STATE ACTION PLAN ON CLIMATE CHANGE (2012 - 17)

MIZORAM

Government of Mizoram

MIZORAM STATE ACTION PLAN ON CLIMATE CHANGE (2012-2017)

Prepared by

Directorate of Science & Technology
Government of Mizoram

CHIEF MINISTER
MIZORAM

MIZORAM STATE

MESSAGE

Climate change is one of the greatest challenges that the global community is facing today. The world is experiencing perceptible temperature rises. A mere single degree change in temperature may look minuscule, but the catastrophic change it could bring along is so huge that no one can ignore it. The global population is threatened with water shortages, hunger and poverty. The security of our planet is also questioned. At this stage we are bound to take concrete actions while, on the other hand, we mainly speak of development which is the central theme of every nation especially the developing countries. But development has to go parallel with sustainability, by putting environmental concerns always at the forefront.

From the days of our forefathers, our little agrarian state has been contributing more of less carbon to the environment owing largely to jhum system of cultivation. Coupled with the technological advancement and development of the modern era, our contribution rises to new heights. So far we are unable to precisely account for neither its volume nor its effect. But even laymen are conscious about the changing weather patterns and the seasonal climate variations. We are no longer isolated from the rest of the world, but are now part and parcel of the community affected by climate change. Whatever befalls the globe, we are in it.

I am happy to learn that a comprehensive Action plan on Climate Change is prepared, touching every corner of possible actions and involving various Departments. The road to combat the effects of climate change is a long one. Hopefully, the road could be much shortened by this Action Plan. We still have time to slow down the process and adapt to climate change.

(LAL THANHAWLA)

VAN HELA PACHUAU IAS
Chief Secretary
Government of Mizoram

MIZORAM STATE

FOREWORD

The 4th Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC) has conclusive evidence that global warming is due to human activity. The Industrial revolution changes the face of the world by creating more urban centers and mass production, which in turn led to rapid depletion of natural resources. Ever since then, it almost seems like the world is journeying in a single trail towards a point of no return, which is irreversible climate change.

The effect of climate change is omnipresent in a way that it follows us everywhere, be it in our home, work or travel whether far or near. Bitter winter and warmer summer has become the talk of the town. It is also directly linked to our economic condition. We are already experiencing changing weather patterns like diminished, irregular or late onset of rainfall which in turn affects our agriculture. Farmers in rural areas are affected the most. The health impact of climate change may be more accountable too.

There have been several laws and acts enacted to tackle climate change. The Government is also doing its duty. However, nothing seems enough in the task of mitigating climate change. It requires continuous and joint efforts comprising the Government and all sections of people. The foremost need of the hour is a comprehensive solution, and this Action plan appears just in time. We cannot be just spectators anymore. We are all a part of the plan and we really must set our target to cut our emissions, increase energy efficiency and make use of our renewable resources.

24.1.2012

(VAN HELA PACHUAU)

Dr. VANLAL ZARA
Chief Scientific Officer
&
Member Secretary
Executive Council on Climate
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MIZORAM STATE

ACKNOWLEDGEMENT

The State Action Plan on Climate Change has been prepared by Directorate of Science & Technology, Government of Mizoram under the aegis of the Executive Council on Climate Change, Mizoram. We are indebted to the Hon'ble Chief Minister, Chief Secretary, Vice Chairman, State Planning Board and Principal Secretaries and Secretaries of the concerned sectors for their interests and support which enables us to bring this Action Plan to a definite shape.

We gratefully acknowledge the initiative and financial help from Ministry of Environment & Forest, Govt. of India without which this Plan may not see the light of the day.

We are also indebted to the Working Groups of concerned sectors for their valuable inputs. Thanks are due to all the Chairpersons and participants in the Stakeholders Workshop for their suggestions and insights which are incorporated in the documents as far as practicable.

Thanks are due to Dr. Sanjay Tomar, GIZ for extending technical support and providing sectoral experts for preparing Climate Change Action Plan. Thanks are also due to Shri Ashok K. Singha, CEO, CTRAN Consulting and his team members for their active support in consultation workshop and in preparing the draft. Significant contribution from members of non Governmental Organisations, Civil Society Representatives and Academic Institutions at several meetings and consultation workshop held at various stages are gratefully acknowledged.

(Dr. VANLAL ZARA)

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EXECUTIVE SUMMARY

I. Climate Change Strategy

One of the youngest state of Indian Union, Mizoram is very much vulnerable to the impacts of a changing climate and sometimes faces wrath of freak weather events due to its geo-climatic condition, making the entire state as one of the most hazard prone states in the country. The state is annually swept by cyclonic storms, cloudbursts, hailstorms and landslides. The valleys are hot and wet during summer and in the upper reaches it stays comfortably cool. However, the effect of global warming has been experienced here with data showing increase in rise in mean and maximum temperature over the last 10 years. There are also frequent occurrence of violent storms during March and April that come from North-West Direction. Mizoram receives an average rainfall of about 3000mm in a year and this is evenly distributed and it is not drought or flood prone.Although the State is enjoying abundance of rainfall during monsoon period, the dry spell during non-monsoon period is really hard for the people. Due to the steepness of the hillsides, underground water retention is minimal, causing perennial water sources to dry up during this period. This had been aggravated by the tradition custom of jhum cultivation, commonly known as slash and burn.

Moreover it also has a very low adaptability due to the socio-economic and bio-physical conditions.A recent report on climate change impact in India highlights that "extreme precipitation events may increase by 5-10 days in all the regions in the Northeast, which might cause wide alarm in the region as many parts of the region are prone to landslides and flash floods which are only aggravated by heavy rainfall due to steep gradient.

The main objective of Climate Change Action Plan is to strategize adaptation and mitigation initiative towards emission stabilization and enhance the resilience of the ecosystem.

Plan Process

Government of Mizoram has taken the climate change issue very seriously. A detailed roadmap has been chalked out to develop the climate change action plan for the state.Climate Change Council of Mizoram is created to develop state action plan for assessment, adaptation and mitigation of climate change with an objective to monitor the targets, objectives and achievements of the national missions specified by National Action Plan on Climate

Change (NAPCC). The respective missions shall be taken care of and attended to by the individual departments who shall strive to attain the listed objectives within stipulated time frames and ensure their vertical integration with the National Mission.

Sl No	Designation	Position in Council
1	Hon'ble Chief Minister, Chairman	Chairman
2	Hon'ble Minister, Rural Development	Member
3	Hon'ble Minister, Agriculture, etc.	Member
4	Hon'ble Minister, PHE, Tourism, etc.	Member
5	Hon'ble Minister, Transport, etc.	Member
6	Hon'ble Minister, Revenue	Member
7	Hon'ble Minister, Forests	Member
8	Vice Chairman, State Planning Board	Member
9	Chief Secretary, Govt. of Mizoram	Member
10	Principal Secy, PHE, Agri, etc.	Member
11	Secretary, Environment & Forests	Member
12	Secretary, Tourism	Member
13	Secretary, R.D.	Member
14	Secretary, Horticulture	Member
15	Principal Secy., Planning & Prog. Implementation	Member Secretary

The operating arm of the Climate Change Council is designated as the Executive Council.

Sl No	Designation	Position in the Council
1	Chief Secretary, Govt. of Mizoram	Chairman
2	Principal Secy, Planning & Prog. Implementation	Member
3	Principal Secretary, PHE, Agri, etc.	Member
4	Principal Chief Conservator of Forests	Member
5	Secretary, Rural Development	Member
6	Secretary, Horticulture	Member
7	Secretary, Tourism	Member
8	Principal Adviser Planning	Member
9	Chief Scientific Officer, Science & Technology	Member Secretary

II. Sustainable Agriculture

TheState'seconomyispredominantlyagrarian, with more than 60% of the total work force engaged eitherdirectly or indirectly with the sector. Irrespective of the considerable dependency of the economy the agricultural sector in the state is quite under developed due to the predominant method of cultivation, lack of irrigation facility which is largely due to unfavourable physical conditions and the land holding pattern that prohibits taking up initiatives towards facilitating increase of yield. As per the present status, the total annual requirement of rice for Mizoram is 19,22,030 Quintals/year but Mizoram produces only 462924 quintals/ year (24% of the total requirement) so the deficiency is 76% which is likely to worsen under negative impact of climate change or weather

variability. Adaptation measure if taken up judiciously can offset the negative impacts of climate change on irrigated rice but in the case of rain-fed rice, growing of tolerant and high input efficiency rice varieties with better management and assured irrigation only can reduce the climate change impacts.

To add on the agricultural issue lies the land degradation problem. Mizoram has experienced land degradation (total of 20.64 % of Mizoram) at an alarming rate owing to the destructive slash-and-burn system of cultivation.

From the animal husbandry and fisheries point of view the state is facing serious problem due to increase in deficiency of rainfall.

Key priorities: Agriculture

1. *Development of Land (Levelling, bundling, etc) for Wetland Rice*
2. *Cultivation (WRC) on available lands having 0-10% slope and Improvement of Existing Wetland Rice Cultivation (WRC)*
3. *Developing data base on genotypes of local crop varieties (mainly rice varieties) and identification of suitable varieties for different agro-climatic zones.*
4. *Impact assessment of paddy cultivation through agricultural inputs such as crop varities, kharif crops and promotion of rain water harvesting and construction of eco friendly mini check dams for irrigation.*
5. *Assessment study and demonstration of Systematic Rice Intensification (SRI) cultivation and Capacity building to train farmers in latest rice cropping techniques specially evolved to counter adverse effects of climate change*
6. *Optimization of jhum cultivation through conservation of arable land, water utilization management, parallel cultivation of alternative crops and Alternative jhum Control to Livelihood*
7. *Construction of Hill Slope terraces for conservation of moisture and cultivation of food grain, vegetable, pulses and oilseed crops*
8. *Increasing the area under perennial fruit plantation crops and low value high volume crops to help cope with uncertain weather patterns.*
9. *Management of climate change impact on horticulture and Climate risk management studies*
10. *Improving post harvest management such as cold chain for perishable crops and winter cultivation practices*
11. *Promotion of organic farming through usage of compost and vermi compost*
12. *Adoption of Integrated Pest Management for improved crop yield, Preparedness to tackle emerging scenarios of pests and capacity building for stakeholders*
13. *Research study on livestock disease and establishment of early warning system and Capacity building to Stakeholders*
14. *Study of impact of Climate Change on the indigenous fauna of aquatic ecosystem and open waters*
15. *Water storage and providing proper diversion channels to the existing ponds for drainage of catchment runoff during sudden heavy rains*
16. *Providing extensive support and services to fishermen through establishment of district level training centres*
17. *Water bodies conservation for fishery sector and establishment of fishery units in reservoirs and riverine area*

III. Sustainable Himalayan Mission

Mizoram is a fragment of Lower Himalayan range exhibiting a part of Mountain ecosystem comprising 21 moderate hill ranges and forest ecosystem. In between these two dominant ecosystems, lies the freshwater ecosystem. Climate Change impacts coupled with anthropogenic pressure is most likely to impart its negative effect on the fragile Mountain Ecosystem of Mizoram. The assessment of impact of climate change on forest ecosystems has clearly demonstrated the possibility of adverse implications on biodiversity and a large decrease in net primary productivity of forest. Such a projected shift or change in forest types likely leads to large-scale forest disappearance and loss of biodiversity. Forest ecosystems are already subjected to socio-economic pressures leading to forest degradation, with adverse impacts on the livelihoods of the forest-dependent communities. Climate change in the projected scenario is like to exacerbate the stress on forest ecosystems. To add on the possibility of stress development of adaptation strategies is constrained by uncertainty in the current projections of

IV. Green Mission

The forest cover in Mizoram is around 91.27% of state geographical area, which in highest in the country and is the richest source of carbon sink. However, the major constraints for the state are higher deforestation rates due to jhum cultivation and forest degradation caused by anthropogenic pressure. Due to this the majority of the forests classified under the open and medium dense forest category and only 1% of forest cover classified under the high dense forest with the canopy cover more than 40%. Lack of infrastructure, Market Linkages and sustainable forest policies making under-utilization of potential for development of forest based enterprises within the state. Almost 2/3rd of the area has already been degraded. These depleted and degraded forests could not meet the growing demands of timber and other forest products in the state and cannot provide a safeguard to the ecological functions like soil conservation, protection of land degradation, maintenance of agricultural productivity and protection of catchment area.

Key priorities: Sustainable Himalayan Mission

1. *Biodiversity Assessment*
2. *Research on Wildlife Population and Corridors - Mountain Goats, Burmese green Peacock, Malayan Bear*
3. *Creation of Biodiversity Park*
4. *Assessment of climate vulnerability and climate change impacts on state biodiversity and forest resources*
5. *Documentation and enrichment of biodiversity database through Peoples Biodiversity Register (PBR) at the JFMC Level*
6. *Inventorying and Conservation of Medicinal Plants*
7. *Monitoring of carbon stock and biodiversity at regular intervals*
8. *Eco-tourism promotion for biodiversity protection and sustainable livelihood*
9. *Undertaking study on valuation of forest resources*
10. *Work to establish new systems to support for public awareness building through Establishment of Envis Centre*
11. *Restructuring land use policy for jhum cultivation and habitation on notified forest lands*
12. *Policy formulation on transportation subsidy or development of low cost transportation for primary Forest products of the state*
13. *Protection of forests and forest land from soil erosion in 1,35, 000 Ha*
14. *Conservation and Management of two major Wetlands*

Key priorities: Green Mission

1. *Improvement of forest quality and density in degraded lands and abandoned jhum lands*
2. *Improvement of the productivity of Bamboo and promotion of local value addition through establishment of market linkages*
3. *Undertaking studies on climate change impacts on NTFP productivity and sustainable harvesting practices for adaptation of climate change*
4. *Capacity building of communities/ community forest management institutions for climate change adaptation*
5. *Prevention and control mechanism for forest invasive species and its utilization strategies*
6. *Promotion of forest based industries*
7. *Formulation of conservation strategies for Orchids and establishment of market linkages for value addition*
8. *Livelihood improvement Activities for forest dependent communities*
9. *Strengthening of Forest Department*
10. *GIS based Monitoring and Evaluation of the program*
11. *Strengthening of Local VSS*
12. *Publicity / media and Outreach*
13. *Establishment of Mission Directorate*

V. Sustainable Habitat

The state has experienced relatively slower economic growth in comparison with rest of India. The state of Mizoram, the smallest state in terms of size, is the fifth most urbanized state in India with 49% of its population residing in urban areas. The level of urbanization in Mizoram is likely to be 99% in 2016. As a result of rapid increase of population within the state spilling of population outside the city limits has taken place. It highlighted the fact that the towns in Mizoram are overgrown villages, trading centres with some rural development administrative office outfits, which become urban settlements. These outgrowth areas are generally devoid of basic urban services and are administered through rural growth mechanism. There are increasing urban problems of overcrowding and growth of slums, scarcity of water supply, inadequacies of public health and sanitation system, mismanagement of waste materials. The existing urban infrastructure for service delivery is increasingly insufficient, even for provision of core urban public services such as water supply, sanitation and sewerage, urban roads and solid waste management. Sanitation possesses major problems with the absence of any sewerage system in urban areas resulting in drainage of domestic effluent into nearby rivers and streams leading to contamination of water sources.Absence of storm water drainage poses problems of water logging and flooding, causing landslides and soil erosion. Indiscriminate developmental activities also add to the problem by obstructing drains and encroaching rainwater flow paths.Solid waste is a pressing urban issue for Mizoram primarily because of its difficult terrain. Inadequate collection and improper disposal currently lead to spillage and contamination of soil and surface as well as groundwater streams.The urban transport sector has been largely neglected in the State, characterised by heavy traffic congestion due to narrow roads, rapid growth in number of vehicles along with highly topographic and concentric development.Integrated sewerage and drainage system is not available in all cities of Mizoram. City development plans are underway for construction of the same in the major cities and district headquarters of Mizoram. Under the Urban Infrastructure Development Scheme for Small and Medium

Towns (UIDSSMT) and Integrated Housing and Slum Development Programme (IHSDP) major initiatives taken for six district headquarters.

Key Priorities: Sustainable Habitat

1. *Capacity Building and research initiatives on Climate Change Impacts and Preparedness*
2. *Improvement in water usage management for urban drainage to reduce climate change impacts*
3. *Development of climate friendly Waste management systems and improvement of aesthetics*
4. *Reduction of disaster risk through climate change adaptation*
5. *Energy efficiency improvement and promotion of renewable energy usage in urban sector*
6. *Improvement of vehicular pollution control mechanism for reduction of GHG emissions*
7. *Assessment and inventorisation of climate change impact on urban sector*

VI. Health

One of the youngest states of the union, Mizoram lying in the far flung area of the country is extremely vulnerable to the extremes of climate change due to its location in the fragile ecosystem and limited access with the rest of the country. Barring the scenario profiling of the health condition towards determining the possible impact of climate change on the health status and modelling the impact reduction framework, it is also essential to have a clear understanding of the socio economic scenario of the region that creates a conducive environment for occurrence and spread of diseases. The socio economic indicators like education, gender, poverty, housing, amenities and employment provide a background towards understanding of the health scenario of the region.

Transmission dynamics of malaria is highly climate sensitive and is severely impacted by the climatic conditions. Epidemiological study substantiated the impact of climate change on malaria. Irrespective of the fact that the number of malarial death has decreased across the year the number of malarial incidence and annual parasite incidence has enhanced across the year substantiating the increase in the morbidity due to malaria.

The State of Mizoram is characterised with poor and unsafe drinking water and sanitation facilities (9.99% of the rural household and 1% of the urban household in the state lacks toilet- 2001 census). The unavailability of safe drinking water and improper sanitation facilities in far off and inaccessible area enhances the chances of incidence of water borne diseases.The situation of quality water availability is further worsen during the dry season due to increase of the pathogen loading of the water as well as during the over precipitation(water contamination via flooding) period due to increase in microbial loading.Of the Water borne diseases the incidence of Diarrhoea and enteric fever are quite noticeable in the state. Although the rate of the both the diseases has decreased in 2010 in compared to 2009 the total number of cases seems to provide additional diseases burden.

Assuming current emission level continue their is high chances for deterioration of air quality in urban region as well increased

exposure to ozone and other air pollutant including particulate matter projecting an increase in cardio- respiratory morbidity and mortality. Certain weather patterns enhances the development of urban heat island, the intensity of which is important for secondary chemical reaction within the urban atmosphere leading to elevated level of some pollutants.

The climate change may also alter the seasonal distribution of some allergenic pollen species leading to physiological problem.

The lowering of yield of food crops due to climatic variability might diminishes dietary diversity and reduces overall food consumption and may therefore lead to micronutrient deficiencies posing impact including death, malnutrition and/or micronutrient deficiencies specially among the vulnerable section of the population with lower economic stability. Food insecurity issue may also lead to urban migration.

VII. Solar Mission and Renewable Energy Sector

Mizoram is far behind in terms of the economic and infrastructural growth level of the nation since last three decades which can easily be depicted from the per capita energy consumption , a key indicator of human development and growth . Availability and access to quality, reliable and affordable power is critical parameters for promoting economic and social development of the developing countries.

The state which is a power deficit owing to minimal in-house power generation capacity is facing a serious power shortage. The change in climate condition and inconsistent rainfall pattern in the state is observed in last few leading to non-availability of water in lean period.

However to cater the ever increasing power demand due to various factors like population

Key priorities: Health Sector

1. *Identify extrinsic and intrinsic drivers of malaria and identifying immunity intervention measures towards control of incidence of malaria.*
2. *Assessment of impact of heat stress on human health and framing adaptation strategy, identification, documentation and awareness creation on temperature related morbidity*
3. *Evidence based assessment of biophysical determinants of malaria and development of framework for adaptation measures for malaria control.*
4. *Carrying out of Adaptation study*
5. *Research initiatives to identify change in pattern of diseases by region due to climate change/ weather variation*
6. *Study and documentation of diseases caused by water (water borne) and development of institutional mechanism to reduce the incidence/outbreaks of such diseases along with awareness generation*
7. *Development of institutional framework and infrastructural facilities for early detection of vector borne diseases, including managing outbreaks*
8. *Establishment of pathological laboratory with state of art technology for diseases identification*
9. *Public health system infrastructure development for extreme climate risk management and managing outbreaks of major diseases*
10. *Capacity building and training for health workers for sensitisation of climate variation and health impacts*
11. *Research study on malnutrition of vulnerable group due to food security caused mainly due to climatic variation*

growth, urbanization and to kick start the industrial development and considering the present power crisis in the state, the state government has begun to explore the possibility of enhancing the power generation by focusing on installation of more number of hydro power plants as the state so as to counter the lower water availability across the lean period. The following facts forms the basis of the stratigising the actions.

Key Priorities: Solar Mission and Renewable Energy Sector

1. **Up scaling Renewable Energy Application for meeting up decentralized distributed or Off-grid area energy demand**
2. **Unlocking grid interactive solar power generation and supplement the conventional grid power under National Solar Mission**
3. **Reduce anticipated energy and peak demand through promotion and implementation of pilot SWH application by undertaking installation of 100 Nos. of 100 LPD systems and 100 Nos. of 200 LPD systems across various demand segments**
4. **Develop RE systems supply chain through empanelment of renewable energy technology manufacturers /distributors with ZEDA and support in development of their set-up in the state.**
5. **Institutional development and strengthening of ZEDA for promotion of Renewable Energy applications**
6. **Awareness creation and manpower development for enhancement of the renewable energy application**
7. **Market Transformation of Renewable Energy applications through policy measures**

VIII. Energy Efficiency

Outlook towards linking climate change and energy sector are usually centred on mitigation effort because the current fossil fuel based energy generation method is a major contributor to climate change. Developing options of low carbon growth and reducing carbon footprint are important activities towards limiting the degree of future climate change. Several mitigation initiatives are conceptualized under National Mission for Enhanced Energy Efficiency (NMEEE) with Bureau of Energy Efficiency (BEE) and Energy Efficiency Services Limited (EESL) to address climate change concerns and attain energy security of the nation. NMEEE has strategized the following initiatives, in addition to the policies and programmes for energy efficiency being implemented by BEE. The state of Mizoram has already started initiation for addressing the climate change issues, with a focus on reduce of energy demand through energy conservation and efficiency improvement measures. However, it is essential that, such efforts are in line with the National Mission on Enhanced Energy Efficiency. The key elements for the multi - pronged strategy of the sector for mitigation and adaptation measures were identified after detailed deliberation in the working groups.

Key Priorities: Energy efficiency

1. *Awareness creation and manpower development to enhance the energy efficiency measures*
2. *Market Transformation of Energy Efficiency applications through policy measures -*
3. *Up-gradation of transmission and distribution network for minimization of energy losses*
4. *Penetration of energy efficient devices in domestic and public utility systems facilitated by financial, supply chain and market incentives*
5. *Unlocking the energy efficiency activity in IGEA mode*
6. *Institutional development and strengthening of Energy departments for Energy Efficiency promotion*
7. *Increase Hydro-power generation by supporting private or public investors in setting up projects and undertake demonstration projects.*

IX. Water

Water is not only the source of sustenance of life the availability of desired quality and quantity of water is the prime factor for economic prosperity, enhancing the quality of life and contributing to the food security of the nation. The assured supply of irrigation water (irrigation is the major consumer of water resources contributing to 83% of the total water consumption) is the primary function of food grain production and contributes towards national food security.

Although the total amount of fresh water available at present is enough to meet up the current requirement of the state but the availability of desired quality and quantity of water may get strained in some places under projected impact of climate changes, increase in population, lifestyle, economic stability, land use pattern, agricultural production, urbanisation and migration of population followed by uneven distribution of precipitation over space and time.

Climate change is likely to impart formidable challenge to the water sector and the adversity may increase due to the location of the sate in fragile ecosystem. The impact of climate change on water sector is likely to be due to erratic precipitation creating variability in river flow and increased frequency/ intensity of extremes events including flood. Increased frequency and severity of floods may affect groundwater quality in alluvial aquifers. Similarly increased rainfall intensity may lead to higher runoff and possibly reduced recharge.

The other consequence of climate change envisaged is increased evapo-transpiration influencing groundwater recharge and change in rainfall pattern resulting in lower agricultural productivity.

National Water mission established under National Action plan on Climate Change is designed to ensure Conservation of water, minimizing wastage and ensuring its more equitable distribution both across and within States through integrated water resources management. Promotion of integrated basin level water resources management (Basin Level management strategies are planned to be reconsidered to deal with variability in rainfall and water flows), increasing water use efficiency by 20%, focussing attention to vulnerable areas including over exploited areas and water conservation are few designed initiative under the programme. The mission will also seek to optimise the efficiency of existing irrigation system including rehabilitation of system that has been run down and also to expand irrigation, where feasible with special effort to increase storage capacity. Initiatives to reduce fresh water use in urban areas are also planned under the mission. Since water is a state subject the plans and programmes under

the mission to be executed falls under the preview of the state government. It is therefore important that the key priorities proposed under National Water mission are consistent with the state plan.

Key Priorities – Water Sector

1. ***Climate change impact assessment of present status of water resources like river, wetland, streams and lakes***
2. ***Finalisation of plan for conservation and preservation of water resources***
3. ***Formulation of State Water policy***
4. ***Catchment and command area treatment through reverine afforestation***
5. ***Capacity building of Water Resources department/ Mizoram PHED for integrated water resources management***
6. ***Capacity building of Water Resources department/ Mizoram PHED for integrated water resources management***
7. ***Expansion of hydrometric network and establishment of micro weather station for regular monitoring***
8. ***Community tank management for combating water borne diseases***
9. ***Promoting zero energy water purification for domestic water supply***
10. ***Renovation and development of traditional water harvesting system with scientific intervention in district level***
11. ***Capacity building of communities on adaptation options required for integrated demand side as well as supply side strategies during climate stressed condition.***

X. Strategic knowledge mission

Mission on Strategic Knowledge for climate Change is framed under the National Action Plan on Climate Change to bridge up, assimilate and upgrade information and knowledge available on climate variability and vulnerability with an objective to forecast as well as appraise for strategic development towards low carbon inclusive growth.

Reduction and mitigation of the impact of disasters depend on the coping capacity of the vulnerable population; poverty makes way for hazards becoming disasters. Climatic changes are expected to severely impact those who are mostly dependent on natural resources for their livelihoods. Climate variability can fundamentally drive processes of impoverishment through direct and indirect routes: (1) Direct: Severe or repeated climate shocks can push vulnerable households into a persistent poverty trap when their individual coping responses involve divestment of productive assets such as land or livestock, (2) Indirect: Climate uncertainty causes inability to anticipate when climatic extremes will occur, which acts as a disincentive to investment, innovation, and development interventions. The main aim of the State mission on strategic knowledge is not only limited to the reduction of green house gases (GHGs) but include building the coping capacity of the vulnerable population to

include the challenge of innovation capacity building for sustainable development among the vulnerable population groups.

Key priorities: Strategic Knowledge

1. Development of Knowledge Management on Climate Change and facilitating its operation for initial period
2. To build GHG inventory and identify the dominant GHG/CO2 emitting sectors, industries, districts, municipalities in order to enable selection of mitigation opportunities.
3. Capacity Building on Climate Change
   - Capacity building of personnel in the service department
   - Exposure visit for capacity building

Way Forward

Changes in policies, organizations and practices:

Analyzing the key priorities revealed that climate change orientation needs to be provided at policy, organizational and practice levels in different sectors. Policies need to integrate climate change considerations. At an organizational level, awareness, skills and capacity has to be built.

Awareness generation and capacity building a focus:

Considering that climate change is a relatively new challenge, the focus of this CAP will be on generating awareness and building capacity. This will be done across all levels of the Government of Mizoram and external stakeholders involved in the different sectors.

Action implemented across the economy:

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

Integrated perspective imperative:

To be effective in implementing initiatives pertaining to the key priorities, it is vitally important to have an integrated outlook and not work in isolation. This will be required to ensure maximum returns to the efforts being made.

Low Carbon economic development:

The various mitigation initiatives being planned across the Missions will ensure that Mizoram proceeds on a low carbon development path.

Biodiversity in addressing livelihoods:

The key adoptive strategy being envisaged in the climate change action plan will facilitate conservation of biodiversity including restoration and rehabilitation which will help vulnerable people, mostly the tribal communities and economically most backward strata, to cope with climate change.

Building climate resilience:

The different adaptation initiatives being planned will ensure better preparedness to climate-induced changes, including extreme events.

Institutional Arrangements

In initiating the preparation of the Climate Change Action Plan the Government of Mizoram had constituted a committee that delegated the responsibility of Climate Change Action Plan preparation subcommittees from line departments to bring greater focus on different sectors. These deliberations revealed that implementation also requires strong inter-sectoral and inter-department coordination.

Financial budgets

Each working group put together a budget for the initiatives proposed to meet the key priorities in each sector. There are a number of ongoing initiatives, which are also relevant to climate change; these budgets have also been included in determining the overall budget for the CAP. The additional resources required in each sector has also been estimated and resources for these will be sourced from the GoI or external funding agencies. The following table provides the rough budget estimate for the first CAP.

S. No.	Particulars	Approx. Amount (Cr)
1	Sustainable Agriculture Mission	420.627
2	Sustainable Himalayan Mission	131.200
3	Green India Mission	283.600
4	Sustainable Habitat Mission	1314.600
5	Mission on Health	301.500
6	Mission on Solar & Renewable Energy	158.175
7	Mission on Energy Efficiency	581.815
8	Mission on Water	469.740
9	Strategic Knowledge Mission	14.000
	Total	**3675.257**

Mizoram Climate Change Action Plan – Monitoring & Evaluation Framework

Areas	Key Impacts to Monitor	Targets to Monitor	Key Programs to Evaluate	Frequency	Feedback Loop
Sustainable Himalayan Mission	Biodiversity Land Use Plan Water Quality	Biodiversity Status Land Degradation	Protection of Land from Soil Erosion Biodiversity Conservation Program Wetland Conservation Programs	3-5 Years	Adjust budgets & Modify programs

Sustainable Habitat Mission	Water Stress Waste Management GHG Emissions form the Sector	Water Collection Traffic Waste Management GHG gas reduction	Urban Planning Waste Management Green highways Construction	3-5	Adjust budgets & Modify programs
Sustainable Agriculture Mission	Changes in yields for key crops Frequency of crop failures Yields in aquaculture Fish Catch rates adjusted for effort Animal weight and Output	Increase in yield in watershed development program areas Adoptions of improved varieties Targets for Livestock improvement Targets for fish catch per year	Integrated watershed development program Perennials plantation Program Skilled animal breeding programs Early warning system for diseases	3 Years	Adjust budgets & Modify programs
Green India Mission	Changes in the Forest Cover Improvement in the Forest stocks GHG Removal from Forests	Reforestation rates Reduction of Forests ANR Coverage Areas Enrichment Plantation rates	Forest Enrichment Plantation Programs Fire Management Programs Capacity Building Programs	3-5 Years	If program do not meet targets modify allocation of budgets
Mission on Solar & Renewable Energy	Energy Security	Installation of Solar Plants Installation of Improved Chullas and Biogas	Biogas Promotion Program Wind and Solar Programs	3 Years	Adjust programs Budgets
Mission on Energy Efficiency	Emission of CO_2 Emission Intensity	Reduce Transmission & Distribution Losses	Awareness creation & Capacity Building State level entrepreneurs to become ESCO	3 Years	Adjust programs Budgets

Mission onWater	Frequency of rainfall in different seasons	Accuracy of flood forecasting Water use efficiency rates No of harvesting strategies	Water supply connection Program Soil erosion Checkup program Water structure constructed	3 years	Modify program according to evaluation
Mission on Health	Incidence of Vector Borne diseases Incidence of Water Borne Diseases Frequency of Heat Waves	Vector Borne Disease impacts relative to baseline Water borne disease impacts relative to baseline	Vector borne diseases programs Water borne diseases program Heat wave impacts program	3 years	Modify program according to evaluation

Chapter - 1

Climate Profile

1.1. Introduction

Description of the state level context; statement of issues and problems

Mizoram is a beautiful state with rich bio-diversity. It is a state of rolling hills with about 21 major hill features running through the state; streams, deep gorges evergreen forests form part of the climate sensitive Himalayan eco-system. The region is also very vulnerable to the impacts of a changing climate and sometimes faces wrath of freak weather events. It also has a very low adaptability due to the socio-economic conditions and bio-physical conditions. The state is heavily forested (>70% of the geographical area) and has got additional incentive due to the conservation efforts. The forests of the region provide life supporting, provisioning, regulating, and cultural 'eco-system' services to millions of local as well as downstream people. The forests are of course highly susceptible not only to anthropogenic activities but also to climate change.

The valleys are hot and wet during summer and in the upper reaches it stays comfortably cool. It has a pleasant climate of 11°C in winter and 20 to 30°C. However, the effect of global warming has been experienced here with data showing increase in rise in mean and maximum temperature over the last 10 years. There are also frequent occurrence of violent storms during March and April that come from North-West Direction. Mizoram receives an average rainfall of about 3000mm in a year and this is evenly distributed and it is not drought or flood prone.

A recent report on climate change impact in India highlights that "extreme precipitation events may increase by 5-10 days in all the regions in the Northeast, the rise in temperature with respect to the 1970s ranges from 1.8°C to 2.1°C. Also, the number of rainy days is likely to increase by 1-10 days with intensity of rainfall in the region to increase by 1-6 mm/day. This may cause wide alarm in the region as many parts of the region are prone to landslides and flash floods which are only aggravated by heavy rainfall due to steep gradient. Flash floods leave very little scope for preparedness and also render crop and pastureland useless. In this context, the state climate change action preparation has been initiated. The initiative is supported under MoEF-GiZ partnership programme and facilitated by knowledge partner CTRAN.

1.2. National Priorities and NAPCC

National Action Plan on Climate Change emphasizes the overriding priority of maintaining high economic growth rates to raise living standards of the people and aligns the measures that promote the development objectives while also yielding co-benefits for addressing climate change effectively.

National Missions

On June 30, 2008, Prime Minister Manmohan Singh released India's first National Action Plan on Climate Change (NAPCC) outlining existing and future policies and programs addressing climate mitigation and adaptation. The plan identifies eight core "national missions" running through 2017. The various missions are presented in the following diagram.

These missions converge to address issue relating to adaptation and as well as mitigation actions to contain climate change.

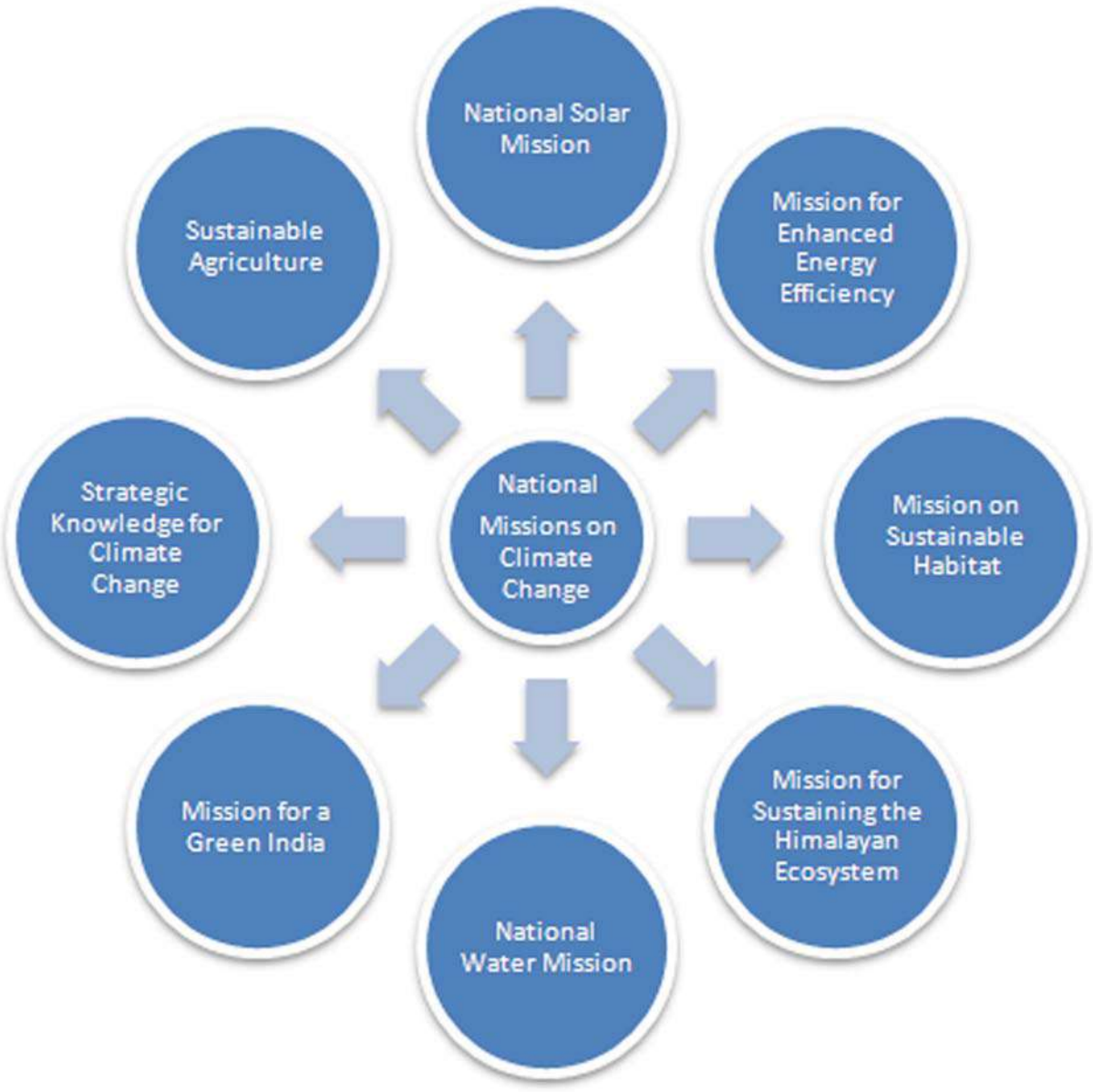
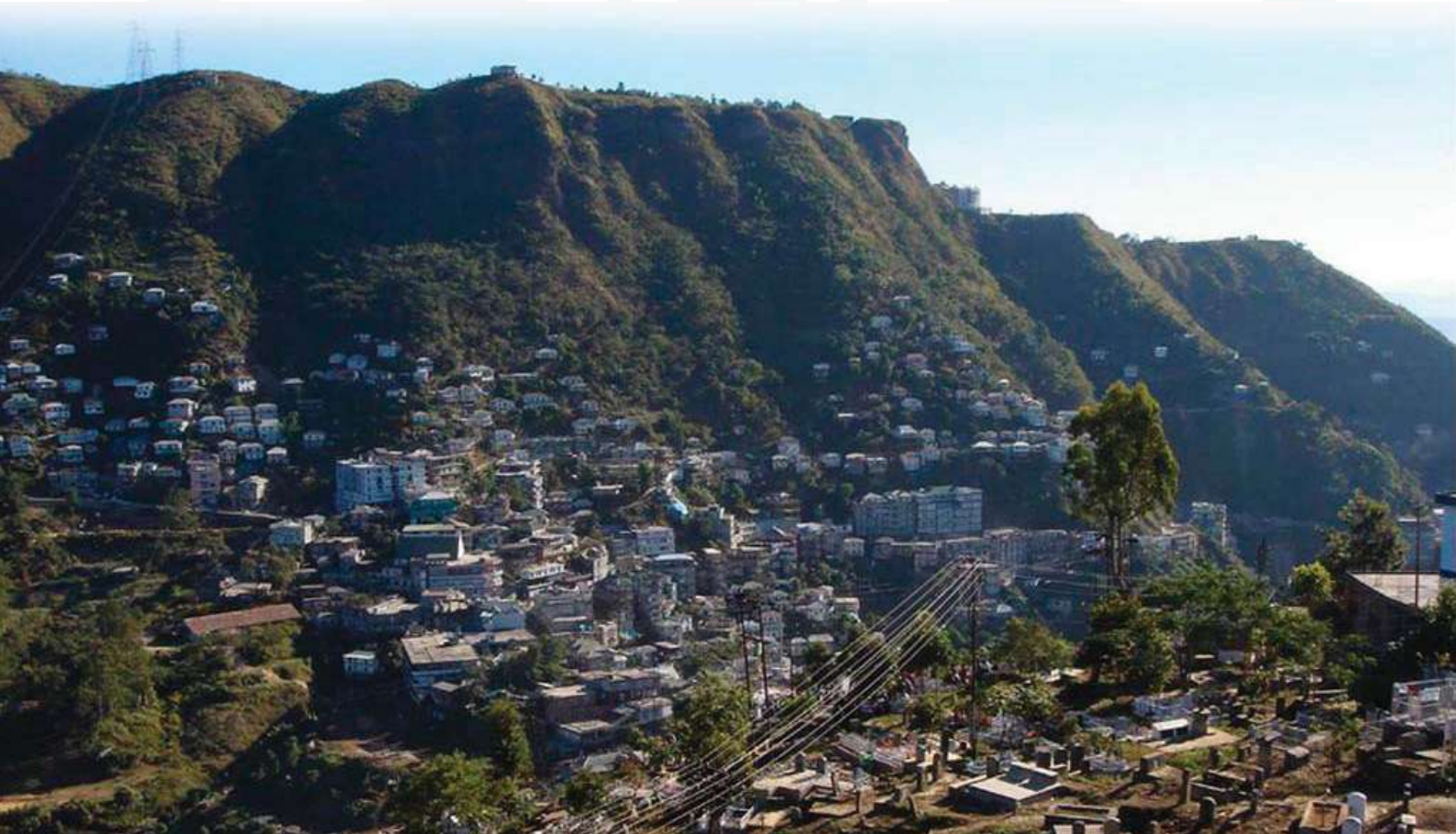


Figure 1.1: National Action Plan on Climate Change

The idea of a sub-national action plan emerged as it is grounded locally and has high ownership, better awareness linking experiences of climate linked issues to corrective actions, better preparedness and also to set strategic priorities at the sub-National level. These priorities would enable the leaders in the states to make plan for the resources and also to see the savings in terms of long run cost associated with climate change more closely.

Other Initiatives

Apart from this there have been several initiatives that have positive influence on mitigating the adverse impact of climate change. These include (a) establishment of creation market based instruments in sectors that have maximum influence on climate change (Perform Achieve and Trade for energy efficiency and white certificates in renewable in energy sector, air pollutant trading in industry and mining sector, offset instruments in forestry sector such as compensatory afforestation (b) encouraging Kyoto market instruments like Clean Development Mechanism. (c) other initiatives like Bio-Diversity Conservation, Wetland Management, Coastal Zone Management, etc.



1.3. Mapping state development issues and Priorities with NAPCC

Some of the sectors that have clear relevance with the national missions are mapped below in the following table.

Table 1.1: Key Sectoral Issues

S l No	Key Sectors	Issues/Priorities at the sub-national level	National Missions for strategic linkage
1	Agriculture and allied	More than 2/3rd are dependent on agriculture and climate change has significant impact. Require diversification, sustainable land use and pest management as well as input management	Sustainable agriculture mission
2	Energy	The state has a shortage of 50% during peak but a clean generator due to high potential for renewable and hydel power and high percentage of educated people can be made aware about energy conservation	Enhanced Energy Efficiency Mission, National Solar Mission
3	Forest	More than 70% of the state's geographical area is forested. However, The primitive slash and burn method of cultivation, or jhumming, in Mizoram has led to a massive destruction of forests and innumerable forest fires causing loss of human lives.	Green India Mission
4	Health	Vector borne diseases like Malaria is increasing the state and deterioration of the water quality too has a bearing on the health	There is no clear national mission addressing this, however, sustainable habitat, national water mission, rural health mission would address these issues
5	Sustainable Habitat	Rapid urbanisation and pressure on urban infrastructure, energy, water, waste handling and disposal	Sustainable habitat mission
6	Water	Water scarcity is a major issue in most part of the state and has become a major challenge	National Water Mission

The sectotal classification also includes:

- Agriculture (horticulture, animal husbandry, fishery and sericulture, soil water conservation;
- Forestry (includes soil conservation and bio-diversity)
- Habitat includes transport and works, housing and urban development

1.4. Baseline assessments

The population of Mizoram is 0.89 million according to 2001 census enhanced to 1.091 million (as per 2011 census) and is scattered over 8 districts, 26 blocks and 830 villages (as per 2011 census). The State has the density of 52 persons per sq. km. As against decadal growth rate of 21.54% at the national level, the population of the State has grown by 29.18%

over the period 1991-2001 (22.78% over the period of 2001-2011). The sex ratio of Mizoram at 970 females to 1000 males is higher than the national average of 940. Female literacy of the State rose to 89.40% from 78.6% in 1991 (as per 2011 census).

One of the youngest states of union Mizoram commands a special status in terms of the Constitution of India. Article 371-G of the constitution provides for special safeguards to the religious and social practices and also respects for the customary laws, ownership and transfer of land requires ratification from the state legislature. There are three autonomous district councils (Mara, Lai and Chakma) have been created. This is significant in the context of climate change as issues relating to land use change, forest protection, sustainable cultivation and orderly development would require significant understanding and participation of the local community to make it legally tenable, socially acceptable and a driver of change for balanced growth of the state.

Table 1.2: Administrative Setup

Description	Unit	Data
Area	Sq. km	21081
Districts	No.	8
Sub-Districts	No.	23
Villages	No.	830
Towns	No.	23
City	No.	1
District Councils	No.	3

(Soruce - census of India 2011, Provisional Report)

The state is predominantly agrarian. More than 70 per cent of the population depend on agriculture for their livelihood but low productivity of the sector its high sensitivity to climate remain a matter of concern.

Table 1.3: Demographic Data

Description	Unit	Data (2001)	Data (2011)
Population	Nos.	888573	1091014
Density of Population	Per Sq. km	42	-
Rural Population	% of Total	50.37	48.49
Urban Population	% of Total	49.63	51.51
Scheduled Tribes	% of Total	94.46	-
Total workers to total population	%	52.57	-
Main workers	% to total	40.79	-
Marginal	% to total	11.78	-
Cultivators	% to total	54.90	-
Agriculture labour	% to total	5.70	-
Household Industry worker	% to total	1.50	-

Per capita income of Mizoram is Rs 45,982 (2009-10) which is higher than the national average. More than 60 per cent depend on agriculture and industry is virtually non-existent.

Key socio-economic and ecological predictors for the climate modelling:

Table 1.4: Socio - Economic and Ecological Predictors

Parameters	Mizoram	North-Eastern Region	India
Area in Sq. km	22,081	2,62,179	32,87,240
Forest area to total area (%)	79%[1]	23.57[2]	23.57
Population in lakh (2001)	8.98	389.84	10,287.37
Literacy Rate % (2001)	88.8	68.5	64.8
Poverty ratio based on MRP consumption (2004-05)[3]	9.5	13.9	23.6

These data can be used for a holistic projection of climate change impact.

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1 FSI data 2009

2 INCA report 2010

3 INCA report 2010

1.5. Past and on-going climate change trends and risks

Due to its geo-climatic condition, the entire state is one of the most hazard prone states in the country. The state is annually swept by cyclonic storms, cloudbursts, hailstorms and landslides. To make matters worse, the State falls under Seismic Zone V, and thus liable to be hit by strong earthquakes. Small tremors are felt every now and then in and around the state. Although the State is enjoying abundance of rainfall during monsoon period, the dry spell during non-monsoon period is really hard for the people. Due to the steepness of the hillsides, underground water retention is minimal, causing perennial water sources to dry up during this period. This had been aggravated by the tradition custom of jhum cultivation, commonly known as slash and burn.The habit of felling trees and foliage of forests and burning them really destroy natural vegetation, thus causing ecological imbalances. Moreover, this usually led to unwanted spread of fire to forests.

A study by remote sensing center in Mizoram that tracks climatic parameters (namely rainfall, temperature and humidity) of Aizawl City for a period of twenty years (1986 . 2005) in Aizawal city has been summarised below. The data were compared and analyzed for two decades taking an average data for 10 years interval as well as 5 years interval to arrive at brief conclusive results on the overall climate change in Mizoram.

Rainfall pattern

Pattern of rainfall in Mizoram during the past 20 years i.e, from 1986 to 2005 follows the usual expected trend in which maximum downpour occurred during the monsoon seasons and declines during the rest of the seasons. However, when analyzed on a yearly basis the trend shows a gradual decline and then a sudden increase from 1990 to 1995. Infact, during the span of the 20 years study period, 1995 recorded the highest rainfall of 3185.98 mm whereas 1994 had the lowest rainfall with a measure of 2278.29 mm only. From here onwards, the trend does not show either a sharp increase or decrease in rainfall.

When analyzed on an average monthly basis per year, the trend shows a gradual increase from January and reaches its peak maximum during July-August and then continues to decrease sharply by the end of the year. Anyway, when taken as a whole the average annual rainfall for the studied 20 years accounts to 2793.67 mm which can be credited to the contribution of downpour recorded during the monsoon seasons. On analysis of the two decades, the monthly average rainfall during 1996-2005 when compared to the previous decade of 1986-1995 shows a gradual increase during the month of March, May, September and then a remarkable increase during the month of July

Thus, it can be interpreted that there is change in the rainfall trend when analyzed and compared between the two decades, but not on an extremely large scale which again shows that this trend can further change the pattern for the consecutive 10 years rainfall data. If this usual small scale change in trend continues, then Mizoram is not expected to experience a sharp decrease in rainfall unless there are other climatic elements that unexpectedly alter the usual trend, which is mostly above the 2000 mm mark.

Temperature

Temperature data has also been analyzed using 20 years temperature data collected and studied for two decades. The average monthly maximum temperature taken during the

decade of 1996-2005 shows an increase over the previous decade of 1986- 1995, during the early part (January-February) as well as later part (November-December) of the years.

However, not much increase is observed during the rest of the months on comparison and the trend is somewhat parallel to each other. However when analyzed on a whole, there has been an increase in the average maximum temperature during 1996-2005 by +0.28°C over the decade of 1986-1995, which denotes a trend in increase in temperature during the last decade. The same increase is also reflected in the average minimum temperature recorded for the decade of 1996-2005 which is +0.30°C, much higher than that recorded for the previous decade of 1986- 1995. The rate of increase is clearly reflected when the overall monthly average temperature recorded for both decades shows an increase of +0.29°C. The overall trend in temperature also shows a gradual increase during the 1996-2005 decade. The increase in temperature as per the data indicates that there might be further rise in the heat wave in the years to come.

Humidity

Humidity is another climatic element that has close relation to temperature and rainfall and also plays a key role in affecting the climate of a region. Average data on humidity for 20 years was collected and analyzed for a period of 5 years each. The results studied for each period clearly indicated that there was a gradual and progressive increase in humidity during the entire span of 20 years. In each of the 5 years period data that was analyzed, the trend seemed to decrease during the month of February but then gradually increased till August where it reached its maximum and then decreased during the end of each year. All the data recorded were within the wide range of +50% to +90% relative humidity, with the highest percentage recorded during June to August.

Taken as a whole, the average relative humidity studied at 5 years interval for a span of 20 years indicated a gradual increase from 73.14% in 1986-1990 to 81.42% in 2001-2005, a marked increase of +8.28% during last two decades.

Data that have been used to study climate change in this context are necessarily simplified representations of the climate system prevailing during 1986-2005. Despite the inevitable limitations, the climate data simulations more or less accurately reproduce the large-scale seasonal distributions of pressure and temperature. In addition, the large-scale structure of precipitation (rainfall) and heat flux (temperature variations) also closely resembles the observed estimates on a global scale (which was +0.3 and +0.6° C during the last 150 years).

Considering all the results obtained from the study, it can be said that the climate parameters studied, have either direct or indirect relation to increased atmospheric concentrations of the principal anthropogenic greenhouse gases which have subsequently increased in significant amount during the last two decades. Elevated concentrations are predicted to persist in the immediate atmosphere for years to come if we do not reduce emissions of greenhouse gases by the end of the next decade. Moreover, the increased atmospheric levels of these gases, especially CO_2, increase the IR (Infrared) energy absorbed by the atmosphere, thereby producing a warming influence at the ground level and sub-surface as a result raising the mean temperatures by a few more degrees.

Chapter - 2

National Action Plan on Climate Change

2.1. Introduction

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

2.2. Approach to Climate Change

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

2.3. Domestic Action

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

Solar Mission

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

Mission for Enhanced Energy Efficiency

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

Mission on Sustainable Habitat

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

Water Mission

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

Mission for Sustaining the Himalayan Ecosystem

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

Mission for a "Green India"

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

Mission for Sustainable Agriculture

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

Mission on Strategic Knowledge for Climate Change

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

developing adaptation and mitigation technologies through venture capital funds.

2.4. Other Initiatives

Apart from the eight National Missions, the National Action Plan also envisages other initiatives aimed at enhancing mitigation and adaptation. These include research & development in the area of ultra super critical boilers in coal-based thermal plants; integrated gasification combined cycle technology to make coal based power generation efficient; setting up more combined cycle natural gas plants; promotion of nuclear energy through adoption of fast breeder and thorium-based thermal reactor technology in nuclear power generation; adoption of high-voltage AC and high-voltage DC transmission to reduce technical losses during transmission and distribution; small and large scale hydro power; promotion of renewable energy technologies such as bio-mass combustion and gasification-based power generation; enhancements in the regulatory/tariff regimes to help mainstream renewable-based sources in the national power system; and renewable energy technologies for transportation and industrial fuels. In addition, the Action Plan envisages effective disaster management strategies that include mainstreaming disaster risk reduction into infrastructure project design, strengthening communication networks and disaster management facilities at all levels; protection of coastal areas, provision of enhanced public health care services, and assessment of increased burden of disease due to climate change. The Action Plan also highlights the role of Central Government, State Governments and local Bodies in putting in place appropriate delivery mechanisms and building adequate capacity and knowledge in the relevant institutions for effective adaptation and mitigation actions.

2.5. Institutional Mechanism

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

Chapter-3

Agro-climatic Zone Level Assessment of Climate Change Impact

The State of Mizoram enjoys a typical climate with variations ranging from Sub-tropical to temperate conditions in hilly areas. The quick changes in topography of Mizoram consequences a significant climate changes within a short distance. According to the Rainfall assessment of last five years, it is seen that the precipitation is decreasing with respect to the average rainfall of last five years. Through assessment of Agro climatic zones of Mizoram, Risks and opportunities were also identified in relation to projected impacts of climate change. Climate change projections were used to define agro-climatic zones, which served to distinguish the priority risks and opportunities and latter we can prioritize the adaptation options. According to Agro Climatic Zones of Mizoram, the prioritization of Mitigation and Adaptation option has been carried out in a three stages. 1) Categorization, 2) semi-quantitative approach (to assess the magnitude and likelihood of risks and opportunities), 3) prioritized according to their combined magnitude-likelihood scores.

The analysis also refers a time-frame; therefore the suggested adaptation and mitigation options are projected risks and opportunities within this period. But, due to the lack of quantified information on uncertainty in climate change scenarios in Mizoram, a detailed time-frame analysis is not carried out. Our findings are given below in a tabular from.

Table 3.1: Problems and Potentials with respect to Agro-climatic region in Mizoram

Agro-climatic region	State	Problems	Typology	Potential Agricultural crops:	Potential Horticultural crops:
Eastern Himalayan Region-II	Mizoram	toxicity and soil acidity, Soil erosion and floods, shifting cultivation, low SRRs, non availability of electricity, poor road, poor Input delivery system and Communication infrastructure.	Fragile land; Low productivity; and Fragile ecology prone to soil erosion with low level of irrigation & recurrent floods.	Rice (kala joha), Rabi maize, rape seed & mustard and pulses	Potato, ginger, cauliflower, cabbage, mushrooms, turmeric, Black pepper, cardamom, medicinal & aromatics (Cinchona, Chiryata, Himalayan Yew, Bhumi aonla & Tejpat) & ornamentals (orchids).

Table 3.2: Agro Climatic features of Sub-Regions of Mizoram

NARP Zone	Agro Climatic Features of the Sub Regions				
	Sub Region	Rainfall(in mm)	Climate	Soil	Crop
1) Humid Sub-Tropical Hill Zone 2) Humid Temperate Sub-Alpine Zone 3) Humid Sub-Tropical Hill Zone	Himalayan Hills	2441	Per humid to humid	Brown Hills	Rice, maize, Ragi, potato
	North-East Hills	3528	Per humid to humid	Red sandy laterite	Rice, rapeseed, maize
	Upper Brahmaputra	2809	Humid to per humid	Alluvial, red loamy	Rice, jute, rapeseed, wheat
	Southern Hills	2052	Per humid to humid	Acidic soils	Rice, maize, sesame, sugarcane
	Lower Brahmaputra	1840	Per humid to humid	Alluvial, red loamy, tarai soils	Rice, rapeseed, wheat, jute, potato

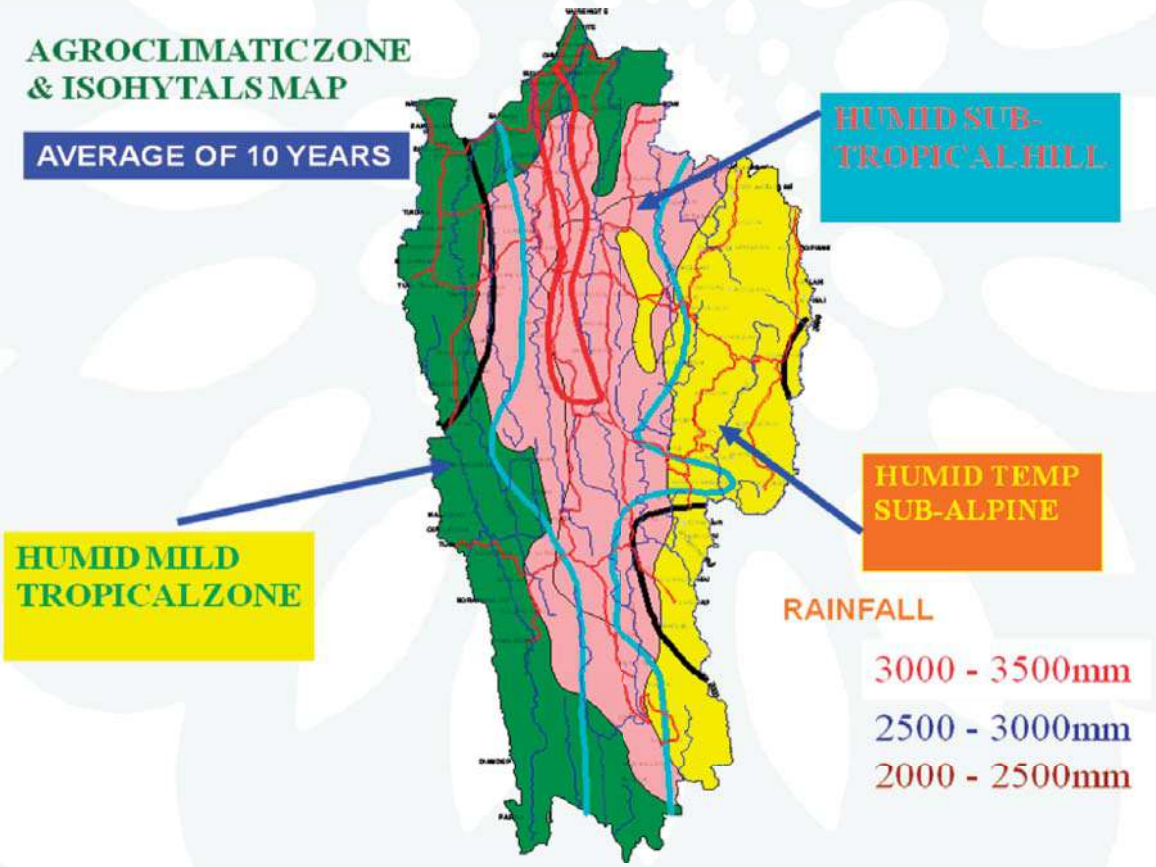


Figure 3.1

Table 3.3: District wise rainfall comparison in Mizoram

Sl.No.	District	Average Rainfall of last five years (in mm)	Rainfall in 2009 upto 24th July (in mm)	Less % from normal
1.	Aizawl	1680.4	951.1	43.4
2.	Champhai	1132.5	802.1	29.14
3.	Kolasib	1398.1	1078.2	22.8
4.	Lawngtlai	1337.5	944.8	29.3
5.	Lunglei	1353.5	759.6	43.8
6.	Mamit	1772.3	1052.3	40.6
7.	Saiha	1628	1151	29.3
8.	Serchhip	1276.5	675.2	47.1
Average Mizoram		1447.3	926.7	35.9

Table 3.4: Sector wise Climate Vulnerability and key Interventions in Mizoram

Modules	Climatic Vulnerabilities	Key Interventions
NRM	• Water scarcity during Rabi season • Poor soil health	• Polythene mulching in vegetables • Rainwater harvesting structure (farm pond) • Percolation pond for recharging ground water • Soil test based nutrient application
Crop production	• Water scarcity during Rabi season • Poor soil health	• Introduction of adapted high yielding varieties of new crop • Appropriate inter-cropping systems • Micro-irrigation systems – sprinkler, drip
Livestock & fisheries	• Mortality and morbidity losses due to biotic and abiotic stresses • Fodder scarcity	• Prophylaxis of livestock • Mitigation of mineral deficiencies in livestock • Production and supply of seedlings of fodder trees/ grasses and Azolla
Institutional	• Low seed replacement rate & poor access to improved seeds • Poor access to farm implements • Poor access to live-stock services • Losses due to highly uncertain weather	• Seed bank/ seed production of seeds through farmers groups • Community managed farm machinery custom hiring centre • Training 2-3 rural youth as livestock service providers for prophylaxis • Agro advisory based on IMD weather forecast and village weather observatory • Training 2-3 rural youth for maintaining micro-irrigation systems and farm machinery

Chapter : 4

Process of Preparation of Climate Change Action Plan in Mizoram

4.1. Formulation of SAPCC

Objective of SAPCC

The main objective of Climate Change Action Plan is to strategize adaptation and mitigation initiative towards emission stabilization and enhance the resilience of the ecosystem.

This exercise helps serving as a platform to take the climate change agenda of the state forward which in future could be a combination of advocacy, knowledge deepening, policy analysis and operational work. However, there is also the need for putting forward actions where public investment would be needed to make the state and community more climate resilient.

4.2. Methodology

Government of Mizoram has taken the climate change issue very seriously. A detailed roadmap has been chalked out to develop the climate change action plan for the state.

Institutional Framework

Climate Change Council of Mizoram will coordinate state action plan for assessment, adaptation and mitigation of climate change. The composition of the Council on Climate Change is as follows:

Table 4.1

S l No	Designation	Position in Council
1	Hon'ble Chief Minister, Chairman	Chairman
2	Hon'ble Minister, Rural Development	Member
3	Hon'ble Minister, Agriculture, etc.	Member
4	Hon'ble Minister, PHE, Tourism, etc.	Member
5	Hon'ble Minister, Transport, etc.	Member
6	Hon'ble Minister, Revenue	Member
7	Hon'ble Minister, Forests	Member
8	Vice Chairman, State Planning Board	Member
9	Chief Secretary, Govt, of Mizoram	Member
10	Principal Secy, PHE, Agri, etc.	Member
11	Secretary, Environment & Forests	Member
12	Secretary, Tourism	Member
13	Secretary, R.D.	Member
14	Secretary, Horticulture	Member
15	Principal Secy, Planning &Prog. Implemtn.	M e m b e r Secretary

Objective: The overall objective of the Council would be to monitor the targets, objectives and achievements of the national missions specified by National Action Plan on Climate Change (NAPCC). The respective missions shall be

taken care of and attended to by the individual departments who shall strive to attain the listed objectives within stipulated time frames and ensure their vertical integration with the National Mission.

The operating arm of the climate change council shall be the executive council. The composition of the council shall be as follows:

Table 4.2

S l No	Designation	Position in the Council
1	Chief Secretary, Govt, of Mizoram	Chairman
2	Principal Secy, Planning &Prog. Implmtn.	Member
3	Principal" Secretary, PHE, Agri, etc	Member
4	Principal Chief Conservator of Forests	Member
5	Secretary, Rural Development	Member
6	Secretary, Horticulture	Member
7	Secretary, Tourism	Member
8	Principal Adviser Planning	Member
9	Principal Scientific Officer, Science & Technology	M e m b e r secretary

Objective:The objective of the executive Council will be to monitor the directions and other related matters of the Climate Change Council.

Roadmap for the development of the climate change action plan

Required institutional arrangement has been put in place for the co-ordination of the preparation of the climate change action plan with the support from GiZ and CTRAN consulting acting as the knowledge partner. The following process will be followed:

Figure 4.1: Way forward for the preparation of the Climate Change Action Plan

Process of Prioritisation of the options

Adaptation and mitigation options will be generated within the working groups and prioritised. This will be based on the state specific barriers. The prioritisation framework has been given below:

Generating the options

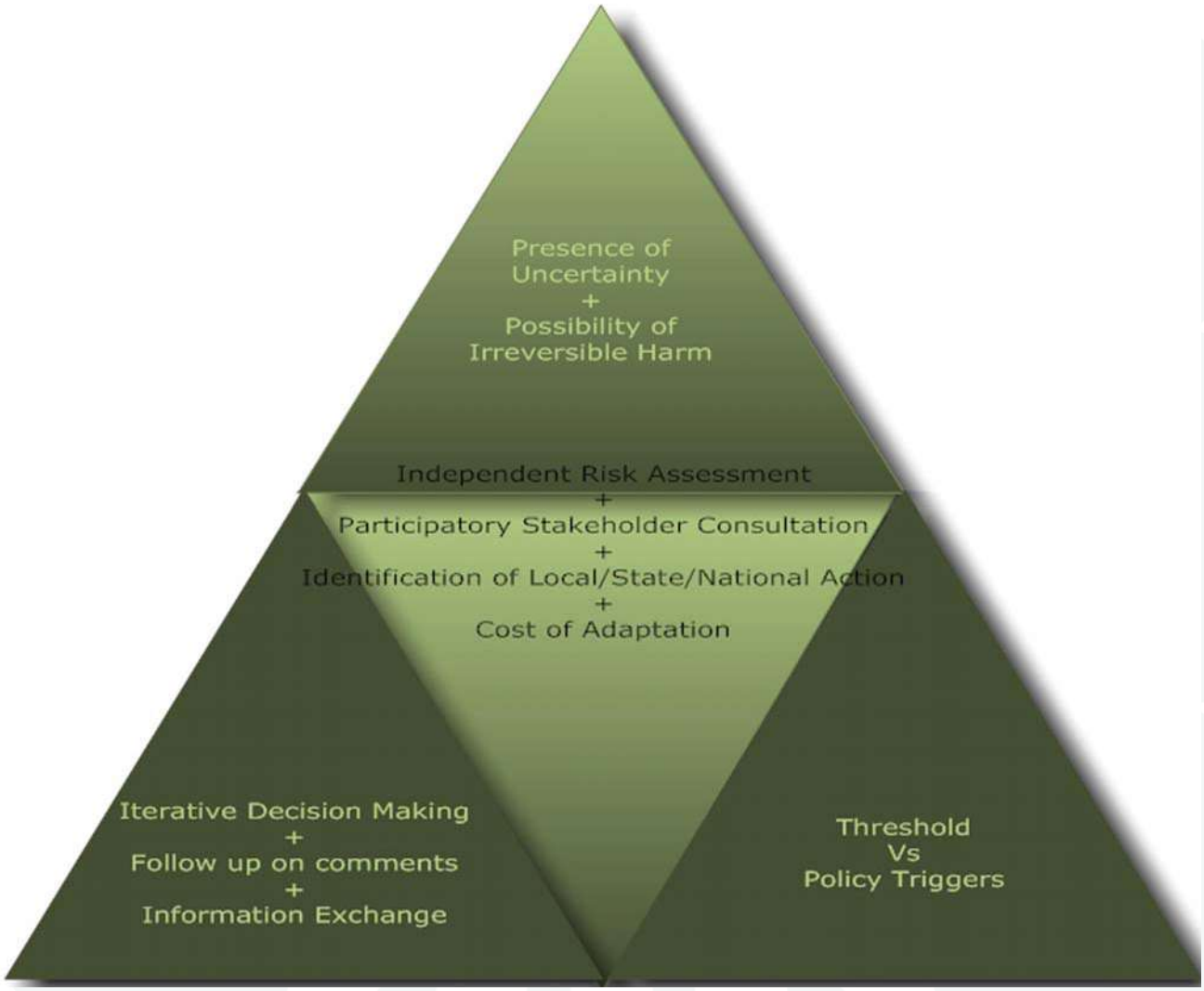


Figure 4.2: Generation of options

While generating the options it will be seen that, there is no strategic disconnect with the national policy with respect to stated positions, no further need to reinvent the wheel and also proposing workable approaches without having extra-emphasis on theoretical issues. The process will be participative and inclusive.

Prioritisation Framework

The process of prioritisation shall be as below:

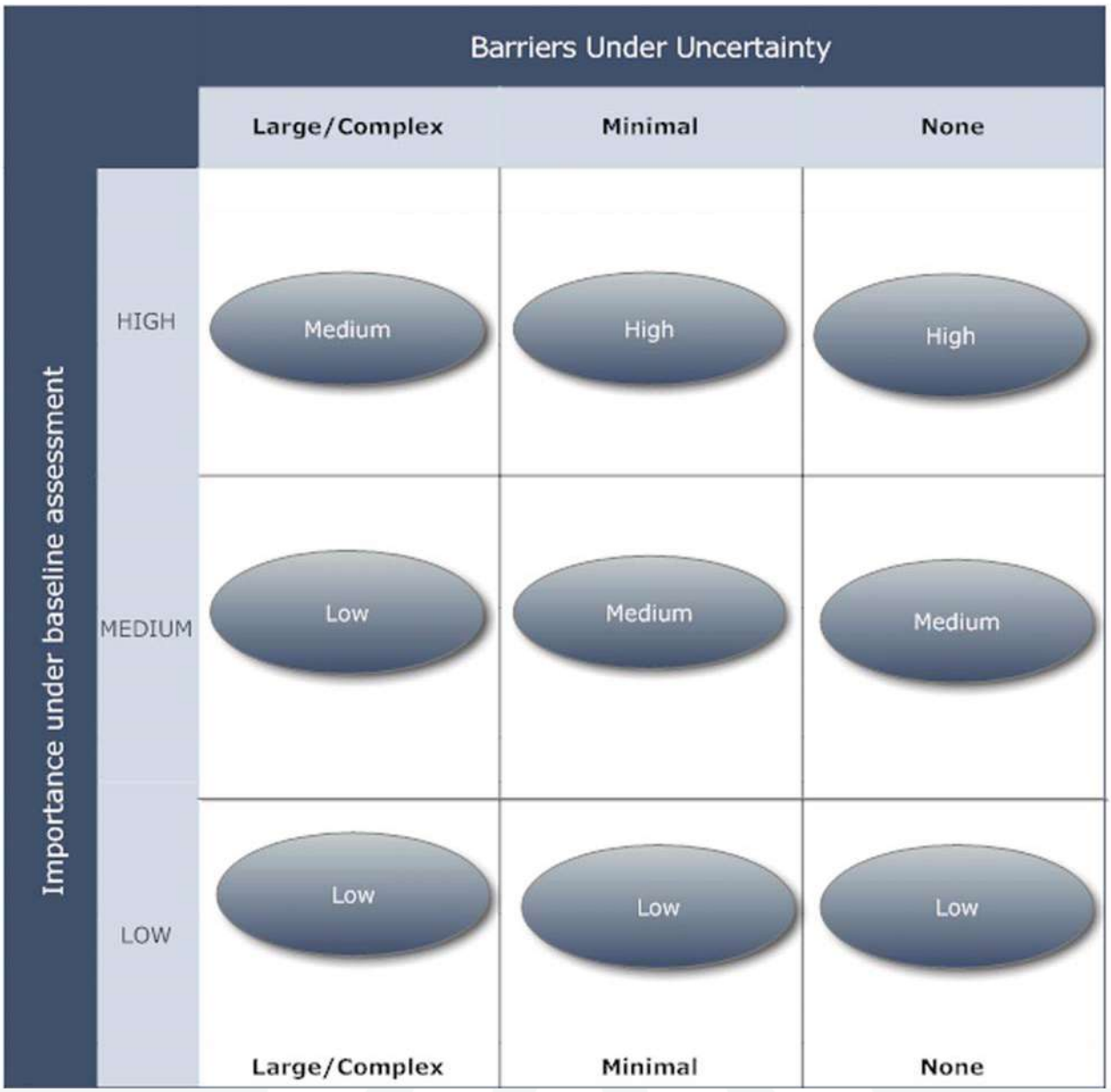


Figure 4.3: Prioritisation of Sectoral Issues

This will give basket of options sectorally and also can later be linked to budgetary and extra-budgetary resources.

Enabling framework

A low carbon development requires an enabling policy and institutional framework. This has been given below.

Incentives	Rationalize energy, water and agricultural policies to Create incentives
Regulations	Efficiency Standards, codes, zoning; climate screening/ proofing of investments
Institutions	Capacity of public, private and financial sector institutions to assess and act on climate risks
Markets	Improve investment climate; deepen financial and capital markets; new markets (cap & trade, CDM)
Public Outreach	Education, raising awareness and promoting change in Behavior of the community and preferences

Figure 4.4: Tools to develop an enabling framework for CCAP

This tool will be used to analyse and develop a plan for carbon conscious development strategy for the state.

Chapter - 5

Sustainable Agriculture

5.1. Sectoral Overview

The State's economy is predominantly agrarian, with more than 60% of the total work force engaged either directly or indirectly in agriculture. Only 5% of the total area is under cultivation and about 11% of the total cultivated area is under irrigation. However, agriculture still remains under-developed and the primitive method of jhum (shifting cultivation) predominates. Both production and productivity are relatively low. As per the Agriculture Census (1995-96), there were 65,919 operational holdings with a total operated area of 85,000 hectares. Out of the total of holdings 42.04% is marginal, 39.0% small, 17.83% semi medium 1.11% medium and 0.01% large holdings. Small holdings make adaptation planning far more complicated as compared to the larger ones.

Mizoram enjoys wonderful blend of climatic conditions ranging from tropical, sub-tropical to temperate conditions. The hill ranges run in North – south direction with varying altitude with an average height of 920m above sea level, coupled with high mean annual rainfall of 2500 mm and high relative humidity upto 90%. Mizoram has primarily sand-loamy and clay-loamy soil rich in organic carbon and moderately rich in available potash. The temperature during summer season varies from 20°C to 34°C and during the winter season varies from 8°C to 17°C. Due to high rainfall during May to September the soil is Acidic ranging from 4.5-5.6 ph. In Mizoram, due to limited availability of irrigation, agriculture is entirely dependent on the rainwater from the driving monsoon downpours. The unfavourable physical conditions do not facilitate irrigation. The uneven terrains in Mizoram are not favourable for the cultivation of crops. The distribution of rainfall that varies between 1900 mm and 3000 mm and the fertile temperate soil smooth the progress of extensive jhum cultivation. This primeval practice of Jhum cultivation is carried out by a large number of people living in rural areas of Mizoram. A number of crops like paddy, beans, cucumber, maize, arum, sesame, mustard and cotton are grown by practicing jhum or shifting cultivation.

5.2. Facts about agriculture & horticulture in Mizoram

In Mizoram, Paddy is one of the most important crops, and after the completion of the of paddy harvesting, the seeds of the other crops are sown. (Paddy occupies almost 50% of the total cropped area and more than 88% of the total area under food grains.) The sowing commences from the end of April, close to the occurrence of the full moon. In Mizoram, two types of paddy are sown: 1) early paddy (short duration) and 2) principal

paddy (long duration). The two crops are grown side by side in the same field. Although, the initial production of early paddy is poor, it ripens quickly and is a means of subsistence till the verdant golden crop of principal paddy is collected. Besides agriculture, the cultivation of crops like sugarcane, cotton, tapioca, oilseeds, mustard, sesame, soybean and pulses like cowpea, french and rice beans also contribute towards the economy of Mizoram. Horticulture also adds substantially to the state's economy.

about 75,000 MT. The major fruit crops are, orange, pineapple, Passion fruit, banana, mango, papaya, guava, jack fruit, grapes, pear, litchi and apple. The major vegetables grown in Mizoram are tomato, brinjal, beans, peas, squash, mustard, cabbage, etc. Among tuber crops, potato, sweet potato and colacasia are major ones grown. The climate in the State is suitable for the cultivation of spices. Ginger, turmeric, chilly, pepper, cinnamon and large cardamom grow very well in the State. At present ginger, turmeric and chillies are commonly cultivated.

Table 5.1: Area and Production of Important Crops of Mizoram

Name of crop	2003-04		2004-05		2005-06		2006-07		2007-08	
	Area (ha)	Production (MT)	Area (ha)	Production (MT)	Area (ha)	Production (MT)	Area (ha)	Production (MT)	Area (ha)	Production (MT)
Paddy	59196	114630	57085	107661	55754	99021	52847	42091	54541	15688
Maize	10481	20282	10505	19788	11742	22703	10775	20969	7328	729
Pulses	4892	4313	6741	7971	2972	2737	5054	5833	5048	2632
Oil seeds	7532	5478	5817	5321	4816	5429	4075	3755	3755	748
Sugarcane	1393	36174	1357	13565	1383	45953	1340	12187	12187	826

Source: Statistical handbook, Mizoram 2008

Since the use of fertilizer and pesticides in agriculture and horticulture fields is almost non-existing in Mizoram, so the agricultural and horticultural products are mostly organic, and the products have very high value in the national and international product market. To motivate and encourage the organic farmers, and also to raise awareness, 2 Nos. of Market Outlet have been established at Aizawl and Dartlang.

Agro-climatic conditions in Mizoram are found to be very much suitable for growing a wide range of horticulture crops covering fruits, vegetables, ornamental crops, and spice crops. About 1600 Hectare has been covered for fruit plantation with the total yield of

5.3. Facts about the Animal Husbandary:

The population of cross breed & Indigenous cattle have increased by 16.60% and 3.88% respectively during the interval between the 16th and the 17th Census. The buffalo and goat population have also increased by 6.84% and 5.88% respectively, signifying the lower growth in this type of livestock. Mithun & Pig population has increased by 33% and 33.09% respectively. Pig is the most populous and popular livestock in Mizoram. While the cross breed population make up for 90% of the total population, the indigenous pig accounts for only 10% of the total population. It is further

observed that as compared to the last census, there is a 44.00% decrease in the indigenous population of pigs.

The Mizo tribes of north east India developed and practiced different types of fishing methods since time immemorial. The people of Mizoram use locally available materials and apply indigenous ideas and skills (indigenous technical knowledge, ITK) for fishing. Various fishing techniques depend on various behavioural pattern and microhabitat type of fishes.

5.4. Key Issues

In the last two decades significant changes in the climatic variables has been seen due to increasing nature of anthropogenic activities. It is estimated that an average area of 2.00 lakhs acres of Forest cover are annually destroyed by slashing and burning of trees for Jhum land in Mizoram. 3.50 lakhs hectares are still utilized for the devastating and unproductive jhumming (Shifting) cultivation of Paddy. This deforestation is due to mainly the change in land use in which shifting cultivation or jhum cultivation is at the centre. Mizoram has experienced land degradation at an alarming rate owing to the destructive slash-and-burn system of cultivation. Mizoram Remote Sensing Application Centre (MRSAC) has identified a total of 20.64% of Mizoram as degraded land, which scientists said is alarming.

Like all other North Eastern states of India-, Mizoram is also facing the prediction and consequences of global climate change. Temperature is generally considered as the first variable assessments of climate change. Followed by other parameters like rainfall and humidity. Agriculture is highly dependent on these three parameters and the production and yield of Agriculture is likely to change due to changes of any of these parameters. Failure of rains and occurrence of natural disasters such as floods and droughts could lead to crop failures, food insecurity, famine, loss of property and life, mass migration, and negative national economic growth within the state.

As per the present status, the total annual requirement of rice for Mizoram is 19,22,030 Quintals/year but Mizoram produces only 462924 quintals/ year (24% of the total requirement) leaving a deficiency in range of 76%. Climate change might change the gap further leading to production security issues.

5.5. Climate Change Adaptation in Agriculture and allied sectors of Mizoram

Adaptation measured can offset the negative impacts of climate change on irrigated rice but in the case of rain-fed rice, growing of tolerant and high input efficiency rice varieties with better management and assured irrigation only can reduce the climate change impacts. With such adaptation strategies, the positive impacts can be improved further.

Meteorological report (Guwahati,2009) depicted deficiency in rainfall which is increasing every year (in 2005 deficiency was 22% and in 2006 deficiency was 25%). Due to low rain fall Mizoram is facing a drought situation affecting fish, agriculture and livestock.

The year 2005, saw extended dry periods in Mizoram. Many springs and streams dried up accompanied by large scale landslides (ICIMOD, 2008). Improper rainfall (earlier or later) adversely affected sowing and harvesting of crops, because of which there was a heavy damage in harvestable grains. Moreover, it is also seen that natural wetlands

are dwindling in many parts of Mizoram. Some of the ecologists have argued that more number of invasive species have appeared and distribution pattern has changed in Mizoram. Out break of more number of diseases and pests occurring in citrus species are also reported. One significant impact which many plant scientists agree to is the changes taking place in the phenological phases in plants (ICIMOD, 2008).

For working out the comprehensive impacts, there is a need to link other influential biophysical and socio-economic driving forces those which are indirectly impacted by climate change but influence the agriculture of the state. Suitable agronomic management options can act as one of the important adaptation strategies to face climate change.

5.6. Adaptation Pathways in Agriculture

Effective and result-based measures should be supported for the development of approaches at all levels on vulnerability and adaptation, as well as capacity-building for the integration of adaptation concerns into sustainable agriculture development strategy in the state.

Table 5.2

Issues	Impact	Pathways
Warm and Humid summer and cold winters	Erratic cropping season, crop loss	Local weather monitoring stations for data and timely predictions, temperature tolerant crop varieties
Heavy and erratic precipitation	Crop damage due to prolonged submergence or lack of timely precipitation	Stress tolerant varieties, water harvesting, mini-check dams and reservoirs
Traditional Jhum cultivation	Deforestation, reduction in carbon sinks, soil erosion and land degradation, livelihoods affected	Jhum optimisation through catchment area protection, plantation crops, soil conservation
Use of fertilisers	Reduction in carbon sink	Organic farming, Using sustainable fertilizer and tillage practices (improving soil drainage, no-till, etc)
Increase in vector-borne diseases	High mortality of farm animals	Vaccination, breeding of climate resilient breeds

The following are the overview of the sectors and how they are likely to be impacted due to climate change. The sheaf of options for adaptations now being mulled over by the working groups and is not yet final. A snapshot of discussions has been presented in the following table.

Table 5.3

Sectors	Possible adaptive options
Agriculture	**Develop new crop varieties including hybrids to increase the tolerance and suitability of plants to temperature, moisture and other relevant climatic conditions**
	Diversify crop types and varieties, including crop substitution, to address the environmental variations and economic risks associated with climate change
	Soil and moisture conservation practices through activities like: contour ploughing, check dams and bunding, organic manuring, mulching etc.
	Develop water management and conservation innovations, including irrigation, to address the risk of moisture deficiencies and increasing frequency of droughts
	Develop early warning systems that provide daily weather predictions and seasonal forecasts
	Change timing of farm operations like sowing and harvesting to address the changing duration of growing seasons and associated changes in temperature and moisture
	Encourage organic farming practices
	Conservation of agrobiodiversity to provide specific gene pools for crop and livestock adaptation to climate change.
	Selection of crops and cultivars with tolerance to pests and diseases to generate greater genetic variability (FAO)
	Developing resilient rice crops to heat stress
	Use of genetic markers for speeding up breeding process
	Geographical analysis of vulnerable regions
	Site-specific adjustment in crop management (e.g. shifting planting dates and improved water management)
	Regional climate modeling to identify future "tilting points" of rice production (e.g. the temperature level or CO_2 levels above which major yield losses are experienced)
	Developing newer crop management trends (e.g. diversification from rice-rice to rice-maize systems) to alter crops' budgets of carbon and nitrogen and thus significantly attempt to reduce greenhouse gas emissions
Animal Husbandry	Breeding livestock for greater tolerance and productivity. Changes in livestock practices may influence future spread/distribution of vector borne diseases
	Breeding livestock for greater tolerance and productivity
	Improving pastures and grazing lands management
	Preservation and conservation (in-situ and ex-situ) of existing animal genetic diversity
	Technological developments, such as the development and promotion of new crop varieties, improvements in water and soil management, and improved animal health
	Planting species with higher tolerance to changing climate

5.7. Key Priorities

The following action points have resulted out of several rounds of discussions between the working group members

Table 5.4

Key priorities: Agriculture	
1.	Development of Land (Levelling, bundling, etc) for Wetland Rice
2.	Cultivation (WRC) on available lands having 0-10% slope and Improvement of Existing Wetland Rice Cultivation (WRC)
3.	Developing data base on genotypes of local crop varieties (mainly rice varieties) and identification of suitable varieties for different agro-climatic zones.
4.	Impact assessment of paddy cultivation through agricultural inputs such as crop varities, kharif crops and promotion of rain water harvesting and construction of ecofriendly mini check dams for irrigation.
5.	Assessment study and demonstration of Systematic Rice Intensification (SRI) cultivation and Capacity building to train farmers in latest rice cropping techniques specially evolved to counter adverse effects of climate change
6.	Optimization of jhum cultivation through conservation of arable land, water utilization management, parallel cultivation of alternative crops and Alternative jhum Control to Livelihood
7.	Construction of Hill Slope terraces for conservation of moisture and cultivation of foodgrain, vegetable, pulses and oilseed crops
8.	Increasing the area under perennial fruit plantation crops and low value high volume crops to help cope with uncertain weather patterns.
9.	Management of climate change impact on horticulture and Climate risk management studies
10.	Improving post harvest management such as cold chain for perishable crops and winter cultivation practices
11.	Promotion of organic farming through usage of compost and vermicompost
12.	Adoption of Integrated Pest Management for improved crop yield, Preparedness to tackle emerging scenarios of pests and capacity building for stakeholders
13.	Research study on livestock disease and establishment of early warning system and Capacity building to Stakeholders
14.	Study of impact of Climate Change on the indigenous fauna of aquatic ecosystem and open waters
15.	Water storage and providing proper diversion channels to the existing ponds for drainage of catchment runoff during sudden heavy rains
16.	Providing extensive support and services to fishermen through establishment of district level training centres
17.	Water bodies conservation for fishery sector and establishment of fishery units in reservoirs and riverine area

- **Development of Land (Levelling, bundling, etc) for Wetland Rice Cultivation (WRC) on available lands having 0-10% slope and Improvement of Existing Wetland Rice Cultivation (WRC)**

In Mizoram, the cultivation method has remained primitive (jhum). The main reasons are(i) lack of suitable land for Wetland Rice Cultivation (WRC) and (ii) lack of adequate resources.

According to Department of Agriculture, Government of Mizoram (2007-08) about 9560 families are practicing WRC under an area of 11,000 hectares. It is seen that more than 90% of them have no irrigation facilities. In the context of environment, household food security and eco-regional imbalances, new directions are required in planning and transfer of technology to meet future challenges of growing demand of food. Shifting Cultivation is destructive for environment, back breaking and less remunerative for the cultivators. Government of Mizoram has taken an initiative to increase and improvement of existing WRC as an alternative farming system. Improvement of WRC will decrease emission of CO_2 from forest fire (Process of Jhum).

- **Developing data base on genotypes of local crop varieties (mainly rice varieties) and identification of suitable varieties for different agro-climatic zones.**

Government of Mizoram has taken initiatives to establish and maintain genetic resource collections of the state's major crop species and their close relatives. These collections are the repository of millions of years of natural selection and contain the genetic diversity necessary for plant breeding efforts to cope with the recurring pressure of pathogen evolution and global changes in climate and soil. Such collections typically contain plant samples per species, usually termed accessions, and in some cases contain some distinct lines or accessions. The collection depends partly on the species of the sample and the collection in which it is maintained. Extensive documentation systems will be put in place to maintain and allow the use of these collections efficiently in plant breeding programs state-wide. These are currently evolving to incorporate developments in information management, such as the use of formal ontology. Government of Mizoram will use global positioning satellite systems used by plant collectors which has made available precise geographic location information for new collections, which in turn means that climatic and edaphic information can be more precisely associated with genotypic and phenotypic information for a given plant line.

This systematic approach of documentation includes the development of concepts and procedures for efficient Gene Bank management, such as reducing the number of duplicate accessions and establishing representative ''core collections'' The goal of these efforts is the efficient management and utilization of the resources by plant breeding programs

- **Impact assessment of paddy cultivation through agricultural inputs such as crop varities, kharif crops and promotion of rain water harvesting and construction of ecofriendly mini check dams for irrigation.**

About 21% of the total agricultural area is put on the paddy/seasonal crop cultivation within the state. Overall 63% of the total crop

area is under jhum cultivation. According to the departmental figure of 2007- 2008 total production of paddy stood at 15688 lakhs MT. Settled agriculture on terraces and valley lands is dominated by rice cultivation. Paddy cultivation has declined by 30% during 2008-09. Due to uneven distribution of rainfall over different seasons, irrigation facility is required by most of the crops viz. field crops like Paddy, Maize, fodders etc., plantation crops like orange, Assam lemon, mulberries, etc. and other cash crops like tea, coffee, red Oil palms, etc. Along with Minor Irrigation facilities there is an urgent need of water harvesting system to support NLUP.

Check Dams/Earthen Dam can be suitably constructed to collect and store surface water from small streams and rivulets. A water body of a reasonable size will augment moisture retention and strengthen the water recharging system at the sub soil level. In spite of plenty of rains, at present, due to hilly terrain rivers and other water sources are usually dry, in winter leaving no scope for irrigation.

A better water management system needs to be introduced to harvest rain water. In Mizoram there are numerous positive benefits for harvesting rainwater. The technology is low cost, highly decentralized empowering individuals and communities to manage their water. It has been used to improve access to water and sanitation at the local level. In agriculture rainwater harvesting has demonstrated the potential of doubling food production by 100% compared to the 10% increase from irrigation. Therefore Mizoram Government has proposed to put up water harvesting system in each of 750 villages.

- **Assessment study and demonstration of System of Rice Intensification (SRI) cultivation and Capacity building to train farmers in latest rice cropping techniques specially evolved to counter adverse effects of climate change**

Use of quality seeds and adoption of System of Rice Intensification are the promising and one of the best practices for raising production and productivity of crops in the State. Rice cultivation is concentrated in 5 districts of Mizoram. Out of which one district falls under medium productivity group, 3 districts are under medium-low productivity group and one district comes under low productivity group. Triennium average area of medium productivity group (yield 2,000-2,500 kg/ha) in one district was 0.173 lakh hectares, which was 32.3% of triennium average area (0.536 lakh hectares) under rice in the State. Triennium average production was 0.349 lakh tonnes, which was 37.4% of triennium average production (0.933 lakh tonnes) of rice in the State. Triennium average productivity of medium productivity group in one district was 2,017 kg/ha as against 1,741 kg/ha triennium average productivity of the State. Low productivity is attributed due to adoption of old traditional varieties and lack of irrigation facilities.

SRI is a simple but very effective approach to the current food crisis. System of Rice Intensification (SRI) cultivation has just been introduced in the state and can contribute to significant reduction of green house gases emission from rice cultivation.

- **Optimization of jhum cultivation through conservation of arable land, water utilization management, parallel cultivation of alternative crops and Alternative jhum Control to Livelihood**

Jhum cultivation is the predominant land use system in the upland areas of Mizoram where 19 to 45% of the forest area is under jhum cultivation. In the hills of Mizoram, agricultural operations are carried out up to a maximum elevation of 5000 m with 'slash and burn' method. More recently, attempts have been made to optimize the productivity of jhum fields. There is a gradual shift in focus from earlier campaigns to eliminate the practice of jhum to increasing its productivity and livelihood potential. But these efforts have not yet been systematic. In order to offset and improve traditional Jhum cultivation, to prevent forest degradation and loss of top soil, the state is likely to emphasise on conservation measures in arable land (such as contour bound, improvement of existing paddy fields, bench terracing), creation of water bodies / up scaling and upgrading of existing water bodies, catchment area protection and encourage parallel cultivation of plantation crops like rubber, cashew nuts etc. Vegetable cultivation to be taken up as a part of Horticutural development Programme. The important species like Turmeric and Ginger will be cultivated in Bench terraces to avoid soil erosion. Proper capacity building and training will be provided to the farmers of Mizoram for optimizing the production from their jhum fields by cultivating alder trees, which regenerate the soil and check erosion. The root nodules of these trees improve fertility by fixing atmospheric nitrogen in the soil.

With a combination of the desired altitude (above 1000m) in Mizoram, climate and rainfall, the tree flourishes in this area grow fast and provide yielding of huge quantities of firewood. The ashes of burnt alder twigs can be mixed with the soil to increase its fertility. No part of the tree is wasted. The wood can be used for firewood, building houses, making furniture and carving. The leaves have medicinal properties and are generally used to stop blood flow. Alder trees if planted in terraces at bench level can prevent run-off of topsoil.

- **Construction of Hill Slope terraces for conservation of moisture and cultivation of foodgrain, vegetable, pulses and oilseed crops**

Tribals of Mizoram are expert in cutting beautiful terraces along mountain slopes. This system of cropping is beneficial in retaining fertility of soil; preventing landslides and checking soil erosion. Secondly, it is helpful in retaining the moisture of soil and conserving water, also. The Mizoram Government understands the benefits of these farming methods and proposes to implement a programme that will lead to permanent cultivation of the land by a transition to terrace farming by construction of terraces on the moderate slopes.

- **Increasing the area under perennial fruit plantation crops and high value low volume crops to help cope with uncertain weather patterns.**

The agro-climatic attributes of the state have

since been found highly congenial for growing variety of horticultural crops particularly on gentle slopes. These are not only highly remunerative land use option but also help in preventing soil erosion, improving soil fertility thereby maintaining ecological balance. The State Govt. has also laid emphasis on the development and expansion of a high market potential fruits like passion fruit, orange, grape, papaya, chow chow (Sechiumedulis), Arecanut (Areca catechu), Hatkora, banana, etc. Passion fruit is cultivated in Mizoram by almost every household as a garden fruit.

In the context of climate change, there is a need to increase the area of plantation for perennial fruit and high value low volume crops. Promotion of fruit plantation will also help in enhancing carbon sinks. It is essential to encourage horticultural activities in the state and minimise the impacts of climate change on horticultural products by increasing the area under perennial fruit and plantation crops, increase in the area in respect of low volume- high value crops under protected condition, improvement in post harvest management such as cold chain for perishable crops and encouraging winter cultivation to increase double and multiple cropping.

- **Management of climate change impact on horticulture and Climate risk management studies**

The state of Mizoram is gifted with natural growing conditions for several economically important horticulture produce like Pineapple, Oranges, Banana, Ginger, Cashew Nut, etc. Climate change will impact the agronomy, economics, and environmental aspects of horticultural production. Under conditions of changing water availability, growers need to consider both short-term and long-term coping strategies. Mizoram's increasingly variable climate poses challenges for horticulture, given the sector's dependency on natural resources, especially water for irrigation. The horticulture sector in Mizoram is still vulnerable to predicted changes to rainfall and temperature that will have a negative impact on, plant growth, pest and disease risk breakout and product quality. To this effect, it is being proposed to carry out a detailed study on the impact of climate change on horticulture sector.

- **Improving post harvest management such as cold chain for perishable crops and winter cultivation practices**

Market infrastructures have not been well organized or built up in the state so far. Storage facilities need to be created as well as transportation facilities for agricultural commodities need to be improved. The district also offers scope for development of post harvest management for many economically viable agricultural and horticultural commodities. Training for different technologies on post harvest may be organized in selected areas. Lack of storage facilities, transportation bottleneck, inadequate grading, packing & drying are the main constraints. Cold storage facilites are available in fisheries sector. Rural godown and market sheds in potential areas may be created.

Processing and preservation of value added products are required as part of the climate change adaptation strategy. There is a need to develop quality control measures, adequate packing and storage techniques. The post harvest loss negates all the efforts that have been made to produce the crop. Thus it is crucial to focus the research and development of post harvest protection method on economically less demanding and consumer friendly alternatives for ensuring

food security to people of Mizoram. The State should focus on training for growers on post harvest crop management, establishment of good go-downs and cold storage centres with grading facilities, market linkages, etc.

- **Promotion of organic farming through usage of compost and vermicompost**

Mizoram being declared an Organic State is all ready to follow a well guided systematic approach towards a uniform development in Organic Farming. Organic farming is a production system that largely excludes the use of chemical fertilizers, pesticides and growth regulators. As large scale use of fertilizers and pesticides pose a number of environmental hazards and imbalances in soil nutrient level, organic farming has been highly encouraged. The uses of Farmyard manure, compost, bio-fertilizer, bio pesticides, etc. are used instead of synthetic fertilizers and chemical pesticides etc. Crop rotation, growing of green manureing crops viz. Dhaincha, Sunhemp, etc. and different cultural practices are followed.

The state realises the need to continue and expand traditional organic farming to reduce use of fertilisers that would lead to reduction of green-house gases in the atmosphere. The Department has established 35 Nos. of Vermiculture and a large number of the Organic farmers were assisted by distributing them Vermi-Mother Culture and Vermicompost harvested from these Vermiculture pits. Promotion of compost /vermicompost requires mass awareness among the farmers and growers which is also economically viable and has greater opportunity all over the state. Small Vermiculture Units have been set up at Farmers field in each District. In all 666 Units have been established by giving assistance @ Rs. 15,000/- per unit to each individual farmer in the previous year and another 120 units already distributed to the Farmers during 2010-11 under various District.

- **Adoption of Integrated Pest Management for improved crop yield, Preparedness to tackle emerging scenarios of pests and capacity building for stakeholders**

Integrated pest management is a broad ecological pest control aiming at best mix of all known pest control measures to keep the pest population below the economic threshold level. The major pest found in the state are Leaf folder, Stem borer, Caseworm, Rice gundhi bugs, Leaf hoppers, Rodents, Pink borer, Striped borer, White grub, Heliothis, Maize Aphid etc. The multiple impacts of climate change could significantly reduce the effectiveness of current IPM strategies leading to higher crop losses.

It is economically justified and sustainable system of crop protection that leads to maximum productivity with the least possible adverse impact on the total environment. In crop production technology integrated pest management is a schedule of practices which starts from field selection till harvest of crop. The major components in this approach are to advocate cultural, mechanical, biological and chemical methods of insect pests, diseases, weeds and rodent control compatibly. Government of Mizoram is taking steps in Motivating farmers to minimize the use of pesticides and to control the environmental population with the adoption of Integrated Pest Management. An area of 1567 ha will be taken up for adoption of Integrated Pest Management as pilot.

- **Research study on livestock disease and establishment of early warning system and Capacity building to Stakeholders**

Mizoram although being an agrarian economy still imports a large quantity livestock like pig, cattle, goat, and poultry essentially required for the overall food supply of the people. Pork consumption in particular is very high. The traders who organize import sell the same in the local market. Particular policy attention should be paid to the health risks posed by the rapid worldwide growth in meat consumption, both by exacerbating climate change and by directly contributing to certain diseases.

Temperature and rainfall variations have increased the incidence of vector-borne diseases. To minimize the impact of climate change on animal health and reduce the vector borne diseases, the state plans to carry out a study on impact of climate change in livestock, piggery and poultry, ensure vaccination of farm animals against contagious diseases, de-worming and early disease warning system, develop a breeding policy and use biotechnology to breed genetically climate resilient breeds of farm animals, and increase the availability of and access to vaccines.

- **Study of impact of Climate Change on the indigenous fauna of aquatic ecosystem and open waters**

Aquatic ecosystems are one of the critical components of environment. It is essential contributors to biodiversity and ecological productivity; they also provide a variety of services for human populations, including water for drinking and irrigation, recreational opportunities, and habitat for economically important fisheries. However, aquatic systems have been increasingly threatened, directly and indirectly, by human activities. In addition to the challenges posed by land-use change, environmental pollution, and water diversion, aquatic systems are expected to soon begin experiencing the added stress of climate change. The effect of climate change on fisheries mainly due to increase temperature and may lead to early maturity and breeding of fishes. However this requires further analysis. Climate change is stress sensitive to freshwater of Mizoram, which are already adversely affected by a variety of other human impacts, such as altered flow regimes and deterioration of water quality. In Mizoram 14 major rivers and 6 lakes are the major water sources. Wetlands are a critical habitat for many species that are poorly adapted for other environmental conditions and serve as important components of fisheries. Aquatic ecosystems have a limited ability to adapt to climate change. Government of Mizoram has taken an initiative to undertake research work on climate change impact on aquatic ecosystem so as to conserve and aquatic ecosystem.

- **Water storage and providing proper diversion channels to the existing ponds for drainage of catchment runoff during sudden heavy rains**

Mizoram has 24,000 hectares of potential area available for fish farming. Due to lack of infrastructure it has not been possible to exploit the potential. So far only 2,640 hectares of water area has been brought under pond fish culture. There are another 400 hectares under paddy-cum-fish culture integrated farming with wet rice cultivation. Besides the area, 6,000 hectares of water area are also available in the riverine sector in the form of rivers and streams.

The demand for fish is likely to further increase

with the increase of State population and earning capacity of the people. This in itself justifies a major investment for the required development of fisheries in the state to bridge the gap between the demand and supply, besides generating self and regular employment.

According to 2007-08 State report, Mizoram gets an average annual rainfall of more than 2445mm and that too in a concentrated period of 6 months resulting in restricting the working season in a year. During the heavy rain or uneven rainfall, Government would take initiative to develop diversion channels to avoid flash flood. At the same time, surface sub-soil being highly absorbant, its retention capacity of water is low. Consequently, Mizoram faces the unique paradoxical problem of scarcity of water in the midst of plenty. To increase the storage of water, government of Mizoram would promote water resource conservation and enhance water-use efficiency for irrigation; on the other hand the government would also create and development of new water bodies for fish farming and integration of Giant freshwater prawn in feasible areas.

- **Providing extensive support and services to fishermen through establishment of district level training centres**

Mizoram has about 3,000 hectare of water area under fish culture. About 7,000 families are engaged in fish farming while another 2,000 are involved in riverine (capture) fishery. An age old method of fishing followed in Mizoram is to put a barrier in the flow of a river or stream by putting stones, felled trees, bamboos etc. and catch fish through cages put in the openings. The existing demand, and anticipated challenges in the state, will require better multi-scale understanding of the impacts of climate change and of the interacting contribution of fisheries and aquaculture to food and livelihoods security. Climate change will increase uncertainties in the supply of fish from capture and culture. Such uncertainty will impose new challenges for risk assessment, which is commonly based on knowledge of probabilities from past events. Data for determining effects of past climate change at best cover no more than a few decades, and may no longer be an adequate guide to future expectations.

A serious need is felt for developing seed farms along with the capacity building of fishermen communities in the private sector to meet the present and future fish-seed requirement from the state itself. Department is planning to establish district level training centres which can provide technical support for water and soil analysis along with identifying training needs, providing training and capacity building of the fishermen communities and fish farmers for adoption of advance and sustainable pisciculture techniques. The existing fishing methods mostly adopted can be modified and improved with enhancement of the capacity building and training procedures along with support services through the district level training centres.

- **Water bodies conservation for fishery sector and establishment of fishery units in reservoirs and riverine area**

It is estimated that Mizoram has a potential area of 24,000 hectares available for fish farming, out of which only about 10.5 percent has been exploited so far. Due to change in temperature and uneven rainfall fish breeding is hampered and earning capacity of fisherman is reduced. The demand for fish will further increase the earning capacity of the people. This in itself justifies a major

investment for the required development of fisheries in the state to bridge the gap between the demand and supply, besides generating self and regular employment. Government of Mizoram has identified some water bodies for fishery sector. As per the Government report 2007-08, the existing water bodies under fish farming in the state was 2840 hectares. Government has taken initiatives for water body conservation and to setup new fisheries unit in reservoirs and riverine area for fishery sector development.

- **Greenery development of the Devastated Barren Wasteland for Fodder Cultivation**

Mizo or Zo indigenous people depend on jhuming type of cultivation since time immemorial. In Mizoram, The State mainly has non-forest wasteland which are classified as abandoned jhum land/current jhum land. The National Remote Sensing Agency in its Publication 'Wastelands Atlas of India' 2005, has indicated that 21.20 % of the total geographical area of 21,081 Sq. km, in Mizoram as wasteland of different categories. This translates into 4469.88 Sq. km as total wasteland in Mizoram. Shifting Cultivation (current) forms the main chunk of such wasteland and next comes the abandoned jhum land. Due to deforestation and uncertainty in rainfall, there is a direct impact on the growth of palatable grass species. Regeneration of fodder species (herbaceous species), in pastures and forest land is also decreasing. As a consequence, there is shortage in quantity of livestock fodder. This will also affects livelihoods of local people through decreased production of milk and milk products.

In this regards Government of Mizoram wants to reclaim wasteland and develop some fodders for livestock through Napier, Stylo etc. This action will enhance the food security of the cattle during extreme climatic conditions and on the other hand the devastated barren lands will be utilized with greenery and some amount of carbon sequestration will take place.

Chapter- 6

Sustainable Himalayan Mission

6.1. Introduction

Mizoram is a fragment of Lower Himalayan range with altitude ranging from 500 m. to 3000 m. The hills are steep and are separated by the rivers which create deep gorges between the hill ranges. There are 21 major hill ranges with average height of 1000 ft to 2000 ft spreading across the state. The average height of the hills is about 900 meters with highest forest cover in the eastern region.

Climate Change impacts coupled with anthropogenic pressure has its negative effect on the fragile Mountain Ecosystem of Mizoram. It faces problems of Jhum cultivation, Soil erosion, siltation, degradation of top soil etc. which affect the forest quality and biodiversity. This requires special attention to combat the situation by way of policy action and sustainable land use systems etc. The immense variety of the climatic, edaphic and altitudinal variations have resulted in a great range of ecological habitats in Mizoram.

6.2. Key Facts

Mizoram is mainly a hilly territory with altitudes varying from 500ft to 3000 ft above sea level. At the ecosystem level, the State exhibits a part of Mountain ecosystem comprising 21 moderate hill ranges and forest ecosystem. In between these two dominant ecosystems, lies the freshwater ecosystem. The state has different forest types belonging to 4 groups Tropical Semi Ever Green, Tropical Moist Deciduous, Subtropical Broadleaved Hill and Subtropical Pine Forests (Champion & Seth's Classification System 1968). Around 70.43% of Forest belongs to Tropical Evergreen forest and 28.91% belong to Tropical Moist deciduous Forest. The state of Mizoram is a part of Indo-Myanmar bio geographic region, which is one of the rich biodiversity regions of the world. Wildlife Sanctuaries and a large number of sacred groves were found in the different parts of the state, these are the main preserves of biodiversity. The floral diversity of Mizoram is quite rich and also harbours about 35 species of Bamboo belong to 8 genera. Besides, a wide variety of wild cultivable plants, edible fruits, leafy vegetables and orchids are found in the natural forests of Mizoram.

Table 6.1: Forest Type

Altitude zone	Very Dense Forest	Medium Dense Forest	Open Forest	Total
0-500 m	1	1,813	6,791	8605
500-1000 m	34	2,921	4520	7475
1000-2000 m	98	1,516	1544	3158
2000-3000m	1	1	0	2
Total	134	6251	12855	19240

(Based on SRTM Digital Elevation Model)

Primarily very dense forest are found in 1000-2000 m altitude range and also partly in 500-1000 m altitude range. Moderately dense and open forests are present mainly in low altitude area of 0-500 m and 500 m to 1000 m *(State Forest Report 2009).*

6.3. Mountain river system

The rivers of Mizoram constitute a major part of the topography and are perennial in nature. These rivers are aided by heavy rainfall in hilly ranges in monsoon and occasional rainfall throughout the year. The northern part of the state comprises of important rivers like the Tlawng or Dhaleshwari, Tuirial or Sonai etc. Rivers like Mat, Tiau, Tuichang, and Tuipui fall in the southern part of Mizoram. The rivers of Mizoram are the main source of water for the people of the state. The perennial rivers of the state feed the lush green vegetation of Mizoram

6.4. Climate

The climate in Mizoram displays characteristics that are typically of the hilly and mountainous region. The change in the topographical features of the region can also cause a change in the climatic conditions in Mizoram.

6.5. Biodiversity

Mizoram is categorized under sub-group-IB Northern Tropical wet evergreen forests. Tropical Semi-Evergreen Forests cover the major central bio-geographic zone and the coverage is approximately 70% of the total geographical area. Sub-Tropical Hill Forests come in the Eastern fringes bordering Myanmar approximately extending from 1500-2158 m mean sea level (MSL). The area constitutes about 24% of the total geographical area. The state has 2 National Parks and 7 wildlife sanctuaries covering an area of 990.75 sq. km which constitutes 4.69% of the state's geographical area.

Flora: The floral diversity includes a large variety of Phanerophytes which includes variety of trees and shrubs, Parasites and Epiphytes and succulent plants. Apart from these, Mizoram offers plants that offer rich timber such as teak and sal woods, plants with medicinal values such as Cinchona, *Taxus baccata*, etc, and plants that offer fruits and vegetables. But the most significant flora of Mizoram is the orchids.

Fauna: The forest of Mizoram hold many threatened animal species including the Tiger, Asian Elephant, Clouded Leopard, Gaur, Goral, Hoolock Gibbon, Stump-tailed

Macaque, Binturong and many others. The avi fauna diversity in Mizoram includes many rare and threatened species which include Mrs Hume's Pheasant (State bird), Blyth's Tragopan, Green Peafowl, White-cheeked Partridge, Blyth's Kingfisher, Blue Pitta, Moustached, Striped, Rufous-vented, Brown-capped and Spot-breasted Laughing thrushes, Crested Finchbill, Olive and Flavescent Bulbuls, Oriental Hobby, Wedge-billed Wren-babbler and Purple-throated Sunbird etc.

6.6. Key Issues

Soil Erosion

The common rocks found in Mizoram are sandstone, shale; silt stone, clay stone and slates. The rock system is weak and unstable, prone to seismic influence. Soils vary from sandy loam and clayey loam to clay, generally mature but leached owing to steep gradient and heavy rainfall. The soils are porous with poor water holding capacity, deficient in potash, phosphorous, nitrogen and even humus.

Table 6.2: Different Types of Land Cover in Mizoram

Type of Land Cover	Area (in sq. km)
1. Closed (good) forest	4,190
2. Closed forest affected by shifting cultivation	13,520
3. Forest degraded by shifting cultivation	2,600
4. Non-forest	640
5. Water bodies	140
Total	21,090

Source: Forest Department, 2003

According to the report of Department of Environment and Forests (2003), 83 percent of the total area of the state (21,087 sq. km) is covered by forest. However, due to the traditional practice of shifting cultivation called 'jhuming', uncontrolled fire, unregulated felling and arbitrary allotment of land to individuals, two-third of the area is reported to have been partly depleted and degraded.

Climate Change Impacts on the Forest Ecosystem

The assessment of impact of climate change on forest ecosystems has clearly demonstrated the possibility of adverse implications on biodiversity and a large decrease in net primary productivity of forest. Such a projected shift or change in forest types is likely result in large-scale forest degradation and loss of biodiversity. Forest ecosystems are already subjected to socio-economic pressures leading to forest degradation and loss, with adverse impacts on the livelihoods of the forest-dependent communities. Climate change will exacerbate the stress on forest ecosystems.

Development of adaptation strategies is constrained by uncertainty in the current projections of climate parameters and impact assessments. Further, there is a need for models where adaptation can be incorporated into impact models. However, given the general accepted knowledge in the sector, certain priorities can be chalked which will have a positive effect on the sustenance of the Eco System.

Adaptation Pathways

Considering the ecological fragility of the region, the concept of 'Sustainable Himalayan Ecosystem' requires promotion. This would include formulation and

implementation of holistic plans at the watershed level to transform human habitats by catalyzing the innate aspirations of local communities towards greater sustainability and habitat conservation. Such efforts would also include functional consolidation of land for promotion of natural resources based employment generation in the region. Sustainable Himalayan Ecosystem Mission would also include adequate representation of regions cultural diversity and prevailing indigenous knowledge.

Table 6.3

Issues	Impact	Pathways
Soil Erosion	Top Soil Loss lead to Barren Hill Ranges Flash floods Water Scarcity Adverse Micro Climate	Afforestation , Prevention of Soil Conservation measurement
Impacts on the Biodiversity	Floral Distribution & Regenerations	Conservation and Management

6.7. Key Priorities

- Biodiversity Assessment

Biodiversity Assessment and mapping is an activity to contribute to the establishment of a biodiversity hotspot and to improve the management plan of the protection of forests within the state. There is a general lack of information and knowledge regarding biological diversity and of the urgent need to develop scientific, technical and institutional capacities to provide the basic understanding on which to plan and implement appropriate measures. The primary objective of the study will include an inventory of fauna and flora; identification of unique features in the area; ethno-botanical data; this will help in increasing the awareness among local people and citizens in general about their natural heritage.

- **Research on Wildlife Populations and Corridors - Mountain Goats, Burmese green Peacock, Malayan Bear**

The forest of Mizoram holds many threatened mammals species like Mountain Goats, Burmese green Peacock, and Malayan Bear. However, the population of these species have decreased over the years. The proposed study will focus on the population distribution and threats. The study will also focus on the connecting corridors and habitat of these endangered species and the impacts of human activities (such as roads, infrastructural development, or logging) on these wild life species. The research outcomes of these populations will contribute in policy actions which will facilitate migration of individuals between populations, issues of inbreeding & reduced genetic diversity (via genetic drift). The study helps in re-establishment of populations that have been reduced or eliminated due to random events (such as fires or disease).

- **Creation of Biodiversity Parks**

The Mizoram state has 2 National Parks and 8 wildlife sanctuaries covering an area of 1241 sq km, which constitutes 5.89% of the state's geographical area. Mizoram forest has rich floral biodiversity with rare species of orchids and medicinal plants. The department is proposing to establish Biodiversity Park in the state for the conservation of rare and threatened floral species in line with National Biodiversity Conservation Act, 2001

- **Assessment of climate vulnerability and climate change impacts on state biodiversity and forest resources**

In Mizoram, Forests are among the most important natural resources, which have played a fundamental role in supporting the livelihood of the people. Due to its sheer importance, the Working Group decided to have a comprehensive study on Climate change Impacts on the Biodiversity and Forest Resources in the with changing climatic conditions so as to preserve and enhance the resilience of the forest ecosystem. In Mizoram, human activities are triggering the biodiversity loss at alarming rates through land use change, forest cover loss, soil and water pollution, and degradation due to forest fires, habitat fragmentation and selective exploitation of species.

In the context of climate change these vulnerability of eco systems will be further stressed. The impacts of climate change will vary with respect to population and composition of species. Species with limited climatic ranges and restricted habitat requirement or small population are typically the most vulnerable to extinction such as endemic mountain species and biota. Infra-specific variation in select species is also proposed to be taken up as a part of the study.

This study will act as a precursor for the future planning of Mizoram forest sector for conservation of forest resources. This study will necessarily focus on the impact of climate Change on Biodiversity, Forest Resources and adaptation measures to be taken in the Planning for minimization of Climate Change Impacts.

- **Documentation and enrichment of biodiversity database through Peoples Biodiversity Register (PBR) at the JFMC Level**

People in Mizoram are continued to depend on biodiversity and bio-resources for their livelihoods. Such populations are directly dependent on local biological resource and have keen sense of observation, practices. This is passed on from generation to generation. Working Group recognized importance of the documentation and to publish the list of rare, endangered and threatened species in their territory and to launch special programmes for conservation. Local bodies will be entrusted with the task of preparing, maintaining and validating people's biodiversity register (PBR) in consultation with local people. The registers will have details of the access to biological resources and traditional knowledge. The PBRs would be digitized and patents will be filled in the future.

- **Inventorying and Conservation of Medicinal Plants**

Mizoram has one of the oldest, richest & most diverse cultural traditions associated with use of medicinal plants. There are large number of traditional herbal medicines practitioners who have traditional knowledge of herbal home remedies of ailments & nutrition. The herbal medicines used by rural people including tribals have not yet been documented. Compiling an exhaustive inventory of medicinal plants in the State is the need of the hour. Although these medicinal plants are less popular but possess a surprising breadth of knowledge on medicinal plants and the specific ailments that they cure. Many of these plants grow in the wild and have never been cultivated. Extensive forest degradation has made several specimens rare and hard-to-find. Conserving them ensures their availability for scientific investigation

and serves to propagate this ancient art, thereby enriching indigenous knowledge in medicine. Documentation of medicinal plants will follow the National Medicinal Plants Board (NMPB), guidelines on Good Agriculture Practices (GAPs) on the pattern of Good Agriculture and Field Collection Practices (GACPs) developed by the World Health Organization (WHO) for medicinal plants.

- **Monitoring of carbon stock and biodiversity at regular intervals**

Reduce Emission from Deforestation and Degradation (REDD) is a climate change mitigation mechanism that could be adopted to compensate Mizoram for keeping their forests standing and also conserve more habitat and ensure greater ecosystem services functions. To implement the REDD a monitoring mechanism for carbon stock and biodiversity at regular intervals is necessary. The monitoring carbon stock includes above and below ground biomass, soil organic carbon and also removals from the forest. This monitoring mechanism also helps in taking scientific management of bio resources and to plan for adaptation strategies.

- **Eco-tourism promotion for biodiversity protection and sustainable livelihood**

Mizoram has wide varieties of hilly terrains, luxuriant valleys, rivers, lakes and rich flora & fauna in the eastern part of India and also shares international borders with Bangladesh and Myanmar. The mild climate conditions in Mizoram throughout the year and types of the forests ranging from the moist tropical and moist sub-tropical have great eco-tourism potentials nationally and internationally. Eco-tourism can provide sustainable livelihood to the rural tribal communities whose primary dependency is Jhum cultivation. The alternative income source through such initive with reduce the extent of Jhum cultivation. The alternate income source through such initiative will reduce the extent of Jhum cultivation.

For promotion and development of eco-tourism in forest areas small degraded or barren land may be put to use along with the landscaping, plantation, regeneration and protection components which would be jointly managed by the Department of Tourism and Department of Forest with the help of local community for which no specific diversion may be required. Sacred Groves in Mizoram has vast amount of tourist potential to be realized. Sacred Groves are the loose ends of relict virgin forests which are quite different from the surrounding degraded forests. Thus these can serve as micro-level biodiversity hotspots.

To secure the necessary funding for the Forestry Administration and to manage the protected area in future, the development of ecotourism as a financing mechanism can be one of the best options for Mizoram. Mizoram Government might develop and promote conservation of natural resources and ecotourism initiatives in collaboration with local communities, with the aim of protecting the landscape and generating new & alternative job opportunities for local people to replace Jhum cultivation and commercial logging that threaten the forest.

- **Undertaking study on valuation of forest resources (Non traded) and climate change impacts on the vulnerable ecosystems**

The forests of Mizoram provide some

tangible benefits in the form of food, fuel, fiber, timber and other forest products and also some intangible benefits like soil conservation, watershed management, ground water recharge etc. There are many uses of forest that are directly or indirectly consumptive and durable or non-durable. These are conservation, recreational benefits, the commercially available benefits (i.e. newsprint, cardboard, building materials, edible fruits, woods, fuel woods etc.), eco services (i.e. bio-diversity, climate regulation service, soil erosion control, etc.)

Till date the Total forest valuation has not been conducted in Mizoram. Considering the natural forest in Mizoram, the commercial and direct value of forest is not sufficient for evaluation of the forest resources. It has some indirect values, which cannot be determined from the market. But at present, estimation procedure of non- marketed forest products, indirect values and non-use values of forest do not properly appear in the state accounts. Forest valuation is required in the state to identify the actual forest revenue and its contribution to state GDP. Climate Change Action Plan working group recognized the importance of the total valuation forest resources to measure the loss of GDP through climate change.

- **Work to establish new systems to support for public awareness building through Establishment of Envis Centre**

The present thrust of forest department is around creating awareness of forest ecosystems. The Climate change action plan will emphasize on the creation of public awareness and greater involvement of people in climate change mitigation and adaptation programmes through this center. Periodic thematic workshops will be organized to sensitize the public and generate awareness in the line of conservation and effect of climate change on local ecosystems.

- **Restructuring land use policy for jhum cultivation and habitation on notified forest lands**

Jhum or Shifting Cultivation, a traditional means of agriculture based on indigenous knowledge system as the major form of livelihood for Mizoram farming community was a viable proposition in the past. About 80 per cent of farmers in Mizoram still depend on jhum cultivation that involves clearing forests and burning trees, weeds and bamboos and is believed to have caused considerable loss of forest cover in the species-rich tropical rainforests of the region. Jhum burning also accounts for a very high percentage of gas emission when every year huge amount of land in rain forest are cut down and burnt.

New Land Use Policy focused on eco-friendly activities, preserving green forest and through programme of bamboo plantation would aim at increasing forest cover from the present 49% to 60% of the total land area. The area between Tuilut to Dampa-Rengpui is dominated and extensively used for jhuming. Restructuring of the present land use policy is required for control of jhuming in notified forest area. The proposed policy will address the issues related to the Innerline Reserved Forest Notification of 17thOctober 1878 and Riverine Reserved Forests Gazatte Notification of ADC on 19 May 1965 which notified the majority of the catchment area of the Rivers as Reserved Forest, These policy actions will take measure to reduce the soil erosion, water conservation and would encourage the forestation on a large

scale with the benefit of environmental protection and over a period time opening up scope for carbon economy.

- **Policy formulation on transportation subsidy or development of low cost transportation for primary Forest products of the state**

Unfortunately, the infrastructure facilities in Mizoram are very poor and the industrial sector has equally been the victim of infrastructural bottlenecks especially in transportation. The high transportation cost of Bamboo and NTFPs from Forest area to consumer market makes it uneconomical. Subsidy and alternative trade route development for Bamboo is very important aspect of bamboo market development.

The state will provide transport subsidy on plant & machinery, raw materials transport to attract perspective entrepreneurs in to this sector. The main objectives of both the policies are ; the enrichment of industrial growth potentials lying in the sectors like agriculture, horticulture, forest and establishment of proper linkage amongst the industries based on resources available in these sectors. Mizoram Government will restructure the existing transport policy to introduce subsidy for transportation of forest based products.

- **Protection of forests and forest land from soil erosion in 1,35, 000 Ha**

Forests play an important role in Mizoram for preventing soil erosion and landslides. They also play regulatory role in water quality of rivers and act as watersheds. However the jhum cultivation in the Mizoram has degraded nearly 2/3 rd of forest land. Hence Soil conservation methods such as construction of check-dams, gully plugging, terracing, Agrostology methods, soil–stabilization plantations etc will be taken in Mizoram State. These measures are also useful for re-charging ground water reserves, to provide employment and livelihood support systems. To stop the soil erosion; measures such as plugging of gullies will also restore and rejuvenate the soil fertility status.

- **Conservation and Management of two major Wetlands**

International Union for Conservation of Nature (IUCN) 2007 report on Wetland conservation indicates that local people's involvement in wetland management can contribute significantly to maintaining or restoring ecological integrity and community wellbeing. Building upon this co-management of two major wetlands viz Palak Dil Lake (Proposed for Ramsar site) and Tamdil Lake were selected for the conservation. Proposed activity involves in mapping of vital parts of hydrological cycle, catchment area development, water quality monitoring, and conservation of biological diversity to support wide range of ecosystem services such as waste assimilation, water purification and livelihood improvement of local communities. This exercise will also help in flood mitigation, ground water recharge and micro climate control in Mizoram State.

Chapter - 7

Green Mission

7.1. Introduction

The forest cover in the Mizoram is 91.27% of state geographical area, which in highest in India (Forest Survey of India (FSI), 2009). Forests and Mountains constitute dominant feature of the state's landscapes, economy and environment. The State enjoys different types of evergreen forests and waterfalls as well as areas of unique floral and faunal varieties. The majority of the forested land lies in notified forest and also significant forest cover lies under the management of communities and individuals. Mizoram has the most variegated hilly terrain in the eastern part of India.

However, the major constraints for the state are higher deforestation rates due to jhum cultivation and forest degradation caused by anthropogenic pressure. Due to this the majority of the forests classified under the open and medium dense forest category and only 1% of forest cover classified under the high dense forest with the canopy cover more than 40%. Lack of infrastructure, Market Linkages and sustainable forest policies making under-utilization of potential for development of forest based enterprises within the state. Almost 2/3rd of the area has already been degraded. These depleted and degraded forests could not meet the growing demands of timber and other forest products in the state and cannot provide a safeguard to the ecological functions like soil conservation, protection of land degradation, maintenance of agricultural productivity and protection of catchment area.

National Mission for Green India under the National Action Plan for Climate Change recognized the forestry sector as one of the most effective carbon sinks to mitigate and adapt to the Climate Change and its indispensible role in the conservation of ecological balance and biodiversity restoration. Mizoram Climate Change Forestry Green Mission Action Plan is prepared as per the guidelines of National Green Mission.

7.2. Key Facts about urban areas in Mizoram

The recorded forest area of the state is 16,717 sq. km out of this reserved forest constitutes 47.31%, protected forest constitutes 21.34% and Un-classified Forests constitutes 31.35% of the total forest area. About 80% of the state geographical area is under recorded forests.

Table 7.1: District wise forest cover in 2005 (Area in km²)

District	Geographical Area	Very Dense Forest	Mod dense Forest	Open Forest	Total	% of G.A	Change*	Scrub
Aizawl	3575	32	1013	2278	3323	92.95	196	0
Champhal	3185	58	1180	1519	2757	86.56	175	0
Kolasib	1,382	0	210	1090	1300	94.07	32	0
Lawngtlai	2557	0	699	1681	2380	93.08	53	0
Lunglei	453	0	1586	2698	4284	94.44	38	
Mamit	3025	41	568	2137	2746	90.78	105	0
Saiha	1400	0	629	703	1332	95.14	-4	0
Serchhip	1421	3	366	749	118	78.68	45	0
Total	21081	134	6251	12855	19240	91.27	640	1
*Change compared to 2005 assessment (revised) : Forest Survey of India, 2009 Report								

The state has about 134 sq. km of very dense forest area covering Aizawl, Mamit and Champhai districts, while Serchip having the lowest amount of very dense forest cover and other districts doesn't have any very dense forest cover. More than half of the moderately dense forest can be found in Aizawl, Champhai and Lunglei Districts. Open forest constitutes 66% of total forest cover spreading across the Mizoram State.

Traditional Community Forest Management has adopted long way back by the local communities in Mizoram by forming village safety and village supply reserve for their daily use of Forest Resources. However, Mizoram forest department has adopted the Joint Forest Management in the year 1998, which envisaged in involvement of the local communities and voluntary agencies in planning, protection, regeneration and development of forests. Already there are 593 JFM committees being formed and managing more than 26000 ha of forest area till date.

7.3. Key Issues

Agriculture and allied sector is the mainstay for 70% of the total population in the Mizoram. However, most of the Geographic terrain of the Mizoram is not conducive to the sustainable agriculture practices due to the slope of the terrain which made them to opt for Jhum cultivation. Jhum cultivation on forest lands has been responsible for habitat fragmentation, destruction and degradation of the forests in the state. Almost the entire state is influenced by age-old practice of Jhum Cultivation, except some pockets of valley bottomlands. Forest Fires, High rainfall and hilly terrain have further accentuated the impact of human activities on the forest.

Table 7.2: Land Use Pattern in Mizoram

Category	Area(ha)	Percentage (%)
Forest	1,593700	75.5
Not Available for Cultivation	1,34050	6.2
Other Uncultivated Land	7,209	3.4
Fallow Land	2,10,928	10
Cropped Area	1,02,903	4.9

Source: Forest Statistical Handbook 2009

Limited Cultivable land availability for the rural population, land tenures and soil erosion are promoting the age old tradition of the Jhum Cultivation. Around 1,20,000 family's dependent on the Jhum Cultivation. Annually about 50000 hectors forest land been diverted for the Jhum cultivation. This practice destroys the protective and productive vegetation in preference to a very brief period of immediate crop production. In order to earn their livelihood people are practicing shifting cultivation and over-exploiting forest resources, which leading to the serious damage to the forest and biodiversity. Mizoram State Government has initiated New Land Use Policy (NLUP) from 2008 to divert Jhum cultivators towards other income generation activities.

Second reason for the Forest degradation is from the Forest fires. NLUP estimated around 50% of the forests estimated to be highly vulnerable to the both manmade and natural forest fires. This threat further intensifies in the case of Bamboo forests in Mizoram, which constitutes around 32% of the total forest area and close to the human habitats.

Some of the emerging problems for Mizoram Forestry sector are increasing number of landslides due to loss of forest cover and soil erosion, reserved forests are constantly over-exploited in unsustainable way, laws applicable to these forests are too weakly enforced, overexploitation of ornamental and medicinal plants, animal products, conversion of forests areas into agricultural lands and habitat destruction. Even the sacred forests maintained as community forests, are rapidly vanishing.

7.4. Climate Change Adaptation in forestry sector of Mizoram

Mizoram has about 91% forest cover of the total land surface. Hence forestry sector plays key role in building adaptive capacities of the local communities.

The life cycles of forests range from decades to centuries. Adaptation to climate changes refers to adjustments in ecological, social, and economic systems in response to the effects of changes in climate. Adaptive management of forests will contribute to sustaining the livelihood of forest dependent communities in Mizoram. Many existing forests within the state and most newly established stands will experience climatic conditions that deviate from conditions today. In Mizoram 67.7% of reserved forests are intensely managed by state department. The other proportion managed by different district councils which fulfils multiple functions at lower management intensity; the remainder is managed at low intensity or for protection, conservation or social services.

Table 7.3: Adaptation Pathways in Forestry sector

Issues	Impact	Pathways
Warmer and drier summer conditions	Reduced growth rates, Increased disturbance through fire and insects, Changes in wood quality and quantity, Reduced regeneration success, Increased competition from exotics (vegetation, insects, and diseases)	Identification of suitable genotypes through provenance trials, Development of technology to use altered wood quality and size, Inclusion of climate variables in growth and yield models, Development of "fire-smart" landscapes
Higher precipitation long dry spell and more extreme weathers	Landslide, Forest fire and flood	Disaster risk reduction, Socio-economic adjustment (water allocation management)
Rainfall inhibition	Draught like situation and loss of vegetation, impact on food security and community livelihood	Conservation measures and policy formulation for forestry
Jhum Cultivation/ Slash and burn technique for agriculture	Increased degradation/ GHG Gas Emissions	Better dialogue and diversification of agro-forestry and agri-sylvicultural system
Outbreak of forest fires	Loss of Forest Cover/ GHG Gas Emissions	Awareness Generation, Alternative Income Generation, Fire management Strategies

Adaptive management of forests contributes in sustaining the livelihood of forest dependent communities in Mizoram. Many existing forests within the state and most newly established stands will experience climatic conditions that deviate from conditions today. Compared to agriculture, decisions taken today for managed forests (e.g. tree species choice) remain irreversible for decades or even centuries. On the other hand, selection of seed provenances for altered climatic conditions will require time.

Preliminary review indicates that concepts and contingency plans for adapting forests are rarely included in state plans. Several management options for intensively managed forests in regeneration, tending, harvesting, protection, conservation and management planning can be formulated state-wide. Intensifying assessment and monitoring, establishing new tools and indicators to rate vulnerability and targeting research efforts appear most promising to cope with climate change in these forests.

While this might be seen as primarily aimed at mitigating climate change, it has an adaptive component of preserving species richness, continuity of forest ecosystems and resilience. It is estimated that adverse climate change impacts will contribute to the destruction of forests and thereby promote the emission of greenhouse gases, which in turn will enhance global warming. Mizoram formulated the key priorities in line with National mission. The following section will focus on the key priorities.

7.5. Key Priorities

The following action points have resulted out of several rounds of discussions between the working group members

Key priorities: Green Mission

- Improvement of forest quality and density in degraded lands and abandoned jhum lands
- Improvement of the productivity of Bamboo and promotion of local value addition through establishment of market linkages
- Undertaking studies on climate change impacts on NTFP productivity and sustainable harvesting practices for adaptation of climate change
- Capacity building of communities/ community forest management institutions for climate change adaptation
- Prevention and control mechanism for forest invasive species and its utilization strategies
- Promotion of forest based industries
- Formulationofconservationstrategies for Orchids and establishment of market linkages for value addition
- Livelihood improvement Activities for forest dependent communities
- Strengthening of Forest Department
- GIS based Monitoring and Evaluation of the program
- Strengthening of Local VSS
- Publicity /media and Outreach
- Establishment of Mission Directorate

- **Improvement of forest quality and density in degraded lands and abandoned jhum lands**

Mizoram Forest sector has highest Forest cover in India; however it is facing challenges in terms of forest crown density and quality. The Jhum practice in Mizoram destroys the protective and productive vegetation in preference to a very brief period of immediate crop production. After the crop production these Jhum cultivation areas are abandoned. Jhum cultivation has been responsible for fragmentation, destruction and degradation of the forests in the Mizoram state. Annually about 50000 hectors forest land has been diverted for the Jhum cultivation. Forest survey of India Report, 2009 reported 91% total forest cover of its Geographical area under tree cover however the very dense forest constitutes less than 1% of total forest area. This is clearly indicating the need for the increasing the tree cover enrichment activities to promote the forest density. Ecological restoration in terms of reforestation and afforestation of degraded lands will reduce the ill effect of climate change. The practice of ecological restoration will develop through block plantation, agro-forestry, farm forestry, reforestation of urban and peri-urban institutional lands and soil moisture conservation measures.

Table 7.4: Fire Incidences (2009 - 2010)

Sl. No.	No. of Forest Divisions	No. of Occurrences	Extent of Area Effected by Fire	Estimated Value of Forest Wealth Lost	Causes of Fire
1	15	1,277	29022.15	Rs. 22,76,900 53,600 Nos. of Seedlings	Jhum Burning &Ground Fire

Source: State Statistical hand Book 2010

- **Improvement the productivity of Bamboo and promotion of local value addition through establishment of market linkages**

Table 7.5: Bamboo Production in Mizoram

Product	Unit	2008-09		2009-10	
		Quantity Extracted	Revenue Generated	Quantity Extracted	Revenue Generated
Bamboo	Nos	182	177	23.44	46.89

Source: State Statistical Handbook, 2010

Over the centuries the clearly feelings for Jhum cultivation has resulted in to the large tracks of pure Bamboo forest in Mizoram. It alone contributes 14% of the country's growing stock of bamboo with about 9210 sq. km (49.10%) of the geographical area of 21018 sq. km of the state. However the productivity of Bamboo production per hector is quite lower than international production per hector. To increase productivity proper Bamboo management techniques need to be developed and applied.

The bamboo even at lower productivity levels represent vast untapped major resource of Mizoram, whose full ecological and economic potential reminded underutilized. The eco-friendly Bamboo crop have immense potential in improving rural economy, industrial development and sound economic base for the state on the sustained basis. The latest growth stock of Bamboo estimated to be 24 Million MT. This implies the need to encourage enterprise activities that will add value to its forest products like Bamboo to generate more income and employment for its generally poor population. Mizoram government will provide enterprise development support which will include the provision of business development and financial services and policy support for forest based sustainable livelihood promotion under climate change action plan.

Bamboo based industries in cottage, small and medium sectors will be established within the state. An investment friendly framework will be designed for implementation financial mechanisms to support the Bamboo industries in terms of associated incentives and subsidy. To improve the quality of the bamboo products, new technologies will be adopted to enhance the market outreach & Linkages. Proper rotation will also ensure sustainable harvest.

- **Undertaking studies on climate change impacts on NTFP productivity and Sustainable harvesting practices for adaptation of climate change**

In Mizoram,people are dependent on the forests resources that are directly or indirectly consumptive and durable or non-durable. These are NTFP Products, conservation, recreational benefits, the commercially available benefits (i.e. newsprint, cardboard, building materials, edible fruits, woods, fuel woods etc.). However, the climate change impacts on these resources may adversely affect the productivity of the NTFP resources in terms of harvesting amount and quality of the NTFPs. Dwindling availability of forest-produce- food, fuel, medicinal herbs, etc. will deprive the rural poor from a supplementary

source of both income and food. Non-timber forest products are likely to be more vulnerable to changes in the climate system than timber production. These products have indirect and incremental impacts on local economies, food security and health. Studies have shown that there is a high percentage of population below the poverty line in forested areas, varying from 47.15% in south Orissa to 37.43% in Madhya Pradesh, as against 26.10% being the national average. This clearly indicates that the local population is not being benefited by the revenue generated by forest as a natural resource. However, baseline of the current NTFP production and the potential impacts of climate change yet to be quantified for the state of Mizoram. Hence research studies on these issues will be undertaken and also on developing & promotion of sustainable harvesting practices.

- **Capacity building of communities/ community forest management institutions for climate change adaptation**

Mizoram adopted the practice of Joint Forest Management (JFM) from 1998-99 onwards and made it essential part of plantation programs. Currently Forest & Environment Department registered 593 (Joint Forest Management Committees) JFMCs and 19Forest Development Agencies (FDA) constituted in 15 Forestry Divisions across the State. JFMC Members are supporting conservation activities around 26000 hectares of forest. The impact of JFM on protection, conservation and regeneration of forests cannot be quantified now as the scheme is initiated only a few years back. However FSI, 2009 report suggesting a fairly regeneration of forest due to the JFM activities.

The objective of proposed activity is to building adaptive capacity among Panchayat Raj Members Community Forest Management Institutions and communities towards Climate Change Adaptation for increasing the forest cover, protection and to reduce the climate change impacts. These activities will be planned under JFM for better capacity building and training of the stakeholders and JFMCs.

- **Prevention and control mechanism for forest invasive species and its utilization strategies**

The propagation of invasive species in Mizoram is aided by the habitat degradation due to deforestation, developmental activities, shifting cultivation and illegal harvesting. The main invasive species considered in the forestry area of Mizoram are Mikaniamicrantha, Eupatorium serotinumm, Musa sp. (wild banana), Ageratum conyzoides etc. Wild banana is predominant in the hilly slopes of Mizoram and hindered the natural biodiversity of these areas. However inadequate research is available on the invasive species potential impacts on the biodiversity. One of the potential cost effective strategies considered for containing the invasive species is through promotion of usage of invasive species. Wild banana will be promoted to utilize as fodder for the livestock and the fibre for local dress materials. State forest dept. will formulate a control mechanism for these invasive species in the forest lands and also develops utilization plan of these invasive species especially the wild banana

- **Promotion of forest based industries**

Mizoram has highest literacy level in the India

however most people are dependent on the natural resources for their livelihood due to lack of infrastructure development, remote location, poor market linkages, inadequate power supply, difficult topography and limited flat terrain (Just around 3%). Hence, the promotion of forest based industries in Mizoram has a vast potential for employment generation and effective usage of its natural resources. Currently forest based industries in Mizoram are very limited; Policy Action and Economic incentive are required to create enable platform to encourage setting up NTFP Processing Units , plywood industry, other timber-based units, plantain fibre and hill broom units. Forest department will give special efforts for promotion of wood based industries by enhancing plantation in abandoned jhum land.

- **Formulation of conservation strategies for Orchids and establishment of market linkages for value addition**

Within the hills of Mizoram about 246 orchid taxa in 74 genera were recorded. Out of these, 67 taxa (including saprophytes) are terrestrial and 179 are epiphytic. Bulbophyllum parryae and Sterogynelushaiensis are endemic. Dendrobium, with 41 species and one variety, is the largest genus. Forty genera, 3 being monotypic, are represented by a single species. About 55% of the total taxa appear to be endangered. The habit, phenology, distribution frequency and conservation status, and phyto-geographical affinities are discussed for all taxa. Apart from these the commonly found species are Vanda coerules (Blue Vanda), Renantheraim schootiana (Red vanda), Paphiopedilum hirsutissimum, P. Villosum which are prohibited from export. Conservation measures for those endangered are also suggested. Local people of the state are well acquainted about the medicinal properties of Orchids growing in their surroundings. The knowledge gained through their experience and on from generation as a guarded secret. Mizoram is a small state but quite rich in orchid diversity.

However these orchids are not properly conserved and developed to a sustainable utilization level due to lack of eco-scientific management. These orchids have domestic and international potential in cut-flower and medicinal markets. There is great export potential for exotic orchid species found in Mizoram. Till date there are no such marketing potential explored in Mizoram. The markets are mostly operated by village councils though constructed by Department of Trade and Commerce. Forest dept. is planning to establish a sustainable cultivation and establishment of market linkages of local orchid species which have high demand outside the state.

- **Livelihood improvement Activities for forest dependent communities**

Climate change impacts are already being observed, signaling an urgent need for response measures that minimize current vulnerabilities. By protecting and enhancing the natural services that support livelihoods, vulnerable communities can maintain local safety nets and expand the range of options for coping with disruptive shocks and trends. The forest dependent communities are mainly economically fragile and rely on forest resources for a range of basic needs like food, shelter, clothing and heating. Promotion of alternative livelihood improvement activates such as Rubber plantation, Bee Keeping, Poultry and engagement in protection activities will motivate the communities to protect the forest and to gain economic

benefits. The people get gainful employment in collection of bamboo and minor forest produce and selling them in the market and other ancillary activities such as value additions. This adaptive measure will help in improvement of livelihood of the forest dependent communities and also encourage forest conservation which will ultimately result in GHG sequestration.

- **Strengthening of Forest Department**

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

- **GIS based Monitoring and Evaluation of the program**

Global information system is also an important tool to digitize the evaluation and scientific management of the resources. It plays a great role in monitoring, creation or demarcation of reserve forests, creation of National parks/Wildlife Sanctuaries including afforestation /reforestation areas. In order to ensure an integrated approach at village/ cluster/sub-landscape/sub- watershed level, the forest department will need new capacities. The Mission would support up-gradation of the Range Office into a forest and wildlife resource center (with library, documentation, map room, GIS and MIS cell facilities). GIS-based framework helps in gaining a scientific understanding and to make informed decision making on Deforestation analysis and implementing successful reforestation programs and sustainable forest management.

Teams of Subject Matter Specialists at Range and Division level (on contractual basis) will bring in new knowledge and skills. There include: Information and Communication Technology (including RS/GIS capabilities), community mobilization, watershed/ Soil moisture /water harvesting; finance, ecological restoration / REDD issues etc.

- **Strengthening of Local VSS**

Given the fast changing rural scenario with increase in the number of educated unemployed/underemployed youth, the Mission would support development of youth cadres to lead the charge at the local level. Support of research institutions, universities/colleges from local area, Forest Department and NGOs would help develop this cadre as Self Employed Change Agents (SECA). The cadre of community youths will help Mission activities at the local level with active support of Forest Department and other agencies. This will also augment capacity of Forest Department to facilitate Mission activities with existing regular staff.

- **Publicity /media and Outreach**

Land use policies, regulation policies and measures in respect of climate change can encounter inertia, passive resistance or active opposition, particularly from the indigenous communities. To providing information and explanations is therefore vital for

generating public and stakeholder support for government policies and regulations. Public outreach can also encourage voluntary changes in habits, address the arguments of those who oppose specific actions and help to prepare the younger generation for living in the climate-change world.

- **Establishment of Mission Directorate**

Department of Forest, Government of Mizoram wants to establish a mission directorate, for Monitoring and Evaluation of forest development program of Mizoram. The body will coordinate all forest development issues to achieve the desired target.

Chapter - 8

Sustainable Habitat

8.1. Introduction

The climate of Mizoram is neither very hot nor very cold, but moderate throughout the year. The whole state falls under the direct influence of south-west monsoon and receives an adequate amount of rainfall. The climate of the state is humid-tropical, characterized by short winter, long summer with heavy rainfall.

Urbanisation is a process, rather than a product by which a group of people start living in towns and cities dominated by industrial and service functions. It is a process by which the population migrates from rural areas to towns and cities which are major commercial and industrial centres in the economy. Mizoram became a state in 1987 and Aizawl the state capital which has been experiencing rapid socio-economic growth. With an 11% growth at two urban centres of Aizawl and Lunglei in 1971 the state claimed to have higher urban population growth in the country (over 36%) with 22 towns according to 2011 census. The population density of Mizoram in 2011 Census is 52 persons per sq. km against 42 persons per sq. km recorded during 2001. Among all 8 districts, Aizawl district occupied the highest density of population with 113 persons per sq. km which is 22 persons more than the figure recorded during 2001 (i.e. 91 persons per sq. km). Aizawl town alone accommodates 56.26% of the total state urban population followed by Lunglei with 31.11%, whereas Mamit shows the lowest Urban Population of 16.96%.

The unique geology and geographical conditions of Mizoram makes the State vulnerable to various natural disasters. The main hazards in the State are Earthquake and Landslides. High winds and floods damage houses and properties during the monsoon season. The problem of flash floods are also being witnessed in some parts of Mizoram, especially in low lying areas causing damage to house, property and crops. The speed of windstorm in the whole State is 55m/s (198 km/h) which is the highest value specified in the country. In such events weak houses made of wood, bamboo etc. are the most vulnerable. The damages which occur in such high winds usually are localised in nature.

Mizoram, being a hilly terrain is prone to landslides. Every year a number of landslides have been reported from various localities. This causes a lot of misery to the public resulting in loss of life and property, disruption of communication network and also economic burden on the society. This is primarily attributed to high slope and relief, immature geology, neo-tectonic activity,

heavy rainfall and unplanned and improper land use practice in the state. *(Source : Environmental studies of Aizawl City using Remote Sensing And GIS, A project report, 2005, Mizoram State Remote Sensing Centre, S&T, Planning Dept' Mizoram).*

8.2. Key Facts about urban areas in Mizoram

The population of Mizoram is 10,91,014. It shows that the state's total population has increased by 201,441 persons during last 10 years (Census 2011). The state has experienced relatively slower economic growth in comparison with rest of India. The state of Mizoram, the smallest state in terms of size, is the fifth most urbanized state in India with 49% of its population residing in urban areas. As a result of rapid increase of population within the state and spilling of population outside the city limits has taken place.

Table 8.1: Population Statistics of Mizoram

Description	2011	2001
Approximate Population	10.91 Lakh	8.89 Lakh
Actual Population	1,091,014	888,573
Male	552,339	459,109
Female	538,675	429,464
Population Growth	22.78%	29.18%

Source: Census 2011

It highlighted the fact that the towns in Mizoram are overgrown villages, trading centres with some rural development administrative office outfits, which become urban settlements. These outgrowth areas are generally devoid of basic urban services and are administered through rural growth mechanism. The state capital district Aizawl has registered the highest urban population with 3,12,837 people living in the city while Mamit district has seen the lowest urban population at 14,809.

Lawngtlai district in southern Mizoram has seen the highest rural population with 96,555 people living in villages while Saiha district also in south has the lowest rural population at 31,301.

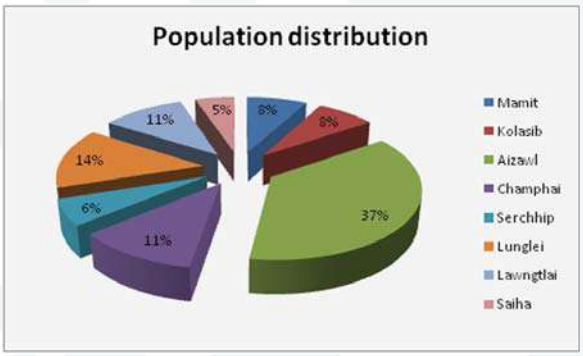


Figure 8.1: Population distribution of Mizoram

Around 5 % of the rural households enjoy water supply within their premises and about 57 % of the households get water from near their premises. For majority of the households (47 %) the main source of water is spring water.

Table 8.2: Distribution of Household by source of Drinking Water

Source of drinking water	Total	%	Rural	%
Tap	51386	31.9	15352	19.3
Hand-pump	3108	1.9	1174	1.5
Tube-well	3394	2.1	2357	3
Well	3213	2	1425	1.8
Tank, Pond, lake	6490	4	3682	4.6
River, canal	18379	11.4	14368	18.1
Spring	65363	40.6	37625	47.4
Any other	9633	6	3379	4.3
Total	160966	100	79362	100

Absence of storm water drainage poses problems of water logging and flooding,

causing landslides and soil erosion. The damages caused to roads, lanes, houses, properties and even lives by heavy rains during rainy season are almost annual phenomenon in Mizoram (especially within urban areas like Aizawl, Lunglei, Champhai, Serchhip, Kolasib, Mamit, Saiha & Lawngtlai). Construction of Retaining Wall drains etc. to prevent calamities, rehabilitate disaster victims as well as for restoration and repair works necessitated by natural disasters is required each year in the urban areas of Mizoram. Due to rapid urbanization owing to movement of rural population to urban areas in view of the incidence of increasing poverty in rural areas, there has cropped up a serious problem as a large number urban poor are not having any suitable place for habitat.

Key Issues

The state of Mizoram is located in a highly seismic zone (Zone V) as per the seismic zoning atlas of India and is prone to frequent earthquake shocks and subsequent hazards. The state also lies in the ecologically sensitive region of the northeast India. Although temperature is usually the first variable considered in assessments of climate change, it is important to consider other data that integrate the state of the climate system over space and time. These include such climate parameters like rainfall and humidity.

As per the present status, there has been a prediction in the change occurring which has been experienced even by the common man either in the form of rise in temperature or increase or decrease in rainfall. Also frequent rainfall makes urban living highly vulnerable to climatic impacts such as floods and landslides. However, when analyzed on a yearly basis the trend shows a gradual decline and then a sudden increase from 1990 to 1995 (Fig 1). In fact, during the span of the 20 years study period, 1995 recorded the highest rainfall of 3185.98 mm where as 1994 had the lowest rainfall with a measure of 2278.29 mm only. Thus, it can be interpreted that there is change in the rainfall trend when analyzed when compared between the two decades, but not on an extremely large scale which again shows that this trend can further change the pattern for the consecutive 10 years rainfall data. If this usual small scale change in trend continues, then Mizoram is not expected to experience a sharp decrease in rainfall unless there are other climatic elements that unexpectedly alter the usual trend, which is mostly above the 2000 mm mark.

There are increasing urban problems of overcrowding and growth of slums, scarcity of water supply, inadequate public health and sanitation system, mismanagement of waste materials. The existing urban infrastructure for service delivery is increasingly insufficient, even for provision of core urban public services such as water supply, sanitation and sewerage, urban roads and solid waste management.

Sanitation poses major problems with the absence of any sewerage system in urban areas resulting in drainage of domestic effluent into nearby rivers and streams leading to contamination of water sources. Indiscriminate developmental activities also add to the problem by obstructing drains and encroaching rainwater flow paths.

Solid waste is a pressing urban issue for Mizoram primarily because of its difficult terrain. Inadequate collection and improper disposal currently lead to spillage and contamination of soil and surface as well as

groundwater streams. Integrated Solid waste Management facility is being implemented in the capital city of Aizawl with the support from Asian Development Bank (ADB).

The urban transport sector has been largely neglected in the State, characterised by heavy traffic congestion due to narrow roads, rapid growth in number of vehicles along with highly topographic and concentric development. Often there are days when some areas remain inaccessible due to blockage of roads by landslides or other damages caused by heavy rains. Public transport is limited due to inadequate road network, poor infrastructure and scattered demand. Except for the National Highways and a few leading roads, much of the road length in Mizoram is unusable for load bearing heavy vehicles. The vehicle population was recorded during 2007-08 was 61000 which is 7.53% more than that of previous year.

Integrated sewerage and drainage system is not available in all cities of Mizoram. City development plans are underway for construction of the same in the major cities and district headquarters of Mizoram. Under the Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT) and Integrated Housing and Slum Development Programme (IHSDP) major initiatives taken for six district headquarters. The Housing and Urban Development Corporation Limited has been appointed as consultant to prepare Detailed Project Report (DPR) to provide services to the poor in Aizawl under the Integrated Housing and Slum Development Programme (IHSDP) programme.

There has been an increase in the average maximum temperature during 1996-2005 by +0.28°C over the decade of 1986-1995, which denotes a trend in increase in temperature during the last decade. The same increase is also reflected in the average minimum temperature recorded for the decade of 1996-2005 which is +0.30°C, much higher than that recorded for the previous decade of 1986-1995. The rate of increase is clearly reflected when the overall monthly average temperature recorded for both decades shows an increase of +0.29°C. The overall trend in temperature also shows a gradual increase during the 1996-2005 decade. In fact, the global temperature increase for 50 years (1951-2000) was 0.5°C (source: NASA GISS) whereas Aizawl is warming at the rate of 1.22°C in 20 years only. It may be noted that the 20 years data may be too little to base upon.

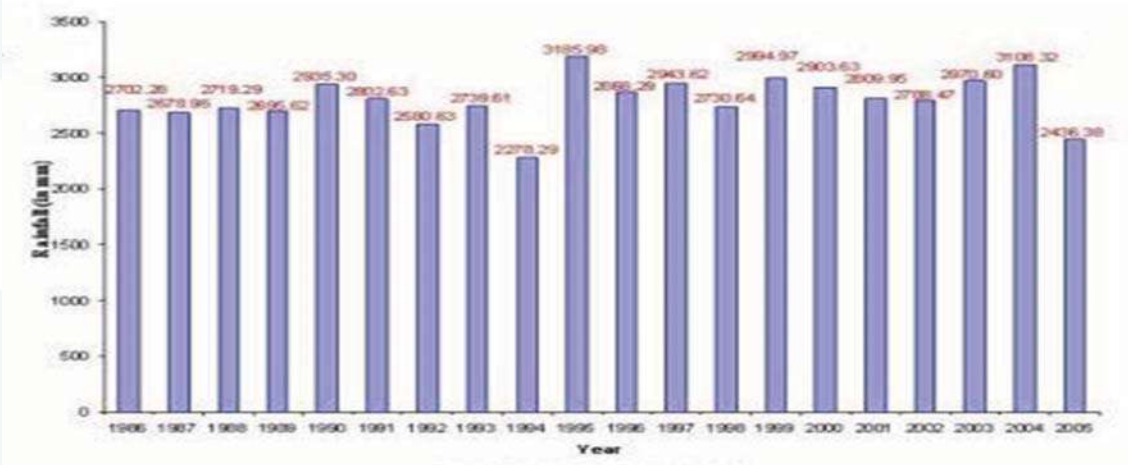


Figure 8.2: Rainfall Variation of Aizawl City

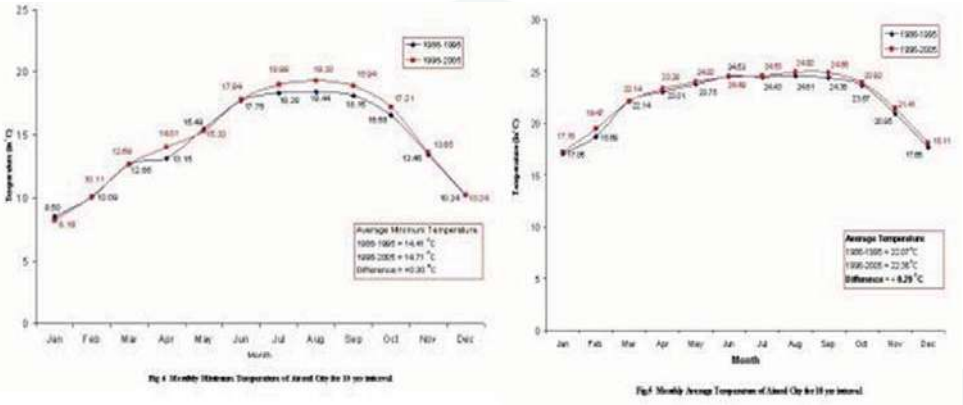


Figure 8.3: Temperature Variation

In addition, poor management of solid and liquid waste, traffic congestion and vehicular pollution, clearance of green areas due to indiscriminate construction, and fossil-fuel energy consumption in city infrastructure contribute to climate change through increase in GHG emissions and reduction in carbon sinks in urban areas. Various features of urban agglomerations in the state interact with the climate and enhance the vulnerability of the city population.

In addition, the large-scale structure of precipitation (rainfall) and heat flux (temperature variations) also closely resembles the observed estimates on a global scale (which was +0.3 and +0.6°C during the last 150 years).In order to combat these odds through a sustainable strategy for climate resilience, the state has envisaged the following key priorities in the urban sector.

Table 8.3: Adaptation Pathways in Cities

Issues	Impact	Pathways
Warm and Humid summer and cold winters	Increased demand for cooling	Create awareness to retrofit building with green design; policy incentive for usage star rated HVAC products
Heavy and aberrant precipitation	Increased storm-water runoff	Development of storm water management plan and investment in sewerage; re-assessment of master plans/land use plans of urban agglomerations, policy incentive use of permeable surfaces and incorporation in the PWD codes
Enhanced waste generation due to urban agglomeration by population influx	Health hazards, soil contamination through leaching, odour pollution	Awareness for waste segregation and policies for landfilling of waste
Transport system congestion and ageing	Congestion and higher GHG emission	Phase out of old vehicles, integrated traffic study and congestion reduction plan
Energy Usage	Higher concentration and higher use	Utility DSM measures in street lighting, solar water heating
Decline in the forest cover	Decrease inbiosequestration of atmospheric carbon dioxide, incur significant adverse soil erosion and frequently degrade into wasteland.	Planting heat tolerant trees, city wide programmes for tree watering and maintenance, roadside plantation programme, development of parks

8.3. Key Priorities

Mizoram is situated in hilly terrain and one of the most vulnerable state with respect to climate change such as warmer temperatures, unusual rainfall, landslides. At the same time, better urban planning and policies can reduce energy use and Green House Gas emissions and improve the resilience of urban infrastructure to climate change, thus shaping future trends. Lack of suitable livelihood and employment facilities further add to the unsustainable exploitation of natural resources. Moreover, the region being in the neighbourhood of Bangladesh, one of the most vulnerable countries in the world in respect of natural calamities is in unique situation unlike any other state of India and requires special attention in initiatives on mitigation and adoption measures under the sustainable habitat mission.

Within the identified key priorities with high importance four actions are adaptation activities and three actions are mitigation activities. The high priorities identified based on the basis of cost effectiveness, cost-benefit,

feasibility, ease of implementation and overall sustainability. Within the Sustainable Habitat six key priorities are under the urban sector, one key priority under transport sector. The total budget proposed for the seven key priorities along with sub activities is 1314.6 Crore INR.

There are multiple opportunities for the mitigation activities to explore the carbon markets with several mechanisms like Clean Development Mechanism (CDM), Voluntary Carbon Standards etc. The revenue generated from the mitigation activities can be used for the effective operation of the activities. Involvement of State Government through "climate-conscious" urban planning and management can help achieve national climate goals and minimise tradeoffs between environmental and economic priorities at local levels. Local authorities can help achieve national climate goals through urban policies to reduce energy demand and improve resilience to climate change National governments can help create a sound institutional foundation and knowledge base to support local decision makers engage with stakeholders to identify and carry out cost-effective actions.

The following action points have resulted out of several rounds of discussions between the working group members.

Key Priorities: Sustainable Habitat

1. Capacity Building and research initiatives on Climate Change Impacts and Preparedness
2. Improvement in water usage management for urban drainage to reduce climate change impacts
3. Development of climate friendly Waste management systems and improvement of aesthetics
4. Reduction of disaster risk through climate change adaptation
5. Energy efficiency improvement and promotion of renewable energy usage in urban sector
6. Improvement of vehicular pollution control mechanism for reduction of GHG emissions
7. Assessment and inventorisation of climate change impact on urban sector

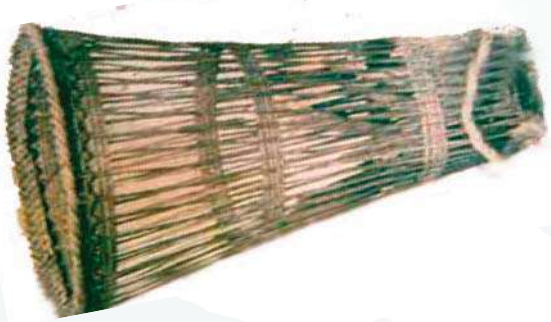
- **Capacity Building and research initiatives on Climate Change Impacts and Preparedness**

The state emphasises the need to enhance capacity of the officials on climate change issues and possible adaptive and mitigating measures so that they can include climatic considerations in their departmental planning as well as day to day operational and monitoring activities. Beginning with a training needs assessment for all relevant departments and agencies, training modules especially on solid waste management, water management and efficient distribution of supply and delivery and urban management would be conducted and training imparted. Capacity building would also be extended for awareness generation of residents on good practices such as source segregation of waste and energy efficiency.

The key priorities identified based on the cost effectiveness, feasible options, sustainable and easy to implement with respect to the present condition of state. New or reformed institutions are needed to enable state governments to facilitate capacity building and decision-making on climate change at the local level. A comprehensive capacity building programme on climate change is necessary which will help to build awareness and increase in knowledge base of the officials responsible. This action is necessary before implementing any climate change mitigation initiatives as comprehensive knowledge base is required for better understanding and better implementation of the initiatives. Department of Urban Development will be the primary responsible department for this key priority action and its sub activities.

- **Improvement in water usage management for urban drainage to reduce climate change impacts**

The water supply in urban areas of Mizoram is inadequate. In order to provide for unforeseen climatic extremes such as floods in urban design, build provisions for storm water flow, and prevent contamination of water streams due to flooding, these aspects would be incorporated into the urban design. The local spring like sources is considered to be converging to the drainage system while its utility to drinking water system remains beyond the normal scope of consideration. In order to provide for unforeseen climatic extremes such as floods in urban areas, storm water flow and contamination of water streams due to flooding, these aspects would be incorporated into the urban design. More frequent rainstorms will also overload the capacity of sewer systems and wastewater treatment plants more often. Saving of 1 MW energy will reduce GHG emission of 6000 ton CO_2 equivalent per annum. It would also lead to energy conservation by reducing energy consumption at pumping stations, wastewater



treatment plants and other relevant facilities. It would include installation of liquid waste treatment facilities, provision of new sewerage system, including the sewerage treatment plant, collection network, outfalls and sewer cleaning equipment, both rehabilitation of the existing water supply and distribution systems and construction of new systems, constitution of water use societies for regular monitoring of services, leak detection and water quality monitoring. Water conservation and enhanced efficiency would help in adapting to water shortage during climate induced dry spells. It would also lead to energy conservation by reducing energy consumption at pumping stations, wastewater treatment plants and other relevant facilities. Activities will include bulk and household water metering and capacity building exercises.

- **Development of climate friendly Waste management systems and improvement of aesthetics**

Solid waste management subprojects include construction and upgrading of landfill sites, transfer station, storage and parking facilities for the collection vehicles and procurement of collection and disposal equipment, as eligible under the subproject selection criteria for the Investment Program. The activity is proposed to establish an integrated waste management plan for cities including measures to improve efficiency of existing solid waste and sewerage management systems, and incorporate a plan for management of construction and demolition (C&D) waste, biomedical waste, and domestic hazardous waste.

As high priority, The Aizawl city solid waste management project will be initiated and subsequently Lunglei town solid waste management will be developed. It will consist of construction of composting plant, procurement of household bins and provision of door-to-door waste collection for the same, construction of sanitary landfill and transfer station, purchase of collection vehicles and equipment and construction of parking facility for collection vehicles, survey in context of urban development. The Urban Development Department had drawn a comprehensive plan for compost production from Municipal Solid Waste and implement the project through ADB financing sources. MSW projects are also highly suitable to attract CDM benefits. Measures to reduce greenhouse gas emissions and adapt to expected climate change impacts will put additional pressure on city budgets and increase the need for additional public resources. These mitigation activities will reduce significant amount of GHG emissions and the revenue flow from the sale of emission reductions will help in sustaining the projects. Composting of 490 TPD MSW will avoid methane emission which will be about 3.61 lakhs ton CO_2 equivalent in next 5 years.

- **Reduction of disaster risk through climate change adaptation**

Climate change and urban disaster risk are the two biggest challenges to Mizoram today, as it faces the consequences of unprecedented rates of population growth, urbanisation, economic development and GHG emissions. Most of the towns and the capital city lies in a mountainous high terrain region where natural hazards strike. Therefore all the towns will be considered for appropriate measures to reduce its vulnerability. Due to the lack of preparedness, emergency

response and post-disaster recovery plans, natural disaster destroyed schools, housing and cultural environment of urban areas, which consequently have serious impacts on efforts towards the sustainable development.

Urban Department will formulate building guidelines with provision for disaster resistance construction, design and materials and will promote traditional environment-friendly & energy-efficient and disaster resistant housing and buildings in urban and rural areas for different agro-climatic zones, flood plains and consideration of seismic vulnerability of the state. Climate responsible master plans for selected cities/towns will be developed considering the disaster risk of the zones. Understanding the function of the land management and revenue department to protect land from encroachment; land revenue code, ownership titles as provided in the present Land Law of Mizoram and reformulation of land tenure policy to enable sustainable urban development is necessary.

- **Energy efficiency improvement and promotion of renewable energy usage in urban sector**

Urbanization and economic development in Mizoram are leading to a rapid rise in energy demand in urban areas in our country leading to enhanced Green House Gas (GHG) emissions. The capital city of Aizawl and other towns are experiencing rapid growth in the peak electricity demand. The local governments and the electricity utilities are finding it difficult to cope with this rapid rise in demand and as a result most of the cities/ towns are facing electricity shortages. In the state a policy mechanism will be formulated for promotion of solar water heating and lighting system for reduction of energy usage and mitigating GHG emissions. This can be promoted as a Public-Private-Partnership (PPP) basis on selected urban areas. Once established and proven a state-wide programme will be launched. Master plan will be prepared for increasing renewable energy supply and energy efficiency measures in the selected city and towns along with awareness generation and capacity building activities will be conducted.

- **Improvement of vehicular pollution control mechanism for reduction of GHG emissions**

Aizawl is linked by the National Highway No. 54 which runs from west to east from Sairang to Zemabawk and passes through the city at Bawngkawn saddle the goose neck point of Aizawl. At present Mizoram is solely dependent on its road network to meet its transportation needs. Most of the prime areas are in the top ridges and saddle areas. It leads to the increase in vehicular movement within the state and the connecting cities and towns.

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. The records by the Motor vehicle Inspection Wing, Transport Department, Govt of Mizoram, for the past 11 years show continual trend of increase in vehicular population. This steady increase of number of vehicles year after year shows that vehicles shall continue to be one of the main sources of air pollution in the state especially in the city. Shift towards public transport or Mass Rapid Transit system, improved urban infrastructure, building concepts of mass

rapid transit, low emission vehicles, electric vehicles in Aizawl city and appropriate urban planning are essential steps to go towards low carbon economy unless the emissions are controlled through better efficient vehicle or introduction of electric vehicle. CNG vehicles are most appropriate for Aizawl city & other small Towns. Considering these facts, implementing this mitigation action considered as high priority and additional revenue from the sale of emission reduction will help in sustaining the activity. Mizoram Government plans to improve the enforcement to control the vehicular pollution which leads to air pollution and GHGs with the help of State Pollution Control Board (SPCB).

- **Assessment and inventorisation of climate change impact on urban sector**

Estimation of emissions load is an essential step in order to quantify the share of Urban Sector in the pollutant levels in the city/ towns. The sources of emissions include vehicles, domestic fuel burning, DG sets, solid waste dumping, liquid waste discharge, energy consumption etc. Accurate and comprehensive emission inventories are needed as a foundation for determining the geographic distribution of pollutants, the evolution of their chemical and physical properties and their impact on human health and ecosystems. Similarly, accurate estimates of emission rates and patterns of pollutants are necessary to support effective air quality management strategies. Emission inventories are typically constructed through a data aggregation process that accounts for emission rates, activity levels, and source distributions. Emission rates are often derived from laboratory measurements (e.g. vehicle dynamometer studies), activity levels can be obtained from traffic counts or surveys of sources and source distributions may come from roadway maps, aerial photographs or estimated from population density. However, the propagation of errors associated with this data process can result in large uncertainties that reduce the utility of emission inventories and consequently impede the air quality management process.

For regular monitoring of the city environment, it is essential to conduct an environmental and emissions profiling of the towns by collecting baseline data on environmental parameters, including emissions, establishing benchmarks for periodic monitoring, checking environmental degradation and identifying scope for mitigation in the relevant areas. This would require setting up of monitoring stations across the towns and capacity building of personnel on monitoring techniques.

Chapter - 9

Health

9.1. Introduction

Accrued empirical evidence has already established climate- disease relationship. Public health which is highly dependent upon the availability of adequate quantity and quality of food, safe drinking water, decent home protected against disasters, a reasonable income and good social and community relations (WHO, 2003) is projected to be affected by climate change (Rahman A, 2008). Climate changes is expected to profoundly catalyses the propagation of infectious, communicable as well as life threatening vector borne diseases (as some of the vectors are highly climate sensitive as regards to temperature and rainfall). Impact of climate related stress due to increased heat, air pollution, malnutrition, increased incidence of water borne diseases like diarrhoea, cholera, typhoid and gastreoenteritis, and vector borne diseases such as malaria will result in increased morbidity and mortality. Mizoram has already a combination of many of this human health related issues. Climate changes may impart an additional pressure on the public health system that is already burdened to cope with the existing level of health issues including communicable and non communicable diseases..

The possible climate related health impacts envisaged are[1]:

1. Progressively increased health burden because of increased proliferation of climate sensitive diseases and premature death (high confidence)
2. Altered distribution of some infectious disease vector that might proliferate due to climate change (medium confidence)
3. Altered distribution of some allergenic pollen species (high confidence)
4. Increased heat wave related death (medium confidence)
5. Projected trends in climate change related exposures of importance to human health

    a. Increased malnutrition (due to deterioration in nutritional health arising from crop failure, which is caused by droughts and especially by high night temperatures that result in reduced cereal yields) and consequent disorders, including those relating to child growth and development highly linked with the economic conditions (high confidence)

[1] *4th Assessment Report IPCC*

b. Increase the number of people suffering from death, diseases, injury from heat waves, flood, storms, fires and drought (high confidence)

c. Increase burden of vector and water borne diseases

d. Increased cardio respiratory morbidity and mortality associated with ground level ozone.

The possible health related adverse impact is likely to damage human well-being and prosperity substantially and especially among the population having lower capacity to combat the impacts and access to medical facilities. The direct impact because of climate change can be in form of heat strokes which might enhance the morbidity or mortality principally amongst the older age group and urban poor. The indirect impact can vary widely including enhancement of transmission window for the vector borne diseases, increased incidence of water borne and communicable diseases, malnutrition/ deterioration of nutritional health and consequent disorder (including those related to child growth and development), food security (resulting from reduced crop yield), increase in poverty/economic decline, population displacement and even loss of livelihood due to outbreaks of natural disaster. The impact would however vary depending on number of factors like adaptive capacity of the population, level of exposure, sensitivity, demographic and socio economic factors like population growth, urbanisation, poor health condition of the populace, water scarcity and inadequate sanitation condition, preparedness and awareness among the population on general health related issues.

Climate Change and Health: Pathways from driving force to potential health impacts (WHO, 2003)

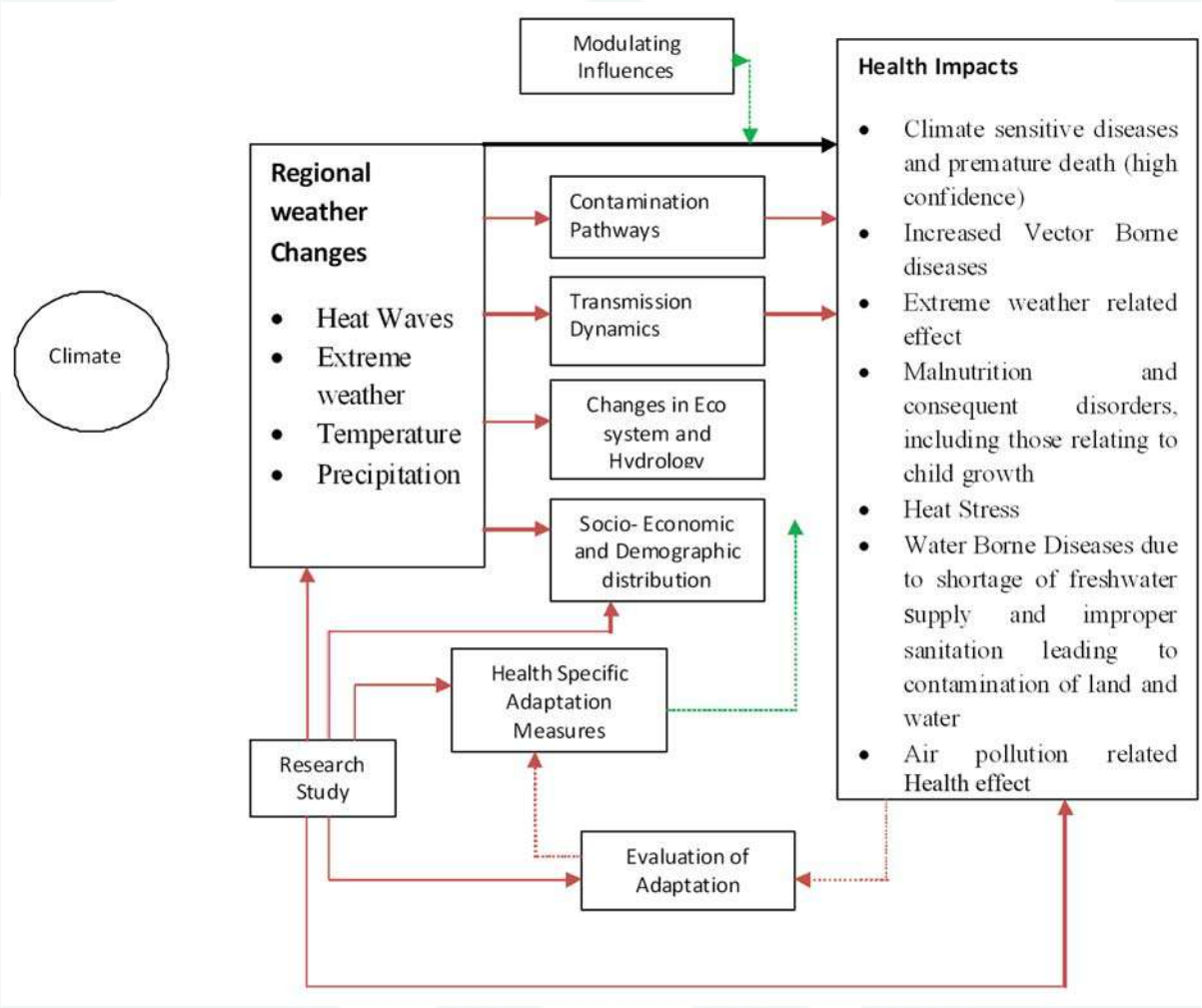


Figure 9.1

One of the youngest states of the union Mizoram lying in the far flung area of the country is extremely vulnerable to the extremes of climate change due to its location in the fragile ecosystem and limited access with the rest of the country. Barring the scenario profiling of the health condition towards determining the possible impact of climate change on the health status and modelling the impact reduction framework, it is also essential to have a clear understanding of the socio economic scenario of the region that creates a conducive environment for occurrence and spread of diseases. The socio economic indicators like education, gender, poverty, housing, amenities and employment provide a background towards understanding of the health scenario of the region. The socio economic scenario of 1.09 million Mizo population distributed across 719 villages and 23 towns in 8 districts is represented in terms of socio-economic indicator like literacy rate (Mizoram's has one of the highest literacy rate in the country 2ER of 91.58%[2]), population density lower population density of 52 persons per sq. km, economic status (12.6% percent of total population lying below poverty line[3]) and employment (total employment of 0.41 lakhs[4]).

[2] *http://censusindia.gov.in/2011-prov-results/data_files/mizoram/Provisional%20Population%20Total%20of%20Mizoram.pdf*
[3] *http://censusindia.gov.in/2011-prov-results/data_files/mizoram/Provisional%20Population%20Total%20of%20Mizoram.pdf*
[4] *http://censusindia.gov.in/2011-prov-results/data_files/mizoram/Provisional%20Population%20Total%20of%20Mizoram.pdf*

Though National Action Plan on Climate change does not identify human health as separate National Mission, Govt of Mizoram focused on health sector envisaging the possible impact of climate change on human health.

The action plan is strategized in order to reduce the impact of climate change related direct and indirect human health relevant exposure, combat the incidence of diseases and promotion of sustainable development. The strategy is framed on the basis of assessment of the scale of impact at regional level, determining the priority and scale of actions and strategising adaptation measures towards reducing vulnerability of climate change. Such strategy broadly includes enhancement of awareness and uptake of effective clinical and public health intervention in high need regions for reduction of impact.

9.2. Key Facts about the Sector

The section intends to present and overview of the health status of the state that has formed an integral part of strategy development. The parameters include overall health scenario, diseases outburst (incidence and prevalence of both communicable and non communicable diseases), morbidity and associated mortality, health risk and available infrastructure. Although the fact remains that trends of diseases over years are not exclusively driven by the impact of climate change but the issue persists that the existing health scenario might deteriorate under weather variability and overall human health impact may escalate with respect to their virulence and spread to hitherto diseases free area.

Demographic Characteristics[5]

Table 9.1: Birth Rate

Category	India		Mizoram	
	2008	2009	2008	2009
Combined birth Rate (Birth rate Per 1000 population)	22.8	22.5	17.8	17.6

Table 9.2: Death Rate

Category	India			Mizoram		
	Male	Female	Total	Male	Female	Total
Death Rate (death rate Per 1000 population) in 2009	8.0	6.8	7.4	6.3	3.9	5.1

Table 9.3: Infant Mortality Rate

Category	India			Mizoram		
	Male	Female	Total	Male	Female	Total
Infant Mortality Rate (death rate Per 1000 population) in 2009	49	52	50	33	38	36

[5] *http://cbhidghs.nic.in/writereaddata/mainlinkFile/Demographic%20indicators.pdf*

Health Status : Communicable Diseases

Table 9.4: Malaria Cases

Category	India		Mizoram	
	Cases	Death	Cases	Death
Malaria Cases (Reference period Dec 2006)	1785129	1707	10650	120
Malaria Cases (Reference period Dec 2007)	1508927	1311	6563	75
Malaria Cases (Reference period Dec 2008)	1526210	1055	7361	91
Malaria Cases (Reference period Dec 2009)	1563574	1144	9399	119
Malaria Cases (Reference period Dec 2010)	1373317	678	15626	31

Table 9.5: Diarrhoeal Diseases

Category	India		Mizoram	
	Cases	Death	Cases	Death
Diarrhoeal Diseases (Reference period Dec 2009)	11984490	1818	21841	17
Diarrhoeal Diseases (Reference period Dec 2010)	10112845	1388	16142	12

Table 9.6: Enteric Fever

Category	India		Mizoram	
	Cases	Death	Cases	Death
Enteric Fever (Reference period Dec 2009)	1099331	436	1163	4
Enteric Fever (Reference period Dec 2010)	1034642	379	1115	0

Table 9.7: Acute Respiratory Infection

Category	India		Mizoram	
	Cases	Death	Cases	Death
Acute Respiratory Infection (Reference period Dec 2009)	28240346	3043	41078	16
Acute Respiratory Infection (Reference period Dec 2010)	24720144	2612	25665	18

Table 9.8: Viral Hepatitis

Category	India		Mizoram	
	Cases	Death	Cases	Death
Viral Hepatitis	124085	600	476	7

9.3. Infrastructure

Health is a state subject in India where the policies and infrastructure are planned and developed by the state government. The health care infrastructure of the state comprises of network of hospitals, Community health Centre (12 CHCs – Community Health Centres are designed to

provide all assured services which includes routine and emergency care in addition to all national Health Programme and all support and service to fulfil national programmes), Primary Health Centre (57 PHCs – Public Health is the first port of call for routine, preventive, promotive, curative and emergency care in addition to all national health programme) and sub-centres (370 sub-centre and 60 sub centres clinic –Sub centres is the most peripheral and the first contact point between the primary health care system and community care system). Despite of the expansion of health care facilities in the state till the last plan period the health care facilities and access to quality health services need improvement in the state especially in the rural areas where there is no public health providers. Rural health care services in the state lacks the adequate infrastructure including shortage of medical and Paramedical staff's absence of medicines and supplies due to limited financial resources.

Apart from the health care facilities rendered in the state, the department has also provisioned to improve the general health of school going children under School health programme through all PHC and CHC. The program is conducted with an objective of promotion of positive health, of school children, prevention of diseases, early diagnosis and treatment along with awakening of health consciousness and improving hygiene and environment.

The health department in the state is bifurcated into two directorates viz, Directorate of health service and Directorate of hospital and medical education. The

organogram for the health and family welfare department is presented below:

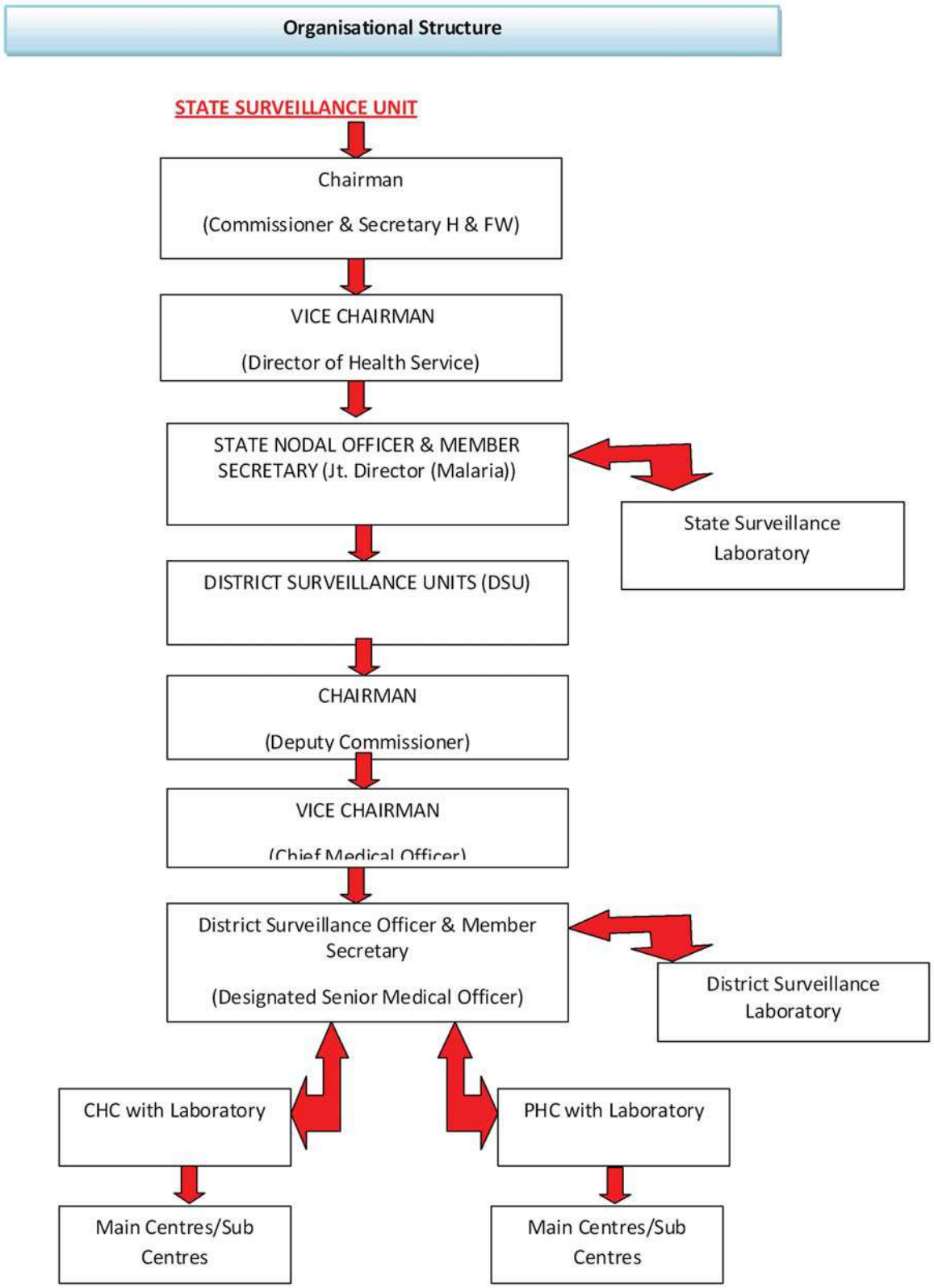


Figure 9.2

9.4. Key Issues

Increase in morbidity/mortality due to increased incidence of Vector Borne diseases

Transmission dynamics of malaria is highly climate sensitive and is severely impacted by the climatic conditions. Epidemiological study substantiated the impact of climate change on malaria. The study revelled decrease in the duration of sporogony in anopheles mosquito with increase in temperature from 20 to 25^{o}C. Since the anopheline mosquito are cold blooded the development of parasite in their body are effected by climatic condition like temperature, rainfall, relative humidity, frost and wind velocity. At increased temperatures the rate of digestion of blood meal in mosquito increases which in turn accelerates the ovarian development, egg laying, reduction in duration of gonotrophic cycle and higher frequency of feeding on hosts thereby enhancing the probability of transmission as reduction in the duration of gonotrophic cycle and sporogony are related with increased rate of transmission[6].

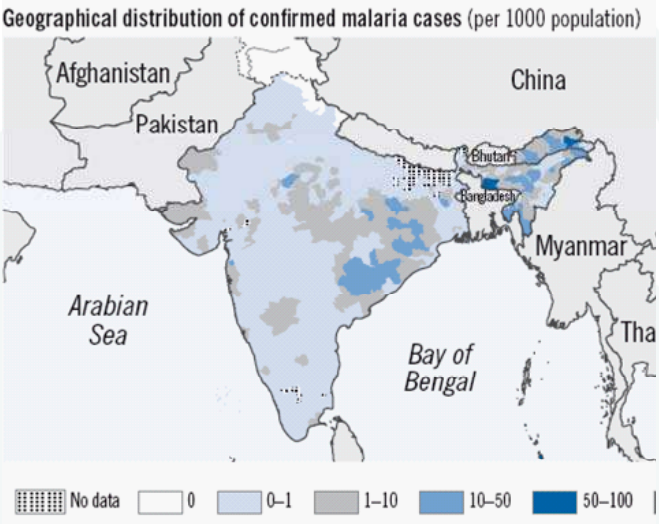
The minimum temperature required for development of P. Vivax and P. falciparum parasite in anopheline mosquitoes is 14.5 –16.5^{0}C and 16.5 –18^{0}C respectively (Martens et al. 1995) which increases due to decrease in temperature till 320C where after there is high mortality in mosquitoes (Martens, 1997).

A relation between the temperature and duration required for the completion of sporogony of the parasite in anopheles mosquito is presented in the table below[7] :

Table 9.9

Parasite Species	No. of Days required for sporogony at different temperature	
	20^{o}C	25^{o}C
P.falciparum	22-23	12-14
P.vivax	16-17	9-10
P.malarie	30-35	23-24
P.ovale	Not known	15-16

Epidemiological Profile (World Malaria Report 2010)



The above representation indicates the susceptibility of the states to the incidence of Malaria.

[6] *Martens et al., 1995, Macdonald 1957; Detinova 1962;Molineaux 1988*
[7] *WHO 1975*

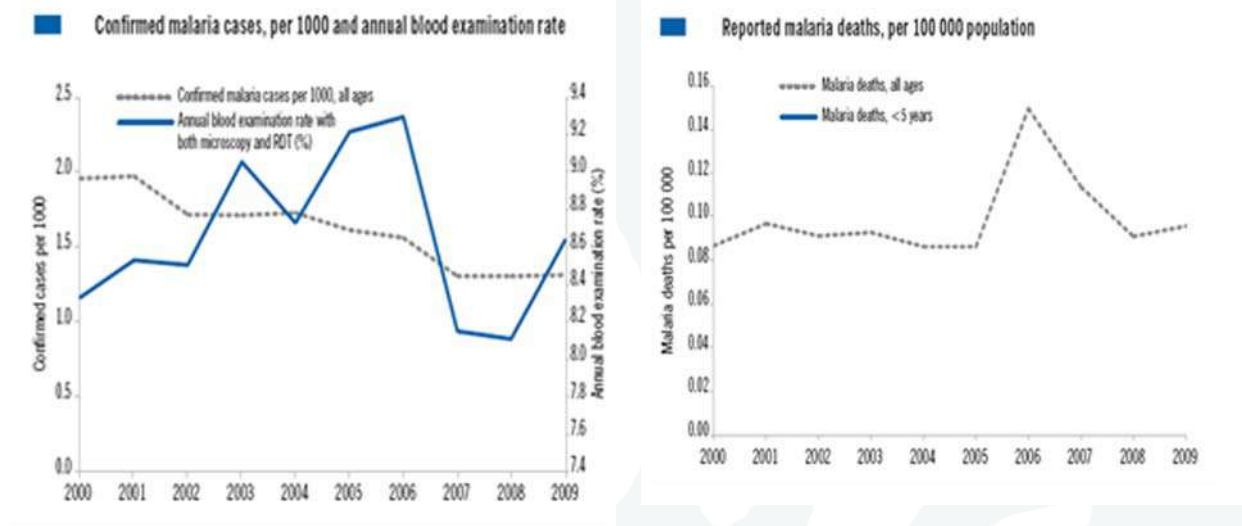


Figure 9.4

9.5. Projection Scenario

The baseline scenario indicates that the state of Mizoram has its transmission windows open for 7-9 months in six district will rise to 10-12 months in 4 districts.

Table 9.10

TWs of Malaria in Mizoram based on temperature (A1B Baseline and projected scenario by 2030)								
	No of Districts	No. of months open for Malaria Transmission						
		0	1 to 2	3	4 to 6	7 to 9	10 to 12	Data Not Available
Baseline	8	0	0	0	0	6	1	1
Projection	8	0	0	0	0	3	4	1
TWs of Malaria in Mizoram based on temperature and RH (A1B Baseline and projected scenario by 2030)								
	No of Districts	No. of months open for Malaria Transmission						
		0	1 to 2	3	4 to 6	7 to 9	10 to 12	Data Not Available
Baseline	8	0	0	0	0	6	1	1
Projection	8	0	0	0	0	3	4	1

9.6. Weather Variability[8]

Temperature

The temperature condition of Mizoram can be described in terms of not so warm summer (20-30^{o}C) and not very cold rain free winter (11-21^{o}C). However Temperature analysed using 20 years temperature data from 1986-1995 and 1996-2005 revelled and increase of average temperature in course of last decade in comparison to earlier. There has been observed increase in average maximum temperature by 0.28^{o}C, average maximum temperature by 0.30^{o}C in 1996-2005 over 1986-1995 periods. The trends of increase in average temperature across the years revealed a probability of gradual increase in temperature.

[8] *R.K. Lallianthanga & Robert Lalchhanhima Sailo, Mizoram Remote sensing Application Centre*

Humidity

A study of 20 years humidity data revealed and average increase of humidity from 73.14% during 91986-1990 to 81.42% in 2001-2005.

Table 9.11: Scenario Analysis of malarial incidence in the State

Year	Population	BSC/BSE	ABER	Total Malaria Cases	SPR	SFR	Death due to Malaria
2006	905689	218072	24.07	10650	4.88	3.18	120
2007	980366	154045	15.71	6563	4.26	2.69	75
2008	980366	165441	16.87	7361	4.4	3.73	91
2009	980366	171793	17.52	9399	5.47	4.29	119
2010	1001289	322929	32.25	15626	4.68	4.39	31

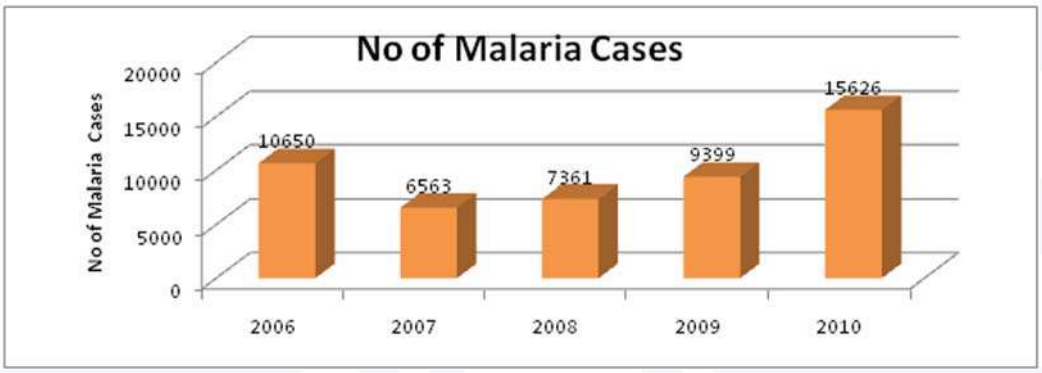


Figure 9.5

Table 9.12: Age wise distribution of Malaria

Age wise	Male	Female	Pregnant woman
0-4	940	892	Among 15626 malarial cases 23 are pregnant woman
5-15	2036	1949	
15 years and above	5553	3831	

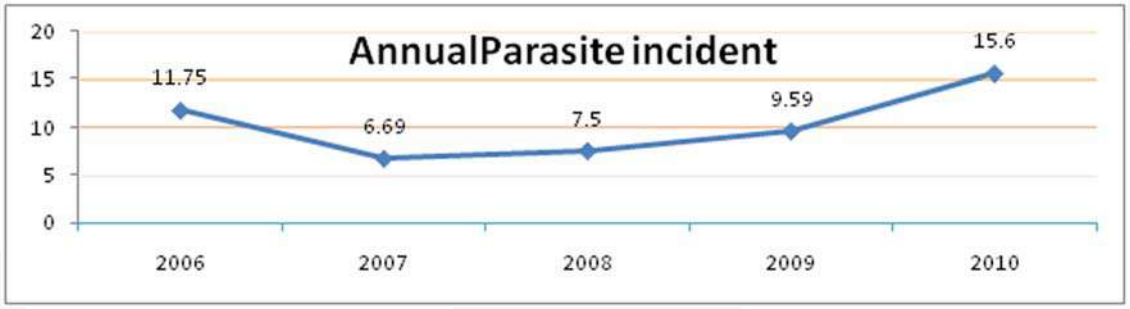


Figure 9.6

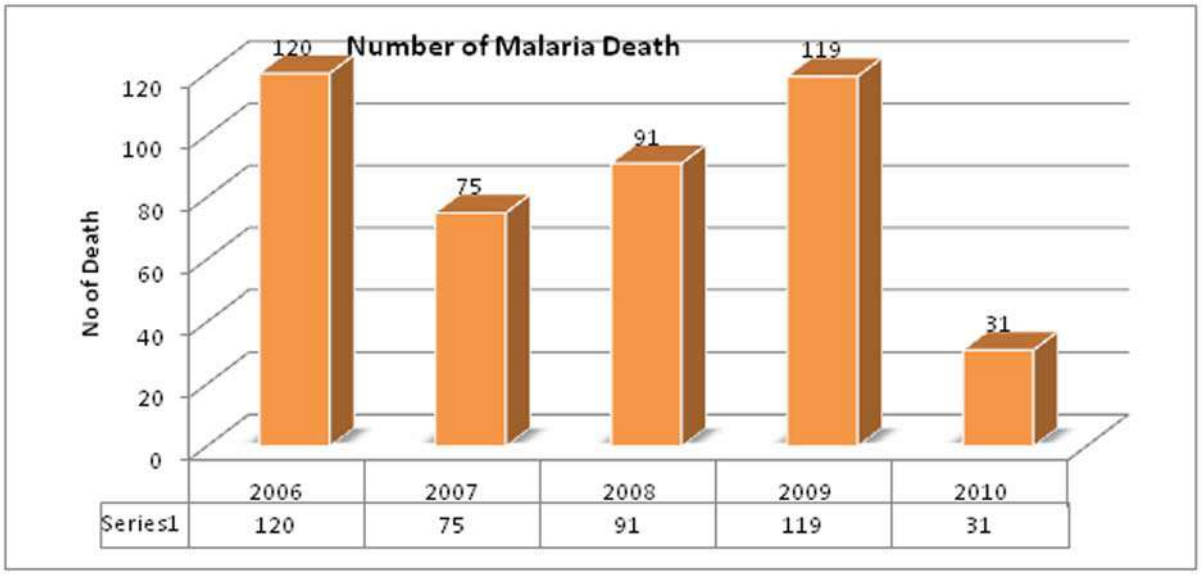


Figure 9.7

From the Above figure it is well evident that although the number of malarial death has decreased across the year the number of malarial incidence and annual parasite incidence has enhanced across the year substantiating the increase in the morbidity due to malaria.

Projection of Malarial Transmission

Based on the minimum required temperature for ensuring transmission of malaria and projected climatic condition a projection is provided for transmission in the year 2030 as against the baseline (1960-1990).

Transmission Window's of Malaria in North-Eastern region based on temperature and RH (Baseline (1960-1990) and projected scenario by 2030)

9.7. Activity Undertaken

1. Distribution of Long Lasting insecticidal Nets in villages where malarial incidence is high (in year 2009 and 2010 around 70,000 and 80,000 numbers of Long Lasting insecticidal Nets were distributed in the villages of Mizoram)
2. Indoor Residual spray
3. Increase awareness to the population regarding the curative and preventive measures under NVBDCP
4. Training, orientation, reorientation and refreshers course is conducted from FTD/ASHA, NGO, Medical officer and specialists.

Table 9.13

State	No. Of District	No. of months open for Malaria Transmission			
			7-9	10-12	Data not Available
Mizoram	8	Baseline	6	1	1
		Projection	3	4	1

5. Surveillance within the state boundary to take blood smear of any fever cases suspected for presumptive dose.

9.8. Gaps

a. Requirement of man power and decentralisation of funds and material for malaria control in far off and inaccessible area.

b. Funds for vehicle hiring and treatment of people living under below poverty line and inaccessible areas.

c. Infrastructure for transfer of slides from sub-centres to PPP microscopy centre or Government microscopy centre.

d. Lack of adequate facility for identifying extrinsic and intrinsic drivers towards devising

9.9 Strategic Framework

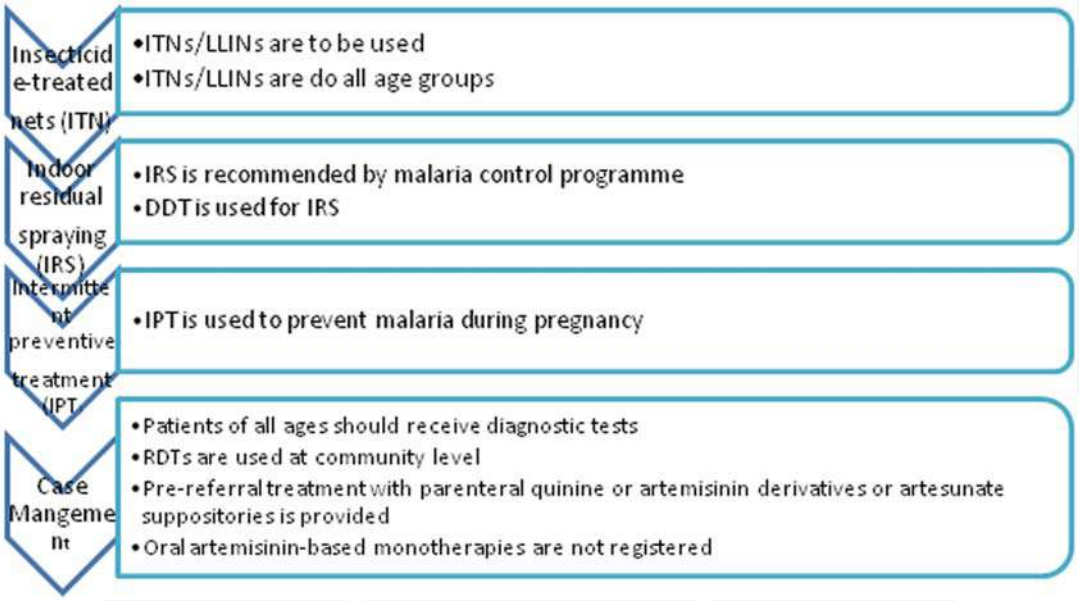


Figure 9.8

9.10. Enhanced exposure to Water Borne Diseases

Water borne diseases are classified as water borne (ingested) and water washed (caused by lack of hygiene). Several factor like water availability, household access to safe water and impact of temperature plays vital role in incidence of water borne diseases.

The State of Mizoram is characterised with poor and unsafe drinking water and sanitation facilities (9.99% of the rural household and 1% of the urban household in the state lacks toilet- 2001 census). The unavailability of safe drinking water and improper sanitation facilities in far off and inaccessible area enhances the chances of incidence of water borne diseases.

Table 9.14

Category	India		Mizoram	
	1991	2001	1991	2001
Household having Safe Drinking water Facilities (in %)	62.30%	77.90%	16.21%	36.00%

The situation of quality water availability is further worsen during the dry season due to increase of the pathogen loading of the water as well as during the over precipitation(water contamination via flooding) period due to increase in microbial loading.

Of the Water borne diseases the incidence of Diarrhoea and enteric fever are quite noticeable in the state. Although the rate of the both the diseases has decreased in 2010 in compared to 2009 the total number of cases seems to provide additional diseases burden.

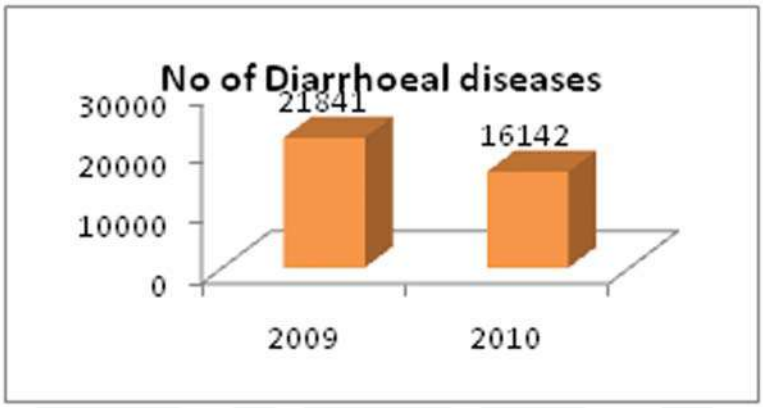


Figure 9.9

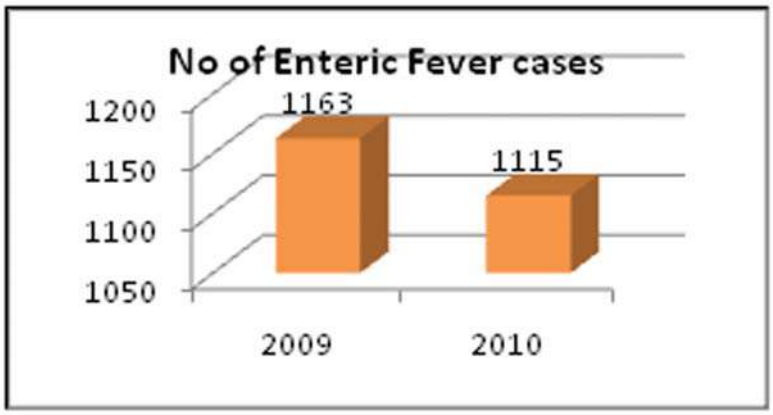


Figure 9.10

9.11. Enhanced exposure to Cardio –Respiratory Problem

Assuming current emission level continue their is high chances for deterioration of air quality in urban region as well increased exposure to ozone and other air pollutant including particulate matter projecting an increase in cardio- respiratory morbidity and mortality. Certain weather patterns enhances the development of urban heat island, the intensity of which is important for secondary chemical reaction within the urban atmosphere leading to elevated level of some pollutants.

The climate change may also alter the seasonal distribution of some allergenic pollen species leading to physiological problem.

9.12. Thermal Extremes

High temperature may also lead to the higher level of urban pollution and humidity or exacerbate pre existing respiratory problems (Gaffin and Ross 1998; Gawith, Downing and Karacostas 1999). Other direct impact

9.13. Enhanced chances of Malnutrition and Food Security

The lowering of yield of food crops due to climatic variability might diminishes dietary diversity and reduces overall food consumption and may therefore lead to micronutrient deficiencies posing impact including death, malnutrition and/or micronutrient deficiencies specially among the vulnerable section of the population with lower economic stability. Food insecurity issue may also lead to urban migration.

Table 9.15: Adaptation Pathway

Climate change Issues	Impact	Pathway
Surface temperature is projected to increase between 0.8-2.10C	Expected to face an increase incidence of malaria due to increase in temperature	Development of adaptation frame work towards reducing the incidence of malaria and enhancing the infrastructural facilities towards facilitating prompt and complete treatment of vector borne diseases
Decrease in winter Precipitation Increase in intensity of summer precipitation Increase in night time temperature	1. Lower crop yield in winter 2. Damage of crop due to higher precipitation 3. Increased pest incidence 4. Increase runoff and landslide during summer precipitation 5. High night temperature reducing cereal yield	1. Management of Malnutrition and addressing food security issues 2. Loss of employment and adverse effect on health
Climate change Extremes like flood, landslide	1. Damage to agriculture leading to Increased Poverty and malnutrition, population displacement 2. Population displacement adversely impacting social cohesion and health	1. Planning effective disaster management programme 2. Increased surveillance for evidence malnutrition including micronutrient deficiencies 3. Addressing the specific needs of the community thereby preventing migration

Adaptation measures are strategized in order to offset and reduce the negative impact of climate change and utilising the positive impacts towards enhancement of overall sustainable development. Adaptation in the context of health includes interventions that may be defined as "Actions that involve making changes to natural or human environment or to human behaviour that have the beneficial impacts (or prevent adverse impacts) on health of humans" (Hutton 2000).

Adaptation can be defined according to the purpose (autonomous and planned), the timing (preventive and reactive), the temporal scope (short and long term), the spatial scope (localised and spread), the form (legal, technical, advisor and behavioural), the function (structural and non structural) and valuation of performance (effectiveness – feasibility) (EEA 2007).

For working out the comprehensive strategy the socio economic driving forces are also linked those are indirectly impacted by the climate change but influence the overall health scenario which forms the fundamental and integral part of socio economic development.

9.14. Key Priorities

Identify extrinsic and intrinsic drivers of malaria and identifying immunity intervention measures towards control of incidence of malaria.

Mizoram is a hardcore malarious area with around 7-9 months of open transmission window. The weather condition (hot and humid for around 9 months) in the region is conducive for both mosquito proliferation and active malaria transmission. Mostly pockets in forest, forest-fringe and foothill villages located along inter country/interstate border are vulnerable to occasional outbreaks. Many of the intervention like indoor residual spray is not operationally feasible as the human settlements are scattered in hilly terrain and are also not accepted among the community.

The quantum of transmission in the region is governed by two entomological indices i.e. vectoral capacity and Entomological Inoculation Rates (EIR) per person/night. These indices are directly affected by the density of vectors in relation to number of humans in a given local situation, daily survival rate, feeding rate of vector mosquitoes and the duration of the sporogonic cycle which are sensitive to environmental conditions.

Although the environmental and eco-climatic factors are assisting in enhancing the breeding of mosquitoes but such parameters cannot be varied. It is therefore highly essential to identify the other extrinsic and intrinsic factor based on the local conditions through detailed entomological investigation in malaria endemic pocket.

The studies can include identification of vectors and parasite prelevence region wise, their breeding time and places, bionomics concerning their breeding, in addition to other parameters like geographic distribution, seasonal prevalence and host feeding preference and other related issues.

Based on the identified extrinsic and intrinsic factor the immunity intervention measures towards control of incidence of malaria will be strategized including variety of options like distribution of LILN, Insecticide treated bed nets, antimalarial drug, introduction of larvivorous fishes in stagnant water, introduction of residual spray, clinical cure and awareness creation through training programme.

Initiatives outlined above are planned as a key priority under state climate change action plan.

Assessment of impact of heat stress on human health and framing adaptation strategy, identification, documentation and awareness creation on temperature related morbidity

The rise in temperature due to climatic change is likely to intensify the summer conditions with heat waves poses risk of deaths from heat strokes, diseases (skin and eye diseases) and injury. The risk is higher among the vulnerable group which includes infants, elderly persons, pregnant woman, urban poor and labourers.

In order to reduce the impact of heat stress on human health it is essential to quantify the heat effect on human health including the identification of medical, social, environmental and other factors that modify the temperature–mortality relationship in line with the local factors like climate, topography, heat-island magnitude, income, and the proportion of elderly people. Based on the assessment the appropriate infrastructure can be developed which includes setting up of intensive therapy units in existing health care facilities for prompt treatment.

Since the climate change and its impact on the health related issues are expected to be widespread, strengthening awareness, knowledge and skills at all levels across the states is highly essential. Such initiatives includes advocacy and sensitization of policymakers, massive general awareness campaign, sensitization of the health service providers (ASHA, AYUSH, Doctors), health workers and paramedic staff, strengthening community resilience.

Initiatives outlined above are planned as a key priority under state climate change action plan.

Evidence based assessment of biophysical determinants of malaria and development of framework for adaptation measures for malaria control.

To frame up the adaptation measures it is essential to undertake multi-disciplinary, multi- institutional and multi- locational study to generate evidence for impact of climate change on malaria. Such study is essential for developing a framework for adaptation measures for addressing the adverse impacts of climate change on malaria. Such study should include field survey in vector and parasite prelevence pockets, surveillance of entomological indices and malaria.

The adaptation measures towards control and outbreak of vector borne diseases includes both proactive initiatives towards reducing the incidence of diseases and reactive measures including preparedness for undertaking prompt and complete treatment.

Development of proactive framework includes

- Enhanced surveillance of suspected fever cases which is the cardinal symptom of malaria
- Supply of LLIN to population at higher risk of malarial incidence
- Supply of Insecticide treated bed nets
- Residual spray
- Chemoprophylaxis -

Chemoprophylaxisisrecommended for travellers, migrant labourers and military personnel exposed to malaria in highly endemic areas. Use of personal protection measures like insecticide-treated bed nets should be encouraged for pregnant women and other vulnerable populations.

- Assessment of malaria related knowledge, practices and behaviour of the community in malaria endemic areas to develop behavioural change for developing strategy towards prevention and control of malaria
- Increased awareness level and enhancing community participation in control of malaria
- Monitoring and supervision of activities to ensure carrying out of Malaria Control Programme in effective and judicious manner which is most often jeopardized due to lack of funding and lack of adequate professional support.

Development of reactive frame work includes

- Early diagnosis followed by Prompt, effective and complete treatment
- Development of adequate infrastructure towards diagnosis of severe malaria cases negative on microscopy
- Strengthening of present health care set-up
- Development of adequate infrastructure for management of complications for management of severe malaria

Initiatives outlined above are planned as a key priority under state climate change action plan.

Carrying out of Adaptation study

Adaptation activity is needed to be implemented in order to counter and reduce the vulnerability to climate change that has already occurred and health risk projected to occur over coming decades. Current levels of vulnerability are due to non performance of traditional public-health activities, including providing access to safe water and improved sanitation to reduce water borne diseases, and implementing surveillance programmes to identify and respond to outbreaks of malaria and other infectious diseases. Weak public-health systems and limited access to primary health care contribute to high levels of vulnerability and low adaptive capacity amongst the people.

In order to reduce the burdens of climate-sensitive health, determinants and outcomes may need to be revised, reoriented and in some regions expanded to address the additional pressures of climate change. To this context an assessment is required to be carried out to determine the degree to which the existing health programmes is need to be augmented depending on factors such as the current burden of climate-sensitive health outcomes, the effectiveness of current interventions, projections of where, when and how the burden could change with changes in climate and climate variability, access to the human and financial resources needed to implement activities, stressors that could increase or decrease resilience to impacts, and the social, economic and political context within which interventions

are implemented. Given the importance of these types of assessments, further research is proposed under the state climate change action plan. The assessment will also include the cost of adaptation.

Initiatives outlined above are planned as a key priority under state climate change action plan.

Research initiatives to identify change in pattern of diseases by region due to climate change/ weather variation

There is high probability that Climate change might enhances the chances of newly emerging infectious diseases, re-emergence of diseases previously under control and redistribution of diseases in new areas/ diseases free area. Since the overall health condition is vital element in determining the adaptive capacity there is a high chance that the burden of disease and disability are likely to be more severe than otherwise in light of change in climatic conditions. The degree of emergence of diseases and climate change related vulnerability in the future, will depend not only on the extent of socio-economic change, but also on how evenly the benefits and costs are distributed, and the manner in which change occurs (McKee and Suhrcke, 2005). Given the importance of these types of assessments, further research is proposed under the state climate change action plan.

Initiatives outlined above are planned as a key priority under state climate change action plan.

Study and documentation of diseases caused by water (water borne) and development of institutional mechanism to reduce the incidence/outbreaks of such diseases along with awareness generation

Climate-change-related alterations in rainfall (enhancement of precipitation- flood situation), surface water availability and water quality (increased contamination) could affect the burden of water related diseases. Extreme summer and lower rainfall is envisaged to enhance the pathogen loading whereas extreme rainfall and runoff events may increase the total microbial load in water courses and drinking water reservoirs. So it is vital that a research study being is carried out to find out the possibility of outbreak.

Institutional development involves strengthening the surveillance with an integrated approach for management of water borne diseases including water source contamination and determining possibility of outbreaks of water borne diseases including developing of infrastructure towards facilitating prompt treatment of the diseases.

Initiatives outlined above are planned as a key priority under state climate change action plan.

Development of institutional framework and infrastructural facilities for early detection of vector borne diseases, including managing outbreaks

Vector-borne diseases such as malaria enhance the morbidity and mortality leading to social disruptions within the community. Besides ecological parameters which influence the disease incidence other local factors such as socioeconomic, socio-cultural and behaviour patterns of the community play a major role in disease transmission. This objective of early detection and managing outbreaks can be accomplished by compilation of generated dataset and its integration within spatial infrastructure (SI) and introducing a geographical information

system (GIS) for analysis and management of diseases outbreaks.

As a part of GIS infrastructure development thematic layers including PHC/CHC locations, geomorphological parameters, land use, soil type, water bodies, drainage network, forest cover and settlement is to be considered to form the basis of analysis towards describing the primary risk factor within the PHC/CHC's. Thematic maps of ecological parameter when overlaid on Malarial API map can guide towards information on malarial epidemiology including early detection and framing up strategy towards managing outbreaks.

Initiatives outlined above are planned as a key priority under state climate change action plan.

Establishment of pathological laboratory with state of art technology for diseases identification

Climate change is expected to enhance burden on the existing health care system and specifically the diseases detection centre in the far off, remote and inaccessible areas or even in malaria endemic pockets where microscopy cannot be conducted within 24 hrs of sample collection or does not have RDT facilities or facilities of storing of RDT under recommended conditions. Such areas call for increase in the test centre for early detection of malaria.

Moreover some patient may not respond to treatment due to drug resistance or treatment failure or happened to be the case of severe malaria where microscopic evidence may examined to be negative. In such cases there is a requirement of well equipped lab.

Judging the necessity on the basis of above scenario well equipped labs are proposed in the state at malaria endemic pocket and also at remote areas that are not well connected to the main part of the sate having well equipped laboratory.

Initiatives outlined above are planned as a key priority under state climate change action plan.

Public health system infrastructure development for extreme climate risk management and managing outbreaks of major diseases

Climate changes posses' high risk of extreme climate events like enhanced precipitation leading to flooding, drought and landslide. A disaster management plan and emergency preparedness measures needs to be facilitated in order to reduce the impact of climate change extreme events. The infrastructural facilities need to be strengthened including strengthening of the current health care facilities to respond during natural disaster. Actions such as community resilience, disaster preparedness, extending psychological aid to victims, retrofitting of vulnerable infrastructure, strengthening surveillance including traditional knowledge and cultural plan is proposed under the initiatives.

Initiatives outlined above are planned as a key priority under state climate change action plan.

Capacity building and training for health workers for sensitisation of climate variation and health impacts

Since the degree, dynamics and intensity of the vector and water borne diseases are changing with changing of time it is highly

essential that training should be imparted to the existing man power on the treatment procedures. The training is to be carried out among the different categories of health care service provider after understanding the training requirement, development of module in consultation with state health department, undertaking training of local trainers and imparting of training among the community through the identified and trained trainers.

Initiatives outlined above are planned as a key priority under state climate change action plan.

Research study on malnutrition of vulnerable group due to food security caused mainly due to climatic variation

Climate change variations are expected to lead to consequential decline in agriculture and increased malnutrition and food security. Given the importance of these types of assessments, further research is proposed under the state climate change action plan to assess the increased impact due to climate change and develop nutritional status of vulnerable population.

Monitoring and managing migration and psychological impacts of food security on the vulnerable rural poor is also planned as a part of the study.

Initiatives outlined above are planned as a key priority under state climate change action plan.

Chapter -10

Solar Mission & Renewable Energy Sector

10.1. Introduction

Energy is a key indicator and input to achieve the desired economic growth. The development growth of a country or state or a region is measured in terms of technological development, industrialization and socio- economic growth. The entire fabric of developmental goals is webbed around a successful energy strategy. Human's quest for leading a better and comfortable life and with the present era of massive growth in all the spheres of life, it has compelled him/her to use all available energy sources irrespective of the involved cost and environmental degradation.

Climate change is admittedly a serious issue and must be a key consideration in any energy policy, but ensuring diversity of energy supply and providing affordable energy options are also important issues. The action plan on solar mission and renewable energy is presented to enable communities to understand the uncertainty of future climatic conditions and engage effectively in a process of developing adaptation and mitigation programmes. The climate change action plan for energy sector is strategized in line with the **National Climate Change Action Plan** objective of promoting the country's development objectives while yielding co-benefits for addressing climate change effects. The solar mission and renewable energy action plan is developed by following the approach of adaptation measures which will help to cope-up with climate change effects and also the mitigation measures to portray the pathway of reducing the carbon emission intensity and achieving the sustainable development.

10.2. Key Facts about the Solar and other Renewable Energy sector

Mizoram is far behind in terms of the economic and infrastructural growth level of the nation since last three decades which can easily be depicted from the per capita energy consumption[1], a key indicator of human development and growth[2]. Availability and access to quality, reliable and affordable power is critical parameters for promoting economic and social development of the developing countries. The per capita energy consumption of the state in all demand segments – domestic consumers, industrial

[1] Per capita electricity consumption of Mizoram as 185 kWh is very low compared to the national average of 566 kWh (World Bank Data for 2008).

[2] According to Human Development Index (HDI), coined by UNDP.

consumers, agriculture consumers, etc. is one of the lowest in the country.

Though population of the state has increased at around 22.78% during 2001 -2011 and achieved 1,091,014[3] numbers. With the overall population increase in the state and further increase in urban population from that of during 2001, the demand of electricity is also increasing day by day being electricity is a key factor to have a high aspiration to achieve better standard of living.

Mizoram which is a power deficit state owing to negligible in-house power generation capacity is facing a serious power shortage[4]. The change in climate condition and inconsistent rainfall pattern in the state is observed in last few years. Around 64% of total rainfall of Mizoram occurs in monsoon period of June to September of every year. Almost all the hydro power plants of Mizoram have seasonal operation due to non-availability of water in lean period.

Table 10.1: Population distribution scenario of Mizoram

Sl. No	State/ District	Population 2011		
		Total	Rural	Urban
1	Mizoram	1091014	529037	561977
2	Mamit	85757	70948	14809
3	Kolasib	83054	36358	46696
4	Aizawl	404054	91217	312837
5	Champhai	125370	77153	48217
6	Serchhip	64875	32894	31981
7	Lunglei	154094	92611	61483
8	Lawngtlai	117444	96555	20889
9	Saiha	56366	31301	25065

[3]Source: Provisional population Data of Census 2011

[4]Source: Zoram Energy Development Agency, August 2009

Table 10.2: Demand Mix

Restricted Peak Demand[5]	**100 MW**
Restricted Off Peak Demand	**50 MW**

Electricity Consumption Pattern	
Domestic Consumers	68%
Commercial	13.65%
Public Lighting	4.95%
Agriculture	0.001%
Public Water Works	28.14%
LT Industrial	2.40%
Bulk Supply (HT)	12.02%

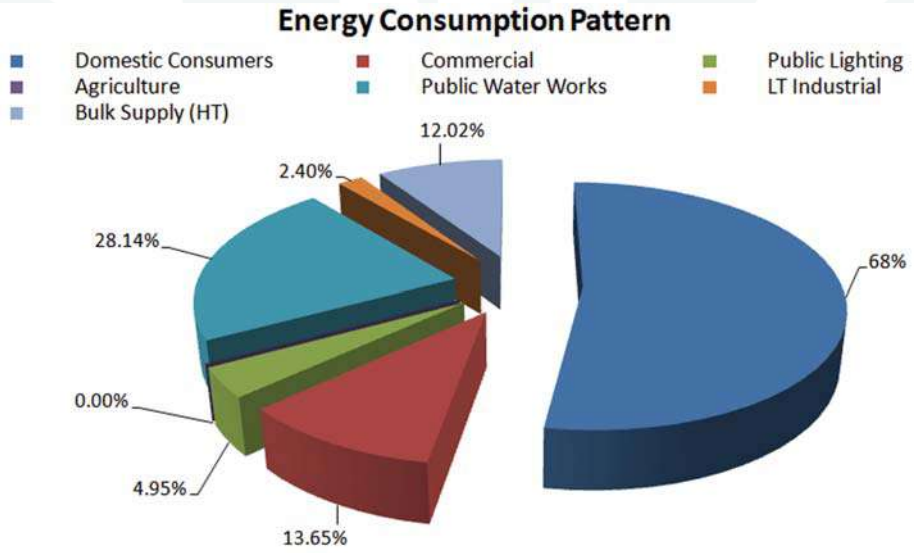


Figure 10.1

Majority of electricity demand is of LT consumers as high as 94% of total electricity consumed out of which 68% is consumed by the domestic sector only.

The power demand of the state is met through its own generation from small hydel, diesel and thermal power stations maintained by the Power & Electricity Department and through import from other NE Grid. Grid electricity penetration in remote hilly areas of Mizoram is techno-economically un-feasible by virtue of geographical disadvantages like steep hills; the division of hills by deep gorges and numerous streams and rivers. Moreover, power sector of the state is experiencing problems in the electric utilities like capacity addition, power evacuation, T&D losses, poor PLF, etc. The one of the feasible solution to overcome this situation is to explore and utilize the renewable energy. Promotion and use of renewable based option will not only reduce the strain on the existing forest but will also promote low carbon growth.

[5]Source: Annual Report on Energy Conservation Measures in Mizoram for 2009-10 by State Designated Agency, Mizoram

The state's own generation is insufficient to meet the peak demand. The hydro power potential of the state is estimated at 2425 MW, out of which only about 1.5% is presently harnessed.

Table 10.3: Power Sector in Mizoram

Year	Energy Consumption (in Million Units)	Energy Generation (in Million Units)	
		Hydel	Total
2004 - 05	125.65	5.92	6.58
2005 - 06	134.51	8.66	11.47
2006-07	151.22	11.14	14.22
2007-08[6]	179.44	16.30	18.92
2008-09[7]	169.86	8.2	10.8
2009-10	190.70	13.48	17.48

The state is yet to attain the target set by the Govt. of India policy under Rajiv Gandhi Grameen Vidyotikaran Yojana (RGGVY) of all villages to be electrified by 2009-10 and all households to be electrified by 2012. Out of 732 inhabited villages, more than 20% Mizo villages are still un-electrified and have no access to electricity as per the definition of Electrified Village from Government of India[8]. Lower electrification in the village level is the result of difficult terrain, unevenly dispersed population and high incidence of rural poverty.

The conventional primary sources of energy in Mizoram are firewood and chips, petroleum products and electricity. Mizoram has been depending mainly on electricity imported from Central sector generation/ other states through grid lines. Electricity is the predominant energy source for rural lighting reported by 86% of the households and remaining households are dependent on kerosene, gas and other sources as well as the urban lighting energy scenario is also almost same with 99.5% of the households using electricity and remaining 0.5% are using gas and other sources[9].

Firewood and chips,a predominant cooking fuel of rural Mizoram is used by around 70% of total households whereas around 29% of them are using LPG and remaining 1% is consuming other sources of energy. But, the urban scenario is significantly different with LPG as main fuel for cooking at around 88% of households whereas 11% of households are using firewood and rest of them are using kerosene, dung cake, etc.

[6]Ref: Economic Survey of Mizoram -2008-09

[7]Ref: Annual Report of Energy Consumption Measures in Mizoram for 2009-10 by State Designated Agency, Mizoram.

[8]Ref: NEDFI Databank

[9]Ref: National Sample Survey 61st Round, 2004-05 by National Sample Survey Organization, Govt. of India April 2007.

To cater the ever increasing power demand due to various factors like population growth, urbanization and to kick start the industrial development and considering the present power crisis in the state, the state government has begun to explore the possibility of enhancing the power generation by focusing on installation of more number of hydro power plants as the state has huge hydro potential and the power generation will be less costly and also decided to encourage power generation from other non-conventional energy sources. In spite of the fact, that generation capacity addition is highly essential for the socio economic growth of the state, the point also crucial for addressing that increasing of large hydro[10] or coal based power plant will contribute to GHG emission. Promotion and use of renewable based option will not only reduce the strain on the existing forest but will also promote low carbon growth.

10.3. Concerns Due to Climate Change

Outlook towards linking climate change and energy sector are usually centred on mitigation effort because the current fossil fuel based energy generation method is a major contributor to climate change. Developing options of low carbon growth and reducing carbon footprint are important activities towards limiting the degree of future climate change.

Energy and water sector are closely and dynamically linked. All human devised energy system have water footprint to one degree or others including non-consumptive transfer of river flow in case of hydro power or consumptive use of water in thermal plant and bio fuel plantation. The envisaged climate change could impact different components of the electricity sector as outlined below:

The projected impact of variation in precipitation level due to climate change will severely impact the hydropower generation which in turn will change the energy supply scenario at the state level where hydro-generation has a lion's share.

On demand side, regions that will face warmer temperature and lower precipitation level will result in increase of electricity demand because of higher use of electric gadget resulting to knock on effect on energy consumption and will thereby enhance the pressure on electricity distribution network through increased seasonal demand.

Impact of extreme events due to climate change on energy sector can damage economic and social infrastructure because of the fact that centralised power plants tend to serve large catchment of population and are also sensitive to climate change.

Biomass still dominates the state energy profile e.g. fire wood, dung, etc. are more vulnerable to adverse effects of water cycle changes on river catchment affecting the poorest segment of the society.

The envisaged climate change could impact different components of the electricity sector as outlined in below.

[10] Review of Greenhouse gas emission from creation of hydro power reservoirs in India, Background paper: Strategies for Low carbon growth, World Bank 2008

Table 10.4

Possible Climate Change Impacts on the Energy Sector	
Climate Change Indicators	Impacts on Energy Sector
Hydrological Variability (Greater Seasonal and year to year variability in precipitation, more frequent and prolonged extreme events like drought or heavy rainfall)	• Variability in Hydropower generation • Variability in water availability for Thermal Generation • Biomass availability vulnerable to water cycle impacts affecting household energy security • Could impact renewable generation potential, especially solar thermal • Threat of damage to infrastructure from extreme events
Increased Temperature	• Impacts Hydropower generation in summer months • Increased requirements of water for cooling in Thermal generation • Increased need of energy in household sector for cooling • Could impact renewable generation potential, especially solar

Assessing the vulnerability of energy supply to climatic events and longer term climate change needs to be formulated with tailor made. A strategic approach is therefore required to be framed up to ensure that timely and effective adaptation measures are taken, ensuring coherence across different sectors and governance to reduce the sectors vulnerability to the impact of climate change.

10.4. Key Priorities to address climate change concerns

The key elements for the multi - pronged strategy of the sector for mitigation and adaptation measures were identified after detailed deliberation in the working groups. The priorities are in line with the concerns raised due to impact of the climate change and the states response.

1. Up scaling Renewable Energy Application for meeting up decentralized distributed or Off-grid area energy demand

The promotion and use of off-grid or decentralized renewable energy generation will reduce greenhouse gas emission by both direct and fugitive emission due to substantial decline in fossil fuel or non-renewable biomass usage. In general rural consumers of entire India is not well conversant with the use of electricity and electrical devices. Hence, they should be educated in

conservation of electrical measures, such as the use of efficient devices and of alternate energy resources like solar energy, biogas plants etc.

- **Maximizing use of stand-alone solar power packs of 250 Wp for decentralized power generation through pilot scale implementation of 100 systems under JNNSM scheme.**

Providing electrical energy will empower the people residing at one of the most difficult terrain or far- flung area in the country with the option to sustain under severe impact of climate change be it the increase in temperature or unavailability of water.To cater the power demand and maximize the judicious utilization of renewable energy resources for meeting up household and other dedicated consumer's requirement, use of solar photovoltaic power packs will be promoted. The systems can be designed according to the power requirement variation for the day with alternative source of back up of solar photovoltaic to avoid power shortage during lean time. Due to use of each unit of electrical energy generated from power packs around 0.8 kgCO_2e emission will be mitigated.

i. Awareness creation and capacity building for incremental usage of solar power packs.

ii. Identification, evaluation and approval to 100 consumers for 250 Wp SPV power pack systems.

iii. Design of solar power pack systems according to the user need.

iv. Identification of technology supporters and empanelment of them with ZEDA

v. Installation of 100 such systems in the approved sites.

vi. Training to users on operation and maintenance support.

- **Promotion and facilitate installation of stand-alone off-grid solar power plant with capacity range below 100 kW with targets of 0.80 MW by 2016-17 and 1.60 MW by 2021-22**

Providing electricity in the off-grid areas or to the small entrepreneurs in the state is a key step towards achieving the socio-economic development of any backward or remote areas. A typical 100 kWp solar power project will reduce GHG emission of around 140 tCO_2e annually. Complying with the National Solar Mission to reduce green-house gas emission, the activity is planned through following sub activities:i. Undertaking study for solar power feasibility and identification of project location where necessity of decentralized power plant exists.

ii. Preparation of Detailed Project Report

iii. Land acquisition and transfer;

iv. Creation of energy evacuation infrastructure

v. Undertake implementation - Reduce the conventional energy dependency for meeting the decentralized or captive power demands and also power demand for commercial/ revenue earning activity by installing standalone Solar Photovoltaic Power

plants. Facilitating installation of standalone solar photovoltaic power plants within 100 kWp capacity with following targets-

- Up to 2016-17 is 0.80 MW
- 2017-18 to 2021-22 is 0.80 MW

- **Electrification of un-electrified villages and hamlets by non-conventional energy sources and undertake pilot electrification of 10 villages through solar and other renewable energy systems to meet the power demand of the remote villages.**

The household energy requirement in the state is met through the use of firewood obtained from forest resulting in increase in the strain over the existing forest. This not only reduces the carbon sink but also enhances the vulnerability of the area in light of the proposed impact of climate change like top soil denudation in case of flood or other impact. Providing electricity to rural household or rural enterprises is a key step towards reducing the vulnerability of this particular section of the society who will be more impacted due to changes in climatic condition. Reduce the conventional energy and firewood dependency for electrification by electrifying remote un-electrified villages through non-conventional energy sourcesto meet the power demand and provide constant source of power to the inhabitants of villages or dispersed area where comparatively concentric population situated and power demand for commercial activity or revenue earning activity persists. The sub- activities to be undertaken are

i. Undertaking study for electrifying remote villages in decentralized mode.

ii. Develop project proposal, DPR.

iii. Apply for Financial closure, land acquisition and transfer,

iv. Infrastructure Creation for energy distribution network.

v. Undertake implementation of total 100 kWp standalone Solar Photovoltaic Power plants in 10 numbers of villages to meet the power demand of the villagers.

The pilot initiative of electrification of remote villages will contribute in approximate 1400 tCO_2e Greenhouse gas emission mitigation.

2. Unlocking grid interactive solar power generation and supplement the conventional grid power under National Solar Mission

The state of Mizoram is highly dependent on import of power from other state grids. Even though hydro power potential of the state is explored through already implemented projects; still the grid interactive solar power generation option is unexploited in the state. The objective is to harness solar energy sources available in the state by creating and enabling policy interventions for diffusion of zero polluting RE technology and deploying solar power projects across the state in a near future and thereby reducing the power import. The following steps will help in achieving the compliance:

- **Undertake a demonstration project of install 1 MW grid interactive solar power plant at Lengpui, Aizwal by 2013**

The state has initiated solar photo voltaic power project in a pilot mode with implementation of 37 number SPV pumps, 315 number of solar street lighting system,

3045 number of solar home lighting system, 5812 solar lanterns, 110 number of solar cookers, 109 kWp solar photovoltaic power plants[11]. With an objective to explore the grid interactive solar power generation in the state which is still untapped following actions will be taken -

i. Survey and investigation to identify appropriate sites

ii. Develop project proposal, DPR and apply for financial closure

iii. Land acquisition and transfer

iv. Infrastructure Creation for energy evacuation to the grid

v. Facilitating implementation of pilot project of 1 MWp grid interactive solar PV power plant under JNNSM scheme at Lengpui, Aizawl.

The renewable power generation from the solar power plant will thus mitigate greenhouse gas emission of around 1400 tCO_2e annually.

- **Facilitate in installation of 2 MW grid connected solar plant of capacity 100 kW - 2 MW by 2022**

With an objective of achieving the target set out in National Solar Mission and increase the state renewable power share, the state has planned to explore and set up grid interactive power generation from solar energy –

i. Survey and investigation to identify appropriate sites

ii. Develop project proposal, DPR and apply for financial closure

iii. Land acquisition and transfer

iv. Infrastructure Creation for energy evacuation to the grid

v. Facilitating installation of grid interactive solar power plants of capacity 100 kWp - 2 MWpwith following target-

- **2 MW Up to 2021-22**

The installation of 1 MW solar power plant can contribute in 1400 tCO_2e of greenhouse gas emission reduction annually.

3. Reduce anticipated energy and peak demand through promotion and implementation of pilot SWH application by undertaking installation of 100 Nos. of 100 LPD systems and 100 Nos. of 200 LPD systems across various demand segments.

Use of Solar Energy for Water Heating has tremendous opportunity in Mizoram. A large amount of energy is consumed for heating water in hotels, hostels, guest houses, nursing homes, hospitals etc. Solar hot water plants can meet this requirement without any fuel and with zero emission. Besides this option, solar driers can be used for small scale as well as medium scale drying applications like agro processing units etc. Solar Water Heater may be used in place of electric geyser. There is a tremendous opportunity to replace these geysers with solar water heaters under National Solar

[11]Source: MNRE as on 31st March 2007

Mission. Though few demonstration projects has been undertaken in the state whereas majority of the solar water heating potential is still untapped as it has not explored by the commercial and residential segments till now. With an objective of reducing dependency over conventional fuel for meeting the hot water requirement in Govt. establishments of the state and consequential mitigation of green-house gas emission; the activities planned are –

i. Declaration of the target action by the State Govt. through policy mechanism.

ii. Developing project proposal, DPR and apply for financial assistance.

iii. Inviting applications for pilot demonstration projects to promote SWH applications.

iv. Developing SWH supply chain involving SWH manufacturers, distributors, installers, etc.

v. Awareness creation and capacity building for promotion of solar water heater use for water heating purpose across the state. Raising awareness amongst the probable users of various demand segments.

vi. Create conducive environment for development of SWH technology supply chain and promotion of manufacturing and supply of SWH systems in the state.

vii. Promoting SWH application by installing pilot projects of 100 systems of 100 LPD and 100 systems of 200 LPD capacity across various demand segments

viii. Training to users on operation and maintenance of the system

The activity will enhance the solar water heater market in the state and contribute in GHG emission mitigation. The action is chosen as priority considering its importance, as it is line with the Govt. of India's initiative under National solar mission, enormous GHG mitigation opportunity and feasible option. A solar water heater of 100 litres can prevent 1.5 tCO_2e[12] GHG emission reductions annually use of 1000 no. SWH of 100 litre capacity each can contribute to a peak load saving of 1 MW.

4. Develop RE systems supply-chain through empanelment of renewable energy technology manufacturers / distributors with ZEDA and support in development of their set-up in the state.

To maintain the quality of the equipment, better and ease of project implementation, adequate support on operation and maintenance of the equipment for specific time period, reduce the cost of equipment, ZEDA will empanel the RE technology provider, implementing agencies. Apart from this, the state govt. will provide support in setting -up of assembling and distributing set up through land allocation and providing

[12]Source: FAQ_MNRE

other necessary clearances, tax rebate, etc. to few early entries of the manufacturer or distributing agencies.

5. Institutional development and strengthening of ZEDA for promotion of Renewable Energy applications

The State of Mizoram is facing a formidable challenge in reform of power sector in terms of functional reorganization and institutional development of the departments to achieve efficient functioning and implementation of renewable energy applications. The option includes –

- **Restructure and functional re-organization including increase of human resource strength at ZEDA to achieve efficient functioning and increase implementation of renewable energy projects.**

To achieve high share of renewable power in the state grid, it is needed to have better support system in the state nodal agency with adequate human resource. The following actions are planned to achieve the above objectives –

i. Recruitment and retaining of technical or engineering officials in ZEDA.

ii. Training of existing staffs on recent technology development to operationalize national solar mission and other ongoing programmes of GoI in the state and to enhance the knowledge about the policy and procedure to implement the policy.

iii. Upgrading the office infrastructure

- **Institutional development of ZEDA to carry out capacity building and training of local entrepreneurs and O&M personnel on setting up of solar, bio-gasifier and other renewable energy systems at household / community level.**

- **Training of the working group members and their representatives from ZEDA and other concerned departments and organizations on sector specific climate change issue and enhance the knowledge about the policy measures.**

6. Awareness creation and manpower development for enhancement of the renewable energy application

The govt. of India with its several promotional programmes and schemes for renewable energy implementation has supported in development of renewable energy technologies market and number of manufacturers is now in the sector but still the country is lagging behind to provide technical support in terms of proper and adequate installation, maintenance and repair of renewable energy systems due to insufficient or technical competency. The state of Mizoram being located in north –east of India where almost no renewable energy technology manufacturer has set up is facing serious problem in the above-mentioned aspect. Therefore,

- **Supporting state level entrepreneurs to become RESCOs, Channel Partners under JNNSM scheme and renewable energy device manufacturers, distributors, installers, etc.**

The ZEDA will support the entrepreneurs

to become RESCO, channel partner under JNNSM in order to maximize solar technology implementation in the state and also to increase renewable energy promotion and reduce the cost of project implementation.

- Curriculum or technical course development with ITIs and other technical institutions in the state for production, engineering, installation and maintenance activities of renewable energy systems–

The introduction of training course in all ITI's will be beneficial for successful implementation and operation of the renewable energy projects.

i. Development of course structure

ii. Training of the teaching staffs and special training will be provided by national and international sectoral experts

- **Awareness creation among the citizens on the need and benefit of new and renewable energy systems and also on wider dissemination of opportunities for diffusion of renewable energy in infrastructure and other socio-economic sectors through all feasible routes, viz. awareness campaign and workshop, print and electronic media, State Nodal Agencies, Village panchayats, CBOs, NGOs.**

The objective of awareness creation amongst the sectors, present and future end users about the benefit and necessity of using renewable energy technology is a pathway of achieving the solar mission target. Apart from that awareness creation among the citizens in the state on renewable energy applications, about the benefit of RE systems, durability, and also diffusion of renewable energy in infrastructure projects is a key element for promotion. Complying with the national mission action plan is to be done through following sub activities:

i. Identification of Agencies for taking up awareness generation activity.

ii. Undertaking Training Need Analysis Study for the department, preparation of manual and carrying out pilot workshop.

iii. Carrying out awareness campaign on use of renewable energy applications.

- Support schools, education institutions in preparing and introducing, curriculum on renewable energy applications and preparation of book.

A paper or subject will be introduced in school level where basic background of renewable energy technology and need of same will be taught. The ZEDA will help in preparing the study material or book on renewable energy applications.

7. Market Transformation of Renewable Energy applications through policy measures -

The renewable energy technology implementation in the state level is still in very pilot scale and to promote and make the technology marketable and viable in the state, following actions to be undertaken –

- **Modification of existing power policy particularly power generation to investment friendly policy for promotion of solar thermal and other renewable energy application in PPP, IPP mode and other options. Inclusion of climate change and CDM aspects in the State Power Policy.**

- **Development of fiscal instrument to promote renewable energy systems and preparation of operation plan for power trading.**

An incentive programme will be worked out for renewable energy implementation for mainly solar photovoltaic and thermal, hydro and biomass technology options.

- **Declaration of tariff policy for solar and other renewable power purchase and incorporation of zero transmission /wheeling charges for transmission of renewable power to the grid.**

- **Modification of building bye- law according to state profile for mandating use of solar water heater and renewable energy systems for lighting in the common or open space of govt. and commercial establishments.**

In line with the objective of national solar mission the state govt. will promote and mandate use of solar energy based water heating and/or lighting by amendment of building bye-laws suitable to state condition. Apart from the JNNSM, the State could take benefit of other Mission schemes of GoI. For instance the Ministry of New and Renewable Energy (MNRE), Govt. of India, is implementing a United Nations Development Programme (UNDP/Global Environment Facility (GEF) assisted Project on Global Solar Water Heating Market Transformation and Strengthening Initiation: India Country Programme. Capital grant and soft loan will be available for implementation of the scheme where minimum installed capacity of solar water heating system should be 2500 Sq. m. The State Government can take advantage of this programme wherein adequate financial resources are available. The activities planned for this action are-

i. Amendment of building bye-law considering state demographic profile for mandatory use of solar water heating systems in all commercial buildings and in private houses with considerable large area.

ii. Declaration of amendment of building bye-laws and awareness of public through notification or advertisements.

iii. Enforcement of incentives / rebate on property tax for use of solar water heaters in buildings.

iv. Designing of simplified compliance procedures for state and local bodies.

v. Commencement of check testing through independent agency and publication of results.

vi. Market transformation in favor of solar water heating equipment's and appliances.

vii. Awareness campaign to educate consumers and regulators – The awareness creation amongst the consumers and encouragement of potential consumers' to implement the law can be taken through awareness campaigns

and workshops. As a requirement of the awareness campaign the preparation of training material in the form of User Guide and distribution to the consumers. The training programmes may be conducted for the regulators to implement the policy in the state and achieve the objective of National solar mission.

The enforcement of building bye – laws is already implemented in few states of India and is a part of National solar mission. Moreover, the state has mandated SWH usage during 2004 therefore, the enforcement of amended building bye-laws according to state scenario is a feasible, ease of implementation.

- **Create demand for renewable energy services through pilot scale demonstration projects in state government and public sector establishments**

  i. Develop guidelines for renewable energy applications in govt. and public sector establishments

Chapter-11

Energy Efficiency

11.1. Introduction

Climate change is recognized both as threat and challenge. Climate has a significant role in the economic development of India. Even though energy is a basic infrastructure for economic development of a country; yet, around 1.5 billion people worldwide lack electricity[1]. The forecast based on the recent analysis in around 100 countries[2] confirms that, the greater the equity in power distribution, better the environmental outcomes, including better access to water, less land degradation and fewer deaths due to indoor and outdoor air pollution and dirty water. The current pattern of conversion and utilization of energy cannot be sustained and the options to address this issue are –

1. Energy efficiency through technological innovation and process modification to reduce energy intensity and also increased generation capacity thereby abating the requirement of fossil fuel

2. Efficient generation of electrical energy through Combined cycle, super-critical technology, IGCC, etc.

3. Judicious use of energy and thereby energy conservation

The accumulated evidence depicts that, the power inequalities affect environmental outcomes in a range in any country where poor people and other disadvantaged groups disproportionately suffer due to the effects of environmental degradation. The energy sector is of course, a major contributor of GHG emissions with 1100.06 million tonnes of CO_2e emission in 2007 by Indian energy sector. Hence, addressing climate change is a key consideration in energy policy while ensuring diversity of energy supply and providing affordable energy options. The **National Action Plan for Climate Change (NAPCC)** emphasises the need of large scale investment of resources in infrastructure, technology and access to energy, towards attainment of India's development goal which seeks eradication of poverty and improved standard of living. The climate change action plan for energy sector is developed in line with the **National Climate Change Action Plan.**

The energy efficiency action plan is developed

[1]Source: Human Development Report, 2011 published by UNDP

[2]Source: Human Development Report, 2011 published by UNDP

in the approach of adaptation measures which will help to cope-up with climate change effects and also the mitigation measures to portray the pathway of reducing the carbon emission intensity and achieving the sustainable development.

11.2. Key Facts about the Energy Sector

Despite having a rich potential in hydro, Mizoram is not having its own power generation worth mentioning[3] and facing a serious power shortage and financial constraints as the majority of power requirement is procured from other states at an average rate of Rs. 6.33 /unit including wheeling charges whereas the state government sold power to the public at an average subsidised rate of Rs. 1.75/ unit[4]. Electrical Energy Requirement and Peak Load Demand are important elements of the grid management. The electrical energy demand represents the productive element which goes into the capital buildings of the state while peak demand is the operational parameter for utilization of electrical energy. However, the energy requirement of various consumers is different for different season, time, place and process and energy peak demand changes accordingly.

Table 11.1: Demand Mix

Restricted Peak Demand[5]	100 MW
Restricted Off Peak Demand	50 MW
Electricity Consumption Pattern	
Domestic Consumers	68%
Commercial	13.65%
Public Lighting	4.95%
Agriculture	0.001%
Public Water Works	28.14%
LT Industrial	2.40%
Bulk Supply (HT)	12.02%

Till now Mizoram is not exposed to any large industrial activities as a result the HT industrial electricity consumption is observed as nil. Majority of electricity demand is of LT consumers as high as 94% of total electricity consumed out of which 68% is consumed by the domestic sector only.

The power demand of the state is met through own generation from small hydel, diesel and thermal power stations owned by the Power & Electricity Department and through import from other NE Grid. The installed capacity of 52.77 MW[6] of power generation in the state is majorly Hydro based which results in around 13.48 million units during 2009 -10 and remaining 3.3 million units from Heavy Fuel Oil based power plant in Bairabi. Owing to high generation cost, diesel, HFO and thermal power plants are kept as standby for emergency requirements. The state's own generation is insufficient to meet the peak demand. The hydro power potential of the state is estimated at 2425 MW, out of which only about 1.5% is presently harnessed.

[3]Per capita electricity consumption of Mizoram as 185 kWh is very low compared to the national average of 566 kWh (World Bank Data for 2008).

[4]Source: Zoram Energy Development Agency, August 2009

[5]Source: Annual Report on Energy Conservation Measures in Mizoram for 2009-10 by State Designated Agency, Mizoram

[6]Ref: Tariff Order of 2010-11 by Joint Electricity Regulatory Commission for Manipur & Mizoram.

Table 11.2: Power Sector in Mizoram

Year	Energy Consumption (in Million Units)	Energy Generation (in Million Units)			
		Hydel	Thermal	Diesel	Total
2004-05	125.65	5.92	0.59	0.07	6.58
2005-06	134.51	8.66	2.43	0.38	11.47
2006-07	151.22	11.14	3.05	0.03	14.22
2007-08[7]	179.44	16.30	2.59	0.03	18.92
2008-09	169.86	8.2	-	2.6	10.8
2009-10[8]	190.70	13.48	-	4.0	17.48

At present only 8% of the total energy demand of the State is met through own generation and the remaining 92% is imported mainly from Central Sector (NEEPCO, NHPC) and TSECL. The daily peak shortage at normal condition accounts for about 34% to 40%. Around 20% of Mizo villages are still un-electrified and have no access to electricity as per the definition of Electrified Village from Government of India[9]. Lower electrification in the village level is the result of difficult terrain, unevenly dispersed population and high incidence of rural poverty.

The conventional primary sources of energy in Mizoram are fuel-wood and chips, petroleum products and electricity. Mizoram has been depending mainly on electricity imported from Central sector generation/ other states through grid lines. Electricity is the predominant energy source for rural lighting reported by 86% of the households and remaining households are dependent on kerosene, gas and other sources as well as the urban lighting energy scenario is also almost same with 99.5% of the households using electricity and remaining 0.5% are using gas and other sources[10].

Considering the present power crisis, the state government with a view of catering the ever increasing power demand due to population growth, urbanization and to kick start the industrial development; has begun to explore the possibility of enhancing the power generation by focusing on exploitation and installation of state's hydro power potential and also decided to encourage reduction of energy demand through energy conservation measures. In spite of the fact, that generation capacity addition is highly essential for the socio economic growth of the state, the point also crucial for addressing that increasing of large hydro[11] or coal based power plant will contribute to GHG emission.

An estimated 38.9%[12] of the total power available for Mizoram is lost through Aggregated Technical and Commercial (AT&C) during 2008-09. The losses are extremely

[7] Ref: Economic Survey of Mizoram -2008-09

[8] Ref: Annual Report of Energy Consumption Measures in Mizoram for 2009-10 by State Designated Agency, Mizoram.

[9] Ref: NEDFI Databank

[10] Ref: National Sample Survey 61st Round, 2004-05 by National Sample Survey Organization, Govt. of India April 2007.

[11] Review of Greenhouse gas emission from creation of hydro power reservoirs in India, Background paper: Strategies for Low carbon growth, World Bank 2008

[12] Ref: Tariff Order for 2010-11 by JERC for Manipur and Mizoram

higher when compared with all India average and much higher than the average T & D losses of other developed nations. It is estimated that, loss may be in tune of 50% but due to inexistence of 100% metering facility, actual loss could not be estimated. The losses are due to factors like inadequate T&D facility, lack of proper distribution planning, defective metering, unmetered supply and pilferage.

Modernisation and renovation of exiting electricity network and addition of transmission and distribution network in the state to reduce the degree of losses and meet the demand-supply gap is an immediate action. The stability of power sector in the state is confronted by the factors like:

a. Lower installed capacity in respect of existing demand

b. Peak demand shortage and energy demand shortage

c. Lack of proper transmission and distribution infrastructure both for evacuation of power from upcoming power projects and also distributing power to all the villages.

d. Lack of funds for further enhancing of power generation capacity, rehabilitation and modernisation of transmission and distribution infrastructure

e. High AT&C losses, lack of metering

f. Unscheduled and prolonged outages

Table 11.3: T & D Loss

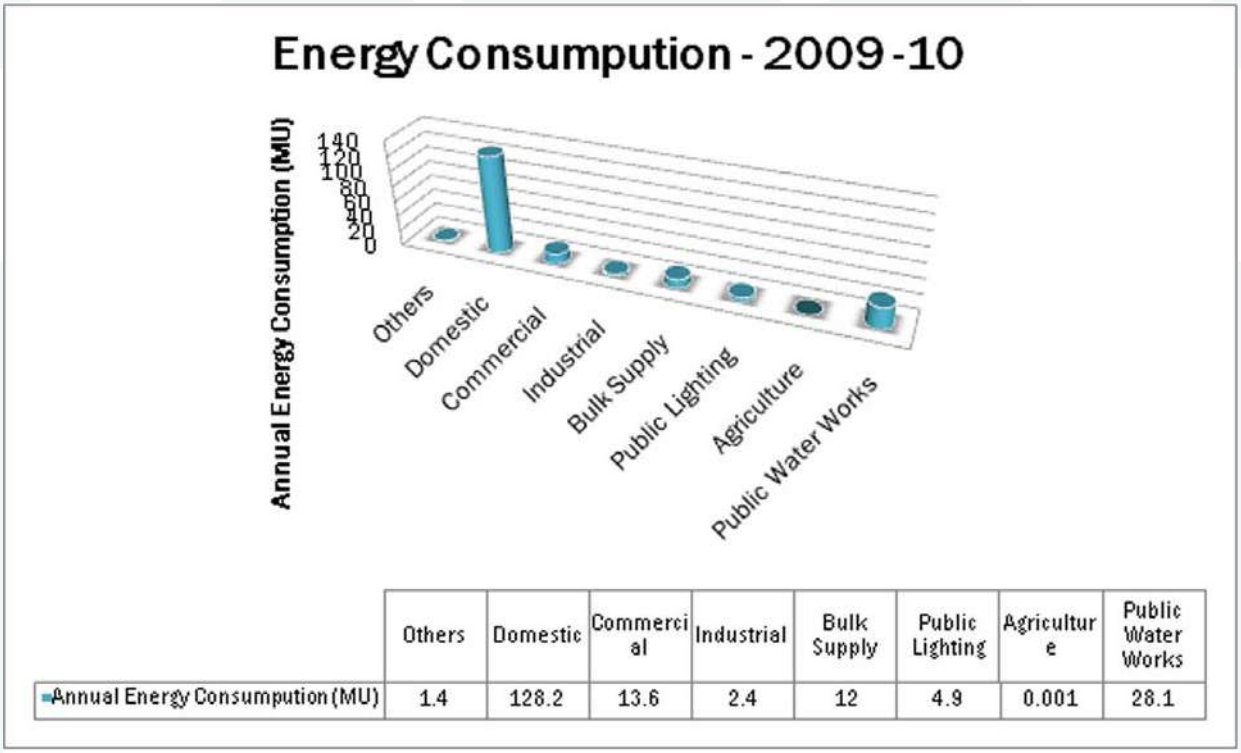
Year	T & D Losses in Million units[13]	Percentage Losses
2004-2005	79.4	39%
2005-2006	76.47	36%
2006-2007	82.32	35%
2007-2008	92.48	34%
2009-2010		33.06% [14]

Energy conservation can be a vital tool for reducing the current demand but it is still at infancy owing to lack of infrastructure. The sectors however has considerable scope of energy saving.

[13]Source: Economic Survey of Mizoram, 2008-09
[14]Source: Annual Report 2009-10 by Power & Electricity Department, Government of Mizoram

ENERGY CONSUMPTION SUMMARY

The annual energy consumption in 2009-10[15] across different demand sectors is as below -



	Others	Domestic	Commercial	Industrial	Bulk Supply	Public Lighting	Agriculture	Public Water Works
Annual Energy Consumption (MU)	1.4	128.2	13.6	2.4	12	4.9	0.001	28.1

Figure 11.1

ENERGY CONSERVATION POTENTIAL

According to the energy study conducted by the National Productivity Council (NPC), there is remarkable opportunity in energy saving. The study summary is as below-

Table 11.4

Sector	Sectoral Energy Consumption (MU)	Projected Sectoral Energy Saving Potential (MU)[16]	Emission Reduction Potential (tCO2e)[17]
Agriculture	Nil	NA	NA
Commercial sector	9.42	1.8	1620
Municipalities	39.26	8.38	7542
Domestic Sector	115.91	23.18	20862
Industries	1.68	0.12	108
Total	166.3	33.5	30,150

[15]Source: Annual Report of 2009-10 by Power & Electricity Department, Government of Mizoram
[16]Source: Annual Report of Energy Conservation Measures in Mizoram for 2009-10 by State Designated Agency, Mizoram
[17]Emission factor is considered as 0.90 tCO_2e/ MWh from Central Electricity Authority: CO_2 Baseline Database, Ver. -6.0

11.3. Concerns Due to Climate Change

Outlook towards linking climate change and energy sector are usually centred on mitigation effort because the current fossil fuel based energy generation method is a major contributor to climate change. Developing options of low carbon growth and reducing carbon footprint are important activities towards limiting the degree of future climate change.

Energy and water sector are closely and dynamically linked. All human devised energy system have water footprint to one degree or others including non-consumptive transfer of river flow in case of hydro power or consumptive use of water in thermal plant and bio fuel plantation. The envisaged climate change could impact different components of the electricity sector as outlined below:

The projected impact of the variation in precipitation level due to climate change will severely impact the hydropower generation which in turn will change the energy supply scenario at the state level where hydro-generation has a lion's share. Also the lower availability of water and enhanced temperature level resulting from heat waves will severely impact the cooling process of thermal power project. Power station other than hydro project that bank on availability of water for its operation (for cooling and also as heat transfer fluid) may have to shut down if water level or availability gets too low. Higher ambient temperatures may affect the efficiency and capacity ratings of fossil-fuel-powered combustion turbines. In addition, electricity transmission losses may increase due to higher ambient temperatures.

On demand side, regions that will face warmer temperature and lower precipitation level will result in increase of electricity demand because of higher use of electric gadget resulting to knock on effect on energy consumption and will thereby enhance the pressure on electricity distribution network through increased seasonal demand.

Impact of extreme events due to climate change on energy sector can damage economic and social infrastructure because of the fact that centralised power plants tend to serve large catchment of population and are also sensitive to climate change.

The envisaged climate change could impact different components of the electricity sector as outlined in below.

Possible Climate Change Impacts on the Energy Sector	
Climate Change Indicators	Impacts on Energy Sector
Hydrological Variability (Greater Seasonal and year to year variability in precipitation, more frequent and prolonged extreme events like drought or heavy rainfall)	• Variability in Hydropower generation • Variability in water availability for Thermal Generation • Threat of damage to infrastructure from extreme events
Increased Temperature	• Impacts Hydropower generation in summer months • Increased requirements of water for cooling in Thermal generation • Increased need of energy in household sector for cooling

Assessing the vulnerability of energy supply to climatic events and longer term climate change needs to be formulated with tailor made. A strategic approach is therefore required to be framed up to ensure that timely and effective adaptation measures are taken, ensuring coherence across different sectors and governance to reduce the sectors vulnerability to the impact of climate change.

11.4. Key Priorities to address climate change concerns

Several mitigation initiatives are conceptualized under National Mission for Enhanced Energy Efficiency (NMEEE) with Bureau of Energy Efficiency (BEE) and Energy Efficiency Services Limited (EESL) to address climate change concerns and attain energy security of the nation. NMEEE has strategized the following initiatives, in addition to the policies and programmes for energy efficiency being implemented by BEE:

- Perform Achieve and Trade (PAT), a market-based mechanism to make improvements in terms of energy efficiency at energy-intensive large industries and facilities. A more cost-effective approach by certification of energy savings that could be traded.
- Market Transformation for Energy Efficiency (MTEE) by accelerating the shift to energy-efficient appliances in designated sectors through innovative measures that make the products more affordable.
- Energy Efficiency Financing Platform (EEFP), a mechanism to finance DSM programmes in all sectors by capturing future energy savings options.
- Framework for Energy Efficient Economic Development (FEEED), or developing fiscal instruments to promote energy efficiency.

The implementation plan of NMEEE seeks for upscale of the efforts to create the market for energy efficiency, which is estimated to be about Rs. 74,000 crore. The mission would create conducive regulatory and policy regime to foster innovative and sustainable business models for unlocking this market. As a result of implementing NMEEE, it is estimated that, by the end of five years, about 23 million tonnes of oil equivalent (MTOE) of fuel will be saved, capacity addition of over 19,000 MW avoided, and emissions of carbon dioxide will be reduced by 98.55 million tonnes annually.

The state of Mizoram has already started initiation for addressing the climate change issues, with a focus on reduce of energy demand through energy conservation and efficiency improvement measures. After detailed deliberation in the working groups; key action points are configured in line with the National Mission on Enhanced Energy Efficiency and new initiativesof Tax incentives, Energy efficiency financing and fiscal incentives under the mission. Since saving of biomass through introduction of cleaner and low carbonfuel option does not comes under direct preview of the National Mission of Energy Efficiency but is highly essential from low carbon inclusive growth and black carbon initiatives point of view and hence included as a part of the action plan under medium prioritisation. **Efficient cooking practice in rural areas and conservation of forest wood**- Around 70% of rural Mizoram are using firewood and chips as cooking fuel which leads to black carbon emission (Black carbon has detrimental effect on climate

due to warming of atmosphere and reducing albedo when deposited on snow and ice), forest degradation (lowering sequestration potential), indoor air pollution, drudgery of woman and children. Only 29% of the rural population in the state are using LPG..In above context and on recommendationof the technical committee it is proposed to reduce fuel wood consumption and facilitate switching to LPG. The steps considered are –

i. Policy action for acceleratingand enhancing penetration of clean cooking practice in rural areas.

ii. Introduction of efficient cooking practice through use of gas (LPG) based cooking and replacing fire wood usage.

iii. No cost LPG cylinder connection to rural households for cooking usage.

iv. Increase of subsidy amount for LPG cylinders to promote LPG usage for domestic cooking.

The high priority actions are -

1. Awareness creation and manpower development to enhance the energy efficiency measures

The Govt. of India (GoI) with BEE has started several promotional programmes and schemes for promote energy efficiency through awareness generation, training programmes on project implementation, pilot demonstration projects, infrastructure development for undertaking energy efficiency measures, etc. The BEE is conducting various training programmes, empaneling Energy Service Companies (ESCOs), Energy Audit firms and Energy Manager & Auditors and supporting in terms of technology development and creating manufacturing base but, still the country is lagging behind to provide technical support in terms of proper and adequate installation, maintenance, repair of energy efficient devices due to insufficient or technical competency and energy efficient devices at affordable price due to less market penetration. The state of Mizoram being located in north–east of India where almost no energy efficient device manufacturer has set up is facing serious problem in achieving the Govt. of India's objective. Therefore, Govt. of Mizoram has planned to take up following activities –

- **Supporting state level entrepreneurs to become ESCO.**

The commercial sector itself is consuming around 13.65%[18] of total energy consumption in the state. Introduction of energy intensive technologies in commercial buildings e.g. primarily air conditioning, more intensive indoor and outdoor lighting drives the rapid growth in the commercial sector. The addition of these energy intensive technologies in existing buildings undoubtedly contributes to greater productivity of the people working in those buildings but, as studies show, these energy intensive applications are not integrated optimally in buildings and are more often than not, operated inefficiently as well. Energy conservation in such buildings can be achieved through well- known interventions, which are cost effective as well. However, the implementation of these interventions is not achieved till date due to institutional,

[18]Source: Annual Report of Energy Conservation Measures in Mizoram for 2009-10 by State Designated Agency, Mizoram

procedural, process barriers, particularly, the inability of building managers to assess and guarantee the energy savings due to these interventions. To address this institutional barrier, following the NMEEE, the Govt. of Mizoram has planned to institutionalizing energy efficiency services and promoting energy efficiency delivery mechanisms, such as the development of a market for Energy Service Companies (ESCOs), which address the risks perceived by building owners.

The SDA of Mizoram will support the entrepreneurs to become ESCO in order to implement energy efficiency projects within the state at affordable price. This will also assist in awareness generation amongst the public.

- **Curriculum development for production, engineering, installation and maintenance activities of energy efficient devices with ITIs and other technical institutions in the state.**

The introduction of training course in all ITI's and other technical institutions will be beneficial for successful implementation and operation of the energy efficiency projects.

i. Development of course structure and study material

ii. Training of the teaching staffs to undertake these courses on installation, operation, maintenance and repair of energy efficient devices. The training programme to teachers will also include special training by national and international sectoral experts.

- **Awareness creation among the citizens on the need of energy efficiency measures, use of star rated devices in everyday life as also for wider dissemination of opportunities for diffusion of energy efficiency measures in infrastructure and other socio-economic sectors through all feasible routes, viz. awareness campaign and workshop, print and electronic media, State Nodal Agencies, Village Panchayats, CBOs, NGOs.**

The objective of awareness creation amongst the various energy consumer sectors, present and future end users about the benefit and necessity of using energy efficient technology and energy conservation requirement is a pathway of achieving the NMEEE target. Apart from this, awareness creation among the citizens in the state on energy efficiency applications - benefit of energy efficient – star rated devices, durability, and application of energy efficient devices in infrastructure projects is a key element for promotion. Complying with the NMEEE, action plan is to be done through following sub activities:

i. Identification of agencies for undertaking Training Need Analysis Study for the department, preparation of manual and carrying out pilot workshop on awareness generation.

ii. Undertake training programmes, awareness workshops.

iii. Advertisements in print and electronic media.

- **Support schools, education institutions in preparing and introducing, curriculum on energy efficiency measures and preparation of book.**

A paper or subject will be introduced in school level where overview, need of energy efficiency technology and energy conservation measures will be taught. The SDA will help in preparing the study material or book on energy efficiency applications.

2. Market Transformation of Energy Efficiency applications through policy measures -

The energy efficiency project implementation in the state level is still in very pilot scale. To promote and make the technology marketable and viable in the state, following actions to be undertaken –

- **Development of fiscal instrument to promote energy efficient systems**

An incentive programme may be worked out for promoting energy efficiency implementation through reducing the Govt. tax on energy efficient devices, providing energy efficient devices at low or no cost and/or rebate on energy conservation in commercial sector or small industries. Apart from these the state govt. may support the manufacturer/ distributor for establishing their set up to either manufacture / assemble or distribute energy efficient devices in terms of providing land at low or no cost, tax rebate for initial years, fast clearance or permission in setting up, providing network to scale up the business, etc.

- **Enactment of ECBC according to state profile for mandating building design in line with ECBC and to build green building.**

The Energy Conservation Act, 2001 empowers the Government to prescribe the ECBC (Energy Conservation Building Code) for efficient use of energy and its conservation in buildings or building complexes. The ECBC sets minimum energy performance standards for design and construction of non-residential buildings. The state govt. will re-draft the ECBC considering the state socio-economic profile and demographic condition. The revised ECBC code will be enacted in the state for all new and upcoming buildings. The following sub-activities will be undertaken –

i. Preparation of ECBC code according to state profile for mandating building design as per the code and to build green buildings.

ii. Declaration or enactment of new ECBC code for the state and awareness of public through notification or advertisements.

iii. Enforcement of incentives /rebate for establishing green buildings.

iv. Designing of simplified compliance procedures for the state and local bodies.

v. Commencement of check testing through independent agency and publication of results.

vi. Awareness campaign to educate builder, promoter, architects and regulators – The awareness creation amongst the builder, promoter, architects and encouragement of potential promoters' to implement the law can be taken through awareness campaigns and workshops. As a requirement of the awareness campaign the preparation of training material in the form of User Guide and distribution to builder, promoter, architects. The training programmes may be conducted for the regulators to implement the policy in the state and achieve the objective of NMEEE.

- **Create demand for energy efficiency activities through pilot scale retrofit projects in state government and public sector establishments.**

There is a clear and urgent need for promotion and wide spread adoption of energy efficient practices which would contribute in energy savings in end use like - lighting, cooling, ventilation, etc. The state govt. has undertaken energy saving potential study in few govt. buildings. Realizing the potential of energy efficiency improvement in the govt., public sector and commercial buildings, Govt. of Mizoram is planning to implement pilot scale retrofit projects through implementing energy conservation measures.

i. Develop guidelines for energy efficiency projects in the govt. and public sector establishments

ii. Identification of Agencies for taking up pilot activity.

iii. Undertaking sectoral and scoping study of the possibility of energy efficiency across above mentioned areas and barrier of taking up the energy efficiency initiatives.

3. Up-gradation of transmission and distribution network for minimization of energy losses

The Aggregated Technical and Commercial (AT&C) losses in Mizoram is very high in comparison with all India level with estimated 38.9%[19] of the total power available for Mizoram. Reduction of T&D losses is prime focus of the energy sector as reduction of energy losses is actually reduction of energy generation and address energy security. Use of energy efficient technology and total monitoring of power generation, transmission and distribution system will lead to energy conservation and thus directly contribute in green-house gas emission reduction. 1000 unit of energy saving through these processes will result in 0.90[20] tCO_2e of green-house gas emission reduction. Complying with the energy efficiency mission, the action plan is planned through following activities –

- **Assessment of T & D infrastructure and development of action plan for improvement of T & D network and setting target for AT&C loss reduction.**

The sub-activities which will be undertaken for assessing the scope of AT&C losses reduction are-

i. Undertake detailed reconnaissance study for assessment of present T&D infrastructure, AT&C loss measurement, identification of loss areas and suggest on improvement.

ii. Prepare an investment plan for improvement of T&D network in the state.

iii. Development of an operational plan for targeted reduction losses due to pilferage and outdated systems.

- **Up-gradation of HT & LT lines and replacement of Distribution Transformers with star rated transformers.**

i. Up-gradation of HT & LT lines to reduce losses.

ii. All old distribution transformers of capacity up to 200 kVA and

[19]Source: Annual Report of Energy Conservation Measures in Mizoram for 2009-10 by State Designated Agency, Mizoram

[20]Source: Central Electricity Authority: CO2 Baseline Database, Ver. -6.0

transformers of above 250 kVA will be replaced with star rated transformers.

- Reduction of AT & C losses by 100% consumer metering of the consumers with a connected load of 20 kW and above and introduction on-line remote monitoring.

  i. 100% consumer metering through SCADA system will be introduced for consumers with a connected load of 20 kW and above.

  ii. Introduction of metering arrangement for on-line remote monitoring right from grid sub-station to the consumer- end.

- **Introducing franchisee model in distribution system to reduce commercial losses & better management of the distribution system.**

The objective of introducing franchisee model is to deploy effective and efficient management system for the sector towards achieving higher billing and collection efficiency. In pursuance of the Provision 7 to Section 14 of the Indian Electricity Act -2003, incorporation of Revenue Based Distribution Franchisee will help in improving technical, operational and commercial efficiencies. The aim of this initiative is to design and implement an institutional arrangement for ensuring sustainability of electricity supply, qualitative transformation of the electricity distribution system and facilitation of superior social and economic outcomes by appointing franchisees in these areas.

i. Develop guidelines for franchisee model in power distribution system.

ii. Identification of Agencies for taking up franchisee.

iii. Allocate the distribution systems on franchisee mode to the identified agencies.

4. Penetration of energy efficient devices in domestic and public utility systems facilitated by financial, supply chain and market incentives

- **Introducing energy efficient lighting in domestic sector by supply and installation of CFLs lights and replacement of incandescent lamps in 1.5 Lakhs domestic consumer**

Majority of the power consumption in the state is consumed by domestic sector with 68% of total energy consumption and most of the energy consumed is for lighting requirement only. Under the Bachat Lamp Yojana (BLY) scheme of Govt. of India, good quality & long-life CFLs to be distributed to the grid-connected residential households of the state in exchange of an incandescent lamp (ICL) and INR 15. Therefore, the State Govt. has planned to implement energy efficiency measures in 1.5 Lakhs domestic households through replacement of incandescent lamps with CFLs which will reduce anticipated energy and peak demand of the state and also the demonstration initiative will encourage the consumers to incorporate the similar activities in future. Each household will get 4 nos. of CFLs on replacement of Incandescent lamps. The SDA, Mizoram will provide data base of households in the project area, assist in the selection of Project Sample Group (PSG), Project Sample Buffer Group (PSBG), and Project Cross-check Group (PCCG) as required in the scheme. The SDA will also provide information available with it for

smooth implementation of BLY in the state.

i. Identification of domestic households for pilot demonstration project

ii. Strengthening of technology supplier and manufacturer database at SDA level through identification and empanelment of technology partners in the state for recent and future projects.

iii. Implementation of pilot energy efficiency measures in 1.5 Lakhs domestic households through replacement of incandescent lamps with 4 Nos. of CFLs.

- **Deployment of energy efficient lighting in public systems by replacing existing 250W of HPSV lamps with 90W LED street lights in 5500 no. of electric poles.**

Around 5% of the energy consumed by the state is for public lighting though more than 137 villages are still un-electrified. According to the energy audit study carried out by National Productivity Council under the BEE program, it is estimated that around 8.4 million units can be saved in municipality activities only which is around 7560 tCO_2e of green- house gas emission reduction. Further, it is estimated that, around 3.21 MU of electricity is consumed annually for public lighting purpose and thus contributing in green- house gas emission by 2900 tCO_2e annually. The SDA, Mizoram has planned to reduce electricity consumption in public lighting by replacing Conventional 250 W High Pressure Sodium Vapour (HPSV) Street lights with90W LED based street lighting system in 5500 Nos. of electric poles. Therefore, annually 0.6 tCO_2e of green-house gas emission reduction in each pole will be achieved through this measure.

i. Undertaking IGEA

ii. Identification of implementing agency

iii. Process of receiving Financial assistance

iv. Taking up pilot implementation of 90W energy efficient LED in 5500 electric poles and replacement of existing 250W HPSV lamps.

5. Unlocking the energy efficiency activity in IGEA mode

The objective of the pilot initiative in demand side management for energy efficiency is to demonstrate the possibility and benefit of energy efficiency through implementation of energy efficiency measures. Such action will enhance the capacity of the state nodal agency to undertake similar initiative in the future and also promote taking up such activity amongst the sector. Compliance of the action plan is planned through following activities:

- **Implementation of energy efficiency measures through demonstration projects in 7 Nos. government buildings in Mizoram under IGEA mode where energy audit is already carried out by the Nodal Department.**

The state designated agency as a part of National Mission on Enhanced Energy Efficiency with support from BEE, has conducted energy audit to identify the energy efficiency improvement opportunities and thereby reducing energy consumption of major Government and public sector buildings in Mizoram. To reduce the energy consumption in such buildings, implementation of pilot

Energy Efficiency measures will be carried out in 7 buildings. Implementation of energy efficiency measures will result in energy consumption reduction and thereby green-house gas emission reduction. Considering the state is falling under North-East-West-North East (NEWNE) grid, the emission reduction of 0.9 tCO_2e will be achieved by saving 1 MWh of electricity.

The sub-activities that are planned to be undertaken to achieve the aforesaid objective is –

i. Identification of Energy Auditors for Investment Grade Energy Audits in the state

ii. DPR Preparation

iii. Sourcing of Fund

iv. Project Implementation

6. Institutional development and strengthening of Energy departments for Energy Efficiency promotion

The State of Mizoram is facing a formidable challenge in reform of power sector in terms of functional reorganization and institutional development of the departments to achieve efficient functioning and implementation of energy conservation, promotion of energy efficient systems, promotion of renewable energy applications, improved transmission and distribution network. The option includes –

- **Restructure and functional re-organization including enhancing the human resources of the energy departments including SDA to achieve efficient functioning, promotion and implement energy efficiency activity in the state.**

The state govt. with a target of achieving the objective of NMEEE in the state level and reduce the energy consumption found the necessity of having better support system in the state nodal agency with adequate human resource. The following sub-activities is planned to achieve the above objective –

i. Support power sector officials in preparation for national accreditation exams of BEE for energy efficiency activity.

ii. Up gradation of the Nodal officer of SDA to provide adequate human resources and authority for taking necessary actions towards energy efficiency measures.

iii. Recruitment and retaining of Energy Auditor and Energy Manager to support the Nodal Officer (for 3 years period) of SDA in achieving energy efficiency in the state.

iv. Upgrading the office infrastructure.

- **Empanelment of Energy Auditors, Energy Services Companies (ESCO) for taking up energy efficiency activities in the state.**

- **Training of the working group members and their representative from different departments and organizations on sector specific climate change issue and enhance the knowledge about the policy measures.**

i. Capacity building of the state designated agencies, existing staff of the energy departments to operationalize energy conservation act in the state and to enhance the knowledge about the policy and procedure to implement the policy.

ii. Training of the members of the working group or their representative of different departments and organizations on sector specific climate change issue. All of these have a direct and indirect bearing on the carbon emission of the sector.

7. Increase Hydro power generation by supporting private or public investors in setting up projects and undertake demonstration project

Around 56% of the state power generation is hydro based whereas remaining part is through fossil fuel based, a more carbon intensive power generation option. To the extent the use of stand-alone or grid interactive renewable based power generation option will be promoted and the extent of greenhouse gas emission both direct and fugitive emission due to use of fossil fuel for the purpose of power generation will reduce substantially.

- **Detailed reconnaissance study on water availability and hydrology data evaluation for identification of new hydro projects and demarcation of hydro power sites with specific capacity mapping.**

To identify the hydro power potential following actions will be undertaken -

i. Identification of agency for study

ii. Study on water availability for energy generation in the state for demarcation of hydro potential map.

iii. Risk Assessment of hydro power sources in anticipated climate change situations (variable rainfall, temperature, extreme events)

iv. Risk Assessment of hydro power infrastructure in climate change situations including extreme events.

v. Projection and risk assessment of energy demand.

vi. Conducting detailed feasibility study and identify viable hydro power project

vii. Promoting micro hydro projects

viii. Awareness programmes and capacity building of nodal agency on technological and regulatory aspect

ix. Creating conducive scenario for investment in pilot micro hydro projects

- **Promotion & facilitation of hydro power project implementation by providing adequate support from the state government in terms of clearance, land acquisition, power transmission network development.**

i. Declaration of tariff policy for hydro power

ii. Facilitating private and public sector participation in hydro power generation by selection of investors, land clearance and acquisition, other support activities through Single window clearance process

iii. Establishment of evacuation corridor and strengthening of transmission & distribution network for 6 no. of new hydro power projects in next 3 years

- **Declaration of water policy and mandate of siltation and pollution control in water bodies of hydro power projects.**

The state will prioritize the control of siltation and pollution in water bodies of existing and upcoming hydro projects by taking necessary steps and mandate it through water policy. In order to promote this activity the state government will undertake two demonstration projects in existing hydro projects.

- **Demonstration of hydro project in already identified project sites -**

Grid interactive micro hydro projects in the catchment area of perennial streams is prime focus of the state government since long as the investment is low and easy construction. Therefore, the state government has planned to undertake implementation of pilot projects through state and central government funding which are-

i. Setting up of 100 kW micro hydel project in Tuinching river which is located in north of Champai District.

ii. Setting up of 100 kW micro hydel project in Tuiriza River which is located in Aizwal district.

Chapter-12

Water

12.1. Introduction

Water is the prime natural resource and indispensible component for sustenance of all forms of life in the earth. Precipitation (including snowfall) is the source of all water on the earth. Part of this precipitation received in an area enhances the ground water storage, a part is lost as evapo-transpiration and the remaining portion appears as surface water. Not only the sustenance of life the availability of desired quality and quantity of water is the prime factor for economic prosperity, enhancing the quality of life and contributing to the food security of the nation. The assured supply of irrigation water (irrigation is the major consumer of water resources contributing to 83% of the total water consumption) is the primary function of food grain production and contributes towards national food security.

Although the total amount of fresh water available at present is enough to meet the current requirement of the state but the availability of desired quality and quantity of water may get strained in some places under projected impact of climate changes, increase in population, lifestyle, economic stability, land use pattern, agricultural production, urbanisation and migration of population followed by uneven distribution of precipitation over space and time.

Climate change is likely to impart formidable challenge to the water sector and the adversity may increase due to the location of the state in fragile ecosystem. The impact of climate change on water sector is likely to be due to erratic precipitation creating variability in river flow and increased frequency/ intensity of extremes events including flood. Increased frequency and severity of floods may affect groundwater quality in alluvial aquifers. Similarly increased rainfall intensity may lead to higher runoff and possibly reduced recharge.

The other consequence of climate change envisaged is increased evapo-transpiration influencing groundwater recharge and change in rainfall pattern resulting in lower agricultural productivity. Determining the degree of aforesaid impact will however require research at basin level but considering water as a finite source and current scenario of scarcity of water at national level (the per capita availability of water for the country as a whole has decreased from 5,177 cubic metres per year (m^3/year) in 1951 to 1,654 m^3/year in 2007 to as low as about 1,140 m^3/yr in 2050) it becomes essential to strategise for water conservation, adaptation of better

management practices with emphasise on optimal utilisation and artificial recharging.

National Water mission established under National Action plan on Climate Change is designed to ensure conservation of water, minimizing wastage and ensuring its more equitable distribution both across and within States through integrated water resources management. Promotion of integrated basin level water resources management (Basin Level management strategies are planned to be reconsidered to deal with variability in rainfall and water flows), increasing water use efficiency by 20%, focussing attention to vulnerable areas including over exploited areas and water conservation are few designed initiative under the programme. The mission will also seek to optimise the efficiency of existing irrigation system including rehabilitation of system that has been run down and also to expand irrigation, where feasible with special effort to increase storage capacity. Initiatives to reduce fresh water use in urban areas are also planned under the mission. Since water is a state subject the plans and programmes under the mission to be executed falls under the preview of the state government. It is therefore important that the key priorities proposed under National Water mission are consistent with the state plan.

The key priorities are therefore strategized considering the national plan and state policies towards meeting up the overall objective of the Climate Change Action Plan.

12.2. Key Facts about the Sector

Mizoram unlike others areas of the country has experienced the weather variability. Although air temperature is usually felt as the first variable in assessment of climate change, it is important to consider other factors like rainfall and transpiration.

Rainfall

The pattern of Rainfall has shown a gradual decrease during 1986-1990, followed by gradual increase from 1990-1995.When analysed on an average monthly basis the trend of rainfall shows a gradual increase from January till it reaches the peak maximum during July – August and then continues to decrease sharply by the end of the year.

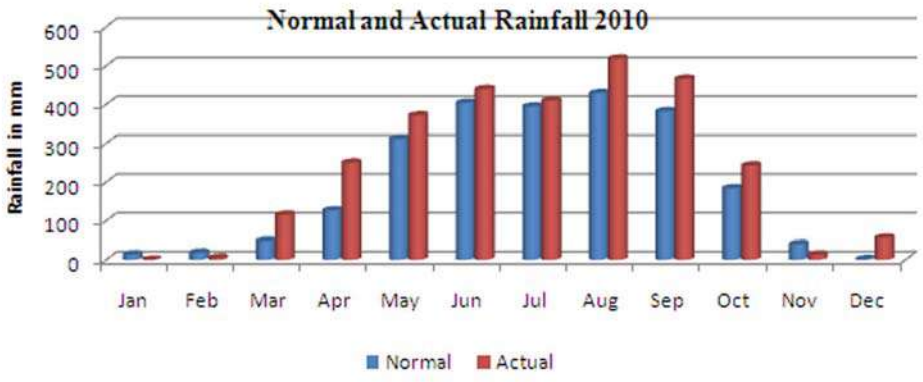


Figure 12.1: Rainfall Pattern

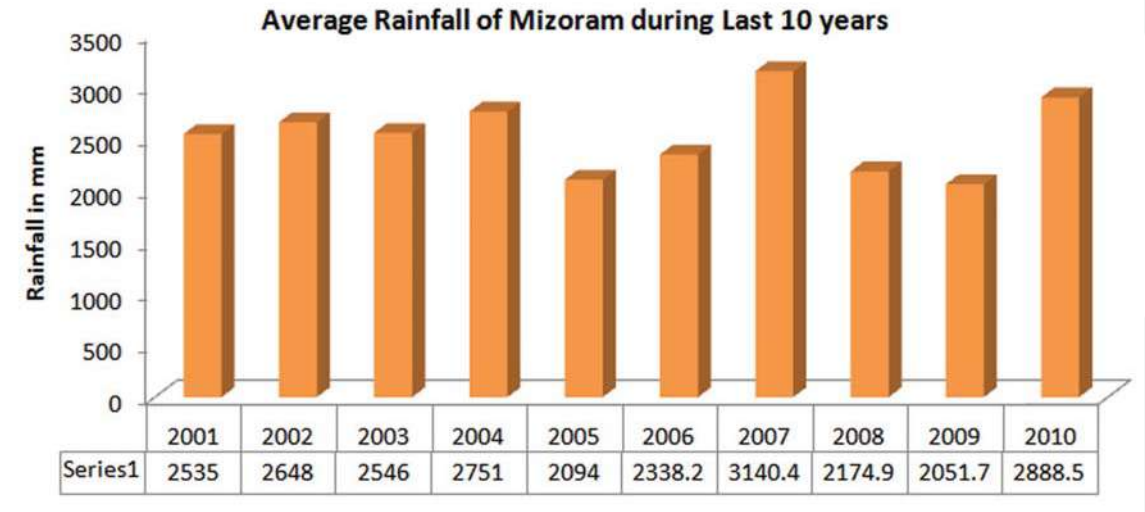


Figure 12.2: Average Rainfall during last 10 years

Ground Water

The ground water is the dynamic resource which is replenished each year. The Annual Replenishable Ground Water Resource is contributed by two major sources – rainfall and other sources that include canal seepage return flow from irrigation, seepage from water bodies and artificial recharge due to water conservation structures. Geologically, the state is underlain by sedimentary rocks of Tertiary age, which have been tightly folded in a series of anticlines and synclines. Ground water occurs under confined and unconfined conditions in sandstones, sandy shales, etc. In the northern and north western part of the State, the relief is much subdued. Mizoram is an abode of springs. These springs are widely utilized by people for domestic needs. Recent study suggests that there is good scope of tapping ground water in the riverbeds with sumps connected to infiltration galleries.

Table 12.1: Ground Water Potential

Annual Replenishable Ground water Resource	0.04 BCM
Net Annual Ground Water Availability	0.04 BCM
Annual Ground Water Draft	0.0004 BCM
Stage of Ground Water Development	0.90%
Artificial Recharge to Ground Water (AR)	Feasible AR structures: 500 check dams, 1000 weirs, 1000 gabion structures, 300 roof top harvesting, 200 development of springs.

State	Annual Replenishable Ground water Resource					Natural Discharge during non-monsoon season	Net Annual Ground Water Availability
	Monsoon Season		Non-monsoon		Total		
	Recharge from rainfall	Recharge from other source	Recharge from rainfall	Recharge from other sources			
Mizoram	0.03	0.00	0.02	0.00	0.04	0.004	0.04

State	Annual Ground Water Draft			Projected Demand for Domestic and Industrial	Ground Water Availability for future irrigation	Stage of Ground Water Development (%)
	Irrigation	Domestic and industrial uses	Total			
Mizoram	0.00	0.0004	0.0004	0.0008	0.04	0.90

Surface Water

Surface water resources in the state comprises of the 1395 km of rivers and cannels (The most important and useful rivers in the state are the Tlawng (also known as Dhaleswari or Katakhal), Tut (Gutur), Tuirial (Sonai) and Tuivawl which flow through the northern territory and eventually join river Barak in Cachar. The Koldoyne (Chhimtuipui) which originates in Myanmar, is an important river in the south Mizoram. It has four tributaries and the river is in patches.) The Western part is drained by Karnaphuli (Khawthlangtuipui) and its tributaries. and 0.02 lakhs hectare of tanks lakes and ponds. The state lack reservoir, flood plain lakes &Derelict water and Barkish water reservoir.

12.3. Key Issues

Change in Precipitation

Studies revealed an annual increase in the level of precipitation (barring some small pocket). An increase in precipitation will result in increase in water yield. Increase in precipitation may also lead to climate extremes like flood leading to loss of agricultural crops and even lives.

Change in Evapo-transpiration

Studies revealed a projected increase in the level of evapo-transpiration in 2030 scenario. Increment of evapo-transpiration might lower water yield in the region. Enhanced level of evapo-transpiration might increases soil moisture stress or enhances the chances of drought conditions.

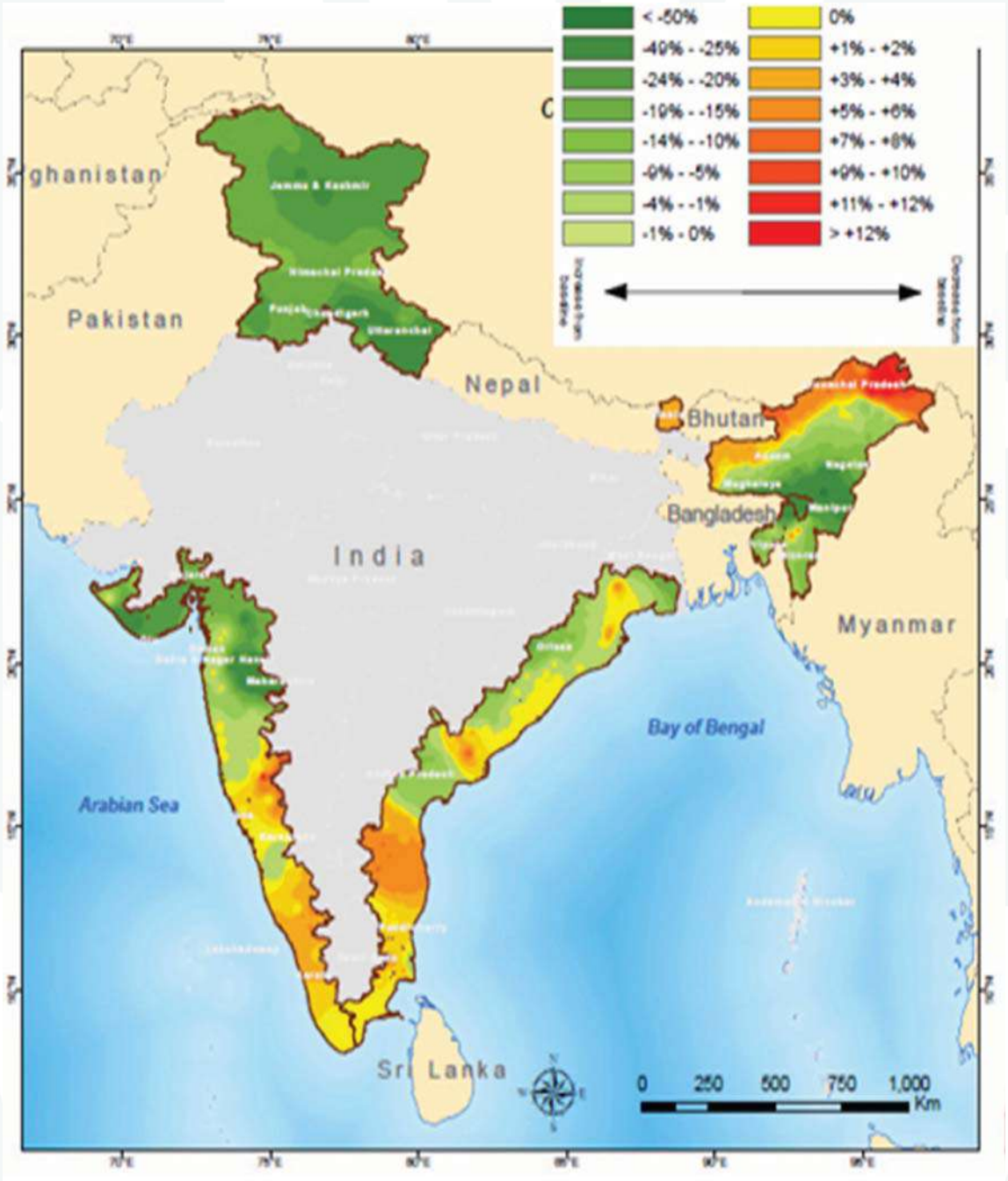


Figure 12.3: Percentage Change in Precipition

12.4. Adaptation Pathways in Water Sector

The impact of climate change on the freshwater system and their management (management includes conservation and optimum utilisation) are mainly due to the projected rise in temperature, increased level of precipitation and evapotranspiration, lower water yield, land use pattern. Adequate availability of water is the prerequisite for sustainable socio economic development. There are perceived conflicts towards availability, usage, distribution, allocation of water both sectorally and inter-sectorally. The anticipated impacts of climate change will exacerbate the challenges and further imperil poverty reduction efforts.

12.5. Key Priorities

- **Climate change impact assessment of present status of water resources like river, wetland, streams and lakes**

The climate change projects possible impacts like flood, higher evapo- transpiration, lower water yield which may lead to severe consequence of climate extreme event like flood or even scarcity of fresh water. It is therefore essential to carry out assessment of current availability of water from ground and surface water bodies and asses the possible impact of climate change on the availability of water to suffice the demand in the projected scenario. The study is hereby proposed to establish gauging station in all the major rivers and tributaries

Table 12.2

Issues	Impact	Pathways
Higher Precipitation and Evapo transpiration	Climate change extremes like flood, impact on agricultural production	Improvising Disaster management technique, capacity building of the communities
Higher variability in monsoon	Landslide, affecting systematic crop planning	Diversification of cultivars, improved soil-water management practices,
Exacerbated flash floods and landslides in upland areas	Variability in water flow regimes may also affect hydropower production, yield of major crops and transport	Identification and development/ promotion of water-resistant varieties and their
Reduction water quality due to heavy siltation downstream	Water-logging, uneven hydrology and diseases and pest incidence	Integrated water resource management; Payment for eco-system services or lost bio-diversity, requisite compensation mechanism and green cover in buffer areas of the mines and sustainable mine closure plan

for collection of hydrological data for water resource planning and management.

- **Finalisation of plan for conservation and preservation of water resources**

Considering water scarcity it is essential that appropriate water conservation technique be planned to provide adequate and equitable supply of water to the communities. The Plan proposes construction of check dams, counter trenches recharge pit and sub surface dykes for the purpose of conservation of water.

- **Formulation of State Water policy**

The state of Mizoram is not having water use policy. The water use policy is required to promote judicious and equitable management of water resource in the context of climate change. Water stress is already high, improved management is critical to ensure sustainable development. Water resources management affects almost all aspects of the economy, in particular health, food production and security; domestic water supply and sanitation; energy and industry; and environmental sustainability. If addressed inadequately, management of water resources will jeopardize progress on poverty reduction targets and sustainable development in all economic, social and environmental dimensions. Hence, such policy initiative will address and involve the practitioners and policymakers of water resources management, sectoral decision-makers as well as those who shape policy regarding climate change

- **Catchment and command area treatment through reverine afforestation**

Heavy precipitation may lead to flood situation with wash away of the top soil. It is therefore essential to undertake special programmes for forest plantation to increase the run off infiltration ratio in identified regions.

As a part of the above plan a collaboration should be sought with the forest department for afforestation at source and in the catchment area of the plant.

- **Capacity building of Water Resources department/ Mizoram PHED for integrated water resources management**

As outlined in the National water mission, promotion of integrated water resources management will get an additional focus as an effective response to climate change. Integrated water resource management leads to conservation of water, minimising waste and ensuring equitable distribution of water for various application.

Capacity building is proposed to make operational integrated water resources management practices across different river basins in the state.

- **Expansion of hydrometric network and establishment of micro weather station for regular monitoring**

Presently there is no such hydrometric station run by the state . However the hydrometric data pertaining to water resources becomes important as variations in availability are caused due to climate change. This will provide a better assessment of water availability and extreme events and information for effective water resource planning. As planned weather station will be installed at all divisions and subdivisions of the state to obtain meteorological

information. Under this initiative, selected locations will be identified and hydrometric stations installed to expand the network. This network will process raw data received from its own and other sources to provide for analysis by different users.

- **Community tank management for combating water borne diseases**

In water scarce areas, there is a potential for climate change to make water availability even more acute. There is high possibility of pathogen loading in the water available during the water scare scenario leading to emergence of water borne diseases. In order to reduce the impact of water borne diseases it is highly essential that fresh water source be maintained properly. There should be proper identification of areas for new creation as well as renovation and protection of water bodies. Ground water recharge options to take care of both domestic and agriculture options in the region.

- **Promoting zero energy water purification for domestic water supply**

Access to safe drinking water is now regarded as a universal right and millennium development goal. However few of the remote areas in the state face lack of supply of safe drinking water. Climate change might also bring about adverse impact on the availability of drinking water. In light of the above context it is proposed to set up zero energy water purification for domestic water supply to provide safe drinking water to the communities.

- **Renovation and development of traditional water harvesting system with scientific intervention in district level**

Groundwater is the major source of freshwater that caters to the demand of ever growing domestic, agricultural and industrial sectors of the country. Rapid

urbanization and land use pattern has resulted in reducing natural infiltration / recharge of aquifers. This has lead to various problems related to quantity and quality and issues like the decline in water levels, depletion of groundwater resource and quality deterioration. There is thus an imperative need for augmenting the valuable ground water resource. Artificial recharge and roof top rainwater harvesting is one such method that can revive this precious resource.

It is therefore proposed to undertake renovation and development of traditional water harvesting system to facilitate water harvesting.

- **Capacity building of communities on adaptation options required for integrated demand side as well as supply side strategies during climate stressed condition**

The speedy and uncontrolled usage of ground water has also created many problems. The intensive ground water development in many parts of the country has resulted in depletion of ground water levels and availability of the resource. The pristine ground water quality too became its victim. Though, for the State as a whole the availability of ground water resources appears quite comfortable but localised areas have shown the deleterious effects of excessive ground water development.

Capacity building is thus planned for communities on adaptation options required for integrated demand side as well as supply side strategies during climate stressed condition.

- **Impact assessment study of climate change on aquatic ecosystem**

The climate change might impact the aquatic ecosystem , it is therefore essential to determine the possible impact and degree of impact. The study is also planned to focus on estimating the adaptation path way for reducing the impact and restoration of the aquatic eco system.

Chapter - 13

Strategic Knowledge Mission

13.1. Introduction

Mission on Strategic Knowledge for climate Change is framed under the National Action Plan on Climate Change to bridge up, assimilate and upgrade information and knowledge available on climate variability and vulnerability with an objective to forecast as well as appraise for strategic development towards low carbon inclusive growth.

Reduction and mitigation of the impact of disasters depend on the coping capacity of the vulnerable population; poverty makes way for hazards becoming disasters. Climatic changes are expected to severely impact those who are mostly dependent on natural resources for their livelihoods. Climate variability can fundamentally drive processes of impoverishment through direct and indirect routes: (1) Direct: Severe or repeated climate shocks can push vulnerable households into a persistent poverty trap when their individual coping responses involve divestment of productive assets such as land or livestock, (2) Indirect: Climate uncertainty causes inability to anticipate when climatic extremes will occur, which acts as a disincentive to investment, innovation, and development interventions. The main aim of the State mission on strategic knowledge is not only limited to the reduction of green house gases (GHGs) but include building the coping capacity of the vulnerable population to include the challenge of innovation capacity building for sustainable development among the vulnerable population groups. While formulating the proposals for vulnerability assessment and measures for adaptation and mitigation, this approach demands the development of strategic knowledge not only for monitoring and assessment of vulnerability but also for assessment of alternatives becoming available in respect of technology systems and for promotion of decentralized capacity for management of development, adaptation and mitigation. Thus, the state mission on strategic knowledge for climate change would be required to plan for feeding into the peoples plan processes for the development, adaptation and mitigation measures to be formulated in an integrated way.

13.2. The mission objective

- To monitor climate variability and make climate change projections for the state.
- To build GHG inventory and identify the dominant GHG/CO_2 emitting sectors, industries, districts, municipalities in order to enable selection of mitigation opportunities.
- To model and plan for the climate sensitive sectors and regions, assess the impacts of climate change, analyze the vulnerability of regions/districts, sectors and population groups and evaluate the traditional adaptation and coping practices to climate variability and extremes.

- To integrate the processes of assessment of vulnerability, knowledge and data of natural resources, institutions and capacities with the bottom up approach to enable the planning of adaptation and mitigation projects for the benefit of climate sensitive sectors, regions and population groups.

- To enable government including its policymaking bodies in the policy-formulation function.

- To inform and assist the development agencies to evolve suitable management of adaptation and mitigation measures.

- To empower and upgrade the capabilities of people to take appropriate steps at their own level for the reduction of risk.

- To strengthen regional cooperation through the establishment of mechanisms for exchanging information with regions sharing the borders and ecology of the state.

As the actions required to be taken for climate change induced disaster risk reduction would need to be undertaken in collaboration with the people and their own state of knowledge and capabilities must also be upgraded. The state mission on strategic knowledge should not be interpreted just as limited to the generation of knowledge. It should also include the challenge of building of the coping capacity of the people of the state as a whole. Steps are required to be planned and taken for the development of their own anticipatory and response capacity in all parts of the state at all levels.

Further, it is also necessary to realize that the formal knowledge producing sector would benefit from the local knowledge available to the people in respect of the management of natural resources and the reduction of climate change induced disaster risks. The advantage that they possess on account of accumulated experience and wisdom must be utilized and made a part of the strategic knowledge that the state of Mizoram needs to create in order to deal with climate change. While undertaking actions for the building of coping capacity of the people the formal knowledge producing sector would also be gaining if the activities and linkages developed are also conscious of the use value of local knowledge. The formal knowledge producing sector will have the chance to pursue the collection of ground truth and practice triangulation. In the implementation of the state action plan the people as a whole would not be passive agents and be better involved in the actions under planning for adaptation and mitigation.

Constraints in respect of generation of strategic knowledge are:

- Insufficient observational and scientific information data base.

- Weak and fragmented knowledgebase for impact assessment and selection of technology choices.

- Knowledge gaps in respect of the impacts of climate change in different sectors of economy.

- Absence of a system of technology watch.

- Lack of institutional mechanisms for collating, synthesizing and delivering knowledge products for decision making.

- Lacking in organized multidisciplinary research capabilities

Approach and Strategies to address the gap areas

Some level of relevant competencies seem to already exist in the Government departments, State level public sector organizations, research institutions, university and

colleges, local self government institutions, mass organizations and trade unions. While drawing this mission document some of these competencies have been mobilized in a preliminary way. There are also some S&T based non-governmental organizations working on climate change which can be mobilized to document and assimilate the local knowledge available with the people. It is also recognized that planning would need to be consciously undertaken at all the levels for the upgrading of competencies in respect of all the identified tasks and challenges.

The proposed approach for addressing the knowledge gaps and mobilization of strategic knowledge in the areas related to climate change are as follows:

1) Strengthen and prioritize ongoing and planned programmes in respect of developing adaptation and mitigation activities.

2) Increase the spatial and temporal coverage and resolution of regional impact of climate change in the state.

3) Develop the state level capacity in distributed form but networked through the activities and programmes identified as a part of the mission.

4) Widen the scope and activities of knowledge generation for observation, monitoring, assessment and actions relating to the management of climate changed induced risk.

5) Use existing delivery structures for knowledge dissemination and application.

6) Create knowledge networks with selected core knowledge generating and applying institutions as nodes that are linked and involved in the development of activities through a wide range of knowledge partners.

7) Use extramural research system to undertake the widening of activities of knowledge generation and delivery.

8) Create new knowledge institutions by leveraging and supplementing existing strengths as far as possible when needed.

9) Develop and provide knowledge and information services and products for use at specific and different levels, for example, develop internal knowledge alert system, risk assessment reports, regular reports on base line information and indicators, policy briefs, discussion papers on scenarios and choices, etc.

For the realization of the above described approach to mobilization of strategic knowledge including the implementation of the mission it is proposed that the mission office should be built as an organization which is designed to promote sharing of data and knowledge, ensuring the flow of resources to all the linked organization for climate change risk management activities, pro-actively designing programmes and activities to partner with and assist the linked organizations in the management of resources and risk and enabling the institutions and agencies, irrespective of the level at which they work, to assimilate, develop, use and act on the new knowledge and information becoming available to the mission office through the knowledge networks.

A legislation to establish a new authority with the representatives of all the different stakeholders / agencies as members of the council governing its activities can be brought out. The S&T department should be vested with the necessary executive powers to operationalise and develop the state level action plan on climate change. The Mission Office of the state mission on strategic knowledge for climate change would be under this authority and be responsible for the design and implementation of this mission as well.

Activities and programmes

As state mission on strategic knowledge for climate change sees its objectives to be arising out of the aim of need to build the human and knowledge, organizational and institutional, evidence-based policy implementation, continuous learning and pro-active designing capacities for vulnerability assessment and risk reduction, it is proposed that in the state as a part of the time bound (short, medium and long term) programmes and continuing activities the followings are to be included in the state mission on strategic knowledge of climate change:

a) Activities aimed at mapping of the knowledge base and data resources relevant to climate change for the mobilization of state specific strategic knowledge are required to be implemented, and identification of the institutional support to be provided for the formation of state wide knowledge network and networking of the state level institutions.

b) Activities aimed at the identification of the knowledge gaps that need to be filled at the state level are required to be undertaken with regard to the areas of climate change impacts on important socio-economic sectors like agriculture, health, natural resources, eco-system, health, biodiversity, etc

c) Activities aimed at the generation and development of knowledge base needed for the development of foresight, assessment and decision making activity with a view to undertake the improvement in and elaboration of sustainable development pathways in the light of responsible climate change related actions

d) Interventions aimed at bringing about a significant improvement in the observations of key climate and biogeochemical variables and development of benchmarked baseline data which would be available to all departments and organizations;

e) studies are required to be formulated and implemented in a collaborative manner in the state level research institutions for the conduct of research on basic phenomena, measurements of key climate and biogeochemical variables including changes in eco-systems and land use change & land cover change, and the possible feedbacks on climate change, climate science with region specific modeling, effects of climate change on different types of ecosystems;

f) programmes are required to be initiated for the assessment of vulnerability of most sensitive populations / occupation groups and areas in the state of Mizoram to climate change;

g) state specific exercises are required to be formulated for an assessment of various technological scenarios and alternatives for meeting the objectives of sustainable development;

h) Studies aimed at design of the improvements and changes in the policies, strategies, plans and programmes of development of the state are required to be undertaken;

i) Activities and programmes are required to be initiated with the objective to actively gain from and contribute to the activities being planned under the national action plan on climate change (NAPCC) for sustaining the eastern and North-Eastern Himalayas eco-system and development of the north-eastern region as a whole;

j) Initiatives are required to be formulated for the strengthening of the state level activities for disaster risk reduction with a view to leverage the plans under development at the national

level for international cooperation with Bangladesh and Southeast Asia;

k) Activities are required to be identified and undertaken for ensuring that practical knowledge gaps in respect of risk management are also bridged in collaboration with the expertise and knowledge available with the vulnerable groups;

l) Activities and programmes are required to be implemented for enabling the people to plan and undertake decentralized actions for coping with the vulnerabilities of their own area of reach

m) Activities and programmes are required to be developed for the creation of institutional and knowledge capacity aimed at capacity building interventions at the various levels including establishment of a nodal institution

n) Programmes and activities are required to be undertaken for strengthening the knowledge infrastructure and research base capable of undertaking climate changed related research, observational, monitoring and assessment activities, creating dedicated centers for the generation and application of relevant robust knowledge, encouraging the participation of the individuals working in the state level organizations in the knowledge networks that are now under formation at the national level;

o) Schemes to be formulated and initiated for the building of the state- level human capacity through a climate change research and fellowship programme

Chapter - 14

Analysis and Synthesis

14.1. Introduction

This chapter outlines the findings from the analysis and synthesis of the previous chapters. The analysis in each sector provided a set of key priorities. Certain cross cutting areas were also identified. These were synthesized to arrive at findings, which describe what the CAP will achieve. The case is made for new institutional arrangements. This institutional framework has been described. The independent monitoring and evaluation required to ensure effective implementation is then described. Finally, the chapter concludes with the financial budget for the Climate Change Action Plan (CAP).

14.2. Findings

Changes in policies, organizations and practices:

Analyzing the key priorities revealed that climate change orientation needs to be provided at policy, organizational and practice levels in different sectors. Policies need to integrate climate change considerations. At the organizational level, awareness, skills and capacity has to be built.

Awareness generation and capacity building a focus:

Considering that climate change is a relatively new challenge, the focus of this CAP will be on generating awareness and building capacity. This will be done across all levels of the Government of Mizoram and external stakeholders involved in different sectors. This strong drive towards building capacity will result in empowering people and organizations to be able to address, manage and respond to climate change concerns.

Action implemented across the economy:

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

Climate-intrinsic sectors distinguished:

Broadly, different sectors can be classified as climate-intrinsic and climate add-on sectors. Climate-intrinsic are sectors that are so heavily associated with climate change that every action within these sectors have a strong bearing or relation to climate change. These include forest, water, agriculture and Energy. Climate add-on sectors are those sectors wherein the climate dimension is

additional, e.g. health and urban. While the key priorities across all these sectors will be met, Government of Mizoram will recognize that every activity particularly any new policies, organizations and initiatives - in the climate-intrinsic sectors will have a strong association with climate change.

Integrated perspective imperative:

To be effective in implementing initiatives pertaining to the key priorities, it is important to have an integrated outlook and not work in isolation. This will be required to ensure maximum return to the efforts being made.

Low Carbon economic development:

The various mitigation initiatives being planned across the Missions will ensure that Mizoram proceeds on a low carbon development path.

Biodiversity in addressing livelihoods:

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

Building climate resilience:

The different adaptation initiatives being planned will ensure better preparedness to climate-induced changes, including extreme events. For a climate sensitive state such as Mizoram, climate change adaptation is an integral part of sustainable development.

14.3. Financial budgets

Each working group put together a budget for the initiatives proposed to meet the key priorities in each sector. There are a number of ongoing initiatives, which are also relevant to climate change; these budgets have also been included in determining the overall budget for the CAP. The additional resources required in each sector has also been estimated and resources for these will be sourced from the GoI or external funding agencies. The following table provides the rough budget estimate for the first CAP.

Table 14.1: Budget for SAPCC

S. No.	Particulars	Approx. Amount (Rs. in Crore)
1	Sustainable Agriculture Mission	420.627
2	Sustainable Himalayan Mission	131.200
3	Green India Mission	283.600
4	Sustainable Habitat Mission	1314.600
5	Mission on Health	301.500
6	Mission on Solar & Renewable Energy	158.175
7	Mission on Energy Efficiency	581.815
8	Mission on Water	469.740
9	Strategic Knowledge Mission	14.000

Table 14.2: Mizoram Climate Change Action Plan – Monitoring & Evaluation Framework

Areas	Key Impacts to Monitor	Targets to Monitor	Key Programs to Evaluate	Frequency	Feedback Loop
Sustainable Himalayan Mission	Biodiversity Land Use Plan Water Quality	Biodiversity Status Land Degradation	Protection of Land from Soil Erosion Biodiversity Conservation Program Wetland Conservation Programs	3-5 Years	Adjust budgets & Modify programs
Sustainable Habitat Mission	Water Stress Waste Management GHG Emissions form the Sector	Water Collection Traffic Waste Management GHG gas reduction	Urban Planning Waste Management Green highways Construction	3-5	Adjust budgets & Modify programs
Sustainable Agriculture Mission	Changes in yields for key crops Frequency of crop failures Yields in aquaculture Fish Catch rates adjusted for effort Animal weight and Output	Increase in yield in watershed development program areas Adoptions of improved varieties Targets for Livestock improvement Targets for fish catch per year	Integrated watershed development program Perennials plantation Program Skilled animal breeding programs Early warning system for diseases	3 Years	Adjust budgets & Modify programs
Green India Mission	Changes in the Forest Cover Improvement in the Forest stocks GHG Removal from Forests	Reforestation rates Reduction of Forests ANR Coverage Areas Enrichment Plantation rates	Forest Enrichment Plantation Programs Fire Management Programs Capacity Building Programs	3-5 Years	If program do not meet targets modify allocation of budgets
Mission on Solar & Renewable Energy	Energy Security	Installation of Solar Plants Installation of Improved Chullas and Biogas	Biogas Promotion Program Wind and Solar Programs	3 Years	Adjust programs Budgets
Mission on Energy Efficiency	Emission of CO2 Emission Intensity	Reduce Transmission & Distribution Losses	Awareness creation & Capacity Building State level entrepreneurs to become ESCO	3 Years	Adjust programs Budgets

Mission on Water	Frequency of rainfall in different seasons	Accuracy of flood forecasting Water use efficiency rates No of harvesting strategies	Water supply connection Program Soil erosion Checkup program Water structure constructed	3 years	Modify program according to evaluation
Mission on Health	Incidence of Vector Borne diseases Incidence of Water Borne Diseases Frequency of Heat Waves	Vector Borne Disease impacts relative to baseline Water borne disease impacts relative to baseline	Vector borne diseases programs Water borne diseases program Heat wave impacts program	3 years	Modify program according to evaluation

Chapter - 15

Implementation Arrangement

The implementation of the climate change action plan has been accorded highest priority from the Prime Minister's office at the national level as well as Honourable Chief Minister's office at the state level. The state climate change action plan has laid out the institutional and policy structure, including specific policy proposals or planning processes, that a state can use to develop and implement a climate change adaptation strategy dovetailing with the state's own planning and budgeting strategy. Additional resource over and above the business as usual have to come from centre, developmental aid from bi-lateral and multi-lateral sources.

In initiating the preparation of the ClimateChange Action Plan, the Government ofMizoram had constituted a committee (name of the committee and GO when it was constituted) thatdelegated the responsibility of Climate ChangeAction Plan preparation to subcommitteesfrom line departments to bring greater focus on different sectoral issues and options. These deliberations revealed that implementation also requiresstrong inter-sectoral and inter-departmental coordination.

To meet this need, a **State Level Committee on Climate Change** will be put in place during the first year of implementation. This will have anadvisory, supervisory and coordinating roleon climate change issues. This Committeewill formulate a Nodal Agency which willbe a single-window contact for dealing withthe Government of India (GoI) and otherexternal funding agencies in issues pertainingto climate change. However, the Agency'srole will include and involve all sectors andall departments. It is envisaged that thisAgency will function in an independentand autonomous manner so that it canexecute its various roles, responsibilitiesand duties in a smooth, quick and effective manner. This will be headed by a senior officer having adequate exposure to technical, managerial and administrative issues relating to climate change. The Agency will be equipped withappropriate quality manpower, resourcesand infrastructure that are commensurate with the requirements and challengesfaced. The Agency's functioning style willbe collaborative and inclusive notonly within Departments of theGovernment but also with the differentexternal stakeholders.

The structure should not be heavy. It should be headed by senior officer and should have an officer having experience in adaptation (NRM issues) and an officer on mitigation (on energy issues) and one officer for M&E and one for finance and accounts (check with Dr Zara) and support staff.

The steps should be to develop annual action

plan based on the climate change action plan sectorally in consultation with respective departments. The primary focus shall be the key priorities identified during the climate change action plan in each sector.

15.1 Implementing the priority Action

For each priority this should be the process of implementation:

- Define program objective and scale (relative magnitude or comprehensiveness):
- Set a time frame for roll out, delivery, and reporting results
- Set a spatial boundary: any location or state-wide or area specific
- Define a baseline and data collection requirements
- Establish a budget in context of broader policy objectives
- Identify evaluation and reporting approaches
- Select who (department/agency) will run the program

15.2 Measuring the results of the actions taken

The tools and approaches available for evaluating the impacts of climate change priority actions range from basic screening methods to sophisticated dynamic simulation models. In selecting the most appropriate tools or method, states can consider many factors, including:

- Purpose of analysis: (who is the user), whether they are willing to fund or if funded want to see what are the outcomes)
- Impact(s) of interest
- Time constraints
- Cost
- Data requirements/availability
- Internal staff expertise

The agency/state can either conduct the evaluation itself or hire consultants. Regardless of who conducts the analysis, the agency should understand the methods and assumptions used in the analyses as they dramatically affect the results of the analyses.

15.3 Communicate the Results

Climate policies and programs require broad public and political support to be effective. Successful programs eventually require an outreach strategy to engage the target audience to take actions that will lead to the projected adapation and mitigation targets.

Any outreach campaign requires a well designed multi-step strategy, whose components typically include the following (although not always in this exact order):

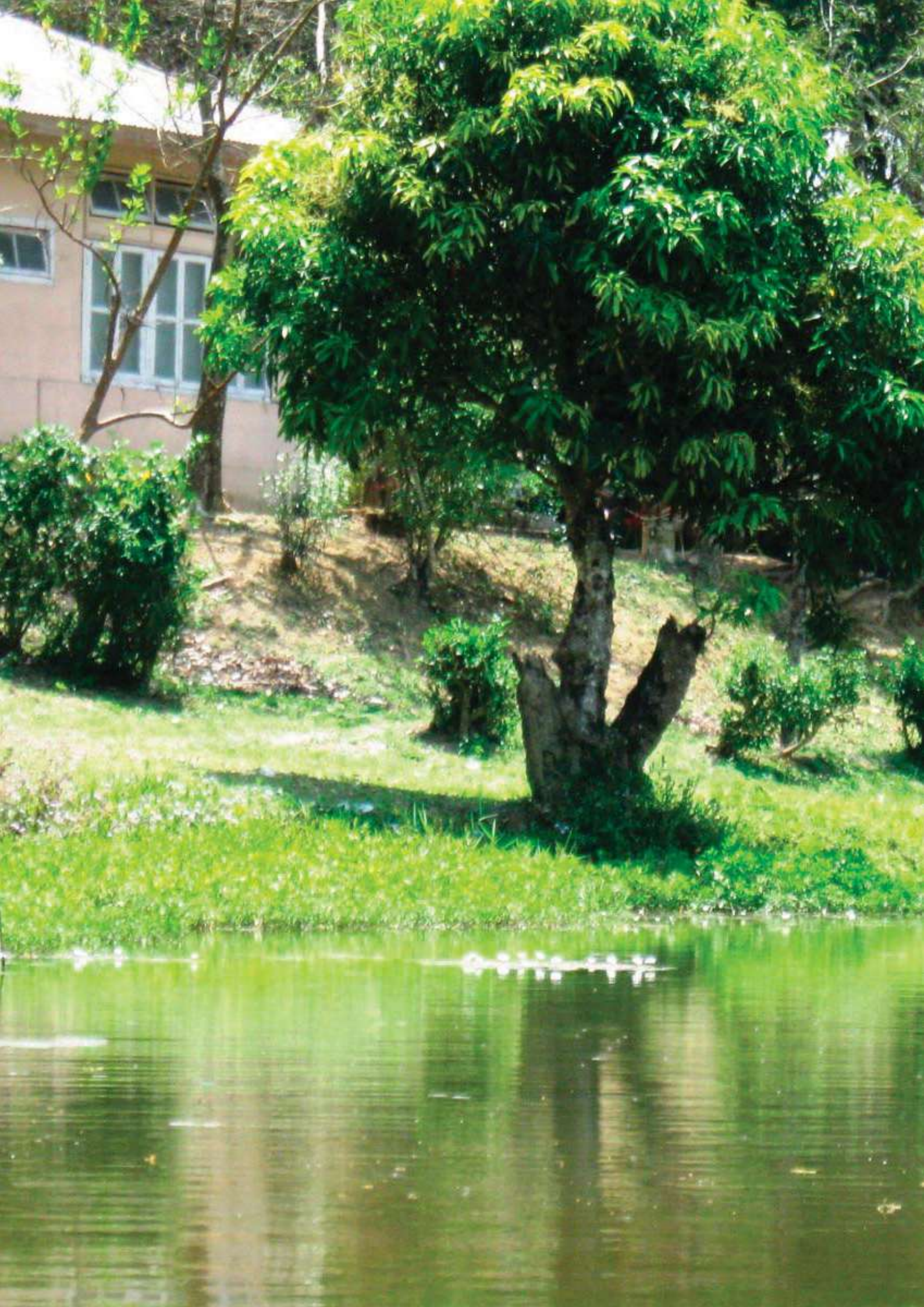
- Establish a Team – Involve the team in each step of the development process.
- Try to get people on your team from both environmental and education backgrounds (e.g., technical staff from your department and outreach staff from the public relations department). Involving external stakeholders on your team as well can add valuable perspectives.
- Identify Goals – Identify a cohesive set of realistic goals that serve the overall

objectives of your outreach campaign and function as achievable milestones. The goal of an outreach campaign typically falls within one of the following three categories:

- Raising awareness about the issue, idea, or program (e.g., increasing understanding of the benefits of the ENERGY STAR brand, publicizing a new green power purchase program).
- Educating your audience about the impacts of their decisions (e.g., providing a climate calculator to understand their emissions profiles).
- Working with a multi–stakeholder team can often allow for leveraging of resources.
- Develop Outreach Materials (e.g. newsletter, website, etc.) – Demonstrate to your intended audience how the content of the material meets their needs.
- Remember to ensure that the materials include messages that will resonate with your audience's current viewpoints, not necessarily what would resonate for you (you're the expert already).

15.4 Establish attention and review of the apex decision makers

The council should be convened twice in a year and to be headed by the chief minister and meetings to be held every quarter to be headed by the chief secretary to take stock of the progress of implementation.



Chapter - 16

Conclusions

The CAP is strategized and planned to lead Mizoram to move towards a carbon-conscious, climate resilient development path. The following are the key conclusions of this Climate Change Action Plan:

16.1. Significance of climate change

The nature, scale and magnitude of the climate change impacts are likely to be high on the State due to its positioning in a fragile ecosystem. In addition, Climate Change impacts on neighboring states and across neighboring countries can magnify the migrations to the Mizoram. Therefore, Mizoram will be a focus of both national and international attention in the context of climate change.

16.2. Addressing both adaptation and mitigation

The state Climate Change Action Plan will address both mitigation and adaptation issues in a holistic manner by implementing all the activities in the action plan. It has been recognized that adaptation is of much greater significance.

16.3. Information on climate change implications

In terms of assessing the climate change implications for the state, Government of Mizoram will adopt a dual approach, i.e. top-down approach through the downscaling of global models as well as a bottom-up approach through collecting empirical evidences of climate change at grassroots level.

16.4. Awareness and capacity-building

Awareness and capacity building to face this new challenge will be the primary focus; this will be undertaken across different sectors and the state economy as a whole.

16.5. Overall approach

A multidisciplinary, integrated and co-ordinated convergence approach is required and will be adopted in implementing this Climate Change Action Plan. Government of Mizoram will adopt a proactive, preventive and preparedness- oriented approach rather than a reactive approach.

Different sectors have different key priorities to be addressed through different initiatives over different timeframe. Each sector will implement its initiatives relevant to their key priorities within themselves and in close integration with different departments and stakeholders involved.

During this Climate Change Action Plan implementation, Government of Mizoram will demonstrate, promote and encourage different initiatives through policy changes and implementation actions as a response to climate change.

16.6. Involve stakeholders

Government of Mizoram will involve stakeholders, particularly community, in a more proactive way in the Climate Change Action Plan implementation. This involvement will relate to (i) promoting much greater climate change awareness within community, (ii) identifying problematic issues relevant to climate change, (iii) support in monitoring of climate-induced problems and (iv) ensuring greater accountability to the people on climate change issues. Stakeholder involvement will be an effective tool with stakeholders, who play an important part in bringing out the solutions. If stakeholder involvement as described here is not initiated, then stakeholders are bound to look at Government of Mizoram as an adversary and not as a partner.

16.7. Going beyond environmental & climate change professionals

From the range of issues / concerns, it is quite clear that even though climate change is an environmental challenge, the response requires non- environmental professionals. Resolving climate change issues cannot be done in isolation by the environmental or climate change fraternity alone. The issues/ problems are so fundamental and deep in the sectoral context that the respective sector professionals have to address these problems. Policy-makers, economists, planners, engineers, scientists, development program specialists and others have to be encouraged to contribute towards resolving climate change problems in a structured way.

16.8. Dynamic document

Approaches to responding climate change are fast changing based on the numerous researches being done across the world. Given this situation, this 5-year Climate Change Action Plan is seen as a dynamic document rather than a fixed in time or static one. The key priorities provide the guidance and direction that Government of Mizoram wishes to take. Keeping these key priorities, flexibility will have to be exercised in implementing the proposed initiatives so that these are in line with the latest and uptodate developments in this fast-changing discipline.

16.9. Integrate climate change in new initiatives

This Climate Change Action Plan was prepared taking into account the current development activities and the need to integrate climate change considerations in those proposed set of activity. Since new development activities would arise in each of these sector, utmost care would be taken to ensure that climate change considerations are integrated with these as well.

16.10. Monitoring of CAP

Climate change is relevant to most sectors and departments within the Government of Mizoram. As activities across all sectors and departments are identified and planned through state planning processes, the monitoring and evaluation of this CAP will be done in close co-ordination with the monitoring of the state planning activities.

Over a period of 1-2 years, the process of monitoring the CAP will be streamlined with the monitoring of activities under the state planning framework with half yearly monitoring of priority actions in respective sector. Those would be compiled and reported to the highest levels of Government.

16.11. Budget

Any estimation for implementation of Climate Change Action Plan will only be a rough estimate. However the budget for climate change response actions has been estimated to be Rs. 3675.257 Crore for a 5-year period between 2012 and 2017. This estimate includes both existing / already earmarked resources and additional resources required to shift Mizoram towards carbon-conscious, climate-resilient development path. Parts of the Action Plan can be implemented with the available resources of the departments and additional funds may have to be provided for certain activities. As the implementation proceeds, the picture will be clearer.

16.12. Recommendations for future CAPs

From the experience of preparing this Climate Change Action Plan, the following are the recommendations for preparing future Climate Change Action Plan in the state:

- Following the implementation of this first Climate Change Action Plan, awareness and knowledge on climate change issues / concerns would have developed across the state. Therefore, the overall capacity of both Government staff across all levels as well as those of the external stakeholders will be considerably higher. Once built, this capacity should be collectively and gainfully used in a consultative, participatory and inclusive manner in determining the focus areas of attention in the next version of the Climate Change Action Plan.

- With regard to the Sector working group as initiated for the first Climate Change Action Plan, a similar group should be created within the Government of Mizoram to prepare subsequent CAPs as well. The ownership and commitment of the Government of Mizoram in implementing this Climate Change Action Plan gets a substantive boost if there is an active involvement and engagement of the Government of Mizoram staff in preparing these plans. A similar multi-sector and integrated approach should therefore be adopted for future Climate Change Action Plan preparations.

- While all sectors were directly or indirectly covered in preparing the CAP Climate Change Action Plan, there were some departments of the Government of Mizoram that were not proactive, e.g. Education, Disaster Management departments. In the next version of the Climate Change Action Plan, those Departments that were not directly engaged should be encouraged for involvement so that new perspectives and approaches emerge.

MINUTES OF STAKEHOLDER CONSULTATION PROGRAMME ON MIZORAM CLIMATE CHANGE ACTION PLAN

Date : 20th October, 2011; Venue : Aijal Club, City Centre, Aizawl, Mizoram
Members Present : 43 Nos. (Attached as annexure)

The meeting started at 10:00 a.m. with a warm welcome address given by Dr. Vanlalzara, Principal Scientific Officer, Directorate of Science & Technology, Mizoram. He then presented a brief overview of the workshop through power point presentation whereby he mentioned that in line with the National Plan on Climate Change released on June 30, 2008, the Mizoram Council of Climate Change was constituted on 17th June 2010 under the Chairmanship of the Hon'ble Chief Minister and that the Executive Council was also created under the chairmanship of the Chief Secretary. He apprised the members that the initiative for preparation of State Action Plan on Climate Change in Mizoram is executed by the Department of Science & Technology with financial support from MoEF-GIZ partnership programme and that CTRAN Consulting, based in Bhubhaneshwar, Orissa is the knowledge partner.

The inaugural address was given by Shri Lalkhama, IAS (Rtd.) and Vice Chairman, State Planning Board. In his speech, he mentioned that the modern day scientists and intellectuals should be more concerned about the influence on climate by humans, and the manner how the land and its resources are used or misused. Under the New Land Use Policy adopted by the State Government, it is intended to keep a large percentage of the state land area under rain forests, and progressively reduce areas under jhum cultivation which is now around 2 lakhs acres annually. He anticipated that the consultation workshop will help in adopting suitable action plan to preserve the natural rhythm of life in the natural environment of cycles of oxygen and other chemical elements in this mysterious universe.

After this, Dr. Vanlalzara extended his appreciation and gratitude to the members attending the workshop who spare their valuable time to share their views and experiences for the success of the workshop.

The technical session of the workshop was divided into three main subjects viz.

Technical Session-1 : Agriculture & Allied, Forestry; Technical

Session-2 : Energy, Health;

Technical Session-3 : Strategic Knowledge Mission, Water, Urban.

The Coordinators for each Technical Sessions were:

Technical Session-1 : Mr. T.V. Fambawl, Secretary, Agriculture Department

Technical Session-2 : Er. Dunglena, Engineer-in-Chief (Rtd.)

Technical Session-3 : Er. Valbuanga, Project Director, SIPMIU

The views and feedback shared by the members in the various technical sessions/ subjects are as below:

1) Sector-Sustainable Agriculture :-

i) No data on allocation of human work force in different agriculture & allied activities based on their demand and availability of workforce and also willingness. (Mr. Arulrajan (IFS), E&F Department)

ii) Type and systems of agriculture practices and their compatibility with each other activities. (Mr. Arulrajan, IFS, E&F Department)

iii) Inclusion of more research works in development of traditional indigenous rice varieties e.g. Phulbuh which have been found to acclimatized climate change by retaining beneficial genes and enhancing the yield, if possible. Promotion of fodder for animals through agro-forestry models is also suggested. (Mr. Lalduhthlana, ACF, E&F Department)

iv) Rice genotype (local species) should be propagated and utilized for effective cultivation. (Mr. Vanramliana, Dept. of Zoology, PUC).

v) Concentrate on paddy and orange only (Mr. Vanramliana, Dept. of Zoology, PUC).

vi) Social history claims that after 20 years of NLUP and MIP, people find it difficult to abandon jhum. So, instead of the current 1-2 years cycle, 7-10 years cycle system may be introduced with modified traditional system. (Mr. Vanramliana, Dept. of Zoology, PUC).

vii) No more exotic species. (Mr. Vanramliana, Dept. of Zoology, PUC).

viii) Shifting cultivation/jhuming is the most primitive method of agriculture and therefore should be replaced by settled agriculture in any forms. While selecting the agriculture/utmost care should be taken: it should be in conformity with agro-climatic conditions, soil and geomorphic characteristics of the area/agricultural land. (Dr. P. Rinawma, Geography & natural Resources Management, Mizoram University) (Also Professor & Dean, School of earth Sciences and Natural resources Management).

ix) Shifting cultivation should not be stopped completely. It has an important place in the culture and way of life of the rural people. (Dr. John Zothanzama Sailo, Environmental Science Department, Mizoram University) (Also, Member, Mizoram Post Graduate Science Society)

x) Research on the alternative plans should be done before implementation in place of jhum cultivation. (Dr. John Zothanzama Sailo, Environmental Science Department, Mizoram University) (Also, Member, Mizoram Post Graduate Science Society)

xi) Quite sufficient, shifting cultivation system may not be abandoned, so instead if this system can be improved and scientific input may be incorporated to a cultivated area as a pilot project. (Dr. Lalnundanga, Dept. of Forestry, Mizoram University).

xii) The proposed strategies of agriculture and allied Departments for Climate Change mitigation and adaptation need more specific strategies. I feel that area-wise specific technologies/models needs to be identified and adopted for uphill and slopelands which consists of more than 80% of landscape in Mizoram. (Dr. F. Lalnunmawia, Dept. of Forestry, Mizoram University) (Also, Member, Mizoram Post Graduate Science Society)

xiii) If the low-lying areas called plains are well irrigated so as to be able to yield double cropping in a year, sustainable agriculture may be achieved, so as to lessen the slash and burn type of cultivation practice elsewhere in the state. (Er. H. Lalsawmliana, Science & Technology)

xiv) Emphasis may be put on organic farming. (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

xv) Control of shifting cultivation by converting the jhum land for permanent cultivation. Jhum land can be used for fodder cultivation, NWFP cultivation. (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

xvi) Rainfall predictive models should be developed based on the analysis of past climate data in order to adopt alternative agricultural practices for the sustainable development. (Dr. Ch. Udaya Bhaskara Rao, Geography and Resource Management, Mizoram University).

xvii) Agricultural practices should be concentrated along the fertile river valleys and valley plains as the terrain is purely sedimentary and can yield good quantities of water from uplands. (Dr. Ch. Udaya Bhaskara Rao, Geography and Resource Management, Mizoram University).

2) Sector-Sustainable Forestry :-

i) Inter-Departmental co-ordination is needed. (Mr. Arulrajan (IFS), E&F Department)

ii) Awareness on policy and programme of environmental concern should be given to all people and department because people (all) are part of ecosystem. (Mr. Arulrajan (IFS), E&F Department)

iii) De-reservation must be revised. If unavoidable EIA should be done and 1-2 riverine areas may be identified and serve as experiment for at least 10 years. (Mr. Vanramliana, Dept. of Zoology, PUC).

iv) Education and awareness to the public may be conducted with educational institutions. (Mr. Vanramliana, Dept. of Zoology, PUC).

v) The forest policy of Mizoram needs certain amendment in regard to riverine forest, village safety forest etc. The good land i.e. arable land may be given for agricultural activities and the unfavourable land may be devoted for forest cover and for development of recreational centres. (Dr. P. Rinawma, Geography

& natural Resources Management, Mizoram University) (Also Professor & Dean, School of earth Sciences and Natural resources Management).

vi) Mitigation measures should be more (Dr. John Zothanzama Sailo, Environmental Science Department, Mizoram University) (Also, Member, Mizoram Post Graduate Science Society)

vii) Agroforestry may be added. (Dr. Lalnundanga, Dept. of Forestry, Mizoram University).

viii) Incentives and support needs to be given for establishment and maintenance of social forestry. (Dr. F. Lalnunmawia, Dept. of Forestry, Mizoram University).

ix) Bamboo and tree based agro-forestry systems needs to be introduced in degraded lands. (Dr. F. Lalnunmawia, Dept. of Forestry, Mizoram University).

x) Environment & Forest Department may co-ordinate with agriculture and allied Departments for introducing agro-forestry system in slope-lands. (Dr. F. Lalnunmawia, Dept. of Forestry, Mizoram University) (Member, MIPOGRASS)

xi) Serious steps should be taken in preventing forest fires and allied destruction. No land in our state is totally or permanently a wasteland, they can be regenerated within 5 years or so. Use of LPG may also be in introduced to preserve the forest. (Er. H. Lalsawmliana, Science & Technology)

xii) The Government of Mizoram may come up with a kind of legislation to improve 'Greenery' by making it compulsory for every citizen of the state to 'plant & nurture' a tree - in line with Kenya Government. (Dr. U.K. Sahoo, Dept. of Forestry, Mizoram University).

xiii) Urban Forestry may be promoted & given priority. (Dr. U.K. Sahoo, Dept. of Forestry, Mizoram University).

xiv) Need for 'Trees outside forests' be kept in mind while making developmental projects; quantification of TOFs may be undertaken. (Dr. U.K. Sahoo, Dept. of Forestry, Mizoram University).

xv) Farmers practicing 'Homegardens' may be evaluated for 'carbon credits' and incentives may be arranged suitably to promote these indigenous home gardens/ agroforestry. (Dr. U.K. Sahoo, Dept. of Forestry, Mizoram University).

xvi) Livelihood improvement activity for forest dependent communities. (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

xvii) Riverine forests (reserve) to be protected as it is rich with bamboo. Bamboos are good plant for carbon sequestration. (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

xviii) Massive afforestation programmes should be implemented at higher elevations and steeply sloping areas as it checks/prevents soil erosion and also keeps the water-table at higher levels. (Dr. Ch. Udaya Bhaskara Rao, Geography and Resource Management, Mizoram University).

xix) Plantation programmes should be implemented within urbanized areas as they act as carbon sinks. (Dr. Ch. Udaya Bhaskara Rao, Geography and Resource Management, Mizoram University).

3) Sector-Energy:-

i) Non-conventional energy (biomass gasification) should be made available to all remote locations where power grids are not possible. (Mr. Arulrajan (IFS), E&F Department)

ii) Instead of efficiency, availability should be ensured. (Mr. Arulrajan (IFS), E&F Department)

iii) Self-reliance is better than feeding from outside. (Mr. Arulrajan (IFS), E&F Department)

iv) Mention is made that about 20 villages are not yet electrified. This has to be taken care of to ensure that all those villages are electrified. (Mr. Lalduhthlana, ACF, E&F Department)

v) The objective to create power plants in all major rivers should be abandoned. Large projects like Kolodyne may be completed first before small projects. (Mr. Vanramliana, Dept. of Zoology, PUC).

vi) If all major rivers are converted to HEP it will affect rainfall, agriculture etc. (Mr. Vanramliana, Dept. of Zoology, PUC).

vii) Distribution and installation of efficient CFL bulbs to BPL families. (Mr. Vanramliana, Dept. of Zoology, PUC).

viii) Hydel power plant may be given priority for power generation. In that, so many small/minor hydel project plant should be minimized, rather one river valley hydel project plant which can meet the energy requirement of the state may be completed so that environment system as a whole may not be disturb. (Dr. P. Rinawma, Geography & natural Resources Management, Mizoram University) (Also Professor & Dean, School of earth Sciences and Natural resources Management).

ix) Hydro power and solar energy generation is a must. Mini hydropower plants at many places will have an impact on local ecosystem and many life forms that adds to the rich biodiversity of the state. (Dr. John Zothanzama Sailo, Environmental Science Department, Mizoram University) (Also, Member, Mizoram Post Graduate Science Society)

x) More developmental approach needed. (Dr. Lalnundanga,, Dept. of Forestry, Mizoram University).

xi) Energy sector needs to be touched up. There is no write-up on how the proposal will be affecting the climate change. (Mrs. Lalhmingliani Hmar, EE, P&E Department).

xii) Major stress/thrust towards adopting renewable energy sources like solar energy/ wind energy etc. (Er. N.L. Jaisi, Assistant Engineer-Investigation, PHED)

xiii) There has to be a limitation in setting up/construction of hydro-electricity project in Mizoram. (Dr. F. Lalnunmawia, Dept. of Forestry, Mizoram University) (Also, Member Mizoram Post Graduate Science Society) (Member, MIPOGRASS)

xiv) Production and sell of power energy at the cost of forest biodiversity and the affected communities may not be recommended. (Dr. F. Lalnunmawia, Dept. of Forestry, Mizoram University) (Also, Member, Mizoram Post Graduate Science Society)

xv) Concerned departments should take utmost interest in producing related energy, whether it is electrical energy, heat energy, so and so forth. Public are still ignorant and lack awareness of our burning topic. They need to be made aware. (Er. H. Lalsawmliana, Science & Technology)

xvi) Southern and eastern rivers of the state to be used for harnessing hydro-potential energy for the entire state. (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

xvii) At village level (rural region) solar energy and biogas energy to be encouraged and implemented by the Government. (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

xviii) Energy and its management as curriculum to be studied at school and college level. (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

xix) Solar water heaters should be produced on subsidized rate in order to save energy. (Dr. Ch. Udaya Bhaskara Rao, Geography and Resource Management, Mizoram University).

xx) Awareness programmes should be conducted to save energy as energy saved is energy produced. (Dr. Ch. Udaya Bhaskara Rao, Geography and Resource Management, Mizoram University).

xxi) As Mizoram is rich in coal reserves to some extent minor thermal power generation stations can be established within the limits of low carbon emissions. (Dr. Ch. Udaya Bhaskara Rao, Geography and Resource Management, Mizoram University).

xxii) Hydel projects should be developed to meet our immediate needs. (Dr. Ch. Udaya Bhaskara Rao, Geography and Resource Management, Mizoram University).

4) Sector-Health:-

i) Climate change increases the risk of malaria and to suppress malaria we are relying on DDT. In developed countries, use of DDT has been banned or restricted due to its adverse impacts on environment. Can we incorporate in our plan to conduct research on impacts of DDT applications on natural environment. (Mr. Lalduhthlana, ACF, E&F Department).

ii) The whole process of malaria control measure must be revised. (Mr. Vanramliana, Dept. of Zoology, PUC).

iii) Rural health management system should be developed. (Mr. Vanramliana, Dept. of Zoology, PUC).

iv) Biotechnology Research Centre may be established. (Mr. Vanramliana, Dept. of Zoology, PUC).

v) Regarding health, it is to be noted that Global warming resulted into various diseases like skin cancer, skin diseases and even blindness. Climate change can cause many more and therefore we should take care of all these factors which can add carbon emissions. (Dr. P. Rinawma, Geography & natural Resources Management, Mizoram University) (Also Professor & Dean, School of earth Sciences and Natural resources Management).

vi) Health seems to be irrelevant to be included in the action plan for Climate Change. If at all it is included certain data(s) needs to be changed as pointed out at the discussions relating to malaria. (Mrs. Lalhmingliani Hmar, EE, P&E Department).

vii) Study and documentation of diseases caused by water and insect borne vestors at different regions of the state. (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

viii) Poverty, malnutrition due to poverty & extreme climate change. (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

ix) Rapid urbanization has great effect on health rather than climate change which is mostly due to pollution. (Dr. Ch. Udaya Bhaskara Rao, Geography and Resource Management, Mizoram University).

5) Sector - Sustainable Habitat :-

i) Recycling plant of paper and rubber/plastic should be proposed. (Mr. Vanramliana, Dept. of Zoology, PUC).

ii) Creation of eco-friendly roads (Plastic waste & tar). (Mr. Vanramliana, Dept. of Zoology, PUC).

iii) Promotion of solar water heating system and lighting of buildings should be done by having a separate ECBC which should match with the socio-economic status of the state. Inclusion in the building bye-law is not practical seeing the socio-economic status of the population. (Mrs. Lalhmingliani Hmar, EE, P&E Department).

iv) Planning infrastructure like road, drainage, energy, transportation, vehicular pollution, check population rise in all the urban areas, rural areas of the state including the city Aizawl. (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

6) Sector – Water :-

i) Water resources availability is very much related to how we use our land resources as well as forest resources. Water management should be incorporated with proper planning. (Dr. P. Rinawma, Geography & natural Resources Management, Mizoram University) (Also Professor & Dean, School of earth Sciences and Natural resources Management).

ii) As our water resources get more and more depleted then our infrastructure itself will not be able to provide adequate water to the public. Hence we have to go in for large water storage projects where conjunctive use of water is possible i.e. power generation, irrigation needs and water supply needs. (Er. N.L. Jaisi, Assistant Engineer-Investigation, PHED)

iii) Meteorological and hydrological data useful for management of water resources of the state. (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

iv) Study on the hydrological cycle of different rivers (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

v) Water harvesting system to be developed in urban and rural centres. (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

vi) Check dams to be constructed which can be used for domestic, cultivation, fishery and allied. (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

vii) Proper measures should be taken to explore ground water in addition to utilization of rainwater and river water. Rain water harvesting reservoirs should be made at eah locality. (Dr. Ch. Udaya Bhaskara Rao, Geography and Resource Management, Mizoram University).

7) Sector – Strategic Knowledge Mission :-

i) It is highly advisable that a definite goal in terms of CO2 emissions, methane emissions, be made in terms of figures/numbers. This would serve as a steering force for the smooth execution of the draft plans. (Dr. John Zothanzama Sailo, Environmental Science Department, Mizoram University) (Member, MIPOGRASS)

ii) Knowledge mission to be used for all people. (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

iii) Inventory of entire profile of GHG of the state to be developed. (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

iv) Technological design to meet the local need. (Dr. Ramachandra Laha, Dept. of Botany, Mizoram University)

After a long day of lively discussion coupled with several presentations from different concerned Departments, the meeting was ended with a brief wrap up from Dr. Vanlalzara, Principal Scientific Officer, Department of Science & Technology. He once again expressed his gratitude to all the members present for their kind presence and contribution, and at the same time invited them for further cooperation in future towards the success of Climate Change Action Plan in Mizoram.

(Dr. VANLALZARA)
Principal Scientific Officer,
Dept. Of Science & Technology

Annexure

LIST OF MEMBERS PRESENT ON MIZORAM CLIMATE CHANGE ACTION PLAN STAKEHOLDER CONSULTATION WORKSHOP AT AIJAL CLUB, CITY CENTRE, AIZAWL ON 20TH OCT., 2011

Sl.No.	NAME	DESIGNATION & DEPARTMENT
1.	Arulrajan	IFS, Dept. of Environment & Forest, Govt. of Mizoram
2.	Lalduhthlana	ACF (P), Dept. of Dept. of Environment & Forest, Govt. of Mizoram
3.	Dr. Ramachandra Laha	Head, Dept. of Botany Mizoram University
4.	Dr. Udaya Bhaskara Rao	Assistant Professor Dept. of Geography & Resource Management, MZU
5.	Dr. P. Rinawma	Dean, School of Earth Sciences & N.R.M., MZU
6.	Dr. U.K. Sahoo	Dept. of Forestry Mizoram University
7.	Vanramliana	Dept. of Zoology, Pachhunga University College
8.	Yograj Chhetri	Principal Adviser, Planning Department
9.	Dr. F. Lalnunmawia	Dept. of Forestry, Mizoram University Member, Mizo Post Graduate Science Society (MIPOGRASS)
10.	Lalhmingliani Hmar	EE, P&E Dept., Govt. of Mizoram
11.	N.L. Jaisi	AE (I) PHE., Govt. of Mizoram
12.	Dunglena	Consultant, Engineer-in-Chief (Rtd.)
13.	Lalnunsiama Colney	Exe. Committee Member Mizoram Science Society
14.	Dr. R.K. Lallianthanga	Project Director, Mizoram Remote Sensing Application Centre (MIRSAC)
15.	Edward Lalzuithanga	Scientist, MIRSAC
16.	Dr. Ramfangzauva	Joint Director Health & Family Welfare Dept. Mizoram
17.	K. Lalrammuana	Exe. Committee Member Mizoram Science Society
18.	Samuel Lalmalsawma	Exe. Committee Member Mizoram Science Society
19.	K. Guite	Chief Engineer Power Department
20.	David C. Zahmuaka	Director, ZEDA
21.	T. Thangzagin	S.E. P&E, Govt. of Mizoram
22.	Dr. Thangzadinga	VD (VE) AH&Vety Department
23.	Saihlira	Adviser, Planning Department
24.	Dr. H. Saithantluanga	Dy. Director (P) Agriculture Department
25.	Lalnunmawii	IPRO, Directorate of Information & Public Relation
26.	Dr. David Sailo	Dy. Director AH & Vety
27.	C. Lalduhawma	Gen. Secretary, Mizoram Science Society
28.	Valbuanga	Project Director SIPMIU
29.	Lalnundanga	Dept. of Forestry MZU
30.	Dr. A.C. Shukla	Associate Professor Horticulture & MAPs Mizoram University
31.	Awadhesh Kumar	Research Scholar Mizoram University

32.	Dr. John Zothanzama Sailo	Asst. Professor, MZU & Member, Mizo Post Graduate Science Society (MIPOGRASS)
33.	T.V. Fambawl	Secretary, Agriculture, Govt. of Mizoram
34.	Vanlalremruati	Scientist, MIRSAC
35.	Rosy Lalremruati	Scientist, MIRSAC
36.	C. Lalzawngliana	Asst. Scientist, MIRSAC
37.	F. Lalramchuana	Scientific Officer MIRSAC
38.	H. Lalsawmliana	Scientific Officer, Dept. of Science & Technology
39.	Lalnuntluangi	Senior H.O.Dept. of Science & Technology
40.	Lalmuanpuii Sailo	Senior H.O. Dept. of Science & Technology
41.	L.H. Lalnunpuia	Scientist MIRSAC
42.	F. Lalthenlova	Dept. of Science & Technology
43.	Lalrothanga	Director, CCDU PHED

Annexure - 1

Key Priorities

Agriculture

Sl. No.	Key Priorities	Depart-ments/ Organi-sation	Budget (Rs. Crore)			Source of funding
			State Source	Other Source	Total	
1	Development of Land (Levelling, bundling, etc) for Wetland Rice Cultivation (WRC) on available lands having 0-10% slope and Improvement of Existing Wetland Rice Cultivation (WRC)	Dept. Of Agriculture		42.0	42.0	Govt. Of India, External funding Agencies
2	Developing data base on genotypes of local crop varieties (mainly rice varieties) and identification of suitable varieties for different agro-climatic zones.	Dept. Of Agriculture		0.25	0.25	Govt. Of India, Govt. Of Mizoram External funding Agencies
3	Impact assessment of paddy cultivation through agricultural inputs such as crop varieties, kharif crops and promotion of rain water harvesting and construction of eco-friendly mini check dams for irrigation.	Dept. Of Agriculture		7.5	7.5	Govt. Of India, Govt. Of Mizoram, External funding Agencies
4	Assessment study and demonstration of Systematic Rice Intensification (SRI) cultivation and Capacity building to train farmers in latest rice cropping techniques specially evolved to counter adverse effects of climate change	Dept. Of Agriculture		0.5	0.5	Govt. Of India, Govt. Of Mizoram External funding Agencies
5	Optimization of jhum cultivation through conservation of arable land, water utilization management, parallel cultivation of alternative crops and Alternative jhum Control to Livelihood	Dept. Of Agriculture, Dept. Of Animal Husbandry		4.93	4.93	Govt. Of India, External funding Agencies

6	Construction of Hill Slope terraces for conservation of moisture and cultivation of food grain, vegetable, pulses and oilseed crops	Dept. Of Horticulture, Dept. Of Agriculture		31.75	31.75	Govt. Of India, Govt. Of Mizoram External funding Agencies
7.	Increasing the area under perennial fruit plantation crops and low value high volume crops to help cope with uncertain weather patterns.	Dept. Of Horticulture, Dept. Of Agriculture		72.40	72.40	Govt. Of India, Govt. Of Mizoram External funding Agencies
8.	Management of climate change impact on horticulture and Climate risk management studies	Dept. Of Horticulture		148.40	148.40	Govt. Of India, Govt. Of Mizoram External funding Agencies
9.	Improving post harvest management such as cold chain for perishable crops and winter cultivation practices	Dept. Of Horticulture, Dept. Of Agriculture		85.92	85.92	Govt. Of India, Govt. Mizoram External funding Agencies
10.	Promotion of organic farming through usage of compost and vermicompost	Dept. Of Horticulture, Dept. Of Agriculture		3.0	3.0	Govt. Of India, Govt. Of Mizoram External funding Agencies
11.	Adoption of Integrated Pest Management for improved crop yield, Preparedness to tackle emerging scenarios of pests and capacity building for stakeholders	Dept. Of Horticulture, Dept. Of Agriculture		6.925	6.925	Govt. Of India, Govt. Of Mizoram, external funding agencies
12.	Research study on livestock disease and establishment of early warning system and Capacity building to Stakeholders	Dept. Of Animal Husbandry		7.597	7.597	Govt. Of India, Govt. Of Mizoram External funding Agencies
13.	Study of impact of Climate Change on the indigenous fauna of aquatic ecosystem and open waters	Dept. Of Fisheries		0.05	0.05	Govt. Of India, Govt. Of Mizoram External funding Agencies
14.	Water storage and providing proper diversion channels to the existing ponds for drainage of catchment runoff during sudden heavy rains	Dept. Of Fisheries	1.5	3.75	5.25	Govt. Of India, Govt. Of Mizoram External funding Agencies

15.	Providing extensive support and services to fishermen through establishment of district level training centres	Dept. Of Fisheries	0.06	0.45	0.51	Govt. Of India, Govt. Of Mizoram External funding Agencies
16.	Water bodies conservation for fishery sector and establishment of fishery units in reservoirs and riverine area	Dept. Of Fisheries	1.65	0.875	2.525	Govt. Of India, Govt. Of Mizoram External funding Agencies
17.	Green the Devastated Barren Wasteland for Fodder Cultivation (7000 Hectares)	Dept. Of Agriculture			1.12	Govt. Of India, Govt. Of Mizoram, External funding Agencies
Total			**3.21**	**416.297**	**420.627**	

Himalayan Mission

Sl. No.	Key Priorities	Departments/ Organisation	Other Source (Rs. Crore)	Total (Rs. Crore)	Source of funding
1	Assessment of climate vulnerability and climate change impacts on state biodiversity and forest resources	Department of Forest	2.1	2.1	Govt. Of India, Govt. Of Mizoram, External Agencies
2	Undertaking study on valuation of forest resources (Non traded) and climate change impacts on the vulnerable ecosystems	Department of Forest	0.8	0.8	Govt. Of India, External Agencies
3	Ecotourism promotion for biodiversity protection and sustainable livelihood	Department of Forest, Dept. Of Tourism	10	10	Govt. Of India, Govt. Of Mizoram
4	Work to establish new systems to support for public awareness building through Establishment of Envis Centre	Department of Forest, SPCB	1	1	Govt. Of India, Govt. Of Mizoram
5	Restructuring land use policy for jhum cultivation and habitation on notified forest lands	Department of Forest, Dept. Of agriculture	0.5	0.5	Govt. Of India, Govt. Of Mizoram
6	Policy formulation on transportation subsidy or development of low cost transportation for primary Forest products of the state	Department of Forest, Dept. Of Transport	0.5	0.5	Govt. Of India, Govt. Of Mizoram
7	Monitoring of carbon stock and biodiversity at regular intervals	Department of Forest	1.3	1.3	Govt. Of India, Govt. Of Mizoram
8	Protection of forests and forest land from soil erosion in 1,35, 000 Ha	Department of Forest and Deptt SMC	81	81	Govt. Of India, Govt. Of Mizoram
9	Conservation and Management of two major Wetlands	Department of Forest	2	2	Govt. Of India, Govt. Of Mizoram
10	Inventorying and Conservation of Medicinal Plants /Orchid	Department of Forest	10	10	Govt. Of India, Govt. Of Mizoram
11	Research on Wildlife Populations and Carridors - Mountain Goats, Burmese green Peacock, Malayan Bear	Department of Forest	2	2	Govt. Of India, Govt. Of Mizoram
12	Biodiversity Assessment	Department of Forest	5	5	Govt. Of India, Govt. Of Mizoram
13	Creation of Biodiversity Park	Department of Forest	5	5	Govt. Of India, Govt. Of Mizoram
14	Documentation and enrichment of Biodiversity database through Peoples Biodiversity Register (PBR) at the JFMC Level	Department of Forest	10	10	Govt. Of India, Govt. Of Mizoram
Total				**131.2**	

Green India Mission

Sl. No.	Key Priorities	Depart-ments/ Organi-sation	Budget (Rs. Crore)			Source of funding
			State Source	Other Source	Total	
1	Improvement of forest quality and density in degraded lands and abandoned jhum lands	Department of Forest, Dept. Of agriculture		200	200	Govt. Of India, External Agencies
2	Improvement the productivity of Bamboo and promotion of local value addition through establishment of market linkages	Department of Forest		2.5	2.5	Govt. Of India, Govt. Of Mizoram
3	Undertaking studies on climate change impacts on NTFP productivity and sustainable harvesting practices for adaptation of climate change	Department of Forest		8	8	Govt. Of India, Govt. Of Mizoram
4	Capacity building of communities/communityforest management institutions for climate change adaptation	Department of Forest		0.7	0.7	Govt. Of India, Govt. Of Mizoram
5	Prevention and control mechanism for forest invasive species and its utilization strategies	Department of Forest		0.65	0.65	Govt. Of India, Govt. Mizoram
6	Promotion of forest based industries	Department of Forest, Dept. Of Industries		0.75	0.75	Govt. Of India, Govt. Of Mizoram
7.	Formulation of conservation strategies for Orchids and establishment of market linkages for value addition	Department of Forest		2	2	Govt. Of India, Govt. Of Mizoram, external agencies
8.	Livelihood improvement Activities for forest dependent communities	Department of Forest		36	36	Govt. Of India
9.	Strengthening of Forest Department	Department of Forest		10	10	Govt. Of India
10.	GIS based Monitoring and Evaluation of the program	Department of Forest		2	2	Govt. Of India
11.	Strengthening of Local VSS	Department of Forest		10	10	Govt. Of India
12.	Publicity /media and Outreach	Department of Forest		2	2	Govt. Of India
13.	Establishment of Mission Directorate	Department of Forest		9	9	Govt. Of India
Total				**283.6**	**283.6**	

Sustainable Habitat

Sl. No.	Key Priorities	Depart-ments/ Organi-sation	Budget (Rs. Crore)			Source of funding
			State Source	Other Source	Total	
1	Capacity Building and research initiatives on Climate Change Impacts and Preparedness 1. Awareness generation and capacity building in climate change impacts and preparedness 2. Capacity building for departments on advance solid waste management 3. Capacity building on Water management and efficient distribution of supply and delivery 4. Capacity building on Urban Management	Dept. of Urban & PA, Power, Transport Dept., PHE		1.3	1.3	Govt. Of India, External Agencies
2	Improvement in water usage management for urban drainage to reduce climate change impacts 1. Liquid waste management through improved sewage design for addressing climate change impacts 2. Developing models of urban storm water flows and capacities of existing drainage system	PHE, Dept. of Urban & PA		600.0	600.0	Govt. Of India, Govt. Of Mizoram, External Agencies
3	Development of climate friendly Waste management systems and improvement of aesthetics 1. Developing a climate friendly waste management system 2. Landfill gas recovery from closure landfills 3. Reduction of vector borne diseases from unmanaged dumping grounds 4. Improvement of collection efficiency and resource recovery	Dept. of Urban & PA, Municipal council		701.0	701.0	Govt. Of India, Govt. Of Mizoram, External Agencies

4	Reduction of disaster risk through climate change adaptation 1. Formulation of building guidelines with provision of promoting traditional houses for different agro-climatic zone, flood plains and in consideration of the seismic vulnerability of the state 2. Developing climate-responsible master plans for selected city/towns (CDP) 3. Reformulation land tenure policy to enable sustainable urban development	Dept. of Urban & PA		5.8	5.8	Govt. Of India, Govt. Of Mizoram
5	Energy efficiency improvement and promotion of renewable energy usage in urban sector 1. Promotion of solar water heating and lighting in buildings through policy mechanisms	Dept. of Urban & PA		0.15	0.15	Govt. Of India, BEE/ MNRE, External Agencies
6	Improvement of vehicular pollution control mechanism for reduction of GHG emissions 1. Improve enforcement to control vehicular pollution	Transport Dept., Dept. of Urban & PA		6.0	6.0	Govt. Of India
7	Assessment and inventorisation of climate change impact on urban sector 1. Quantitative assessment of the impact of climate change	Dept. of Urban & PA		0.35	0.35	Govt. Of India
Total				1314.6	1314.6	

Health

Sl. No.	Key Priorities	Departments/ Organisation	Budget (Rs. Crore)	Source of funding
1	Identify extrinsic and intrinsic drivers of malaria and identifying immunity intervention measures towards control of incidence of malaria.	Health dept, Research institute	3.5	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
2	Assessment of impact of heat stress on human health and framing adaptation strategy, identification, documentation and awareness creation on temperature related morbidity	Health dept, Research institute	5	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
3	Evidence based assessment of biophysical determinants of malaria and development of framework for adaptation measures for malaria control.	Health dept, Research institute, Mizoram Remote sensing Application Centre	3	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
4	Carrying out of Adaptation study	Health dept, Research institute	10	Govt of Mizoram, Govt of India
5	Research initiatives to identify change in pattern of diseases by region due to climate change/ weather variation	Health dept, Research institute	7	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
6	Study and documentation of diseases caused by water (water borne) and development of institutional mechanism to reduce the incidence/outbreaks of such diseases along with awareness generation	Health dept	35	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
7.	Development of institutional framework and infrastructural facilities for early detection of vector borne diseases, including managing outbreaks.	Health dept	10	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
8.	Establishment of pathological laboratory with state of art technology for diseases identification	Health dept	15	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies

9.	Public health system infrastructure development for extreme climate risk management and managing outbreaks of major diseases	Health dept,	200	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
10.	Capacity building and training for health workers for sensitisation of climate variation and health impacts	Health dept, NGO	8	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
11.	Research study on malnutrition of vulnerable group due to food security caused mainly due to climatic variation	Health dept, Research institute	5	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
Total			**301.50**	

Solar Mission

Primary Dept: ZEDA & Power & Electricity Dept.

Line Dept.: Minor Irrigation Dept., JERC, Soil & Water Conservation Dept., Directorate of School Education, Urban Development Dept., PHE, PWD, Revenue Dept., Local Administrative Dept.

Sl. No.	Key Priorities	Budget (Rs. Crore)	Source of funding
1	**Up scaling Renewable Energy Application for meeting up decentralized distributed or Off-grid area energy demand**		
1.1	Maximizing use of stand-alone solar power packs of 250 Wp for decentralized power generation through pilot scale implementation of 100 systems under JNNSM scheme.	0.675	Govt. of India and Govt. of Mizoram, Users, Funding Agencies
1.2	Promotion and facilitate installation of stand-alone off-grid solar power plant with capacity range below 100 kW with targets of 0.80 MW by 2016-17 and 1.60 MW by 2021-22	64.000	Govt. of India, Govt. of Mizoram, REC, Users, Funding Agencies
1.3	Electrification of un-electrified villages and hamlets by non-conventional energy sources and undertake electrification of 10 villages through solar and other renewable energy systems to meet the power demand of the remote villages.	27.000	Govt. of India, Govt. of Mizoram, REC, Users, Funding Agencies
2	**Unlocking grid interactive solar power generation and supplement the conventional grid power under National Solar Mission**		
2.1	Undertake a demonstration project of install 1 MW grid interactive solar power plant at Lengpui, Aizwal by 2013	25.000	Govt. of India and Govt. of Mizoram, Pvt. Or Public Investor, Power Utilities, Funding Agencies
2.2	Facilitate in installation of 2 MW grid connected solar plant of capacity 100 kW - 2 MW by 2022	40.000	Govt. of India and Govt. of Mizoram, Pvt. Or Public Investor, Power Utilities, Funding Agencies
3	**Reduce anticipated energy and peak demand through promotion and implementation of pilot SWH application by undertaking installation of 100 Nos. of 100 LPD systems and 100 Nos. of 200 LPD systems across various demand segments.**	**0.800**	Govt. of India, Govt. of Mizoram, Pvt. Or Public Investor, Users, UNDP/ GEF - GSWH, Funding Agencies

4	**Develop RE systems supply chain through empanelment of renewable energy technology manufacturers /distributors with ZEDA and support in development of their set-up in the state.**	**0.00**	Govt. of India, Govt. of Mizoram, Solar and other Renewable Energy Technology Manufacturer's Association, Funding Agencies,
5	**Institutional development and strengthening of ZEDA for promotion of Renewable Energy applications**		
5.1	Restructure and functional re-organization including increase of human resource strength at ZEDA to achieve efficient functioning and increase implementation of renewable energy projects.	0.250	Govt. of Mizoram and Govt. of India
5.2	Training of the working group members and their representative from ZEDA and other concerned departments and organizations on sector specific climate change issue and enhance the knowledge about the policy measures.	0.100	Govt. of Mizoram, Govt. of India, Funding Agencies,
6	**Awareness creation and manpower development for enhancement of the renewable energy application**		
6.1	Supporting state level entrepreneurs to become RESCOs, Channel Partners under JNNSM scheme and renewable energy device manufacturers, distributors, installers, etc.	0.050	Govt. of Mizoram, Govt. of India, Funding Agencies,
6.2	Curriculum or technical course development with ITIs and other technical institutions in the state for production, engineering, installation and maintenance activities of renewable energy systems	0.050	Govt. of Mizoram, Govt. of India, Funding Agencies, Govt. or Private colleges and institutions
6.3	Awareness creation among the citizens on the need and benefit of new and renewable energy systems and also on wider dissemination of opportunities for diffusion of renewable energy in infrastructure and other socio-economic sectors through all feasible routes, viz. awareness campaign and workshop, print and electronic media, State Nodal Agencies, Village panchayats, CBOs, NGOs.	0.100	Govt. of Mizoram, Govt. of India, Funding Agencies, NGOs
6.4	Support schools, education institutions in preparing and introducing, curriculum on renewable energy applications and preparation of book.	0.050	Govt. of Mizoram, Govt. of India, Funding Agencies,
7	**Market Transformation of Renewable Energy applications through policy measures**		

7.1	Modification of existing power policy particularly power generation to investment friendly policy for promotion of solar thermal and other renewable energy application in PPP, IPP mode and other options. Inclusion of climate change and CDM aspects in the State Power Policy.	0.000	Govt. of Mizoram,
7.2	Development of fiscal instrument to promote renewable energy systems and preparation of operation plan for power trading.	0.000	Govt. of Mizoram,
7.3	Declaration of tariff policy for solar and other renewable power purchase and incorporation of zero transmission /wheeling charges for transmission of renewable power to the grid.	0.000	Govt. of Mizoram,
7.4	Modification of building bye- law according to state profile for mandating use of solar water heater and renewable energy systems for lighting in the common or open space of govt. and commercial establishments.	0.000	Govt. of Mizoram,
7.5	Create demand for renewable energy services through pilot scale demonstration projects in state government and public sector establishments	0.100	Govt. of Mizoram, Govt. of India and Funding agencies
Total		**158.175**	

Energy Efficiency

Primary Department: SDA and Power & Electricity Dept.

Line Department: Directorate of School Education, Urban Development Dept., PWD.

Sl. No.	Key Priorities	Budget (Rs. in Crore)	Source of funding
1	**Awareness creation and manpower development for enhance the energy efficiency measures**		
1.1	Supporting state level entrepreneurs to become ESCO.	0.050	Govt. of India and Govt. of Mizoram, Funding Agencies
1.2	Curriculum development for production, engineering, installation and maintenance activities of energy efficient devices with ITIs and other technical institutions in the state.	0.200	Govt. of India and Govt. of Mizoram, Pvt. Institutions, Funding Agencies
1.3	Awareness creation among the citizens on the need of energy efficiency measures, use of star rated devices in everyday life as also for wider dissemination of opportunities for diffusion of energy efficiency measures in infrastructure and other socio-economic sectors through all feasible routes, viz. awareness campaign and workshop, print and electronic media, State Nodal Agencies, Village panchayats, CBOs, NGOs.	0.250	Govt. of India, Govt. of Mizoram, Funding Agencies, NGOs
1.4	Support schools, education institutions in preparing and introducing, curriculum on energy efficiency measures and preparation of book.	0.100	Govt. of India, Govt. of Mizoram, Funding Agencies,
2	**Market Transformation of Energy Efficiency applications through policy measures**		
2.1	Development of fiscal instrument to promote energy efficient systems	0.000	Govt. of Mizoram, Funding Agencies
2.2	Enactment of ECBC code according to state profile for mandating building design in line with ECBC code and to build green building.	0.000	Govt. of Mizoram, Funding Agencies
2.3	Create demand for energy efficiency activities through pilot scale retrofit projects in state government and public sector establishments	0.100	Govt. of Mizoram and Govt. of India
3	**Up-gradation of transmission and distribution network for minimization of energy losses**		
3.1	Assessment of T&D infrastructure and development of action plan for improvement of T & D network and setting target for AT&C loss reduction.	0.500	Govt. of Mizoram, Govt. of India, Funding Agencies, Power Utilities,

3.2	Up-gradation of HT & LT lines and replacement of Distribution Transformers with star rated transformers.	45.000	Govt. of Mizoram and Govt. of India, Funding Agencies, Power Utilities
3.3	Reduction of AT & C losses by 100% consumer metering of the consumers with a connected load of 20 kW and above and introduction on-line remote monitoring	5.000	Govt. of Mizoram, Govt. of India, Funding Agencies, Power Utilities,
3.4	Introducing franchisee model in distribution system to reduce commercial losses & better management of the distribution system.	0.250	Govt. of Mizoram, Govt. of India, Funding Agencies, Power Utilities,
4	**Penetration of energy efficient devices in domestic and public utility systems facilitated by financial, supply chain and market incentives**		
4.1	Introducing energy efficient lighting in domestic sector by supply and installation of CFLs lights and replacement of incandescent lamps in 1.5 Lakhs domestic consumer.	10.800	Govt. of Mizoram, Govt. of India, Funding Agencies,
4.2	Deployment of energy efficient lighting in public systems by replacing existing 250 HPSV lamps with 90W LED street lights in 5500 no. of electric poles.	13.750	Govt. of Mizoram, Govt. of India, Funding Agencies,
5	**Unlocking the energy efficiency activity in IGEA mode**		
5.1	Implementation of energy efficiency measures through demonstration projects in 7 No. of government buildings in Mizoram under IGEA mode where energy audit is already carried out by the Nodal Department.	0.104	Govt. of Mizoram, Govt. of India, Funding Agencies, User Organizations
6	**Institutional development and strengthening of Energy departments for Energy Efficiency promotion**		
6.1	Restructure and functional re-organization including enhancing the human resources of the energy departments including SDA to achieve efficient functioning, promotion and implement energy efficiency activity in the state.	1.000	Govt. of India and Govt. of Mizoram, Funding Agencies
6.2	Empanelment of Energy Auditors, Energy Services Companies (ESCO) for taking up energy efficiency activities in the state.	0.000	Govt. of Mizoram,
6.3	Training of the working group members and their representative from different departments and organizations on sector specific climate change issue and enhance the knowledge about the policy measures.	0.100	Govt. of India, Govt. of Mizoram, Funding Agencies
7	**Increase Hydro power generation by supporting private or public investors in setting up projects and undertake demonstration project**		

7.1	Detailed reconnaissance study on water availability and hydrology data evaluation for identification of new hydro projects and demarcation of hydro power sites with specific capacity mapping.	0.300	Govt. of India, Govt. of Mizoram, Funding Agencies
7.2	Promotion & facilitation of hydro power project implementation by providing adequate support from the state government in terms of clearance, land acquisition, power transmission network development.	500.050	Govt. of India, Govt. of Mizoram, Pvt. Or Public Investor, Funding Agencies
7.3	Declaration of water policy and mandate of siltation and pollution control in water bodies of hydro power projects. Two demonstration projects to be undertaken in existing hydro projects.	0.500	Govt. of Mizoram and Govt. of India
7.4	Demonstration hydro project in already identified project sites - Setting up of 100 kW micro hydel project in Tuiching river which is located in north of Champai District. Setting up of 100 kW micro hydel project in Tuiriza River which is located in Aizwal district.	3.761	Govt. of Mizoram, Govt. of India, Funding Agencies, Power Utilities,
	Total	581.815	

Water

Sl. No.	Key Priorities	Department	Budget (Rs. Crore)	Source of funding
1	Climate change impact assessment of present status of water resources like river, wetland, streams and lakes	Water Resources Dept/ Mizoram PHED	2.64	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
2	Finalisation of plan for conservation and preservation of water resources	Water Resources Dept/ Mizoram PHED	160	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
3	Formulation of State Water policy	Water Resources Dept/ Mizoram PHED	0.1	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
4	Catchment and command area treatment through reverine afforestation	Water Resources Dept/ Mizoram PHED/forest Department	22	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
5	Capacity building of Water Resources department/ Mizoram PHED for integrated water resources management	Water Resources Dept/ Mizoram PHED	10	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
6	Expansion of hydrometric network and establishment of micro weather station for regular monitoring	Water Resources Dept/ Mizoram PHED	3	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
7	Community tank management for combating water borne diseases	Water Resources Dept/ Mizoram PHED	100	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
8	Promoting zero energy water purification for domestic water supply	Water Resources Dept/ Mizoram PHED	80	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies

9	Renovation and development of traditional water harvesting system with scientific intervention in district level	Water Resources Dept/ Mizoram PHED	80	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
10	Capacity building of communities on adaptation options required for integrated demand side as well as supply side strategies during climate stressed condition	Water Resources Dept/ Mizoram PHED	10	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
11	Impact assessment study of climate change on aquatic ecosystem	Water Resources Dept/ Mizoram PHED	2	Govt of Mizoram, Govt of India, External source of funding from Multilateral agencies
Total			**469.74**	

Strategic Knowledge Mission

Primary Department: Department of Science & Technology

Sl. No.	Key Priorities	Budget (Rs. Crore)	Source of funding
1	Development of Knowledge Management on Climate Change and facilitating its operation for initial period	10.00	Government of India, Government of Mizoram and External Agencies
2	Capacity Building on Climate Change • Capacity building of personnel in the service department • Exposure visit for capacity building	3.00	Government of India, Government of Mizoram and External Agencies
3	To build GHG inventory and identify the dominant GHG/CO2 emitting sectors, industries, districts, municipalities in order to enable selection of mitigation opportunities.	1.00	Government of India, Government of Mizoram and External Agencies
Total		**14.00**	

Annexure - 2

Comprehensive list of Activities Considered

Agriculture

Sl. No.	Activities	Impor-tance	Const-raint	Priority	Type	Scale	Nature	Time frame
1	Development of Land (Levelling, bundling, etc) for Wetland Rice Cultivation (WRC) on available lands having 0-10% slope and Improvement of Existing Wetland Rice Cultivation (WRC)	H	None	H	S	AD	PA PS, DP -	LT
2	Developing data base on genotypes of local crop varieties (mainly rice varieties) and identification of suitable varieties for different agro-climatic zones.	H	Medium	H	S	AD	CB -	ST
3	Impact assessment of paddy cultivation through agricultural inputs such as crop varities, kharif crops and promotion of rain water harvesting and construction of eco-friendly mini check dams for irrigation.	H	None	H	S	AD	RS	ST
4	Assessment study and demonstration of Systematic Rice Intensification (SRI) cultivation and Capacity building to train farmers in latest rice cropping techniques specially evolved to counter adverse effects of climate change	H	None	H	S	MI	RS - CB -	ST
5	Optimization of jhum cultivation through conservation of arable land, water utilization management, parallel cultivation of alternative crops and Alternative jhum Control to Livelihood	H	None	H	S	MI	PA, PS -	MT

6	Construction of Hill Slope terraces for conservation of moisture and cultivation of foodgrain, vegetable, pulses and oilseed crops	H	None	H	S	AD	, PS	LT
7.	Increasing the area under perennial fruit plantation crops and low value high volume crops to help cope with uncertain weather patterns.	H	Medium	H	S	AD	PAPS -	ST
8.	Management of climate change impact on horticulture and Climate risk management studies	H	None	H	S	AD	RS -	ST
9.	Improving post harvest management such as cold chain for perishable crops and winter cultivation practices	H	None	H	S	AD	PS	ST
10.	Promotion of organic farming through usage of compost and vermicompost	H	Low	H	S	MI	PA	ST
11.	Adoption of Integrated Pest Management for improved crop yield, Preparedness to tackle emerging scenarios of pests and capacity building for stakeholders	H	Low	H	S	AD	PA	ST
12.	Research study on livestock disease and establishment of early warning system and Capacity building to Stakeholders	H	Low	H	S	AD	RS	ST
13.	Study of impact of Climate Change on the indigenous fauna of aquatic ecosystem and open waters	H	None	H	S	AD	RS	ST
14.	Water storage and providing proper diversion channels to the existing ponds for drainage of catchment runoff during sudden heavy rains	H	Low	H	S	AD	RS -, PA -, PS -	LT
15.	Providing extensive support and services to fishermen through establishment of district level training centres	H	None	H	S	AD	, CB	LT

16.	Water bodies conservation for fishery sector and establishment of fishery units in reservoirs and riverine area	H	None	H	S	AD	PA, PS	LT
17.	Green the Devastated Barren Wasteland for Fodder Cultivation (7000 Hectares)	H	Low	H	S	AD	PA -	ST

Priority	H – High, M – Medium, L – Low;
Type	MI - Mitigation, AD – Adaptation;
Scale	S – State-wide, A – Particular / Focused Area
Nature	RS - Research Study, PA - Policy Action, PS - Pre-investment Study, DP - Demonstration Project, IP - Investment Project, CB - Capacity Building, OM - Regular Operation & Maintenance;
Timeframe	ST – Short-term, MT - Medium Term, LT – Long term
Constraint	Nil, Low, Minimal, Large

Himalayan Mission

Sl. No.	Activities	Impor-tance	Const-raint	Priority	Type	Scale	Nature	Time frame
1	Inventorying and Conservation of Medicinal Plants /Orchid	H	None	H	AD	S	PA/IP	LT
2	Protection of forests and forest land from soil erosion in 1,35, 000 Ha	H	None	H	AD	S	PA	LT
3	Research on Wildlife Populations and Carridors - Mountain Goats, Burmese green Peacock, Malayan Bear	H	None	H	AD	S	RS/PA	LT
4	Conservation and Management of two major Wetlands	H	None	H	AD	S	RS/IP	LT
5	Biodiversity Assessment	H	None	H	AD	S	RS	LT
6	Assessment of climate vulnerability and climate change impacts on state biodiversity and forest resources	H	Nil	H	AD	S	RS	ST
7	Monitoring of carbon stock and biodiversity at regular intervals	H	M	H	AD	S	ROM	MT
8	Policy formulation on transportation subsidy or development of low cost transportation for primary Forest products of the state	H	None	H	AD	R	PA/IP	LT
9	Documentation of the People's Biodiversity Registers	H	None	H	AD	S	RS	ST
10	Undertaking study on valuation of forest resources (Non traded) and climate change impacts on the vulnerable ecosystems	H	None	H	AD	S	RS	ST
11	Ecotourism promotion for biodiversity protection and sustainable livelihood through Pre-investment feasibility study, DPR preparation, pilot implementation in 2 regions	H	None	H	AD	S	IP	LT

12	Work to establish new systems to support for public awareness building through Establishment of Envis Centre	L	High	M	AD	S	IP	ST
13	Documentation of Medicinal Plant resources in Tripura	H	None	H	AD	S	RS	ST
14	Restructuring land use policy for jhum cultivation and habitation on notified forest lands	H	None	H	AD	S	PA	ST
15	Consider unique mountain spaces as entities with "Incomparable Values", in developing strategies for their protection	L	None	M	M	S	PA	LT
16	Assessing threats to biodiversity and wildlife	L	None	M	AD	S	RS/PA	LT
17	Creation and management of community and conservation reserves for economic welfare of local communities and conservation of biodiversity.	M	None	M	AD	S	IP	LT
18	Capacity building of JFM committees and Panchayati Raj Institutions to adapt to climate change	M	None	M	AD	R	CB	ST
19	Assessment and quantification of the changes in the Himalayan eco system attributable to the climate change as a result of global emissions and human activities in the region and model for future projections	M	None	M	AD	S	RS	LT
20	Exploration of linking of traditional and formal knowledge systems through strategic mechanism of formalization for mutual benefit and value for the sustainability of the Himalayan ecosystem	M	None	M	AD	S	CB	LT

21	Adaptive species identification for effective plantation through establishment of Permanent Nursery	M	None	M	AD	S	RS	ST
22	Sequestering carbon through avenue plantations	L	None	M	M	S	IP	ST
23	Study on dependence of ecosystem people on forestry resources.	L	High	M	AD	S	RS	ST
24	Promoting community-based management through developing mechanisms for incentives for protection and enhancement of forested lands.	L	High	M	AD	S	PA/IP	ST
25	Building human and institutional capacities in the different existing / new Institutions in the Himalayan region.	L	High	L	AD	S	PA/IP	LT
26	Identification of most-desirable Adaptation Policies to Improve Regional Sustainability.	L	High	L	AD	S	RS/PA	LT
27	Creation of Biodiversity Park	H	High	H	AD	S	IP	LT
28	Documentation and enrichment of Biodiversity database through Peoples Biodiversity Register (PBR) at the JFMC Level	H	High	H	AD	S	CB	LT

Green India Mission

Primary Department: Department of Forest

Sl. No.	Action Point	Impor-tant	Const-raint	Priority	Type	Scale	Nature	Time Frame
1	Improvement of forest quality and density in degraded lands and abandoned jhum lands	H	None	H	S	MT	Impleme-ntation Program	LT
2	Improvement the productivity of Bamboo and promotion of local value addition through establishment of market linkages	H	None	H	S	AD	Capacity Building/ Impleme-ntation Program Impleme-ntation Program	LT
3	Undertaking studies on climate change impacts on NTFP productivity and sustainable harvesting practices for adaptation of climate change	H	None	H	S	AD/ MT	Research Study / Implem-entation Program	LT
4	Capacity building of communities/ community forest management institutions for climate change adaptation	H	None	H	S	AD/ MT	Capacity Building	LT
5	Prevention and control mechanism for forest invasive species and its utilization strategies	H	None	H	S	MT/ AD		
	Implementation Program	LT						
6	Formulation of conservation strategies for Orchids and establishment of market linkages for value addition	H	None	H	S	AD	Impleme-ntation Program	LT
7	Strengthening of Local VSS	H	None	H	S	AD	Research Study	LT

8	Publicity /media and Outreach	H	None	H	S	MT	Implem-entation Program	LT
9	Strengthening of Forest Department	H	None	M	S	AD	Capacity Building	LT
10	GIS based Monitoring and Evaluation of the program	H	None	H	S		Implem-entation Program	LT
11	Strengthening local level institutions about Forest Management Climate Change Adaptation	H	None	H	S	MT	Implem-entation Program	LT
12	Livelihood improvement Activities	H	None	H	S	AD	Capacity Building	LT
13	Establishment of Mission Directorate	H	None	H	S	-MT/ AD	Implem-entation Program	LT
14	Increasing plantation activities on outside forest land (Plantation Activities and Supporting natural Regeneration in 5000 Ha)	M	None	M	S	AD/ MT	Implem-entation Program	LT
15	Enhancing the Resilience and Ability of vulnerable Species / ecosystems to adapt to climate change	M	High	M	S	AD	Research Study	ST
16	Enabling adaptation of forest dependent local communities In the face of climatic variability	M	High	M	S	AD	Research Study	ST
17	Assessing Fire management Strategies	M	None	M	S	AD/ MT	Implem-entation Program	LT

Sustainable Habitat

Sl. No.	Activities	Impor-tance	Const-raint	Priority	Type	Scale	Nature	Time frame
1	Awareness generation and capacity building in climate change impacts and preparedness	H	Nil	H	AD	S	CB	LT
2	Capacity building for departments on advance solid waste management	H	Nil	H	AD	S	CB	LT
3	Capacity building on Water management and efficient distribution of supply and delivery	H	Nil	H	AD	S	CB	LT
4	Capacity building on Urban Management	H	Nil	H	AD	S	CB	LT
5	Liquid waste management through improved sewage design for addressing climate change impacts	H	Low	H	AD/ MI	S	PA, CB, OM	MT
6	Developing models of urban storm water flows and capacities of existing drainage system	H	Low	H	AD	S	RS	ST
7	Developing a climate friendly waste management system	H	Nil	H	AD/ MI	A	RS, PA	LT
8	Landfill gas recovery from closure landfills	H	Low	H	MI	A	RS, IP	LT
9	Reduction of vector borne diseases from unmanaged dumping grounds	H	Nil	H	AD	A	CB	MT
10	Improvement of collection efficiency and segregation at source	H	Nil	H	AD/ MI	A	IP, ROM	LT
11	Formulation of building guidelines with provision of promoting traditional houses for different agro-climatic zone, flood plains and in consideration of the seismic vulnerability of the state	H	Nil	H	AD	A	IP	LT
12	Developing climate-responsible master plans for selected city/towns (CDP)	H	Nil	H	AD	A	PA	MT

13	Reformulation land tenure policy to enable sustainable urban development	H	Nil	H	AD	S	PA	LT
14	Promotion of solar water heating and lighting in buildings through policy mechanisms	H	Low	H	MI	S	IP	MT
15	Improve enforcement to control vehicular pollution through certification of PUC	H	Low	H	MI	S	PA	LT
16	Quantitative assessment of the impact of climate change	H	Nil	H	AD	S	RS	LT
17	GHG Emissions foot printing for all urban bodies including upcoming satellite townships	M	Large	M	AD/ MI	A	RS, OM	MT
18	Improvement of Water Use Efficiency and conservation through leak reduction, reuse and recycle in Urban Areas	M	Large	M	AD	S	PS, OM	LT
19	Urban poor Mapping to Identify vulnerable urban population	M	Large	M	AD	S	RS	LT
20	Improvement of Pumping energy efficiency in Water supply system	M	Low	M	MI	A	IP	MT
21	Assessment of carbon emissions from the transport sector	M	Large	M	AD/ MI	S	RS	ST
22	Replacement of more polluting old vehicles with advance low emission vehicles	M	Large	M	MI	S	IP	LT
23	Piloting low carbon highways	M	Large	M	AD	S	IP	LT
24	Energy efficient Street Lighting	L	Low	L	MI	A	PS, PA	MT

Priority	H – High, M – Medium, L – Low;
Type	MI - Mitigation, AD – Adaptation;
Scale	S – State-wide, A – Particular / Focused Area
Nature	RS - Research Study, PA - Policy Action, PS - Pre-investment Study, DP - Demonstration Project, IP - Investment Project, CB - Capacity Building, OM - Regular Operation & Maintenance;
Timeframe	ST – Short-term, MT - Medium Term, LT – Long term
Constraint	Nil, Low, Minimal, Large

Health

Sl. No.	Activities	Impor-tance	Const-raint	Priority	Type	Scale	Nature	Time frame
1	Identify extrinsic and intrinsic drivers of malaria and identifying immunity intervention measures towards control of incidence of malaria.			H	AD	S	RS, PS	MT
2	Assessment of impact of heat stress on human health and framing adaptation strategy, identification, documentation and awareness creation on temperature related morbidity			H	AD	S	RS, PS, CB	MT
3	Evidence based assessment of biophysical determinants of malaria and development of framework for adaptation measures for malaria control.							
H	AD	S	RS,CB,IP	ST				
4	Carrying out of Adaptation study			H	AD	S	RS	MT
5	Research initiatives to identify change in pattern of diseases by region due to climate change/ weather variation			H	AD	S	RS	ST
6	Study and documentation of diseases caused by water (water borne) and development of institutional mechanism to reduce the incidence/ outbreaks of such diseases along with awareness generation			H	AD	S	RS,CB,IP	ST

7	Development of institutional framework and infrastructural facilities for early detection of vector borne diseases, including managing outbreaks.			H	AD	S	RS, IP	MT
8	Establishment of pathological laboratory with state of art technology for diseases identification			H	AD	S	DP, IP	ST
9	Public health system infrastructure development for extreme climate risk management and managing outbreaks of major diseases			H	AD	S	RS, PS	LT
10	Capacity building and training for health workers for sensitisation of climate variation and health impacts			H	AD	S	CB	ST
11	Research study on malnutrition of vulnerable group due to food security caused mainly due to climatic variation			H	AD	S	RS,IP	ST
12	Up gradation of state health policy through incorporation of health impact due to climate change			M	AD	S	PA	MT
13	Capacity building and training of the health sector practitioners for psychological or physical trauma due to the impact of extremes climate event			M	AD	S	RS,CB	ST
14	Establishment of mobile health centre to provide medical facilities in far off areas during extreme climatic events			M	AD	S	DP,IP	MT

Solar Mission

Sl. No.	Action Point	Impor-tant	Const-raint	Priority	Type	Scale	Nature	Time Frame
1	Up scaling Renewable Energy Application for meeting up decentralized distributed or Off-grid area energy demand							
1.1	Maximizing use of stand-alone solar power packs of 250 Wp for decentralized power generation through pilot scale implementation of 100 systems under JNNSM scheme.	H	Low	H	MI	S	PS, DP	MT
1.2	Promotion and facilitate installation of stand-alone off-grid solar power plant with capacity range below 100 kW with targets of 0.80 MW by 2016-17 and 1.60 MW by 2021-22	H	Low	H	MI	S	PS, IP	LT
1.3	Electrification of un-electrified villages and hamlets by non-conventional energy sources and undertake electrification of 10 villages through solar and other renewable energy systems to meet the power demand of the remote villages.	H	Low	H	MI	S	PS, IP	MT
2	Unlocking grid interactive solar power generation and supplement the conventional grid power under National Solar Mission							
2.1	Undertake a demonstration project of install 1 MW grid interactive solar power plant at Lengpui, Aizwal by 2013	H	Low	H	MI	A	PS, IP	ST

2.2	Facilitate in installation of 2 MW grid connected solar plant of capacity 100 kW - 2 MW by 2022	H	Low	H	MI	S	PS, IP	LT
3	Reduce anticipated energy and peak demand through promotion and implementation of pilot SWH application by undertaking installation of 100 Nos. of 100 LPD systems and 100 Nos. of 200 LPD systems across various demand segments.	H	Nil	H	MI	S	PS, IP	ST
4	Develop RE systems supply chain through empanelment of renewable energy technology manufacturers / distributors with ZEDA and support in development of their set-up in the state.	H	Nil	H	AD	S	RS, PA	MT
5	Institutional development and strengthening of ZEDA for promotion of Renewable Energy applications							
5.1	Restructure and functional re-organization including increase of human resource strength at ZEDA to achieve efficient functioning and increase implementation of renewable energy projects.	H	Low	H	AD	S	PA, IP	ST
5.2	Training of the working group members and their representative from ZEDA and other concerned departments and organizations on sector specific climate change issue and enhance the knowledge about the policy measures.	H	Nil	H	AD	S	CB	MT

6	Awareness creation and manpower development for enhancement of the renewable energy application							
6.1	Supporting state level entrepreneurs to become RESCOs, Channel Partners under JNNSM scheme and renewable energy device manufacturers, distributors, installers, etc.	H	Low	H	AD	S	PA, CB	MT
6.2	Curriculum or technical course development with ITIs and other technical institutions in the state for production, engineering, installation and maintenance activities of renewable energy systems	H	Nil	H	AD	S	CB,	MT
6.3	Awareness creation among the citizens on the need and benefit of new and renewable energy systems and also on wider dissemination of opportunities for diffusion of renewable energy in infrastructure and other socio-economic sectors through all feasible routes, viz. awareness campaign and workshop, print and electronic media, State Nodal Agencies, Village panchayats, CBOs, NGOs.	H	Low	H	AD	S	CB	MT
6.4	Support schools, education institutions in preparing and introducing, curriculum on renewable energy applications and preparation of book.	H	Nil	H	AD	S	CB	ST

7	Market Transformation of Renewable Energy applications through policy measures							
7.1	Modification of existing power policy particularly power generation to investment friendly policy for promotion of solar thermal and other renewable energy application in PPP, IPP mode and other options. Inclusion of climate change and CDM aspects in the State Power Policy.	H	Nil	H	AD	S	PA	ST
7.2	Development of fiscal instrument to promote renewable energy systems and preparation of operation plan for power trading.	H	Low	H	AD	S	PA	ST
7.3	Declaration of tariff policy for solar and other renewable power purchase and incorporation of zero transmission /wheeling charges for transmission of renewable power to the grid.	H	Nil	H	AD	S	PA	ST
7.4	Modification of building bye- law according to state profile for mandating use of solar water heater and renewable energy systems for lighting in the common or open space of govt. and commercial establishments.	H	Nil	H	AD	S	PA	ST
7.5	Create demand for renewable energy services through pilot scale demonstration projects in state government and public sector establishments	H	Low	H	AD & MI	S	PA, DP	LT

8	Improved and geographically focused assessment of energy potential from solar, biomass, etc. particularly solar radiation to be undertaken	H	Large	M	AD	S	RS, PS,	MT
9	Engage with bilateral and multi-lateral fund managers for project report preparation for funding in pilot implementation project and also undertake CDM activities	H	Large	M	MI	S	RS, PA, PS	LT
10	Installation and promotion of solar pumps for agriculture practice in hilly and remote areas as a demonstration project	M	Large	M	MI	S	PS, DP	MT
11	Promotion of use of Community based solar cooker system at schools/ education centers	L	Large	L	MI	S	PS, DP	MT

Energy Efficiency

Primary Department: SDA & Power & Electricity Dept.

Line Departments: JERC, Directorate of School Education, Urban Development Dept., PHE, PWD.

Sl. No.	Activities	Impor-tance	Const-raint	Priority	Type	Scale	Nature	Time frame
1	**Awareness creation and manpower development for enhance the energy efficiency measures**							
1.1	Supporting state level entrepreneurs to become ESCO.	H	Low	H	AD	S	PA	MT
1.2	Curriculum development for production, engineering, installation and maintenance activities of energy efficient devices with ITIs and other technical institutions in the state.	H	Nil	H	AD	S	CB, PA	MT
1.3	Awareness creation among the citizens on the need of energy efficiency measures, use of star rated devices in everyday life as also for wider dissemination of opportunities for diffusion of energy efficiency measures in infrastructure and other socio-economic sectors through all feasible routes, viz. awareness campaign and workshop, print and electronic media, State Nodal Agencies, Village panchayats, CBOs, NGOs.	H	Low	H	AD	S	PS, CB, PA	MT
1.4	Support schools, education institutions in preparing and introducing, curriculum on energy efficiency measures and preparation of book.	H	Nil	H	AD	S	PA, CB	ST
2	**Market Transformation of Energy Efficiency applications through policy measures**							
2.1	Development of fiscal instrument to promote energy efficient systems	H	Low	H	AD	S	PA	ST

2.2	Enactment of ECBC code according to state profile for mandating building design in line with ECBC code and to build green building.	H	Low	H	AD & MI	S	PA, CB	ST
2.3	Create demand for energy efficiency activities through pilot scale retrofit projects in state government and public sector establishments	H	Low	H	AD & MI	S	PA, CB, DP	MT
3	**Up-gradation of transmission and distribution network for minimization of energy losses**							
3.1	Assessment of T&D infrastructure and development of action plan for improvement of T & D network and setting target for AT&C loss reduction.	H	Low	H	AD	S	RS, PS, PA	ST
3.2	Up-gradation of HT & LT lines and replacement of Distribution Transformers with star rated transformers.	H	Low	H	MI	S	PS, IP	MT
3.3	Reduction of AT & C losses by 100% consumer metering of the consumers with a connected load of 20 kW and above and introduction on-line remote monitoring.	H	Low	H	MI	S	PA, PS, IP, RO&M	MT
3.4	Introducing franchisee model in distribution system to reduce commercial losses & better management of the distribution system.	H	Low	H	MI	S	PS, PA, CB, IP	MT
4	**Penetration of energy efficient devices in domestic and public utility systems facilitated by financial, supply chain and market incentives.**							
4.1	Introducing energy efficient lighting in domestic sector by supply and installation of CFLs lights and replacement of incandescent lamps in 1.5 Lakhs domestic consumer	H	Low	H	MI	S	PS, CB, IP	MT

4.2	Deployment of energy efficient lighting in public systems by replacing existing 250 HPSV lamps with 90W LED street lights in 5500 no. of electric poles.	H	Low	H	MI	S	PS, CB, IP	ST
5	**Unlocking the energy efficiency activity in IGEA mode**							
5.1	Implementation of energy efficiency measures through demonstration projects in 7 No. of government buildings in Mizoram under IGEA mode where energy audit is already carried out by the Nodal Department.	H	Low	H	MI	A	PS, CB, PA, DP	ST
6	**Institutional development and strengthening of Energy departments for Energy Efficiency promotion**							
6.1	Restructure and functional re-organization including enhancing the human resources of the energy departments including SDA to achieve efficient functioning, promotion and implement energy efficiency activity in the state.	H	Nil	H	AD	A	PA, CB, RO&M	ST
6.2	Empanelment of Energy Auditors, Energy Services Companies (ESCO) for taking up energy efficiency activities in the state.	H	Nil	H	AD	S	PA, CB	ST
6.3	Training of the working group members and their representative from different departments and organizations on sector specific climate change issue and enhance the knowledge about the policy measures.	H	Nil	H	AD	A	CB	MT
7	Increase Hydro power generation by supporting private or public investors in setting up projects and undertake demonstration project							

7.1	Detailed reconnaissance study on water availability and hydrology data evaluation for identification of new hydro projects and demarcation of hydro power sites with specific capacity mapping.	H	Low	H	AD	S	RS,	ST
7.2	Promotion & facilitation of hydro power project implementation by providing adequate support from the state government in terms of clearance, land acquisition, power transmission network development.	H	Low	H	AD	S	RS, PA	MT
7.3	Declaration of water policy and mandate of siltation and pollution control in water bodies of hydro power projects. Two demonstration projects to be undertaken in existing hydro projects.	H	Nil	H	AD & MI	S	RS, PA, DP	ST
7.4	Demonstration hydro project in already identified project sites - Setting up of 100 kW micro hydel project in Tuiching river which is located in north of Champai District. Setting up of 100 kW micro hydel project in Tuiriza River which is located in Aizwal district.	H	Low	H	MI	A	PS, IP	ST
8	Life cycle analysis of existing hydro power plant and implementation of R&M measures.	H	Large	M	AD	A	RS, PS, IP	LT
9	Survey and investigation of seven hydro projects namely – Ngengpui, Hnahthial&Piva, Marlui, Tuisalui, Ngengrual III, Tuiphai and Sekulhlui	M	Large	M	AD	A	RS, PS	MT

10	Deployment of Improved chulha in rural households for efficient energy consumption and reduce deforestation through enabling policy and subsidy framework.	M	Low	M	MI	S	PS, IP	MT
11	Engage with bilateral and multi-lateral fund managers for project report preparation for funding in pilot implementation project and also undertake CDM activities.	H	Large	M	AD & MI	S	PA, CB, PS	LT
12	Promotion and implementation of energy efficient pumps in agriculture and urban sector for drinking water supply through introduction of comprehensive scheme.	H	Large	M	MI	S	PA, IP	MT
13	Enactment of mandatory use of energy efficient lights by reviewing standards & rules for public lighting, bill boards or hoardings for advertisement, commercial area lighting such as shopping malls, shops, etc.	H	Large	M	MI	S	PA, CB, PS	MT
14	Formulation of Demand Side Management projects in P&E Dept.	M	Large	M	AD & MI	S	PA, IP	LT
15	Efficient cooking practice in rural areas and conservation of forest wood	M	Large	M	AD & MI	S	PA, IP, OM	LT

Priority	H – High, M – Medium, L – Low;
Type	MI - Mitigation, AD – Adaptation;
Scale	S – State-wide, A – Particular / Focused Area
Nature	RS - Research Study, PA - Policy Action, PS - Pre-investment Study, DP - Demonstration Project, IP - Investment Project,
	CB - Capacity Building, OM - Regular Operation & Maintenance;
Time frame	ST – Short-term, MT - Medium Term, LT – Long term
Constraint	Nil, Low, Minimal, Large

Water

Sl. No.	Action Point	Impor-tant	Const-raint	Priority	Type	Scale	Nature	Time Frame
1	Climate change impact assessment of present status of water resources like river, wetland, streams and lakes	High	None	High	AD	S	RS, PS	ST
2	Finalisation of plan for conservation and preservation of water resources	High	None	High	AD	S	RS PS, DP, IP	MT
3	Formulation of State Water policy	High	None	High	AD	S	PA	MT
4	Catchment and command area treatment through reverine afforestation	High	None	High	AD	S	DP IP	MT
5	Capacity building of Water Resources department/ Mizoram PHED for integrated water resources management	High	None	High	AD	S	CB	ST
6	Expansion of hydrometric network and establishment of micro weather station for regular monitoring	High	Minimal	High	AD	S	IP	ST
7	Community tank management for combating water borne diseases	High	Minimal	High	AD	S	DP IP	ST
8	Promoting zero energy water purification for domestic water supply	High	Minimal	High	AD	S	DP IP	ST
9	Renovation and development of traditional water harvesting system with scientific intervention in district level	High	Minimal	High	AD	S	OM IP	ST
10	Capacity building of communities on adaptation options required for integrated demand side as well as supply side strategies during climate stressed condition	High	Minimal	High	AD	S	CB	ST

11	Impact assessment study of climate change on aquatic ecosystem	High	Minimal	High	AD	S	RS	ST
12	Assessment of climate change impact on food security due to water stress	Medium		Medium	AD	S	RS	ST
13	Assessment of Ground water availability in usage and conservation plan	Medium		Medium	AD	S	RS	MT
14	Mandating water harvesting and artificial recharge in water stressed area	Medium		Medium	AD	S	PA	MT
15	Enhancement of recharge of the source and recharge zone of deeper ground water aquifers	Medium		Medium	AD	S	DP IP OM	MT
16	Institutional development of ground water board	High	High	Medium	AD	S	CB	MT
17	Capacities (Storage) through multipurpose hydro projects and integration of drainage with irrigation infrastructure	High	High	Medium	AD MI	S	DP IP	MT
18	Awareness generation of local communities on importance of aquatic ecosystem	Low		Low	AD	S	CB	ST

Priority:	H – High, M – Medium, L – Low;
Type:	MI - Mitigation, AD – Adaptation;
Scale:	S – State-wide, A – Particular / Focused Area;
Nature:	RS - Research Study, PA - Policy Action, PS - Pre-investment Study, DP - Demonstration Project, IP - Investment Project, CB - Capacity Building, OM - Regular Operation & Maintenance;
Timeframe:	ST – Short-term, MT- Medium Term, LT – Long term

Strategic Knowledge Mission

Primary Department: Department of Science & Technology

Sl. No.	Action Point	Impor-tant	Const-raint	Priority	Type	Scale	Nature	Time Frame
1	Knowledge Building on Climate Change	H	NIL	H	AD	S	PA/CB	ST
2	To build GHG inventory and identify the dominant GHG/CO_2 emitting sectors, industries, districts, municipalities in order to enable selection of mitigation opportunities.	H	NIL	H	MT	S	RS	ST
3	Development of Knowledge Management on Climate Change and facilitating its operation for initial period	H	NIL	H	AD	S	RS	ST