Horti, S &WC, & NEPED
3.9	Post- harvest technology and value addition			
3.9.1	Intensification of cold storage facilities programme to store perishable horticultural products	1500	GoN, GoI	Horticulture/ Agri/Fisheries
3.10	Mineral Mixture mapping			
3.10.1	Conduct mineral mapping to know type of mineral deficient in soils.	300	GoN	Veterinary and Animal Husbandry
3.10.2	Supply specific mineral mixture to farmers			
3.11	Fodder development			
3.11.1	Study the scope for establishing fodder banks	200	GoN	Veterinary and Animal Husbandry
3.11.2	Conduct pilot projects			
	Total	**18000**		
	Rupees One Hundred and Eighty Crore only			

Chapter 6

Forests and Biodiversity

6.1 Status of Forests and Biodiversity

Nagaland has a vast and rich forest resource base that provides livelihood to a significant population. The state has 13318 sq. km, which constitutes 80.33% of the state's geographical area, under forest cover. Forests occupy an area of nearly 53% of the geographical area[19]. 88 per cent of the forests are owned and managed by the village councils, communities or privately while the government has control over only 11.7 per cent of the forests. In terms of forest quality, the state has only 9.7% of the area of the total forest cover classified as very dense forests while 37% of the total forest cover is moderately dense, and 53.3% of the total forest cover is classed as open forests[20]. *Forests are amongst the most species-rich and widespread eco-systems in the state*[21].

Box 4 : State of forests in Nagaland

The protected areas constitute 1.34% of the geographical area of the state and comprise of Intanki National Park and 2 Wildlife Sanctuaries – Singphan and Fakim. Forests in the state can be categorized as Tropical Semi Evergreen, Tropical Moist Deciduous, Subtropical Broadleaved Hill, Subtropical Pine and Montane Wet Temperate Forests. Forests are classified as Reserved Forests (0.93%), Protected Forests (5.51%) and Unclassed Forests (93.56%).

The state is also blessed with rich biodiversity, and is part of the Indo-Burma global biodiversity hotspot. The rich diversity of flora and fauna in the state has, however, not yet been fully documented. The richness is evident in the available documentation of approximately 2,431 species belonging to 963 genera and 186 families under angiosperms and 9 species, under 6 genera from 5 families of gymnosperms22, about 20 species of medicinal plants, which also have high commercial value and are found in the state, such as *Aconitum ferox*, ginseng, lemon grass, *Aconitum heterophyllum, Smilax china, Tagetes minuta, Taxus baccata, Valeriana wallichii* etc. Various species of Bamboo, Cane and Orchids are grown and harvested for commercial purpose in the state. Many of these species are endemic to the state or the north-eastern region. The state boasts the presence of the tallest rhododendron in the world, the tallest rice plant, rare orchids such as the Tiger orchid, Cymbidium tigrinum, Bulbophyllum rothschildianum.

Though the fauna variety in the state has been under tremendous stress due to traditional hunting practices, endemic and rare species, such as the Hollock Gibbon, Mouse Deer, the Blythe's Tragopan, Mrs Hume's bar-tailed pheasant are present in the state and new species are occasionally discovered in the eco-systems of the state. About 32 species of mammals, 65 species of birds and 42 fish species belonging to 10 families and 24 genera, and 9 species of reptiles have been documented.

6.2 Importance and contribution to the state's economy

The forests, its resources and the biodiversity wealth of the state are a direct or indirect source of livelihood sustenance to its 82 per cent rural population. According to some rough estimates the forests of Nagaland provide a range of ecosystem services valued as 49.39 billion rupees at 1994 prices. Forest and Logging, as a sector constituted 21 per cent of the state's primary sector, contributing 5.8 per cent

[19] Forest cover denotes all land more than one hectare in area with a tree canopy density of more than 10 percent whereas the term 'forest areas' refers to all such geographical areas recorded as forests in government records (Forest Survey of India).

[20] Forest and tree resources- Nagaland, Report on State of Forests in India, 2011

[21] http://www.cepf.net/Documents/final.indoburma_indochina.ep.pdf

[22] See list in http://nagaforest.nic.in/Biodiversity.htm

to the State's GSDP (at constant 2004-05 prices) in 2008-09. Excessive logging during the last century has degraded most of the pristine forests of the state. During the 1990s, the state government has encouraged planting of commercial species of timber resulting in large number of plantations being taken up, which have a good future potential for harvesting. The Supreme Court orders in the Godavarman case has resulted in stricter regulation of timber export from the state, with an estimated 40000 cu. m. of timber still being exported annually. Dimapur and other foothills like Tuli have large number of timber conversion industries.

Table 13: District-wise forest and tree cover of Nagaland (area in Sq. Km.)

District	Geographical Area	Dense forest	Open forest	Total	% of G.A.	Change*	Scrub
Dimapur	758	126	257	401	52.90	7	0
Kohima	3,283	1,179	1,659	2,865	87.27	50	0
Mokokchung	1,615	538	857	1,395	86.38	-50	0
Mon	1,786	534	760	1,294	72.45	-32	1
Phek	2,026	962	749	1,711	84.45	49	0
Tuensang	4,228	1,778	1,562	3,340	79.00	-122	1
Wokha	1,628	512	902	1,414	86.86	-50	0
Zunheboto	1,255	515	529	1,044	83.19	-53	0
Total	16,579	6,171	7,293	13,464	81.21	-201	2

Source: State of Forest Report – 2009, Forest Survey of India, MoEF, GoI.

Note: The tree cover (outside forest area) in the State is 300 Sq. Km., which is 1.81 % of geographical area of the State.

6.2.1. Bamboo, Fuelwood and NTFPs

Nagaland's bamboo growing stock, covering 448,000 ha of land and comprising 22 species is about 5 per cent of the total stock in the country. The penetration of LPG in the state entire fuelwood needs of the state are met from internal harvest. A significant portion of fuelwood is harvested as part of the jhum cycle. Other Non-Timber Forests Produce (NTFP) products are crucial in meeting local communities' subsistence needs, providing a safety net in times of need and contributing to seasonal income.

The contribution of NTFP to the forestry sector in Nagaland is significant, and contributes to around 90 per cent of total agriculture production from traditional Jhum Cultivation dependent on forests. The biophysical condition that naturally prevails in their fallowed shifting cultivation areas during the fallow periods provides the ideal condition for promotion and collection of the resources. Nearly 60 percent living in and around forests in the State rely on NTFPs as a critical component for their sustenance. Since NTFPs involve a large variety of seasonal products, returns are frequent and relatively continuous. In addition to subsistence and income-generating potential, NTFPs also provide food security to large low-income populations.

6.2.2. Forests and Agriculture

Shifting cultivation is the major agricultural practice in the state. This traditional agriculture farming practice, also known as jhum involves slash and burning of forest patches, utilising the fertility gained from humus created in these forest patches, and then allowing them to be fallow for regeneration of forest and fertility for a period ranging from 6-20 years. The practice provides food security to a large

chunk of the population. Jhum for most people, and definitely for majority of villages who practice it, is not simply a farming technique but a way of life.

With average 2200 mm of annual rainfall, forests play an important role in conserving the water resources in reservoir and soil degradation through vast root system of trees and wild vegetation. Forests through its vegetative growth also play an important role in mitigating disasters like floods and droughts that could hamper agriculture yield. The water conserved by forest flora ensures availability of adequate moisture to crops to the maximum period of cultivating year and the regulated role played by forests in flow of run off during excessive rains mitigated floods in downhill areas protecting them from flash floods. Such eco-system services are significant for the survival of poor populations.

6.3 Institutional Arrangements for Forest and Biodiversity Management

6.3.1. Organisational Set-up

The Department of Environment and Forests, Nagaland is the nodal department entrusted with the enforcement of various central and state government regulations for movement of timber, protection and conservation of forests and biodiversity, etc. The state forest department administers 'reserved' and 'protected' forests, which constitute only around 12 per cent of the forests of the state. Nearly 88 per cent of the forests are with the Village Councils, the communities or private individuals traditionally. The Village Councils (VCs) have the power under s. 12 (1) The Nagaland Village and Area Councils Act, 1978 to supervise the maintenance of forests in their respective jurisdictions. Village Development Boards have become an important developmental arm of the VCs and have an important role in balancing developmental needs and forests' conservation.

The department, therefore has a largely developmental role in the village controlled forests though the Supreme Court's orders in the Godavarman case has extended the writ in regulation of timber movement from these forests. The Supreme Court mandated SIT tightly regulates the movement of timber outside the state. The department has adapted the Joint Forest Management concept to constitute Joint Forest Management Committees (JFMCs) at the village level to extend the reach of various development programs in the villages. There are around 971 JFMCs managing about 52,000 ha of forest area, and are involved in plantation as well as preservation works. The State Forest Development Agency (SFDA) and the District Forest Development Agencies supervise the JFMCs developmental works.

In addition, the Land Resources department, NEPED (Nagaland Empowerment of People through Economic Development), and Nagaland Bamboo Mission are important governmental organisations involvement in forest and related development. The close linkage of agriculture and forestry in the state owing to the widespread, traditional practice of shifting cultivation (jhum) also ensures that Agriculture and allied departments like Horticulture and Soil & Water Conservation are also major actors having an impact on forestry policies and programs.

6.3.2. Policies and Programs

Specific state regulations include the Nagaland Forest Act, 1968, the Nagaland Jhumland Act, 1970 and the Nagaland Tree Felling Regulations 2002. The Forest Conservation Act, 1980 has been extended to Nagaland state in respect of the Government Reserved Forests and such other Forests and Wildlife Sanctuaries under the control of the State Government23. Since the Supreme Court (SC) judgments in

[23] The state enjoys special privileges under Art. 371A of the Constitution of India. The Article bars automatic extension of any central legislation to the state.

the Godavarman case, commercial timber trade outside the state is strictly regulated and has reduced with little regulation within the state.

With the broad objectives of conserving and managing forests, to create and support sustainable forest dependent livelihoods and to enhance and sustain environmental services from forests to other dependent sectors, the state departments mainly implement the centrally sponsored schemes like the National Afforestation Program, the Integrated Watershed Management Program, Integrated Forest Management program, Development of Parks & Sanctuaries and Community Biodiversity program. In addition, the state departments formulate its own programs against the State Plan where funding constraints limit the activities that can be taken up. Thirteenth Finance Commission awards, with the broad objective of compensating states and the communities for maintaining forests and improving their quality has enabled the state to launch a larger effort at motivating communities' conservation efforts under the nomenclature 'Management of Traditional Forests'.

6.4 Challenges and Opportunities in Forest and Biodiversity Management

6.4.1. Forest degradation

The continued loss of forest cover, and biodiversity, over the last few decades can be attributed to various anthropogenic pressures, e.g. logging, clearance of vegetation for agriculture land, establishment of new human habitations, mining, etc., which are further accentuated by the heavy rainfalls and hilly terrain in the state. The increase in anthropogenic pressures, and the resultant overexploitation of forest resources, can be attributed to the inability to have effective and appropriate regulation to meet demand for timber from the rest of the country and development aspirations of the growing local population, which increased by nearly 64 per cent since 1961. The land tenure systems in the state and traditional practices like jhum, hunting have further accentuated the pressures on forests and biodiversity. The degradation of forests has resulted in reduced carbon sequestration, which may be seen from the lowly volume per hectare of forest at 44.4 cum/ha. It, however, provides the state with the high potential for increasing the quality of forests and, thereby gaining the co-benefits from sequestered carbon. Carbon has to become an important factor, in addition to other economic parameters in the management of forest cover.

6.4.2. Unique land ownership

Nagaland has a unique system of land ownership which is governed by tribe-specific customary laws and traditions, and has been roughly brought under the institutional framework of Village Councils by the State Government. Land and its resources, including water and biodiversity, are controlled by individuals, family, clans, chieftans or communities under this traditional system. With over 88 per cent of forests in private, community or village ownership, role of these entities in management and conservation of forests is predominant. The traditional self-regulatory practices have withered under increasing anthropogenic pressures, sometimes replaced with unsustainable and unsuitable practices, e.g. monoculture plantations of commercially profitable species not endemic to the area, many a time at the prodding of the government departments. Climate change related pressures will increase and accentuate the need for building communities' capacities and an intense collaboration between the forest department and the communities. The reluctance of, and limited capabilities of the forest department to interact productively with the communities, build its own capacities as well as that of the communities to imbibe scientific management practices is a challenge which needs to be overcome.

6.4.3. Shifting cultivation

Jhum or shifting cultivation is not only a traditional method of farming, it also is intricately linked with Naga culture and other traditions. There is a wide regional variation within the state about the jhum practices. Out of total geographical area of 16579 sq. km. approximately 937 sq. km is cleared annually for shifting cultivation in the State. Normally, the land is cropped for two years, and then allow to lapse back into fallow. Paddy (rice) is the main crop in shifting cultivation. Shifting cultivation being carried out in approx. 5229 Ha (i.e. 31.5 percent of total wasteland) that leads burning of vegetation, soil erosion (55 tonnes/Ha[24] annually), wetland siltation and clearing of natural vegetation.

The narrative that shifting cultivation is a main culprit of tropical deforestation has been widely challenged over the years, and the alternative narrative that it is a sustainable practice, which conserves the rich bio-diversity available to the farmers, while allowing the forests to regain their productivity during the fallow period, has gained ground and more acceptability. The fact remains, however, that, firstly, there is destruction of forests involved, secondly, there is a vast scope for improving the jhum practices by introducing soil conservation, agro forestry and other practices, and thirdly, during the period from the decade of 1970s to 200s, increasing population pressure had resulted in reducing jhum cycle thereby decreasing the fallow cycle raising questions about its sustainability.

However, with the increasing trend of urban migration, increasing education levels, and availability of alternative livelihoods, anecdotal evidence suggests that the number of farmers involved in jhum have been decreasing during the past decade. An internal study carried out by NEPED25 indicates that shifting cultivation area has decreased from 1.87 million in 2003 to 1.2 million hectares in 2005-06. If this trend continues, shifting cultivation may become viable but the practice itself may face extinction, which may not be a desirable outcome.

6.4.4. Forest fires

Jhum involves controlled burning of forest patches. Farmers take extreme measure to prevent the spread of fire into adjoining areas. However, accidental fire incidents do take place, and are becoming more frequent due to increasing dry period. The risk of forests fire is higher in dry climatic conditions. Fire incidents at ecologically sensitive areas like the Dzukou valley are alarming and cause irreparable loss to the biodiversity of these regions.

6.4.5. Developmental pressures

Increasing urbanization with the concomitant adverse impact on vegetation and biodiversity, continued dependence on forest products for livelihoods, unregulated exploitation of mineral resources, viz. mining in lower hills of Mokokchung and Mon districts, and other developmental pressures, viz. construction of rural roads leading to direct destruction of forests and biodiversity as well as indirectly by providing access to hitherto inaccessible areas continue to play a significant role in decreasing the resilience of the local eco-systems to adapt to climate change and also their capacities to provide critical services necessary for sustaining life in the hills.

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[24] Prof. BS Chauhan, 2001. Shifting Cultivation in Perspective. Nagaland University Publication

[25] To convert Jhum area to climax forest in Nagaland, Vengota Nakro, NEPED, 2011 (internal study)

6.4.6. Projected Impact of Climate Change on Forests and Biodiversity

The change in rainfall pattern changes, humidity and temperature increases and larger number of extreme events, leads to a higher projected Net Primary Productivity (NPP) figures for the forests in Nagaland. Various factors, as discussed in the previous section, leading to greater human interference in eco-systems and

Modelling results using the biophysical vegetation model IBIS with climate scenario inputs from PRECIS from the study carried out by carried out by Ravindranath of Indian Institute of Science indicate that of the 515 forested grids of 50kmx50km resolution covering Nagaland Forests, only 16.7 percent of those grids will be impacted by climate change in the short term period of 2030s and undergo change in vegetation type in Mid Century (MC) period (2021-2050) due to changes in observed climate with respect to baseline (BL) period (1961-1990). The grids corresponding to the likely change in the forest types correspond to the western region of Mon district, northern region of Tuensang and northeastern region of Mokokchung (See Figure 16- the red coloured grids).

The Forest Vulnerability has been assessed in terms of changes in composite forest vulnerability index (CFVI, refer box) between BL and MC scenarios. The analysis indicates that Mon and Mokokchung are the most vulnerable as the CFVI is greater than 4.5. Tuensang and Zunheboto are moderately vulnerable as CFVI is between 3-4. The districts of Kohima, Wokha and Phek are least vulnerable as the CFVI is less than 3.5 for these districts.

Climate change is also likely to aggravate human induced pressures on eco-systems leading to progressive biodiversity decline. However, there is insufficient understanding at the moment on the exact nature of the complex interactions of various pressures and the responses of ecosystems and the time span over which these will play out. Species extinction at the local level is a cause of concern as it can reduce societal options for adaptation. For the mountain regions in the state, it is expected as experienced in other mountains that, with current level of increase in mean annual temperature over various parts of the Himalayas, an upward movement of plants is expected (INCCA Report # 2).

Box 5: Projecting *Impacts* and Vulnerability of Districts – Tools and Methods

Forests: An assessment of the impact of projected climate change on forest ecosystems in Nagaland is made using global dynamic vegetation model IBIS at 50kmx50km resolution with climate inputs generated by PRECIS run on A1B scenario for MC (2021-2050) and EC (2071-2100). Inputs to IBIS include 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 Composite Forest Vulnerability Index that took into account the changes in vegetation type across the grids in MC scenario wrt EC scenario along with forest disturbance index indicating level of human interference in the forests for each grid, the Fragmentation status of the forest patch and the status of biological diversity. The percentages of vulnerable grids thus derived for each districts then were ranked from 1 to 5 by linearly scaling the same. Ranking 1.0 indicated very low vulnerability and ranking 5 indicating highly vulnerable.

Sources: 1. Climate Change Assessment for Nagaland, Ravindranath et al., 2011, IISc Bangalore; 2. Climate Change and India: A 4X4 Sectoral and Regional Analysis for 2030s, INCCA Report no.2, 2010, MoEF

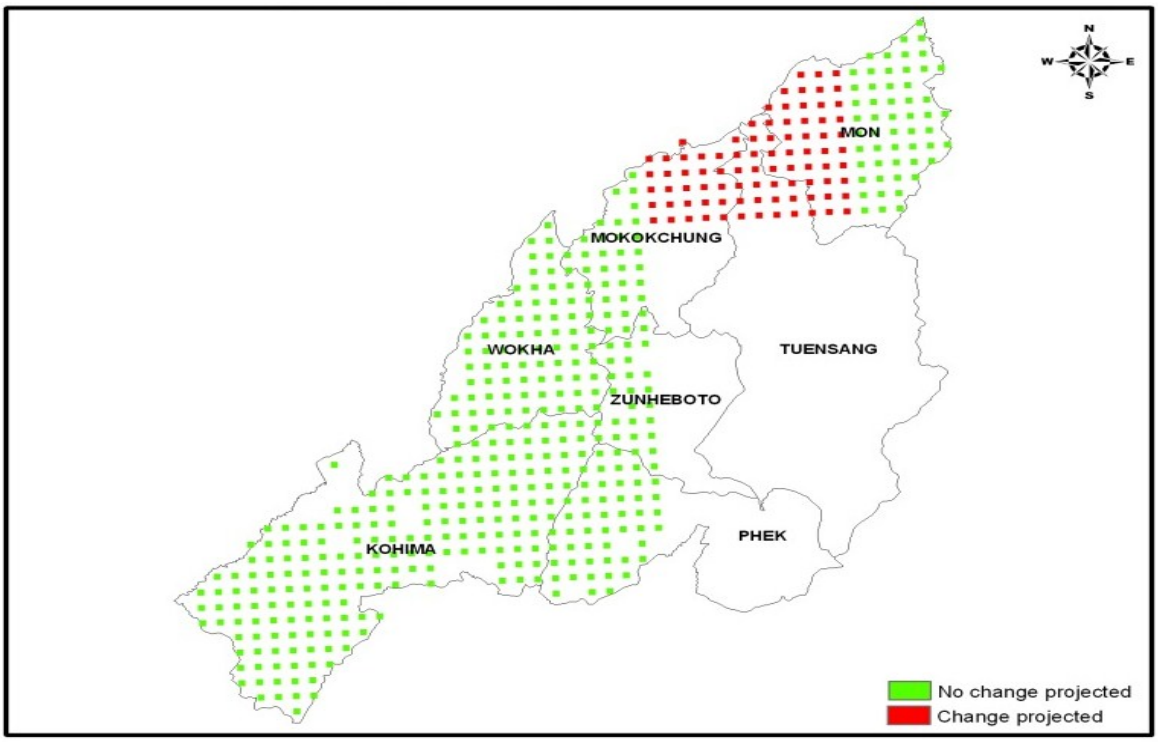


Figure 19: Forest vegetation change projected by 2035

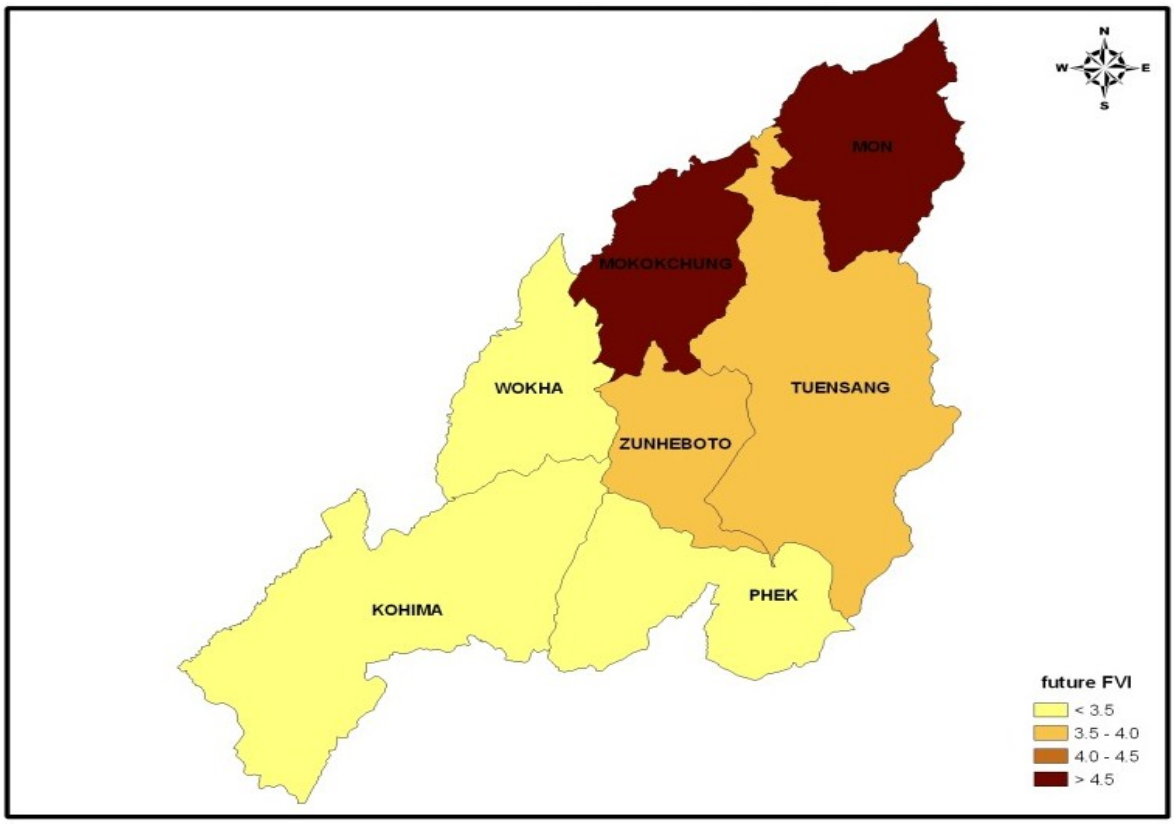


Figure 18 : District-wise representation of the area that is projected to undergo change in vegetation type by 2021-2050 in Nagaland

6.5 Strategies and Action Plan for Adaptation to Climate Change Effects

The lives of the people of Nagaland are closely intertwined with forests eco-systems. It is essential for the society's survival that the resilience of these eco-systems to adapt and continue providing various services for sustenance is not adversely affected. The objective of improving quality of forests is in consonance with the objective of improving adaptive capacity of forest dependent communities, as it will not only bring benefits due to improved quality of NTFPs but also the likely transfers due to carbon capture co-benefits. Further, due to the long term impacts of decisions regarding managed forests, which require decades for reaching maturity, in contrast to agriculture, climate change concerns have to be adequately researched and built in while selecting and promoting species.

The evaluation of existing programs of the government indicate that though there are already components of climate change adaptation in existing programmes, some of the activities need to be strengthened further in the context of perceived climate impacts. The State is being covered under the Government of India's Green India Mission. In the first phase, the most vulnerable districts of Mokokchung have been selected under the Mission. It is expected that the Mission will not only help in enhancing the quality of forests and thus enhancing the carbon retention, but also identify vulnerable species, ease pressures on eco-systems while addressing livelihood issues of dependent communities.

Though there are a number of governmental agencies involved in the forestry sector in the state and all of them have important roles to play, the primacy of the Forest department and importance for it to lead from the front cannot be understated. There is a need of reforming the institutional oversight of the state's forest sector, which is covered under the institutional reforms and capacity building part and covers primarily the Forest department, while the other strategies identified in this section are cross-cutting across departments.

6.5.1. Institutional Reforms and Capacity Building

The roles and responsibilities of the forest department have to be re-defined, its training institutions strengthened and training curricula revised to make an effective transition to facilitating the village communities to manage their forest eco-systems. This transition has to come without undermining the regulatory role of the department. The existing statutes of the state will be looked into in a systematic way to meet the likely climate change impacts and also address other reform issues.

Forest Department has an organizational strength of 1248 regular personnel and almost 200 numbers of fixed pay employees out of which nearly 70% are engaged in frontline field duty. These forest officers and workers need to be imparted climate change knowledge, equipped with the conceptual tools and trained on the strategies for facilitating communities, community outreach and focus on preservation, carbon sequestration and eco-system management. The higher level of extension services to the communities may be provided through establishing forest extension centres on the lines of KVKs, that should make conscious efforts to disseminate the scientific information on complex issue of climate change and actions required.

Simultaneously with reforms, institutional strengthening by improving the infrastructural and logistical support to the frontline staff will be carried out to improve its capacity to deliver.

6.5.2. Community Managed Areas

Forest department can act as a facilitator and motivator for managing the 88 percent of the forest cover in the state, which is privately/community owned. NEPED has already identified community conserved areas in Tuensang and Mon areas, while the department has been promoting successful efforts at Sendenyu, etc. The objectives of conservation and preservation of the state have to be in sync with the community objectives. Rural to urban migration seems is resulting in area previously under jhum being vacated providing an opportunity to reclaim this for plantations/reserved forests for which the communities need to be motivated. With a view to achieve this, the following strategies will be followed.

i) Development of village-level holistic micro-plans for sustainable management of forests, which will incorporate the traditional management practices for conservation of forests and biodiversity, the forest based livelihood needs of the communities, and incorporate climate change concerns.

ii) Assistance to the communities in the form of Grant-in-Aid with a view to strengthen their conservation efforts. Nearly 40 per cent of the JFMCs are aimed at community managed forests, which will be strengthened and transformed into Community Management Committees.

iii) Enhancing capacities of communities conserving forests to understand climate change and its impacts.

iv) Tap into carbon sequestration funding mechanisms like REDD + to directly transfer resources paying for the conservation and forest quality improvement linked efforts of communities/individuals.

v) Building a robust baseline data on the forest quality, carbon content and cover parameters and GIS based monitoring mechanism for monitoring quality changes in community owned forests.

Box 6 : Some Community conservation efforts and success stories

- *The Sendenyu Village Community Biodiversity Reserve:* The alarming rate of loss of wildlife and its habitat from the Sendenyu village area has led the VC to declare a portion of land within the village community land for conservation of biodiversity. The village delineated an area of 8 sq. km and declared it as "Sendenyu Village Wildlife Protected Area." A committee was constituted at the village to manage the area. Habitat management activities such as enrichment planting of indigenous species of birds and wildlife importance, preservation of existing natural forests, etc. was undertaken. Planting of fruit trees, developing natural waterholes and salt licks, protection of the area are carried out with the help of volunteers from the Sendenyu Youth Organization. The flagship species for conservation is the stag. With the recommendation of the committee, the Sendenyu Villages community wild life reserve has now been declared as the "Sendenyu Village Community Bio-diversity Reserve."
- *Tragopan Conservation Area, Khonoma:* The "Rüfünuo" are a group of retired government officials in Khonoma village. The group highlighted to the Village about the need to conserve biodiversity, and held a series of consultative meetings with the village functionaries and the youth. The village adopted a resolution to declare the village as a Green Village and prohibited hunting, bio - prospecting, logging and even the collection of wild vegetables for commercial purpose. They demarcated their primary forest as a Tragopan Wildlife sanctuary.
- *Community Biodiversity Reserve, Kanglatu, Changtongya:* The VC of Changtongya village in Mokokchung district of Nagaland has declared the village as a no-hunting zone since 2001. The council resolved that no one be allowed to kill wild animals or use poisons for fishing and those found violating these rules will be penalised. It was also resolved to plant wild fruit trees in the forest and jhum areas. The council decided that the moratorium on hunting would be for five years initially and has been extended as wildlife population has increased. This area is also home to annual migratory birds such as the Amur Falcon which nest in thousands for about a month and a half in the last week of October and staying till the 1st week of December.

Other community conservation initiatives include the declaration by the VCs of Merangkong village in Mokokchung District, Hakchang, Longkim villages in Tuensang, Lethromi, Kikruma, Pholami, Sakraba, Zapami villages in Phek District, and Benreu, Old Jalukie villages in Peren District of similar bans on hunting of wild animals and birds in their jurisdiction. "Culture Guard," a group of educated youth from Mezoma Village in Kohima district has also initiated their own awareness campaign on conservation of nature in and around their village. Other joint conservation initiatives of cluster villages strengthened and/or established by NEPED and others include:

1. Saramati Awung Conservation and Management Committee (Kiphire District) consisting of 17 villages;
2. Zanubu Range Forest Committee (Phek District) consisting of 7 villages;
3. Helipong Khong Joint Biodiversity Conservation Area (Tuensang District) consisting of 6 villages;
4. Hongmong Conservation (Mon District);
5. Zhipihu (Meluri - Phek District) consisting of 6 villages; and
6. Nyungnyushang Range Conservation (Longleng district) consisting of six villages.

6.5.3. Sustainable Shifting Cultivation

Jhum is an entire knowledge system, and not only a traditional agriculture practice, preserving the local biodiversity and may provide necessary inputs at climate change adaptation. Though current discourse concerning climate change is prejudiced against traditional, shifting cultivation practices as a cause of carbon emissions, deforestation and environmental degradation, these practices, has assured self-reliance among the farmers, and high crop diversity, which is fundamental to building resilience and ensuring adaptation. The safety net these forest dependent agricultural practices are providing cannot be ignored. Policies and programs have to aim at intensification of jhum cultivation in limited areas instead of at rehabilitation. The Sub Mission 2a (ecosystem restoration and increase in forest cover) of Green India Mission, has to be suitably modified to shift the focus from rehabilitation of shifting cultivation to intensification, and limiting to secondary forests.

Agro forestry has been proved to be an important intervention to intensify jhum, with a potential to provide higher returns to farmers while improving soil conservation and building resilience against failure of rainfall, excessive temperature, prolonged humidity, etc. in jhum areas. Traditional models like the Khonoma Alder based agroforestry method exist and may be promoted. Water harvesting and soil conservation measures have been proven to sustain the productivity of the cultivable land, and such interventions may help in intensification of jhum.

As there are sufficient government programs like the MGNREGA and the various agriculture and allied department programs are already providing support for alternative livelihoods[26], which have, and continue to wean away farmers from jhum practices, fresh initiatives further accelerating the decline of this practice may not be required.

6.5.4. Forest-based product climate resilient value chains

The remunerative benefits available to the forest dependent rural livelihoods, for both timber based and non-timber based forest produce e.g. medicinal plants, orchids, etc. need to be enhanced with emphasis on skill building, value addition, providing necessary linkages to markets, and providing infrastructure, etc. These efforts will be promoted through specific value chain analysis methods, adapting to the likely climate change impacts. Bamboo as a product will be promoted through NBRM intensively. Other adaptive, indigenous, plantation species will also be identified and promoted.

6.5.5. Intensification of departmental afforestation programs

It is likely that the area under forest will be reduced due to added pressure of extraction by communities getting reduced returns from agriculture due to climate impacts. Also natural regeneration rate may go down due to the adverse impacts on slope terrain due to heavy run-offs due to intense rains in short period of time, which may in addition to degrading the top soils also wash away seeds ready of regeneration. Interventions like aided natural regeneration will be required more frequently.

[26] These programs aim at providing for off farm enterprises like trading of vegetables, masonry, basket making, rope making, cane furniture, etc. and on-farm enterprises like cultivation of vegetables in home farms, organic agriculture, animal husbandry, dairy, processing of minor forest produce, honey collection, etc.

In addition departmental programs aimed at afforestation and restoration of degraded forest lands through encouraging plantations, agro-forestry, reforestation of peri-urban and urban institutional lands through JFM and other Plan funded mechanisms will continue.

6.5.6. Promote use of alternate sources of energy to reduce dependence on forests

The Government will aim to reduce dependence on firewood, primary source of energy in the villages by providing solar energy lighting, LPG and also tapping pico/micro hydel power sources, in conjunction with the Non Renewable Energy department and NEPeD

6.5.7. Sustainable exploitation of biodiversity resources

The state's unique floral and faunal biodiversity is the insurance of the people against the adverse impacts of the changing climate, as the local plants species are always more adaptable to changing weather conditions. In 2002, under the National Biodiversity Strategy and Action Plan (NBSAP) Project, the State Level Biodiversity Strategy and Action Plan of Nagaland had been brought out for its incorporation into the National Biodiversity and Action Plan of India. This needs to be re-looked and refined further in order to provide the necessary policy support for protection and sustainable exploitation. Some actions sought to be undertaken for conservation are as follows.

i) Creating Wildlife and Biodiversity corridors by stringing together a network of Community Conserved Areas[27].
ii) Documentation and preservation of gene pool will require establishment of a gene bank

6.5.8. Enhance Soil and Water Conservation Practices

Intense rains are likely to result in heavy run-offs, especially in degraded forests and forests with slope gradient of more than 10 degree. Efforts have been concentrated towards mitigating run-off impact on agricultural lands only. With changing rainfall patterns, these soil conservation measures, along with water harvesting, particularly in catchment areas, are also important for forested areas. This will not only arrest soil erosion but also prevent denudation and landslides.

6.5.9. Promote Research to understand the impacts of Climate Change on local forest eco-systems

The capacity to research in the state is limited. Building Nagaland University as the hub for research in forestry activities, networking with other national research agencies like TERI will need to be carried out, for carrying out research in the following areas:

i) Vulnerability mapping of forests in the state, including assessment of impact on species movement and forest types.
ii) Scientific Assessment of Carbon Capture Potential of Forests in Nagaland.
iii) Take inventory of the range of climate change activities currently on going in the region, including research, resilience/adaptation, and mitigation so as to synergise and leverage limited resources available.
iv) Develop a baseline methodology for CDM, REDD+ for community conserved areas and a policy for selection of these for posing in international markets.
v) Assess the carbon cycle for the traditional jhum practices.
vi) Documenting indigenous knowledge & practices for forests & biodiversity preservation, and also identify policy changes required to protect/replicate these practices.
vii) Strengthening policy and legislation to support forestry sector.
viii) Climate Change impacts on commercial species planted in the state. Address issues of adaptation concerning tree genotypes, particularly indigenous tree species.
ix) Documentation of biodiversity of the state.

[27] Rising temperatures and humidity levels could impact shifting of habitats of fauna, as well as flora. A larger, connected corridor will provide better chances of adaptation and reduce human – animal conflict.

x) Valuation of eco-system services

6.6 Budget

(₹ in lakh)

S.No.	Activity/ Project	Budget (2012-17)	Source of Funding	Implementing Agency
1	Convert 25%of total Jhum area to secondary forest in Nagaland (1,00,000 ha @ 0.2 lakhs/ha)	20000	GoI (GIM)	NEPED and Forest Department
2	Protecting existing forests/ Conserving existing carbon pool (30000 ha) @ 0.15 lakhs/ha	4500	GoI (GIM), External funding	Forest Department
3	Increasing forest area/ Expanding carbon sink			
3.1	100ha/village for 100 nos.(10000 ha)	5000	GoI (GIM), GoN	Forest Department, NEPED
3.2	Afforestation of degraded areas &Jhum areas-AR @ Rs.20000/- per ha. (20,000 ha)	4000	GoI (GIM), GoN	
3.3	Roadside plantation @ Rs. 1,04,000/- per km (5000 km)	5200	GoN	
4	Wildlife & Biodiversity Conservation			
4.1	Habitat improvement @ Rs.15, 810/- per ha. (10,000 ha)	1581	GoI, GoN	Forest Department
4.2	Waterholes Rs.2000/- per hole. (10,000 no.)	200		
4.3	Fodder & prey base improvement @ Rs.15810/-(10,000 ha)	1581		
5	Reducing dependence on forests			
5.1	Energy saving devices - Improved chullahs @ Rs.1500 (100,000);	1500	GoI, GoN, External Funding Agency	Forest Department
5.2	LPG connection @ Rs.8100/- (50,000)	4050		
5.3	Energy plantation (fuel wood & fodder) Rs. 15,810/- per ha. (30,000)	4743		

6	Awareness & Capacity Building (Establishment of Centre for Env. & Biodiversity; Dev. Of scientific forest management systems; Evolving environmental disaster& ecological management strategy-(forest fire, landslides, windstorms, cloud burst & flash floods, biological invasions, etc; Mechanism to monitor & evaluate impact of interventions)	500	GoI, GoN	Forest Department
7	Soil & Moisture Conservation			
7.1	Gully plugging, check dams, gabionic structures Rs.20,000/- per unit	10000	GoI, GoN	Forest & Soil Conservation
7.2	Vegetative measures, hedgerows, etc. Rs. 15,500/- per ha. (30,000 Ha)	4700		
7.3	Staggered trenching, contour trenching, etc. Rs.179/- sq. m.	5000		
8	Commissioning Related Research	2500	GoI, GoN	Forest
9	Value addition & marketing of NTFP & Medicinal Produce by JFMCs (through SFG) @ 10.00lakhs/unit for 200 units	2000	GoI, GoN	Forest
10	Institutional strengthening	10000	GoI, GoN, External Funding Agency	Forest
	TOTAL	87055		

Chapter 7

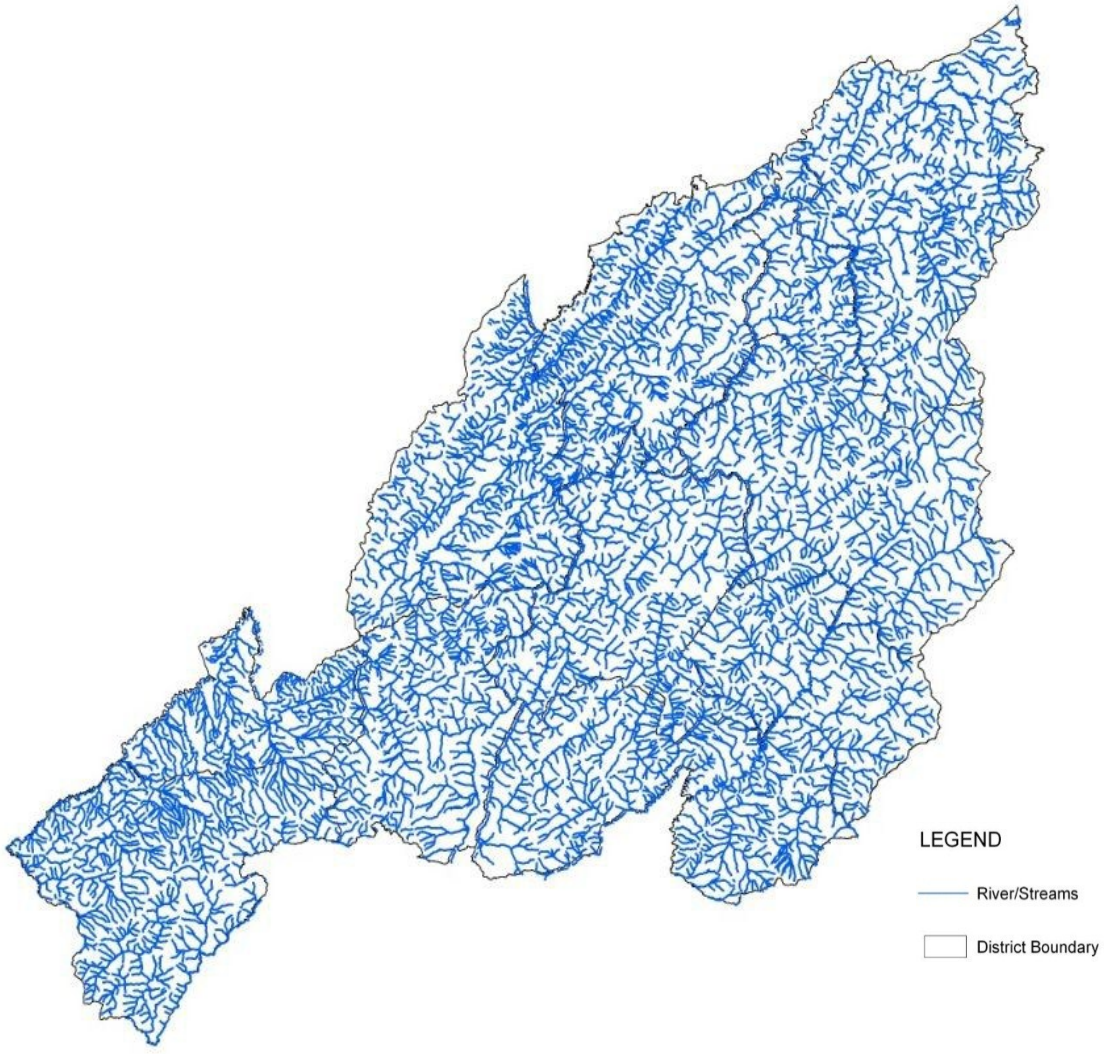
Water Resources

7.1 Water Resources of the State – Availability and Usage

Rain fed rivers and streams, and ground water in the form of natural springs in the hills and dug wells in the foothill areas are the sources of water for the state. The heavy rainfall received in the state, which is of the order of 2000 -2500 mm, one of the highest amongst all states in India sustains the water flow in these.

Nagaland has four main rivers, namely, Doyang, Dhansiri, Dhiku, and Tizu[28]. Of these, the first three flows towards west through Assam plains to join the mighty Brahmaputra, while Tizu river system flows towards the east and southeast and pours into the Irrawaddy in Myanmar. The Barak River, itself a tributary of Brahmaputra, also drains a small area, in Peren district, of Nagaland. *The drainage map of Nagaland is shown in* Figure 20 *below*. The catchment area of Brahmaputra in the state is 65 percent (10,803 sq. km) of the total area leading to a total water yield of 537000 million cu. m. (*see* Table 14). The catchment area of Barak River is only 728 sq. km, which is around 4 percent of the total area.

Figure 20: Drainage map of Nagaland



The ground water potential as compared to the plains is low in Nagaland as in terms of physiography, the state consists of narrow strip of hills running from east to southwest and facing the Assam plains to

[28] http://nagaland.ws/rivers-of-nagaland/

its north and northeast. The ground water resources are under developed and under used and are mostly developed in the Southern plain region of the state (*see*

Table 15 *detailing groundwater resources in Nagaland*).

As per the 4th Minor irrigation census, the State has created an irrigation potential of 103740 ha. The Tsurang small irrigation project, being implemented in Mokokchung district is going to add 1500 ha area under irrigation. The proposed Dzudza medium irrigation project under Niuland subdivision of Dimapur will add another 9540 ha under irrigated area in the state.

Table 14: Availability of surface water and its accessibility in Nagaland[29]

River	Total Catchment Area (sq km)	Catchment Area within Nagaland (sq km)	Total Yield (Million Cu m)
Brahmaputra	464130	10803	537000
Barak	26193	728	-

Table 15: Dynamic ground water resources in Nagaland[30]

Head	Data/Information
Annual Replenishable Ground water Resource	0.36 billion cu m
Net Annual Ground Water Availability	0.32 billion cu m
Annual Ground Water Draft	0.009 billion cu m
Stage of Ground Water Development	3 %
Ground Water Development & Management	
Over Exploited	Nil
Critical	Nil
Semi- critical	Nil
Ground water user maps	4
Artificial Recharge to Ground Water (AR)	Feasible AR structures: 500 check dams, 1000 weirs, 1000 gabion structures, 300 roof top harvesting, development of 200 springs. AR schemes completed during IX Plan: 3

The status of coverage of rural habitations with drinking water supply, under the norm of 40 litres per capita per day (40 lpcd) is given in the Table 3 below. However, according to a survey carried out by the

[29] Source: Office of the C. E. (P & D), Brahmaputra Board, Basistha, Guwahati-781 029, Assam
[30] Source: http://cgwb.gov.in/gw_profiles/st_nagaland.html

Bharat Nirman Programme for Rural Water Supply, as of 2008-2009, as of 1.4.2011, quality of water is poor in 166 habitations, mainly affected by iron contamination[31].

Table 16: Status of Drinking Water Supply in Rural Habitations in Nagaland (As on 01-02-2012)

S.No.	% of population covered with water supply upto Feb 2012	No of habitations
1	0%	201
2	0%-25%	29
3	25-50%	16
4	50-75%	47
5	75-100%	25
6	100%	1114
	Total no. of habitations	1432

(Source, PHED, Nagaland)

In urban areas, the PHED is able to supply piped water to populations varying between 20–40 percent of the population. The remaining urban population relies on water from private suppliers supplying from privately owned water sources arising out of springs or streams in the hills, and dug wells in the plain areas of Dimapur and other foothills. Infrastructure for water resource augmentation and water resource distribution has been created or is under creation in Kohima, Phek, Zunheboto, Wokha, Chumukedima, Mon, and Tuensang towns and it is expected that the percentage of coverage will increase.

7.2 Managing Water Resources in Nagaland

The departments of Irrigation and Flood control, Soil and Water Conservation, Public Health Engineering, and the Nagaland Pollution Control Board are the key institutional players involved in the management of water resources in the state. The private sector also plays a significant role in distribution of water, especially during the lean period. A brief description of the ongoing activities of the department is given in the following section[32].

7.2.1. Department of Public Health and Engineering

PHED in Nagaland is mandated to provide safe drinking water and adequate sanitation for people of the State in both rural and urban areas. The department obtains funding under the centrally sponsored programs of Accelerated Urban Water Supply Programme (AUWSP) of the JNNURM and the MoUD-ADB-North Eastern Capital Cities Development Programme (NECCDP), and the Bharat Nirman – Rural Drinking Water programme (National Drinking Water Mission) in addition to State Plan. The department also does conservation of water resources in and around their catchment areas, institutionalizing community participation in the implementation and management of rural water supply projects, restoration and revival of old water bodies such as wells and lakes, etc.

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[31] ddws.gov.in/bharatnirman/ DMU-Report.pdf, accessed on 8th Dec 2011

[32] : [1,4]http://nlsic.gov.in/chapter/flood_control.htm, accessed in Oct, 2011;

[8]Sources: http://nlsic.gov.in/chapter/soil&water.htm; Selected case studies of traditional rain water harvesting and Artificial recharge, Central Ground water Board, 2011, http://cgwb.gov.in/documents/Case-studies-RWH-AR-May2011.pdfhttp://nlsic.gov.in/chapter/phed.htm; The draft Annual Plan, 2011-2012, Govt. of Nagaland, Annual report 2010-2011 of the Nagaland Pollution Control, Board

7.2.2. Department of Soil and Water Conservation:

The mandate of the department includes conservation of water resources with a focus on enhancing agriculture production and its sustainability in the state and increasing drinking water potential in the rural areas. The department regularly monitors meteorological parameters, soil status and land use across the state. The department also undertakes integrated water shed management, including activities related to soil moisture conservation, water conservation, land management[33], and anti-erosion and anti-soil runoff; stream bank erosion control to protect river banks from heavy rainfall runoff, floods and change in river course; and is also involved in restoring existing water bodies such as traditional wells, water holes, lakes and building water conservation structures. Drinking water sources in rural areas is being created by the department through rooftop water harvesting structures, and through catchment area treatment of springs in some areas of the state. The department gets its funding from the ministry of Agriculture, IWMP, Prime minister's package, State plan, and Negotiated loans from various agencies (e.g. NABARD, World Bank, etc.).

7.2.3. Department of Irrigation and Flood Control

The department is involved in the construction of irrigation projects; groundwater development, command area development and flood management through Anti-erosion/Drainage/Flood Mitigation works. The Department also conducts Irrigation Census every five years in consonance with all the States of the country. In addition, the Department undertakes the civil works of Land Record & Survey Department, and Land Resources Development Department Nagaland. Funds from the Accelerated Irrigation Benefit Programme (AIBP), the Bharat Nirman Programme (BNP), the Command Area Development and Water Management Programme (CADWMP) of MoWR, the NLCPR -Non Lapsable Central Pool Resources, and the State Plan are available for the above activities.

Anti erosion works along the rivers of Dhansiri, Chathe, Nkwareu, Milak, Tizit and Dikhu to protect Dimapur area, suburban areas of dimapur district, Jalukie area, Tuli town, Tizit town, and Naganimora town respectively have also been undertaken under the Flood Management Programme of MoWR.

7.2.4. Nagaland Pollution Control Board

NPCB monitors the discharge of sewage and trade effluents in the streams as per laid down standards. Special campaigns have been launched to monitor water quality in three rivers in Nagaland, namely, Dhanasiri in Dimapur, Chathe in Medziphema and Dzu-u in Kohima. The National Water Quality Monitoring Programme (NWMP) is the main source of funding of these activities

7.2.5. The Private Sector

Nagaland, in the lean period suffers from acute drinking water shortage. Private players access water from perennial streams originating in privately owned lands and sell the water to general public. In Kohima, the private distributors have their own network of rubber pipelines (many overhead) in addition to provisions for supplying water in tankers. There is no regulatory mechanism to guide the supply and demand side management of water from these sources.

[33] Mechanized land development is carried out through narrow bench terracing, wide bench terracing, and contour bunding.

7.3 Broad concerns and issues

7.3.1. Problems of aplenty and scarcity:

During the monsoon period from May to September, water is aplenty in Nagaland as about 1800-2250mm of rain falls during this period. Most of the agriculture activities are carried out during the monsoons. The traditional Jhum cultivation is completely rain fed while terrace cultivation draws water through channels drawn from springs that are charged during the monsoon season, or through traditional means such as Zabo. The lean season spanning over October to April sees hardly any rains, and as a result the entire Nagaland faces acute water scarcity during these months.

7.3.2. Drying of springs and streams

Anecdotal evidence indicated that many of the perennial springs and streams are either drying up or becoming seasonal, mainly due to their catchment area being affected by deforestation due to timber extraction, developmental activities or jhum, etc. and as a result spring recharge capacity going down. As a result, irrigation for the terrace fields through channels is being adversely affected.

7.3.3. Land ownership

Nagaland being a unique land ownership system, where authority over land and its resources is largely vested with the communities and the government is not in a position to invoke its eminent domain rights to develop these resources. Local conflicts have come in the way of development of viable resource sharing models, limiting benefits and optimal utilisation of the individual or community owned water sources.

7.3.4. Low exploitation of ground water resources

Low lying areas of the state to a certain extent though are using underground water for irrigation, however, hydrological surveys have revealed fine grained nature of the aquifer materials indicating low water yields, heavy draw down and the depth of the peizometric surface at more than 6m depth. Also the chemical quality of underground water in the valleys and the foothills is not uniform.

7.3.5. Increasing demand for water

With increasing population, rapid urbanisation and increase in developmental activities in the hilly areas in the last few years, the demand and need for fresh water resources in all sectors is increasing exponentially, putting pressure on the available resources.

7.3.6. Gaps in existing institutional arrangements

The activities of the departments of Soil and Water Conservation (DSWC) and the Department Irrigation and Flood Control (DIFC) are mostly stand alone in nature, actions implemented are mostly reactive and not proactive and are not necessarily based on sound scientific assessments, their programmes do not cover the entire state comprehensively, and the actions taken by each department mostly are not synergized and located at one place to have an effective solution. The Public Health Engineering Department and the Soil and Water conservation Department working towards ensuring drinking water security do not yet have the infrastructure and technical capacities to design storage of excess water / or allow excess water to recharge springs that almost entirely flows out as run off during the monsoon. Similarly the Irrigation and Flood Control Department is yet to map soil erosion and land slide prone regions to plan and systematically implement anti land

slide works and implement measures for protecting soil from getting eroded. An integrated approach by the departments in implementing their various programmes would be more effective and lead to better outcomes rather than the present stand-alone, reactive approaches.

7.4 Impact of Climate Change on Water Resources in the state

The climate change projections for Nagaland indicate that its likely to be vulnerable in the period 2021-2050s due to heavier precipitation during monsoon, increase in extreme precipitation events, further decrease in precipitation in summer and winter periods, warmer average annual temperatures , and increase in droughts during monsoon, and increase in flood discharge. The changes in climate are projected to be spatially variable as indicated in the district wise vulnerability assessment below.

Box 7: Projecting Impacts and vulnerability of districts - Tools and Methods

Changes in water resource availability for MC and EC (MC-mid century covering the period 2021-2050 and EC –End of Century covering 2071-2098) have been projected in terms of rainfall, evapo-transpiration and water yields using the Soil Water Assessment Tool (SWAT) (http://swatmodel.tamu.edu/) with inputs from the PRECIS model run on GHG emission drivers generated by the IPCC SRES A1B scenario, Digital Elevation data, Drainage Network, Soil data and associated soil characteristics and Land use data: For Nagaland, the SWAT outputs are only for the Brahmaputra catchment area occupying 65% of the total area across the state. The Change has been derived with respect to base line scenario BL covering 1961-1990. The Vulnerability of each district was assessed by estimating a composite Water Vulnerability Index that includes indices of water availability, evapotranspiration demand, number of drought weeks, and flood magnitude.

Source: 1. Climate Change Assessment for Nagaland, Ravindranath et al., 2011, IISc Banagalore,

2. Climate Change and India:A 4X4 Sectoral and Regional Analysis for 2030s, INCCA Report no.2, 2010, MoEF

7.4.1. Projection of changes in rain fall, evapotranspiration and water yields

The projections indicate a reduction of precipitation by about 2% in Nagaland in MC scenario and an increase of about 9.5% in EC scenario. An increasing trend in evapotranspiration is projected by about 14.3% in MC and 27.9% in EC respectively, probably due to warming. The increased evapotranspiration may lead to water stress in the near-term future. The water yields which is a function of which is a function of total rain fall, increase in evapotranspiration, flood magnitude and drought weeks in monsoon period, reduces by 4.2% in MC and increase by about 7.4% in the EC. Table 17 summarizes the results of impacts of climate change on water resources in Nagaland.

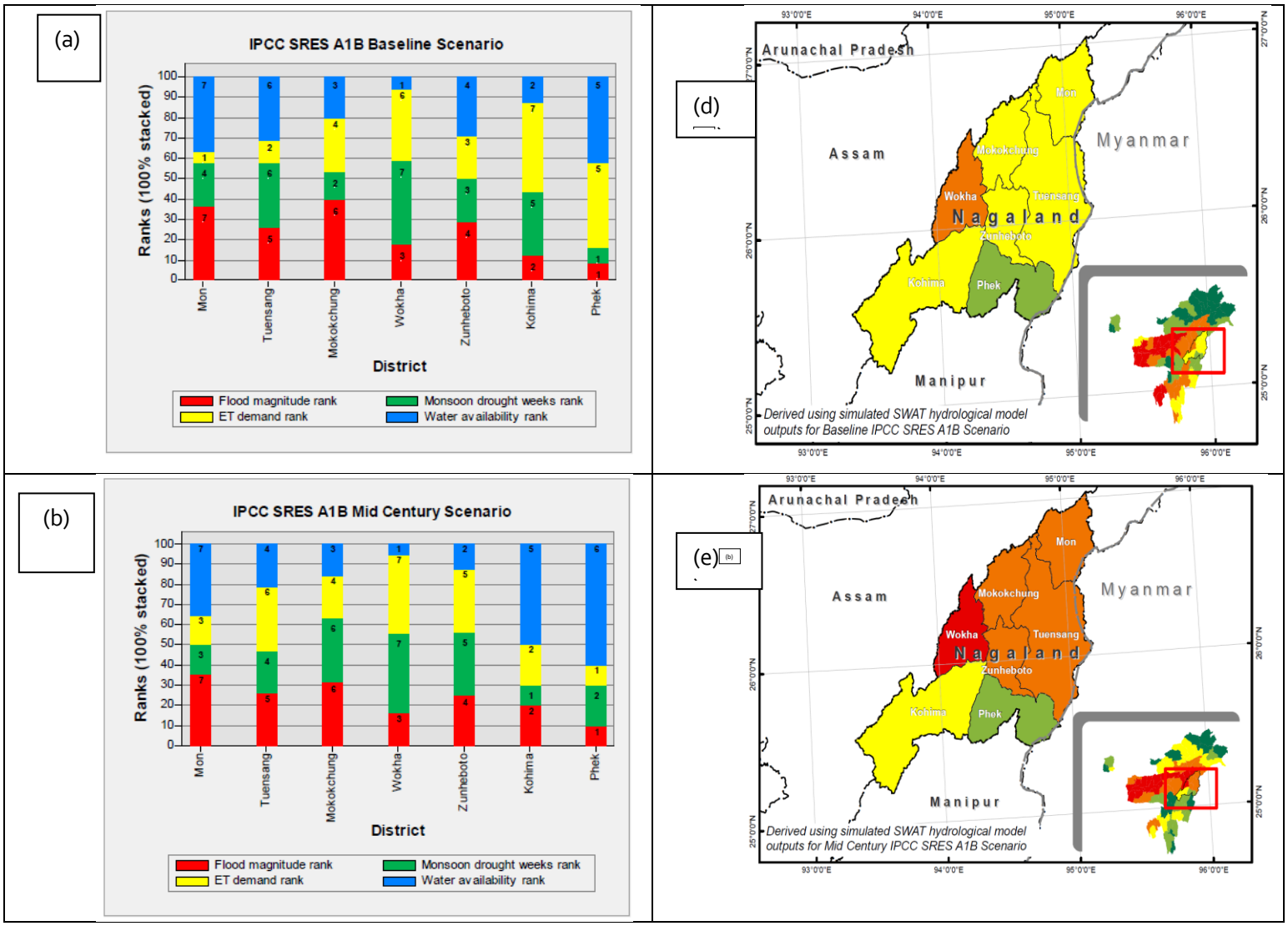
Table 17: Trend in water balance for baseline, near and long-term climate scenarios (IPCC SRES A1B) for Brahmaputra basin

Scenario	Rainfall mm	Change over baseline %	Water yield mm	Change over baseline %	Actual evaporation-transpiration mm	Change over baseline %
1961-1990 (BL)	2409.0		1922.3		391.4	
2021-2050 (MC)	2361.4	-2.0	1841.3	-4.2	447.3	14.3
2071-2098 (EC)	2637.5	9.5	2063.9	7.4	500.4	27.9

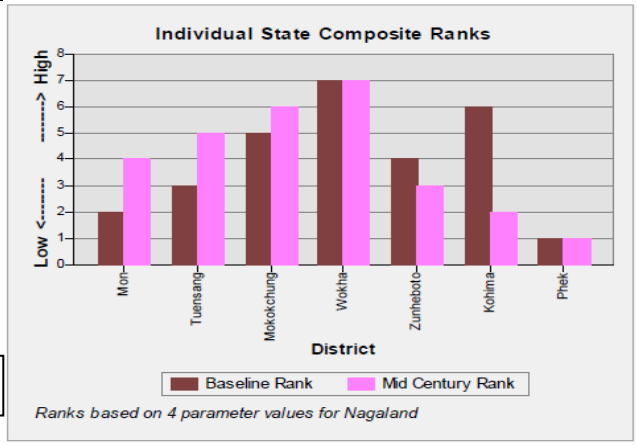
7.4.2. Water Vulnerability at District Level

The analysis indicates that Wokha district is the most vulnerable and Phek the least vulnerable in both BL and MC scenario. The other districts, namely, Mon, Mokokchung, Tuensang and Zunheboto are moderately vulnerable in BL, but become more vulnerable in the in MC (see Figure 21). The 7 districts are ranked according to vulnerability status on a scale of 1 to 7. The Ranking has been made both for the base line scenario (1961-1990) and for the mid century scenario (2020-2050) and is summarized in Table 18. This increasing water vulnerability in the Northern districts including Wokha, is mainly due to decrease in water yield which is a function of total rain fall, increase in evapotranspiration, flood magnitude and drought weeks in monsoon period. Rank 1 being least vulnerable and Rank 7 being the most vulnerable.

Figure 21: Distribution of Water vulnerability indices by district (a) for base line (1961-1990), (b) for mid century (2021-2050), and (c) composite WV Index for base line as well as mid century. (d) and (e) Spatial spread of WVIndex across the districts in Nagaland in base line and mid century scenario respectively



(c)



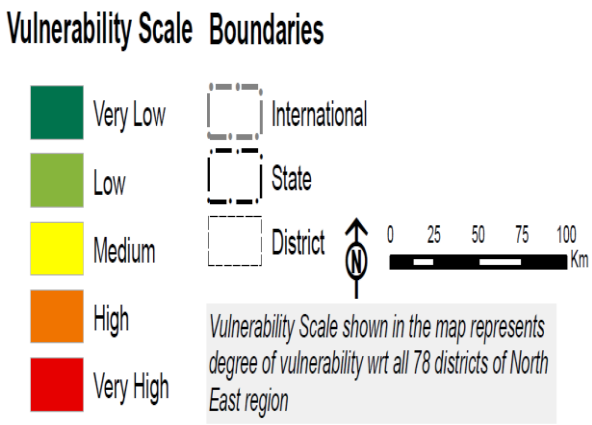


Table 18: Composite Water Vulnerability Index Ranking of various states of Nagaland in base line (1961-1990) and mid century scenario (2021-2050)

Ranking*	Base Line scenario	Mid Century scenario
1	Phek	Phek
2	Mon	Kohima
3	Tuensang	Zunheboto
4	Zunheboto	Mon
5	Mokokchung	Tuensang
6	Kohima	Mokokchung
7	Wokha	Wokha

7.4.3. Climate Change Concerns

Heavier monsoon precipitation

Heavier precipitation during monsoon will manifest itself into higher surface runoffs, higher frequency of landslides, higher soil erosion and hence heavier silt load in the rivers leading to frequent meandering of rivers and river bank erosion. The higher runoffs may lower the recharge capacity of soils in and around the spring heads of perennial springs, damage existing water storage structures built in the hills, lead to loss in soil minerals, and may make non-landslide prone areas also prone to landslides. The water from existing storage structures, storing irrigation and drinking water are likely to brim over, making the excess water received go waste.

Increase in extreme precipitation events

Extreme precipitation events are again a potential threat and increase in their frequency by 1 or 2 days is likely to exacerbate the damages already caused by heavier precipitation. The deluge, may lead to heavier soil erosion and higher incidence of landslides, including in non prone areas as well, and block roads and access to markets and other social infrastructure leading to economic losses. The landslides are likely to damage water conservation structures and water pipes affecting drinking water availability. Farmers may be forced to abandon their farming activities due to landslides.

Increase in annual average temperature

The productivity of certain crops is likely to shift to higher altitudes as the annual average temperature increases further. This may lead to encroachment of pristine forest land at the higher altitudes to ensure

food security. This will again mean disturbance in the recharge zones of the perennial springs. Increase in ambient temperature, may also lead to excess water pollution, especially in the plains in the southern parts of the state. Further, turbidity in water due to excess siltation from increase in rainfall, is likely to increase the amount of heat absorbed from sunlight. Increase in ambient temperature affects the physical, biological, and chemical characteristics such as the amount of oxygen that can be dissolved in water, rate of photosynthesis of plants, metabolic rates of fish and other organisms residing in the water, and the sensitivity of organisms to toxic wastes, parasites, and diseases.

Increase in number of drought days during monsoon period

Increase in the number of drought days in the northern districts is likely to lead to uncertainty in yields of crops and increase the vulnerability of the agriculture system as a whole affecting the food security in these districts. An improvement in the southern districts of drought days may enhance crop productivity in that area. Scarcity in drinking water is an additional impact that the populace is likely to face due to drying up of perennial streams as well in the lean period. Therefore storage of water when it is received in abundance is important and required and its efficient use in the lean periods is one of the key challenges of the state.

Increase in flood discharge

Increase in flood discharge in the narrow valleys and in the southern districts in the period 2021-2050s may lead to choking of the drainage systems, damage standing crops on the river plains, affect infrastructure, and potability of drinking water in these areas.

7.5 Adaptation Strategies

The issues highlighted in above sections can be tackled through a three pronged approach in the state, namely, through:

- Planning and implementing activities that fit into the scope of the National Missions articulated in the National Action Plan on Climate Change that are suitable for addressing the climate change issues in this sector. For Nagaland, the Water Missions and Green India Mission can be implemented through strengthening of existing activities. ***A Climate Change Coordination Committee for the Water sector will be set-up under the chairmanship of APC or Development Commissioner for coordinating all activities.***
- Adopting additional new strategies which will facilitate the adaptation actions
- Adopting a state water policy that takes into account the needs of the state to ensure water security in the current climate variability context as well as in the context of climate change
- Building Capacity of all stakeholders *vis a vis* knowledge of climate change, and technologies to combat climate change, and for monitoring and evaluation of actions taken.

Keeping in view of the climate change adaptation requirements of the state of Nagaland and the objectives of the water missions, The following strategies are envisaged to lead the state towards water security through resource augmentation, efficient use and equitable distribution..

7.5.1. Storing excess water received through heavier precipitation and increase in extreme events

The National Water Policy in consultation with the states aims to implement basin level management strategies to deal with variability in rainfall and river flows due to climate change. This will include creation of enhanced storage both above and below ground, rainwater harvesting, coupled with equitable and efficient management structures. This aim of the National Water Policy (NWP) provides guidance for developing state specific strategies for enhancing water storage in the context of projected receipt of rain fall through heavier downpour and increase in extreme precipitation events. In effect this

would mean, up scaling the existing programs. A comprehensive list of activities, in accordance, is given below:

i. ***Documenting natural water resources all across Nagaland:*** Train departmental personnel and village communities to understand and document geo-hydrology of the villages, map village springs and identify their sources, demarcate the spring recharge zones, and map natural lakes and ponds including the ones that have gone dry.

ii. ***Artificially recharge water in and around the spring heads for maintaining perennial water flow:*** (a) The departments (DIFC, DSWC) along with the villagers will identify and implement appropriate artificial recharge techniques through rain water harvesting and afforestation in and around the spring heads to increase the base flow of the streams in the lean period. (b) Since the spring heads lie in the upper reaches of the hills and are forested, therefore the Department of Forests (DF) can undertake afforestation activities under the *Green India Mission* in and around the spring heads. The other artificial recharge techniques can be implemented through the MGNREGA program of the MRD, GOI. (c) Further, mechanisms need to be devised such as payment for ecosystem services to incentivize land owners to protect spring heads lying within private land or community land.

iii. ***Increase irrigation potential of the state:*** The irrigation potential of the state can be enhanced by (a) Accelerating the implementation of medium and small irrigation projects that have been planned and by (b) Store the excess water in structures along the streams. The Department of Irrigation and Flood control can make an assessment of the excess water that is likely to be received and construct reservoirs and make arrangements to have sluices to control the water flow for irrigation from the water storage structures. The capacity of the reservoirs needs to be in consonance with the maximum water that can be stored *vis-à-vis* the maximum rain likely to fall. For this the state government needs to accelerate the implementation and coverage of small and medium irrigation projects.

iv. ***Increase area under terraces to utilize excess water receipt during monsoon thereby increasing area under assured irrigation and hence increase agriculture productivity and optimize Jhum:*** The Department of Soil and Water Conservation can extend its activities of land management for *Jhum* optimization by creating deep or shallow terraces as per the carrying capacity of the land and which will be connected to the reservoirs through small canals dug across the hills.

v. ***Increasing storage capacity by building water reservoirs in rural and urban areas:*** (a) In villages which are located on the top of hills, there is perennial water shortage and one of the strategies is to construct roof top rain water harvesting tanks or over ground storage with water diverted from sloping roofs. Also create community reservoirs. The PHE can extend its work on coverage of rural households under its various programmes. (b) Explore the feasibility and effectiveness of extending traditional water harvesting methods such as the zabo (the word means 'impounding run-off') system is practiced in Nagaland. Also known as the Ruza system[34], it combines water conservation with forestry, agriculture and animal care. (c) Promote roof top water harvesting

[34] Villages such as Kikruma, where Zabos are found even today, are located on a high ridge. The rain falls on a patch of protected forest on the hilltop; as the water runs off along the slope, it passes through various terraces. The water is collected in pond-like structures in the middle terraces; below are cattle yards, and towards the foot of the hill are paddy fields, where the run-off ultimately meanders

in all household in cities (d) Restore the old lakes, tanks and ponds on hill tops and plains and use them for drinking water supply in towns and villages.

vi. ***Identify the enhanced hydro-power potential of the state in the climate change scenario:*** A study can be instituted to identify the hydro-energy potential of the state due to excess rainfall receipt during monsoon. This can also lead the state to a self sufficient energy scenario in the future.

7.5.2. Efficient demand side management

The National Mission on Water aims to ensure integrated water resource management helping to conserve water, minimize wastage and ensure more equitable distribution both across and within states. The Mission takes into account the provisions of the National Water Policy that aims to develop a framework to optimize water use by increasing water use efficiency by 20% through regulatory mechanisms with differential entitlements and pricing. The State will seek to ensure water needs of urban areas through recycling of waste water. In keeping with the Mission objectives, the following strategies are suggested:

i. ***Assess change in demand of water in the climate change scenario between 2021 -2050:*** A study needs to be carried out to understand the likely demand of water by sector for effective planning for supply side management of water resources for the base line (current climate) and in the future climate scenario.

ii. ***Enhance water use efficiency in urban households:*** Limited urban areas are being metered to regulate water use efficiency in the state. Also Water Tax is being levied from Consumers in accordance with the Nagaland W/S Consumers Rules 1998 and rates are revised from time to time. However, the charges levied are nominal and are no deterrent to wastage of water. A systematic evaluation for options for an efficient pricing of water as a commodity especially by the urban users may help in sustainable utilization of water by this category.

iii. ***Reutilization of domestic waste water in lean period in urban households and for agriculture:*** Assess the process and feasibility of waste water utilization in towns for sanitation purposes at least. In the rural areas the waste water can be used for agriculture purpose for non-horticultural purposes and in fisheries by applying excreta treatment[35].

iv. ***Promote use of water efficient technology for agriculture that can be carried out during lean period:*** The state can explore the possibility of growing horticulture crops in the lean season using sprinklers, drip irrigation and ridge and furrow irrigation technologies, making use of the stored water available due to heavier precipitation in the future.

7.5.3. Averting disasters due to heavy precipitation and increase in extreme events (extreme rain fall, floods and droughts)

The likely disastrous impacts can manifest as heavy soil erosion, soil leaching and loss of soil nutrient, landslides, river meandering, river bank erosion and flash floods, damage to infrastructure such as roads and bridges, pipelines, water storage structures, housing and damages to standing crops.

This would entail (i) expanding and up scaling the activities of the existing departments by factoring in climate change scenarios, along with undertaking specific measures that would help in scientific

[35] Excreta treatment not only destroys pathogenic microrganisms but also converts these nutrients to forms more readily usable by crops and stabilizes the organic matter, producing a better soil conditioner.

implementation of the actions, (ii) Undertaking scientific studies to understand the likely extent of damages and (iii) Gearing disaster management services to react to the exacerbated impacts of climate change. Some of the actions that can be taken up are:

i. ***Set up additional Automatic Weather stations at high resolution to take into account the changes in microclimate with topography of Nagaland:*** The IMD, DSWC, and the DIFC are undertaking meteorological measurements as a part of their mandate. However, these need to be collated on a common platform, corrected for any aberrations. The data also needs to be reconstructed across time and space to account for the data gaps. These data sets however, do not exist at enough high resolution that can represent the micro climate of the region that varies at very small spatial scales across altitude. Thus automatic weather stations should be set up to complement the existing stations and fill in the requirement of high resolution data collection. The data base thus developed form the basis for a robust scientific analysis of the climate in the region and also for validation of climate change models that can simulate the current climate of the state and hence can project climate change at a less uncertain manner. Access of this data should be available to the departments of PHE, Irrigation and Flood Control, Soil and Water Conservation, Pollution Control Board, Agriculture, Horticultures, fisheries, Animal Husbandry, Forest and Environment, and to the researchers of Nagaland.
ii. ***Assess the likely recurrence, magnitude, and location of floods and droughts, and landslides in a climate change scenario at a resolution that represents the undulating topography of the state:*** Undertake climate change modeling study to understand the magnitude and frequency of occurrence of floods and droughts in the state in a climate change scenario
iii. ***Arrest flash floods:*** (i) Improve and install drainage system in towns in plains to deal with drainage of flash floods in the southern part of the state: This will entail extending drainage where it does not exist and improving drainage systems where it is not fully effective[36]. The list of measures for appropriate drainage can be identified through a study, that takes into account heavier precipitation and increase in extreme events in the climate change scenario. (ii) Undertake works for stream training emanating from springs, river training and Anti-erosion works in identified areas as per the climate change projections.
iv. ***Integrate climate change concerns in planning for disaster preparedness –*** undertake training of disaster management officials and develop manuals for action to be taken during a disaster

7.5.4. Adapting to the impacts of higher annual average temperatures

i. ***Undertake study to understand the impact of climate change on water quality in all regions in Nagaland and the effect on aquatic life:*** This study can reflect on likely migration of fish species to higher altitudes along the rivers and streams, and the measures can be identified that will be needed to overcome the pollutant loads.
ii. ***Extend water quality monitoring to rivers and other water bodies not yet covered[37]*** - The Nagaland Pollution Control Board can install water quality monitoring systems in rivers and water bodies used for drinking as well as used for fisheries, livestock, and agriculture purposes. This constant monitoring will enable the board to take action in case the water quality deteriorates as temperature increases.

[36] The measures can include de-silting and rehabilitation of trunk sewers, pumping station upgradation, outfall canal upgradation, providing additional gully pits, extension of sewerage systems in areas not covered, waste water treatment plants, storm drainage tunnels, Intervention studies

[37] For detailed technology see Report of the Working Group on RIVERS, LAKES AND AQUIFERS, Ministry of Environment & Forests, for the Eleventh Five Year Plan 2007-2012),

iii. ***Strengthen regulations for controlling waste water discharge in rivers –*** The pollution control board needs to identify the nature, quality and quantity of waste water disposed in the main rivers of Nagaland and install appropriate waste water management treatment plants before discharging the water in the water bodies or rivers.

7.6 Budget

The details of the actions, costs and time lines of actions and the concerned departments that will take action for the strategies identified above are indicated in the Table below.

				(₹ In Lakh)
S. No.	**Activities**	**Budget (2012-17)**	**Funding Source**	**Implementing Agency**
Strategy 1. Actions for storing excess water received through heavier precipitation and increase in extreme events				
1.1	Rejuvenating and recharging springs and streams			
1.1.1	Identify and map springs and streams at risk, and their associated watershed, geo-morphology and interventions required.	20.00	AIBP, MGNREGA, BNP, JNNURM	PHE, DSWC, DIFC, DF&E
1.1.2	Create recharge structures in and around spring heads @ Rs. 3.00 Lakh for each spring (assuming approx. 3 streams on an average for 1428/4 villages and 19/2 towns).	3298.50		
1.1.3	Afforestation @ Rs. 0.50 lakh/ha. To cover approx. 500 ha. In1428/4 villages and 19/2 towns (to be taken up under Forestry sector)	0.00		
1.1.4	Assess the potential of payment for ecosystem services for springs that are originating in private and community land and design the implementation of the same.	15.00		
1.2	Increase irrigation potential (Refer to Agriculture chapter also)			
1.2.1	Accelerate implementation of current medium and minor irrigation projects (Costing already done in the annual plan)	0.00	BNP, AIBP, CADWMP, DoNER	DSWC ,DIFC
1.2.2	Ascertain amount of excess water likely to be received as precipitation at a resolution of about 1kmx1km	15.00		
1.2.3	Assess the structural requirements to accommodate water due to heavy as well as extreme rain fall	15.00		
1.2.4	Construct at least 5 structures along the springs @ cost of Rs. 3 lakh for 1428/4 villages.	1785.00		

1.2.5	Train communities in regulation of water use for agriculture (replicate best practices) @ Rs. 0.50 lakh in 100 villages	50.00		
1.3.	Increase area under terraces to utilize excess water receipt during monsoon			
1.3.1	Identify areas where terraces are viable and can be irrigated	15.00	Ministry of Agriculture, Plg Com, JNNURM, BNP, MNREGA, National Mission on Water, National Rural Urban Drinking Water Programme, MNRE	PHE, DSWC, DA, DIFC
1.3.2	Undertake land management activities for building terraces @ Rs.60000/ha and 100 ha per village in 100 villages	6000.00		
1.4	Increasing storage capacity by building reservoirs in rural and urban areas			
1.4.1	Promote household level storage @ 10000 l per household @ Rs 3 lakh in villages (private investment).	0.00	Ministry of Agriculture, Planning Commission, JNNURM, BNP, MNREGA, National Mission on Water, National Rural Urban Drinking Water Programme, MNRE	PHE, DSWC, DA, DIFC
1.4.2	Build community level reservoirs @ 25 lakh litre, Rs. 7.5 Lakh, 1 reservoir per village for 200 villages.	1500.00		
1.4.3	Undertake study to assess the feasibility of implementing traditional storage methods in different areas of Nagaland	15.00		
1.4.4	Restore natural water sources by aiding artificial rainwater recharge along their sides, at least one such natural structure in 100 villages @ Rs 2 lakh/ water body.	200.00		
1.4.6	Balancing reservoirs for storage of water in urban areas, in PPP mode, @ Rs. 2000/- per capita (Refer Urban Dev chapter)	0.00		
1.5	Quantify the hydro-power potential of the state in a given climate change scenario	25.00	MNRE (RE Mission)	Department of NRE, Nagaland
	Sub Total:	12933.50		
Strategy 2: Actions for efficient demand side management				
2.1	Assessment of demand of water by sector in current and climate change scenario			
2.1.1	Study to assess change in demand of various sectors between 2020-2050s with respect to current base line, considering the projected climate change impacts	15.00	BNP, JNNURM, HM	PHE, DIFC, DSWC, DA, DF&E

2.2	Enhance water use efficiency in urban households			
2.2.1	A systematic evaluation for options for efficient pricing of water as a commodity. Study efficient pricing of water use by urban population (Refer Urban Dev chapter)	0.00	BNP, JNNURM, HM	PHE, DIFC, DSWC, DA, DF&E, DH
2.2.3	Implementation of tax regime in all urban households (ADB funding exists for water metering, Rs. 50 crore, Urban Development chapter)	0.00		
2.3.	Reutilization of domestic waste water in lean period in urban households and for agriculture			
2.3.1	Initiate studies to assess the process and feasibility of wastewater utilisation in towns for sanitation, agriculture purposes (Refer Urban Dev chapter).	20.00	BNP, JNNURM, HM	PHE, DIFC, DSWC, DA, DF&E, DH
2.3.2	Promote use of water efficient technologies for agriculture in lean period	20.00		
	Sub Total	55.00		
Strategy 3: Actions for averting disasters due to heavy precipitation and increase in extreme events				
3.1	Set up additional Automatic Weather stations at high resolution to take into account the changes in microclimate with topography of Nagaland			
3.1.1	Set up AWS for 74 blocks @ RS. 2.5 lakh / AWS	185.00	State Plan funds, Water Mission, Knowledge Mission	IMD, ISRO, DIFC, DSWC, DA, PHED, NU, DF&E
3.1.2	Develop a centre, in collaboration with NU for weather forecasting - set up data bank, undertake scientific analysis of data and its dissemination for informed decision making @Rs.50 lakh/year	250.00		
3.2	Assessment of climate change			
3.2.1	Undertake scientific assessment to assess climate change impacts especially due to change in rainfall patterns, on landslides, and other natural disasters, at a high resolution	15.00	Water Mission, Knowledge Mission	IMD, ISRO, DIFC, DSWC, DA, PHED, NU, DF&E
3.2.2	Integrate climate change concerns in planning for disaster preparedness	15.00		
3.3	Stream and River training (Refer urban development chapter also)	2000.00	JNNURM, MoWR	DIFC
	Sub Total	2465.00		
Strategy 4: Actions for Adapting to the impacts of higher annual average temperatures				

4.1	Study to understand the impact of climate change on water quality in all regions in Nagaland and the effect on aquatic life	15.00	MoEF, Water Mission, NPCB	NPCB, MoEF
4.2	Extending water quality monitoring including up scaling of ground water monitoring and water quality in all major rivers.	200.00		
4.3	Identify stretches polluting the rivers, identify industrial units,			
4.3.1	Undertake manual cleaning of plastic and other non soluble deposits and install units for cleaning waste water discharge into Dhansiri river, Dimapur and major streams (refer Urban Development chapter also).	4000.00	MoEF, Water Mission, NPCB	NPCB, MoEF
	Sub Total	4215.00		
	Grand Total	**19668.50**		
	(Rupees One Ninety Six Crore Sixty Eight Lakh Fifty Thousand Only)			

Chapter 8

Energy

Energy plays a vital role for economic and social development of a region or a country. Energy consumption figures for various countries indicate a correlation with per capita GDP and per capita energy consumption. Energy can be termed as an important factor of production, contributing to increased productivity. However, consumption of fossil fuels for generation of energy is the major cause of air pollution and climate change. Reducing dependence on fossil fuels for energy generation and improving energy efficiency at the generation and consumption stages are desirable objectives for minimizing impacts of economic development on climate and ensuring long term sustainability.

The overall energy mix of the state can be broadly classified as electricity (from renewable and non-renewables), biomass (fuelwood), petroleum products[38] (including LPG) addressing the household (lighting, cooking, heating), entertainment, transport, commercial and industrial needs. The household requirements of energy, for cooking are primarily met by firewood (58 percent of rural households and 7 percent of urban households) while lighting requirements are met by electricity.

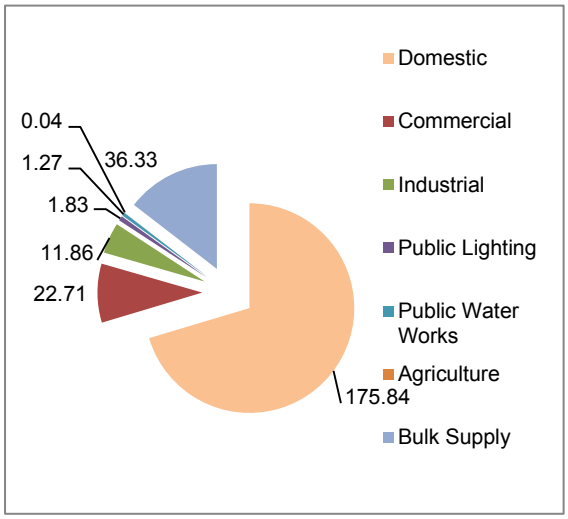
Firewood consumption is a concern which is dealt here also and in the Forestry chapter. The transport sector, which is also a major part of the energy sector is dealt with in the chapter on Urban Development. With the objective of achieving a low carbon growth trajectory, implying ensuring sustainable level of per capita energy consumption growth while reducing level of emissions due to generation and consumption, the present chapter primarily focuses on the electricity power aspects of energy.

8.1 Key electricity statistics for Nagaland

8.1.1. Electricity Demand

The per capita electricity consumption figures for Nagaland at 242.35 kWh (2009-10) is much lower than that of the country at 778.6 kWh (2009-10)39. The consumption has been steadily increasing since 1990-91, when the per capita consumption was only 75 kW. The state's peak hour electricity demand is 110 MW off peak demand varies between 55 MW during the period November to June, and 70 MW during July to October.

Figure 22 : Sale of Electricity by Class of Consumers



Bulk of the electricity consumption in the state which corresponds to 55% of the supplied electricity is by the domestic sector. Although the State has fairly high electrification with the percentage of household electrification being 97% and 90% for urban and rural areas, supply and infrastructure constraints exist in both urban and rural areas though they are much more pronounced in the rural areas, with some villages40 though electrified, not receiving electricity for days together. The domestic sector consumption has seen an upward trend, particularly from 2008-09. One of the reasons for this is due to

[38] The state has abundant potential oil and gas reserves along the foothills and reasonable deposits of coal, but these are not being discussed here as these are largely linked with national policies.
[39] Central Electricity Authority
[40] The State had achieved 100 percent electrification as per 1991 Census, but new settlements have been established since then.

growth of urban centres, improved economic conditions of people and thereby changes in lifestyle patterns, leading to increase in demand for electricity. In the domestic sector the major consumption of electricity is lights, fans and television, with air conditioning registering a consumption of around 5 percent of the total electricity consumed, mostly in Dimapur.

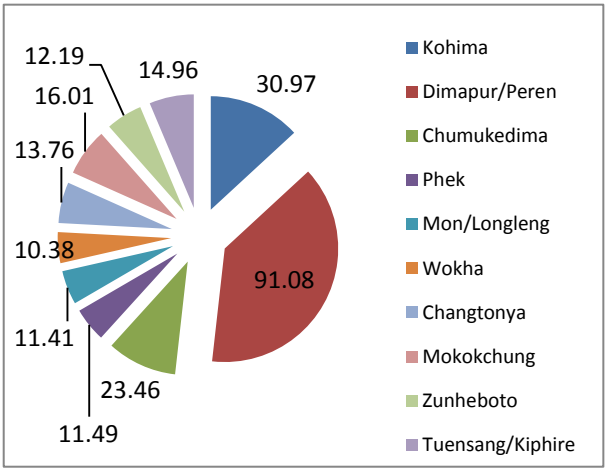
Table 19: Growth of consumption of electricity under different classes of consumers

	2005-06		2006-07		2007-08		2008-09		2009-10	
	No	MU	No	MU	No	MU	No	MU	No	MU
Domestic	133,374	126.20	136,041	128.71	152,178	117.68	159,788	127.63	164,515	175.84
Commercial	13,803	21.11	13,947	21.31	17,320	21.22	16,375,	23.37	17,273	22.71
Industrial	1379	27.17	1292	27.44	1353	31.85	1958	34.30	2095	11.86
Public Lighting	823	0.26	829	0.44	852	2.90	824	1.94	581	1.83
Public Water Works	22	2.98	22	3.01	20	4.29	27	4.37	27	1.27
Agriculture	0		0	0	0	0	2	0	2	0.04

Source: Department of Power, Nagaland

The agriculture sector is not a consumer of electricity, as most of the irrigation is either rain-fed or through water canals or natural springs. The water supply sector is also a very low consumer of electricity as again the main sources of supply is from natural water bodies such as springs and by and large supply is through gravitational force. The state has very little piped water supply and has virtually no water treatment facility and therefore the energy consumption in the water sector is extremely minimal. Consumption in the industrial sector is very low, indicating the status of industries but also reflects the bottlenecks identified above. As can be seen from Table 19, the consumption in the industrial sector has actually seen a downward trend, particularly from 2009-10, largely due to the closure of a few industries, primarily due to poor electricity supply.

Figure 23: Town Wise Electricity Consumption (in MU)



Within the urban areas also, the main consumption is in the commercial capital of Dimapur and the state capital Kohima, with the consumption in these two towns exceeding the combined electricity consumption in all other towns. Dimapur, located in the plains, is the largest consumer of electricity.

8.1.2. Electricity Generation

The state has a total installed generation capacity of 28.30 MW, derived from hydel (27.50 MW), diesel (0.80 MW) and biomass. The net generation from the installed capacity has varied between 71.44 MU to 75.51 MU during the period 2007-08 to 2011-12. In addition, the state has a share of free power from the 75 MW Doyang Hydro Electric Power, Nagaland (DHEP) and has been allocated a share from the other central government generating units in the north east, namely Loktak, RHEP, Kopili-I and II, Khangdong. 80 percent of the generating capacity allocated is hydro, which may be good from the emissions perspective, but makes the availability variable and rainfall-dependent. As a result, there is a shortfall in availability varying from 25MW (off peak) to 60 MW (peak) during the period November to June. The electricity availability and the typical seasonal shortfall are indicated in the Table 21.

Table 20: Seasonal Supply of Electricity

	From November to June		From July to October	
	Peak Hour	Off-Peak Hours	Peak Hours	Off-Peak Hours
Demand (in MW)	110 MW	55 MW	110 MW	70 MW
Availability (in MW)	50 MW	30 MW (Grid Only)	110 MW	110 MW
Surplus or deficit (in MW)	-60 MW	-25 MW	0 MW	+40 MW

Source: Department of Power, Nagaland

Table 21: Electricity availability in the state - A snapshot

S. No.	Elect availability	2007-08	2008-09	2009-10	2010-11	2011-12
1	Installed Capacity (MW)	27.60	27.60	27.60	27.60	27.60
	Hydel (MW)	27.50	27.50	27.50	27.50	27.50
	Diesel (MW)	0.10	0.10	0.10	0.10	0.10
2	Share in Central Govt Units (i/c of DHEP & Eastern grid (MW)	81.00	105.00	105.00	103.80	103.80
	DHEP MW	13.52	13.52	13.52	13.42	13.42
	Other CGUs (MW)	0.00	24.00	24.00	24.00	24.00
3	Net Own Generation (MU) LHEP	73.95	75.51	73.36	76.74	74.16
4	Power Purchase (MU)					
	From Central Sector (MU)	326.90	423.26	421.33	488.81	517.03
	Free power from DHEP (MU)	29.67	27.36	17.67	29.82	27.00
5	Total Power available (3+4)	430.52	526.13	512.36	595.37	618.19
6	T&D Losses (MU)	156.71	163.16	186.81	217.60	231.60
7	Energy available for sale (MU)	273.81	362.97	325.55	377.77	386.59
	Within State	172.73	192.97	249.88	284.94	345.59
	Trading/UI	101.08	170.00	75.67	92.43	60.00

8.2 Institutional Framework – Organisations, Policies and Programs

The **Department of Power (DoP), Nagaland**, is responsible for generation, transmission, and distribution of power and maintenance of generation stations, transmission and distribution network in the State. The department performs the regulatory and developmental role as laid out in the Electricity Act, 2003, the National Electricity Policy and the Rural Electrification Policy. The unbundling envisaged in the Act is, however, yet to be undertaken. The department also implements the central programs - Rajiv Gandhi Grameen Vidyut Vitaran Yojana (RGGVY) aimed at rural electrification; and the Re-structured Accelerated Power Reforms Project aimed at reducing transmission and distribution losses. The department has also introduced single point metering and communitisation in rural as well as urban areas as a strategy to improve revenue collection.

The **Department of Electrical Inspectorate (DoEI)** is mandated with the administration of the provisions of the Energy Conservation Act 2001 in the state. The DoEI is also mandated to inspect all electrical installation of high tension and medium voltage consumers, and permit new high-tension lines. In addition to implementing the Energy Conservation Act, 2001, it implements various programmes of the Bureau of Energy Efficiency namely:

a. The Energy Efficient Lamps Programme – Bachat Lamp Yojana;
b. The Standards and Labelling Programme for promoting energy saving appliances and devices;
c. The Energy Conservation and Building Code;
d. The Municipal Demand Side Management Programme, aimed at replacements of equipment and appliances for street lighting and water pumping with energy efficient systems; and
e. National Mission on Enhanced Energy Efficiency

The Department of New and Renewable Energy (DoNRE), Nagaland is tasked to implement all the programmes and policies for the promotion and penetration of new and renewable energy sources. Specifically, the DoNRE implements the following central government programs:

1. The National Solar Mission
2. The Off-grid programme, primarily:
    a. Biomass based heat and power projects and industrial waste to-energy projects for meeting captive needs
    b. Biomass gassifiers for rural and industrial energy applications
    c. Watermills/micro hydro projects – for meeting electricity requirement of remote villages
    d. Small wind energy & hybrid systems - for mechanical and electrical applications, mainly where grid electricity is not available.
    e. Solar photovoltaic roof-top systems for abatement of diesel for power generation in urban areas

The National Grid Programme, which is primarily to promote grid-interactive renewable power projects based on wind power, biomass, small hydro and solar with the objective of ensuring that it is mainly private investment driven, with favourable tariff policy regimes established by **Nagaland Electricity Regulatory Commission (NERC)** and almost all-renewable power capacity addition during the year has come through this route. The NERC is mandated to determine the tariff for generation, supply, transmission and wheeling of electricity, wholesale, bulk or retail, as the case may be within the State and to regulate electricity purchase and procurement process of distribution licensees including the price at which electricity shall be procured from the generating companies or licensees or from other sources through agreements for purchase of power for distribution of supply within the State.

The Nagaland Empowerment of People through Energy Development (NEPeD) is a people centric project that works with the farmers of Nagaland, to develop community centric small hydroelectric systems with their current focus being to design and develop "Pico Hydro Models" that are efficient, cost effective and can be deployed at homes to generate sufficient electricity to meet the requirement of rural households of Nagaland. NEPeD is also in the process of establishing a Centre of Excellence on Renewable Energy Studies (CERES).

The Department of Industries and Commerce (DoIC) should, technically, be the largest consumer of electricity in the state of Nagaland, if the plans of the Government as envisaged in the Industrial Policy of 2000, revised in 2004 had materialized. However, as of now, the industries department is trying to ensure that adequate energy is available to propel their MSME sector, and specifically for the Nagaland Mini Tool Room and Training Centre, the Nagaland Pulp and Paper Company, and the SEZ. The DoIC is mandated to create a favourable environment for industrial growth in Nagaland and one area where they are working in coordination with the DoP, is to ensure that the power infrastructure is strengthened in order to ensure that there is a suitable environment created for industrial promotion in the state.

8.3 Key issues and challenges in the energy sector

8.3.1. Insufficient Energy Supply

Nagaland has very low electricity generation capacity and depends largely on the central grid for its electricity demands. However the supply from the Central Grid is unable to meet the demands of the State especially during the period between November and June where there is a deficit of -60MW and -25MW for peak and off peak hours respectively. This not only makes the people of the state suffer in terms of long hours of load shedding, with the rural areas being more adversely affected, but also the quality of electricity in terms of load low voltage. The shortages at peak hours for sustained periods also mean that the state has to pay high cost for purchase of electricity from the grid. The situation is going to worsen as the demand increases (projected at 500 MW by the end of the decade).

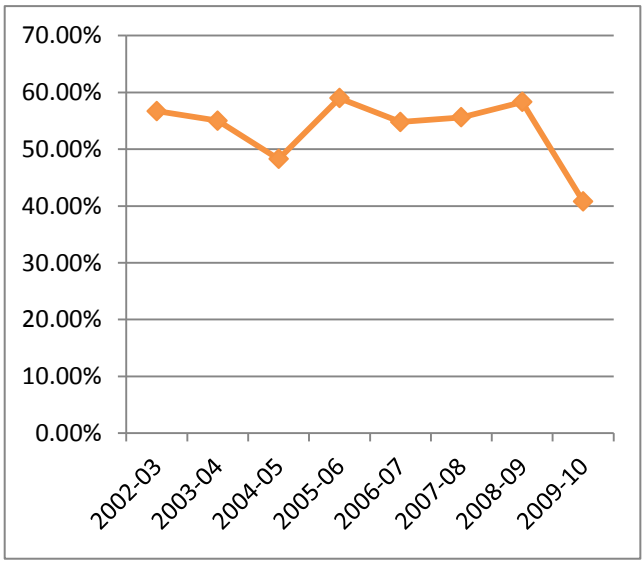
8.3.2. Poor Electricity Infrastructure

The installed transmission and distribution systems were designed for lower load carrying capacities. The repair and maintenance, and augmentation of capacity have not kept pace with the increasing demand, with the result that there is frequent breakdown of transformers due to overloading and higher transmission and distribution losses. The department has also not kept pace with the other states in terms of system modernization, which further affects management of electricity demand and supply.

8.3.3. High T&D losses

The Energy sector in the state has poor infrastructure and this is one of the main reasons for very high Aggregate Technical and Commercial (AT&C) loss. The transmission & distribution (T&D) losses estimated by the Nagaland Electricity Regulatory Commission (NERC) for the year 2009-10 are 40.77%, while the estimate of the Department of Power, Nagaland was 36.46%. As per the data of the Central Electricity Authority, the T & D Losses for the state in 2002-03 was around 56.71% which has now come down to 40.77%. Figure 24 gives an indication of the T & D Loss trends in the state, from 2002 till date. If commercial losses are also factored in, the total AT&C loss in the state will be around 60%, one of the highest in the country.

Figure 24: Trend of T&D Losses (in %age)



Source: Department of Power, Nagaland

8.3.4. Gaps in Management Systems

Sectoral reforms have not been attempted in the state, partly because of the apprehension about viability of independent generation, transmission

and distribution units. In addition to the inefficiencies in the transmission systems, the legacy management systems translate themselves into poor operation and maintenance of equipments, high commercial losses due to low metering/ billing/ collection efficiency, theft, pilferage and tampering of meters and absence of energy accounting and auditing. The innovative use of communitisation in the sector, using the single metering system in urban wards and villages is an improved management practice which may, perhaps, be part of a larger sectoral reform strategy.

8.3.5. Dependence on Traditional Biomass Energy

Traditional biomass is one of the predominant fuels in Nagaland particularly for cooking and heating purposes. The average family usage of firewood and wood chips for heating and cooking purposes is 63 Kg per month, 1.11 Kg of liquefied petroleum gas (LPG) and 0.13 Kg of Kerosene in rural households. In urban households too, fire-wood and wood chips is the dominant fuel for cooking and heating, with the total fire-wood consumption per month per household being around 20 Kg and 3 Kg of LPG.

8.3.6. Implementation constraints for central sector programs

The state, with limited resources of its own, is dependent of the centrally sponsored schemes for financing the development of the electricity sector. Some of the main implementation constraints cutting across all the concerned departments of the energy sector with regard to funding from the central Government arise out of limited flexibility to take into account specific requirements of the state. The unique land holding system in the state, where 90 percent of landholding is private, requires that land be acquired at market prices, which cost is not provided for in the schemes. The high transportation costs due to the remoteness and hilly terrain add upto 15-20 percent over and above the price benchmarks used by Government of India. These affect the programs of Ministry of New and Renewable Energy as well as of the Ministry of Power.

Also, being a hilly terrain with a relatively low solar insulation, particularly in winter months, the efficiency rate of some of the solar related application is lesser than what it would be in the Plains of India. Therefore, some of the existing schemes of the government where only "interest subsidy" is given as against "capital subsidy" will not be viable, as the "payback period" will be huge and people will not be able to afford it. Therefore, there needs to be special assistance given to North East States where in addition to "interest subsidy", "capital subsidy", also needs to be given to encourage people to go in for costlier renewable energy options. This is largely applicable to "solar thermal applications." The subsidy element for "individual bio-gas" plants needs to also go up, to encourage people to install biogas plants. Given the terrain of Nagaland, schemes which are aimed to strengthen electricity distribution networks need to be supported to a large extent through Central Government Schemes, as these would also be cost intensive.

8.4 Projected Impacts of Climate Change

8.4.1. Increased Energy Demand

The projected temperature rise for the various districts of Nagaland during the period 2021 – 2050 is 1.6°C – 1.8°C. It has been estimated that, with a 1°C ambient temperature rise, the consumption of electricity would increase by 9.2% of domestic consumption, 3% of commercial consumption and 2.4% of industrial consumption[41]. Based on the projected temperature, it is estimated that there would be approximately a 14-15% increase in electricity consumption in the state, due to temperature rise only. In the urban habitation of Dimapur, a temperature rise of 1.6°C is likely to lead to an increase in electricity consumption by 20% to 30% primarily due to increased use of cooling appliances and this trend is likely to be seen in all low altitude areas of Nagaland.

[41]http://www.ucdenver.edu/academics/colleges/Engineering/research/CenterSustainableUrbanInfrastructure/LowCarbonCities/Documents/Wing-tat%20Hung/WTHung%20energy%20consumption.pdf

Climate change may also usher more intense winters in some areas, though the spells may be shorter. However, considering that with the exception of the foothill areas, all the other regions of Nagaland experience peak winters; this may potentially lead to an increase in the use of room and water heating thereby increasing consumption even during winter.

The increased demand for energy in a climate change scenario accentuated by decreased supply may further put stress on the energy efficiency and accentuate the need for upgrading technology and management system in the energy sector.

8.4.2. Impacts on Electricity Supply

Climate change is projected to adversely impact the global hydrological cycle, affecting both ground and surface water supply[42]. This may result in reduced river yields. With the huge dependence on electricity generated from hydro-electric sources – the state faces a shortfall of upto 60 MW of peak demand during the lean season – the shortfall would be further aggravated.

This could lead to stress on the other sources of energy in the state mainly on fuel wood. Even at present, traditional bio-mass is one of the predominant energy sources in Nagaland particularly for cooking and heating purposes (refer above). It can therefore be assumed that in case of a decreased supply in electricity, forests would likely be most affected as it is the primary source of fuel/fire wood in the state leading to loss of carbon sinks which would further accentuate climate change.

8.4.3. Increased infrastructural vulnerability due to Climate Change

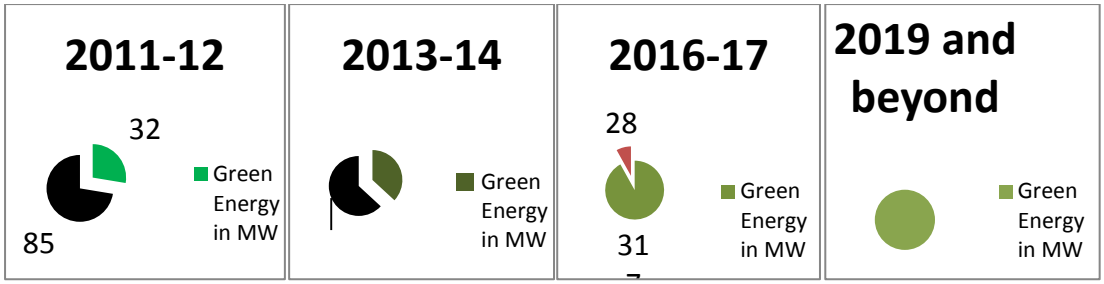
Climate projections forecast increased extreme events in the state. Such extreme events are likely to increase natural disasters such as landslides that could seriously affect the transmission and distribution infrastructure in the state, further increasing the stress on it due to absence of adequate technology and poor maintenance of equipment.

8.5 Strategies and Action Plan for Adaptation to Climate Change Effects

The vision of the Nagaland Government in the sector is to ensure energy access to all. Based on projections, it is estimated that the per-capita energy consumption will grow from the current level of roughly 240 kWh to at least 800 kWh by 2031. The connected load for industrial connection at the current level of less than five MW is projected to touch 110 MW by 2027, in keeping with the state's thrust on promoting small and agro-based industries.

Being a state with very little or no emission from the energy sector, the state envisages to continue to be "carbon neutral", despite the steep growth in energy consumption (Refer ***Annexure*** 9 for Supply and Demand projections). The state envisages to vigorously promoting Green Energy, which is a combination of energy efficiency, AT & C loss reduction and increased generation capacity through renewable energy (Refer ***Annexure*** 10 for future plans for Renewable Energy). By 2019-20, it is expected that the state will generate surplus green energy. The following graphs indicate the projections in case the strategy is followed.

[42] Fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC)



The strategies to increasing resilience of the state's energy sector lies in the up scaling of current programmes and activities along with new interventions. Some of the current programmes that needs up scaling are:

a) AT&C Loss Reduction Programme
b) Energy Conservation and Efficiency Programmes
c) Implementation of "sustainable habitat" programmes and putting in place legal framework for "green buildings".
d) Implementation of the Solar Mission.
e) Coordinated effort with the Green India Mission to reduce the use of traditional bio-mass for cooking and heating.
f) Strengthen Centre of Excellence on Renewable Energy Studies (CERES), Dimapur

New interventions that are envisaged are:

a) Renewed efforts to set up "decentralised renewable energy solutions," primarily through a combination of small hydro (Pico or mini or micro), solar, small wind generators and bio gas plants to ensure 24x7 clean energy supply at the village level. The current focus of either the Solar Mission or other renewable energy solutions is largely for "grid connected systems" whereas the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) does have schemes for decentralised distributed generation, which can be utilised for "energizing" Nagaland villages but requires certain flexibilities (allowing already electrified villages (but without adequate supply) to have their own decentralised systems.
b) Since Nagaland does not have adequate "electricity generation capacities" of its own, to meet the state's growing requirements, "renewable energy generation capacity addition" needs to be relooked at for the state and if required, "caps on generation capacities" needs to be removed to facilitate rapid expansion of renewable energy generation capacities.
c) Implement Renewable Energy projects addressing livelihood concerns, strengthening value chains of agriculture and other products.

The Adaptation Strategies have been selected keeping in mind the following broad parameters:

a) Increase generation capacity without compromising on environment issues, with a thrust given to decentralised renewable energy solutions.
b) Ensure that the dependence on the central grid for electricity needs is reduced gradually.
c) Project a demand growth which factors in possible increase in demand for electricity as an "adaptive measure" to address climate change.
d) Address the issue of "energy access" to people by providing them with "clean energy" and thereby reduce the unhealthy trend of dependence on "traditional bio-mass" for heating and improving efficiency and management of the energy sector.

Key strategies to be adopted by the energy sector are summarised in the table below:

Table 22: Key strategies for the energy sector in Nagaland

Issues of Concern from a Climate Perspective	Strategies	Activities to Address it
Increase in Energy Consumption	Promoting Energy efficiency and sustainable use of electricity at all levels and categories of usage	• Identifying and Converting the Lighting Devices in all key Government Buildings to Energy Efficient Lighting by 2015 • In a phased wise manner, converting all street and public lighting to LED Lighting • Energy Auditing of all Government buildings • Promotion of building star rating systems and incorporate building bye-laws for energy conservation • Program for awareness building on BEE star labelled appliances • Initiating and Implementing demo projects on energy efficiency in commercial sector • Reducing T & D Losses – Modernize substations, upgrade and replace old transformers, replace old transmission lines (including planned 220kV line), rationalising and strengthening the Billing system • Improving electrical infrastructure
Inadequate Electricity Supply	Enhancing domestic power generation and increasing resilience of the energy sector.	• Increase generation capacity • Maximizing the potential of community owned decentralized renewable energy option • Promotion of Small Hydro Projects • Promotion of Solar PV Projects • Promotion of biogas plants and manure management • Promotion of bio-mass gassifier projects • Identify wind potential sites and promote wind power

Issues of Concern from a Climate Perspective	Strategies	Activities to Address it
		• Prepare a master plan for all district HQs under the "Solar City project" • Incorporate measure to increase infrastructural resilience.
Impacts on natural carbon sinks	Reducing dependency on Traditional biomass energy	• Increasing de-centralized energy applications • Promotion of alternative sources of energy (refer Forestry chapter)
Strengthening Electricity Management structure	Limited unbundling	• Un-bundle distribution in Dimapur and Kohima.

8.6 Action Plan and Budget

(₹ In Lakh)

S.No.	Strategies & Activities	Budget (2012-17)	Funding Source	Implementing Agency
1	Strategy 1. Promoting Energy efficiency			
1.1	Activities under R-APDRP to reduce AT&C losses to 37%	53500.00	GoI (MoNRE, MoP), GoN, External Funding	Power department
1.2	Detailed mapping and auditing of all Government buildings for energy efficiency	50.00		The Electrical Inspectorate, Municipalities, Urban Development, NRE Department
1.3	Implementation of Energy efficiency in accordance to the Energy Conservation Act	500.00		
1.4	Conversion of street lights in Kohima, Dimapur and other district headquarters to LED lighting	100.00		
1.5	Conversion of 100 villages into 100 percent LED lighting	1400.00		
1.6	Incorporating principles of energy conservation in building code/bye laws and strengthening implementing institutions	50.00		
2	Strategy 2: Enhancing state's own power generation capacity			
2.1	Promotion of small hydro projects			
2.1.1	Detailed investigation and survey of 17 potential hydro sites.	500.00	GoI (MoP), GoN	Department of New and

2.1.2	Commissioning of 12 MW micro/ mini/ small hydro projects	20000.00		Renewable Energy
2.2	Commissioning and operationalising grid interactive solar PV & solar wind hybrid project- 10 MW & implement solar city project	22800.00	GoI, GoN, External Funding Agencies	Department of New and Renewable Energy
2.3	Promotion of biogas gasifier projects			
2.3.1	Commissioning & operationalising of grid interactive biogas gasification- 5 MW	300.00		Department of New and Renewable Energy
2.4	Large Hydro projects			
2.4.1	Commissioning of 186 MW hydro project at Dikhu (Rs. 1800 crore, State Equity - 24 percent, Acquisition of land costs)	50000.00	GoI, GoN	Power department
3	Strategy 3: Reducing dependency on traditional biomass energy			
3.1	Increasing de- centralised energy applications			
3.1.1	Solar water heater coverage of 1000 sq. m/ year with 100 litres system	500.00	GoI, GoN	Department of New and Renewable Energy
3.1.2	Increasing coverage of biogas programme from current level of 1000 household plants to 2500 household plants / year	1000.00	GoI, GoN	Department of New and Renewable Energy
3.1.3	Commissioning of 5MW off grid project under remote village electrification project	14500.00	GoI, GoN	Department of New and Renewable Energy
3.1.4	Development of pico hydro projects totalling 1MW	1500.00	GoI, GoN	NEPeD
	Total	166700.00		

Chapter 9

Urban Habitats and Transportation

9.1 Urban Habitats

Urbanization is an integral part of economic development. The trend of urbanization is likely to increase in the coming decades. Urban areas are also termed as engines of economic growth, contributing more than sixty percent of GDP nationally. In doing so, they also consume bulk of the energy produced in the country. Globally, urban areas also contribute more than three quarters of greenhouse gas emissions. Urban planners in the country have a huge task at hand of not only improving on their existing planning capacities but also to take on the challenges of improving the existing, deficient infrastructure and urban services, while absorbing and providing for the increasing inflow of population. Climate change can be an added impact, but provides opportunities, for example interventions aimed at reducing greenhouse gas emissions, etc. for higher levels of, greener and more inclusive economic growth due to co-benefits of energy efficiency, improvement in public health, etc. Having said that, however, urban populations, especially the urban poor, have a higher risk in terms of impact on people and assets. Climate Change is likely to accentuate the vulnerability of urban infrastructure thereby further deteriorating quality of urban life, and is likely to exacerbate the frequency and intensity of hydro-meteorological disasters and can add new disaster risks. The greening and containment of electricity consumption has been dealt comprehensively in a separate chapter. The present chapter deals with the other aspects of urbanisation and climate change, including urban transport. The chapter also draws from the key strategy identified by the State Government, of developing the foothill corridor from Dimapur to Tizit through a series of urban habitations to encourage migration of population from the interior, rural areas.

9.2 Key Urban Growth Indicators

9.2.1. Urban Habitations in Nagaland

The state of Nagaland has seen rapid urbanization since attaining statehood. From only one town in 1951, three till 1980, seven in 1991, eleven in 2001, the number has risen to 19 statutory towns and 6 census towns in 2011 (Census 2011). Further, there has also been a change in the grade of towns, with towns being upgraded from Grade V to Grade IV and from III to II and even from II to I, indicating the rapid urban growth.

Table 23: List of 19 statutory towns and 7 Census towns of Nagaland

Kohima	Dimapur	Mokokchung
Tuensang	Mon	Wokha
Zunheboto	Phek	Kiphire
Longleng	Peren	Jalukie: Peren
Naginimora: Mon	Pughoboto: Zunheboto	Tseminyu: Kohima
Medziphema: Dimapur	Mongkolemba: Mokochung	Pfutsero: Phek
Chentongya: Mokokchung	Alichen: Mokokchung	Impur: Mokokchung
Aghunato: Zunheboto	Tizit: Mon	Bhandari: Wokha
Tuli: Mokokchung	Akuluto: Zunheboto	

Source: Provisional Census 2011, Census of India

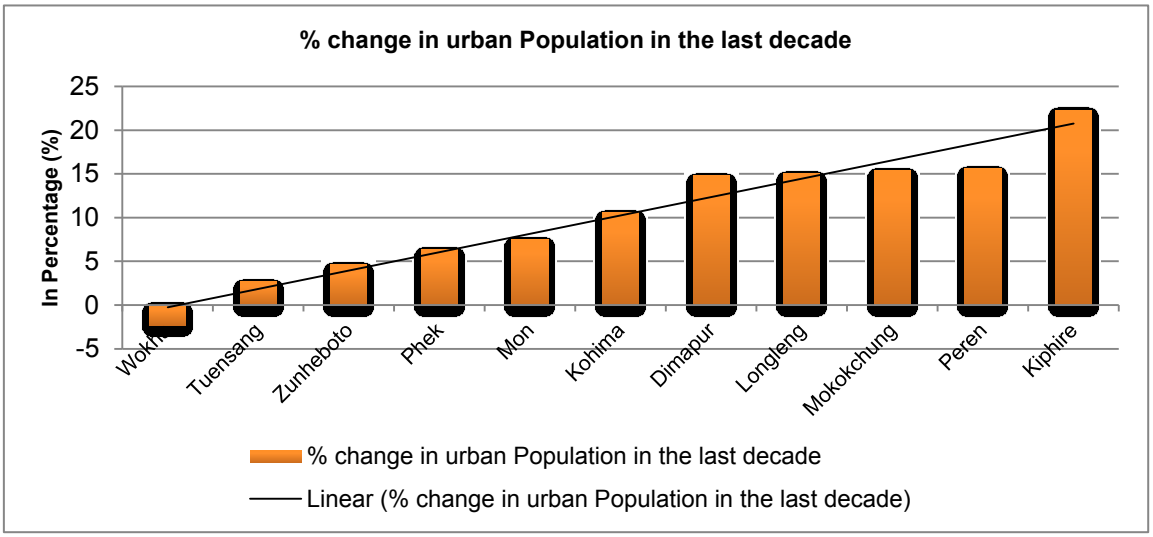
As per the provisional population figures from 2011 Census, the total population of the state stood at 19,80,602. Of this the urban population stands at 5,73,741. Dimapur district has the highest urban population of 1,97,277, comprising of 34.8 percent of the total urban population of the state. The lowest urban population of just 7,609 is in Longleng district, accounting to just 1.33 percent of the total urban

population of the state respectively. The urban population percentage for Nagaland stood at 17.23 in 2001, and has gone up to 29 percent in 2011.

Table 24: District-wise Urban Population as per 2011 Provisional Census

Sl No.	District	Total Population	Urban Population	% Urban Population
1	Mon	250671	34717	13.8
2	Mokokchung	193171	55652	28.8
3	Zunheboto	141014	27610	19.6
4	Wokha	166239	34993	21.0
5	Dimapur	379769	197290	52.0
6	Phek	163294	24608	15.1
7	Tuensang	196801	36841	18.7
8	Longleng	50593	7609	15.0
9	Kiphire	74033	16495	22.3
10	Kohima	270063	123149	45.6
11	Peren	94954	14803	15.6
	Total	1980602	573767	29.0

Figure 25: Urban population growth in Nagaland

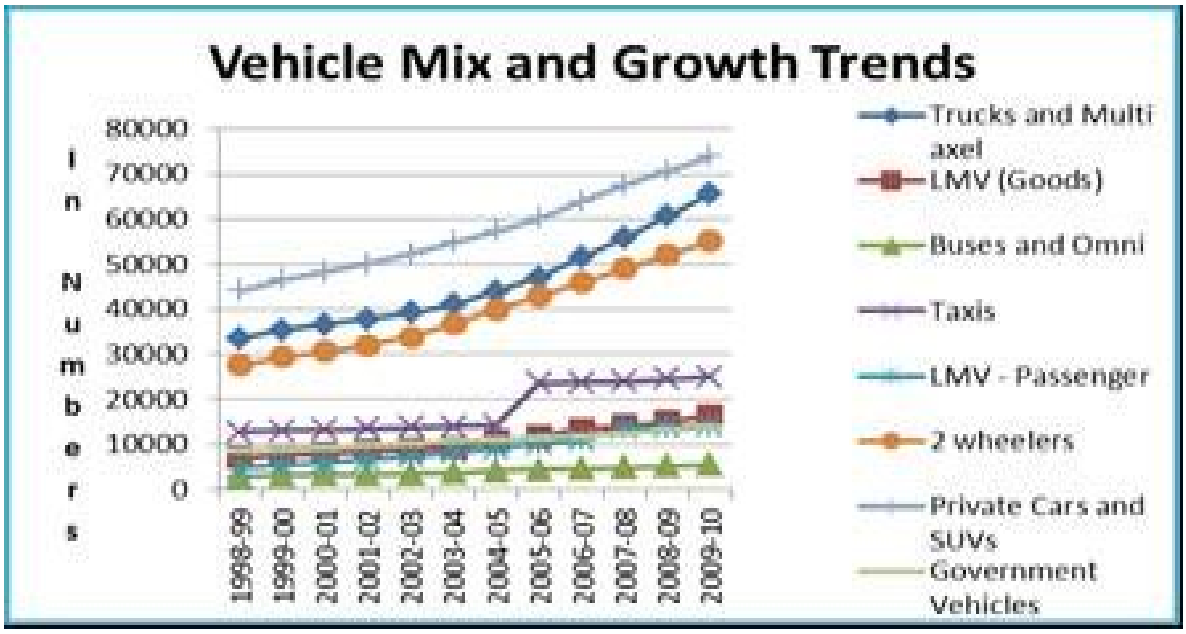


As can be seen from *Figure* above, with the exception of Wokha, all the other districts saw an increase in the urban population in the last decade, with the increase ranging from 2.71 percent to a high of 22.28 percent in Kiphire.

9.2.2. Urban Vehicular Growth

The transport sector of the state has also seen a substantial growth in the last decade, particularly with an increase in personal transport. The average growth rate of the vehicle population of Nagaland has been in the region of 5-7% in the last decade. One of the most glaring features in the transport sector is the substantial growth of the personal vehicle segment. Figure below clearly indicates that the fastest and the highest growth rate is of private cars and SUVs, with heavy vehicles also having a steady and high growth rate along with 2 wheelers. The growth rate for cars has been in the region of 5% per annum for the period of 1998-99 to 2009-10, with the growth rate for the years 2008-09 and 2009-10 being in the region of 7% per annum. This trend is similar for 2 wheelers.

Figure 26 : Vehicle Mix and Growth



Kohima and Dimapur have the highest vehicle population. 35 percent of all vehicles registered in Nagaland are in Dimapur district, with Kohima having 29 percent and Mokokchung having 18 percent of all vehicles. Only Kohima, Mokokchung, Wokha and Tuensang have limited town bus service, whereas Dimapur relies mainly on privately operated auto-rickshaws.

In terms of road network, most of the town roads are narrow. The average carriageway available is 3.0 to 5.5m which is further decreased by the unauthorized use of the roadsides and kerbs by hawkers, vendors, and shopkeepers, with the exception of highways. The major highways that run through Nagaland are NH 36, NH 61 and NH 150 and NH 155.

9.3 Urban Governance and Institutional Arrangements

The Nagaland Municipal Act, 2001 replaced the vintage Assam Town Committee Act, 1956 with a view to delegate greater responsibilities to urban local bodies. Subsequently, the Urban Development and Municipal Affairs department was separated and entrusted with the responsibility of overseeing the development and governance affairs of the urban areas. Three Municipal Councils and sixteen Town Councils have been formed under the Act.

Delegation of responsibilities, entrustment of adequate financial resources and empowerment of the municipalities is still in an evolutionary mode, and the traditional departments of PHED, PWD, School Education, Health & Family Welfare, etc. continue to maintain the urban infrastructure and provide

services to the urban population. For example, PHED is entrusted with the task of ensuring water supply, maintenance of sewerage and storm water system, the Town Planning Department, the Public Works Department (PWD) is responsible for road maintenance. Municipalities primarily regulate commercial areas, manage sanitation and solid waste, and to a certain extent are involved in development and maintenance of public amenities such as parks, etc.

The Municipalities are dependent on grants and transfers from the state and central government for its development functions, though Dimapur, Kohima and Mokokchung are able to meet expenditure on account of its limited manpower. JNNURM, Swarna Jayanti Shahari RozgarYojana (SJSRY), Integrated Development of Small and Medium Towns and JNNURM are the major centrally sponsored schemes, and financing sources, for the development and employment programs in the urban areas in the state. The ADB is assisting the creation and improvement of infrastructure in Kohima town as part of its Northeaster region project.

9.4 Broad Concerns & Existing Vulnerabilities in the Urban Habitats

On the one hand, increasing population has been putting stress on urban infrastructure and services, the urban institutions have not been able to cope with this stress owing to inability to modernise, mobilise revenues, and inability to put in place effective regulations. Some of the key challenges faced are explained below. Population growth, with the total population projected to reach nearly 35 lakh by 2031, 40 percent of which is likely to be will be living in urban areas with the maximum migration to Kohima and Dimapur towns, implying a near 3 fold increase in urban population, could further multiply the challenges in urban centres.

9.4.1. Water Supply

The public water supply of most towns in Nagaland is met through surface water, mainly rivers, streams and springs. Public water supply is inadequate and spatially restricted[43], with availability limited at best to 30 lpcd. In Dimapur, Ring Wells are used to access ground water but lack of sewerage system poses high risk of contamination of these sources. Unregulated access may also lead to severe decline in water table.

In Kohima and other towns, there are private water suppliers, who own natural streams and springs and distribute through their own water lines. There is a high seasonal variation in availability of water in Kohima and other hill towns, with water aplenty during the monsoon period from May to September, as the state receives about 1800-2250mm of rainfall during this period but severe scarcity during the lean season between October to April.

9.4.2. Sewerage and Sanitation, Solid Waste Management

At present none of the towns in Nagaland have proper sewerage[44]/waste water management systems or systematic and scientific mechanisms for addressing solid waste. Sanitation is through septic tanks (there is still prevalence of open defecation as well) and pit toilets. Even these do not have functional soak-pits. Untreated wastewater is thus allowed to flow into natural water systems such as river, rivulets, streams or springs and the waste water from kitchen is allowed into storm water drains, which in turn flows into the natural water system, leading to pollution of water bodies.

With a total urban population of 573,767 in Nagaland and with an average generation of 0.39 Kg per capita waste generation per day, the total waste generation in urban centres in Nagaland would

[43] PHED caters to around 32280 persons out of 116,837 persons in Kohima area. The remaining are dependent on private sources. In Dimapur, PHED caters to about 20 percent of the population.

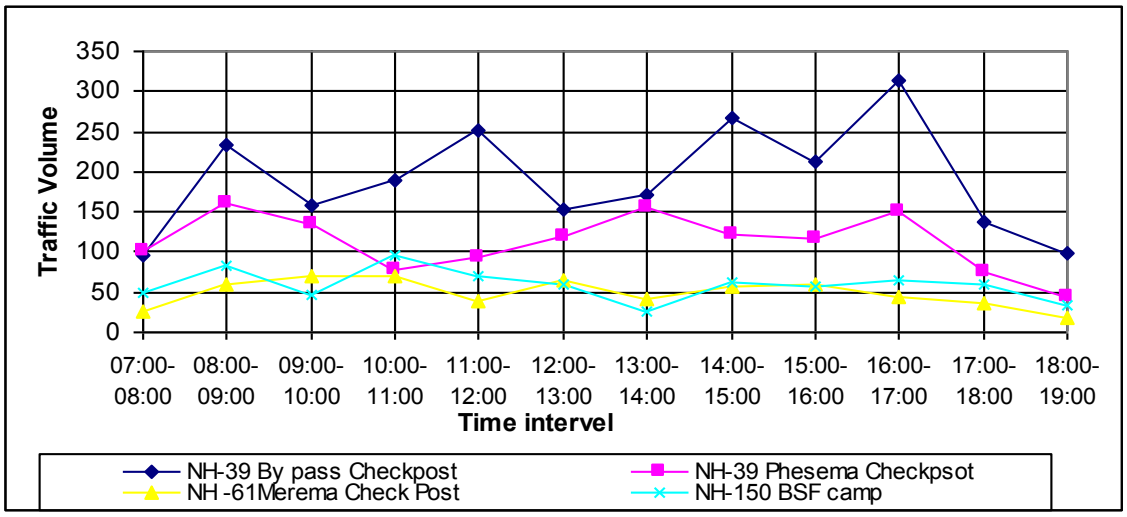
[44] Kohima has no sewerage system, except in one Block, which is built and operated by the community.

approximately be in the region of 223 tonnes every day or 81,395 tonnes every year. The local bodies are estimated to have the capacity to cater to only about 30-40 percent of the waste generated. The collected waste is also disposed off without treatment.

9.4.3. Transportation and Road network

Poor or lack of public transport, increasing number of personal vehicles, narrow roads with limited scope for expansion, absence of parking areas in most towns of Nagaland, the lack of adequate traffic management systems, and virtual non-existence of foot paths/pedestrian pathways have made traffic

Figure 27: TIme wise, traffic volume chart at busy junctions of Kohima



congestion and snarls a common feature in Kohima and Dimapur towns. Figure 27 gives an indication of the traffic congestion at varying points of time at key junctions of Kohima.

Based on information collected from petrol bunks, it has been estimated that annual consumption of 730,000 Kilo litres diesel and 492,750 kilo litres of petrol was consumed in Nagaland in 2010, bulk of it in Dimapur and Kohima. The average carbon emission per litre of diesel is 2.68 Kg and that of petrol is 2.34 Kg. Vehicular air and noise pollution is also an added concern, with above normal levels continuously recorded in Dimapur and Kohima towns for the past 2-3 years[45].

9.4.4. Drainage, Landslides and Inundations

Absence of drainage systems[46] is a serious issue to be addressed in all towns. While their absence leads to serious inundations leading to loss of property, assets and disruption to economic activities in Dimapur, in Kohima and other hill towns, it is a cause of soil erosion, landslides and major damage to roads. Lack of maintenance, choking due to waste disposal, and encroachments are also serious causes of concern for drains, where they exist.

9.4.5. Governance Systems

Unlike rural counterparts in the state, which have a strong history of effective local governance, the governance systems in urban areas are still in an evolutionary stage, with the traditional systems breaking down or becoming less relevant while the modern systems are yet to take root.

9.4.6. Cross cutting issues – Energy Access & Environmental Health

Increasing urban population and deteriorating infrastructure, and deteriorating air and water conditions have cross-cutting impacts. These have been dealt in the relevant sectors.

[45] Nagaland Pollution Control Board.

[46] Though Kohima has numerous drains, they are in a dilapidated state or choked with solid waste.

9.5 Projected impacts of climate change in Urban Habitats

Climate change, due to its likely adverse impact on agriculture and natural resource based rural livelihoods, may increase the rate of migration from rural to urban areas, thus increasing stress on the already stressed urban infrastructure and services and increasing urban sprawl, implying increase in consumption of energy consumption and increased greenhouse gas emissions. Increasing population influx in the urban centres means enhanced waste generation thereby leading to health hazards, soil contamination through leaching, odour pollution. Transport system congestion due to increasing vehicular population and non implementation of pollution norms further exacerbate climate change through higher GHG emissions and also contribution to the overall congestion in urban centres.

Climate change projections of increasing warm and humid summer and cold winters would mean increasing energy demand for cooling and heating respectively. Projections of heavy and aberrant precipitation would mean increased storm-water runoff exerting heavy pressure on the weak drainage and sewerage system, and leading to landslides and inundations. Generally, water vulnerability has increased over Nagaland. In climate projections for the near-term future, districts of Wokha, Mokokchung, Mon, Tuensang and Zunheboto exhibit very high- high vulnerability, while the water vulnerability of Kohima remains moderate and the water vulnerability of Phek remains low. This increased water vulnerability is mainly attributed to decrease in rainfall and water yield. Water availability will be a major issue in almost all towns of Nagaland.

9.6 Strategies and Action Plans for Adaptation to Climate Change Effects

9.6.1. Strategies for adaptation to water stress

To adapt to water stress, basin level management strategies have to be put in place to deal with variability in rainfall and river flows due to climate change. This will include creation of enhanced storage both above and below ground, rainwater harvesting coupled with equitable and efficient management structures.

Strategy 1: Storing Excess Water

The actions required to implement this strategy are:

1. Documenting water resources all across Nagaland towns and cities: Train departmental personnel and communities to understand and document geo-hydrology of their respective localities in urban centres and map all springs, identify their sources, demarcate the spring recharge zones and map natural lakes and ponds. This is particularly important in the urban context, since bulk of the supply comes from springs and natural sources of water and most of them are privately owned.
2. Increasing storage capacity by building reservoirs for drinking water in urban areas: Increase in storage capacities needs to have a two-fold approach. One is to build reservoirs for drinking water in all urban centres and two simultaneously promote roof top water storage and harvesting in all households in urban centres.

Strategy 2: Efficient Demand Side Management

This strategy aims at an integrated water resource management helping to conserve water, minimize wastage and ensure more equitable distribution both across and within states. It also envisages taking into account the provisions of the National Water Policy that aims to develop a framework to optimize water use by increasing water use efficiency through regulatory mechanisms with differential entitlements and pricing. It further seeks to ensure water needs of urban areas through recycling of wastewater.

The following are the actions that are required to be taken under this strategy

1. Piped Drinking water facility to all Urban Households:

Piped drinking water supply with very limited coverage is only provided in some towns. This has led to indiscriminate use of water from streams, springs, and other natural water bodies. With the intention of minimizing the indiscriminate use of water, piped water supply to all urban households in the immediate phase and all households of Nagaland in the next phase is proposed. This would also facilitate in introducing water use efficiency in all households. However piped drinking water facility will have to be integrated with water treatment and recycling facility.

2. Enhance water use efficiency in urban households:

Limited urban areas are being metered to regulate water use efficiency in the state. Also water tax is being levied from consumers in accordance with the Nagaland W/S Consumers Rules 1998 and rates are revised from time to time. However, the charges levied are nominal and fail to deter wastage of water. A systematic evaluation of options for efficient pricing of water as a commodity especially by urban users may help in sustainable utilisation of water. Additionally, regulation of water use in the lean period for agriculture is also envisaged.

3. Reutilization of domestic waste water in lean period in urban households:

The feasibility of wastewater utilisation in towns for sanitation purposes is proposed to be assessed.

4. Detailed mapping exercise to assess water requirements for the urban sector between now and 2050:

A study needs to be carried out to understand the likely increase in demand of water in urban centres for effective planning of the supply side management for the base line (current climate) and in the future climate scenario.

9.6.2. Strategies for Sewerage, Sanitation, Storm Drainage, Landslip Management and Solid Waste Management:

Strategy 1: Create/Strengthen Sewerage and Sanitation System in Nagaland:

The JNNURM and the ADB assisted North Eastern Region Urban Development Programme (NERUDP) provide support to states to ensure that the vision of the National Urban Sanitation policy is met. The strategy is to further upscale activities already being undertaken. The key actions for the strategy include,

1. Awareness generation, capacity building of institutions,
2. Capacity building of institutions
3. Building, strengthening of a sewerage system and reaching out to uncovered areas
4. Provide Public toilets to prevent open defecation
5. Introduction of treatment plants before sewerage discharge into rivers

Strategy 2: Comprehensive Plan for Rain Water Drains and Drainage Zone

The National Disaster Management Authority (NDMA) has guidelines for a comprehensive plan for rainwater drains and management and creation of drainage zone. The JNNURM and the NERUDP provide support to states for taking appropriate actions as recommended by the NDMA Guidelines. Nagaland already has a State Disaster Management Agency mandated to undertake such activities. The actions proposed are:

- Comprehensive mapping of all drains and assessment of their capacities and strengths
- Arrest flash floods by (i) Improving and installing drainage system in towns in plains to deal with drainage of flash floods in the southern part of the state: This will entail constructing drainage systems where it does not exists and improving drainage systems where it is not fully effective (ii) Undertaking works for stream training, river training and Anti-erosion works in identified areas as per climate projections.

- Ensure the separation of rain water drains and sewerage and sanitation systems to prevent contamination of water.
- Rain water harvesting for not only water storage but to prevent excess water flow into rainwater drains.
- Identifying drainage zones, demarcating them to ensure that these zones are not encroached upon and strengthen the areas if required to prevent landslips.

Strategy 3: Comprehensive Landslip Management and Zoning Plan Identifying Vulnerable Zones

The NDMA has come up with clear guidelines for a comprehensive plan on Land Slip management and creation of zones. The JNNURM and the NERUDP provide support to states for taking appropriate actions as recommended by the NDMA Guidelines. The State Disaster Management Agency has already undertaken mapping of some landslip prone areas in the states. This activity is proposed to be further extended to cover the entire state. Some of the actions that are proposed are:

- Inventorisation of all Landslip prone areas
- Building Bye-Laws to ensure compliance of building regulation in sensitive zones

Strategy 4: Comprehensive Solid Waste Management Plan

The actions proposed under this strategy are:

- Initiate house to house waste collection with source segregation;
- Promote recycle of plastic wastes
- Regular maintenance of the container bins;
- SWM coverage areas to be increased
- Adopt segregation of biomedical waste from municipal solid wastes

9.6.3. Strategy to Integrate Climate Change Concerns in Planning for Disaster Preparedness

The following action are proposed for preparedness in the event of disasters due to climate change

- Undertake training of disaster management officials and develop manuals for action to be taken during a disaster
- Preparation of a detailed plan for disaster preparedness and management which will be in tandem with the town master plan and building bye laws.

9.6.4. Strategies to address Vehicular GHG emissions

Vehicular emission is one major source of pollution as there is no significant industrialization. The steady increase in number of vehicles in the state is contributing to the deterioration of ambient air quality. Statistical data for the past 12 years show continual trend of increase in vehicular population. In the absence of major industries in the state, vehicular emission is likely to be the biggest contributor of GHG in the state. The following strategies have been identified to address the issue:

Strategy 1: Improve Public Transport Systems in All Urban Centres

The actions that are proposed are:

- Capacity enhancement of existing public transport system by adding to transport infrastructure
- Build parking lots in central business areas to reduce traffic congestion

Strategy 2: To Promote Alternative Transportation in All Towns

The actions that are proposed are:

- Creation of pedestrian pathways and cycle pathways to promote non-motorised transport within urban areas
- Prohibit encroachment of common spaces (footpaths) to facilitate pedestrian movement

- Convert the Government staff bus/s operating from the new secretariat to Kohima city into battery operated bus on a pilot basis

Strategy 3: Plan new Townships in the foothills and Self-Sufficient Satellite Townships

- Plan for and develop the foothills from Dimapur to Tizit as an urban corridor.
- Plan for new satellite townships to ease population pressure on urban centres.

Strategy 4: Implement strict pollution control norms

- Adopt Euro IV emission standards for private cars

9.6.5. Strategies for Sustainable Urban Planning and Promotion of Sustainable Growth of Towns:

The guidelines for scheme for Urban Infrastructure very clearly underline the need to develop sustainable urban infrastructure and identifies the following as key priorities that need to be addressed:

- Rectifying unplanned and haphazard growth to the extent possible by
- Introducing mandatory planning tools such as Master Plans, Building bye laws etc.
- Building capacities for creating master plans, building byelaws, in planning for city/town development, implementing programmes, and revenue connection of Municipal bodies.
- Reducing urban sprawl and planning for compact cities

Strategy 1: Introduction of Appropriate Land Management Practices

The actions that are proposed are:

- Preparing Master Plans for all towns (or updating them in the case of the Comprehensive Development Plan for Kohima), with zoning identifying vulnerable areas to natural disasters
- Introducing building bye laws
- Promote avenue plantations and establish urban green lungs such as parks.

Strategy 2: Decentralization of Urban Functions to Local Bodies

- Building capacities of Municipal bodies

9.7 Action Plan and Budget

(₹ In Lakh)

S.No.	Strategies & Activities	Budget (2012-17)	Funding Source	Implementing Agency
1	**Strategies for adaptation to water stress**			
1.1	Storing Excess Water			
1.1.1	Building of storage capacities through reservoirs in the district head quarters	10000.00	GoI (National Water Mission, JNNURM), GoN	PHED
1.1.2	Assessment of demand of water by sector in current and climate change scenario and identify potential water sources for supply			
1.1.3	Augmenting water supply from the various sources of water to each of the districts by identifying other sources of water supply: Mapping of other sources of water supply			

1.2	Efficient demand side management			
1.2.1	Increase the coverage of piped drinking water to all urban households of Dimapur and Kohima	2500.00	GoI (National Water Mission, JNNURM), GoN	PHED
1.2.2	Initiate metering of supply to all connections with rationalization of tariffs			
1.2.3	Initiate feasibility studies to set up waste water recycling and supply to urban households for sanitation purposes			
1.2.4	Assess feasibility for reutilization of domestic wash water			
2	**Strategies for Sewerage, Sanitation, Storm Drainage, Land Slip Management and Solid Waste Management**			
2.1	Create/Strengthen Sewerage and Sanitation System in Nagaland			
2.1.1	Awareness generation campaign on the need for sanitation	15000.00	GoI (National Water Mission, JNNURM), GoN	Municipal & Town Councils, PHED
2.1.2	Capacity building of institutions to implement sanitation programme			
2.1.3	Building, strengthening of a sewerage system to start off in Kohima and Dimapur			
2.1.4	Provide public toilets to prevent open defecation in Kohima and Dimapur			
2.2	Comprehensive Plan for Rain Water Drains and Drainage Zone			
2.2.1	Comprehensive mapping of all drains and assessment of their capacities and strengths	10000.00	GoI (National Water Mission, JNNURM), GoN	Municipal & Town Councils. Urban Development Department
2.2.2	Improve and install drainage system in Kohima and Dimapur			
2.2.3	Undertake works for stream training that are emanating from springs, river training and Anti-erosion works in identified areas as per the climate change projections (refer Water resources chapter also).			
2.2.4	Ensure the separation of rain water drains and sewerage and sanitation systems to prevent contamination of water			
2.2.5	Compulsory rainwater harvesting for all public buildings.			
2.3	Comprehensive Landslip Management and Zoning Plan Identifying Vulnerable Zones			
2.3.1	Inventorisation of all landslip areas of all towns of Nagaland	200.00	GoI (JNNURM), GoN	NSMDA, Urban Development
2.3.2	Implement Building Bye-Laws to ensure compliance of building regulation in sensitive zones in all towns			

2.4	Comprehensive Solid Waste Management Plan			
2.4.1	Initiate house to house waste collection with source segregation;	5000.00	GoI (JNNURM), GoN	Municipal & Town Councils
2.4.2	Promote recycle of plastic wastes			
2.4.3	Regular maintenance of the container bins;			
2.4.4	SWM coverage areas to be increased			
2.4.5	Adopt segregation of biomedical waste from municipal solid wastes			
3	**Strategy to Integrate Climate Change Concerns in Planning for Disaster Preparedness**			
3.1	Undertake training of disaster management officials and develop manuals for action to be taken during a disaster	10.00	GoI (NDMA), GoN	NSDMA
3.2	Preparation of a detailed plan for disaster preparedness and management which will be in tandem with the town master plan and building bye laws.	40.00	GoI (NDMA), GoN	NSDMA, UD (Town Planning)
4	**Strategies to address Road Congestion, Traffic Management and Transportation**			
4.1	Improve Public Transport system in all Urban Centres			
4.1.1	Capacity enhancement of existing public transport system by adding to transport infrastructure - Introduction of Energy efficient, Green, Public buses in all major towns	7500.00	GoI (JNNURM), GoN	Municipal & Town councils, Transport Department, Urban Development
4.1.2	Build parking lots in central business areas to reduce congestion			
4.2	To Promote alternative transportation in all Towns			
4.2.1	Creation of pedestrian pathways and cycle pathways to promote non-motorised transport within urban areas	1000.00	GoI (JNNURM), GoN	Municipal & Town councils, Transport Department, Urban Development
4.2.2	Prohibit encroachment of common spaces (footpaths) to facilitate pedestrian movement			
4.2.3	Convert the Government staff bus/s operating from the new secretariat to Kohima city into Battery operated bus on a pilot basis	10.00	GOI(MoNRE), GoN	NRE, UD, Transport
4.3	Develop Self-Sufficient Satellite Townships			
4.3.1	Plan and develop urban corridor from Dimapur to Tizit	30000.00	GoI, GoN	PWD, Urban Development, Planning Deptt.

4.3.1	Plan and build new satellite townships near Kohima and Dimapur	3000.00	GoI, GoN	Urban Development, Planning, PWD Deptt
4.4	Implement strict pollution control norms			
4.4.1	Adopt Euro IV emission standards for private cars	10.00	GoN	NPCB, Transport Department
5	**Strategies for Sustainable Urban Planning and Promotion of Sustainable Growth of Towns:**			
5.1	Introduction of Appropriate Land Management Practices			
5.1.1	Preparing/Updating Master Plans for all towns (or updating them in the case of the Comprehensive Development Plan for Kohima), with zoning identifying vulnerable areas to natural disasters	500.00	GoN	Municipal & Town Councils, UD (Town Planning)
5.1.2	Introducing building bye laws			
5.2	Decentralization of Urban Functions to Local Bodies			
5.2.1	Building capacities of Municipal bodies	50.00	GoN, GoI (JNNURM)	Municipal & Town Councils, UD (Town Planning)
	Total	**83820.00**		
	(Rupees Eight Hundred Thirty Eight Crore and Twenty Lakh)			

Chapter 10

Health

Climate impacts human health both directly as well as indirectly and climate change can exacerbate some of the impacts that may affect the basic requirements for maintaining health, clean air, water, sufficient food and adequate shelter.

Climate though is the underlying driver for climate sensitive diseases, the socio economic parameters driven by different developmental paradigms, including types and level of interventions such as management of the disease source, the advancing medical science and pharmacology determine the level of occurrence and spread of diseases, masking the climate driven nature of the diseases. However, socio-economic drivers notwithstanding, projected climate change threatens to slow, halt or reverse the progress that the public health community is now making against many of these diseases.

Adaptation to climate change therefore is necessary and needs to take place at the physiological, behavioural, social, institutional, and organizational scales facilitating implementation of adaptation at temporal and spatial scales. Taking adaptation steps now to adjust to current climate variability and modifying existing programs to address the anticipated impacts of climate change will make future adaptation strategies more effective (Ebi et al. 2006). In order to design actions for adaptation, it is necessary therefore to take (a) Advantage of the already ongoing public health responses to climate change impacts, (b) Develop baseline understandings of the demographic, social and ecological determinants of health, (c) Assess the baseline prevalence of climate-sensitive diseases, (d) Assess existing infrastructure, available public health services, and autonomous responses to climate impacts on health and (e) Identify the vulnerable communities/section of societies.

10.1 Health Status – Key Indicators

With a population of 1.98 million in 2011, Nagaland has shown a negative decadal growth rate of minus 0.47 as opposed to a positive 17.4 for India[47]. Other key indicators such as birth and death rates, total fertility, and infant mortality indicators are well below the national averages.

Table 25: Demographic, health and socio-economic statistics of Nagaland

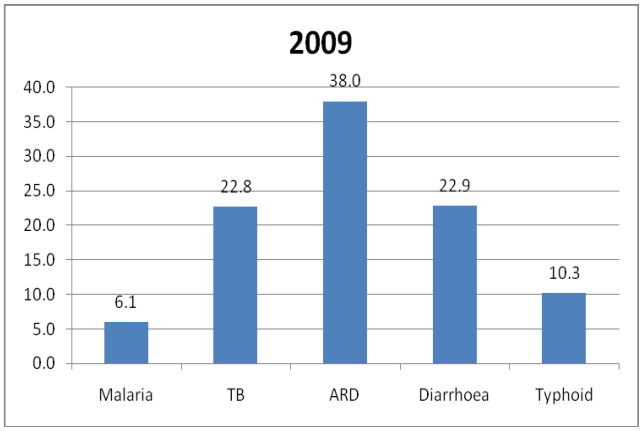
Item	Nagaland	India
Total population (2011- in million)	1.98	1210.19
Decadal Growth (Census 2011) (%)	-0.47	17.64
Birth Rate (SRS 2011)	17.2	22.5
Death Rate (SRS 2009)	3.6	7.3
Total Fertility Rate (2009-NFHS-3)	3.7	2.6
Infant Mortality Rate (SRS 2011)	26	50
Maternal Mortality Ratio (SRS 2004 - 2006)	NA	254
Sex Ratio (Census 2011)	931	940
Population below Poverty line (%)	32.67	26.10

[47] The population figures from the 2001 Census were disputed and may not accurately reflect the State's population. It may be appropriate to take the 1991 Population figures for computation of decadal growth, which gives a figure of 24.96 per cent.

10.2 Trends of Climate Sensitive Diseases in Nagaland

Climate change impacts infectious disease dynamics, and thereby impacts risks to human health indirectly. Vector borne, water borne, tuberculosis, and respiratory diseases are likely to be impacted due to climate change. As of 2009, the total cases reported for these diseases in Nagaland was 140,277 (Figure 28), Acute Respiratory Diseases being the largest cause of morbidity in the state.

Figure 28 : Percentage of cases detected in Nagalnad under different climate related diseasese category



Amongst all the vectors, malaria is endemic in the state. The prevalent mosquito species causing malaria in Nagaland are *Anopheles diurus, anopheles minimus*, and *anopheles stephensi*. *Anopheles stephensi* is present throughout the year; therefore some cases of malaria are also reported in winters. Dengue and Japanese Encephalitis (JE) has made recurrence in the state off and on. Other vectors, namely, Filaria, Kala-azar, and Chikungunya though not endemic in the state, are showing signs of emergence in recent years. Scrub typhus has also been detected.

10.2.1. Malaria

The average temperature ranges offered by Nagaland between Jan to Dec is around 15°C to 25°C, which is an optimal window of transmission for most malaria vectors[48]. The incidence of malaria has shown a marked increase during the period 2005-2010 as compared to the period 2001-2005 (*see Figure* 29). The increase in the later period may be partly attributed to better surveillance since 2005. The districts of Dimapur, Mokokchung, and Wokha report consistently higher incidence over the years. Further, except for the districts of Kiphire and Longleng, the remaining nine districts of Nagaland showed a declining trend of malaria in 2010. The urban area of Dimapur shows a decreasing trend in malaria cases since 2009, though the Pf percentage has risen sharply from 27.62 percent to 72.37 percent during the period 2001-2010. This has a deleterious implication on the morbidity. The mortality associated with malaria in Dimapur on an average varies between 30-80 percent of the total mortality in the state.

Figure 29 also shows the malaria spread in Nagaland in 2010. As can be seen, the spread of malaria is primarily along the foothill areas bordering Assam, but over the years the endemicity has spread over the interior, hilly regions of the state.

10.2.2. Dengue and Chikungunya

Dengue[49] has been generally found in the district of Dimapur, even in the early 1980s. Actual numbers of occurrence are only available from 2005 with the data available from the Integrated Disease Surveillance Program (IDSP). The IDSP reports 16 and 25 +ve cases in 2008 and 2010 in Nagaland. The only case of Chikungunya[50] detected in Nagaland in 2010 has been of an affected person, who had migrated from Assam. In 2011, an epidemic of Chikungunya was reported in Karbi and Anglong Districts of Assam and Nagaland has been alerted already about the danger of its spread into the state.

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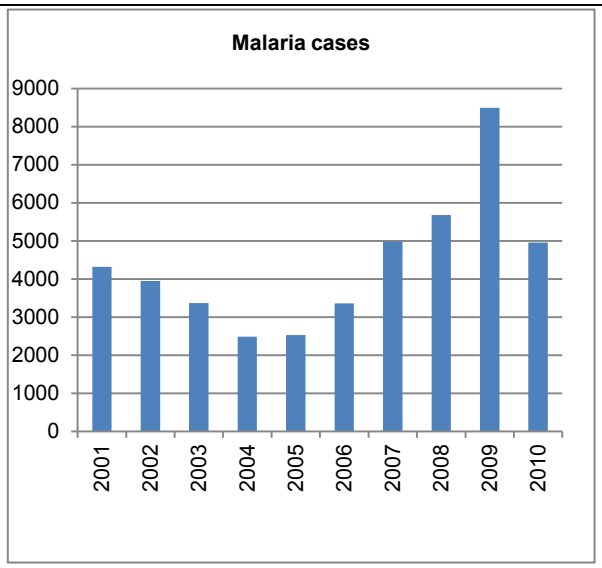
[48] Malarial parasites develop into mosquito between 14°C to 40°C and when relative humidity in the air is equal or greater 55 percent.

[49] Dengue is a self-limiting viral disease, caused by the bite of infected Aedes egypti mosquitoes.

[50] Chikungunya is a viral illness that is spread by the bite of infected mosquitoes. The disease resembles dengue fever, and is characterized by severe, sometimes persistent, joint pain (arthritis), as well as fever and rash.



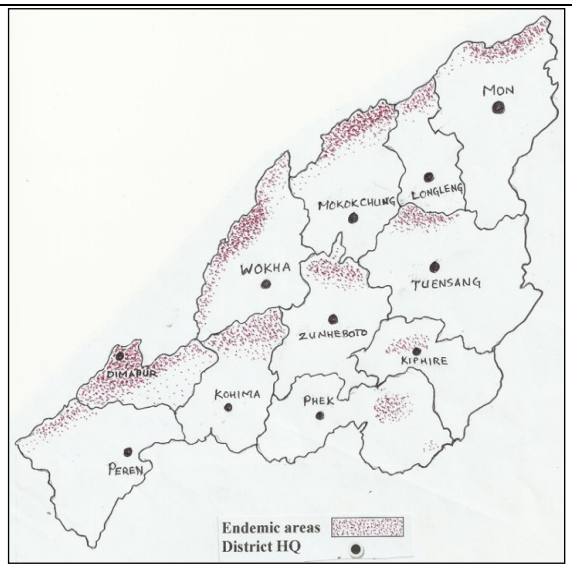
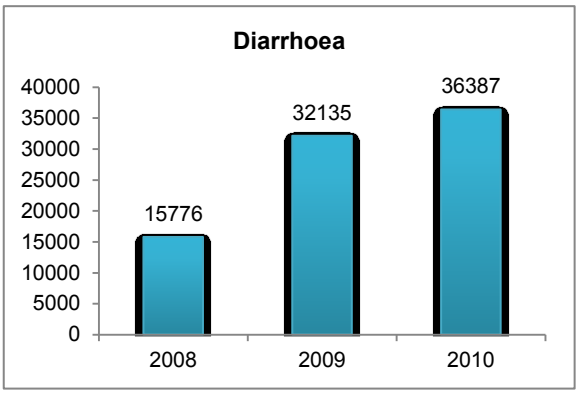


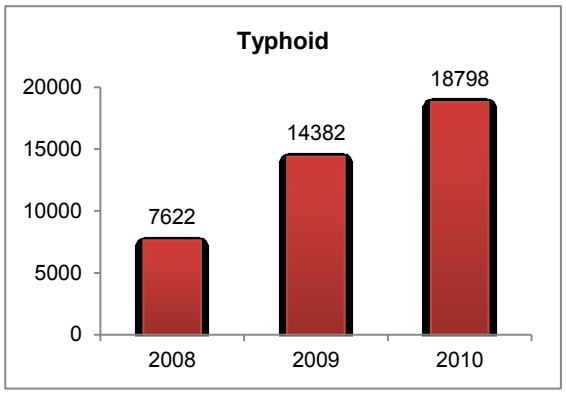
Figure 29: Malaria incidence and spread in Nagaland[51]

10.2.3. Acute Encephalitic Syndrome/Japanese Encephalitis:

Incidence has been reported from Dimapur, Kohima, Mokokchung, and Tuli, with Dimapur being the most affected district. About 36 incidences were reported in 2007, 9 in 2009 and 24 in 2010 (IDSP, 2011).

Figure 30: Trends of diarrhoea and typhoid cases in Nagaland Source: Health Intelligence Bureau, Nagaland, 2011





10.2.4. Water borne diseases

In Nagaland, diarrhoeal[52] disease is the second leading cause of death in children, particularly in children younger than 5 years of age. There has been an increase in acute diarrhoeal disease incidences in the state during the period 2008-2010 (*see Figure* 30). About 50 percent of these cases are reported from children alone. Typhoid cases in Nagaland also show a rise, of more than 2.5 times, in incidences during the period 2008-2010.

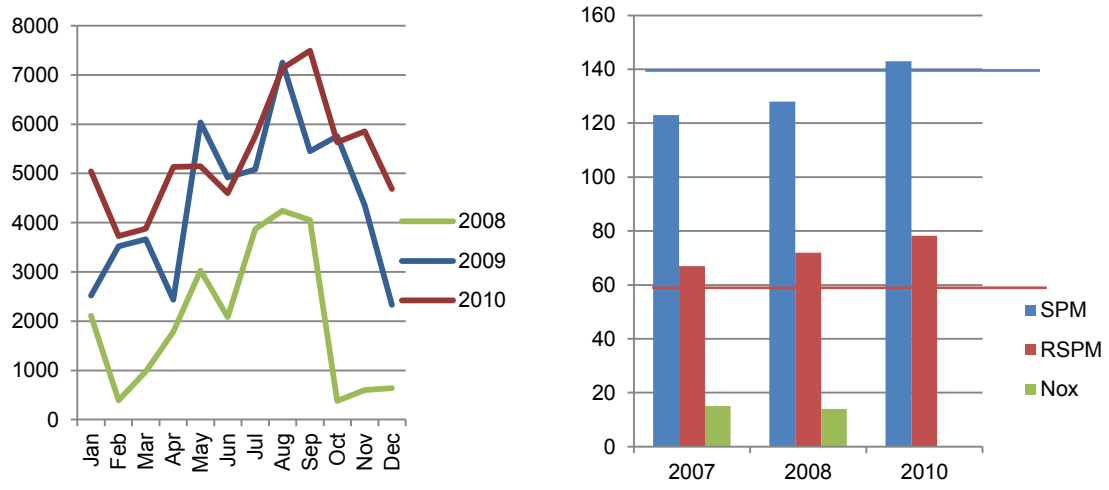
[51] Source: National Vector Borne Disease Control Programme (NVBDCP), 2011, Nagaland

[52] Diarrhoea spreads from person-to-person via the faecal-oral route, with greater rates of disease found in day-care centres, hospitals and nursing homes. In addition, these diseases are frequently reported in food-borne and water-borne outbreaks.

10.2.5. Tuberculosis

The estimated smear positive cases are 75/100,000 population per year in Nagaland[53]. The percentage of smear positive cases detected is going up in the state, from 50 percent in 2002 to about 85 percent in 2010 indicating the success of the Revised National Tuberculosis Control Programme (RNTCP). The cure rates have touched a high of 91 percent of the detected cases in 2010. District-wise performance of Longleng, Phek, Peren, and Zunheboto is poor. TB suspects examined per lakh population are low in Phek, Zunheboto, and Longleng and moderate in Mokokchung, Kiphire, and Peren. In Longleng and Phek case detection rate is low and moderate in Zunheboto and Peren. Sputum conversion rate being low in Longleng & Zunheboto and cure rates are low in district Phek.

Figure 31: Seasonal distribution of acute respiratory diseases in Nagaland between 2008 and 2010 and Trends of pollutants in Dimapur, Nagaland in µg/m3



Note: (NO_x-oxides of Nitrogen, SO_2 – measured below detectable levels). The red and the blue lines indicate the national standards of emissions of RSPM and SPM respectively. Source: (a) Nagaland, Health Intelligence Bureau, 2011; (b) Nagaland Pollution Control Board, 2011.

10.2.6. Respiratory Diseases

Acute respiratory diseases are associated with increase in pollutant loading in the outdoor as well as indoor atmosphere and with virus/bacterial or pollens/allergens etc. The acute respiratory diseases in Nagaland have increased almost 3 times from 2008 to 2010. This data includes respiratory diseases related to pollution, pollens and allergens as well as infections such as viruses and bacteria. The seasonal distribution of acute respiratory diseases for the period 2008-2010 is shown in Figure 27. Correspondingly, limited measured data available from an urban area, namely Dimapur, indicates that the Respirable Suspended Particulate Matter (RSPM) is increasing along with Suspended Particulate Matter (SPM) – see Figure 31– and have increased to more than the allowed national standards of 60µg/m^3 and 140µg/m^3 respectively.

10.3 Institutional Arrangements

10.3.1. Health service delivery network

The Department of Health and Family Welfare (DoHFW) manages the health of 1.98 million population of Nagaland through a network of hospitals, community health centres (CHCs), primary health centres

[53] Nagaland State Report on national health programmes, 2010

(PHCs), sub centres, doctors, paramedical staff, and nurses. The infrastructure and work force currently in place in Nagaland is shown in Table 26.

Under the aegis of the National Rural Health Programme, the state has made significant progress in terms of its health services delivery, especially, by communitization of primary health system as it has built improved access to basic needs, such as nutrition, safe drinking water, sanitation, shelter, preventive and curative health, through empowerment, leadership and participation of communities in integrated, bottom-up, socioeconomic planning. All the community health centres and sub-centres, and 86 percent of the Primary Health Centres in the state are communitized i.e. being run by the community themselves.

Table 26: Infrastructure built up to May 2011

Item	Required	In Position	Shortfall
Sub-centre	535	396	139
Primary Health Centre	80	126	-
Community Health Centre	20	21	-
Subdivision Hospitals		0	
District hospitals	11	11	
Referral Hospitals		0	
Ayurvedic and homeopathic dispensaries and hospitals		201	
Mobile medical units		11	
Multipurpose Worker (Female)/ANM in SC and PHCs	522	822	-
Health Worker (Male)/MPW (M)	396	241	155
Health Assistants (Female)/LHV	126	31	95
Health Assistants (Male) at PHCs	126	15	71
Doctor at PHCs	126	102	24
Surgeons+ Obstetricians & Gynaecologists+ Physicians+ Paediatricians	84	34	50
Radiographers	21	1	20
Pharmacist	147	112	35
Laboratory Technicians	147	104	43
Source: RHS Bulletin, March 2010 - May 2011, M/O Health & F.W., GOI			

The Naga Hospital at Kohima and the Christian Institute of Health Sciences and Research provide basic referral facilities. Private hospitals and practitioners are available in the major towns of Dimapur, Kohima and Mokokchung, but their presence in the other towns/districts is very limited.

10.3.2. Policies and Programs

The Department of Health and Family Welfare, Government of Nagaland implements all the centrally sponsored schemes/programs through the prescribed management/implementation structures– the National Aids Control Program (NACP), National Mental Health Programme (NMHP), Drug Control programme, Prevention of Food Adulteration (PFA), Universal Immunization Programme (UIP) and the National Rural Health Mission (NRHM). Within the NRHM, 10 sub programmes are operating in the state - the Reproductive Child Health (RCH) programme, National Vector Borne Disease Control Programme (NVBDCP), Revised National Tuberculosis Control Programme (RNTCP), National Cancer Control Programme (NCCP), National Programme for Control of Blindness (NPCB), National Iodine Deficiency Disorder Control Programme (NIDDCP), Oral and Dental Health programme (ODHP), Ayurvedic Yoga Unani Sidha Homeopathy (Ayush) programme, the National Leprosy programme (NLEP) and the Integrated Disease Surveillance Project (IDSP).

In addition, the Rashtriya Bima Suraksha Yojana (RSBY), another centrally sponsored scheme has been successfully taken up through the Labour department, providing insurance cover to the rural and urban poor.

10.4 Key Concerns and Issues

The Health systems in the country as well as the state face a broad range of governance, infrastructural, human resource and the financing challenges. A systems approach was adopted by the Government of India through the National Rural Health Mission (NRHM) to bring in the necessary health sector reforms to address the various issues in the health sector.

In keeping with the national goals, the state has also articulated a vision to provide comprehensive access to health and delivery systems to all by strengthening the existing infrastructure and deployment of required minimum manpower to all health units, especially in far flung areas. It has used the opportunity provided by NRHM to make significant progress in improving infrastructure of its primary healthcare facilities.

The state's innovative initiative of communtisation, wherein all the community health centers and sub-centres, and 86% of the primary health centres in the state are communitised i.e being run by the community themselves, has empowered the communities to make improvements in healthcare delivery and a number of innovations, at improving the other determinants of health, viz. sanitation, etc. have also been positively impacted. However, lack of adequate numbers of allopathic physicians and the unwillingness of, and inability of Government to motivate/compel doctors to serve in remote and rural areas, have been a constraint in the effective functioning of the primary health system.

Lack of adequate specialist manpower coupled with the small size of the state and its population, etc. have also been a constraint in the state having full-fledged referral facilities, and not able to provide all the prescribed services at the district hospital level and primary facilities. Facilities like the Disease Investigation Cell could not be set-up also.

Though Rashtriya Swasthya Bima Yojana (RSBY) has made good progress in the state since its launch, inability of empanelling Government hospitals remains a constraint in providing services and effective utilisation of the financial cover of insurance to the rural poor. The lack of fully functional public facilities, lack of insurance mechanisms, and the dependence for referral services on facilities outside the state, ensure high level of out-of-pocket expenditures for the majority.

10.5 Impact of Climate Change

The climate change projections for Nagaland indicate that, between 2021 and 2050 with respect to 1961-1990 (refer to chapter on climate), the temperature in the state is likely to rise between 1.60C to 1.80C precipitation is likely to increase overall by 10-20 percent, and the number of extreme rainfall conditions (100 mm/day) are likely to increase. Further, it is projected that the southern districts will experience higher level of change in climate compared to the northern districts.

The climate change, along with socio-economic factors, is likely to lead to change in disease incidence in the state. Various studies have indicated that the burden due to diarrhoeal disease, cardio-respiratory diseases and malaria may increase in the eastern Himalayan region due to the elevated temperatures, deteriorating water quality, increase in air pollutants and increased spread of vectors54. This is further discussed in the following paragraphs.

10.5.1. Vector borne diseases

It has been observed that over the past decade, the spread of malaria has increased from the foothill regions of Nagaland bordering Assam to the interior, higher altitude regions of Peren, Dimapur, Wokha, Mokokchung, Longleng and Mon. The increase in temperature and relative humidity is likely to provide a longer, year-long transmission window55 for all the prevalent mosquito species. It is likely that Anophoeles Diurus, Anopheles Minimus will also be active along with Anopheles Stephensi throughout the year, thereby increasing the malaria incidence. Spatially also, with increase in temperature, malaria may become endemic at higher altitudes56. With continued rural-urban migration, the unplanned towns of the state are likely to face greater stress on its sanitation and drainage facilities, increasing malarial incidence in towns.

Both Chikungunya and Dengue virus development and female Aedesa Egypti mosquito biting rates are sensitive to temperature and the potential risk rises to approximately by 31%-47% when temperature rises by 10C and irregular precipitation pattern persist. Further, the minimum temperature threshold for dengue vector to survive is 11.9^{o}C, implicating that dengue can occur in winters in Nagaland as well. Also the maximum temperatures up to which the dengue vector can survive is yet not determined[57]. With increase in droughts, accumulation of water in water containers in households to meet the enhanced household demand for increase in water consumption, may provide more frequent ideal conditions for breeding of Aedes-aegypti mosquito, the vector responsible for both chikungunya and Dengue. Similarly, in the case of Japanese Encephalitis (JE) caused by the female Culex, increase in temperature may trigger certain biotic and abiotic conditions favouring early seasonal amplification of virus and mosquito and hence their transmission and spread within Nagaland.

Table 27: Summary of likely impacts on vector borne diseases due to climate change in Nagaland

Vector borne disease	Driving climate and socio-economic Parameters	Likely manifestation
Malaria, Dengue, Chikungunya, Japanese Encephalitis, Kalazar, Filariasis and others	Increase in maximum Temperature, RH remaining >55%	Wider spatial spread and spread to higher altitudes
		Windows of transmission open for all 12 months
		Emergence of new vectors

[54] Tsering et al, 2010, Epstein et al. 1995, Patz et al. 2005
[55] Climate Change and India:A 4X4 Sectoral and Regional Analysis for 2030s, INCCA Report no.2, 2010, MoEF
[56] Bhattacharya et al., Impacts of Climate Change on Malaria, Current Science, 2006.
[57] Patz and Olson, 2006

		Increase in Urban malaria
	Decrease in minimum temperature, RH remaining >55%	Possibility of dengue even in winters
	Increase in precipitation, RH increasing further	Leave behind flooding conditions for mosquitoes to breed in their habitats*
	Land use change (deforestation) leading to changes in micro-climate in terms of changes in temperature, evapotranspiration, surface runoff, soil moisture etc.	More pathogens breed at a shorter period of time leading to a probability of higher incidences of vector borne diseases
	Migration of population	Bringing in new vectors in the region that might acclimatize to the climate conditions

10.5.2. Water borne diseases

Studies indicate that there is a definite relationship between diarrhoea and water quality that gets affected by rise in temperature, changes in precipitation pattern, humidity and extreme weather events such as floods and droughts. Table 28 below summarizes some of the global findings that relate increase in temperature with increase in diarrhoea incidences. Diarrheal incidences in Nagaland are numerous even in the present climate and are likely to escalate as temperatures increase and the pressure on urban sanitation and drainage increases due to increasing urban population. Similarly, the probability of increase in frequency and intensity of occurrence of typhoid and cholera incidences increases as well.

Table 28: Evidences of changes in incidences of diarrheal cases with increase in temperatures in various regions of the globe

Country	Rise in temperature	% rise in no. of water borne disease incidences
Peru[11]	1°C	8% increase in the risk of getting sever diarrhoea
China[12, 13]	◦ 1°C rise in maximum temperature ◦ 1°C rise in minimum temperature	11% rise in bacillary dysentery 12% rise in bacillary dysentery
India	◦ Observed increasing trends in temperature ◦ Increase in temperature	Leading to decrease in diarrheal incidences in Pune, India Increase in incidences of cholera in Kolkata
Bangladesh	1°C rise in temperature above 29°C	40.2% increase in incidences

10.5.3. Respiratory diseases

The key drivers of increase in respiratory diseases in Nagaland could be increase in air pollution, indoor pollution, and early emergence of allergens all due to increase in ambient air temperature. Increase in

precipitation, could increase dampness leading to high mold population. Table 29 summarises the likely impacts of climate change drivers.

Table 29: Likely impacts of climate change on respiratory diseases in Nagaland

Climate Driver	Change in pollutants	Likely respiratory diseases implications
Increase in temperature	Increase in tropospheric ozone concentration	° Exacerbation of chronic respiratory diseases ° Increases in respiratory hospital admissions and ° Increase in mortality
	Increase in particulate matter in the atmosphere	° Increased symptoms and reduced lung function in asthmatic children ° Higher mortality in adults, including lung cancer deaths. ° Increases in cardio-pulmonary hospital admissions and mortality.
	Increase in indoor pollutants including black Carbon	° Increase ARI in children and in COPD in women
	Increase in allergens- pollens, moulds, dust mites in households, wet air fungal spora	° Outbreak and Exacerbations of asthma and allergic rhinitis
Increase in precipitation	Increase in damp housing, and moulds	° Respiratory ill health – coughing and wheezing in children and adults

10.5.4. Malnutrition and access to safe water

Climate change is likely to affect all four dimensions of food security, namely food availability (i.e., production and trade), stability of food supplies, access to food and food utilization[39] (FAO, 2003). Crops that are important for food security of Nagaland are rice, maize, millet, pulses, oil seeds, sugarcane, and potato. Specific crop yield projections for 2030s for Nagaland region, as a part of the NE can be deduced from the projections made by Naresh Kumar et al. (201141), using INFOCROP with inputs on climate change from PRECIS run on A1B scenario, indicate an overall reduction in productivity, except for irrigated rice (see Table 30). Increased number of extreme precipitation events, may lead to more landslides affecting rain fed farms and hence production of crops. These factors indicate the likelihood of the food security, especially of population directly dependent on local produce, being affected adversely. This may lead to increased malnutrition amongst the population, especially the poor.

Table 30: Projected yields of different crops in Nagaland in 2030s

Crop	Change in yields in 2030s
Irrigated rice	+1-5%
Rainfed rice	-1-10%
Maize	-15 -30%
Wheat	+0 -10%
Potato	-1-10%

Source: Naresh Kumar et al., 2011[41]

Access to safe drinking water in the future might be an issue in Nagaland, though most parts of Nagaland will receive on an average an increase in rainfall, with respect to what it receives in the current climate. However, as the rains will be more in the form of extreme rainfall events, with increase in intensity, the storage and distribution of water might be an issue leading to large scale scarcity of water and hence health issues related to stored contaminated water.

10.5.5. Extreme temperatures and Health

Maximum temperature between 27°C and 30°C is experienced during the months of April to October in the state and the average maximum temperature in Nagaland does not exceed beyond 300C. The population is tolerant to this range of temperatures. However, as the average maximum temperature in Nagaland is likely to increase by 1.6-1.8°C in 2030s, if temperatures beyond the tolerance level of the population persists for a few days, it may make the population experience heat stress conditions and hence morbidity/mortality. With increase in temperature, there might be increase in dehydration amongst population, and spurt in skin diseases such as acne, cellulitis, furunculosis etc. especially in the southern districts may be seen.

10.6 Strategies and Action Plan for Adaptation to Climate Change

The challenge of managing health impacts due to climate change will be to deal with the enhanced level of disease burden and emergence of new and unfamiliar diseases. An important guiding principle for adaptation therefore is to increase the priority given to currently important health burdens with greater emphasis on disease prevention, providing a better balance with the current focus on curative and reactive measures. Potential adaptation strategies could focus on:

10.6.1. Addressing Enhanced Disease Burden

Enhancing the Scope of Existing Programmes

Vector borne diseases: To cope with increased malaria transmission window, detection of hitherto absent Kala Azar and Scrub Typhus in the state, and the spread increasing to hilly and interior regions, it would imply that the National Vector Borne Disease Control Programme (NVBDCP) will have to expand its prevention and control activities for all the six vectors throughout the state, and also intensify the prevention and control activities gradually all through the year and not just concentrate on the malarial season. Integrated vector control activities like IRS, fish, chemical, and bio-larvicide, source reduction etc. will have to be scaled up to meet the challenge. Activities under the Urban Malaria Programme of the NVBDCP will also need to be enhanced in the state. Through the municipalities, and urban development department, advocacy for measures such as better drainage systems, refuse disposal, wastewater management systems etc. will be taken up to avoid breeding of mosquitoes, flies and rodents and to control spreading of the diseases, with intensive sanitation and IEC campaigns.

Water bore Diseases: One of the indirect impacts of climate change is likely to be increase in water borne diseases. Resultant outbreaks of cholera, typhoid, gastroenteritis, leptospirosis, etc. could be catastrophic as it may affect entire communities. Lack of a proper sewage and drainage system, deficiencies in public water supply systems are fault lines along which climate change may aggravate the incidence of these diseases. The department will have to act as a catalyst with the Urban Development, and Public Health Engineering departments to bring around an improvement in these areas, and also lend its expertise in identification of vulnerable areas, especially in the context of climate change, and plan out preventive and curative measures in these areas.

Respiratory diseases: Since increase in temperature is likely to increase the pollutant load in the atmosphere as well as in water, monitoring and control of pollutants is essential. While working with other departments to control pollutants, the health department will strengthen respiratory diseases speciality in Naga Hospital and CIHSR, it will establish special respiratory health units in the District

Hospitals to start with and gradually build capacities in rural areas that help screen the population for chest infections and provide treatment.

Tuberculosis: Rates of transmission of tuberculosis may increase in the future due to changes in the biotic and abiotic conditions offered to the bacteria as a result of changing climate. RNTCP activities will be intensified in the state, aimed at improving on case detection and cure rates. Infrastructure for surveillance for detecting suspected cases through regular screening of the population will be upgraded along with infrastructure i.e. labs and equipment, kits, special health care centres will be scaled up.

Heat Stress: Considering that morbidity of the population might increase with increase in temperatures, it will be necessary to identify the region/(s) in which populations will be at risk. A scientific assessment for the same will be carried out. An early warning forecasting system will also be put in place that will alert the population and help them take necessary precaution to prevent heat stress. In addition, designs for houses/buildings that absorb less heat will be popularized in these regions.

Enhancing Infrastructure Support

This strategy will include a number of actions including bridging gaps in health infrastructure and personnel including developing the referral hospital into a teaching hospital, as well as reaching out to remote populations through fully loaded mobile medical Units (MMUs) with doctors and other staff.

10.6.2. Managing Emergence of New Diseases and Spread to New Areas

Improved Surveillance and Monitoring

Presently there are only two priority laboratories under IDSP in the State - State IDSP Laboratory, Kohima and Dimapur District Hospital Laboratory – manned by two microbiologists and other support staff. For strengthening of laboratory surveillance, there is a need to include and strengthen the existing district hospital laboratories in the other 10 districts under IDSP with additional work force of one microbiologist each in the district hospital laboratories, in a phased manner. The District Rapid Response Teams (RRTs) also have no mobility support at the moment. There is only one vehicle for the mobility of the State RRT. Therefore there is a need for mobility support for all the districts in order to rapidly respond to outbreaks/epidemics and augment surveillance activities. An entomological survey will also be carried out to develop entomological mapping and study the trend/distribution of vector borne disease over the years.

Further, surveillance across all health units is not available; this will be extended for capturing new disease or disease outbreak. Also a methodology will be developed to achieve convergence of surveillance and monitoring activities of IDSP and other programmes to develop an integrated health and disease management system (IHDMS). The IHDMS will be made available for each level, namely at village level, at urban entre level, a consolidated one at district level and a master IDMS at State level with DoHFW. The IHDMS can be used for planning of health measures at all levels and deployment of infrastructure, health personnel, and drugs and other things as per requirements.

Development of an Integrated Early Warning System

An early warning system will be developed with climate as an indicator to prevent large-scale damage by diseases outbreak and avoid impacts of extreme heat or cold or other extreme weather events. The early warning system will include a forecasting of climate by region within the state, coupled with early warning for extreme events such as floods and extreme heat. Climate forecasting would require instalment of high-resolution weather monitoring stations and analysis of the data generated from the same, including forecasting of weather and projections of climate for the future. The other elements in the system can include a forecast for diseases including the likely emergence of new or re-emergence of eradicated diseases that are conducive to the changed climate.

Establishment of an Investigative Research Centre with Bio Safety III laboratory

It is proposed to establish an Investigative Research Centre in Nagaland, which will carry out research on various aspects of disease prevention and cure and also establish linkages with climate and disease prevalence in the state. It will carry out epidemiological investigation, undertake confirmation of suspected cases, study the trend of diseases etc. It will also undertake ecological study of air pollutants, and pollen that triggers asthma and respiratory diseases and how they are affected by climate change as well as study the response of vector borne biology due to climate change.

Further, Nagaland does not have any modern or well equipped Investigation laboratory, neither in public or private sector, as such samples of suspected cases of Dengue or JE are still being sent to National Centre for Disease Control in Delhi or Regional Medical Research Centre Dibrugarh to confirm the diagnosis during epidemics. Therefore, it is proposed that the research centre will also have a state of the art Bio Safety Level III laboratory and will monitor all laboratories in the state. This lab can help diagnose all diseases from samples collected and help to isolate even dangerous biological agents in an enclosed facility such as Leishamania Donovani (kala-Azar), Mycobacterum Tuberculosis, Bacillus Anthracis (Anthrax), Chlamidophila Psittaci (Chlamydia), Venezuelan Equine Encephalitis virus, Coxiella Brunetti, Rift valley fever virus, Rickettsia Ricketsii and yellow fever virus etc.

10.6.3. Ameliorating Impacts of Extreme Events – Disaster Risk Reduction Plan (DRRP)

A special DRRP will be developed related to climate change disease outbreak and counter mortality/morbidity due to landslides due to heavy precipitation events and large-scale migration. The health department in association with the disaster management cell of the state will launch research studies to understand the impacts of climate change on various aspects of health in the state, and design disaster preparedness plans in collaboration with the NDMA.

10.6.4. Capacity Building and Public Education

A climate change cell (CCC) within the DoHFW will be set up to oversee the integration of climate change concerns in all the programmes of the department and provide the directions to the state to take climate change related health issues. The cell will also undertake monitoring and evaluation to check the effectiveness of adaptation measures to prevent mal adaptation to climate change. Further, the cell will undertake training programmes of health personnel to make them understand the climate change and disease burden for the state and the actions required for adaptation. The cell will develop literature in local language for improved communication in disease prevention and cure towards enhancing resilience of rural communities to changes in climate, and scale up IEC activities to the optimum. It is planned to intensify electronic media as well as print media in local tribal dialects, which the villagers can easily accept. Inter personal communication programmes will be taken up, and hoardings, posters, pamphlets etc. will be produced in regional tribal languages for all districts.

10.7 Action Plan and Budget

(₹ In lakh)

Strategy/ Sub strategy	Sub-strategy/ Programme (Funding Source)	Actions	Implementing Agencies/Institutions that can be involved	Budget (2012-2017)
Strategy 1: Addressing enhanced disease burden				
Improving current programmes	Controlling vector borne diseases – Enhancing the scope of NVBDCP (GoI)	Intensify mosquito control measures: through source reduction/anti larval measures in identified hotspot areas- measures to include avoidance of stagnation or collection of water, through biological control e.g. larvivorous hatchery, through proper disposal of waste – biomedical waste as well as municipal solid waste and domestic waste water	DHFW, NVBDCP cell, Municipalities, Rural Development, Urban Development, NPCB	100
		Enhanced Source reduction measures to be carried out in the most endemic blocks		
		Increase period of anti malarial activities e.g. DDT /Malethion spray/fogging	DHFW, NVBDCP cell, Municipalities, Rural Development, Urban Development, NPCB	100
		Carrying out anti malarial activities throughout the year in identified hotspots		
		Enhanced actions for protection against Mosquito bites e.g. Bed--nets/LLIN, Treatment with Cloroquine/Quinine/ACT drugs	DHFW, NVBDCP cell, Municipal, Cooperation Rural Development, Urban Development, NPCB	100
		Carry out the protection measured in hotpots		

		Research on vector prevalence, triggering mechanisms that lead to outbreaks and study on impacts of climate change on vector spread, morbidity and mortality		50
		To be carried out within 12th plan (3 years)		
	Water borne diseases (GoI, State Plan)	Apply preventive measures to deal with deterioration of water quality in identified areas	DHFW, RD, PHE	20
		Scale up the level of existing operations for covering at least 50% of districts in Nagaland		
		Enhance the curative measures for diarrhoea/typhoid/cholera in low lying area	DHFW	75
		Cover 50% of the areas identified		
	Respiratory diseases (NRHM (GoI), State Plan)	Extend monitoring of vehicular pollutant levels across the state in all urban centres	DHFW, NPCB, VPCD/Transport dept.	20
		Monitoring of industrial pollutants including small scale industries	DHFW, NPCB	20
		All industries including small scale industries		
		Monitoring of domestic pollutants due to biomass burning	DHFW, NPCB	20
		Sample study in 4-5 districts, in rural settings		
	Infectious diseases- Tuberculosis (GoI)	Upgraded infrastructure i.e. labs and equipment, kits etc.	DHFW	500
		Upgrade 50% of the requirement		
		Upgrade 50 percent of	DHFW	nil

		health care centres in order to improve the detection and cure rates.		
	Combating Heat Stress (GoI, State Plan)	Identify the regions (s) at risk to heat stress	DHFW, Nagaland University, Urban Development	10
		Promote green , energy efficient buildings using natural cooling	Urban Development	20
Enhancing infrastructure support	NRHM (GoI)	Bridge identified gaps in health infrastructure	DHFW	Separately projected
		Improve access to specialists by including teaching (DNB courses) in the state referral hospital	DHFW	2000
		Improve Mobile Medical Units with existing doctors	DHFW, Private entity	1000
Strategy 2: Managing emergence of new diseases and spread to new areas				
Improved Surveillance and monitoring - Strengthening IDSP	IDSP (GoI)	Enhance man power – microbiologists	DHFW	50
		Hire 10 microbiologists for all 10 hospitals in 10 districts		
		Enhance mobility for District Rapid Response Teams (RRTs)	DHFW	100
		Entomological mapping and assess trend / distribution of vector borne disease over the years	IDSP	100
		Two studies to be carried out within 12th plan		
Establishment of	IDSP (GoI)	Strengthen State level	DHFW	500

an Investigative Research Centre with Bio safety III laboratory		Laboratories at Naga Hospital/CIHSR; Setting up of State Disease Investigation and Research Laboratory with Bio-safety Level-III.		
		i Develop capacity for analysis and modelling for climate projections and predictions and for developing the early warning system in collaboration with scientists who understand the linkages between disease vector/pathogen and climate	DST, DHFW, IMD, University	200
		(For 5 persons for 5 years- 2 scientists, 3 research student)		
Strategy 3: Managing morbidity/mortality due to extreme events				
Disaster risk reduction	Strengthen the state disaster management plan *vis a vis* climate change and health	Review the current disaster management plan *vis a vis* the health component and strengthen the components that are impacted by climate change	DHFW, Research institution, Department of Home	20
		Undertake research to understand the impact of climate change on various diseases – their likely source of origin, regional spread, impacts on morbidity and mortality etc.	DHFW, research institution/ NGO/ Consulting company	50
Strategy 4: Capacity Building and Public Education				
		Create climate change cell within the DoHFW with a nodal officer from within DHFW	DHFW	nil

		Integrate CC in all training programmes of the DHFW- Develop modules that need to be introduced in the identified training programmes	DHFW, RHM, NVBDCP, RNTCP, IDSP, HIB, and NHIMS	100
GRAND TOTAL				**5155**
(Rupees Fifty One Crore Fifty Five Lakh)				

Chapter 11

Cross Cutting Issues

Streamlining Climate Change concerns into ongoing development agenda, particularly in the context of climate change adaptation is definitely a challenge, but has become an absolute necessity to climate proof development. It also ensures that the vulnerable communities, regions and sectors become climate resilient to overcome the possible impacts of climate change to the extent possible.

However, to ensure that every sector adopts policies and implementation framework to ensure climate resilient development in each of the sectors, it is imperative to have a deeper understanding of the possible impacts of climate change in each of these sectors, assess the level of vulnerability. This will ensure that policies and framework identify the possible ways to adapt to climate change, while also embarking on mitigation actions where required.

Further, the implementation of such a policy framework would also require appropriate capacity building of organisations/institutions and personnel. It would also require to tailor make appropriate monitoring and evaluation tools to assess the progress and to identify possible area/s for course correction, if required.

In addition to the above, a comprehensive coordination plan, which integrates all the programmes/activities of the various departments/agencies, needs to be put in place, as all actions need to be put in place. This is particularly so for a number of cross-cutting issues strategies such as low-carbon development, where in the power and energy departments, the urban habitat departments, the industry departments, the forest department need to converge and develop collective implementation strategies.

An example for a comprehensive multi-department approach to address "energy access", would be through ensuring that people not only get access to electricity but also access to modern energy for meeting their cooking and heating requirements, which would in turn reduce the dependence on firewood from forests.

Similarly in the development of adaptation strategies for Nagaland, the departments that definitely need to converge for joint strategy development would include the rural development department, the public health and engineering department, the municipal councils, the urban development department, the forest departments, the agriculture and allied departments amongst others.

Nagaland has some extremely evolved adaptive mechanisms backed with traditional knowledge and practice. While efforts needs to be put into conserving and strengthening these practices, the state also has to catch up with modern science and technology and learn from adaptation and mitigation practices elsewhere which is relevant to the state to ensure the development of effective strategies and actions for implementation to climate proof development.

11.1 Livelihoods

11.1.1. Overview

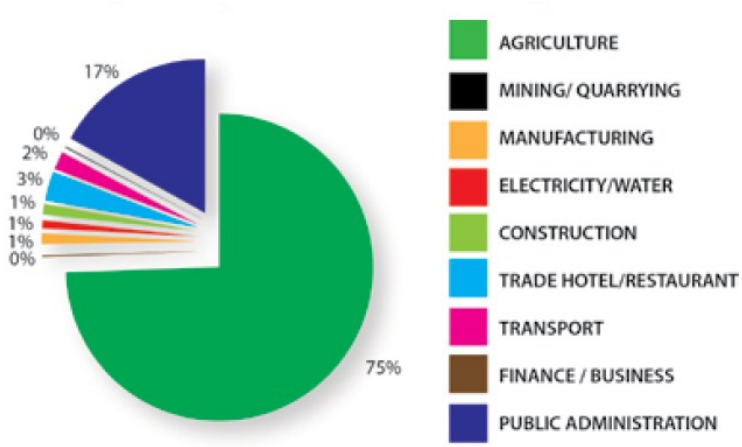
The population of Nagaland has increased more than fivefold since its formation, from 3.69 lakh in 1961 to 19.80 lakh in 2011. The State has, however, remained predominantly rural, with 71.03 percent (2011 census) of the population living in villages. 68 percent of the population, implying almost the entire rural population of 14.07 lakh, is dependent on agriculture and natural resources. As per NSSO, 61st Round, 60 percent of rural households are self-employed in agriculture, another 5 percent are agricultural labourers, and only 12 percent are employed in non agriculture activities like weaving, black smithy and handicrafts[58].

[58] Livelihood and Employment : Opportunities in Nagaland : Sectoral Issues, Government of Nagaland, 2009

Government is the largest employer in the formal sector, giving direct employment to nearly 1.20 lakh[59] (more than 5 percent of the population) at present. Nearly half of the urban population of 5.73 lakh is dependent on government for employment, though services such as trade and hotel, and construction are also providing employment to a rising number of youth. Manufacturing, though, is as good as nonexistent. There is an increasing out-migration amongst the unemployed youth to seek service sector employment, in the hospitality and call centre business, outside the state.

The high population growth rates during the past four decades are providing the state with a young and growing workforce. However, on the one hand, the education system of the state is on the one hand churning out educated youth with little employable skills, and on the other hand there are insufficient employment opportunities being generated leading to growing unemployment both in the rural and urban areas. There are nearly 62000 employees on the live registers of the employment exchanges.

Figure 32: Distribution of workers by principal status and industry – rural Nagaland



Source: National Sample Survey Report No. 455, Employment and Unemployment in India, 1999-2000 in Key Results

11.1.2. Sectors with High Livelihood Generation Potential

Considering the overall Nagaland situation, the sectors that have high livelihood generation potential include agriculture, horticulture, floriculture, medicinal and aromatic plants, livestock, fisheries, forestry, industry, tourism, information and communication technology, bamboo, apiculture, handicraft and handloom, and construction, apart from the services sectors. Most of these sectors have been covered in some detail in the other chapters of NSAPCC, and as such will not be elaborated upon further here. The sectors that have potential, but that have not been covered as focus sectors under this NSAPCC will be taken up for consideration in subsequent revision iterations of the report.

11.1.3. Livelihood and Employment -- Key Agencies and Initiatives

The **MGNREGA** provides employment support to 28,000 households in the State. 29.95 percent person days of employment has been provided to women and 100 percent to members of Scheduled Tribes (ST). The **Chief Minister's Corpus Fund** has provided several initiatives for employment generation and capacity building where more than 5000 beneficiaries have directly benefited. **NEPED** working closely and directly with 104 selected VDBs, has been able to extend a credit mechanism operated by the VDBs, which function as a grassroots credit institution. This project was an attempt to shift focus of the VDBs from that of external grant reliant functions to that of self-reliant credit based approach. **NABARD** as an apex institution, since its inception on July 12, 1982 has been extending credit for infrastructure support

[59] Finance Department, Government of Nagaland figures. This is one of the largest figure of Government employees compared to the population.

in agriculture and rural development activities as an active partner of the State Government and the banking system.

11.1.4. Climate Change Impacts

With the vast majority of the population dependent on agriculture and natural resources for livelihoods, changes in natural resource base due to climate change will affect livelihood of rural households directly. Conversely, the high dependence of livelihoods on natural resources, especially forest produce, also puts a question mark on the sustainability of the resource use. It is, therefore, important to climate proof livelihoods of those who are dependent on natural resources, and make the resource use by them more sustainable, reducing their carbon footprint. Shift away from natural resource usage may not be an appropriate strategy in view of the vast land resources, with a low population density of 119 persons per sq. km.

Climate change impacts on livelihoods can arise out of crop failures due to delayed or erratic monsoonal rainfalls, loss of harvest due to flash floods and landslides, shift from self-employment to wage labour as agriculture productivity gets affected, increase in labour requirements to harness water due to drying up sources, etc. Shift in forest vegetation, biodiversity and cover will also have positive or negative impact on the livelihood of local communities. As demonstrated in the study conducted by Indian Institute of Science, geographically, the rural and urban households in Tuensang, Kiphire, Longleng and Mon are more vulnerable to climate change than the other districts, even though they are also face a high degree of vulnerability.

11.1.5. Adapting to Climate Change

Communities are adapting to climate change using their traditional knowledge. In order to adapt to changing climatic parameters, people have already started cultivation of crop varieties that required less water. Villagers have also adopted new enterprises for income generation. However, the response is not in a planned manner and exposes them to unmitigated risks.

Enhancing adaptive capacities

The capacities of the communities and individuals need to be enhanced. The various activities in the agriculture and allied sectors, water resources and forest sector plans projected in the various chapters of the NSAPCC are aimed at improving the adaptive capacity of the communities. These activities are also aimed at strengthening extensions services and bringing service delivery closer to the rural households, making use of traditional knowledge to enhance the communities' capacities instead of thrusting alien, untested practices and technologies, etc. Examples are building water storage and irrigation facilities in the villages, introducing indigenous climate resilient cultivars after conducting thorough research, etc.

Livelihood diversification

In view of the increased risk of failure of natural resource based produce, whether these are NTFP or agriculture produce, it is important that alternative livelihood options are available to individuals. Introduction of horticulture crops, agro-forestry, livestock in addition to agriculture, value addition through processing, establishing market linkages through support organisations, etc. are examples which have been incorporated in various sector strategies given in detail in other chapters of NSAPCC. In addition, there is a need for building skills in non-climate sensitive trades, which can be taken up as part of the MGNREGA and other livelihood guarantee programs of the Government. The Self Help Groups created by various departments and NEPED can be strengthened for continued extension of credit, which is a pillar for ensuring sustainable livelihood and helps in diversification of employment opportunities for the rural households.

Development of safety nets

While building adaptive capacities and extending services, including credit services, itself acts to mitigate risks due to erratic weather and climate change, formal risk mitigation mechanisms, like crop insurance, draught and disaster relief, etc. need to be extended in a fair manner to the rural households, and have been accounted for in the agriculture and allied sector response.

In addition to already detailed strategies and actions, specific actions that will be further undertaken towards up-scaling the above strategies are

Strengthen Self-Help Groups and Micro Credit

The Self Help movement has still to take off in a big way. Support from the Government is essential in the absence of other players in the state. The NEPED model will be examined for more widespread deployment and efforts will be made to leverage institutional credit for SHGs that have become viable.

MGNREGA

In addition to provide livelihood security, MGNREGA provides an opportunity for building an adaptation mechanism to build resilience in the rural communities by taking on works like water conservation, drought-proofing, afforestation, tree plantation, minor irrigation works, renovation of traditional water bodies, desilting of tanks, land development, flood control and protection, drainage in water-logged areas and rural connectivity, in that order. These works not only provide local environmental services, they have the potential to yield co-benefits of adaptation and mitigation to global climate change. The implementation of the scheme may be suitably modified to take into account this aspect.

Promote Eco-Tourism

The state has huge potential to promote eco-tourism providing livelihood options. This will require improving the transport infrastructure and communication network so that tourists can receive all facilities making the State one of the destinations to visit all year round. As such, a comprehensive study of leveraging tourism, with an emphasis on eco-tourism will be undertaken, and tourism will be taken as a focus sector in the next revision of this NSAPCC.

Promote non-farm enterprises in villages

In addition to agriculture, the state will initiate programmes to help villagers to make earnings from non-farming enterprises like blacksmith, handicrafts, motor mechanics, carpentry, etc. Investments will be made to promote enterprises that are least affected by climatic variability.

Scaling up Missions

Nagaland Bamboo Development Authority (NBDA), Nagaland Bioresources Mission (NBRM), Nagaland Honeybee Mission (NHBM) and NEPED are important agencies involved in promoting entrepreneurship and supplemental income sources for the farmers and rural households. They are also providing the much needed forward linkages in their respective domains. Up scaling their activities will be beneficial.

Additional missions/mini-missions in key identified areas, e.g. in promoting eco-tourism, orchids may also be instituted.

Build Capacity and Spread awareness on alternative livelihood options among youths

Vulnerable Communities have to be made aware of the consequences of climate change and the alternatives available to them. Spread Awareness in local context through schools, colleges, VCs, etc. may be planned, which may be aimed at imparting additional skills to manage existing livelihoods options that are vulnerable to climate impacts, etc. Also, it may be aimed to impart trainings and build capacity to promote new enterprises and diversify employment opportunities in the State and build capacity (technical and infrastructure) to continue monitoring the changes in climate and its perceived impacts that will ensure required response in time.

11.1.6. Budget

(₹ in lakh)

S.No.	Activities	Budget	Source of Funds	Implementing Agency
1	Missions – scale up existing 4 missions @ Rs. 4 crore per year per Mission	8000.00	GoI, State Plan, External Funding Agencies	Respective Missions
2	Missions – 3 Additional Missions additional missions with 2 cr. per year for 5 year	3000.00	GoI, State Plan, External Funding Agencies	Respective Missions
3	Developing Eco-tourism	1000.00	GoI, GoN	Tourism, Forest Departments
4	Spreading Awareness – in 11 Districts	200.00	GoI, GoN	
5	Promote nonfarm based livelihoods	50.00		
	TOTAL	12250.00		

11.2 Research and Knowledge Management

The knowledge base on Climate change is still evolving. The impacts of Climate Change are still to be fully understood. The climate variability at regional level requires capacities of the local institutions to be developed to research and produce the necessary evidence for right policy decisions to be taken and converted into implementable programs.

The need for improving scientific knowledge and evidence base, and connecting it to practice and police is a must, if the state has to ramp up from coping only to effective adaptation to climate change. In keeping with this, after a lot of debate it is proposed to constitute a **Climate Studies and Knowledge Solutions Centre**, within the Nagaland University, and till the time it is established there, a mechanism may be set-up in the nodal department to bring scientific organisations and academia on board with regard to Climate Change. This arrangement is also appropriate as there is adequate human resource with presence of experts and research scholars from different science streams in the university. The dedicated cell in the university solely for the purpose of climate studies would require strengthening existing infrastructure and other facilities and also establishing a link between the Climate Change Cells of the line departments such as Soil and Water Conservation department (Meteorology), NPCB etc and the nodal agency for flow of data and information. The Centre is envisaged to fulfil the following outcomes.

- Strengthening of observation networks and data gathering and assimilation to enhance the access to and availability of relevant climate data.
- Develop protocols for new knowledge creation and documenting emerging best practice as well as people's perceptions on climate change and its impacts on an on-going basis;
- Creation of essential research infrastructure to enable access and sharing of computational and data resources.
- Research in key substantive domains of climate science where there is an urgent need to improve the understanding of key phenomena and processes for example ecosystem responses

11.2.1. Tentative Research Areas

A number of areas of research, which are critical to addressing climate adaptation and further deepen the understanding of the issues, have already been identified in the NSAPCC. An illustrative list is given below, on which the Centre can immediately start working on.:

a) Agriculture Sector:
   - Assessing the impacts of climate change on agriculture at varying time scales of short, medium and long term
   - Identification of species tolerant to climate change- Agricultural crops, horticulture crops and livestock species

b) Water:
   - Assessing Impacts of climate change on Water availability in the short, medium and long term time scales.
   - Study the status of major perennial springs, their recharge sources, including existing management systems, their utilization, estimate impacts of climate change on these springs and develop suggestions for their maintenance and suggest alternative mechanisms
   - A detailed assessment of current groundwater resources and status with regard to ground water contamination and propose strategies for augmentation of groundwater resources through artificial recharge.

c) Forest and bio-diversity:
   - A detailed Assessment of the impacts of climate change on short, medium and long term time scales on forests and biodiversity
   - Assess C sequestration potential of all species of trees available/grown in Nagaland

d) Health Sector:
   - A detailed assessment of the impacts of climate change on short, medium and long term time scales on the health sector

e) Knowledge Management Repository:
   - Create climate change related databases and identify responses to climate change.
   - Creating a data repository of implementation strategies adopted globally, particularly in similar eco-systems
   - Developing and assessing climate change scenarios
   - Prepare and upgrade environmental status reports with special emphasis on climate change.
   - Documenting tradition knowledge and practices of adapting and mitigating climate change
   - Creating a single source platform for data storage. For instance, data on rainfall is required by the departments of agriculture, water, public health engineering department, renewable energy department, town planning authorities amongst others. A single access platform will ensure that every department has access to the information and so will researchers and policy makers to help them make their assessment of issues and take necessary policy decisions.
   - Assessment of various department programme to understand their climate resilient quotient and suggest measures to climate proof them.

f) Carbon Mitigation Potentials:
   - Identification of technologies and processes that our climate friendly and potentially mitigate emissions cutting across all sectors

11.2.2. Integrating Climate Change concerns in planning and implementation

A very important pre-requisite to address climate change is to integrate climate change in the development planning and policy formulation. This would ensure that the development agenda and

pathway is sufficiently climate proofed and is resilient to climate change. This requires a paradigm shift in the current mode of planning and policy formulation. Thus, building of capacities at various levels, from the policy makers, field officials to other stakeholders, is of utmost importance in the following areas is another aspect on with the Centre can immediately start working on:

- Applying a climate lens to identify the relevance of climate change to a policy, programme, plan or project.
- Interpreting climate data from different standard climate data sources.
- Assessing vulnerability for identifying factors contributing to vulnerability in a system.
- Identifying adaptation options from a range of adaptation options to adjust or improve planning and management.
- Selecting adaptation measures by evaluating priorities and prioritize options using selected criteria.
- Developing an M&E framework for monitoring and evaluation of adaptation options
- Identify institutional capacity requirements for adaptation and identify institutions with such capacities, if absent build capacity to deal with adaptation as a continual change process.
- Assessing local climate stresses, vulnerability, resilience for local information on climate change vulnerability.
- Implementing action at local level and beyond: Identify action at the local level and how it links to sub-national, national and other actors and
- Integrating adaptation into the project cycle: Identify key steps to integrate adaptation according to the various steps of the project cycle.

11.2.3. Budget

S.No.	Activities	Budget	Source of Funds	Implementing Agency
1	Establishing Climate Studies and Knowledge Solutions Centre	1000.00	GoI, State Plan, External Funding Agencies	NU, APC Cell
2	Studies not included in respective sections	7000.00	GoI, GoN	G&M, NU and other deptts.
	TOTAL	1700.00		

Annexures

Annexure 1 : Composition of Task Force and Working Group Members

A. COMPOSITION OF CLIMATE CHANGE TASK FORCE

NAME	DESIGNATION	DEPARTMENT
Shri Amardeep S Bhatia, Chairperson	Commissioner & Secretary, and Team Leader	Forest NEPED
Shri Albert Solo, Member Secretary	Chief Conservator of Forest	Forest
Shri Temjenwapang	DCF, PCCF Office	Forest (Incorporated Member)
Late Shri Raj K. Verma	Joint Secretary & Deputy Team Leader	NEPED
Shri Vengota Nakro	POU Team member	NEPED

B. COMPOSITION OF SECTORAL WORKING GROUPS

1. AGRICULTURE SECTOR WORKING GROUP

NAME	DESIGNATION	DEPARTMENT
Shri E.H. Lotha, Joint Convenor	Director	Agriculture
Smt. Chozoulie Kikhi	Deputy Director	Horticulture
Shri Rosenyuba,	Deputy Director	Fisheries
Dr. Imliangshi	Veterinary Assistant Surgeon	Veterinary & Animal Husbandry
Dr. K. Vizo	Deputy Director	Soil & Water Conservation
Er.Njilo Kemp	Superintending Engineer	Irrigation & Flood Control

2. WATER SECTOR WORKING GROUP

NAME	DESIGNATION	DEPARTMENT
Er. Kruse, Convenor	Additional Chief Engineer	Public Health Engineering
Er. T. Yanger	Additional Chief Engineer	Irrigation & Flood Control
Shri Rusovil John	Member Secretary	Nagaland Pollution Control Board
Dr. K. Vizo	Deputy Director	Soil & Water Conservation

3. URBAN PLANNING SECTOR WORKING GROUP

NAME	DESIGNATION	DEPARTMENT
Shri Takatoba, Convenor	Joint Director	**Urban Development**
Shri Tarachu Fithu	Assistant Director	**Urban Development**
Er. S.N. Meren	Superintending Engineer	PWD- Works & Housing
Er.Limanaro	Executive Engineer	PWD- Roads and Bridges
Shri Rusovil John	Member Secretary	**Nagaland Pollution Control Board**
Shri Elias Lotha	Road Transport Officer	Transport
Shri Johnny	State Project Officer	Disaster Management (Home)

4. ENERGY SECTOR WORKING GROUP

NAME	DESIGNATION	DEPARTMENT
Er. Imli, Convenor	Additional Chief Engineer	**Power**
Er. Kavito	Joint Director	New & Renewable Energy
Er.Kenyunile T. Lorin	Project Manager	Industries & Commerce
Shri Takum	POU Member	NEPeD

5. HEALTH SECTOR WORKING GROUP

NAME	DESIGNATION	DEPARTMENT
Dr. N. Kire, Convenor	Additional Director	**Health & Family Welfare**
Shri K. Haralu	Joint Director	**Women & Child Development**
Smt. Viselule	Asst. Director	Social Welfare
Shri Rusovil john	Member Secretary	Nagaland Pollution Control Board

6. FORESTRY SECTOR WORKING GROUP

NAME	DESIGNATION	DEPARTMENT
Dr. K. Kire	Conservator of Forest	**Forest**
Shri Puvil Kikhi	District Project Officer	**Land Resources**
Shri. Pikato Zhimo	Team Member	NEPED

7. LIVELIHOOD SECTOR WORKING GROUP

NAME	DESIGNATION	DEPARTMENT
Shri Pangjung Jamir, Convenor	Deputy Director	Land Resources
Shri I Panger	Joint Director	Agriculture
Shri Waichiba	Additional Director	Rural Development

Dr. K. Vizo	Deputy Director	Soil & water
Er. Vikiye Sema	Mining Engineer	Geology & mining
Shri Thomas Kent	Joint Director	Tourism

8. CLIMATE CHANGE STUDIES WORKING GROUP

NAME	DESIGNATION	DEPARTMENT
Dr.S.K.Singh, Convenor	Senior Assistant Professor	Nagaland University
Shri Rusovil john	Member Secretary	Nagaland Pollution Control Board
Er. Vikiye Sema	Mining Engineer	Geology & Mining
Shri Ango Kongyak	Team Member	NEPED
Dr.Zavei Hese	Senior Scientific Officer	Science & Technology
Dr. K. Vizo	Deputy Director	Soil & Water Conservation
Dr. Sanjay Sharma	Senior Assistant Professor	Kohima Science College

Annexure 2 : Identifying Adaptation and Mitigation Activities

Template A & B: Identifying adaptation and mitigation actions in ongoing programmes, projects and schemes

Sector identified for SAPCC	On-going programme/project/scheme	Budget outlay (Rs. in crore; 2007- 2011)	National objective(s) of the programme / project/scheme	State objective(s) of the programme / project/scheme	Activities to achieve the programme / project objective(s) in the state	Performance Monitoring Indicator (s)	Identify and classify activities in programme / project/schemes			Institutional Responsibility	
							Adaptation component	Mitigation component	Over-lapping Adaptation/Mitigation components	Co-ordination Agency / Convener	Collaboration Agency
1	2	3	4	5	6	7	8	9	10	11	12
									-		

Template C: Identifying issues/concerns, causes, impacts/risks and opportunities for sectoral working groups

Issues/concerns	Causes	Impacts/risks	Opportunities	Need for action
1	2	3	4	5

Template D: Identifying Priorities, Activities, Performance Indicators, Scale of Activities and Nature of Activities for sectoral working groups

Priorities/ Objectives	Activities	Classification of Activities			Performance indicator	Scale of activities	Nature of activities
		Adaptation	Mitigation	Overlapping			
1	2	3	4	5	6	7	8

Template: E: Template for inventorying policy and regulatory framework

Policies/ Acts/ Notification a. (National/State)	b. Current Schemes & Programmes	c. Current Activities	d. Future Activities
1	e. 2	f. 3	g. 4
	h.	i.	j.

Steps that can be followed to fill various templates:

1. Template for current programmes/projects/schemes for identifying adaptation and mitigation components (Template A &B)
2. Identifying issues, causes, impacts and risks that need to be addressed (Template C)

3. Template for Priorities, Activities, Performance Indicators, Scale of Activities and Nature of Activities (Template D)
4. Template for inventorying policies and regulatory framework (Template E)

Guidelines to fill the template

Guiding principles for policies, plans, programmes/projects may be based on:

1. Scaling up and replication of existing good practices across sectors.
2. Exploring possibilities of innovations for change in direction; enhancing scope and effectiveness of ongoing programmes/projects/schemes in the area of adaptations (i.e. specific actions assisting in reducing and preventing risks and vulnerability from natural disasters, harvest failure, pestilence, etc. and mitigations (i.e. minimize intensity of green house gas emissions such as methane and nitrous oxide from wet paddy fields and sequestering carbon in forest biomass/agriculture soils/switching from fuel wood to cleaner fuel (LPG) to reduce global warming.
3. Identifying capacity building needs of existing institutions in view of taking adaptation and mitigation measures for example training local agricultural institutional in System Rice Intensification techniques, municipal bodies undertaking composting of municipal solid waste etc
4. Identifying the need of new institutions and creating enabling environment for nurturing them for example setting climate cell in the state.
5. Integrated and decentralized development planning of identified sectors (to address cross sectoral issues)
6. Budgetary outlay for the year 2010-2011 has been given in the template, budget for FY 2007-08, 2008-09, and 2009-10 can be provided
7. Externally aided programmes/projects/schemes may also be considered.

Guiding principles for defining activities

1. Existing good practices/management practices in Nagaland/NE region may be factored into current and future plans
2. Scale of current and future activities may be defined in terms of state/district/block level activities
3. Nature of proposed current and future activities may be of research and development studies, demonstration projects, policy interventions, operations and maintenance, feasibility studies, detailed project reports, investment projects etc.
4. Activities may also be prioritized as per importance of the current and future activities for the sector as High/ Medium/Low. High priority may be accorded to high importance with low or minimal constraints, medium priority may be accorded to high importance and large constraints, low priority to low importance/impact activities.
5. Current and future activities may factor in Agro-climatic zone wise planning.

Identifying issues/concerns, causes, impacts/risks and opportunities for sectoral working groups

Agriculture Sector

Issues/concerns	Causes & Signals of concern	Impacts/risks	Opportunities	Need for action
Horticulture				
1.Low quantum production (in volume). Too much to eat but too less to sell.	- Labour shortage, Inadequate access to marketing information, processing/value addition units, road connectivity and remoteness, less social cohesion. - 'Time' – essence in plantation. Delay in fund release/saplings means, a year loss in agril/Horticulture cycle.	Loss of interest and motivation, loss of expected return/income, high dependency on Govt. resources for survival, rise in poverty level, rise in anti-social elements.	-Effective technology transfer, timely release of funds and good planting material coinciding with planting season, - Effective field supervision, information on marketing network, pricing, processing/value addition units and connectivity	H
2. Sustaining Horticultural Productivity	- Insufficient technical knowledge and skills - Low managerial capacity among farmers.	- Loss of investment (resources - both human and material) - Loss of anticipated income -	- Participatory Planning - Enhance farmers' technical Knowledge and skillls - Effective Marketing Linkage - Effective –Small Scale Value Addition and Processing Units - Effective Connectivity	H
3. Moisture stress in dry months and unpredictable high precipitation	- Degradation of Natural Resources and disturbance in ecological balances	-Drought-like situation -Low productivity (planting season, survival rate, pollination; growth rate are all affected)	- Recognize the value of water as "Blue Gold" (no longer a free commodity), - Preserve forests. - Create/conserve/ Protect existing water source - Rain water harvesting - Effective management of community tanks - Protected cultivation	H
4. Fire	Cultural factor (hunting), incidental	loss of plantation, agroforestry, forest, water scarcity, species biodiversity; increased GHGs emissions	-Awareness campaign on the affect of fire, - Documentation of the best practices of traditional fire management for policy advocacy.	M

5. Poor Development Research to know farmers' (men/women) perspective, needs and interests to secured livelihood and income generation.	- Gender blind – with a notion that both men and women have the same needs and interests. - Lack adequate institutional support; financial constraints	- Poor knowledge about farming families and food security. Thus, blur for intervention strategy. - Effects in the level of development results. - The poor - mostly women, climate change may not be an issue, but getting an immediate secured livelihoods may be a concern.	Participatory planning with community (men/women) to identify priorities, needs and interests. - Action research to address identified problems and priorities. - Capacity building through action research to change the mindset of all boundary partners.	H
6. Natural Calamities (Drought, Flood)	- Human activities in disturbing ecological balance - Forest Degradation - Biodiversity Loss	- Disturbs Food Chain - Degrades Ecosystem Services - Species Extinction - Poor Productivity - Increase Vulnerability	- Community awareness Campaign on Natural Resources degradation, conservation and protection - Document the best traditional management practices of Natural Resources of each tribe for policy advocacy.	H
7. Land holding system	Traditional land ownership rights	Scattered/fragmented land holding pattern of the Nagas, who have less than 5 hectares in a compact area may be excluded from the project.	Develop an alternative option with primary objective to enhance household nutrition, income and green cover for farmers with small land holdings below 5 hectares.	M

Soil & Water Conservation Department

Degradation of both arable& non-arable land	1) Extensive & intensive Jhuming 2) Degradation of forest 3) Population pressure	1) More soil erosion 2) Loss of soil fertility 3) Low yield 4) More siltation 5) Degradation of vegetation	1) Land Development in the form of Bench Terracing, Contour Bunding Half Moon Terracing for arable land. 2) Conservation forestry for non-arable land.	H
Sustaining agricultural productivity	1) Rainfed agriculture 2) Non adoption of conservation measures	1) Low productivity 2) Food shortage	1) Land development to conserve soil & soil moisture in-situ for sustainable	H

			permanent cultivation. 2) Promotion of conservation agronomy.	
Conserving water for sustainable agriculture	1) Rapid surface runoff water 2) Low retention of moisture in the soil 3) Drying of water Systems	1)Drought like situation 2)Low yield	1) Development, conservation & management of water bodies 2) Construction of multipurpose water harvesting ponds 3) Integrated Watershed Management	H
Ground water recharge	1) Poor seepage 2) Loss of vegetation 3) High intensity rainfall	1) Land degradation 2) Low water table 3) Moisture stress	Construction of WHP, farm ponds, embankments, contour trenching etc.	M
Drinking water security	1) Degradation of catchment area	1) Drying of water source 2) Shortage of water 3) Poor health & sanitation	Treatment of catchments areas with conservation technologies like forestry, desiltation structures, drainage etc.	M
Natural calamities like floods, landslide etc.	1) Erratic rainfall 2) Degradation of forest 3) Faulty agricultural practices 4) Poor drainage systems	1) Extensive soil erosion 2) More siltation 3) Damage to agricultural land 4) Damage to life & properties	Adoption of natural resource conservation measures	H
Land ownership system	Traditional rights/ownership on land & water sources	1) Problem in bringing land under permanent cultivation 2) Hampering developmental activities	1) Change of ownership 2) State Land Use Policy	H
Fisheries Sector				
Entry of pollutants/effluent in the fish farm	Industrialization and use of chemical fertilizers	Depletion of biodiversity and occurrence of water born diseases	To establish fish farm away from industrial area	H
Illegal/unethical fishing methods	Use of fishing methods such as river poisoning, electric fishing, dynamiting etc.	Depletion of natural stock and effect on health.	Involve village community/administration in controlling unethical fishing methods.	H
Poor production of	Poor management of	Huge economical	Need to adopt "	H

fishes	fish farm/Traditional fish farming method	loss.	Intensive" fish farming methods and scientific way of farming.	
Juvenile fishing	Unethical fishing	Depletion of natural stock Huge economical loss.	Regulation of mesh size of fishing nets	M
Obstruction of fish migration	Construction of barrages and dams/weirs	Depletion of natural stock Huge economical loss.	Construction of fish ladders/pass.	M
Research,Training & Extension	Lack of researches	Lack of technical know how	To train fish farmers	H
Development of marketing infrastructure	Lack of cold storage	Perishes local produces causing huge losses to farmers	Construction of ice plant &cold storages	H
Veterinary Sector				
Poor production of Animals	Poor management of farm /Traditional farming method	Huge economical loss.	Need to adopt " Intensive" animal farming methods and scientific way of farming.	H
Illegal transportation of Animals	Introduction of new diseases	Depletion of natural stock and effect on health.	Involve village community/administration in controlling unethical farming methods.	H
Entry of pollutants/effluent in the Animal Husbandry farming	Industrialized farming	Depletion of biodiversity and occurrence of water born diseases	To establish animals farm away from industrial area	M
Entry of pollutant in the fodders	Due to rampant use of chemicals and pesticides	Adverse effect on animal and human health	Need to adopt cross seeds & drought resistance fodder.	M
Lack of identification of alternative crops to Jhum cultivation for farmers	Rampant destruction of Livestock (Mithun & Thotho) habitat	Population of livestock (Mithun & Thotho) in decreasing trend	Conservation of forest and converting Jhum land into forestation for development, conservation and propagation of Livestock (Mithun & Thotho	H
Placement of subject matter specialized in right place	Poor management and cruelty to Animals	Prone to risk on animal and human life	Placement of professional at the right place. Eg. Zoological parks, Slaughter houses.	H

Irrigation & Flood Control				
Gap between irrigation potential created and its utilization	a. Mono-cropping practices. b. Lack of land development in the command area. c. Improper water distribution amongst the users.	a. Agriculture productivity is low	a. Land development and agriculture extension services to be incorporated along with Irrigation Projects. b. Implementation of Rotational distribution of Irrigation water through PIM.	M
Damages of Irrigation infrastructure due to natural calamities	a. Flashfloods b. Landslides	a. Farming activities are abandoned in the command area b. High cost of repair, renovation and restoration	a. Restoration of Damaged Structures.	M
lack of funding under operation and maintenance	a. Lack of Budgetary support from the State Government.	a. Low utilization of Irrigation Potential created.	a. Provide budgetary support to the WUAs through PIM.	M
Water rights and land ownership	a. Village/ community/ land owners specific traditional rights	a. Hampering the implementation of the developmental programmes	a. Sanitization of the stakeholders.	L
Water management	a. Unregulated use of water resources b. Non efficient use of Irrigation water in the field.	k. Low productivity	a. Provide efficient water distribution mechanism. b. Capacity Building of the WUAs in Water Management.	H

Progressive depletion of River discharge	a. Deforestation	a. Design Canal Discharge is not fully realized b. Low Productivity	a. Catchment area treatment.	H
7. High rate of Silt Load.	a. Deforestation b. Jhuming c. Developmental Works; Roads, Township. d. Landslide	a. River meandering b. Bank Erosion c. Flash Flood	a. Catchment Treatment b. Sustainable developmental planning. c. River training works d. Anti-Erosion measures.	H

Climate Change Studies

Issues/concerns	Causes & Signals of concern	Impacts/risks	Opportunities	Need for action
Local mine/quarry owners/land owners' unscientific mining.	Lack of awareness about mining rules and regulation, no regulation within the community	Casualty, loss of life, Loss of resources, premature mine closure, environmental damages, local climate change etc	Organize and impart awareness, adequate input on scientific mining policy, plan, development etc	H
Coal Mining in Nagaland	Commercial benefit; availability of minerals; demand in the market etc.	Landscape and environment degradation, health hazards, local climate change, etc.	Rehabilitation , reclamation and re-vegetation of the mined out areas	M
Limestone mining including cement factory.	Commercial benefit; availability of minerals; demand in the market etc.	Landscape and environment degradation, health hazards, local climate change etc.	Rehabilitation , reclamation and re-vegetation of the mined out areas, develop abandoned mine/quarry into public utility etc	L
Mineral road and infrastructures	Easy and economic accessibility	Degradation of forest and landscape, increased surface runoff leading to poor ground water recharge, local climate change etc.	To plan and set up cost-effective value added industry in the vicinity of mineral deposit,	M
Surface water security	Forest degradation, increased runoff and hence inadequate recharge of aquifers, increased population, unplanned urbanization , infrastructure	Scarcity of water, lowering of ground water peizometric level, depletion of forest, local climate change etc.	Develop water harvesting structure; regulate efficient and equitable distribution of water, developing water sanctuaries,	M

	development and resource exploitation such as roads, mining, etc.		identification of important catchment areas etc.	
Ground water exploitation	Scarcity of surface water; increase in population, infrastructure development etc.	Depletion of groundwater level, over exploitation of groundwater etc. depletion of forest, local climate change etc.	Rain water harvesting, Ground water recharging projects in catchment areas, Monitoring of groundwater level and perennial springs	M
Water contamination and pollution	Natural resources through dissolved solids and chlorides, Iron & magnesium, nitrates; Human activities like waste disposal practice , septic system, mining practices; Agriculture activities like fertilizers, pesticides, irrigation etc.	Health hazard, degradation of ecosystem	Develop water quality testing lab.(physical, chemical & biological parameters); Frame rules & regulations	L
Decreasing snow line.	Logging, jhuming, shifting cultivation, jungle burning etc.	Drying up of streams and rivers, deficient groundwater recharge, local climate change etc.	Develop monitoring system of snow line behavior (visual / telescopic) of Mt. Saramti, Chotta Saramati Khaliaking, Japfu,Dzukou etc.	L
Geological hazards	Earthquake, landslide, other mass movements etc	Changing landforms and landscape, natural calamity, loss of property , local climate change etc	Mitigation and monitoring works, installation of V-SAT surveillance, piezometer, inclinometer, Meteorological observatory station etc	M
Aeration and change of river course	Degradation of forest, excavation of river pebbles, flood currents etc	Depleting water level, riverbank erosion, change in landforms, etc.	Mitigation and monitoring works, GIS & Remote Sensing	L
Spillage of crude oil and natural gad at Changpang oilfield Flash flood in the foot hills	Exploratory oil drilling and extraction Debris and rock avalanches and deforestation.	Degradation of soil and vegetation , contamination of surface and ground water , fire hazard Loss of lives and properties, damage of utilities, defacing landforms.	Sealing/capping/plug ging /of spillage/leakage well and removal of spilled oil Loss of lives and properties, damage of utilities, defacing landforms.	

Energy Sector

Issues/concerns	Causes & Signals of concern	Impacts/risks	Opportunities	Need for action

New & Renewable Energy				
Emmission of GHGs	Use of fossil fuels for energy generating stations	Long term climatic changes, environmental degradation	Use of Renewable and green energy to reduce carbon emmission, promote SSIs	H
Dependency on grid connectivity for basic energy needs	Local energy generation not accesible. Widening of demand supply gap	Energy security absent. Multifaceted social progress slowed down	Providing cost effective decentralized mode of renewable energy generation to communities thereby reducing dependency on grid connectivity which is also at the same time enviroment	H
Continued pratice of old techniques	Lack of knowledge, technical know-hows, habits and ignorance	May degrade present environment. Loss of biodiversity, financial losses	Impart trainings, conduct awareness campaigns, facilitate as agent of information provider	M
a) Switch to LEDs, CFLs, etc., enhancing reduction in usage of Incandenscent bulbs	Age old habits and ignorance, accesibility and associated costs	Economic loss, more energy consumption facilitating dependency on central grid Economic savings	Economic savings	M
b) Adapting capacity of communities through use of solar cookers, biogas, smokeless chulla and electric cookers reducing the use of fuelwood and other fossil fuels susch as kerosene and LPG	Age old habits - traditional kitchens, ignorance, accessibility and associated costs	Health risks for children and women, degradation of forest	Overall improvement in quality of living, gender equity, economic savings	M
Power				
Low power generation	Inadequate internal resources, lack of funding, weak investor environment.	1. Effect on the overall economic developmental activities. 2. Spent huge amount in power purchase. 3. More T&D losses leading to more emission from the source. 4. Energy security	1. Develop additional hydro power projects. 2. Develop thermal plant to streamline rampant coal mining thereby reducing environmental concerns at source	H

High AT&D losses	1. Power theft 2. In-efficient billing mechanism 3) Technical losses - old equipment	Contribute to the loss of Govt. revenue and higher energy consumption.	1. Modernization of equipment 2. Streamline Revenue management 3. Capacity building on new technologies	H
Environmental concerns, loss of natural resources	Rampant and uncontrolled exploitation of natural resources	Environmental Pollution, degradation of land and forest, health issues	1.Adopt mining policy 2.Regulated mining/scientific techniques 3.Thermal Power Plant with Clean coal technologies	H
Industries				
Industrial wastes	Environmental pollution	Health hazards	Recycling of waste materials to reduce carbon emission.	L
Dependence on grid connectivity for various industrial Units and Industries other than Village & Small Scale.	Non-availability of local energy generation and inability to supply required energy by the concerned Department	Energy security absent . Multifaceted social progress slowed down	Use of various renewable energy.	M
Wastage of seasonal vegetables/food crops etc.	Absence of Cold storage facilities and ready markets.	Decay of vegetables/food crops emits methane gas.	Functionality of Cold storage and SEZ for ready markets.	L
NEPeD				
Emmission from energy sources	Increase in green house gas	Global Warming	Explore renewable energy sources like solar, wind and small hydro energy	M
Accesibility of energy to rural communities	Prohibitive Cost and affordability	Cross-cutting social development	1. Providing affordable, eco-friendly energy servcies, catchment area conservation, afforestation, community reserved forest 2) Dissimination of RE Technologies - Trainee (human resource development) 3) Local energy services	H

Forestry Sector

Issues/concerns	**Causes & Signals of concern**	**Impacts/risks**	**Opportunities**	**Need for action**
Degradation in the extent and quality of forests	Traditional agriculture practices, increasing population, forest fire,	Loss of biodiversity, habitat fragmentation, loss of ecosystem services.	Afforestation, creating community conservation areas, incorporating mountain specificities for	H

	logging, unplanned infrastructure development, soil erosion moisture stress.		sustainable development policies.	
Loss of biodiversity	Habitat degradation & fragmentation , hunting.	Species disappearance; low habitat integrity; low capacity to cope climate change challenges	Creation/restoration of forest corridors & sacred grooves, creation of CCAs	H
Fire & other Disturbances	Anthropogenic & Natural	Forest degradation; loss of biodiversity; increased emissions of GHGs	Develop appropriate management plans, awareness creation, Deploying fire fighting tools in sensitive areas.	H
Logging	Commercial benefits	Forest degradation; Loss of biodiversity/ecosystem services	Alternative livelihood incentives (PES), develop frame work to regulate market pressures.	M
Dwindling Water security	Forest degradation, increased runoff and hence inadequate recharge of aquifers, increased population, unplanned urbanization , infrastructure development and resource exploitation such as roads, mining, etc.	Health & Sanitation, lowering of ground water table leading to moisture stress and more forest degradation	Develop water harvesting structure, develop and promote norms for efficient use of water, equitable distribution of water, developing water sanctuaries, identification of important catchment areas and its conservation	M
Unsustainable agricultural practice	Shortening of jhum cycle, increased soil erosion and scarcity of wild food resources	Declining productivity; forest degradation & loss of biodiversity	Strengthening agro-forestry in jhum lands	M
Biological invasion	Forest degradation	Loss of biodiversity; loss of livelihood opportunities	Planned restoration of degraded forest land	M
Poor documentation of flora and fauna	Lack of adequate institutional support; financial constraints	Poor knowledge of biodiversity and impact of climate change on flora & fauna and hence lack of climate change strategies to assist species.	Creation/establishing centres for environmental & biodiversity studies, capacity building	M
Bio-piracy	Lack of documentation of Traditional Knowledge System; lack of policy support	Economic deprivation	Maintaining community Biodiversity Register, Creating digital database, Capacity building.	M
Mining	Commercial benefit; availability of minerals; no regulatory framework in place.	Landscape and environment degradation	Develop Environmental Management Plan, land rehabilitation / reclamation plans/strategies	M

Lack of Alternative or improved technology (Forest resource utilization)	Lack of policy and institutional support, remoteness/ poor connectivity	Forest degradation; increased pressure on forest with increasing population and growing consumerism	Identifying and creating alternatives with the help of enabling policy and institutional support	M
Inadequate research and climate change related information.	Poor infrastructure; lack of adequate finances	Lack of adequate data/information to frame appropriate adaptation & mitigation strategies	Establishing center for environment studies, generate information to minimize climate change impacts on biophysical, socio- economic systems, multi-sectoral convergence; enhanced participation with local communities; developing alternative livelihood; Promoting & protecting Indigenous Knowledge System.	M
Conservation development dilemma (Trade-off)	Increased consumerism; Infrastructural development	Forest environment degradation; habitat fragmentation; bio invasion; loss of biodiversity	Rethink development paradigms, developing mountain specific norms.	L
Land tenure system	Traditional rights/ownership on forests	Implementation of National and State conservation policies	Developing a participatory forest management system	L

Health Sector

Issues/concerns	Causes & Signals of concern	Impacts/risks	Opportunities	Need for action
Increase Outbreak of Diseases	Due to increase in temperature and humidity there will be paradigm shift of disease pattern from climate change: a. Increase transmission windows for Malaria and other vector borne diseases. i) Dengue fever ii) Japanese Encephalitis (JE) b. Increase outbreak of water borne diseases, eg. Cholera, Typhoid, c. Increase respiratory infections due to air pollution: Asthma, Tuberculosis. d. Others i) Malnutrition ii) Dehydration, etc.	a. Malaria is a single largest disease killer b. Increase morbidity and mortality c. Low socio economic status and slum dwellers	a. Set up State Diseases investigation Laboratory and Research Centre with Bio-Safety Level III. b. Expand the health care and infrastructure to meet the expected rise of OPD and IPD cases c. Deploy latest means of scientific drugs and technology to combat the diseases.	H
Research and Development	a Absence of Infrastructure including experts/specialist in	a. Lack of understanding	a. Setup State Disease Investigation and	H

Infrastructure	various disciplines. b. Constraints of fund c. Ban in creation of post	the disease behavior and patterns, b. Delayed response to epidemic	Research Laboratory with Bio-safety Level III standard c. Study Vector biology/ disease pattern d. Capacity building e. Strong monitoring and evaluation.	
Poor sanitation and waste Management (liquid and solid)	a. Lack of proper planning b. Lack of financial resources c. Low awareness	a. Outbreak of diseases b. Breeding of mosquitoes and vectors including rodents ,flies, Rodents etc. c. Increase of morbidity/mortality due to diseases like Malaria, JE, Dengue Diarrhea, Cholera and other Water borne diseases,	a. Develop proper Bio medical waste Management system in all Districts.	H
Low awareness of health care	a. Poor literacy and difficult terrain b. Poor communication among the Multiple tribes without a common language. c. Poor outreach of print and electronic media in the villages. d. Poor health seeking behavior. e. Inadequate financial resource.	a. Lack of personal hygiene and Sanitation b. Poor Health status c. Poor access to health care services.	a.Intensify ICE/BCC activities. b.Improvement of transport communication c.Develop relevant Electronic and Print Media materials and programmes.	M
Influx of population from neighboring states/country	Due to difficult climate changes (flood, drought, property, business, etc.) people may migrate to hilly areas	a. Transmission of communicable diseases which otherwise is not normally prevalent. b. Socio economic impact c. Effect on the social cultural practices	a. Develop proper screening methods for infected migrants b. Strengthen Sentinel Surveillance .	L

Information Technology	Poor infrastructure and connectivity	a. Lack of access to Information Technology hampers all programs planning and implementation b. Slow response to epidemics c. Access to latest medical technology and treatment, etc.	a. Develop proper infrastructure for IT b. Organise Training for official and staff at all levels Develop infrastructure to address Climate change : i. Bio medical waste ii. Solar refrigerator. iii.Energy efficient Air Conditioner. iv.Safe drinking water plants. v.Internet connectivity/ Tele medicine. vi. Expansion of Health centres for increased Outdoor and Indoor cases.	M
Poor Health Care Infrastructure	Lack of Infrastructural facilities related to Climate Change.	Inadequate coverage on patients at the Health centres on climate change related services.		H
Vulnerable Population	i. Malnutrition ii. Lack of Food security	Climate Change is expected to impact the vulnerable population first, eg Infants, Elderly, Differently abled persons , BPL families. etc	i, Built up support system for nutritional supplement . ii, Food security. iii, Livelihood opportunities. etc.	M

Livelihood Sector

Issues/concerns	Causes & Signals of concern	Impacts/risks	Opportunities	Need for action
Poverty	l. 1. Poor choice of crops at given m. time. n.2. Lack of technology. o.3. Due to the traditional type of p.farming q.4. Unable to employ fully r. leading to poverty. s. 5. Low productivity	1. Starvation and Diseases. 2. Malnourishment and low birth rate	1.Issue job card to all the villagers under NREGS. 2. Imparting improved Technologies through extension educations	H

	per unit t. area. u.6.Due to social Customs.			
Insufficiency in food grains	1. Traditional and subsistence farming.	Depending on other area	1.Use of manure and fertilizer to boost up the productivity of the land 2. Use of good quality seeds. 3. Utilization of land according to Land capability class	H
Promotion of purchasing power in the rural area	1. Poor harvest and income. 2. Poor livestock management.	1.Education and health care affected. 2. Exploitation of natural resources.	1. Farm visits 2. Supply of good seeds and planting materials. 3. Subsidizing Form Machinery and equipments.	H
Landless Farmers	1. Shortage of cultivable land	1. Exploitation by the Land owners.	1.Indoor Farming eg: mushroom Cultivation, Carpentry, Black smiting, Kitchen gardening etc	M
Poor Livestock production	1.Poor management	1.Importing meat from other state.	Training and awareness programme. Free lance services from the expert.	M
Sustaining agricultural productivity	Shortening of jhum cycle, increased soil erosion and scarcity of wild food resources	Declining productivity; forest degradation & loss of biodiversity	Strengthening agro-forestry in jhum lands	M
Jhum Land Act	Prejudice Unsustainable cropping	Limiting livelihood	Rich Agro Biodiversity	Policy Amendment

Urban Planning Sector

Issues/concerns	**Causes & Signals of concern**	**Impacts/risks**	**Opportunities**	**Need for action**
Urban development				
Non-Availability of Land	Peculiar land tenureship	Development works are delayed, costlier	Involve Community based NGOs, Youths. Enact Urban Land Policy.	H
Lack of sufficient manpower	No. of posts within the Department is very less compared to other Deptt. to enable the Department in preparin Master Plan	Affects preparation of Master Plan, Development Plans, DPRs etc	Either create more technical posts or engage consultants	H

Landslides/ soil erosion	Poor soil bearing capacity, Absence of proper drainages	Loss to property, risk to life, damage to infrastructure	Channelise more funds for soil erosion protections	H
Limited capacity of ULBs	Not properly organized	Limited ability to manage the towns	More capacity building programmes, Establish Institutions for ULBs	M
Unscientific handling of Solid waste	Lack of sufficient resource/manpower with the ULBs	Unhygeinic environment	Channelise resources such as JNNURM other EAP in solid waste management	M
Floods in Dimapur	Low laying area and absence of proper drainage system	Health hazards and loss of property	Preparation of Comprehensive Drainage Plan for the Dimapur city	M
Traffic congestion	Less road, less parking, too many private vehicles, inefficient public transport system, no by-passes, poor road conditions, narrow roads.	Waste precious time in the traffic, more pollution	Improvement of existing roads, construction of by-passes, improvement of public transport system. Enact State Transport Policy, Preparation of Comprehensive Transport Plan.	H
Transport				
Vehicular air pollution	Use of old age vehicles and non maintenance of vehicle	Emission from vehicles mainly CO,HC,NOX are injuries to health.	- Proper checking facilities will improve and control the emission level. - Development of pollution free vehicles and use of emission free alternative fuels (electric Cars).	M
Road congestion & Parking congestion.	Non expansion/ improvement of roads and infrastructure and improper traffic management and traffic engineering.	Low operating speed of vehicles result into burning of more fuels and more emission thereby affecting the climate change.	Proper parking and good infrastructure facility like developing parking areas for public vehicles, developing parking areas in existing residential for private vehicles.	H
Poor public transport system	a. Inadequate bus/taxi services in the rural sector b. Lack of parking facilities for goods carrier vehicle in the urban sector.	Encourage public to use more personalize vehicle than the public transport system because of poor quality thereby more private vehicles are increased and also the	Development of bus/truck terminus, mass transport system for commuters in the form of mono rail/rope ways etc.	H

		infrastructure will not be sufficient to sustain this problem in the long run which will not only cause traffic problem but more vehicular emission.		
Nagaland Pollution Control Board				
Increasing Population In The Urban Centres Leading to i. Congestion ii. Water Resource Depletion iii. Air Pollution iv. Water Pollution/River Pollution v. Noise Pollution	Population pressure Four air pollutants viz., Sulphur Dioxide (SO_2), Oxides of Nitrogen as NO_2, Suspended Particulate Matter (SPM) and Respirable Suspended Particulate Matter (RSPM) are being monitored by NPCB in Dimapur and Kohima. Based on the records, the average concentration of RSPM was found to exceed the permissible limits of 100µgm/m^3 (National Standards). The main cause for the increase of particulate matter in the dry season is because of the dust –from stone crushers, bad roads, construction and commercial activities, vehicular emission One cause for the pollution of the river is that there is no sewage treatment system Bursting of fire crackers during new year, Christmas & Diwali particularly in Dimapur and Kohima	Deterioration of environment especially in urban areas and health risks Various Health problems Pose a threat to human health consuming this water and disturbing the marine ecosystem Loss of hearing power, lack of concentration, headache and other health problems	Implementation of the Environment (Protection) Act, 1986 and rules framed thereunder Relocation of polluting industries, improvement of roads, comply with vehicle emission standards Proper Sewage system To comply with the Noise Pollution (Regulation & Control) Rules, 2000, Create awareness	H

Land degradation	i) Quarrying ii) Mining iii) Random construction of roads	Loss of top soil and activating landslides	Proper Planning, Create awareness, Follow mining rules	M
Disaster Management				
Landslide	Loss soils in the state and Jhumming cultivation and cutting of trees	Impact on social and economy of the State		H
Conditions of building structures especially in Kohima	Lack of awareness and other related issues such as land/space	Most building structures in the State capital are less resistant to earth quake or any disaster (fire, landslide). If a major earth quake strike most buildings will collapse and many life and properties will be damaged.	Enforcement of building by-laws and retrofitting of the buildings especially schools and colleges and pulic buildings.	H
Forest Fire	Natural and manmade causes	environmental hazard, and damage to spices	Mitigation and training of villagers on fire fighting.	M
PWD (Housing)				
Local method of house construction(Thatch house)	Locally available material with low cost	Shorter life with less facilities	Unskilled labour employed. Shorter time for construction.	L
RCC building	Building materials from market with high price	Longer life with more comfort. Pollution during construction	Proper/better arrangement for habitation	M
Architectural design building	Economic arrangement of space,more beautiful living.	More expensive. Not affordable for lower people	More hygiene ,safe and sound	M
Maintenence	Require time to time renovation	More risk in old age	Plan for restoration maintain longer life	L
Green compound	Maintenance	More expensive for maintenance, more space required	Better habitation	L
PWD (R&B)				
Landslides	Destabilizing the natural soil stability during road construction	Road blockage		H
Subsidence	Deforestation	Accidents and damage to buildings and other structures		H
Road damage	Quarrying works	Economic impact/Road Damage		H

Priority: H=High (Importance is high and constraints are minimal); M=Medium (Importance is high but constraints are also high); L=Low (Importance is low)

Annexure 3 : State Government Initiatives on Climate Change Adaptation

Phase I and Phase II Projects of NEPED

NEPED was Nagaland's first foreign aided project funded by CIDA (Canadian International Development Agency) under ICEF (Indo-Canada Environment Facility). NEPED was implemented in two phases -- the first phase started in February 1995 and ended in March 2001. The second phase-commenced operations from April 2001and ended in March 2006. The first phase of the project was called Nagaland Environment Protection and Economic Development through People's Action. The programme undertook a project for planting trees along with jhum (swidden or slash and burn) cultivation practiced by the tribes of Nagaland. The second was called Nagaland Empowerment of People through Economic Development and centred on creating a microcredit mechanism in the villages, through which a paradigm shift from subsidy-oriented mind-set of the people towards self-reliance was created. In both the phases, the project was implemented by a team of government officers drawn from various government departments and is called the Project Operations Unit (POU). A Team Leader who is also a senior Secretary level bureaucrat to the GoN heads the POU. NEPED is currently on a third phase, and additionally focuses on rural energy interventions through pico-hydels, apart from undertaking a range of initiatives to consolidate its work from earlier phases.

NERLP

The development objective of the NERLP is to improve rural livelihoods, especially that of women, unemployed youths and the most disadvantaged, in the participating North Eastern States. There are four components to the project. The first component is social empowerment. The objective of this component is to empower the rural communities, create sustainable institutions so that they manage common activities around microfinance, livelihoods, and natural resource management. The second component is economic empowerment. The objective of this component is to develop the capacity of rural communities to plan and manage funds for various economic initiatives and common public-good activities. Third component is partnership development. The objective of this component is to partner with various service providers, resource institutions and public and private sector organizations to bring resources such as finance, technology, and marketing into the project so that the community groups and organizations are able to improve their livelihoods. The fourth component is project management. The component will facilitate various governance, implementation, coordination, learning, and quality enhancement efforts in the project.

NECCAP

The State is currently in the early stages of implementing the NECCAP, a multi-year initiative supported by the German Development Bank, KfW, through MDoNER, GoI. The overarching goal of the project is to minimise vulnerability due to climate change and enhance adaptive capacity of rural population in Nagaland who are heavily dependent on natural resources for their sustenance. The project seeks to:

- Increase food production in Jhum and traditional cultivation;
- Enhance water security of the vulnerable population in lean periods and decrease in diarrheal diseases;
- Improve the ability to cope with extreme events such as extreme rain and floods;
- Enhance earnings of the majority of the households dependent on the natural resource based livelihoods;
- Improve overall coping capacities of population in targeted villages through improvement in social infrastructure to be attained through convergence with other projects and programmes in these villages;
- Improve access to water, access to markets, access to health services, electricity, and education facilities; and

- Reduce overall vulnerability of the State, resulting in improved vulnerability indices of natural resources

Nagaland University

The Department of Geology, Nagaland University in collaboration with the Space Applications Centre, Ahmedabad and the Department of Science & Technology, New Delhi took up research projects mainly for Micro-Hazard Zonation Mapping for landslides of Kohima Town, The NH 39 between Chumukedima and Kohima, Kohima and Senapati (Manipur), and the NH 61 between Kohima Town and Zhadima Junction.

Nagaland Pollution Control Board

The NPCB constituted with a view to protecting the environment and preventing and controlling pollution in the State of Nagaland. Some of the key activities of the board are:

- Comprehensive programme on testing water, air, land etc., pollution control and execution thereon and advice and liaison with the State Government on any matter concerning environmental pollution;
- Collection and dissemination of data and information on pollution and environmental problems and preparation of reports thereon. Investigation and research relating to pollution and environmental problems;
- Collaboration with the programmes of the Central Pollution Control Board, MoEF, State Government, NGOs and other organizations relating to pollution control and environment and organize Mass Education Programmes;
- Issue of consent to establish/operate to industries and other development projects and advise the State Government regarding location of industries, etc.; and
- Monitoring of industrial/trade effluents, water bodies, air and soil, and laboratory analysis thereon.

Directorate of Geology and Mining

The directorate of geology and mining perform following activities:

- Studies of landslide of various locations/places in Nagaland;
- Preparation of landslide hazards maps of NH 29;
- Geological hazards studies of 6 districts headquarter township of Dimapur, Kohima, Wokha, Mokokchung, Zunheboto and Phek;
- Geo-environmental studies;
- Groundwater investigation and exploration in the plain and hilly areas;
- Monitoring of groundwater levels in the observatory wells through the state;
- Enforcement of mine closure plan in all relevant open cast coal mines; and
- Monitoring of crude oil spillage at Champang oil field etc.

Kohima Science College

Main objectives of the Atmospheric Physics Research Laboratory of Kohima Science College are:

- To classify cloud types from satellite imageries at visible, infrared, and microwave frequency bands;
- To develop rainfall estimation algorithms by using satellite imageries at various frequency bands and its validation;
- To study rain climatology and its variability; and
- To study raindrop size distribution in association with cloud characteristics.

Department of Science and Technology

The Department of Science & Technology is primarily concerned with the promotion and development of new areas of science & technology and coordination of multi-institutional and inter-disciplinary activities of national relevance which could be gainfully utilised for all round development of Nagaland, including, sustainable development of its Environment and Ecology. The department is the nodal agency for implementing activities relating to non-conventional energy sources. Under this mandate a survey on wind energy potential is being carried out in a few selected places to study the feasibility of wind power projects.

Department of Soil and Water Conservation

The department does classification of soil resources in the state scientifically by conducting systematic survey for soil research and long term land use planning. Soils based on classification are grouped, sub-divided, and regrouped to permit the largest number and the most precise predictions possible about responses to management and manipulation. The department also collects climate data on a regular basis from the meteorological stations and provides analysed information to other departments for taking actions. The department also implements watershed development activities.

Climate Change Leaders

The Climate Change Leaders (CCLs) initiative was developed by the Leadership for Environment and Development (LEAD) India programme as part of an effort to build, sustain, and network a new and emerging leadership network for Climate Change in India. Nagaland currently has eight CCLs, and these come from different background from forestry, agriculture, research scholar to engineers and working in different fields NGOs, Government employees and freelance. The CCLs were the leaders in creating an affective awareness on Climate change issues in Nagaland from meeting the Governor and Chief Minister to highlight the importance of recognizing the issue of CC, to writing in the local dailies on the various effects of climate change being faced in Nagaland and also visiting schools in Kohima and Dimapur.

The world event of Earth Hour was initiated by the CCLs in Nagaland, which was supported by the Government and the public and has now become a yearly event observed by the people. Although the CCL do not meet regularly since last year they do have an active network within sharing ideas and highlighting issues of climate change faced locally in any platform offered. The CCLs are also individually linking up with NGOs having concern for our environment and providing them with guidance and leadership.

Annexure 4 : Key programs implemented by Agriculture

No	Programme	Programme focus	Strengths/Gaps
1	Nagaland Agriculture Marketing Board	To provide marketing support farmers	Scattered nature and remoteness of villages make market access to farmers is difficult, demotivating them from increasing production.
2	Formation of cropping zones	To generate marketable surplus production within a concentrated area.	Farmers get more options to produce market demand driven crops.
3	Organic Cultivation	To make state as organic and in long help farmers to get premium price for their produce.	Potential organic markets are yet to be explored. Need to control use of excessive fertilizers and pesticides
4	Rashtriya Krishi Vikas Yojna (RKVY)	To achieve 4 percent agriculture growth.	Productivity of several crops have increased
5	Distribution of Improved seeds	To increase the productivity and ensure higher income to farmers	Too much dependence on outside for HYV. Higher threat for local varieties in a long run is observed if the state continuously depends on HYV.
6	Manure and fertilizers	Improve the soil fertility and production	Contributing to productivity augmentation but against organic .
7	Research and development through State Agriculture Research Station (SARS)	To conduct need based technical research	Research focus on traditional varieties and their adaptation capacities to increased temperature seems to be not on the agenda
8	HRD through Integrated extension training centre	To build the capacities of farmers and field staff	Extension system is mainly confined to input distribution Farmers suffer from lack of timely advices on good management practices.
9	Sustainable development of sugarcane based cropping system	To encourage the farmers to take up sugarcane based cropping system for enhancing the income	It is a high water intensive crop. Without assurance of timely irrigation productivity may be difficult…
10	Pulses development programme	To popularize both traditional and non-traditional pulses production in the state.	There is a scope for increasing he productivity as the state has high potential
11	Oil seeds development programme	To popularize oil seed cultivation in the state with modern technologies to achieve self sufficiency and improve economic	Contribute to productivity enhancement but with weak extension system adoption of technologies may take longer

No	Programme	Programme focus	Strengths/Gaps
		condition of the farmers	time.
12	Maize development programme	To encourage farmers to take up both high yielding varieties as well as local cultivars.	Contributing the productivity enhancement and protect extinction of local cultivars
13	*Jhum* intensification and extension of cropping phase	To increase the *Jhum* cycle for increasing productivity by adopting improved farming practices and indigenous fallow management system.	More area has to be brought under permanent agriculture. Productivity in *Jhum* area increased
14	National Watershed development project for rain fed areas (NWDPRA)	To take up micro watershed projects and treat land for improving productivity	Improves the soil strength and contribute to the productivity enhancement
15	Farm mechanization	To improve efficiency in farming operations.	Mechanization improves farm efficiency in the farm operations and addresses the shortage of labour issue.

Annexure 5 : Key Programmes Implemented by the Department of Animal Husbandry

No	Programme	Objectives	Strengths/gaps
1	Bovine development	To improve milk productivity of local animals through crossbreeding programme.	Through cross breeding programme the crossbred population increased to more than 45 percent. Monitoring of blood levels in the field is lacking resulting in increased exotic blood levels which in long turn can impact the productivity
2	Cattle induction	To improve milk production by inducting superior quality animals	Lack of timely health and extension services may jeopardize the programme
3	Community dairy project	To improve income levels of poor farmers through dairy programme	To ensure higher yield it is essential to feed animals with quality feed and fodder which is a key constraint in current situation
4	Model dairy project	To create milk marketing facilities through milk processing units.	Location of units still seems to be not ideal which is the reason contributing to low capacity utilization of dairy plants.
5	Poultry and duck development	To improve local germplasm through supply of quality checks.	The growth of the poultry sub sector is showing encouraging trend. However, lack of preventive health services seems to be a setback.
6	Sheep and goat development	To improve quality of small ruminants through supply of quality kids.	The programme is contributing to growth of the sector.
7	Feed and fodder programme	To demonstrate good management practices in feeding through establishing farms	The programme require intense extension service and will require a long term programme before villagers realise the benefit of stall feeding and fodder production is inculcated into their farming system
8	Piggery development programme	To improve quality of local pigs ruminants through supply of superior quality piglets.	Monitoring seems to be a weak area. This is attributed to low weight gain in pigs.
9	NEPED	To improve quality of pigs through selective breeding and building capacities of farmers.	The approach contributes to adaptation of local breeds to local conditions. However, monitoring the performance of local animals seems to have not been documented.
10	Swarnajayanti Gram Sawrozgar Yojana (SGSY)	To enhance incomes of poor through implementation of pig rearing programme.	Pig rearing through community mobilization will upscale good practices in a shorter duration.

Annexure 6 : Key Programmes of the Fisheries Department

Sl.No	Programme	Objective	Strengths/gasps
1	Extension and Training	To build the capacities of marginal and progressive fish farmers on Intensive Aquaculture in Ponds and Tanks, Value Additions, Ornamental Fisheries	Contributing to increased production. But the limitations of department human resource could slow down the extension activities
2	Development of Natural Water Bodies	To bring unutilized resources by involving communities	Increase in area has contributed to more production and gradual reduction in dependence on out side the state still the lot of potential yet to be explored.
3	Paddy-cum-fish culture:	To develop wet terrace paddy fields into semi-permanent embankment to augment the productivity level at 500 kg/ha/yr.	Contributing to the productivity enhancement at a low cost.
4	Development of Inland Fisheries and Aquaculture	To provide technical, financial and extension support to fish farmers.	Contributing to the productivity enhancement
5	National Fisheries Development Board		Contributing to the production enhancement
7	North Eastern Council Sponsored Scheme.	To construct Retail Fish Market Outlet at Dimapur	Facilities created for marketing fish. However, without proper cold chain and poor market infrastructure post harvest losses could continue to be an issue.
8	RashtriyaKrishi VikasYojana (RKVY):	To develop sustainable fish production through improvements of untapped water bodies	Contributing to the productivity enhancement
9	Development of Cold chain/Cold storage	To renovate storage facilities for preservation and marketing of	Reduces post-harvest losses
10	Compact Area Fishery Development Programme (Mission Mode):	To convert the traditional intensive cultures by way of diversifying modern technologies	Contributing to the productivity enhancement

Annexure 7 : Key Programmes of the Soil and Water Conservation Department

S.No.	Programme	Objectives	Strengths/gaps
1	Soils survey and testing:	To generate information on soil health status and weather conditions on daily basis for planning and development.	The programme contributes to improved soil fertility and lead to productivity enhancement
2	Remote sensing scheme	To appropriately use remote sensing technology and develop plans for soil and water for sustainable agricultural production	Contributes to water conservation and leading to higher productivity
3	Mechanised land development scheme:	To control soil erosion, recharge ground water for sustainable crop production and land development	Contributes to productivity enhancement Contribute to increased ground water level.
4	Conservation of water bodies:	To harvest runoff water for multiple development uses in agricultural production.	Improves crop productivity. Contributes to increased ground water level.
5	Integrated land development project (negotiated loan):	To develop water management systems for permanent cultivation of crops	Increases cropped area and resulting in higher productivity
6	Watershed development project in shifting cultivation areas (WDPSCA):	To protect the jhum land with soil and water conservation measures. Together with capacity building of stake holders	Improves soil quality in Jhum field and contribute to productivity augmentation.

Annexure 8 : Existing Forest Management Practices/Initiatives

No.	Sub - Objectives	Programmes/Schemes	Activities	Adequacy
1	a. Improve Natural Forest Stock	JFM (NAP) Supported through Forest Development Agency (FDA)	• Assisted natural regeneration • Artificial regeneration and enrichment planting	Due to changes in forest surface temperature and moisture, the natural regeneration will be affected and that could compromise the regeneration rate of saplings. Thus it is necessary that additional investments on artificial regeneration are made JFM Programme.
	b.	IWDP (Integrated Wastelands Development Programme) & IWMP (Integrated Watershed Management Programme)	• Afforestation,	Watershed development is not enough with climate threats, as it needs to deliver the set of solutions strengthening natural resource management and livelihoods. The existing water harvesting structures like check dams, ponds siltation, etc... are constructed on hill gradients based on slope percentage and rainfall of the area with an objective of breaking the speed of water down the slope and to check soil erosion. With large quantity of rainfall in short time span, the guided structure of check dams are inadequate and thus need to account the extreme conditions due to changing weather patterns. Thus supported afforestation is must and the practice needs additional measure of nurturing the saplings through mechanical methods like fencing and

No.	Sub - Objectives	Programmes/Schemes	Activities	Adequacy
				contour development.
2	a. Soil and Water Conservation	IWDP (Integrated Wastelands Development Programme) & IWMP (Integrated Watershed Management Programme)	• Land Development, • Afforestation,	Achieving soil and water conservation objectives is challenge due to excessive run-off of water on hills. The existing water and soil conservation structures like check dams, ponds siltation, etc.... on hills are eroded due to frequent rainfalls with large quantity of water.
	b.	JFM (NAP) Supported through Forest Development Agency (FDA)	• Assisted natural regeneration • Participatory micro planning, implementation and monitoring of projects • Biological SMC supplemented by physical SMC treatment as per local site condition	With reduced agriculture yield, the forests remains the sole source of income for communities and in absence of accounting climate threats, the activity planned in micro plans are very likely to fail.
	c.	Additional Central Assistance for regeneration and restoration of forest	• Conservation of existing forest areas, Soil & moisture conservation,	'Refer 2a'
3	a. Enhanced opportunity for local forest-based micro-enterprises	Rubber development	• Testing pilot projects and its feasibility	Rubber Plantation are in testing phase in the State and could be developed into an alternative livelihood option, when most of the natural resource based enterprises are threatened due to additional burden of climate factors.
	b.	JFM (NAP) Supported through Forest Development Agency (FDA)	• Promotion of Non-Timber Forest Products (NTFPs) • Awareness generation,	Regulated NTFP extraction is not enough, as the production will go down due to affected plant growth. Thus unless

No.	Sub - Objectives	Programmes/Schemes	Activities	Adequacy
			training and linkage with other institutions • Promoting Agro-forestry practices	processing is also incorporated in the scheme, the objectives of 'Enhanced Opportunity of Micro-Enterprises' could not be achieved.
	c.	IWDP (Integrated Wastelands Development Programme) & IWMP (Integrated Watershed Management Programme)	• Supporting Plantation/Cash Crop Developments • Horticulture Development • Constituting SHGs, • Supporting alternative Livelihoods	'Refer 1a'
	d.	Additional Central Assistance for regeneration and restoration of forest	• Protection & regeneration of forest, production of quality seedlings,	'Refer 2a and 2b'
	e.	Social & Farm Forestry	• Roadside & Aesthetic plantation • Plantation of wild fruits • Industrial Plantation	The growing demand of fuel wood threatens the forest cover and dedicated energy plantations being managed by private players has an inbuilt co-benefit to address climate related pressures.
4	a. Forest Fire Control and Infrastructure development	Integrated Forest Protection Scheme	• Creation of fire-lines. • Engagement of firewatchers. • Infrastructure development. • Awareness creation. • Field survey & demarcation. • Digitization of forest boundaries. • Control and eradication of	Prolong dry spell has been predicted in many parts of the state that will increase the incidence of forest fire threatening the rich diversity. Thus the scheme will only prepare inadequately if non-information is spread about climate impacts and possible changes in the ecosystem. The monitoring needs to be enhanced with effective coordination among state

No.	Sub - Objectives	Programmes/Schemes	Activities	Adequacy
			invasive species	department.
5	a. Conservation, Restoration and Regeneration of forest cover	Dev. of Parks & Sanctuaries	• Setting up of watch towers and elephant corridors • Setting up of protection camp and other habitat enrichment • Raising of wildlife protection force.	The scheme does have an inbuilt co-benefit to address climate impacts. With extreme weather events happening, the food reserve for wildlife is expected to shrink and that could lead to migration of wildlife towards greener pastures. The scheme ensures dedicated movement corridors and raising protection force in the cases to human – animal conflict; where the later need to be protected.
	b.	Additional Central Assistance for regeneration and restoration of forest	• Enhanced livelihood avenue creation for the villagers	The additional assistance to regenerate and restore forests patches with active engagement of community will ensure the protection of forestland and creation of new sustainable livelihoods for villagers. The programme will ensure forest playing an appropriate role in local economy without being threatened due to over exploitation.
	c.	JFM (NAP) Supported through Forest Development Agency (FDA)	• Problem lands rehabilitated through Participatory forest management initiated by supporting the immediate needs of fringe – community	'Refer 1a. 2b and 3b'
6	a. Biodiversity Conservation	Community Biodiversity Conservation	• Checking illegal hunting and trading of wildlife & its products.	Biodiversity of forest has an inbuilt adaptation

No.	Sub - Objectives	Programmes/Schemes	Activities	Adequacy
			• Awareness creation amongst the communities. • Ban on commercial exploitation of forest. • Eco-restoration of sacred grooves/forests. • Promotion of cultural activities that help in biodiversity conservation	capacity and thus active initiatives need to be taken to conserve biodiversity. Thus scheme will certainly climate proof the forest sector enabling it for building resilience among vulnerable village communities.

Annexure 9 : Future Demand and Supply Projection of Electricity

A detailed projection for demand for electricity has been worked out. This is based on past trends, increase in per-capita consumption. However, the projection is based on a "Business as usual approach". A detailed explanation of how the projections have been worked out is given below. The demand projections have been made for until 2027, factoring in the 12th and 13th plan and 14th Plan.

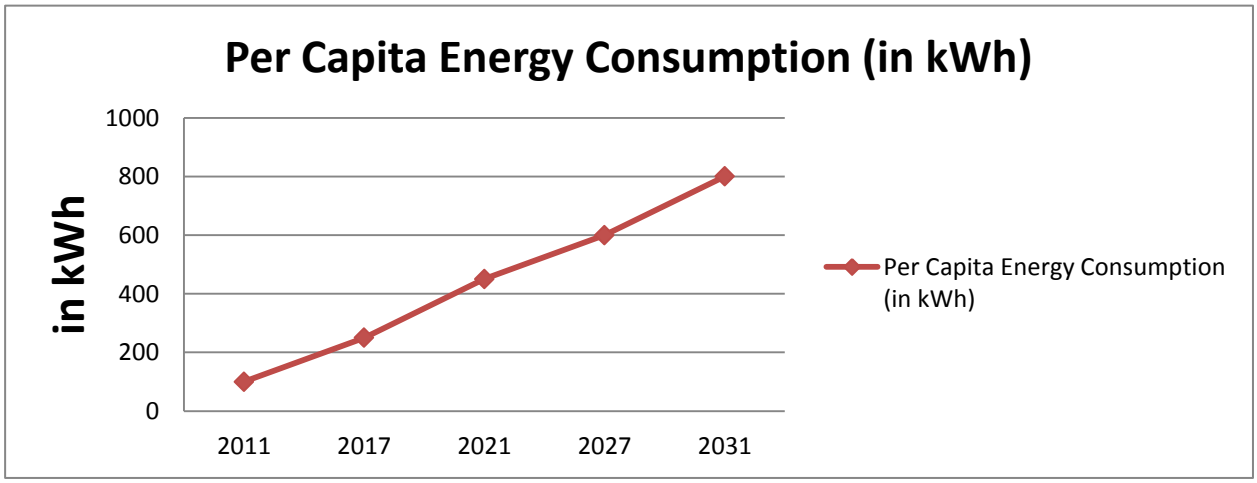
Energy Consumption – in MU	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27
Domestic	250	335	375	425	520	563	700	810	927	1187	1350	1506	1597	1685	1740	1806
Commercial	35	40	45	75	100	120	165	185	200	231	256	285	315	340	371	401
Public Lighting	5	10	15	20	25	30	33	37	40	50	60	65	65	65	65	65
Public Water Works	2	10	20	25	30	35	40	44	48	50	55	60	60	60	60	60
Industries	30	50	70	90	120	150	175	190	215	250	300	350	400	450	500	550
Bulk Supply	41	45	70	90	120	200	250	300	350	400	427	454	487	511	567	591
Total Energy Consumption	363	490	595	725	915	1098	1363	1566	1780	2168	2448	2720	2924	3111	3303	3473
T & D Losses in MU	236	318	369	435	549	659	750	814	890	1019	1053	1088	1111	1089	1057	1042
T & D Losses (in %)	65.00%	65.00%	62.00%	60.00%	60.00%	60.00%	55.00%	52.00%	50.00%	47.00%	43.00%	40.00%	38.00%	35.00%	32.00%	30.00%
Total Energy Requirement in MU	599	765	964	1160	1464	1756	2113	2380	2670	3187	3501	3808	4035	4200	4360	4515
Peak Load (MW)	117	150	189	227	287	344	414	467	524	625	686	747	791	824	855	885

Rationale for Demand Projections and Graphical Representation of Demand Growth:

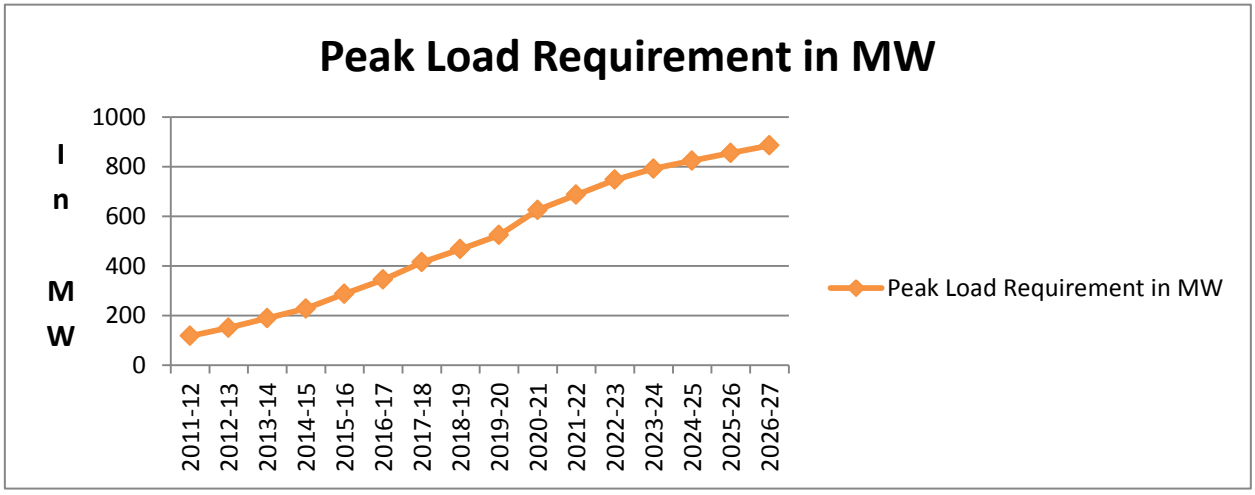
The Demand projections have been computed on a "Business as Usual Approach", factoring in a number of factors and key drivers of the Government of India and Government of Nagaland. They being the following:

a) An increase in per-capita energy consumption over the years, starting off with at least 1 unit per family per day by 2012 for all households.
b) An increase in economic growth and fostering economic and industrial development along with agricultural development
c) Agricultural growth also linked to market access and facilities for "value-add", which would require additional energy access
d) 24 x 7 x 365 days supply to all electricity connections.
e) Give stimulus for industrial investments by providing infrastructure. The electricity sector infrastructure improvement and development being one of the key priorities for increasing industrial investments.

Based on the above parameters the demand projections have been worked out. However, while computing it, we have not factored in either ATC Loss reduction or reduction in energy consumption due to "energy conservation and efficiency improvements". These have been taken into the "Supply side", as "energy saved is equal to energy generated".

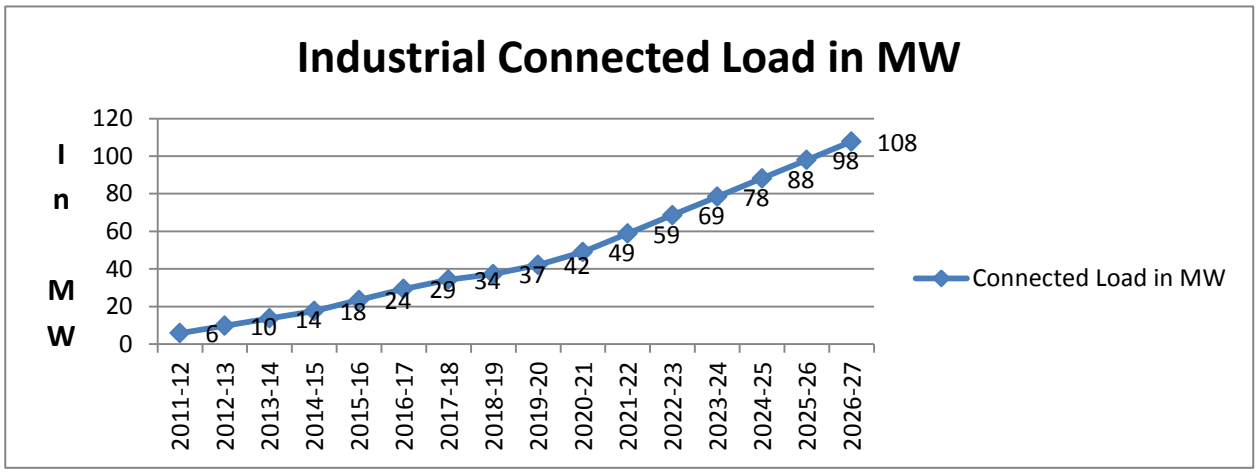


The demand for domestic consumption will grow from a per-capita energy consumption of roughly 87 kWh in 2004 to 800 kWh in 2031, while it would increase to 250 kWh by 2017, the end of the 12th Five year Plan. The proposed plan is to increase the consumption of electricity from the 2012 target of at least 1 kWh per family per day to at least 2 kWh per family per day on an average, as can be seen from the graph alongside.



The growth in the energy requirement is from the current level of 110 MW to approximately 400 MW by 2017, and close to 1000 MW by 2027, the end of the 14th Plan period. This energy requirement is based on a business as usual scenario and the actual installed capacity requirement will not be as much, since ATC loss reduction will play a major role and so will energy conservation and efficiency improvements.

However, the key issue to factor into any planning, is that Nagaland would require close to 1000 MW of generation by 2027.



Similarly, the industrial demand has also increased from the currently level of just around 15 Million Units to 30 Million Units by 2012 and 150 million units by 2017. The aim of the government is to foster economic growth through a combination of promoting industrial growth and reviving some of the existing industries with promoting agro-based processing units. The target of the government is to establish a 25 MW industrial capacity load by the end of the 12th Plan, and gradually increase it to 100 MW by the end of the 14th Plan period. Industrial development has always been on the cards, but a number of industries which have come forward to set up units in Nagaland could not do so, due to poor energy infrastructure. However, with modernization of transmission and distribution infrastructure along with generation infrastructure, it is proposed to open up Nagaland for rapid industrialization, with focus primarily on agro-based and small industries which could enhance income and livelihood options for the communities.

The public works and public lighting segment will also see a tremendous growth in energy consumption, as the Nagaland government has an ambitious target of ensuring street lights and piped drinking water to every community and household in Nagaland by the end of the 14th Plan period. In terms of public lighting, while there would be a rise in growth till 2021-22, it would remain stable thereafter and even the rate of growth would reduce by 2017, which means that attempt would be made to ensure that all new street lights will be with LED lamps and the existing and old ones would also be in a phased manner be replaced with LED lamps. In the public water sector, more reservoirs and water treatment plants will be set up in all districts. It is proposed to pump water to all households through piped connections. While, gravitational system would work in some places, water pumping systems need to be installed and energy would also be required for water treatment plants and sewerage treatment plants. Therefore this segment would also see a growth in energy consumption.

T & D Loss Projections and trends:

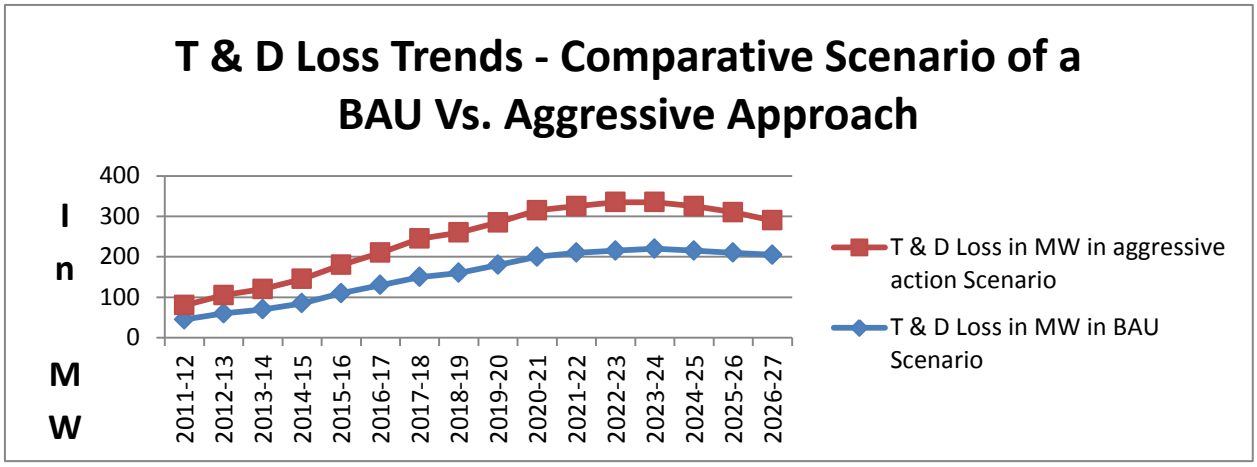
The aim of the Department of Power, Nagaland is to reduce the T & D loss to 15% by the end of the 14th Plan period. Some efforts into the direction is already underway with detailed plans to upgrade transmission and distribution infrastructure.

In a Business as Usual Scenario, the ATC Losses will come down to 30% by 2027, which is as below:

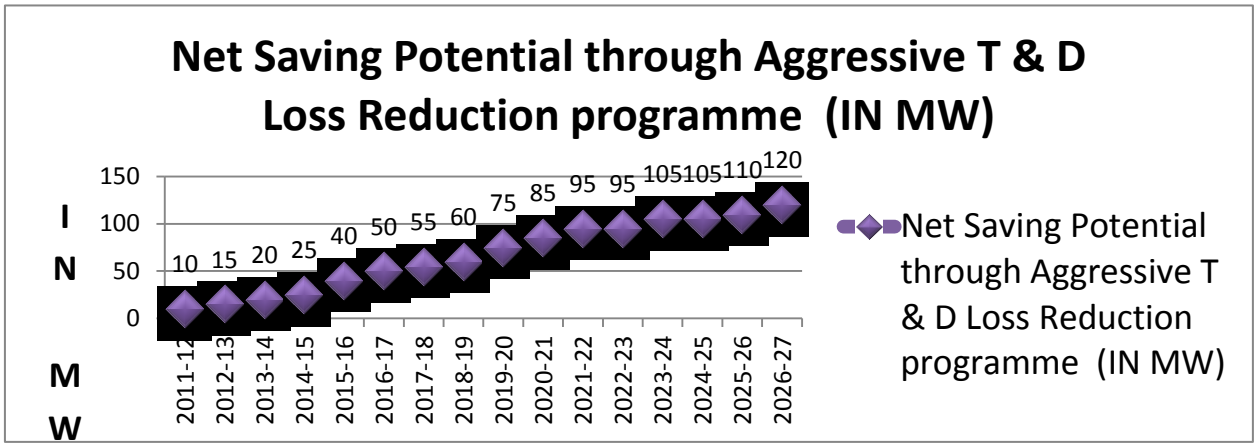
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27
Total Energy Consumption in MU	363	490	595	725	915	1098	1363	1566	1780	2168	2448	2720	2924	3111	3303	3473
T & D Losses in MU	236	318	369	435	549	659	750	814	890	1019	1053	1088	1111	1089	1057	1042
T & D Loss in MW	45	60	70	85	110	130	150	160	180	200	210	215	220	215	210	205
T & D Losses (in %)	65.00 %	65.00 %	62.00 %	60.00 %	60.00 %	60.00 %	55.00 %	52.00 %	50.00 %	47.00 %	43.00 %	40.00 %	38.00 %	35.00 %	32.00 %	30.00 %

However, in an aggressive scenario, the ATC losses will come down to 12% by 2027, which the Nagaland Government proposes to embark on, subject to getting the resources for the same.

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27
Total Energy Consumption	363	490	595	725	915	1098	1363	1566	1780	2168	2448	2720	2924	3111	3303	3473
T & D Losses in MU (rounded off to the nearest round number)	180	235	270	310	360	405	480	515	530	585	585	600	585	560	495	415
T & D Losses in MW	35	45	50	60	70	80	95	100	105	115	115	120	115	110	100	85
T & D Losses (in %)	50%	48%	45%	43%	40%	37%	35%	33%	30%	27%	24%	22%	20%	18%	15%	12%



The graph a gives above depicts the saving potential through addressing the ATC losses in a Business as Usual approach, which in itself, is fairly ambitious, bringing the ATC loss from the current levels of 65% to as low as 30% by the end of the 14th Plan, while the other scenario is ambitious and aggressive, which the Government proposes to embark on, that brings down the losses to 12% by the end of the 14th Plan.



The Net saving potential of electricity through aggressive implementation of T & D Loss is 10 MW in the year 2011-12 and goes up to 50 MW by 2017, the end of the 12th plan, increases to a saving of 100 MW by the end of the 13th Plan, which is 2022, with a saving of up to 120 MW by the end of the 14th Plan period, which is 2027.

The business as usual approach primarily refers to the implementation of routine ATC loss reduction programmes of the Central Government and the State Government. However, given the fact that energy is a scarce commodity and also in view of the serious impact of climate change, the more reduction in fossil fuel or electricity generation by conventional power plants is followed, the better it is for the environment.

Projected Efficiency and Conservation Trends:

The current electricity consumption pattern amongst all segments of consumers indicate that close to 60% of the electricity is for lighting purposes. An average of 15% of electricity consumption is for air-conditioning.

The 15 year electricity consumption from 2011-12 to 2026-27 for Public Lighting segment alone is projected to 70 MU. By converting all Public Lighting to efficient lighting, it is possible to reduce the consumption from 70 MU to 25 MU.

The total consumption by the domestic and commercial segment over the span of 15 years is working to 6400 MU. Assuming that 60% of this consumption is for lighting purposes, and with modest efficient lighting application being introduced, the consumption can reduce by 30%, the total consumption from the two segments can be reduced to 5000 MU.

As an immediate measure, the government of Nagaland proposes to convert all the 11 audited buildings of Dimapur and Kohima to lighting efficient buildings and also ensure that the main street lights of Kohima and Dimapur are converted to LED, Solar lit street lights. In the next stage, the main street of all district head quarter would also be converted in to solar powered, LED street lights and similarly, it would target the conversion of all government buildings in Kohima and Dimapur and select buildings in other district head quarters to lighting efficient buildings.

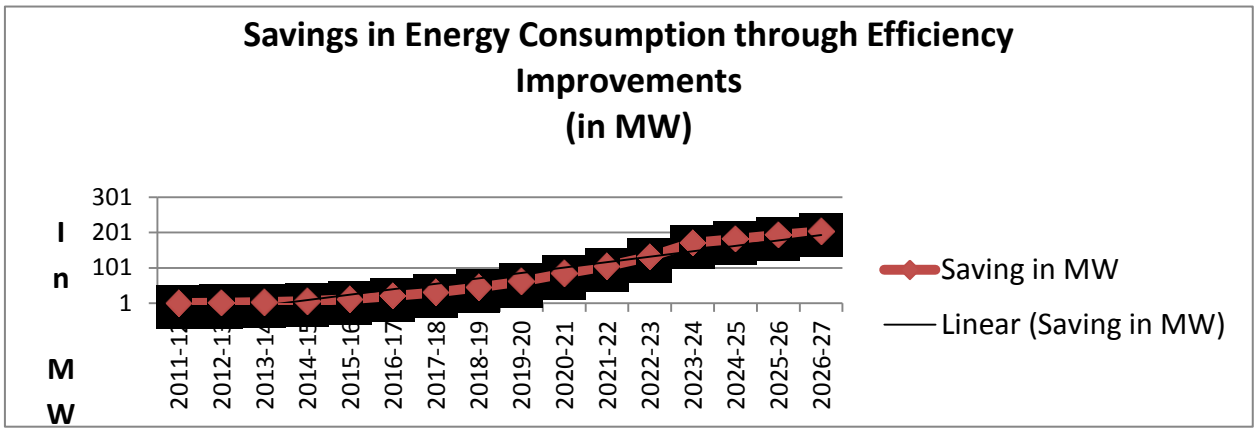
With the Bureau of Energy Efficiency proposing to gradually phase out energy in-efficient air-conditioning by 2012, all new air-conditioners being installed in Dimapur from 2012 is expected to consumer at least 15-30% less energy, which could further reduce the consumption of electricity.The table below gives a very conservative estimate of the saving potential in the total energy consumption by implementation of energy conservation and efficiency measures.

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Total Energy Consumption (IN MU)	363	490	595	725	915	1098	1363	1566	1780
Saving Potential Through Energy Efficiency and Conservation	2%	3%	4%	5%	7%	10%	12%	15%	18%
Savings in MU	7	15	24	36	64	110	164	235	320
Saving in MW	1	3	5	7	13	22	32	46	63

	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27
Total Energy Consumption (IN MU)	2168	2448	2720	2924	3111	3303	3473
Saving Potential Through Energy Efficiency and Conservation	20%	22%	25%	30%	30%	30%	30%
Savings in MU	434	539	680	877	933	991	1042
Saving in MW	85	106	133	172	183	194	200

The estimates that have been taken is from a low of 2% to a maximum of 35%, while, the saving potential could be a lot more too.

In the initial years, the percentage of savings is taken at a low of 2%, given that much of the savings could be done through Government and Public Buildings, and also factoring in that energy audit for only 11 Government buildings have been carried out so far. However, with the implementation and phasing out of energy inefficient products as mandated by the Energy Conservation Act 2001, by 2015, a number of inefficient product and appliances will be phased out. The total savings in energy consumption starts off with a modest 1 MW by March 2012 and increases to roughly 200 MW by the end of the 14th Plan period, which is 2027.



Future Supply Projections

As per the demand projections detailed above for the plan period of 2012-2017, Nagaland would require 400 MW by 2017 and go up to 1000 MW by 2027. As of now, the state has just one 24 MW hydel generating station at Likhimro, with a maximum generation of only 20 MW.

There is also substantial savings by implementing an ambitious and aggressive ATC reduction plans, improve and install modern transmission and distribution infrastructure which would not only reduce the technical losses but also ensure

Given that, out of the required 400 MW of power by 2017, Nagaland has only 20 MW (on a conservative estimate), the question is how much more can the state add to its generation capacity to be less dependent on the Central Grid.

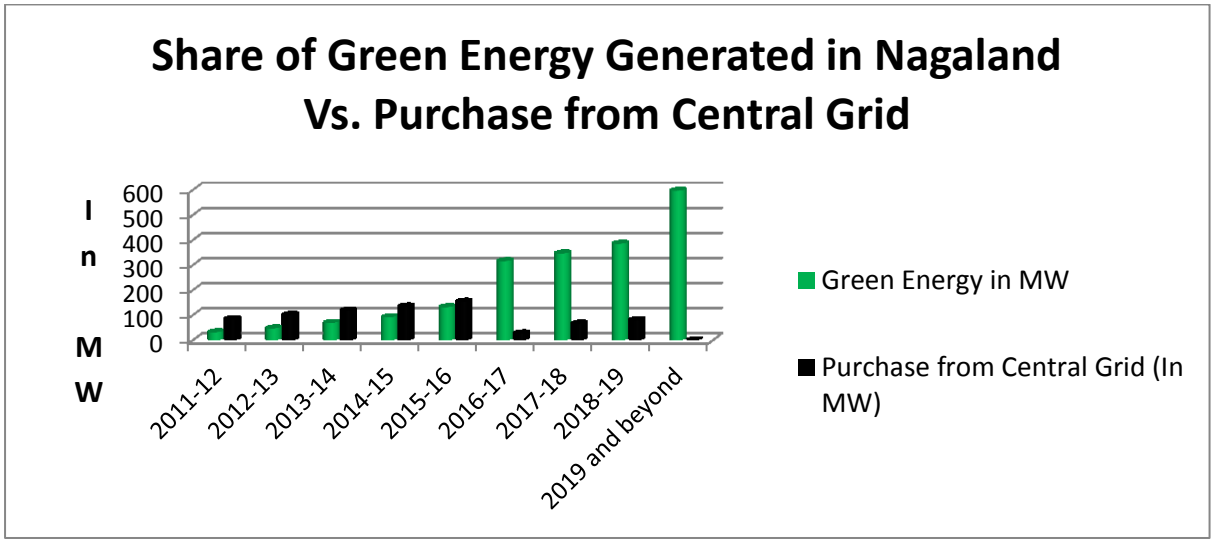
The following table gives an indication of the power required and supply status as of now. It also projects the future supply scenario.

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27
Peak Load (MW)	117	150	189	227	287	344	414	467	524	625	686	747	791	824	855	885
Savings potential through Energy Efficiency and Conservation measures (IN MW)	1	3	5	7	13	22	32	46	63	85	106	133	172	183	194	204
Savings through ATC Loss Reduction Measures (Aggressive Implementation)	10	15	20	25	40	50	55	60	75	85	95	95	105	105	110	120
Existing Hydro Unit of the Nagaland Department of Power (in MW)	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Capacity Addition Planned by the Department for New and Renewable Energy (In MW) (through Grid and Off Grid applications)	1	10	25	40	60	75	90	110	125	150	200	250	300	350	400	450
Other Large Hydro (Run of the river Sources Explored (Dikhu and Tizu-Zunki Hydro Power plants) (In MW)						150	150	150	315	315	315	315	315	315	315	315
Total Green Energy in the state in MW	32	48	70	92	133	317	347	386	598	655	736	813	912	973	1039	1109
Net additions Capacity additions Needed (In MW) (Peak Load minus Green Energy)	85	102	119	135	155	28	67	81	-74	-30	-49	-67	-121	-150	-184	-224

As can be seen from the above table, the carbon foot print of the energy generation sector of Nagaland will still be very low, with the Green Energy Component increasing from a modest 32 MW by 2011 to as much as 317 MW by 2017, assuming that the Dikhu Hydro Power plant is commissioned by then. By the year 2020, the state will have surplus green energy, which can be sold to the central grid, earning revenues for the Government of Nagaland.

The net energy which will be required from the central grid for the period till 2019, may not necessarily be carbon intensive, given that bulk of Nagaland's energy requirement from the central grid is currently met through hydro sources. However, given that the state has requested the Government of India for a 1000 MW coal fired power plant to be built to meet its requirements using the coal block allotted to the state, the purchase from central grid is being assumed to be carbon emitting.

The following graphs show the share of Green Energy Vs Carbon Emitting Energy over the period of 2011 to 2027.



Notes for the above: (To substantiate arriving at the above figures for renewable energy generation)

1. The Department for New and Renewable Energy for the 12th plan period proposes the following projects totaling to 36 MW:
   a) Firmed up Bio-mass Projects: 2 MW
   b) Firmed up Grid connected Solar PV: 2 MW
   c) Firmed up Off-Grid Solar PV: 2 MW
   d) Firmed up Small Mini and Micro Hydel Project: 10 MW
   e) Possible Other potential Micro-Mini Hydro Projects: 20 MW (Under investigation)
   f) NEPeD is working on setting up 15 kW projects in 11 districts: 165 kW
2. For the Major hydro projects namely the Dikhu (165 MW) and Tizu-Zunki (150 MW), preliminary feasibility report is done and the detailed project report is under preparation.
3. Savings from ATC Loss reduction detailed in section above
4. Savings from Energy Conservation and Efficiency Improvement implementation detailed in section above.

Annexure 10: Adding Electricity Generation (Renewable Energy) Capacities in the State

11th Plan Period

Source	No of Projects	Total Size in MW
Solar PV Grid Connected Projects	A cluster of Projects	2 MW
Solar Grid cum for captive consumption on Government Buildings in Kohima and Dimapur	A total of 47 projects, already sanctioned	670 kW
Off grid Solar PV Projects	A cluster of Projects	2 MW
Solar – Wind Hybrid Project	1 sanctioned for implementation this year (Pfutsero)	10 kW
Bio-Mass Projects	Cluster of them	2 MW
Bio-Gas Project	For captive consumption of veterinary college	100 kW
Micro/Mini and Small Hydro	Micro – 10 sites (1 MW); Mini- 1 site (2 MW) and Small – 1 site (3 MW) – Supply erection and commissioning work has begun	6 MW
Micro/mini and small hydro	Investigation and detailed survey – 100 sites	
	Total	12.7 MW

12th Plan Period

Source	No of Projects	Total Size in MW
Solar PV Grid Connected Projects	A cluster of Projects	10 MW
Solar City Project in Kohima and Dimapur		2 MW
Off grid Solar PV Projects	A cluster of Projects	5 MW
Wind Projects	Some Sites have been identified	5 MW
Bio-Mass Projects	Cluster of them	2 MW
Micro/mini and small hydro	100 Sites	49 MW
Major Hydro Projects	Tizu-Zungki (150 MW)	150 MW
A number of community projects with multiple source	All districts of Nagaland	2 MW
	Total	225 MW

13th Plan Period

Source	No of Projects	Total Size in MW
Solar PV Grid Connected Projects	A cluster of Projects	30 MW
Solar City Project in Kohima and Dimapur		5 MW
Off grid Solar PV Projects	A cluster of Projects	10 MW
Wind Projects	Some Sites have been identified	25 MW
Bio-Mass Projects	Cluster of them	5 MW
Micro/mini and small hydro	100 Sites	120 MW
Major Hydro Projects	Dikhu (165 MW) and Tizu-Zungki (150 MW)	315 MW
A number of community projects with multiple source	All districts of Nagaland	5 MW
	Total	515 MW

14th Plan Period

Source	No of Projects	Total Size in MW
Solar PV Grid Connected Projects	A cluster of Projects	100 MW
Solar City Project in Kohima and Dimapur		10 MW
Off grid Solar PV Projects	A cluster of Projects	50 MW
Wind Projects	Some Sites have been identified	50 MW
Bio-Mass Projects	Cluster of them	20 MW
Micro/mini and small hydro	100 Sites	200 MW
Major Hydro Projects	Dikhu (165 MW) and Tizu-Zungki (150 MW)	315 MW
A number of community projects with multiple source	All districts of Nagaland	20 MW
	Total	765 MW