

First Draft

Recommendations for
**State of Assam's Strategy and
Action Plan on Climate Change**

Prepared by

Climate Cell, Environment Division

**Assam Science Technology
& Environment Council**

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Through Consultative workshops in

Assam University

Gauhati University

& Tezpur University

Supported by

**Department of Science & Technology
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About the report

This report contains the compiled recommendations of three consultative workshops organized in Assam University, Gauhati University and Tezpur University by the Climate Cell of Environment Division of Assam Science Technology and Environment Council in collaboration with **Department of Ecology and Environment Science, Assam University, Silchar, Department of Geography, Gauhati University, Guwahati and Department of Environmental Science, Tezpur University**. The consultations were held in the six thematic areas, viz. Water Security and Sustainability, Sustainable Agriculture and Livelihood Security, Sustainable Habitat for quality of life, Mitigating disaster and crisis management, Energy Efficiency and Sufficiency and Protection and Sustainable Management of Forest and Wildlife. The recommendations are grouped in respective thematic areas in four broader groups of Required Policy based initiatives, required developmental interventions, proposed areas for further research/study and Proposed areas for capacity building with a brief note on thematic areas. There is a concluding recommendation to reflect the overall view and concerns of the participants of the workshop. The annexure section contains the recommendation of respective university as reported on date along with list of participants, core group of the collaborative organization and the team working for organization of consultation and compilation of the report.

It is a first draft only, it will be open for public opinion through ASTEC's website and will be finalized in the proposed workshop going to be organized in NEIST, Jorhat.

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An initiative to ***“Create a path for adaptation and mitigation based on its rich natural resources and diversity and to develop means of resilience with a national perspective in order to ensure environment and livelihood security”***.

1.0. Background of the consultation

Climate change is perhaps one of the most important global environmental challenges being faced by humanity today, with its implication on food production system, natural ecosystems, fresh water supply, health and weather related calamities. The North East region of India including Assam is expected to be highly prone to consequences to climate change because of its sensitive geo-ecological set-up, strategic location with international boundary, presence of the Eastern Himalayan ranges, transboundary river systems, inhabitation of ecosystem by people of different ethnic groups and inherent socio-economic differences.

The Intergovernmental Panel on Climate Change (IPCC), in its Fourth Assessment Report, re-emphasized the need for adaptation to address the impacts of climate change on lives and livelihoods across all sectors.

The main characteristics of climate change include rising temperatures, changes in rainfall pattern, melting of glaciers and sea ice, sea level rise and an increased intensity and/or frequency of extreme events. These changes in physical processes have impacts on biological and socio-economic factors such as: shifts in crop growing seasons; changes in disease vectors; increased rates of extinction of many species; severe water shortages; and heavy deluges and flooding. Furthermore, rising sea levels will increase the risk of storm surges, inundations and wave damage to coastlines.

The IPCC defines adaptation as an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Adaptation activities comprising of:

- Technological planning and intervention (for improving resilience systems, mitigation and reducing climate risk),
- Policy-based intervention (for improved risk management, reducing vulnerability and mitigation),
- Behavioural change approaches (for wise use and sustainable consumption),
- Managerial initiation (for sustainable management of Natural Resources) and
- Developmental planning and intervention (for ensuring sustainable development).

Therefore, there are urgent needs to prepare a plan for adaptation and mitigation, along with strategic developmental plan for the state. The state climate change action plan has to enable communities to understand the uncertainty of future climatic conditions and engage effectively in a process of developing adaptation programmes. It is noteworthy that, the processes of intervention have to focus more on local level through the hierarchy of Panchayat to district to state. It must cover all the formal and informal sectors, with spatial perspectives of agro-climatic zones of

the state. In the process of preparation of such action plan, there may be the requirement to re-look into existing policies of the state with the perspective of reframing and restructuring along with creating mechanism for integration/coordination at sectoral and spatial level.

In these perspectives, a series of consultation through the leading Universities of the state was initiated by the 'Climate Cell' of Environment Division of Assam Science Technology and Environment Council. In doing so, the National Action Plan of Climate Change will be considered as the base to step forward with local/regional priorities.

1.1. Objectives:

- To identify key issues for preparation of state climate change action plan;
- To design a plan and action frame-work to address the issues of climate change impact through mitigation and adaptation in the context of Assam;
- To identify reframing of existing policies so as to meet the requirement of climate change mitigation and adaptation approaches;
- To identify approaches of planning and action in order to finalize the State climate Change Action Plan in the context of National Climate Change Action Plan.

1.2. Proposed thematic areas for discussion:

- **Sustainable Habitat for quality of life** : Major concern will be human settlement (includes housing, sanitation, drinking water, transportation, health and other amenities both in rural and urban context).
- **Water Security and Sustainability**: Major concern will be sustainable management of water resources for ensuring water security (includes ground water, surface water in the context of integrated watershed management, adoption, popularization and modernization of traditional water harvesting systems, wet land management, riparian management and other water related issues).
- **Sustainable Agriculture & Livelihood Security**: Major concerns will be eco-friendly approaches of agriculture for ensuring food security (includes agriculture and allied activities along with protection and harnessing of agro-biodiversity).
- **Mitigating natural disaster and crisis management**: Major concerns will be on preparedness, mitigation and vulnerability reduction in all forms of climate induced natural disaster.
- **Adaptation to climate change** (focuses on **Energy sufficiency and efficiency**): Major concerns will be technological initiations and intervention with more focus on harnessing new and renewable energy, energy efficiency and conservation.

- **Protection and sustainable management of Forest and Wild Life:** Major concern will be on forest and wild-life protection and developing resilience of eco-system services (includes RF, VF, PA and CCA and wetland under forest areas too).

2.0. Brief Climatic Vulnerability Scenario of the state

The north-eastern region of India is expected to be highly prone to the consequences to climate change because of its geo-ecological fragility, strategic location vis-à-vis the eastern Himalayan landscape and international borders, its transboundary river basins and inherent socio-economic instabilities. Environmental security and sustainability of the region are and will be greatly challenged by these impacts. Since the General Circulation Models (GCM) do not provide high resolution information for small regions, the impacts of climate change on regions like northeast India and even a smaller state like Assam are less explored and less known till now making the future scenarios more uncertain for risk management. The climate change scenario for a state like Assam can be considered in the context of its physiographic setting vis-à-vis the northeast India region in the perspective of the overall Himalayan climate change scenario as well as in the light of certain indicators that have already been observed. The annual mean maximum temperatures in the region are rising at the rate of $+0.11^{\circ}\text{C}$ per decade. The annual mean temperatures are also increasing at a rate of 0.04°C per decade in the region. Assam is very much a part of this regional warming trend. However, there is no significant trend in rainfall for the region as a whole i.e. rainfall is neither increasing nor decreasing appreciably for the region as a whole. However, for a part of the region comprising Nagaland, Manipur, Mizoram, Tripura and parts of the Barail Hills, making one of the 36 meteorological sub divisions of the country, a significant change in seasonal rainfall has been observed. The summer monsoon rainfall is found to be decreasing over this region significantly during the last century at an approximate rate of 11 mm per decade. More rigorous studies are required at regional scale to ascertain intra-regional trends in temperature and rainfall in this part of India. Several districts of Assam were badly affected due to drought like situations consecutively for two years in 2005 and 2006 which had a signature of climate change on them as vindicated by the IPCC report of 2007(IPCC, 2007a). In the intense drought-like conditions that prevailed in as many as 15 districts of Assam during the summer monsoon months of the year 2006 owing mainly to below normal (nearly 40%) rainfall in the region, more than 75% of the 26 million people associated with livelihoods related to agriculture in these districts were affected and the state suffered a loss of more than 100 crores due to crop failure and other peripheral effects. The recent spell of drought during October 2008 to July 2009 also has severely affected agriculture and production of hydropower in Assam and its neighbouring states. Normally such fluctuations in rainfall are considered as results of inter-annual variability of the southwest monsoons, but then the normal mode of this variability has changed (becomes erratic) because of climate change.

As a result of global warming, glaciers in the Himalayas are retreating at an average rate of 15 meter per year, consistent with the rapid warming recorded at Himalayan climate stations since the 1970s. Under a warming environment the Himalayan

glaciers are expected to melt faster leading to increased summer flows and flooding initially for a few decades followed by progressive reduction in flow as the river-feeding glaciers recede and disappear from the headstreams. Moreover, in case of glacier-fed rivers, glacial-melt runoff is seen to augment winter flow in the lean season. The mainstream of the Brahmaputra river (known as the Yarlung Jhangbo in Tibet, China) and some of its tributaries like the Subansiri and the Jia- Bharali are partly fed by snow-melt run-off in the trans- Himalayan and Himalayan parts of their basins. With glacial contribution decreasing over the years, future lean season flow (low flow) may decrease in the Brahmaputra basin leading to increased water stress and changed hydrological regimes of the rivers as well as altered eco-hydrological characteristics of the riparian ecosystems. As a result agriculture on which large populations depend for livelihoods and diverse ecosystems that sustain a rich biodiversity and food security in the state may be jeopardised. Important forest ecosystems (especially grassland and wetland environs) on river banks such as those in Kaziranga, Manas, Pobitora, Burhachapori, Panidihing and Dibru Saikhowa may see changes in the normal mode of land water interactions which may have significant detrimental effect on the micro-environment characterised by temperature, soil moisture, humidity and radiative properties on which the sustenance of many wild flora and fauna depends. Projected increase in rainfall and accelerated summer flows may give rise to more intense flooding and flood hazards in the Brahmaputra valley as an immediate consequence, but subsequent retreat of glaciers may reduce flows in the long run.

Extreme precipitation events (heavy rain storm, cloud burst) may have their own impacts on the fragile geomorphology of the Himalayan part of the Brahmaputra basin causing more widespread landslides and soil erosion. The response of hydrologic systems, erosion processes, and sedimentation in the Himalayan river basins could alter significantly due to climate change. Glacial recession is also linked to increased sediment load in rivers. A number of major flash floods have occurred in this decade due to heavy rainstorms or cloud bursts in the state or in the upper catchments of the rivers in the neighbouring states (Meghalaya, Arunachal Pradesh) and highlands in other countries (Bhutan, China). Some of the major flash flood episodes took place in Goalpara (2004), Bordekorai (Sonitpur, 2004), Dhemaji (Jiadhal, 2007), Lakhimpur (Ranganadi, 2008), North Kamrup (Puthimari, 2008), and Dhemaji (Nanadi, 2009). These flash floods have caused hundreds of deaths, huge economic loss and colossal damage to infrastructure and public and private property. Such extreme events, many of which go unrecorded due to lack of an adequate hydro meteorological gauging network, may be indicators of a changing climate in this region. Over exploitation of the ground water resources in this fluorosis affected zone may also lead to increased proliferation of fluoride contamination.

The southern part of Nagaon district in central Assam valley and adjoining parts of Karbi Anglong form a rain-shadow zone where annual rainfall is as low as 800-1200 mm. Water scarcity is a potential constraint for the people living in these areas. Absence of effective irrigation systems or water harvesting practices adds to the vulnerability of the people. Lumding, located centrally in this zone shows a decline in rainfall at a rate of 2.15 mm per year. As a result water crisis might aggravate in this region in the coming years.

Recession of glaciers caused by climate change have created more glacial lakes in the Nepal, Bhutan and Tibet Himalayas and increasing glacial lake outburst floods(GLOF) have caused more flash flooding in the Greater Himalayan Region in recent times. On the other hand increase in landslides have led to natural damming of upland river courses and consequent bursting of the same have produced landslide dam outburst floods (LDOF) sending off waves of flash floods in downstream areas. GLOF and LDOF- induced flash flooding are ubiquitous in the Himalayan landscape and those occurring in the western as well as eastern Himalayas have already affected people in Himachal Pradesh, Uttaranchal, Arunachal Pradesh and Assam very severely. The catastrophic floods in western Assam in 2004 were a result of a landslide induced flood in the Bhutan hills. Similarly another large LDOF-induced flash flood caused havoc in the bordering areas of Arunachal and China in June 2000.

The Northeast Indian region is going to see massive distortion of its hilly landscape due to the construction of large dams as part of more than 168 hydropower projects envisaged in the next five decades, out of which more than 100 hydropower dams are in Arunachal Pradesh alone. Government of India is also promoting large dam-based hydro projects in Bhutan like the Mangdechhu Hydroelectric Project in the Manas river basin (in Bhutan). Given the high probability of increased heavy rainfall events, landslides, formation of GLOFs and LDOFs due to climate change in the Himalayan region, threats of flash floods from the large dams in Arunachal and Bhutan, will always loom large over the downstream populations in Assam.

Last but not the least, Assam, which is endemic to malaria, is slated to become more vulnerable with widespread transmission of malaria by the year 2050 due to impact of climate change that helps vector borne diseases to thrive and propagate in increased temperature and humidity conditions. The current spate of deforestation and degradation of primary forests will make the state even more susceptible to climate change in the coming years.

3.0. Views and recommendation in different thematic areas

3.1. Water Security and Sustainability

The Brahmaputra and Barak are the major river systems of Assam having a dense network of tributaries that have created a large fluvial base for the entire geographical area of the state. These rivers have given rise and are linked to most of the wetlands of the state. There are 764372 ha of land area that belongs to wetlands in the state, which represents 9.74 % of the total geographical area, out of which 637164 ha of area belongs to rivers and streams, 51257 ha belongs to lake/ponds, 47141 ha to water logged area and 14173 ha is occupied by Ox-bow lakes (***National Wetland Atlas: Assam**, MoEF, GOI, Space Applications Centre, ISRO, ARSAC, 2010*). Moreover, the state has large numbers of water tanks and wetlands with heritage importance and these are distributed through out the state.

The discussion on the issues of water basically highlights the need for a database on water availability, water quality as well as access to data sources for different uses

and applications. Moreover, the discussions highlight the concerns about the degradation of sources of natural water through unplanned developmental activities, pollution, and over-exploitation. Issues related to water borne diseases, water logging and flood were also discussed. The participants took note of the fact that the state has vast areas belonging to rain-shadow areas and piedmont plains. Such areas also experience intense water crisis throughout the year depending on variability of rainfall, surface and sub-surface water. Therefore, participants put forward their opinion to address such issues.

3.1.1. Required policy interventions:

- Review of existing draft water policy of the state is needed with due consideration of the ground reality of each of the agro-climatic zones of the state. There is need to consider the characteristics of the ground water regime (occurrence, variability in quantity and quality and pattern of use), mechanism of water sharing by ensuring water based equity in execution of plan and action.
- Integration of all existing acts, laws and rules related to water to a single act is desirable. Integration of state level policies in National Water Mission and other relevant missions of the National Action Plan on Climate Change are also required.
- Fundamental right of every citizen to water shall remain non-negotiable. Privatization, if deemed unavoidable, should be limited only to treatment, distribution and associated activities while taking care that those who cannot afford to pay for privatized service charges (e.g. BPL families) should be exempted as far as possible or compensated by subsidies from the Government
- Government needs to be careful in planning and execution of hydel project and negative impacts should be avoided as far as possible specially when there is a large population in the downstream areas of a river on which project is being planned.
- Water security issues should be given priority over all other issues in case of hydro-power/storage reservoirs projects. The state Government must negotiate the riparian and downstream rights of its people with neighbouring states upstream, with whom the state shares river courses and basins. Those projects in neighbouring states that have a high potential of affecting downstream areas in Assam detrimentally must be vetoed against through administrative and legal means
- Creating regulatory strategies for usage of ground water in both urban and rural areas of the state has become a necessity.
- Strategic policy interventions are required in the case of common property resources (CPR) such as wetland and other water sources.
- Integrated data base on water resources of the state (addressing both quantity and quality) is essential. It should be entrusted to one single body for creation and management of data base, so that people's access to data base can be ensured without procedural complexity and different stake holders can

use the same for different public interest works (e.g. knowledge, research, community based work, sustainable private use).

- Following important wetlands, apart from the wetlands already declared as sanctuary/proposed to be sanctuary (e.g. Deepor Beel and Bordoibam), should be declared as a State Wetland of Importance and specific conservation, restoration and development initiatives should be undertaken for protection of their ecological integrity and livelihood security :
 - i. Merbeel (Dibrugarh)
 - ii. Maguri Motakong (Tinsukia)
 - iii. Morikolong, Samaguri (Nagaon)
 - iv. Saron, Morakolong, Bormonoha (Morigaon)
 - v. Silsako (Kamrup)
 - vi. Kapla Beel (Barpeta)
 - vii. Tamranga, Kanara, Suksuka, Kayakujia (Bongaigaon)
 - viii. Dhir, Diplai, Saraswar (Dhubri)
 - ix. Hasila, Urpada (Goalpara)
 - x. Bathabeel (Darrang)
 - xi. Satla (Cachar)
 - xii. Sonbeel (Karimganj)
- It is important to identify water heritage sites and develop appropriate plans for their preservation. Such sites may incorporate the historically important water bodies (like the water tanks and temple tanks of Upper Assam,) lakes, streams, part of river etc.
- The state should go for a single “State Wetland Authority” to take care of conservation (ecosystem, aquatic flora, fauna and dependent wildlife in general), sustainable utilization (fishing, collection of aquatic plants), eco-tourism, eco-restoration and other economic uses.
- Emphasis should be given on developing micro level plans for conservation of surface and ground water systems in urban and rural areas with involvement of local communities preferably in tune with and to complement existing micro-watershed development schemes.

3.1.2. Required developmental interventions

- Restoration of wetland in different ecological settings: The scope of existing programmes like NREGS should be extended to include such activities like wetland restoration and creation of new water sources as well as making water harvesting structures.
- Renovation and development of traditional water harvesting systems like Dong, Longsor etc and augmentation of their utility by appropriate scientific intervention.

- Communities dependent mainly on water bodies for their livelihood e.g. fishermen communities, Makhna harvesters, boatmen, dairy farmers etc. should be given special status and support.
- Rainwater harvesting and other water saving techniques should be intensively promoted and integrated in all developmental programmes.
- Roof-top harvesting should be made mandatory for all urban areas as well as in all public buildings of the state.
- Traditional drinking water sources, both natural and man-made, should be restored and developed.
- Plantation, management and improvement of riparian vegetation along water bodies, especially rivers by promoting indigenous practices of food and fodder cultivation with participation of local people is necessary to arrest river bank and soil erosion, shifting of river channel, river bed siltation as well as to enhance livelihood options.
- The coverage of area under Integrated Watershed Management Programme (IWMP) should be increased in all watersheds of the state with more opportunities for community participation in preparation of plan at the micro-watershed level.

3.1.3. Proposed areas of further research

- Real time water quality monitoring of all streams and rivers, more specifically in the confluence zones.
- Strategic research to develop riparian management plan in relation to riparian right, land-use planning and protection and enhancement of ecological services.
- Water audit in the industrial houses, irrigation projects, river dams (for any purpose), tea gardens, public buildings and housing complexes for preparation and promotion of water conservation measures. The possibility of working in the Public-private partnership (PPP) mode can be explored in such cases.
- Study of present status of wetlands and preparation of conservation, management and development plan.
- Documentation of best practices in water harvesting incentives for innovative ideas and application thereof for improving the usefulness of these practices.
- Research on healthcare to fight water-borne diseases.
- Development of low cost water purification technology to remove contaminants like iron, arsenic, fluoride and biological pollutants.

3.1.4. Proposed areas of capacity building

- Awareness among the masses on water harvesting and water conservation (with emphasis on wise use and prevention of wastage of

water) both in domestic, community and commercial sectors in urban and rural areas through

- A state-wide Water Literacy Campaign.
- Capacity building of technical and management personnel both in Government and private sector involved drinking water supply and management, in the aspects of new technology of water purification.
- Community based awareness, capacity building and action initiation in wetland conservation, restoration and management.
- Capacity building of relevant people of different sectors in water audit and water budgeting.

3.2. Sustainable agriculture and livelihood security

Agriculture plays a vital role in the economy of Assam with 28,75,896 hectares of land under agricultural use, which represents 36.66% of the geographical area of the state (*Statistical Handbook, Assam, 2008, GoA*). The gross cropped area occupies about 36.37 lakh hectares. The cropping intensity is 152.43 percent. Rice, which is at present grown mainly during the kharif season, dominates the agriculture scenario in Assam, of which winter (Sali) rice in 2002-03 occupies an area of 17.49 lakh hectares and autumn (Ahu) rice another 4.64 lakh hectares. The third rice known as summer (Rabi) rice is grown in an area of 3.27 lakh hectares. The area under summer rice has shown an increasing trend with advancement of irrigation facilities mainly by way of Shallow Tube Well (STW). The other food grain crops like wheat (0.70 lakh hectares), pulses (1.23 lakh hectares) and maize etc. (0.20 lakh hectares) are also grown. The important commercial crops are oilseeds (3.39 lakh hectares), sugarcane (0.25 lakh hectares) and jute (0.68 lakh hectares).

Irregular climate variability leading to erratic monsoon, frequent floods, drought-like situation and warmer winter have had detrimental impact on agriculture in Assam. Though the recurrent floods have been the major causes of crop loss, drought –like situation also affected several districts of the state during 2005, 2006 and 2009. Increase in intensity and frequency of flooding with more flood waves per season will damage more standing crop and crop land. Increased erosion of soil from upstream hills due to enhanced extreme rainfall episodes will increase silt load of rivers. It will result in rising of river bed, and consequent flooding with less input of rainfall. Spreading of excessive silt and sand has already damaged vast areas of arable land in several districts of Assam like Dhemaji, Lakhimpur, Morigaon, Dhubri etc. The intensity of land degradation due to sand casting by flood waters is likely to increase in future.

Agriculture in Assam has remained rain-fed and will continue to do so in the next few decades. Therefore, significant aberrations or change in regional weather climate patterns will negatively affect the agricultural output of the state. Fluctuations in the amount and distribution of rainfall, minimum temperature, sunshine and moisture content of air influence occurrence of flood, drought and cause changes in the disease-pest complex., which may exert impact on agricultural productivity.

Climatic change is likely to aggravate the heat stress in domesticated animal, adversely affecting their productive and reproductive performance. Increasing temperature of river water and wet land water is likely to affect breeding, migration and harvest of fish reducing productivity of natural and reared fisheries. Moreover, increase in flood events associated with increased precipitation and melting of glaciers may make wetlands unproductive by siltation. In these contexts it is very much essential to adopt suitable adaptation strategies in the areas of agriculture.

3.2.1. Required policy initiatives

- Review and reframing of 'state agriculture policy' in the context of climate change vulnerability, incorporating the strategic guideline for each of the agro-climatic zones.
- Establish linkage of agricultural policy with those on water and land use so that they become synergistic and complementary to one another, especially with respect to irrigation and other means of water harvesting for agricultural uses.
- Introduce and promote insurance of crop, farm land and livestock by ensuring minimum risk for farmers.

3.2.2. Required developmental interventions

- Restructuring or re-designing of crop calendar and cropping systems /patterns and crop adaptability.
- Promotion of System of Rice Intensification (SRI) approach in selective agro-climatic zones and promotion of aerobic rice.
- Application of organic carbon (by use of weeds for charcoal making) to enrich soil with moisture.
- Specific measures for weed control and pest management.
- Promotion of traditional water harvesting practices with scientific improvisation, e.g. farm pond, dong, longsor etc.
- Introduction of the concept of seed village to ensure the reliability of seed supply through proper procurement and distribution systems.
- Promotion of community managed wetland fishery with proper care taken for ecological integrity and sustainability of resources.
- Promotion of agro-forestry in different agro-climatic zones, with special attention to the hill areas for improvisation of traditional agricultural practices like shifting cultivation (jhum), to reduce ill effects on environment and increase productivity.
- Promotion of summer rice (e.g. boro varieties) with provisions of irrigation.
- Popularization of culture/cultivation/plantation of nutrient rich crops, e.g. mushroom.
- Promotion of post harvest value addition, rural agro-based entrepreneurship development with ensured access to market.

- Restoration of soil degraded due to deposition of sand to recover its productivity along with incentives and subsidies to affected farmers.

3.2.3. Proposed areas of further research/ study /planning

- Developing Decision Support System combining database (of crop, soil, weather) and modern information tools (with simulation models, remotely sensed information, use of GIS platforms) to provide drought/flood alerts, monitoring the vegetation condition, develop crop yield forecasts and, identify best agronomic practices
- Define land use suitability classes at water shed/micro-watershed level for the entire state and renewal of the classification every five years to deal with changes occurring to agricultural land due to natural and anthropogenic factors.
- Development of appropriate crop rotation systems.
- Developing data base on genotypes of local crop varieties (mainly rice varieties,) and identification of suitable varieties for different agro-climatic zones. Special care for developing genotypes for tolerance to biotic/abiotic stress, e.g. drought, flood, disease and pest resistance.
- Documentation of wild edibles and assessing the prospects of domestication.
- Studies on weather-pest relationship and developing strategies for pest management.
- Documentation of Indigenous Technical Knowledge (ITK) and its standardization in the context of climate change adaptation in the areas of agriculture.
- Development and transfer of integrated nutrient management techniques to villages.
- Proper research on making agriculture possible on soil degraded due to sand deposition as well as on restoration of such soil to reclaim productivity

3.2.4. Proposed areas of capacity building:

- Awareness and capacity building of management staff and frontline staff of the line departments on the issues of climate change adaptation, crop rotation, water harvesting, pest management etc.
- Awareness and capacity building of farmers on climate change adaptability.
- Capacity building of farmers and other agro-dependent population on post harvest management and value addition.
- Use of mass media and other communication channels for disseminating agro-meteorological information acquired from agro-meteorological sources and other relevant services.
- Popularization of high yielding, low green house gas (GHG) emitting varieties/cultivars.

3.3. Sustainable Habitat for quality of life:

Sustainable habitat can be built through proper settlement planning in the aspects of housing, drainage, drinking water, sanitation, transport and communication, etc. both in the rural and urban areas. There are spatial inequalities in the quality and quantity of distribution of such amenities in the state (as in map -1, 2, 3 and 4). Moreover, many urban centres are facing serious problems of environment (pollution, degradation) and sanitation. Other important issues discussed by this thematic group include lack of land use policy and planning leading to unplanned development of settlement, industrial activities including developing industries in the residential and other sensitive (e.g. eco-sensitive area, fragile hills, green belts) areas, improper execution of building norms and codes in urban areas, problems of drainage and bad practices of waste disposal and management.

3.3.1. Required policy initiatives:

- It is necessary to adopt a state land use policy with specific consideration of rural area, urban area, areas under water and areas under wilderness. It may incorporate flood plain zoning, mapping of major and minor watershed, Panchayat level land-use mapping along with identification of habitat zones for the entire state.
- There is a need to develop strict building guidelines with provision of promoting traditional type of houses for different agro-climatic zone, flood plains and in general consideration of the seismic vulnerability of the state.
- Integrated drinking water, sanitation and drainage & waste disposal plan is required for both rural and urban areas.
- A perspective plan of settlement development for the state is needed with focus on reducing vulnerability and achieving sustainability especially in geo-ecologically fragile zones like river banks, river-islands (char lands), hill slopes and disaster prone areas adjoining industries, factories and four lane high ways.

3.3.2. Required developmental interventions:

- Strengthening the existing developmental programmes related to drinking water, sanitation, housing etc with priorities on vulnerable areas and marginalized under-privileged communities.
- Special initiatives for iron removal in case of drinking water with incorporation of new technology and improvisation of traditional practices.
- Urban settlement development plan is to be adopted with more priority on sanitation and environment.
- To improve the transport situation, there are requirements to improve the public transportation system and needs to be improved by transporting more people in less time with strategic plan for better traffic management which will reduce consumption of fossil fuel (petrol, diesel, CNG, LPG). Moreover, promotion of non-motorised vehicle (e.g. cycles, cycle-rickshaws) with

improved design to reduce physical strain in urban areas is also essential to reduce carbon footprint.

- A plan may be conceived to structure habitations of people and their association with environmental assists in conformity to the different agro-climatic zones that they live in. Such a plan may be piloted to develop some eco-villages in different agro-climatic zones to demonstrate people's traditional responses to environmental settings and changes.
- Important natural elements like wetland, hills, forests, vegetation cover in fringe areas that enrich a number of urban landscapes in the state should be preserved to ensure the ecological integrity of such landscapes by applying green technology to enhance ecological services of the urban ecosystems. Such urban areas include Tezpur, Nagaon, Jorhat, Sibsagar, Silchar, Goalpara, besides the city of Guwahati. Such urban centres can be developed as green urban centres.

3.3.3. Proposed areas of further research:

- Scientific study of the merits of traditional housing systems of the state and developing strategies for improvement of the same is urgently needed.
- Identification of locally available eco-friendly building material and research on production of such resources is required to reduce use of brick and mortar. Review of traditional land use practices among different ethnic groups of the state and identification of the best practices for re-application of the same in other situations to develop resilience in human settlement systems is essential.

3.3.4. Proposed areas of capacity building

- Awareness programmes on building safe household with good sanitation and waste management practices,
- Creating awareness on drinking water, sanitation, health and less consumptive lifestyle (requiring less use of energy, fuel, and synthetic material).
- More awareness camps and workshops are to be organized for the masses to make people aware of the environmental laws, regulations, norms and best practices related to housing, sanitation, water management, waste disposal etc.

3.4. Mitigating Natural Disaster and Crisis management

The geo-environmental setting of the state makes it highly susceptible to multiple hazards caused by geological, climatic and hydrological factors. The north region being a hotbed of the monsoons and the rivers of the region being hydrologically dynamic in tune with the monsoons and the freeze and thawa cycle of the Himalayann and trans-Himalayan glaciers and snowcover and Assam being surrounded by hilly areas through which most of the major rivers enter the valleys the state regularly experiences very high rainfall in the summer season including extreme events like cloud bursts often leading to catastrophic hydrometeorological

hazards mainly floods and flash floods. Anomalies in local and regional weather and climate triggered by global climate change have of late resulted in increase in occurrence of such hazards and consequent affect. Such affects will continue in the near future according to recent climate change predictions. The river Brahmaputra has 20 major tributaries joining from its north and 13 from its south. The north bank tributaries are mostly unstable, carry excessive sediments and therefore mainly responsible for the heavy sediment load of the Brahmaputra river, siltation of the river bed and lateral shifting of the river resulting in acute erosion of river banks and.

As much as 45% land area of 25 districts of the state is flood prone. Since 1950 river bank erosion became a major threat for the state because of the affect of the major earthquake in the eastern part of the state. So far, around 7.5% land of the state has been eroded by the Brahmaputra River which amounts to an annual average of 8000 ha of land erosion by rivers. Two hill districts and hilly belts of other districts including the hills of Guwahati city regularly experience landslides. Rainstorms and thunderstorm are two other hazards that the state suffers from, particularly during the pre-monsoon season. Occasional cyclones during monsoon season also cause severe damage to life and property. The severity of such cyclones is more in the western Assam. In the recent times, many parts of the state also witnessing drought like situation particularly in the dry winter and pre-monsoon seasons..

Some of the important factors, that makes the state vulnerable to climate-induce hazards are:

- Heavy sediment influx to the major rivers of the state due to changes in land use and land cover patterns in the upper catchment areas
- Lack of proper measures to improve carrying capacity of the major rivers for mitigating flood and erosion risk.
- Poor maintenance of the earthen embankments and dykes constructed to protect 1.63 million ha out of 3.15 million ha flood prone area of the state.
- High rate of embankment breaching during monsoon period and sand deposition on fertile cultivable lands.
- Floods created by large river dams built to produce hydropower
- Landslide dam induced flooding from high hills of Tibet(China), Bhutan, Arunachal Pradesh and Meghalaya
- Lack of genuine downstream impact assessment and damage mitigation plan of the ongoing hydroelectric projects.
- De-stabilization of river beds by boulder collection; encroachment of wetland and natural reservoirs; permanent settlement in char areas (sand bars/island) of the rivers etc.
- Enhancement of land slide risk in hilly ranges, including those around Guwahati city, due to violation of land use regulations and other human activities.

- Haphazard urbanization, unsustainable development and absence of genuine district disaster management plans (DDMP) for all the districts of the state based on hazard pattern and location specific risk assessment.
- Non-implementation of Incident Command Systems in most of the districts.
- Lack of a well structured and equipped disaster management unit in the state (having academic, administrative, management, financial...wings) for formulation and execution of disaster management (DM)plans.
- Lack of skilled and trained manpower, emergency equipments, tools and kits in the DM cells/ organizations of the districts.
- Lack of coordination among government,. line departments, academic institutions and vulnerable communities.

3.4.1. Required policy initiatives

- A state policy for natural disaster management should be framed, with shifting approaches from relief operation to crisis management, emphasizing on
 - Establishment of separate Disaster Management (DM) wings in every districts with required skilled manpower, infrastructure, emergency equipment and tools for preparation of District Disaster Management Plan (DDMP) and its proper execution.
 - Early establishment of State Disaster Response Force (SDRF) in the line of National Disaster Response Force (NDRF), involving police and fire brigade personnel with the provision of training of the SDRF by NDRF, capacity building of the SDRF in terms of skilled manpower, equipment, tools and adequate fund provision.
 - Establishment of well equipped District Disaster Response and Block Disaster Response Forces involving volunteers trained up by the SDRF/NDRF (students, NCC, NSS, NGO, CBO and community members) with the provision of procurement of emergency equipment and tools, monthly remuneration, insurance of the volunteers etc.
 - Establishment of separate DISASTER MEDICAL TASK FORCES for all the blocks with trained doctors and staff to handle disaster like situations. Provisions should be there for procurement and storage of medical kits and life saving medicines.
 - Standardization of relief policy and calamity relief funds.
 - Guide lines for mass awareness of land use regulation, catchment management, relief camp management, environmental management, first aid, health and hygiene etc.
 - Enforcement of laws and norms in the above domains

3.4.2. Required developmental interventions

- Flow treatment of minor and major streams.
- Strengthening crop and livestock insurances.
- Development of seed and fodder bank in flood prone areas.
- Maintenance and close monitoring of existing embankments and their timely repair in case of sudden breaches with participation of local communities. Preparation of village, Panchayat and block level inventory planning, contingency planning.

3.4.3. Proposed areas of further research/ study /planning:

- Vulnerability Assessment (physical, social, environmental, economic, infrastructure and other related issues) and hazard mapping using RS/GIS technology.
- Flood plain zoning and zone wise land use plan development.
- Development of early warning systems for floods and flash floods.
- Development of Community Based Disaster Management Plan.
- Economic and environmental damage estimation of on going disasters or those that have happened in the recent past.

3.4.4. Proposed areas of capacity building:

- Awareness and training on disaster preparedness, risk minimization and management in all the public institutions, establishments with focus on disaster preparedness education.
- Capacity building of the people involved in relief, rescue and management operation.
- Developing 'ham radio' network along with training of operation through educational institutions like Higher Secondary schools and colleges for information networking in the crisis period and for disseminating early warning information in vulnerable areas.
- Developing community radio for information networking.
- Incorporation of compulsory credit based disaster management courses in school and college curricula in the line of national policy.

3.5. Protection and Sustainable Management of Forests and Wildlife

The geographical areas of the state lies in the transitional zone of Indo-Malayan and Indo-Chinese and India, along with two migratory route of birds - the Central Asian flyway and East Asian-Australian flyway which enriches floristic and faunal composition of the region.

The major types of plant communities found in the region can be grouped under Moist Evergreen Forest, Moist Semi-Evergreen, Moist and Dry Deciduous forest,

Hydrophytes in vast stretches of wetlands (riparian belts, swamps and marshes), Bamboo brakes, Scrubland and Grass land (both wet and dry). These vegetation type creates the treasure house multidimensional biotypes in the region with occurrences of a number of Endemic Plant Species and some important primitive Angiosperms.

The region is blessed with very high degree of endemic, taxonomically and ecologically high valued faunal species. The richness of the composition is reflected with 3017 species of flowering plants, more than 193 species of Orchids, 41 species of Bamboo, 14 species of Canes, more than 164 species of Mammals, 9 species Primates, more than 800 birds' species, more than 60 amphibians, etc. The forest cover of the state represents 34.45% area of the state with 17.68% of geographical area in Reserve Forest and 5% of geographical area under protected area net work. It is noteworthy that there are a larger numbers of rare, threaten and endangered species found in the state out side the formal forest areas too.

The climatic abrasion and weather anomalies will exert impacts on phonological cycle of the floral species and disturbed the ecosystem interlink in specific eco-regions and exerting impacts on habitat pattern of fauna over there. Similarly there are possibilities of impacts out of flood and draught on wildlife habitat also. Moreover, if the on going anthropogenetic pressures are not addressed pragmatically it may also worsen the situation. Therefore, there is the necessity of taking care of protection and management strategies for these forest and wildlife resources with priority in issues of maintaining the ecological integrity, people participation in interventional initiatives and livelihood security measures for the people of forest fringe areas, eco-system benefit sharing mechanism in the approaches protection and conservation practices.

3.5.1. Required policy based initiatives

- The existing state forest policy to be reviewed to incorporate strategic issues of climate change vulnerability and incorporation of guideline for the state in the areas of carbon trading issues with prioritization protection of public interest instead of creating path way corporate houses.
- It is necessary to incorporate some incentive mechanisms or benefit sharing mechanisms in the area Community Conserved Areas and protection of valuable species outside the forest.
- The list of forest product has to review for incorporation of new product or exclusion of some product in relation to the ground reality.
- Pragmatic and speedy implementation of all institutional /bodies in all the levels up to the village Panchayat as per the guide line of Biodiversity Act, 2002 along with the initiatives for developing People's Biodiversity Register (PBR) for all the Panchayat of the state.
- Special strategies for sustainable harvesting of NTFP, value addition and marketing.
- Prioritization of species in plantation programme in relation to eco-region/agro-climatic zones with mandate of incorporation of endemic species only.

- Review of Forest Right Act (FRA), 2006, with impetus on regional changes and localized issues of encroachment/issues of immigrant settlement in encroachment of the state. The Original cut-off date (13th Oct, 1980) desired to be applied in case of Assam. It is desirable that implementation of act to be stopped until proper local strategic precautions are not incorporate in execution ground role. GIS based mapping to be carried out as necessitated in Sec. 6 (1) of FRA with immediate effect.
- Special strategies for recovering encroached areas.
- Demarcation of eco-sensitive zones and regulation of developmental projects like industrial activities, quarrying and mining in such areas in the context of the state.

3.5.2. Required developmental interventions

- It is the need of the hour to strengthen and coverage of the on going programme/project of forestry sectors, viz. Joint Forest Management, Project Tiger, Project Elephant, Project Rhino, Eco-development programme, National aforestation programme, etc.
- New initiatives for watershed development and management within forest networks, management of wetland (within forest areas), new initiatives for grass land management.
- Special initiatives for protection of vulnerable species outside the forest areas.
- Special initiatives for promotion of Community Forestry in the state.
- Initiatives for strengthening the management and protection network and focused emphasis to be given on community participation.
- Strengthening the initiatives to control the wildlife trading.
- Strengthening the on going initiatives as well as incorporation of new initiatives to develop eco-tourism in wildlife areas with wider scope of community based management and sharing mechanism.
- Drives for alternative livelihood opportunities for the people living in the fringe areas of forest.
- Drives for protection of wildlife corridors.
- Initiatives for bio-diversity documentation at the village Panchayat level, along with documentation ethno-cultural interlink to safe guard IPR.
- Special drive for control of the alien /invasive plant species.
- Plantation on the degraded forest, riparian sites (Promotion of bamboo and can plantation in riparian areas).
- Use modern information technology and geo-informatics in day to day management practices.
- Preparation of latest comprehensive database of biodiversity- species, ecosystems & genetic traits with reference to status, pressures & ongoing responses with reference to Climate Change.

3.5.3. Proposed areas of further research/ study /planning:

- To undertake long term study to assess the vulnerability of major forest types and associated fauna found in the state to Climate Change in PAs and outside PAs.
- Research programme to identify the changes in phenology of wild flora in different ecosystems/habitat with the degree of changes.
- Pilot study for the critical ecosystem like grassland, riparian forests (prone to erosion & flooding) and patches of the rain forests in eastern Assam to assess the impacts of Climate Change and possible adaptation interventions.
- Studies for identification of endemic plant species having high carbon sequestration potentials,
- Studies on identification of keystone species for different eco-zones with perspectives of developing strategies for eco-restoration,
- Study on the process of carbon sequestration, REDD, methods of capture & storage for future scope of trading.
- Intensive research on the sensitivity of the endemic taxa - both flora and fauna to Climate Change including the probable impact on restricted range, limited dispersal capability & low population.
- Identification of natural threats /disasters to the forest Landscapes with special reference to Climate Change and the forest products,
- Long term study on the changes in Life cycle- physiology, reproductive biology & feeding behaviour of wild fauna specially the endangered keystone species (both herbivore & carnivore) with reference to Climate change.
- Studies on weather & climatic anomalies and invasive species,
- Study the natural adaptation mechanism of species and the degree of resilience of their habitats to climate change
- Study of the intensity of Diseases of wild flora & fauna due to changing climatic conditions.
- Study & restoration of Natural corridors for natural connectivity and efficient resource use by wildlife specially in disturbed habitats to minimize the Human-Animal conflict due to fragmentation & habitat loss.
- Creation of long term research plots,
- Use and application of geo-informatics in forest and wildlife management,
- Assessing livelihood alternative for forest dependent people/eco-system people,
- Studies on wild edibles as alternative food sources and issues of domestication along with scope of bio-technology application.

- Documentation of indigenous knowledge and practices used for adaptation/coping to climate change.

3.5.4. Proposed areas of capacity building:

- Awareness among the masses on forest and wildlife protection, Sustainable Lifestyle, low carbon use/alternative energy sources
- Capacity building of front line staff of the forest department in the aspects of crisis management in disaster situation, use of new tools and techniques of information technology & geo-informatics in day to day management practices, community based management practices to ensure community participation in the protection and management issues.
- Capacity building of NGO's working in the field of forest and wildlife in the context climate change vulnerability minimization and crisis management and mobilizing community participation,
- Launching of short term and long term curricular intervention through higher educational institutions in the areas of wildlife management, eco-restoration, natural resource management, wetland management, etc with an objectives of developing more trained man power.
- Strengthening the implementation of on going compulsory subject of Environmental Studies both in schools and colleges.
- Creation of a multi-stake holder Climate change network / State Climate Change Board involving scientists/researchers/corporate/civil society/government etc for sharing and exchange of information and data with strict control over sensitive data access & use.
- Development of communication material in different areas forest, wildlife and environment not only in Assamese but also in other ethnic languages like Bodo, Karbi, Dimasa, etc.
- Launching of new programmes in the line of National Green Corps (NGC) to involved youth (graduate and post graduate students) in Environmental Protection Initiatives.

3.6. Energy sufficiency and efficiency

Energy is a critical commodity. It functions as factors of production, as a process feed stock and as consumer goods. In the context of climate change efficient and rational uses of energy as well as use of renewable sources helps in the mitigation processes and reducing the carbon foot prints too.

The state having an immense potentiality in energy sectors with its stocks of water resources, oil and natural gas, coal, bio-resources mainly. Assam produces very limited amount of electricity in comparison to country's scenario, where per capita consumption is also limited. But in recent decades scenario is changing in urban centers of the states, where uses of electrical appliances/gadgets are increasing along with uses of personal vehicles. The peak demand of the state varies from 720 MW to 780 MW. Out of this only 130 MW to 150 MW of power is being generated from its own power stations. Around 400 MW power is being imported from central

sector generating stations in North Eastern Region and reaming from other sources like private producers, power trading agencies etc. There is a shortfall of about 100-150 MW during peak demand. On the other hand Assam still having places with inaccessibility from the electricity grid line, constant supply of commercial energies, where woody biomass dependent consumption pattern still exists. In these context there is need of changing energy focuses of the state to DEFENDUS (Development Focused End Use – oriented service directed) approaches, focuses of energy services with prioritization of conservation, getting maximum efficiency in low inputs from diversified renewable by mix with non-renewable sources. For which decentralized energy planning and management mechanism to be adopted. Moreover, to achieve a desired result following step's can be undertaken in the line.

3.6.1. Required policy based initiatives

- Formulation of localized programme (for each regional agro-climatic zone) connecting the grass root issues in the light of national programmes,
- Framing of state energy policies with incorporation of new demands which focuses on following aspects :
 - Mixed use strategies in energy sector – Small Hydro Power strategy,
 - Promoting energy efficiency in the residential, commercial and official complexes and buildings.
 - Adopting energy conservation building codes (ECBC) during construction of buildings,
 - Promotion and popularization of solar thermal technology in water heating to replace electric geysers in households and commercial establishments like guest houses, hotels, hospitals etc.
 - Mandatory use of solar water heaters in public and private buildings.
 - Solar thermal technology for industrial and commercial heating specifically for water and air heating.
 - Industrial houses particularly (tea, cement and pulp, paper etc.) should be involved in the energy sufficiency and efficiency programme and industry-friendly policy measures should be in place. Stringent measures for violation of “Energy conservation and energy efficiency norms” are to be ensured.
 - The initiations that have begun in utilization of bio-energy in small scale industries (Tea processing, biscuit processing etc.) and enterprises (dhaba, restaurants etc.) in Assam should be provided with necessary techno-economic back-up.
 - Utilization of degraded forest/unutilized govt. land and agricultural land for optimal renewable energy generation with coordinated research back-up.
- Environmental aspects of any power project needs to be pre-evaluated strictly.
- Proper Implementation of Energy Conservation Act.
- A special Climate Change fund – Adaptation fund in the energy sector.

- Incentives to energy users adopting Energy Efficiency
- Effective measures to be adopted to reduce transmission and distribution losses including better enforcement.
- Special incentives to private power producers through solar photo voltaic and solar thermal for grid fed electricity are to be incorporated in the light of the JNNSM of Gol.

3.6.2. Required developmental interventions

- Establishment of solar thermal power stations.
- Grid Interactive Solar Photovoltaic power plant.
- Solar Home Lighting Systems in rural areas to replace kerosene lamps.
- Solar Street Lights/Solar Garden Lights in all streets, campuses, parks, lawns, crematoriums.
- Public toilet Units with self sustaining biogas generation.
- Community kitchens/Hostel kitchens with biogas generation from wastes.
- Power generation units from MSW in all towns, cities, semi-urban areas, villages.
- Extensive public transport facilities and non-motorized modes over personal vehicles.
- Promotion and use of energy saving devices BEE's Star labeled appliances.
- Ensure easy availability of solar appliances for domestic users with adequate publicity, capacity building and accessibilities.
- Popularization of improved chullas., with appropriate design suitable to different agro-climatic zones,
- Introduction of improved chullas for preparation of mid day meals in all schools and Anganwadi centers along with fuel wood tree plantations.
- Promotion of community based small, micro, mini hydel plants.
- Promotion of energy plantation.
- Power generation units from MSW in all towns, cities, semi-urban areas, villages.
- Launching of energy audit in all commercial and industrial houses, public buildings.
- Mandatory energy efficiency lighting in all advertisement drive like hoardings etc.

3.6.3. Proposed areas of further research/ study /planning

- Development of Solar Home Lighting systems appropriate to the region through technological research,

- Energy need/demand assessment in all users sectors including agriculture, industry, commercial sector, service and domestic sector up to the next 50 years.
- Assessment of renewable energy resources availability and their competitive uses.
- Technological status (existing as well as prospective up-gradation) and R & D requirements particularly in biomass, solar, hydro in independent as well as in hybrid mode (based on locally available prospective resources viz. crop residue biomass, woody biomass including forests and bamboo biomass with provision for re-plantation.)
- Best practices adopted elsewhere in the country on renewable energy and energy conservation application be analyzed in view of the geo-climatic condition of the state and adopted wherein possible.
- Generation of database on issues like bio resources assessment, NPP (Net Primary Products) load and demand assessment and mapping on bio energy resource is recommended.

3.6.4. Proposed areas of capacity building:

- Generation of awareness in all sections of the society regarding energy conservation, renewable energy sources and its uses,
- Sensitization and capacity building of SHGs for propagation of improved chullas and biogas plants.
- Training professionals on energy audit and management by introducing short term courses in technical educational institutions,
- Capacity building of the technician (like electrician) on energy efficient devices and its uses,
- Promotion of solar passive housing concept,
- Energy conservation campaign through mass media and other means of communication.

4.0. Final recommendation

Reviewing the situation, the gathered scholars, academia and civil society in all the consultative workshops put forward following important suggestion:

- Initiatives for inter-departmental coordination at all level for pragmatic execution of all the action plan,
- Capacity building of the concern departmental people about climate change adaptation and mitigation issues and strategies,
- More focus on community participation with adaptation of Community Based Adaptation (CBA) approaches,
- Priority to involved community based institution, local NGO's and Civil Society, Local R& D institution and expert group in all the aspects planning, execution and monitoring exercises,

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- Formation of core expert group with experts from the respective field, representative of line department, R&D institutions, Donner agencies and civil society for finalizing strategies which must be open for accessing the public opinion too.

5.0. Additional thoughts

Dr Partha J Das (Water, Climate and Hazard Programme; Aaranyak, Guwahati)

Introduction

Starting with the second half of the last century strong and unambiguous evidences have emerged establishing the fact that the earth's climate has been significantly altered by impacts of anthropogenically induced changes in its natural systems. These changes are different from those generated by the intrinsic internally driven natural variability that has remained a part of the earth's climate system for millions of years. The earth's atmospheric composition has been subjected to significant changes due to human activities like excessive burning of fossil fuel and large-scale tropical deforestation since the pre-industrial era. This has resulted in a consistent build-up of heat trapping green house gases (GHG) and consequent rise in the globally averaged temperature near the earth's surface,. The Intergovernmental Panel on climate change (IPCC) defines climate change as any change in climate over time whether due to natural variability or as a result of human activity. Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be caused either due to natural internal processes or external forcings, or persistent anthropogenic changes in the composition of the atmosphere or in land use.

Climate change has cascading and far reaching affects on almost every aspect of environment and societies as have been observed all over the world. The prognostications for the 21st century climate are serious enough to warrant the maximum possible efforts on a war footing to deal with the challenge of mitigating the adverse impacts. In a developing country (that are most vulnerable to climate change) like India it has become indispensable for Governments, institutions and individuals alike to understand the basics of climate change and its implications at appropriate levels and take suitable mitigatory and adaptive measures to reduce the detrimental affected being forseen.

Climate change scenario in northeast India

The northeastern region of India is expected to be highly prone to the consequences to climate change because of its geo-ecological fragility, strategic location vis-à-vis the eastern Himalayan landscape and international borders, its trans-boundary river basins and inherent socio-economic instabilities. Environmental security and sustainability of the region are and will be greatly challenged by these impacts. The annual mean maximum temperatures in the region are rising at the rate of +0.11°C per decade. The annual mean temperatures are also increasing at a rate of 0.04°C per decade in the region. However, there is no significant trend in rainfall for the region as a whole. However, for a part of the region comprising Nagaland, Manipur,

Mizoram, Tripura and parts of the Barail Hills, making one of the 36 meteorological sub divisions of the country, a significant change in seasonal rainfall has been observed. The summer monsoon rainfall is found to be decreasing over this region significantly during the last century at an approximate rate of 11 mm per decade. More rigorous studies are required at regional scale to ascertain intra-regional trends in temperatures and rainfall in this part of India.

Implications of climate change for Assam

Assam is very much a part of this regional warming trend. Assam is even more vulnerable to climate change than its neighbouring states in case of some of the impacts such as climate induced water hazards because of its location at the feet of hills all around. Several districts of Assam were badly affected due to drought like situations consecutively for two years in 2005 and 2006 which had a signature of climate change on them as vindicated by the IPCC report of 2007(IPCC, 2007). In the intense drought-like conditions that prevailed in as many as 15 districts of Assam during the summer monsoon months of the year 2006 owing mainly to below normal (nearly 40%) rainfall in the region, more than 75% of the 26 million people associated with livelihoods related to agriculture in these districts were affected and the state suffered a loss of more than 100 crores due to crop failure and other peripheral affects. The recent spell of drought during October 2008 to July 2009 also has severely affected agriculture and production of hydropower in Assam and its neighbouring states. Normally such fluctuations in rainfall are considered as results of inter-annual variability of the southwest monsoons, but then the normal mode of this variability has changed (become erratic) because of climate change.

The mainstream of the Brahmaputra River (known as the Yarlung Jhangbo in Tibet, China) and some of its tributaries like the Subansiri, the Jia-Bharali, the Manas and the Sonkosh are partly fed by snow-melt run-off in the trans-Himalayan and Himalayan parts of their basins. With glacial contribution decreasing over the years, future lean season flow (low flow) may decrease in the Brahmaputra basin leading to increased water stress and changed hydrological regimes of the rivers as well as altered ecohydrological characteristics of the riparian ecosystems. As a result agriculture on which large populations depend for livelihoods and diverse ecosystems that sustain a rich biodiversity and food security in the state may be jeopardised. Important forest ecosystems (especially grassland and wetland environs) on river banks such as those in Kaziranga, Manas, Pobitora, Laokhowa-Burhachapori, Panidihing and Dibru Saikhowa may see changes in the normal mode of land-water interactions which may have significant detrimental effect on the micro-environment characterised by temperature, soil moisture, humidity and radiative properties on which the sustenance of many wild flora and fauna depend (Das, 2009).

Projected increase in rainfall and accelerated summer flows may give rise to more intense flooding and flood hazards in the Brahmaputra valley as an immediate consequence, but subsequent retreat of glaciers may reduce flows in the long run. It has been projected that Himalayan river basins like that of the Brahmaputra river may experience increased summer flows and more flooding for a few decades initially, due to rapid melting of Himalayan and Trans-Himalayan snow and glaciers. In the long run however, such rivers will face scarcity of water as a result of progressive reduction of flow as the river-feeding glaciers recede and disappear from the headstreams (Kundzewicz et al., 2007). In fact, the Upper Brahmaputra river basin has already lost roughly 20% of its water reserves bound in glaciers during the thirty years between 1970 and 2000, which is equivalent to the loss of 175 cubic km of glacier mass in that period and about 7 cubic km of glacial mass lost per year (Frauenfelder and Käb 2009). While such melting of glaciers leads to increased dry season runoff in the short term, in the long-term there could be a decline of dry season river runoff from glaciers, turning perennial rivers like the Brahmaputra into seasonal river systems (Cruz et al, 2007). Although there will be an initial increase in flow in the Brahmaputra basin due to accelerated glacial melt till about the fourth decade of this century and increase in mean rainfall over the upstream of Brahmaputra basin by about 25 %, the overall summer and late spring discharges are eventually expected to be reduced consistently and considerably, at least by 19.6% on an average during the years 2046 to 2065 (Immerzeel et al., 2010).

Extreme precipitation events (heavy rain storm, cloud burst) may have their own impacts on the fragile geomorphology of the Himalayan part of the Brahmaputra basin causing more widespread landslides and soil erosion. The response of hydrologic systems, erosion processes, and sedimentation in the Himalayan river basins could alter significantly due to climate change. Glacial recession is also linked to increased sediment load in rivers. A number of major flash floods have occurred in this decade due to heavy rainstorms or cloud bursts in the state or in the upper catchments of the rivers in the neighbouring states (Meghalaya, Arunachal Pradesh) and highlands in other countries (Bhutan, China). Some of the major flash flood episodes took place in Goalpara (2004), Bordekorai (Sonitpur, 2004), Dhemaji (Jiadhal, 2007), Lakhimpur (Ranganadi, 2008), North Kamrup (Puthimari, 2008), and Dhemaji (Nanadi, 2009). These flash floods have caused hundreds of deaths, huge economic loss and colossal damage to infrastructure and public and private property in downstream plains of Assam. Such extreme events, many of which go unrecorded due to lack of an adequate hydro meteorological gauging network, may be indicators of a changing climate in this region.

The southern part of Nagaon district in central Assam valley and adjoining parts of Karbi Anglong form a rain-shadow zone where annual rainfall is as low as 800-1200 mm. Water scarcities are a potential constraint for the people living in these areas. Absence of effective irrigation systems and water harvesting practices adds to the vulnerability of the people. Lumding, located centrally in this zone shows a decline in

rainfall at a rate of 2.15 mm per year (Das, 2004). As a result water crisis might aggravate in this region in the coming years. Over exploitation of the ground water resources in this belt is one of the probable causes of increased proliferation of fluoride contamination in the natural sources of ground water.

The Northeast Indian region is going to see massive distortion of its hilly landscape due to the construction of large dams as part of more than 168 hydropower projects envisaged in the next five decades, out of those more than 100 hydropower dams which are coming up in Arunachal Pradesh alone. Government of India is also promoting large dam-based hydro projects in Bhutan like the Mangdechhu Hydroelectric Project (720 MW) in the Manas river basin (in Bhutan). Given the high probability of increased heavy rainfall events, landslides, formation of Glacial Lake Outburst Flood (GLOF)s and Landslide Dam Outburst Flood(LDOF)s due to climate change in the Himalayan region, threats of flash floods from the large dams in Arunachal and Bhutan will always loom large over the downstream populations in Assam. For example, The Mangdechhu hydroelectric Project (720 MW) on the Mangdechhu, a tributary of the Manas river, is prone to be affected by GLOFs since the headstream region of the river adjoins expanding glacial lakes. Similarly the three hydro projects planned on the Sonkosh river (Punatsangchhu in Bhutan) viz. the Punatsangchhu hydroelectric Project Stage-I (1200 MW) and Stage-II (990 MW) and the Sonkosh Multipurpose Storage Project (4060 MW) may be a cause of aggravated flood hazards in future, (both in Bhutan and Assam) as the upper reaches of one of its tributaries, the Pho Chhu is severely GLOF- affected in northeast Bhutan (Vagolika and Das, 2010).

Assam, which is endemic to malaria, is slated to become more vulnerable with widespread transmission of malaria by the year 2050 due to impact of climate change that helps vector borne diseases to thrive and propagate in certain increased temperature and humidity conditions. The current spate of deforestation and degradation of primary forests will make the state even more susceptible to climate change in the coming years.

Dealing with climate change impacts

The Prime Minister's Council on Climate Change, in its first meeting on 13th July, 2007, decided that "A National Document compiling action taken by India for addressing the challenge of Climate Change, and the action it proposes to take" be prepared. Accordingly the National Action Plan for Climate Change was conceived and prepared as a response to the decision of the PM's Council, as well as to update India's national programmes relevant to addressing climate change. The National Action Plan on Climate Change (NAPCC) was launched by the Government of India and released by the Indian Prime Minister PM on 30th June, 2008. The NAPCC identifies measures that promote our development objectives while also yielding co-benefits for addressing climate change effectively. It outlines a number of steps to

simultaneously advance India's development and climate change related objectives of adaptation and mitigation.

There are Eight National Missions which form the core of the National Action Plan, representing multi-pronged, long-term and integrated strategies for achieving key goals in the context of climate change. These Missions are National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Water Mission, and National Mission for Sustaining the Himalayan Ecosystem, National Mission for a Green India, National Mission for Sustainable Agriculture and National Mission on Strategic Knowledge for Climate Change. While several of these programmes are already part of the country's current actions, they may need a change in direction, enhancement of scope and effectiveness and accelerated implementation of time-bound plans. The implementation of the Plan is envisaged through appropriate institutional mechanisms suited for effective delivery of each individual Mission's objectives and includes public private partnerships and civil society action. The overall focus of the Plan is on promoting understanding of climate change, adaptation and mitigation, energy efficiency and natural resource conservation.

The document of the Plan also describes India's willingness and desire, as a responsible member of the global community, to do all that is possible for pragmatic and practical solutions for all, in accordance with the principle of common but differentiated responsibilities and respective capabilities. The purpose of this document is also to create awareness among representatives of the public at large, different agencies of the government, scientists, industry - in short, the community as a whole- on the threat posed by climate change and the proposed steps to counter it. The NAPCC will continue to evolve, based on new scientific and technical knowledge as they emerge and in response to the evolution of the multilateral climate change regime including arrangements for international cooperation.

The State Action Plan on Climate Change for Assam

Under the mandate the NAPCC process the states of India are supposed to prepare their own action plan to deal with observed and probable affects of climate change for the respective states in line with the National Plan document. Several states like Orissa, Sikkim, Gujarat and Maharashtra have already completed developing their state plans. It was with this objective that the Assam Science Technology and Environment Council initiated the process of preparing a climate change action plan for the state of Assam with support from the Department of Science and Technology, Government of Assam. With this objective three public consultations have been organised till now since January, 2011 in Silchar, Guwahati and Tezpur respectively and one more consultation is scheduled for the coming month at Jorhat. These consultations attended by a large number of stakeholders like experts, researchers, academicians, practitioners, civil society and corporate representatives resulted in

very fruitful discussions, debate with the final outcome being a rich rapporteur of information, knowledge, observations and recommendations. This report compiles the outcome and output of the consultations organised in six thematic notes and presents the results of each event in annexure. This is a draft of a partial appraisal of the consultation process and the resulting information. It will be updated in near future as the next event gets over and inputs are received from various sides to the present version.

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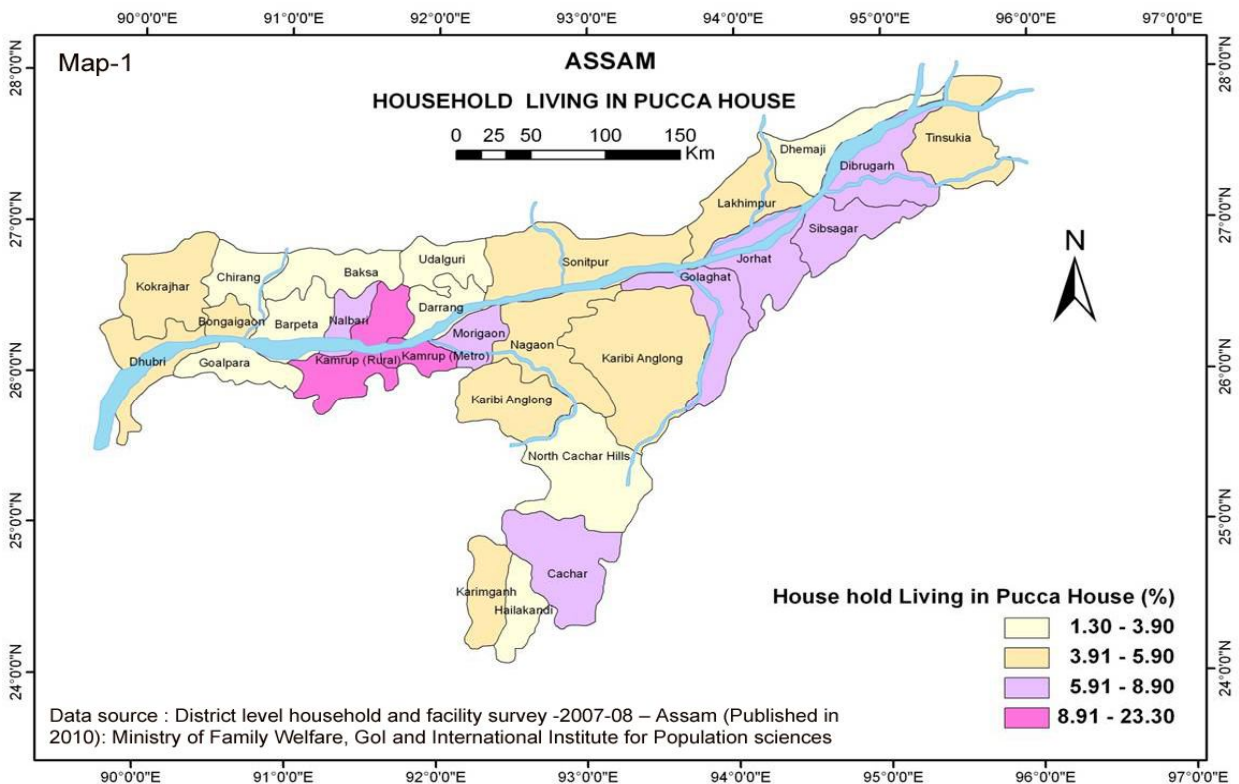
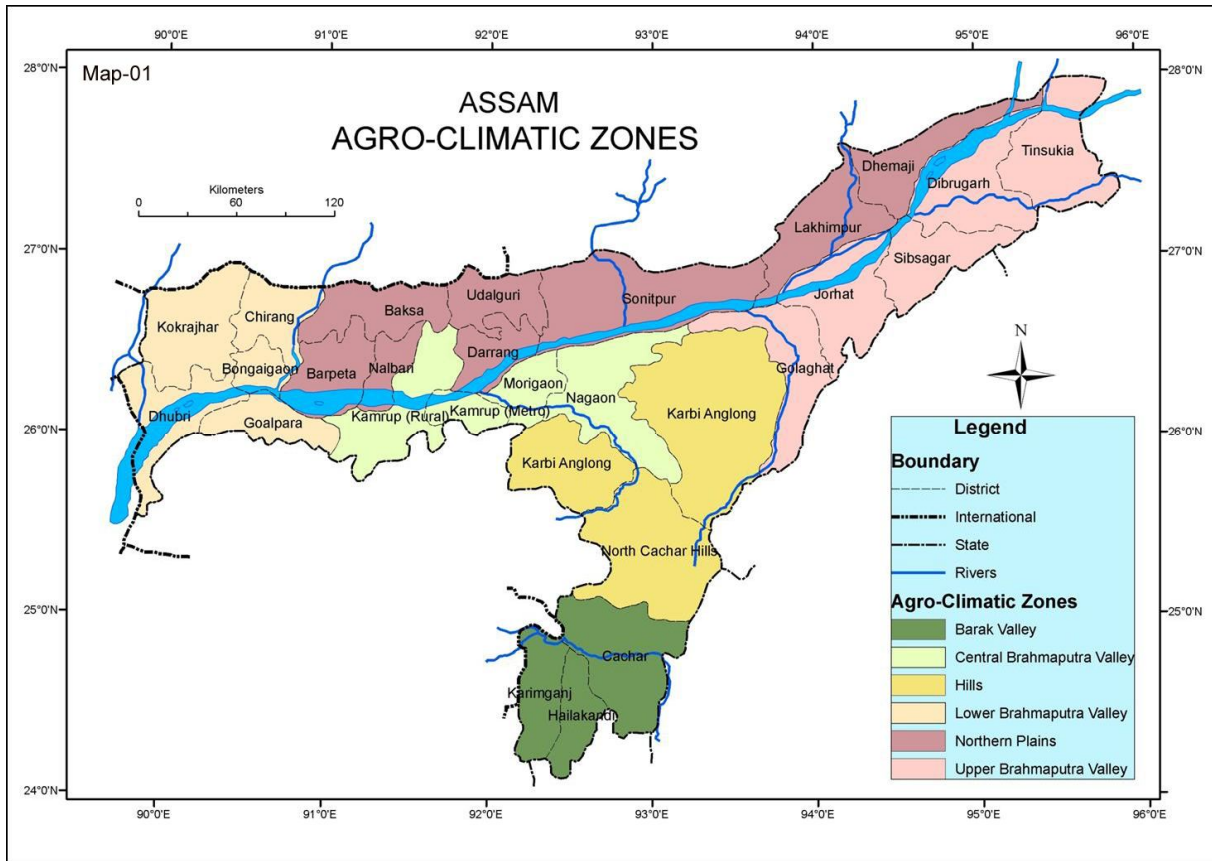
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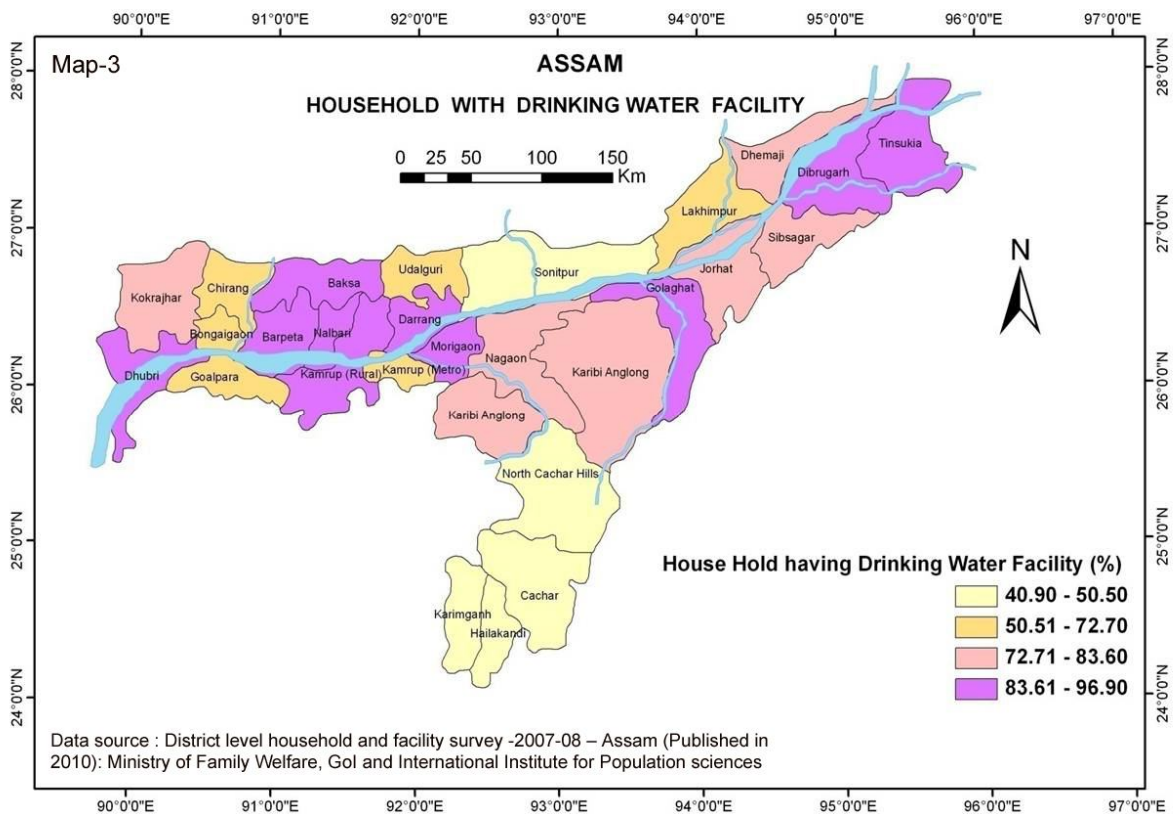
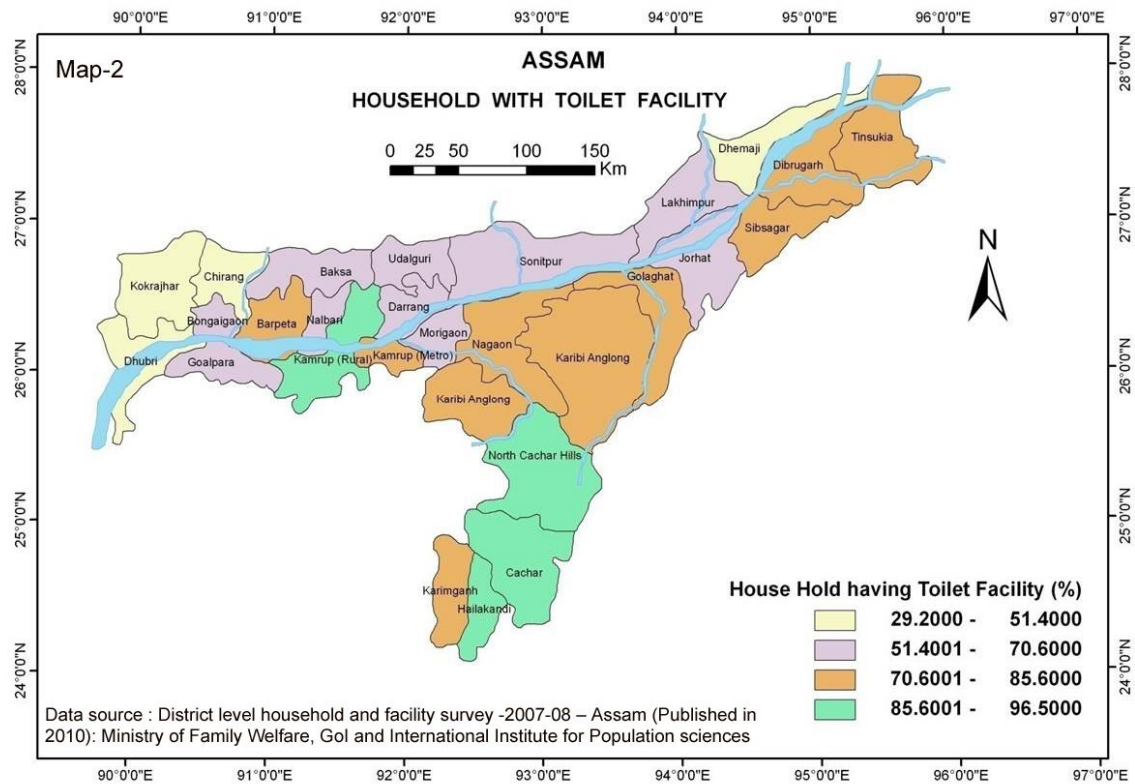
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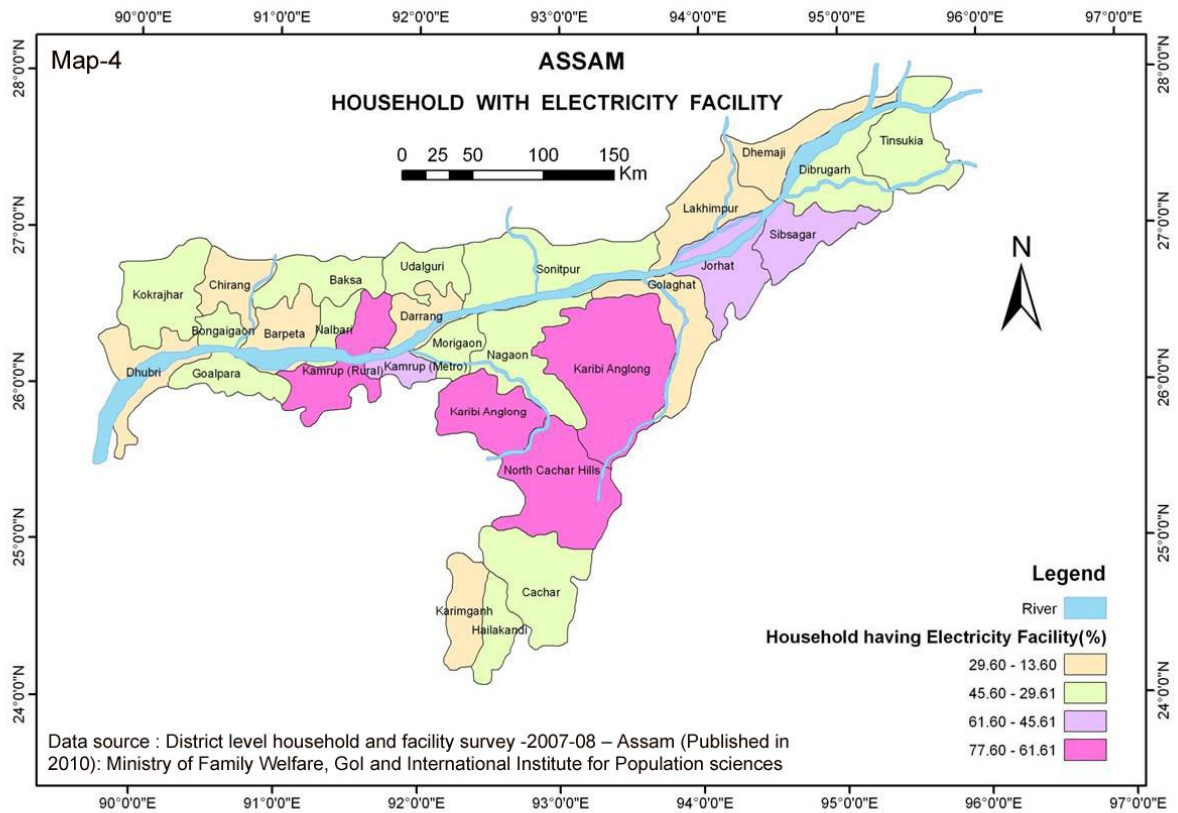
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Glimpses of the Consultation at Gauhati University, Guwahati





GLIMPSES OF THE CONSULTATION AT
ASSAM UNIVERSITY, SILCHAR





**Records of the Consultation at
Department of Geography, Gauhati University
Date: January 28, 2011**

Thematic area: Sustainable Agriculture and livelihood Security.

Chairperson : Dr Nalin Mohan, Former Chief Scientist, AAU Horticulture Research Station,
Kahikuchi, Guawahati

Coordinator: Mr Dhruba Sarma, AFRO, Task Force, Guwahati

| Issues | Context | Required Intervention | Recommendation for State Action Plan | Policy Guidelines | Areas and Issues for research |
|-------------------------------|------------------------------|--|---|--|-------------------------------|
| Database management | Spatial and Temporal context | Basic information on climate change | Dedicated nodal centre to be setup for data management | | Early warning system |
| Crops | | Development of suitable varieties | Restructuring of cropping system/pattern and crop adoptability. | AAU and other universities and concerned institutions may be involved. | |
| Soil Health | | Sustaining soil health | Soil health should be maintained using bio-resource as far as possible. | | |
| ITK | | Documentation | Standardization of the ITK | Concerned educational/ Research institutions may be involved | |
| Hill Agriculture | Shifting Cultivation | Adaptability and proper implementation | Sustainable eco-friendly agriculture may be encouraged in the hilly areas | Concerned departments, Research Institution may be involved. | |
| Crop and Livestock Insurance | | Improvement of the system | Existing insurance system may be strengthened and regularized | All the concerned Depts., Organization, Institutes may be involved. | |
| Irrigation/water conservation | | Improvement of the system | Irrigation activities should be supported by the Govt. | Concerned departments/ Organization, and institutions may be involved | |

| Issues | Context | Required Intervention | Recommendation for State Action Plan | Policy Guidelines | Areas and Issues for research |
|---------------------------------------|-----------------------|--|---|---------------------------------------|-------------------------------|
| Ground Water | | Improvement in maintenance of Ground water | Provision may be created to recharge and maintenance of the ground water level. | Concerned departments may be involved | |
| Awareness | Creation of awareness | Awareness should be created about adverse effect of climate on agriculture among farming community | Concerned Organizations, NGOs, Educational Institutions. | | |
| Livelihood Security | | Alternative agricultural produce in livelihood | Rural agri-based entrepreneurship should be encouraged. | IIE, SIRD and other Govt. Depts. | |
| Marketing and Post-harvest Management | | | Post – Harvest and Value – addition and Marketing Management should be ensured | Concerned Departments. | |
| Research Institute | Research | | Full-fledged research institute on environment should be set-up. | Involvement of State Government. | |

Thematic area: Mitigating Natural Disaster and Crisis Management

Chairperson: Dr Dulal Goswami, Former Professor and HoD of Environment Science, GU

Coordinator: Dr Pradip Sharma, Associate Professor, Department of Geography, Cotton College, Guwahati

| Issues | Context | Required Intervention | Recommendation for State Action Plan | Policy Guidelines | Areas and Issues for Research |
|--------|---------|-----------------------|--------------------------------------|---|-------------------------------|
| | | | | Considering the findings of different studies and present trend of climate change in the N.E. region, policy guidelines for | |

| Issues | Context | Required Intervention | Recommendation for State Action Plan | Policy Guidelines | Areas and Issues for Research |
|------------------------|---------|------------------------|--|---------------------------------------|--|
| | | | | disaster management should be framed. | |
| Flood and Bank Erosion | Assam | Mitigation Structural | <ul style="list-style-type: none"> • Realignment of existing embankment according to local needs. • Flow treatment of minor and major streams | | a. Hydrological Data generation. b. Research on Flood, Causes and Consequences of the region. c. Research on soil quality. d. Real time data. |
| | | Non Structural | <ul style="list-style-type: none"> • Flood plain zoning • Vulnerability mapping • Change or redesign in cropping pattern • Fodder banks • Early warning system • Crop and Livestock insurance • Livelihood restoration • Vulnerable group identification (women, child and old) • Co-adjustment with flood • Adaptation of standard relief policy. | | Regional technical institutes should emphasize on developing technical expertise on these issues. |
| | Assam | Preparedness Awareness | Awareness at all levels, especially among poor, illiterate, school children. Emphasizing participatory planning in all levels. | | |
| Earthquake | Assam | | <ul style="list-style-type: none"> • Seismic map preparation. | | Seismic mapping at micro level. |

| Issues | Context | Required Intervention | Recommendation for State Action Plan | Policy Guidelines | Areas and Issues for Research |
|-----------|---------|-----------------------|---|-------------------|--|
| | | | <ul style="list-style-type: none"> • Enhancement of information network. • Enhancement of emergency services. • Group formation at village level as task force. • Mock drill. • Safe area selection • Implementation of local contingency plan. | | |
| Landslide | | | <ul style="list-style-type: none"> • Slope vulnerability assessment • Rockfall probable areas • Strict regulation an its implementation • Regreening • Enforcement of existing laws and modification as required. | | Mapping of vulnerable slope areas and probable rock fall areas |
| Drought | | | <ul style="list-style-type: none"> • Trapping of surface area to maximum possible area. • Community water bodies to be preserved and utilized. • Time testing effective method of water collection. | | |

Thematic Area: Protection and Sustainable Management of Forest and Wildlife.

Chairperson: Prof. P.C. Bhattacharjee
Coordinator: Dr. Partha Pratim Baruah

Issues:

- Forest Area Degradation
- Encroachment
- Peoples participation (PPP)
- Proper execution of JFM

- Alternative livelihood
- Innovation of exotic supplement
- Developmental interventions
- Ecotourism
- Policy Conflict
- Public attitude towards Forest and Wildlife.

| Speaker | Issues | Context | Recommendation for State Action Plan | Remarks |
|-------------------|---|-----------------------|--|--|
| Mrinal Nath | Depletion of Reserve Forest should be protected. | Forest area depletion | <ul style="list-style-type: none"> • To protect and preserve and manage the encroach forest area. • Work should be done in these areas. • Project/Schemes should be launched on these areas to make it green. | <ul style="list-style-type: none"> • Depletion of forest in upper Assam with special reference to bordering Nagaland. |
| Rabindra Hazarika | Encroachment of forest land Interlinking of forest and culture. | Encroachment | To train or build the capacity of the forest dwellers. Awareness for community Strategies should be made area specific. | |
| Ajit Basumatary | | | Alteration livelihood generation | |
| | Protect grassland not only trees. | Grassland protection | | |
| | Reduction of wetlands. | | Proper management of habitat composition. | Flood and fix regulate the spp. Composition. |
| Kuleshwar Sinha | JFM management NRMIL project. | | <ul style="list-style-type: none"> • Corruption is seen in the scheme. • Efficient JFM practices with short term perspective. • In Behali Reserve Forest:- • We are still following Assam Forest Act 2004. • Meghalaya encroached 8 kms of Behali Reserve Forest. • Meghalaya Government should give all facilities inside the forest. | A selection of community wants the JFM to fail so that the land can be converted to the tea garden. |
| Rahul Sarma | Due to poor economic condition people cut trees. | | Community should given short term benefited schemes. | |

| Speaker | Issues | Context | Recommendation for State Action Plan | Remarks |
|---------------------|---|---|---|---------|
| | | | Alternative livelihood. | |
| Mrinal Nath | Some kill tiger to earn money. Some kill tiger to protect themselves. | | | |
| Dhrubajyoti Saharia | We are giving more importance to protect but not give too much attention to the local forest patches. | | <ul style="list-style-type: none"> To protect and conserve urban as well as rural forest. Awareness should be given to institutional head. Government initiative should there to protect rural forest. | |
| Manas Das | International organ marketing of wild animals. | Poaching in the forest areas. | To aware the people about the importance of wildlife. | |
| D. Saharia | Protection of wildlife in the smaller patches in the rural areas (other than RF). | Protection of wildlife. | | |
| Rahul Sarma | To stop damage caused to forest by picnic parties. | | To take necessary steps to stop use of plastics and polythenes within R.F. | |
| D. Saharia | Policy conflict. | Wetland conservation | | |
| Mukul Ch. Bora | Hill cutting and Road development. | | | |
| Manas Das | Leasing out of hills to collect boulder and stone. | | To take strict surveillance on collection of FP and NTFP from hills and forests. Ban on long term lease out of forest for plantation, mining and quarrying within R.F. | |
| Several speaker | Habitat loss | | Value addition to indigenous foods for economic benefits. | |
| Bhaskar J. Saud | Integration of various academic branches to protect Environment. (at policy level) | | | |
| Krishna Das | Environmental change in the Dam sites of Subansiri. | Political influence in policy making to be stopped. | Need of local language for the awareness campaign. | |

| Speaker | Issues | Context | Recommendation for State Action Plan | Remarks |
|-----------------------|---|--|---|---------|
| | Defective management - | Role of media in order to aware the people to protect environment. | To inculcate the positive attitude of media and politician. | |
| Kuleswar Sinha | Motivation programme | | Awareness to forest officials. | |
| Manas Das | Demand and supply. Demands are created by rich people. Market for tiger skin. | | To find out alternative source for construction or decrease the demand for forest product. To create awareness on conservation through educational materials. | |
| P.K. Saikia | Establishment of tourism hub within the forest area. | | | |
| Rahul Sarma | To stop picnic on or near the forest areas | | Ban on picnic in the vicinity of R.F. to Protected Areas. | |
| D.Saharia | We have conflict policy. | | To formulate policy without conflict in the long run implementation. | |
| | | | To avoid inter-agencies policy conflict. | |
| Mukul ch. | Road expansion material collection from forest. Lease of land and forest. | | | |
| Rabindra Hazarika | There is no adequate study on habitat level. | | There is no adequate data on rural wildlife. Value addition and development of market link for the indigenous food for economic upliftment of beneficiary. | |
| Bhoben Tati | People should be honest. | | | |
| Dr. P.P Baruah | Conservation | Encroachment | <ul style="list-style-type: none"> Allotment of lands for non plantation purposes. Removal of village huts from the vicinity of the forest. Jatrophas should not be practiced in the forest areas. | |
| Dr. Rabindra Hazarika | Cultural diversity in relation to biodiversity | Biodiversity conservation. | To link up the cultural diversity with the | |

| Speaker | Issues | Context | Recommendation for State Action Plan | Remarks |
|-------------------------|--|--|---|---------|
| | | | biodiversity at local level. | |
| | | Priority for the people | Reassessment of Eco-tourism in the context of biodiversity loss. NREGA like community participation. | |
| Kuleswar Sinha | | | Development of Remote Sensing and GIS database for forest and wildlife of Assam. | |
| P.P Baruah | | | Encourage people for Carbon Trading. Encourage people and Govt. agencies to plant trees which have much more capacity for Carbon sequestration. | |
| Dr. Bhaskar -jyoti Saud | | Setting up Broader goal to meet or mitigate CC with PPP. | <ul style="list-style-type: none"> • Population Control for conservation of forest and wildlife. • Incentive may be provided to the beneficiary people. • Setting up of Community Reserve and Conservation Reserve where threatened supplements are adequate. • Mechanism to safe the wildlife/birds outside the protected areas including road side. • There should have consistent policy in any developmental activity. • Development of document of environmental threat in regional level. • Protection of river islands of Brahmaputra as animal corridor. | |
| Rabindra Hazarika | To aware the people of the areas close to R.F. | | To go for other economic activities not causing harm to forests. | |

| Speaker | Issues | Context | Recommendation for State Action Plan | Remarks |
|-----------------|---|--|--|---------|
| Ajit Basumatary | Invasion of Simul trees in Manas National Park. | | Eradication of the trees to control their number of these trees within the grassland | |
| K. Sinha | JFM scheme has not shown the desired outcome. | Emphasized on short term perspective instead of long term. | Take up necessary steps to eradicate invasion of exotic species of plants from the grasslands of protected areas. | |
| Rahul Sarma | Open felling of trees in the R.F. how to stop? | | | |
| Mrinal Nath | Deforestation at Govt. level should be stopped. | Material collection from the hills. | Construction of Roads, supply of electricity, construction of schools, offices, petrol pumps, in R.F. should not be allowed. | |

Thematic Area: Sustainable Habitat for quality of life

Chairperson: Prof. Arup Kr. Mishra, AEC

Coordinator: Dr. Bimal Kar, Associate Professor, Dept. of Geography, Gauhati University

| Speaker | Issues | Context | Recommendation | Remarks |
|---------------|------------------|---|---|---------|
| Arup Mishra | Land Use Pattern | Drawbacks in present trends of land use. | Regulatory bodies should come up strongly to control landuse and enact strict laws on housing, based on master plans. | |
| | Water | Present/senseless use of ground water, rather than surface water. | Deep boring should be discouraged in the light of F and As problems, sinking water table. Instead, the use of surface water with proper treatment should be promoted | |
| | Transportation | Accidents, jams, pollution due to these, etc. | Development of public transport, awareness etc. | |
| Dr. Bimal Kar | Calamities | | <ul style="list-style-type: none"> Local level eco-friendly activities should be promoted and protected. Use of solar energy at household as a substitute to fossil fuels may be promoted. Rain water harvesting should be promoted by | |

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|------------------------|--|--------------------|---|--|
| | | | adequate regulations. | |
| Dipankar Mahanta | Awareness and education | | <ul style="list-style-type: none"> • Education institutes and NGOs should participate in spreading the message of holistic living, sustainable life with respect to inter-relatedness and inter-connectedness. • Short-term strategies of “educating the educated” should be taken up, with effective presentations on the darker sides of climate change. • Eco-friendly processes and products should be promoted for a better and manageable environment. | |
| Dr. Nripen Ram Kalita | Poor planning and lack of land use mapping | | <ul style="list-style-type: none"> • Govt./concerned authorities should take up in right earnest the preparation of land use/habitat zoning maps for the entire state. • Surface water should be promoted as far as possible and the domestic dwellings should be forced to abide by building laws, sewage line norms, placements etc. | |
| Prof. Sriprakash Sarma | Loss of forest cover | East-west corridor | <ul style="list-style-type: none"> • Afforestation along the east-west corridor to compensate for the losses. • Afforestation should be taken up with useful, fruit-bearing, indigenous trees for better management. • People living in flood prone areas must be provided with raised platforms and be trained to co-exist with such facilities. | |
| Dr. Madhushree Das | Cable service transportation. | Cable service | To reduce traffic congestion on land or roads, cable services/ropeways may be planned in all places favourable to it. | |
| | Segregation of solid wastes. | Waste disposal | Solid wastes should be segregated at household | |

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| | | | level with respect to biodegradable and non-biodegradable types. | |
| | Sustainable energy | Energy/Renewable sources. | Feasibility studies for installation of windmills must be taken up. | |
| Manas Jyoti Nath (DRL, Tezpur) | Health | | <ul style="list-style-type: none"> To identify new diseases catalysed by climate change and make people aware of these. Remote areas of the state should be brought under better/accessible medical facilities. | |
| Prasanta Bhattacharyya (Dept. of Geography, G.U.) | Environment-friendly practices | | <ul style="list-style-type: none"> Traditional knowledge and practices should be assessed once again in light of global climate changes, and they should be promoted if found healthy and eco-friendly. Water transport means must be promoted as far as possible. Tourism as a tool for conservation and motivation of local people, value addition may be encouraged. | |
| Hupesh Das (N.Guwahati College) | Mapping/Master plan | | <ul style="list-style-type: none"> Scientific land use mapping of the entire state should be taken up for demarcation of agricultural, industrial, residential areas etc. Intra-state railway network should be vigorously promoted for mass transport. | |
| Samir Sarkar (Dept. of BA, G.U.) | Re-organizing the living condition of people. | | <ul style="list-style-type: none"> Building and transforming the existing villages into eco-villages as far as possible. Planning of the developmental and environmental issues should be given to block level instead of district level. | |
| Bulen Kakoty | Agricultural | | Promote more eco-friendly | |

| | | | | |
|---|-----------|--|--|--|
| (N. Guwahati College) | practices | | agricultural practices throughout the state. | |
| Biman Lahkar (Bapuji College, Sarthebari) | | | Decongestion of urban centres may be taken up in proper way by creating more facilities in rural and suburban areas. More awareness camps and workshops should be organized in remote areas/other places to make people aware of the environmental laws, regulations, rooms etc. | |

Thematic Area: **Water Security and Sustainability**

Chair-person: Prof. Chandan Mahanta, IIT Gh.

Co-chair : Dr Dilip Sharma, Project Engineer, Guwahati

Coordinator: Dr. Partha J. Das, Aaranyak

| Issue | Context | Required intervention | Recommendation for State Action Plan | Policy guideline | Areas and issues for research |
|-----------------------------------|---------------------------------------|-----------------------|--|------------------|-------------------------------|
| Water quantity | | | <ul style="list-style-type: none"> • Formation of reliable water database. • Reliable assessment of water resources. | | |
| Access to data | | | <ul style="list-style-type: none"> • Formation of nodal data source created by a nodal body that will give data access to all concerned people. • Water policy to include free access to data. | | |
| Identify important research areas | | | <ul style="list-style-type: none"> • Collaborative research with all important research institutions (eg. Universities, colleges, organizations etc.) • Create a knowledge base by integrating research. | | |
| Water quality | Ground water contamination (As and F) | | <ul style="list-style-type: none"> • Create baseline data on water quality and then maintain a data bank. • Implementable research in the area of water contamination and treatment for real time | | |

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|--------------|---|--|---|--|--|
| | | | <p>applications to solve water quality problems.</p> <ul style="list-style-type: none"> • Setting up of water quality monitoring labs at district level. • Centralization of data through nodal agencies for free accessibility to available data. | | |
| | Surface water | | Real time water quality monitoring of all streams and rivers more specifically in the confluence zones. | | |
| Wetlands | <ul style="list-style-type: none"> • Degradation • Loss of ecosystem services and livelihoods | | <ul style="list-style-type: none"> • Awareness of Common Property Resources perception of wetlands amongst the public. • Immediate formation of a Statutory body for management of wetland systems . • Community participation for sustainable management, preservation and benefit sharing. | | |
| Water stress | | | <ul style="list-style-type: none"> • Rainwater harvesting and other water saving techniques should be intensively promoted and integrated in all developmental programs. • Roof-top harvesting should be made mandatory for all urban areas of Assam. • Awareness on rationalization of usage of water and regulatory measures to prevent contamination of streams, rivers etc. • Intensive awareness programs and education at all levels for proper and wise use of water and prevent its wastage. This could be done through preparation of documentaries, | | |

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|----------------------|--|--|---|--|--|
| | | | presentations etc. | | |
| Water Stress | Scarcity of safe drinking water in the rural sector. | | <ul style="list-style-type: none"> • Proper implementation of existing policies. • At rural levels it should be implemented by panchayats. • Supply safe drinking water to all rural areas. • Traditional water harvesting systems should be preserved, promoted and renovated. • Traditional drinking water sources should be preserved and promoted. | | |
| Stress on livelihood | Water scarcity | | Communities dependent on water bodies for their livelihood should be given special status and support. e.g.: Fishermen communities, Makhna Harvesters, boatmen, dairy farms associated with wetlands etc. | | |
| Big dams | <ul style="list-style-type: none"> • Construction. • Detrimental downstream effects due to dam construction. | | <ul style="list-style-type: none"> • Govt. needs to be careful and construction should be avoided as far as possible specially if there is a large population downstream. • Water security issues should be given priority over all other issues in case of hydropower/storage reservoirs projects. | | |
| Water security | Privatization | | Fundamental right to water shall remain non-negotiable. Privatization should be limited only to treatment, distribution and associated activities. | | |
| Governance of water | | | <ul style="list-style-type: none"> • Integration of all existing acts and laws related to water to a single Act. • Integration of state level policies in National Water Mission and other relevant missions of the National Action Plan on Climate | | |

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| | | | Change. • Proper implementation and enactment of the acts should be ensured. | | |
| In general, involve youth and students extensively in making and planning. | | | | | |
| Water related micro-climatic mapping of the drought prone areas and data collected should be part of the database to be created. | | | | | |

Thematic area: Adaptation to Climate Change (focuses on energy sufficiency and efficiency)

Chairperson : Dr. A.K. Baruwa, Former Director, ASTEC

Coordinator : Dr. Anup Saikia, Associate Professor, Dept. of Geography, Gauhati University

| Issues | Recommendations |
|--|---|
| Sectoral approach on energy sufficiency, energy efficiency and energy use. | <ul style="list-style-type: none"> • Generation of awareness in all sections of the society regarding energy conservation from school level onwards. • Mixed use strategies in energy sector – Small Hydro Power strategy. • Technological options for GHG mitigation in the industry sector. |
| Energy efficient buildings and building components. | <ul style="list-style-type: none"> • Promoting energy efficiency in the residential, commercial and official complexes and buildings. • Adopt energy conservation building codes (ECBC) for construction of buildings. |
| | <ul style="list-style-type: none"> • Promotion and popularization of solar thermal technology in water heating to replace electric geysers in households and commercial establishments like guest houses, hotels etc. • Mandatory use of solar water heaters in public and private buildings. • Solar thermal technology for industrial and commercial heating. • Establishment of solar thermal power stations. • Grid Interactive Solar Photovoltaic. • Solar Home Lighting Systems in rural areas to replace kerosene lamps. • Development of Solar Home Lighting systems appropriate to the region through technological research at NEIST, IIT GHY and other research institutions. • Solar Street Lights/Solar Garden Lights in all streets, campuses, parks, lawns, crematoriums. • Public toilet Units with self sustaining biogas generation. • Community kitchens/Hostel kitchens with biogas generation from wastes. • Promotion of bio fuels – possibility to be explored. • Power generation units from MSW in all towns, cities, semi-urban areas, villages. • Extensive public transport facilities and non-motorized modes over personal vehicles. • Promotion and use of energy saving devices BEE's Star labeled appliances. • Proper Implementation of Energy Conservation Act. • Water metering. • Rainwater harvesting. |

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| | <ul style="list-style-type: none"> • A special Climate Change fund – Adaptation fund in the energy sector. • Improved Chullah technology. • Incentives to energy users adopting Energy Sufficiency. • Ensure availability of solar appliances for domestic users with adequate publicity and accessibilities. • Effective measures to be adopted to reduce transmission and distribution losses including better enforcement. • Free subsidized power supply schemes to be checked. |
| Supply of energy to vulnerable communities | <ul style="list-style-type: none"> • Char communities in Assam may be identified as vulnerable community as they are hit hardest in the present energy scene. Forest is too far na dother bio sources and energy sources are also not accessible due to their poor economic conditions. As such they depend on a plant locally known as 'Dhaincha'. This plant belongs to cane family and these grow abundantly in the riverine environment. No study has yet been carried out on plantation, efficient use, marketing etc. this may act as a potential source of bio fuel for the entire riverine sandbars of Assam. |
| | <ul style="list-style-type: none"> • Sensitization and adoption of SHGs for propagation of improved chullas and biogas plants. • Introduction of improved chullahs for preparation of mid day meals in schools and Anganwadi centres along with fuel wood tree plantations. • Promotion of community based small, micro, mini hydel plants. • Enhanced incentives to private power producers through solar photo voltaic for grid fed electricity is to be incorporated. • Best practices adopted elsewhere in the country on renewable energy and energy conservation application be analyzed in view of the geo-climatic condition of the state and adopted wherein possible. • Generation of database on issues like bio resources assessment, NPP (Net Primary Products) load and demand assessment and mapping on bio energy resource is recommended. |

**Records of the Consultation at
Department of Environmental Science, Tezpur University**

Date: 03 March, 2011

Thematic area : Sustainable Agriculture and Livelihood Security

Chairperson : Prof. K. K. Baruah, Dean, School of Energy, Environment and Natural Resources, Tezpur University

Coordinators : Dr. N. Gogoi and Dr. S. S. Bhattacharya, Asstt. Professor, Dept. of Environmental Sc. Tezpur University

| Issues | Recommendations |
|--------|--|
| | <ul style="list-style-type: none"> • Identification and transfer of suitable technology on water management. • Demonstration of rain-water harvesting. • Development of research network on water resources. • Popularization of seed village concept. • Transfer of integrated nutrient management technology to villages. • Research on weather-pest relationship (there are research gap in this area). • Adequate implementation on agromet services. • Restriction on organic enrichment of soil, since higher organic carbon accelerates the production of GHGs, CH₄ and NO₂ from agricultural field. • Identification and development of genotypes for tolerance to biotic/abiotic stress, e.g. Drought, flood, disease and pest resistance. • Popularisation of varieties with low GHG emission and with potentiality of higher yield. • To strengthen and demonstrate traditional farming system so as to adapt to climate change. • Implementation of crop insurance scheme. |

Thematic area : Adaptation to Climate Change (Focuses on Energy Sufficiency and Energy Efficiency)

Chairperson : Prof. D. C. Baruah, Head, Dept. of Energy, TU

Coordinators : Dr. R. Kataki and Dr. D. K. Borah, Associate Professor, Dept. of Energy, TU

| Issues | Recommendations |
|--------------------|--|
| Energy Sufficiency | <ul style="list-style-type: none"> • Formulation of localized programme (for each regional agro-climatic zone) connecting the grass root issues in the light of national programmes. • Energy need/demand assessment in all users sectors including agriculture, industry, commercial sector, service and domestic sector up to the next 50 years. • Assessment of renewable energy resources availability and their competitive uses. • Technological status (existing as well as prospective upgradation) and R & D requirements particularly in biomass, solar, hydro in independent as well as in hybrid mode (based on locally available prospective resources viz. crop residue biomass, woody biomass including forests and bamboo biomass with provision for re-plantation.) |

| Issues | Recommendations |
|-------------------|---|
| | <ul style="list-style-type: none"> Any prospective “Renewable and sustainable programme should be able to generate local employment and should address socio-economic concerns of this region/zone. |
| Energy efficiency | <ul style="list-style-type: none"> Industrial houses particularly (tea, cement and pulp, paper etc.) should be involved in the energy sufficiency and efficiency programme and industry-friendly policy measures should be in place. Stringent measures for violation of “Energy conservation and energy efficiency” are to be ensured. The initiations that have begun in utilization of bio-energy in small scale industries (Tea processing, biscuit processing etc.) and enterprises (dhaba, restaurants etc.) in Assam should be provided with necessary techno-economic back-up. Utilization of degraded forest/unutilized govt. land and agricultural land for optimal renewable energy generation with coordinated research back-up. Environmental aspects of any power project needs to be pre-evaluated strictly. |

Thematic area : Mitigating natural disaster and crisis management

Chairperson : Dr. A Dutta, Associate Professor and Head, Dept. fo Civil Engg., TU

Coordinators : Dr. A.K Das, Associate Professor, Dept. of Environmental Sc. and Dr. D. Nath, Disaster Management Cell, TU

| Issues | Recommendations |
|--------|--|
| | <p>Since genuine risk assessment of the districts need expert human resource, infrastructure, equipment and tools, the state govt. may request all the universities and institutions of the state to prepare separate projects for hazard and location specific risk assessment of all districts (preferably covering surrounding districts of the institution) involving,</p> <ul style="list-style-type: none"> Climate induced Hazard Assessment and Hazard Mapping (considerably GIS based) of the individual districts. Vulnerability Assessment (physical, social, economical, infrastructure....related issues) Resource assessment and resources at risk. Probable impact assessment of the exposures. Funding of the projects should be responsibility of the state. Establishment of separate DM wings in every districts with required skilled manpower, infrastructure, emergency equipment and tools for preparation of DDMP and its proper execution. Early establishment of SDRF in the line of NDRF, involving police and fire brigade personnel with the provision of training of the SDRF by NDRF, capacity building of the SDRF in terms of skilled manpower, equipment, tools and adequate fund provision. Establishment of well equipped District Disaster Response and Block Disaster Response forces involving volunteers trained up by the SDRF/NDRF (students, NCC, NSS, NGO, CBO and community members) with the provision of procurement of emergency equipment and tools, monthly remuneration, insurance of the volunteers etc. Establishment of separate DISASTER MEDICAL TASK FORCES for all the blocks with trained doctors and staff to handle disaster like situations. Provisions should be there for procurement and storage of medical kits and life saving medicines. Relief camps should be as per norms. |

| Issues | Recommendations |
|--------|--|
| | <ul style="list-style-type: none"> • Provision should be there in the state disaster management policy for awareness and enforcement of land use regulation, catchment management, relief camp management, environmental management, first aid, health and hygiene etc. • State govt. may consider for compulsory credit based disaster management COURSES in school and college curricula in the line of national policy. • Assess the historical experiences of people's response to climatic changes. • Storage of surface water to be used in nthe time of lean rainfall period as well as to recharge ground water. • Regulation of ground water extraction/recharge. • Health warning system in the context of heat stroke, extreme weather event and disease outbreak. • Introduce large scale vaccination programme to prevent communicable diseases. • Mosquito nets impregnated with repellent and water filters to prevent spread of disease. • Potable water and sanitation technologies which can easily be deployed during emergencies. • Proper implementation of population policies and land-use regulations. • Conservation of natural vegetations . • Habitat and agricultural adjustments. • Research for developing prediction techniques based natural vegetation dynamics in this region. • Early warning system and community radio. |

Thematic area: Protection and Sustainable Management of Forests and Wildlife

Chairperson : Dr. Chandan Goswami, Associate Professor, Dept. of Business Administration, Tezpur University

Coordinator : Tarun Jyoti Borah, Technical Assistant, Dept. of Business Administration, Tezpur University

| Issues | Recommendations |
|--|--|
| Forest Rights Act (2006) | <ul style="list-style-type: none"> • Reviewing Forest Rights Act (FRA), 2006, with impetus on regional changes and localized issues of migration in Assam. • Original cut-off date (13th Oct, 1980) should be applied. • Stop implementation of the act at its present level. • GIS based mapping as necessitated in Sec. 6(1) of FRA to be done immediately. |
| <ul style="list-style-type: none"> • Land use policy • Deforestation and lack of awareness amongst local people. | <ul style="list-style-type: none"> • Preparing state level land use policy particularly in eco-sensitive areas. • Proper documentation on land holdings/land use for settlement of ownership claims. • Developing alternative livelihood strategies for local people in the fringe areas of eco-sensitive areas. • Adoption of model plantation programmes and model villages. • Coordination of various Govt. agencies in development work. • Ecological protection services should be awarded with incentives. |

| Issues | Recommendations |
|--------|--|
| | <ul style="list-style-type: none"> • Biodiversity register that will possess base-line information must be prepared. • Formation of all boards necessitated by Biodiversity Act, 2002, upto Village Panchayat Level. • Strengthening research programmes by involving local research institutions. • Tezpur University should collaborate with external organizations to carry research work of localized importance, e.g. Bio-information bank. • Detailed climate change vulnerability study specific to local condition of Assam should be done. |

Thematic area : Sustainable habitat for quality of life

Chairperson : Prof. K. P. Sarma, Professor and Head, Dept. of Environmental Sc., Tezpur University

Coordinators : Dr. R. R. Hoque, Associate Professor, Dept. of Environmental Sc. and Dr. Kamal Uddin Ahmed, Dept. of Civil Engg., Tezpur University

| Issues | Recommendations |
|------------------------|--|
| | <ul style="list-style-type: none"> • Secure the wholesome environment including land, water and air – flood plain of Brahmaputra, Majuli. • Proper drainage to prevent water logging and flooding. • Prevent pollution of water, land and air. Manage solid wastes in cities and towns with technological know how with a perspective of recovering resource out of them – waste recycle with recycle of solid waste and waste water. • Secure drinking water needs. Recognize the pivotal role of water, including its human rights dimensions, in adapting to climate change in order to increase resilience and achieve sustainable development. • Prioritise climate change interventions to protect or ensure access to safe drinking water and to sanitation for marginalized or discriminated against groups who risk suffering the most from climate change. |
| Sanitation | <ul style="list-style-type: none"> • Sanitation for all. Explore sanitation technologies which offer alternatives to water borne sanitation, and increase commitments to capacity development and technology transfer. • Analysis of technology needs in the water and sanitation sectors should take full account of the root causes of lack of access, including barriers related to the structure of the relevant technology markets, the pricing and technology transfer models, as well as political or ideological barriers. |
| Awareness and research | <ul style="list-style-type: none"> • Pollution and quality of life in the context of climate change may be component of primary education. Environmental awareness campaigns through government identified nodal agencies (colleges, universities, schools, NGOs etc.). • Encourage and fund research to build on local and traditional knowledge to increase the likelihood of adaptation measures to ensure adequate access to water and sanitation. Identify the nodal agencies to carry out the research forward. • Ensure adequate and flexible financing mechanisms to speed up investment in water management. • Collect the necessary data on a comprehensive and regular basis to enable adequate monitoring of the quality of water, air and sanitation in the face of climate change risks. Data should be disaggregated by reference to excluded groups of people and under served areas, with a particular focus on gender, urban and rural disparities, at a minimum, along with the prohibited grounds of discrimination in accordance with national needs and capacities. |

Thematic area : Water security and sustainability

Chairperson : Prof. S. K. Duloi, Dept. of Chemical Sciences, Tezpur University

Coordinators : Dr. Manab Mandal, Associate Professor, Dept. of MBBT, Tezpur University

| Issues | Recommendations |
|--------|--|
| | <ul style="list-style-type: none"> • Developing a model for studying the possible effects of climate change on surface and ground water systems of Assam. • Developing climate change mitigation for Brahmaputra and Barak basins of Assam. • Estimation of water flow in all tributaries of Brahmaputra and other big and small rivers. • Identification and segregation of drought prone and flood prone areas of Assam. • Instituting studies to identify strategies for flood and drought control in Assam. • Developing micro level plans for conservation of surface and ground water systems in urban and rural areas with involvement of local communities. • Creating a plan to involve local communities in management and improvement of riparian vegetation along water bodies by promoting indigenous practices of food and fodder cultivation. • Initiating stringent measures to prevent excavation of sand and boulder from rivers and water banks. • Devising strategies to promote and support healthy agricultural practices among communities living in the catchment areas. • Creating regulatory strategies for usage of ground water in urban and rural areas of Assam. • Formulation of strategies for augmenting ground water through natural and artificial means. • Creating guidelines for mandatory rain water harvesting systems in govt. buildings, urban housing societies and industries. Encouraging general people for usage of rain water for domestic use. • Encouraging the rural population for harvesting rain water in mud tanks. • Encouraging traditional management system of using rain water/ surface water for agricultural use. Scientific improvisation should be adopted in the field. • Construction of multi-purpose hydro projects for irrigation and other use. • Modern irrigation systems like drip-irrigation systems are to be adopted for agriculture. • There should be proper arrangement for sediment arrester in small rivers. • Databank of information generated by different organizations undertaking research on effects of climate change must be created for dharing the stake holders. • Creating partnership of local bodies and institutions to develop better climate change strategies . • Concept of water budgeting should be implemented. • Prioritizing integrated watershed management through scientific inputs. • Updating and strict implementation of water law. |

**Records of the Consultation at
Department of Ecology and Environmental Science, Assam
University**

Date: December 17, 2010

Thematic Area: Water Security and Sustainability

Chair Person: Dr Abhik Gupta, Department of Ecology and Environment Science

| Issue | Context | Required Intervention | Recommendation for state action plan | Any policy provision or intervention or change required |
|---|---|--|--|--|
| Flood | Structural/Non-structural measures | Developing floodplain wetlands as retarding basin; community preparedness; | Settlement plans and rehabilitation of settlements in vulnerable zone; Integrated programmes | State Water Policy vis-a-vis Integrated Water Resources Management (IWRM) |
| Water-borne disease and rural sanitation | Possible epidemics | Epidemiological research and action programmes at all levels | Training in PHCs; Strengthening epidemiological wings in medical colleges and universities | The Water (Prevention and Control of Pollution) Act, 1974; Policy gap to be filled up by appropriate adoptions in Health and other relevant policies |
| Domestic water availability and quality | Conservation and restoration of water sources | Eco-restoration programmes | Action through rural development programmes | Utilize NREGA for village level restoration |
| Groundwater pollution by arsenic and fluoride | Conservation and restoration of surface water sources | Eco-restoration programmes | Action through rural development programmes Advisory for deep tubewells in arsenic and fluoride-prone areas | Utilize NREGA for village level restoration Urban Housing Policy to recommend measures IWRM implementation |
| Large dams and hydropower | Submergence of bio- and cultural diversity-rich areas Displacement of indigenous communities | Case by case appraisal and re-examination Risk assessment | Emphasis on multi-purpose small to medium size projects and micro hydropower projects | National and State water and power policies: need appropriate adoptions keeping CDM in perspective |
| Rainwater harvesting | Water security | Popularization and promotion | Rainwater harvesting to be mandatory for all | National and State water |

| Issue | Context | Required Intervention | Recommendation for state action plan | Any policy provision or intervention or change required |
|------------|------------------------------------|---|---|---|
| | | | public and private buildings | policies: need appropriate adoptions |
| Irrigation | Surface vs. groundwater irrigation | Threat of contaminants in groundwater-based irrigation | Role of state in developing surface water-based irrigation | State water policy: needs appropriate adoptions |
| Fishery | Capture vs. culture fisheries | Depletion of wild stock; endangered fish species; culture fishery promotion | Biodiversity conservation in general and aquatic/fish diversity conservation in particular; support for culture fisheries | State Wildlife Board to include aquatic biodiversity issues; fishery development legislations |

Thematic area: Agriculture and agro-forestry

Chair Person : Dr S. Das, Department of Ecology and Environment Science

| Issue | Context | Required Intervention | Recommendation for state action plan | Any policy provision or intervention or change required |
|------------------------------|--------------------------------|---|---|--|
| Agriculture and agroforestry | Emission of green house gases | For food security | 1. aerobic rice may be recommended 2. traditional pest management system Local rice varieties may be conserved Use of synthetic agrochemical 4. conservation and documentation of locally available seeds | |
| Fishery | Local fish germplasm depletion | Conservation and mass multiplication required | 1. Traditional local germplasm to be conserved 2. Promotion of wetlands for aquaculture and fishery purposes 3. Poor fisherman may be given incentives for fish culture | Govt agency may intervene, local people should be mass awarded |
| Duckery | Livestocks: duckery farming | Mass education for awareness | 1. Duckery may be encouraged to the villagers as the valley is potential with wetlands | |

| Issue | Context | Required Intervention | Recommendation for state action plan | Any policy provision or intervention or change required |
|---------|-----------------|---|--|---|
| | | | 2. Excreta may be used as fish food and nutrient to agricultural land | |
| Piggery | Piggery farming | Awareness required to the villagers for the potentiality of piggery farming | Villagers both tribal and non-tribal can be involved in farming practice in the valley | |
| Poultry | Poultry farming | Village economy will change and poor people can earn substantial earning | Poultry may be encouraged to the tribal and non-tribal people | |

Thematic area: Sustainable habitat development

Chair Person: Dr Mitra Dey, Reader Department of Ecology and Environment Science, Assam University

| Issue | Context | Required Intervention | Recommendation for state action plan | Any policy provision or intervention or change required |
|----------------------|---|---|--|---|
| Housing | 1. Earthquake | 1. Construction of houses/buildings following the standard norms for seismic zone-V | To have adequate space, wide stair case and proper exist from building | Construction of 3-4 storied building to be followed |
| | 2. Flood | 2. Rehabilitation of people in low lying areas to higher elevation areas | | |
| Drinking water | Water storage and lowering of water table | Rainwater harvesting to be introduced | To be made compulsory | |
| Solid waste disposal | Open drains and pollution through waste | Introduction of waste collection, segregation and proper disposal | Incentives and monitoring of areas rewards to be given | Compulsory door to door collection |
| Sanitation | Cleanliness and hygiene | Introduction of public urinals | | |
| Health | To overcome disease occurrence | Introduction of low cost sanitation | | Health and sanitation provisions should be adequately |

| Issue | Context | Required Intervention | Recommendation for state action plan | Any policy provision or intervention or change required |
|-------|---------|-----------------------|--------------------------------------|---|
| | | | | designed |

Thematic area: Disaster management

Chairperson : Prof. B.K. Dutta, Department of Ecology and Environment Science, Assam University

| Issue | Context | Required Intervention | Recommendation for state action plan | Any policy provision or intervention or change required |
|--------------------------|---|--|---|---|
| Flood incidences | Flood victims | Rescue and rehabilitation, compensation to crop loss to farmers | Rescue and rehabilitation, compensation to crop loss to farmers | Corruption free implementation of the suggestions/ govt grants so as the target group gets the benefits |
| Landslide | Heavy rain, flood | Mass education Quick relief should be provided to the victims | Rescue and rehabilitation, compensation to crop loss to farmers | |
| Drought related disaster | Scanty rainfall, failure of growth of agricultural crop | 1. Dissemination of scientific knowledge 2. Financial assistance 3. Provision of artificial irrigation 4. Rehabilitation of domestic livestock, cattle with respect to health, fodder and shelter 5. Rehabilitation of marginalised businessman and artisans | Rescue and rehabilitation, compensation to crop loss to farmers | |
| Epidemics | Malaria, Diarrhoea | Adequate health care | Initiate necessary measures | Area specific initiative should be taken |
| Hailstorm/croploss | Rain | Financial help and help in crop recovery | Rescue and rehabilitation, compensation to crop loss to farmers | |

Thematic area : Forest and Wildlife

Chairperson : Dr A.K. Das, Professor, Department of Ecology and Environment Science, Assam University

| Issue | Context | Required Intervention | Recommendation for state action plan | Any policy provision or intervention or change required |
|-----------------------|------------|--|--|---|
| Climate change impact | Forest | Creation of awareness on climate change impact on forests among the local people (Forest Ecosystem People) | Creation of awareness on climate change impact on forests among the local people (Forest Ecosystem People) | |
| Degraded land | Plantation | Plantation on degraded lands with indigenous species | Plantation on degraded lands with indigenous species | |
| Forest product | Livelihood | Provision of alternative source of livelihood through value addition of forest products | Provision of alternative source of livelihood through value addition of forest products | |

Future Research Needs:

1. Identification of keystone species for eco-restoration
2. Long term studies on phenology of trees
3. Analysis of wildlife habitat through RS and GIS
4. Identification of plant species having high carbon sequestration potential
5. Long term monitoring of migratory birds
6. Land use/cover mapping through RS and GIS
7. Creation of long term research plots (LTRP)
8. Climate change and invasive species
9. Assessment of natural resource dependency by forest dependent people

8.2 List of participants in the Consultation Workshops

Assam University

Date : 17th December, 2010

| SL.NO. | NAME OF THE PARTICIPANTS | ORGANISATION |
|--------|---------------------------|---|
| 1 | Dr. S. Roychoudhury | Dept. of Life Science and Bioinformatics, AU |
| 2 | Bhuttu Chakraborty | Dept. of Ecology and Bioinformatics , AU |
| 3 | Pinky Purkayastha | JRF, Dept.of Ecology, AU |
| 4 | Purabi Das | K.V., Silchar, AU |
| 5 | S.Z. Barbhuiya | Range Officer, R.K.Nagar, SC Range. |
| 6 | Aftab Ahmed | Dept. of Ecology., AU |
| 7 | Gita Roy | Dept. of Ecology, AU |
| 8 | Dharitri Borah | Research Scholar of Environment Science, AU |
| 9 | Dr. Pulak Das | Geopetrol International Inc. |
| 10 | Sonam Inaobi Singh | Student of Ecology & Environment Science, AU |
| 11 | Shikhasmita Nath | Student of Ecology & Environment Science, AU |
| 12 | Aparijita Das | Student of Ecology & Environment Science, AU |
| 13 | Poppy Rajbongshi | Student of Ecology & Environment Science, AU |
| 14 | Moniruzzaman Rahman | Student of Ecology & Environment Science, AU |
| 15 | Arif Uddin Ahmed | Student of Ecology & Environment Science, AU |
| 16 | Sushmita Dey | Student of Ecology & Environment Science, AU |
| 17 | Luthun Nath | Student of Ecology & Environment Science, AU |
| 18 | Arpita Bhattacharjee | Student of Ecology & Environment Science, AU |
| 19 | Soma Das | Student of Ecology & Environment Science, AU |
| 20 | Dipankar Debnath | Student of Ecology & Environment Science, AU |
| 21 | Sufia Begum Barbhuiya | Student of Ecology & Environment Science, AU |
| 22 | Aftab Ahmed Shah | Student, Life science,AU |
| 23 | Mayukh Ghose | Student, Life science,AU |
| 24 | Garland Star Swett | Student, Life science,AU |
| 25 | Pator Singnar | Student, Life science,AU |
| 26 | Biswajyoti Bikomiya Deori | Student, Life science,AU |
| 27 | Nabajyoti Borah | Research Scholar |
| 28 | Deepti Mala Singha | Research Scholar |
| 29 | Dinam Ibetombi Devi | Research Scholar |
| 30 | Ajay Dutta | Student of Ecology & Environment Science, AU |
| 31 | Yumnam Devashree | Research Scholar |
| 32 | Prithwi Jyoti Bhowmik | State Institute of Public Administration and Rural Development, Agartala, Tripura |
| 33 | Shampa Deb | Assam University Silchar, Research Scholar. |
| 34 | Nirmal Debnath | Assam University Silchar, Research Scholar. |
| 35 | Subhendu Nath | Assam University Silchar, Research Scholar. |
| 36 | Biplab Brahma | Assam University Silchar, Research Scholar. |
| 37 | Dr. Tapati Das | Faculty |
| 38 | Rangdeb Nath | Forest Department, ACF,o/o,DFO,Cachar Div. |
| 39 | Ram Ratan Dusad | Member West Sonai, Z.P. |

| SL.NO. | NAME OF THE PARTICIPANTS | ORGANISATION |
|--------|------------------------------|---|
| 40 | Suraj kr. Dusad | Durgakana |
| 41 | Hari Moni Bardi | Burrukana, Ward member |
| 42 | Tagodish Bhar | Dorrakana |
| 43 | Hari Kumar Bhumij | Dorrakana |
| 44 | Mohan Bhar | Burrukana |
| 45 | Joydeep Shil | Student, Ecology |
| 46 | Pravakar Chakraborty | Student, Mass Comm. |
| 47 | Mahabir Prasad Khandeua | Student, Ecology |
| 48 | Ningombam Sharan Kumari Devi | Ecology and Environmental Sc. |
| 49 | Okram Gangarani Devi | Ecology and Environmental Sc. |
| 50 | Maisnam Sapana Devi | Ecology and Environmental Sc. |
| 51 | Mira Ghosh | Student, life science |
| 52 | Pijush Kanti Das | SAVE/COPE |
| 53 | Abidayanurani Laskar | Student, life science |
| 54 | Deepankar Barman | Ecology and Environmental Sc. |
| 55 | Nilkamal Choudhury | Ecology and Environmental Sc. |
| 56 | Pranab Gogoi | Ecology and Environmental Sc. |
| 57 | Biswajit Chakdar | Ecology and Environmental Sc. |
| 58 | Manabendra Ray Choudhury | Ecology and Environmental Sc. |
| 59 | Romila Thoudam | Ecology and Environmental Sc. |
| 60 | Rimakshi Choudhury | Ecology and Environmental Sc. |
| 61 | Sangeeta Haflongbar | Ecology and Environmental Sc. |
| 62 | KSH Bijaya Laxmi | Ecology and Environmental Sc. |
| 63 | Tampak Meena | Ecology and Environmental Sc. |
| 64 | S. Manoranjan | Ecology and Environmental Sc. |
| 65 | A. Satish Chandra Sharma | Ecology and Environmental Sc. |
| 66 | Jayata Kumar Roy | Ecology and Environmental Sc. |
| 67 | Rinku Moni Kalita | Assam University Silchar, Research Scholar. |
| 68 | K.H. Romesh Singh | Assam University Silchar, Research Scholar. |
| 69 | Mofidul Islam | Assam University Silchar, Research Scholar. |
| 70 | Siddhartha Sen | Ecology and Environmental Sc. |
| 71 | Chinmoy Choudhury | Life Science |
| 72 | Dulumoni Tamuli | Ecology and Environmental Sc. |
| 73 | Manika Das | Ecology and Environmental Sc. |
| 74 | Ranabijay Gope | Ecology and Environmental Sc. |
| 75 | Damayanti Bhar | 3 No. Ward Member |
| 76 | Lalchand Bagdi | Durgakona |
| 77 | Hiraman Bhar | Durgakona |
| 78 | Sharmila Naosekpm | Assam University Silchar, Research Scholar. |
| 79 | H. Khuman Liema | Assam University Silchar, Research Scholar. |
| 80 | Longjam Razya Chanu | M.Sc.,1st sem.,Ecology and Envnt. |
| 81 | Yumnam Ronibala Devi | M.Sc.,1st sem.,Ecology and Envnt. |
| 82 | Leimapokpm Amarjit Singh | Assam University Silchar, Research Scholar. |
| 83 | Rajashree Saikia | Ecology and Environmental Sc. |
| 84 | Dr. Ajit kumar Das | Ecology and Environmental Sc. |

| SL.NO. | NAME OF THE PARTICIPANTS | ORGANISATION |
|--------|--------------------------|--|
| 85 | Dr. Kulendra Chandra Das | Biotechnology |
| 86 | Himangshu Sharma | Ecology |
| 87 | Panna Deb | CBNRC |
| 88 | Dr. Mithra Dey | Dept. of Ecology and Environmental Science, Assam Uni. |
| 89 | Aparajita De | Dept. of Ecology and Environmental Science, Assam Uni. |
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Thematic area: PROTECTION AND SUSTAINABLE MANAGEMENT OF FORESTS AND WILDLIFE

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Thematic area: "SUSTAINABLE HABITAT FOR QUALITY LIFE."

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Thematic area: PROTECTION AND SUSTAINABLE MANAGEMENT OF FORESTS AND WILDLIFE

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Thematic area: MITIGATING NATURAL DISASTER AND CRISIS MANAGEMENT

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