



Department of Science and Technology  
Ministry of Science and Technology  
Government of India

**NMSHE** NATIONAL MISSION FOR  
SUSTAINING THE HIMALAYAN  
ECOSYSTEM



State Climate Change Cell, Manipur

Directorate of Environment  
Government of Manipur

মহা অটোরক্ষা সংস্থা ল'ন স্কটিয়াল  
**State Climate Change Cell, Manipur**  
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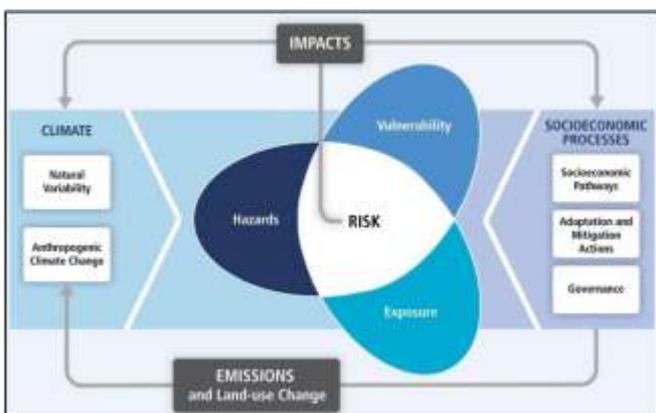
**VULNERABILITY ASSESSMENT : A NEED IN THE CHANGING CLIMATE SCENARIO**

*“The increasing trend of climate variability has escalated the need for assessment of vulnerability to strengthen the adaptation strategies for climate change.”*

**- Yengkokpam Satyajit Singh & Dr. Bharati Brahmacharimayum**

During the last millennium, a lot has been changed in the climatic conditions all around the world. The atmospheric temperature keeps on increasing along with the growth of human population and development. The rainfall became erratic with increasing intensity and decreased in the number of rainy days. Reports of frequent occurrence of other weather events, flood and droughts marked the last decade. In the face of all these changes, the need for the living population to survive has brought the world together to seek for a solution.

The economic disparity and bio-physical differences of one region to another have a close relation to the ability to adapt to the changing climatic scenario. Poor countries are considered more vulnerable to the high climate variability as it will affect their livelihood. The increasing trend of climate variability has escalated the need for assessment of vulnerability to identify and strengthen the adaptation strategies for climate change. Various climate change impact assessment studies on highly vulnerable sectors such as agriculture, forests and water resources have been reported. As per the Report of Intergovernmental Panel on Climate Change (IPCC) 2014, vulnerability is defined as “the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.” Vulnerability is an endogenous characteristic of a system and is determined by its sensitivity and adaptive capacity. The main objective for the vulnerability assessment is to reduce the risk that arises from interaction of hazard, exposure and vulnerability. . Vulnerability is a new concept for studying the climate change impact and policy. To assess the types of vulnerability to climate change, different approaches have been formulated over the years. Assessment of vulnerability to climate change is needed to have a proper idea about the necessary requirements for developing better adaptation measures.



Risk management and assessment framework (Source: IPCC, 2014)

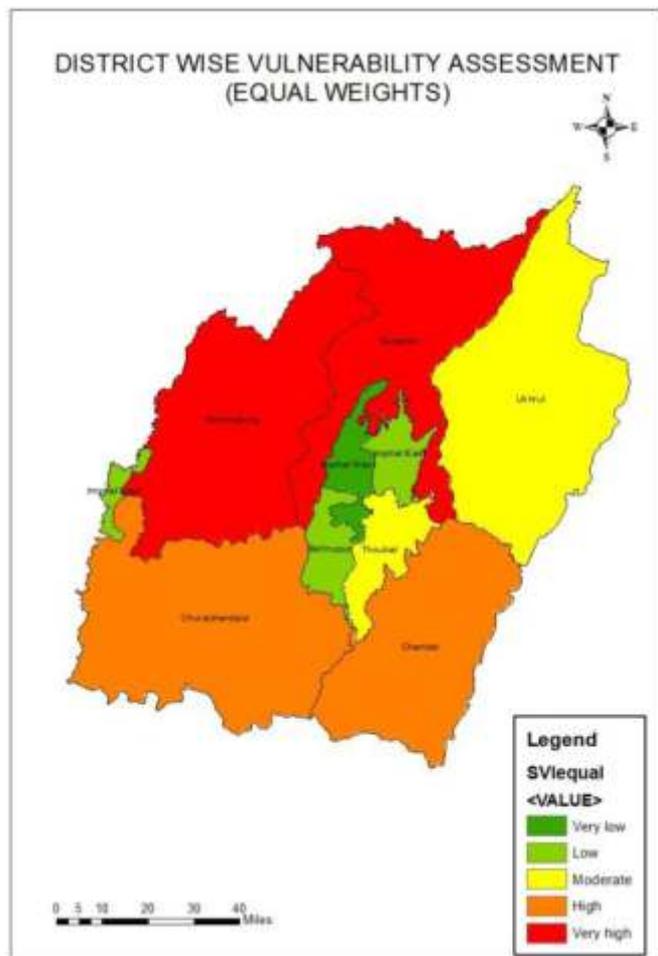
The state of Manipur is characterized by ranges of hills surrounding a small valley with its biophysical richness and a populace of different tribes. This region is part of the Himalayan ecosystem which is highly fragile and the climatic stress makes this region all the more highly vulnerable. Also the state being an agrarian economy with agriculture based income as the primary source of income, impact of the changing climate will have direct impact on the livelihood as well. The high rate of unplanned urbanisation, high dependence on the natural resources, decline in the productivity, less options for employment are some of the bottlenecks in achieving environmental sustainability of Manipur.

A preliminary tier 1 approach for district wise assessment of vulnerability for the state of Manipur was carried out considering the present socio-economic status utilising the readily available secondary data. The assessment in this study was done on the basis of two components as per the conceptual framework suggested by IPCC (2014), which are sensitivity and adaptive capacity. A number of indicators that are directly or indirectly connected to climate variability are selected. An indicator represents either the sensitivity or adaptive capacity of a system, community or region .The selected indicators reflect the importance or contribution to the total vulnerability of the system or communities. As majority of the population has their main source of income in the agricultural and allied sectors, the assessment is more inclined towards agriculture based livelihood. Socio-economic Vulnerability Indices (SVI) is developed based on several selected indicators that represent both the socio-economic and agricultural parameters. The IPCC-2014 framework for assessing vulnerability was adopted at the present case to identify and prioritize the most vulnerable districts in Manipur. The methodology followed is below given.

- Step 1 Scoping and objectives of vulnerability assessment
- Step 2 Selection of type of vulnerability assessment
- Step 3 Selection of Tier method
- Step 4 Selection of sector, spatial scale, community/ system and period for assessment
- Step 5 Identification, definition and selection of indicators for vulnerability assessment
- Step 6 Quantification and measurement of indicators
- Step 7 Normalisation of indicators
- Step 8 Assigning weights to indicators
- Step 9 Aggregation of indicators and development of vulnerability index
- Step 10 Representation of vulnerability: spatial maps, charts and tables of vulnerability profiles and index
- Step 11 Vulnerability ranking of sectors, regions, communities, cropping systems, river basins, watersheds, forest types, etc.
- Step 12 Identification of drivers of vulnerability for adaptation planning

Steps in vulnerability assessment

The level of vulnerability is categorized into five groups, viz. Very low, low, moderate, high and very high. The result of the analysis shows two districts each in the very high and high vulnerability category. Out of the remaining districts, two districts each were found to be in the moderate and low vulnerable category while only one was observed under very low category.

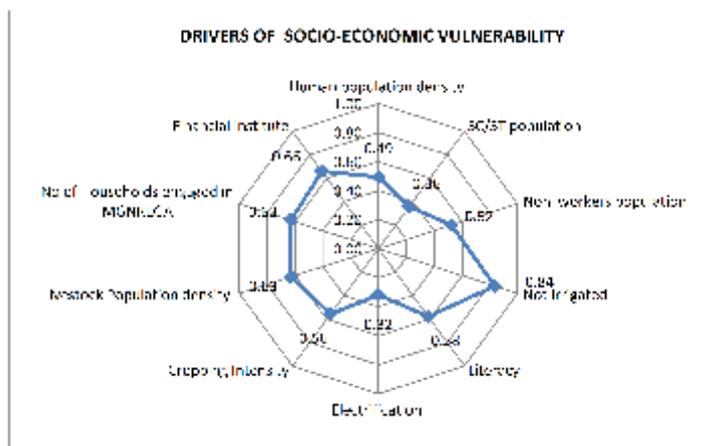


From the assessment, it was found that non-irrigated areas and financial institutes contribute as the major drivers for the vulnerability. Since agriculture is the main occupation, lack of irrigation facilities leads to a more vulnerable scenario in the case of climate adversities. Also as compared to other parts of the country, the numbers of financial institutes in some of the districts is very few in numbers and people have limited access to such facilities especially in the hill districts. It is important to prioritize the drivers to achieve effective adaptive measures in tackling the issues of climate vulnerabilities.

*The high variability in the average annual rainfall have increased the occurrence of climate extremes in the form of floods and droughts leading to increased agricultural vulnerability and uncertainty of water security.*

The contribution of indicators to overall vulnerability at the district level is presented as a radar plot, where the weights and significance of each indicator's contribution to inherent vulnerability are plotted, and the dimensions of vulnerability

are represented by spokes of the plot – greater the significance, further away from the centre of the plot.



The findings are based on the preliminary tier 1 approach and from the results the drivers of vulnerability could be determined thereby enabling the prioritisation of the policies and programmes. In a similar manner for a more detailed assessment, one could opt for the tier 2 and tier 3 approaches which involves the participation of the people and the actual stakeholders. The assessment could prove to be a path finder for the formulation of policies and adaptation strategies for climate change after the ground realities are assessed and problem areas are highlighted.

Manipur, being a part of North Eastern region is believed to be highly vulnerable to climate change because of the changing pattern of agriculture, forests, socio economic status, ethnic composition, age structure and governance which have a significant influence on the outcomes of past related calamities and climate hazards. The high variability in the average annual rainfall have increased the occurrence of climate extremes in the form of floods and droughts leading to increased agricultural vulnerability and uncertainty of water security. Currently and in the near future, the districts of the state are subjected to climate induced vulnerability. Thus, the need to rank the districts of Manipur based on assessment of the vulnerability index will be of great significance to identify and prioritize the most vulnerable districts for adaptation interventions.

The success of adaptation strategies is addressing the root causes of vulnerability to climate change and yet reducing vulnerability is one of the greatest challenges faced by the policy makers, implementing agencies and communities in their efforts to tackle climate change. The most effective adaptation strategy would be implementation of adaptation programmes for particular target groups based on their inherent level of vulnerability. As such assessment of vulnerability is a vital preceding step to develop adaptation policies, strategies and practices. Based on the assessment approach, the policy makers need to focus on the drivers of vulnerability in order to take up adaptation measures of climate change of the state in the upcoming policies and programmes. It is the high time to collect effective information on vulnerability in tackling the issue of climate variability and its adaptation approach.

## CLIMATE CHANGE: ENDANGERING EXISTENCE

*"If the current trend of increasing temperature continues then global warming may turn out to be the greatest cause of extinction for many species."*

- **Yengkokpam Satyajit Singh**

The balance of nature has been disrupted through generations of development by the human. Abundant resources of the forest have been over exploited for our greed and luxury. The passionate relationship between human and the natural environment that existed in our bedtime stories remain as such. The present generation have experienced the effect of the industrial revolution and realized the need for a change in our thinking and action. Only after the impact of the changing climate became intense, we started off with the action to conserve what is left.

Through the ages, as a result of anthropogenic activities, many species have become endangered while few have been marked extinct. The increasing temperature along with the unprecedented rainfall have caused variation in the habitable condition of many species and inhibited their ability to adapt to such abrupt change in the climate. Many of these species have lost their habitat due to interference by human, be it in the form of encroachment, deforestation, urbanization, etc.

Variation in the climate is control by various factors but most importantly, it is the forest, which is a living entity that keeps the balance in nature and ensures our existence. Forest helps regulate the world's climate by absorbing carbon dioxide, the main greenhouse gas responsible for global warming. Degradation of forest have brought destruction to the habitat of many species and this resulted in invasion of alien species that are more suited to the changed environment. The existing ecosystem services provide along with the livelihood of the people that depend on that forest will be affected to a great extent. Such turn in the way of life will further fuel more destruction leading to a vicious circle.

As per the Intergovernmental Panel on Climate Change (IPCC), a 1.5°C average rise of the global temperature may put 20-30% of species at risk of extinction. If the current trend of increasing temperature continues then global warming may

turn out to be the greatest cause of extinction for many species. It may also be noted that many of the world's threatened species live in areas that will be severely affected by climate change and if the planet warms by more than 3°C, most ecosystems will be struggling to survive. At present the climatic condition is changing at a faster rate making difficult for many species to withstand such change and it became a bane to their existence.

The variability in the climatic phenomenon is increasing over the decades. Every concurrent year breaks the record for the highest temperature with the ever increasing concentration of CO<sub>2</sub>. The intensity of rain also increases leading to frequent flood, and more intense form of various other climatic events are witnessed in the recent time. Even in the case of human, death due to climate related events like heat stress, flood, drought, storms have been reported in many corners of the world. Island nation across the globe are being threatened by the rise in sea levels and the increasing severity of natural disasters. There is a fear among them that their homelands would vanish beneath the waves as the atmospheric temperature rises.

*...climatic condition is changing at a faster rate making difficult for many species to withstand such change and it became a bane to their existence....*

The industrialized nations have been blamed for the emission of greenhouse gases and it is the poor countries who will be most affected from the impacts of climate change. Amid the many developments, participating countries at the Paris Climate Conference 2015 or COP21 agreed to reduce carbon emissions while supporting efforts to adapt to the long term impacts of climate change. COP23, 2017 at Bonn, Germany continued to negotiate paving the way for the rules that will set the Paris agreement in motion. The conference resolved a handful of issues dear to vulnerable nations, but the more thorny decisions were kicked to 2018 and called on countries to be more ambitious in tackling emissions. If we human beings are the root cause for such innumerable destruction to nature and its resources, we should also share the responsibility to fix it. Such concurrent steps would ensure to prevent further deterioration of the climate and to make possible for every species on this planet to survive.



**MONTHLY ANALYSIS OF MEAN MAXIMUM AND MINIMUM TEMPERATURE AND RAINFALL OF MANIPUR FOR THE 3<sup>rd</sup> QUARTER, 2018**

DISTRICT	JULY			AUGUST			SEPTEMBER		
	Max temp (°C)	Min temp (°C)	Total Rainfall	Max temp (°C)	Min temp (°C)	Total Rainfall	Max temp (°C)	Min temp (°C)	Total Rainfall
BISHNUPUR	33.81	20.20	C	33.60	21.02	S	32.93	19.93	S
CHANDEL	38.55	18.76	S	38.16	17.83	E	37.35	17.06	N
CHURACHANDPUR	33.82	20.34	E	33.13	19.11	N	34.45	18.40	S
IMPHAL EAST	37.04	22.56	E	37.73	22.20	N	36.52	20.61	S
IMPHAL WEST	36.25	22.01	E	36.70	20.46	E	35.93	18.72	S
SENAPATI	34.70	16.60	F	32.86	16.16	F	33.65	15.26	S
TAMENGLONG	37.40	18.98	D	39.92	18.16	C	36.78	17.22	C
THOUBAL	34.02	20.90	C	34.83	20.38	C	34.37	18.88	N
UKHRUL	27.73	15.75	C	30.34	15.40	C	27.71	14.70	C
<b>MEAN</b>	<b>34.81</b>	<b>19.57</b>		<b>35.25</b>	<b>18.97</b>		<b>34.41</b>	<b>17.86</b>	
<b>MANIPUR</b>	<b>MAN</b>	<b>AN</b>		<b>AAN</b>	<b>N</b>		<b>MAN</b>	<b>N</b>	

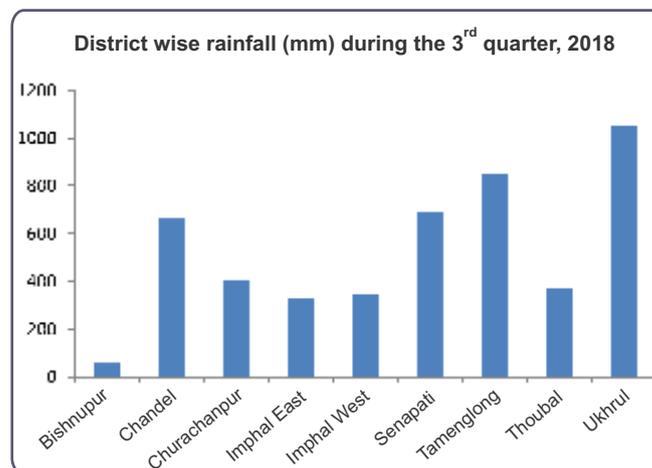
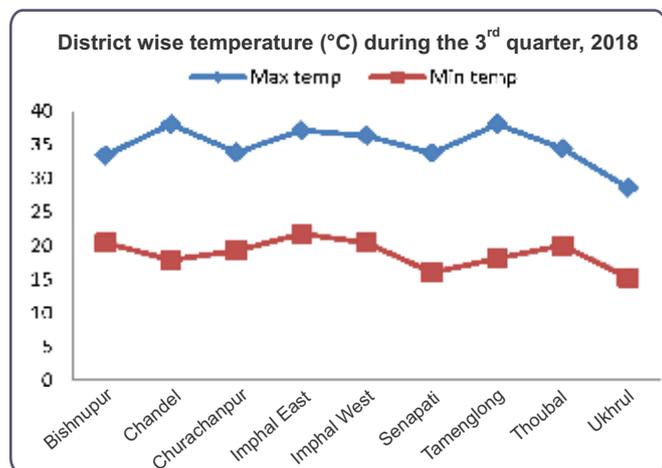
**Note :**

- N : Normal (N, N+1, N-1)°C
- \* : Cold/Heat wave condition
- \*\* : Severe Cold/Heat wave condition
- BN : Below Normal (N-2)°C
- AN : Above Normal (N+2)°C
- ABN : Appreciably Below Normal (N-3, N-4)°C
- AAN : Appreciably Above Normal (N+3, N+4)°C

- MBN : Markedly Below Normal (N-5 and Below)°C
- MAN : Markedly Above Normal (N+5 and Above)°C
- E : Excess, (+20% or more of Mean rainfall)
- N : Normal, (+19% or -19% of Mean rainfall)
- D : Deficient, (-20% to -59% of Mean rainfall)
- S : Scanty, (-60% to -99% of Mean rainfall)
- NR : No Rain, (-100% of Mean Rainfall)

The varying topographical features of the state also causes for a wide range of temperature. There are distinct variation in the atmospheric temperature between the districts. Even the diurnal temperature range varies from 10°C to 20°C in the districts of Manipur state. It is observed that Ukhrul district recorded the least maximum temperature throughout the 3rd quarter and also its minimum temperature is lowest. Variation in altitude with the district can be cause for the changes in the peak temperature. Variability in the temperature has been increasing in the last decade and it effect the pattern of rainfall which has become erratic in the state.

With excess rainfall received in most of the district during the pre-monsoon, the rainfall continue to splash out during the months of the monsoon. Most of the districts received rainfall in excess during the month of July and August, however during September, the rain thin out. Ukhrul district continue to received excess rain during the whole quarter. All the hill districts normally receive good amount of rain as compare to the valley districts. But for Tamenglong, average rainfall has decreased since the last quarter. Bishnupur district in the valley region is the least rainfall area for this quarter with its rain gauge measurement of August and September inclining towards scarcity.



Source: State Climate Change Cell, Manipur, Directorate of Environment, Government of Manipur

— Analysed by Yengkokpam Satyajit Singh

## Forest conservation in Chandonpokpi village, Chandel district

- *Kt Khino Anal & Ashem Rahul Singh*

Chandonpokpi village lies in the northern part of Chandel district. The village was established in the year 1977 and is mostly inhabited by Chothe tribe. The name Chandonpokpi is derived from the two words 'Chandon' and 'Pokpi'. Chandon is basically 'clay' of good quality usually used by Meitei women folks as a mark on their forehead, nose and other parts of the body for traditional reasons. Pokpi is the original place where chandon is found. The village is 13 kms away from the Chandel district headquarter. The nearest town, Pallel, is about 5 kms from the village. According to the village chief, the village has about 40 households with a total population of not more than 200 people. Chandonpokpi is surrounded by six (6) villages namely Ziontlang, Khurthar, Old Wangparal, Purum Chumbang and Kapaam villages. Economically, majority of the localities depend on agriculture and agricultural based products for their livelihoods. Permanent cultivation of paddy is the only type of agriculture practices followed in the village. The village already banned the practice of slash and burn cultivation decades ago.

In the village, women play an important role in agriculture and its allied sectors such as crop production, livestock production, horticulture, post harvest operations, agro-forestry, etc. in the village. To contribute additional income for the family, the women folks also participate in the self help groups which involved in activities like pickle and juice making from fruits and vegetables like the passion fruit, pineapple, wild apple, chilly, fishes and meat. Most of the fruits for making pickles are obtained from the forest and home orchard. Besides, there is growing momentum on youth participation within the development community. The youth participation aims to help build and harness young people as assets. They help in demonstrating the positive contribution to development in organizational development, policy and planning, implementation, and monitoring and evaluation of the village development programmes.

As the present scenario of changing climate touches all life, an innovative programme was taken up for promoting the 'Community Conserved Areas' in the village. Today, Chandonpokpi village has specifically demarcated 25 acres of land as 'Community Conserved Area' in order to tackle the climate change challenges for the next generation. The conservation initiative is a collaborative step taken up by the village head and the chief functionary of the United Tribal Development Project (UTDP) Romeo Yuhlung Chothe and North East Region Community Resource Management Project (NERCORMP). The objective of the conservation programme is to conserve a particular portion of community land for preserving the natural resources, faunal and floral diversity present in the surrounding environment.



*Community conserved forest at Chandonpokpi village*

Through this programme, the conserved land is properly maintained by the village authority and no villager or authority has the rights to fell or sell timbers from the conserved community areas in any cases. The method benefit all round scenarios in reducing felling of timbers for business purposes; gradually help in reducing the traditional style of shifting cultivation practices. The same practice also solve the problems of wildlife poaching and hunting in the surrounding area. In addition, the conservation of community forest has enhanced the ecology and ecosystem services, regulate water sources, natural resources management, protect soils and help in moderating the climate.

Climate change is disturbing the ecological balance of rural diversity in terms of environment, health and socio-economic livelihoods both directly and indirectly at this era. The existing forests have gradually degraded because of the sudden change of vegetation covers due to human activities and pressures. Over the last few years, Chandel districts had experienced heavy flood, mudslide, landslide, increased atmospheric temperature and drying up of water sources. The model of 'community conserved area' is steadily adopted in 36 villages of the districts as one possible way to strategize in combating climate change.



## World Bamboo day: An Overview

- Ashem Rahul Singh



Globally, World Bamboo Day (WBD) celebration takes place on 18th September every year. The day was first acknowledged by the Thai Royal Forest Department on 18 September 2009 in Bangkok, the capital of Thailand. The function was attended by 350 participants from 41 different countries. Each of the representative members planted a bamboo seedling as a symbolic gesture during the ceremonial function. The declaration is to raise awareness about the importance of bamboo and its co allied. Moreover, the World Bamboo Organization (WBO) brings the potential of bamboo to a more elevated exposure in terms of protecting the natural resources and the environment, to ensure sustainable utilization, to promote new cultivation of bamboo for new industries as well as promote traditional uses locally and for community economic development.

Belonging to grass family, bamboo is the fastest growing plant species. The species is also an important sink of carbon. Bamboo sequesters carbon through photosynthesis and store in the fiber and in the soil where it grows. It minimizes the carbon dioxide gases and generates 35% oxygen more than an equivalent stand of trees. If planted, one hectare of bamboo sequesters up to 62 tons of carbon dioxide per year whereas one hectare of young bamboo plantations sequesters more than 15 tons of carbon dioxide per year. Studies revealed that bamboo absorbs 12 metric tons of carbon dioxide per hectare from the air, which is twice that of a similar size forest. In fact, bamboo is the only grass species which sequester carbon faster than other fast growing tree species like Chinese teak and Eucalyptus species.

Additionally, bamboo is used in rehabilitation process of degraded ecosystems especially in shifting cultivation areas to mitigate the changing climate. Besides, all its importance and mitigating climate change effects, bamboo is missing from the Marrakech Accords definition of forests, as well as from IPCC Assessments and IPCC Guidelines for greenhouse gas inventories and reporting. Botanically, bamboos are not trees but grasses which cannot form forests consisting of trees, as defined by the Kyoto Protocol. Bamboo forests are renewable resources, and their carbon sequestration potential has attracted wide attention in the present situation. It captures and stores biomass quickly and creates opportunity to maintain and increase carbon stocks in its biomass. Therefore, with proper guidance and planning, bamboo will help in solving the problem of climate change and also enhance the socio economic status of the state.

Manipur observed the first bamboo day in the year 2011 to raise awareness of its importance, co relationship with the environment and other socio economic benefits. Programme like awareness rally, bamboo handicrafts exhibition, bamboo food delicacies stall and bamboo theme pavilion are other part of the bamboo day celebration. Apart from this, bamboo made products cum exhibition were the centre points of attraction where an array of bamboo products like bags, cycle, lamp, decorative items, kitchenware and furniture were displayed. Some bamboo experts also highlighted the different uses of Bamboo on the occasion. Experts also report the present status of bamboo species found in the state and the need to explore more for possibilities in the establishment of bamboo industry. The state has already contributed in the production of bamboo shoot as a form of nutrient food items like Kakching Soibum, Kwatha Soibum and Bishnupur Soidon and other utilities in our day to day life. Some common species of bamboo found in the state are *Arundinaria callosa* (Soidon), *Bambusa balcoona* (Leewa), *Bambusa nana* (Khokwa), *Bambusa natans* (Utang) and *Dendrocalamus flagellifer* (Longwa). The Bamboo Day, 2018 was observed with a rally starting from Kangla Palace to Singjamei by focusing on the potential of bamboo to be used in food processing, green construction, sustainable industry and manufacturing.

At present, climate change is not sparing the bamboo species, which becomes a need for better management to adapt. Plantation of bamboo in urban ecosystem, croplands, agro forestry and shifting cultivation areas would help in expanding the services. Physically, bamboo is a perfect tool for solving many environmental problems such as soil erosion control, water purification and so on. In addition, bamboo occupies an important position in the climate change mitigation, adaptation and sustainable development. It also improves the environment in practical ways and at the same time, bamboo can improve the welfare of a local population by providing as source of income. Unlike bamboos no other plant has the ability to interrelate ecological, social and industrial functions, including the purification of the soil, water and air. Proper and judicious use of bamboo species will help to a great extent in the creation of a green economy via the localization of renewable products, alternative fiber and the establishment of a secure sustainable energy source.

## About the State Climate Change Cell

The State Climate Change Cell was established in 2013-14 under the Directorate of Environment, Government of Manipur. The Cell has been undergoing research on climate change issues and coordinating with all the stakeholders in respect to the regional climate information. Now, the Cell has been strengthened by the Ministry of Science and Technology, Govt. of India since October 2014 aligning to the two specific dedicated missions under the National Action Plan on Climate Change (NAPCC) viz. National Mission for Sustaining the Himalayan Ecosystem (NMSHE) and National Mission on Strategic Knowledge for Climate Change (NMSKCC).

## Thematic sectors of the Cell

### Agriculture and its allied Sectors:

All agricultural production is sensitive to the climate variability. Extreme events like droughts, floods, tropical cyclones, heavy precipitation and heat waves are known to negatively impact agricultural production and farmers' livelihood. Yield variability can be attributed to the increase in temperature and CO<sub>2</sub> concentration coupled with the change in rainfall pattern over the region. Climate change could have positive as well as negative impacts on the agricultural production in Manipur.

### Health Sector:

Climate change and its impact may link to health directly and indirectly in many ways. It may lead to extension of the window period for propagation of the vector borne diseases such as malaria, dengue, JE etc, and deterioration in nutritional health due to loss of food security and reducing cereal yields. Moreover, with projected increase in surface temperature along with increase in frequency and intensity of extreme events such as hailstorms, heavy precipitation etc. in the future; the impact of climate change on human health are likely to escalate.

### Water Resources:

Different catchment areas are likely to respond differently to climate drivers, depending largely on catchment physio-geographical and hydro-geological characteristics. The IPCC has also predicted that the drought will increase in frequency as well as its severity on the affected areas. The trend in precipitation in the NER exhibits considerable spatial variability with respect to the predictions for the year 2030. An overall increase in water yield is seen in Manipur with a magnitude up to about 40%.

### Forests & its ecosystem and biodiversity

The forest could be vulnerable due to many factors such as forest fragmentation, forest degradation and forest conversion. A Composite Forest Vulnerability Index (CFVI), developed by the INCC (Source: Report on Climate Change India: 4x4 Assessment) for the two scenarios viz.: current CFVI and future CFVI, found that the forests of some districts of Manipur namely Bishnupur, Churachandpur, Senapati, Imphal, Tamenglong and Chandel have high CFVI (have high overall vulnerability).

### Socio-economic based on source of livelihood

The state of Manipur with an agrarian economy has a major section of population depending upon agriculture as their source of livelihood. Increasing population and decreasing land productivity, relatively higher dependence on natural resources (e.g. forests) are also major constraints for Manipur's environmental sustainability. Vulnerability to climate variability will depend on the ability of the populace to adapt to the changes.

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