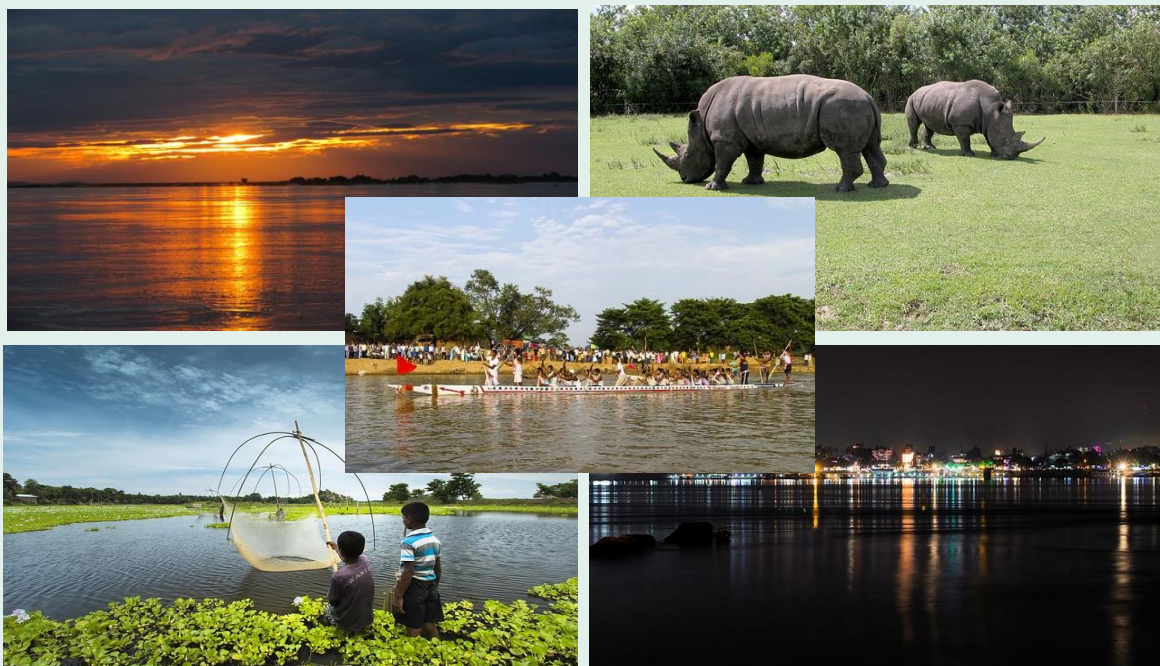


Revised Assam State Action Plan for Climate Change with Monitoring and Evaluation Framework- 2019



सत्यमेव जयते

Department of Environment & Forests

Government of Assam, India

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Abbreviations

AASC	Assam Administrative Staff College
ACCMS	Assam Climate Change Management Society
ADB	Asian Development Bank
AEDA	Assam Energy Development Authority
AHDR	Assam Human Development Report
APDCL	Assam Power Distribution Company Ltd.
APFCB	Asian Pacific Federation of Clinical Biochemistry
APGCL	Assam Power Generation Company Ltd.
ARI	Acute respiratory Infection
ASAPCC	Assam State Action Plan on Climate Change
ASDMA	Assam State Disaster Management
ASEB	Assam State Electricity Board
ASTC	Assam State Transport Corporation
ASTEC	Assam Science Technology and Environment Council
ASWRC	Assam State Water Resource Council
BEE	Bureau of Energy Efficiency
BL	Base line
BRT	Bus Rapid Transport
CAMPA	Compensatory Afforestation Fund Management and Planning Authority
CC	Climate Change
CDM	Clean Development Mechanism
CESPR	Centre for Environment, Social and Policy Research
CFL	Compact Fluorescent Lamp
CNG	Compressed Natural Gas
CPHEEO	Central Public Health & Environment Engineering Organization
CR	Crore
CSO	Civil Society Organization
CSS	Central Sponsored Scheme
CWC	Central Water Commission
DALY	Disability Adjusted Life Years
DDL	Disease Diagnostic Limited
DFID	Department for International Development
DoA	Department of Agriculture
DoHF&W	Department of Health and Family Welfare
DoNER	Development of North Eastern Region
DoUD	Department of Urban Development
EPC	Engineering, Procurement and Construction
GDD	Guwahati Development Department
GDP	Gross Domestic Product
GHG	Green House Gas
GIM	Green India Mission
GIS	Geographical Information System
GMC	Guwahati Municipal Corporation
GoA	Government of Assam
Gol	Government of India
GSDP	Gross State Domestic Product
GW	Giga Watt
H	High
Ha	Hectare

HH	House hold
HRF	Horizontal Roughing Filter
IBIS	Integrated Biosphere Simulator
ICAR	Indian Council of Agricultural Research
ICMR	Indian Council Medical Research
IEC	Information and Education Communications
IL & FS	Infrastructure Lease and Finance
IMD	Indian Meteorological Department
INECC	Indian Network for Ethics and Climate Change
IPCC	Inter-governmental Panel on Climate Change
IPP	Independent Power Producer
ISRO	Indian Space Research Organization
IWT	Inland Water Transport
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
KNP	Kaziranga National Park
KW	Kilo Watt
LED	Light Emitting Diode
LPG	Liquefied Petroleum Gas
M	Moderate
MNRE	Ministry of New and Renewable Energy
MoA	Ministry of Agriculture
MoEF & CC	Ministry of Environment, Forests and Climate Change
MoF	Ministry of Finance
MSW	Management Solid Waste
MW	Mega Watt
NABARD	National Bank for Agriculture and Rural Development
NAPCC	National Action Plan on Climate Change
NBA	National Biodiversity Authority
NBPGR	National Bureau of Plant Genetic Resources
NE	North East
NEC	North Eastern Council
NEEPCO	North eastern Electric Power Corporation Limited
NEIIPP	North East Industrial and Investment Promotion Policy
NESAC	North East Space Application Centre
NMEEE	National Mission on Enhanced Energy Efficiency
NMSA	National Mission for Sustainable Agriculture
NMSH	National Mission on Sustainable Habitats
NMSHE	National Mission on Sustainable Himalayan Eco System
NRHM	National Rural Health Mission
NTFP	Non Timber Forest Produces
NWM	National Water Mission
OPML	Oxford Policy Management Limited
PA	Protected Areas
PCCF	Principal Chief Conservator of Forests
PHD	Public Health department
PHE	Public Health and Engineering
PRECIS	Providing Regional Climate for Impact Studies
REDD	Reducing Emissions from Deforestation and Forest Degradation
SME	Small Medium Enterprise
SPV	Solar Photo Voltaic
SSS	State Sponsored Scheme

STW	Shallow Tube Well
SWM	Solid Waste Management
T&D	Transmission and Distribution
TA	Technical Assistance
TERI	The Energy and Resource Institute
THI	Thermal Heat Index
TRAI	Telecom Regulatory Authority of India
TRI	Tea Research Institute
ULB	Urban Local Bodies
VH	Very High
VVH	Very, Very High
W.R.T.	With respect to
WATSAN	Water and Sanitation
WRD	Water Resources Department
WTP	Water Treatment Plant
WW	Waste Water

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We would like to extend our sincere thanks to the Chief Secretary, Government of Assam for supporting ACT initiatives targeted at revising the State Action Plan on Climate Change (SAPCC) of Assam in light of the Sustainable Development Goals (SDGs) and Intended Nationally Determined Contributions (INDCs).

Mainstreaming the Climate Change approach by the governments must be on priority to ensure the sustainability and for safeguarding its own citizens. In this perspective, the Assam State Action Plan on Climate Change was prepared in 2015. The current document, the **Revised State Action Plan on Climate Change- 2019** is the outcome of incorporation of afterward developments including SDGs, INDCs, and other knowledge and information updates.

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Executive Summary

Setting the Context

Given the unique physiography, climate and location of Assam in the North Eastern Himalayas with mighty Brahmaputra flowing through, the State is endowed with ample water resources and rich floral and faunal biodiversity. As a result, more than 80% of its population thrives on agriculture and allied activities. Changing course of Brahmaputra and recurrent floods have led to widespread damages, but people residing in these regions have adapted to such hazards using indigenous approaches developed since ages. Discernible changes in these systems are now emerging due to changes in climate, impacting the economy associated with these resources. Observations indicate that since the last 60 years (1951-2010), the annual mean temperature in Assam has increased by 0.59 °C and the annual rainfall has decreased by 2.96 mm per year.

Frequent, intense heavy precipitation in the form of cloud bursts have been reported in recent years which have led to devastating flash floods. Climate change projections for the Assam indicate that mean average temperature is likely to rise by 1.7 to 2.2 °C by mid-century with respect to 1971-2000. There is likely to be increase in extreme rain fall events by 5 to 38%. All across the State, except in the southern districts, droughts weeks are going to rise as well, by more than 75% with respect to the base line (1971- 2000). As regards floods, projections increase a rise in events by more than 25%. It is essential that adaptation plans to combat the impacts of climate change are factored in the development process now to avoid economic burden of adaptation in the long run and gain from new opportunities that will be thrown up along the way.

It is equally important to include gender-sensitive adaptation measures. This is because a large number of poor, rural women depend on climate-sensitive resources for survival and their livelihoods, they are also less likely to have the education, opportunities, authority, decision-making power and resources they need to adapt to climate change. Though SDGs are gender-sensitive in their composition but in order to implement it so that gender-sensitivity is maintained and/or is addressed *collecting gender-segregated data, doing gender-budgeting and developing monitoring indicators focusing on gender* remains the key. Thus, for example, if more women are engaged in farming due to extensive male migration (seasonal or permanent), more adaptation funds must be targeted for women and accounted for. Again, adaptive measures to augment water sources must be directed towards women's involvement (as owners, workers, managers, etc.) if women shoulder the responsibility of accessing water. Gender-based budgeting also allows for a robust monitoring, evaluation and reporting tool to address gender-imbalances.

The following sections describe briefly the challenges and corresponding adaptation strategies.

Strategies to combat climate change in Assam

Water resources: Currently, the overall resource seems adequate, but water stress conditions in many parts of the State are common during lean flows in the rivers. Increasing incidences of extreme rainfall in the hilly areas are leading to high run-offs affecting ground water recharge. Lack of irrigation is also a significant issue of concern in major part of the state. For sustainability of water resources and ensuring that sectoral demands are met with in the future, the proposed adaptations strategies are focusing on institutional reforms, water use efficiency in different sectors, water resource augmentation, and diversified livelihoods.

S. N.	Strategy	Responsible Agency and Time Period	Cost (INR Cr)	Priority	Possible Financing Source
1	Undertake assessments to ascertain the institutional reforms requires to address water distribution, and use issues in a climate change context	Dept. of Water Resources PHE Irrigation	0.50	VH	Climate change fund mechanism
2	Set Up Assam State Water Resource Council		-	H	Climate change fund mechanism
3	Assess the amount of water use efficiency taking place by applying the following in one location wrt baseline and replicate in later years	Dept. of agriculture	1.00	VH	Climate change fund mechanism
	Reuse of wastewater (1000 ha) -Water efficient crops (1000 ha) SRI or multiple aerations for rice cultivation (1000 ha)		0.30		
4	Improving irrigation through creating a canal irrigation system to bring 150 thousand ha land under cultivation	Irrigation Department/Department of water resource	300		
5	Increased resilience of crop by promoting the farm ponds in agriculture farms (30000 farm ponds)	Department of Agriculture/ Department of Rural Development	300	H	Rural Development
6	Improve water efficiency through the conjunctive use of surface and groundwater over at a pilot scale covering 1000 ha	Dept. of water resources	2.00	VH	Climate change fund mechanism
7	Undertake a study to explore the possibility of Improving water use efficiency in the industry -Explore the possibility of water markets -Through reuse of wastewater	Dept. of Industry	0.50	VH	Climate change fund mechanism
8	Encourage the use of recycled water from domestic wastewater in urban areas (2 wards in one city)	ULBs	1,00	VH	Climate change fund mechanism
9	Continuous awareness raising on water conservation habits through media	PHE/ULBs	0,10	H	Dept. budget
10	Enable spring shed development in hilly areas to restore the perennial streams within forests (districts close to Nagaland)	Water Resources Dept.	3.50	VH	Climate change fund mechanism
11	Backyard fisheries in small tanks in the same area where water use efficiency will be piloted in agriculture	Fisheries Dept.	1.00	VH	Climate change fund mechanism
	TOTAL		10.40		

Floods and Erosion: Given the fact that substantial increase in extreme precipitation events are expected in the future, managing erosion and impacts of flooding events will be a major challenge that the State will have to combat annually. The strategies envisaged are as follows.

S. N.	Strategy: Floods	Responsible Agency and time period	Cost (INR Cr)	Priority	Possible Financing Source
1	Detailed scientific study to understand the nature of river flow and its impact on erosion to control erosion in the state of Assam and enable land reclamation	WRD	0.50	VH	

S. N.	Strategy: Floods	Responsible Agency and time period	Cost (INR Cr)	Priority	Possible Financing Source
2	Undertaking study to assess the intensity and recurrence frequency of floods due to climate change and extent and depth of flooding. In 14 major Urban Agglomerates in the 14 districts prone to floods –Done by the ACT	WRD	2.8 (@ 0.2 Cr per city)	VH	
3	Develop an integrated flood, erosion, and sediment management Action Plan for the Brahmaputra basin 3 major regions in Assam, namely, for Upper, Middle and Lower Assam and drawing upon knowledge on improved technical standards, global best practices and the technologies-under review will be implemented by Flood and River Management Agency of ASSAM (FREMAA)	Executing Agency: WRD Partners: ASDMA, NESAC, IMD, Research Instt, NGOs	1500.00	VH	World Bank /any other
4	Extending River Bank Stabilisation work using geotextile material for river bank training all along the Brahmaputra and Barak river banks. – Under implementation through different small schemes	WRD	750.00	VH	
5	Setting up a North East Hydrology Data Management Centre through basin management approach for managing flash floods. Bidding Process has started for the data center	WRD	2.00	VH	
6	Documenting possible indigenous community based and new adaptation strategies for adapting to floods and implementing the same at pilot scale along with the development of fiscal measures for averting climate-induced risks.	WRD	5.00	VH	Adaptation Fund
7	Construction of multipurpose flood shelter with an inmate capacity of 500 people / Unit in Dhemaji, Lakhimpur, Barpeta; Morigaon & Majuli	ASDMA	14.00	H	
8	Develop district level management plans to deal with multiple hazards including floods in a changing climate context	ASDMA	8.10	H	
9	Infrastructure strengthening Community-based flood early warning system	ASDMA	8.00		
	TOTAL		2282.40		

Water resources planning should be managed at the lowest appropriate level that can ensure that the decisions are supported by those who will implement on the ground, who are more often than not women. Keeping in mind women's traditional roles in water resources management and accepting that they have less bargaining power in resource allocation, it is critical that special emphasis is placed on planning and practice of water strategies and targeting at least **30-40%** of the total budget in the above-mentioned strategy for water resources and flood management for women and accounted for in the final implementation.

Agriculture, Horticulture, Tea and Fisheries: Warming of the temperature reduces production of staple crops such as rice, horticulture produce, economically important tea produce, milk yields and fish catch. Coupled with increasing intensity of rain fall in some areas and intensive droughts in others, emergence of new pests and diseases, the yield realization in a business as usual agriculture practice scenario are likely to become lower. Following are some strategies identified to make agriculture, horticulture and fisheries sustainable to the extent possible in a changing climate scenario.

S. N.	Strategy- Crops	Responsible Agency and time period	Cost (INR Cr)	Priority	Possible Financing Source
1	Strategy 1: Development district wise climate smart and resilient agriculture adaptation action plans				
1.1	Assessing District wise exposure and vulnerability of agriculture systems to climate variability and change and developing climate smart and resilient Strategies through stakeholder consultation for all 33 districts taking into consideration the agro-climatic zone in which they are located	DoA	10.00	VH	
	Total Strategy 1		10.00		
2	Strategy 2: Develop, disseminate, and practice climate smart and climate resilient agriculture packages at Pilot scale, Coverage: 90,000 ha	DoA			
2.1	Preparation of DPR through PRA to record variances in crops/plants, soil types, soil and water conditions, new pest host relationships	DoA	1.00		
2.2	Application of climate smart and resilient agronomic practices to retain and enhance production to optimum levels	DoA	6.00		
2.3	Assessing and broadcasting knowledge on appropriate seed rate, soil moisture conservation activities, water efficient technologies including drip irrigation and village operations	DoA	81.00		
2.4	Redefining cropping pattern suitable for each agro-climatic zone	DoA	6.00		
2.5	Establishing demonstrative integrated farming systems by introducing agroforestry and agro-pastoral practices	DoA	81.00		
2.6	Restore natural water bodies to conserve run off.	DoA	80.00		
2.7	Community vermin-composting	DoA	100.00		
2.8	Expansion of area under low water requiring crops	DoA	15.00		
2.9	Integrated diseases management practices	DoA	15.00		
2.10	Develop and propagate crop specific weather indexed crop insurance	DoA	60.00		
2.11	Train farmers on disaster risk reduction techniques	ASDMA and DoA	2.00		
	Total (Strategy 2):		447.00		
3	Research				
3.1	Developing water and temperature stress tolerant varieties with focus on integrating C4 characteristics in C3 Rice to make photosynthesis efficient at higher temperatures and hence make rice plants temperature and water stress resilient	DoA	0.10		
	Identifying the potential of improving the productivity of winter rice to comparable	DoA/AAU	1.50		

S. N.	Strategy- Crops	Responsible Agency and time period	Cost (INR Cr)	Priority	Possible Financing Source
	levels of states with high yields of the same				
	Total Strategy 3:	DoA	1.60		
4	Knowledge management, training and skill development	DoA			
4.1	Automatic weather stations (8 in number) at block level	DoA	17.52		
4.2	Sustainable eco-friendly horticulture in hilly areas	DoA	25.00		
4.3	Computerised weather recording and synthesizing centre	DoA	0.10		
4.4	Establishment of Climate Change Agriculture research Centre	DoA	0.20		
4.5	Training of department functionaries on CC adaptation for developing climate resilient agriculture	DoA	2.00		
4.6	Training of farmers on climate smart and climate resilient packages of practices	DoA	1.00		
4.7	Documenting indigenous knowledge on adaptation for integration with modern techniques	DoA	0.05		
4.8	Publication and dissemination of success stories	DoA	0.05		
4.9	Workshops/seminars on CC resilient agriculture system development	DoA	0.10		
	Total Strategy 4:		46.02		
5	Strengthen accessibility to markets				
5.1	Establish market intelligence cell	DoA	1.00		
5.2	Skill development towards producing benefited food products (cover 14 districts in Phase 1)	DoA	14.00		
5.3	Establish farmers' companies (village cluster approach in 14 districts)	NABARD	28.00		
5.4	Strengthen cold storage networks (14 districts)	NABARD	14.00		
	Total Strategy 5		57.00		
6	Strategy 6: Protect irrigation schemes from siltation due to soil erosion				
6.1	Improving irrigation through creating a canal irrigation system to bring 150 thousand ha land under cultivation	Irrigation Department/Department of water resource	300.00		
6.2	Increased resilience of crop by promoting the farm ponds in agriculture farms (30000 farm ponds)	Department of Agriculture/ Department of Rural Development	300.00	H	Rural Development
6.3	Plant plantation trees every 25 m on both sides of irrigation canals and reservoirs and beside inspection roads- cover 19244 km	Irrigation/Rural Dev/Forest Department	124.48		
6.4	Install 10 HP pumps sets in irrigation scheme to offset emission from fuel combustion in motors (10 numbers)	Department of Irrigation	4.00		
	Total Strategy 6		728.48		
	TOTAL AGRICULTURE CROPS		1290.1		

S. N.	Strategy Horticulture;	Responsible Agency	Budget (INR Cr)	Priority	Source of Funding
1	Sustainable horticulture in hilly areas through plantation crops like cashew nut – Focus: Jhum areas and others. Coverage: 5000 ha.	Directorate of Horticulture Assam	25.00	VH	Horticulture mission
2	Popularisation of indigenous thermal and water stress resistant varieties – black Jamun (<i>Polnia</i>), Sapida (<i>Leteku</i>), Jackfruit, Hog plum (<i>Amara</i>) etc. Coverage: 1000 ha,	-do	2.50	H	RKVY
3	Growing vegetables in protected condition through Crop diversification and thus facilitating off season production	-do	4.00	H	Horticulture mission/RKVY
4	Promoting water use efficiency-Construction of water harvesting structures, promotion of drip and sprinkler irrigation: Coverage: 100 ha.	-do	20.05	VH	Horticulture mission
5	Ensuring soil health – promotion of integrated nutrient management in hilly areas prone to soil erosion: Coverage: 2500 ha.	-do	4.0	H	Horticulture mission
6	Managing emerging pests and disease management-Integrated pests and disease management. Coverage: 2500 ha	-do	4.0	VH	
7	Developing disease prevalence maps and tracking the same across the years in the entire State Developing disease forecasting systems and disseminating it to farmers through SMS and other media	-do	0.25	VH	
8	Treat micro water sheds for soil and water conservation (16 thousand ha) in hilly Jhum areas	Department of soil and water conservation	20.00	VH	
9	Develop and propagate weather indexed crop insurance	-do- with insurance agency	1.00	VH	
10	Farmers training on climate change adaptation and disaster risk reduction packages of practices for different agroclimatic zones	ASDMA with Directorate of Horticulture	2.00	H	
TOTAL			82.8		

S. N.	Strategy -Tea;	Responsible Agency	Budget (INR Cr)	Priority	Source of Funding
1	Real time remote-sensing based soil moisture mapping to help in crop planning along with validation at field level; Coverage: All Tea growing areas	Tea Board	10.00	VH	ISRO/Tea Board/
2	Assessing soil carbon across all tea Stations.	Tea Board	10.00	VH	Tea Cess
3	Identifying, procuring and broadcasting thermal and water stress resistant tea varieties,	Tea Board	10.00	VH	Tea Research Station
4	Dissemination of water efficient technologies – sprinkler and drop irrigation Coverage: small holders in 1/4th of area under small holders	Tea Board	10.00	VH	Tea Cess
5	Creating water harvesting structures for small tea growers	Tea Board	15	VH	Tea Cess

6	Developing pest and disease forecasting systems for tea related pests and planters	Tea Board	2.50	VH	
	TOTAL		88.00		

S. N.	Strategy Livestock	Responsible Department	Budget (INR Cr)	Priority	Source of Funding
1	Grading up of local cattle and buffalo stock with suitable high milk yielding Indian indigenous varieties such as Murrah/Sahiwal through Artificial Insemination-Cover at least 13 districts Assam, including remote districts	Animal Husbandry	10.00	VH	GoA, ICAR, Multilateral funding
2	Undertake Anoestrus management in buffalos simultaneously in the above chosen districts	Animal Husbandry	10.00	VH	GoA, ICAR, Multilateral
3	Creation of gene bank for conservation of threatened breeds (Five)	Animal Husbandry	5.00		
4	Establish scientifically designed community-based shelters in all 219 blocks to accommodate at least 300 cattle of small and marginal farmers-with plantations around for reducing temperature of the surrounding microclimate, and water harvesting structure	Animal Husbandry	21.90	VH	Rashtriya Gokul Mission
5	Harness energy from dung and produce 1000 cum of biogas in each of the 219 blocks	Animal Husbandry	219.00	H	Entrepreneur based
6	Undertake fodder cultivation using hydroponic technique-in the shelters in 219 blocks	Animal Husbandry	10.95	VH	ICAR/Entrepreneur
7	Develop and propagate Weather indexed insurance for loss in milk yield due to heat stress. Coverage: All crossbred and genetically upgraded indigenous cattle and buffalo in 219 blocks	Animal Husbandry	5.00	VH	AHD, Insurance company, Any other
8	Develop disease forecasting system	Animal Husbandry	1.00	VH	AHD
9	Disease Management – vaccination, fumigation etc.	Animal Husbandry	233.68	VH	AHD
10	Disease diagnostic (DDL) (Contractual Doctor, TA and other recurring expenses) in 33 districts	Animal Husbandry	99.00	H	AHD
11	Training / capacity building of technical and non-technical person on adaptation to climate change and relevant technologies-219 blocks	Animal Husbandry	21.90	VH	AHD
12	Safe, quick and effective transfer of milk from producer to chilling plants to avoid spoilage of milk in all 33 districts	Dairy Development	180	VH	
13	Establishment of new and refurbishment of existing Milk collection Centres with required technical infrastructure in all 33 districts	Dairy Development	60	VH	
14	Setting up of chilling plants to stop bacterial growth at higher temperatures in all 33 districts	Dairy Development	140	VH	
15	Capacity Building of Dairy farmers in all 33 districts on - Scientific dairy cow management - Improved milk hygiene and quality - Transfer and practice of quality milk production - Capacity building of farmers on climate	Dairy Development	40	VH	

	change adaptation				
16	Develop and disseminate package of practices amongst farmers for mitigating disaster risk reduction such as during floods and droughts (in all 33 districts)	Animal husbandry and dairy development	33.00	VH	
	TOTAL		1090.43		

The gender gaps in agriculture go back to differential allocation of responsibilities and access to common property resources and which sometime place women in disadvantaged position and also affect their productivity in agriculture and overall bargaining power in resource access amongst others. The gender gaps and stereotypes are further reinforced in the event of negative climate change and their ability to respond to it effectively and sustainably. Addressing women's knowledge gap on climate change adaptation strategies in agriculture & allied sector and providing them with appropriate financial access will strengthen their roles as producers and widen the economic opportunities that they can avail. Overall this will put them in a better position to respond to climate change. Strategies to address the livestock issues

S. N.	Strategy- Fisheries	Responsible Dept	Estimated Cost (INR Cr)	Priority	Source of Funding
1	Creation of up-to-date state level GIS based database on water and fish & fishery resources; water resources and their potential users	Dept of Fisheries	15.00	VH	State Fund-work to be done by research Instt's
2	Restoration of natural fish breeding and feeding grounds	Dept of Fisheries			
	Establishment of small and medium size feed mills (one each in all 33 Districts)	Dept of Fisheries	33.00	H	
	natural water resources -Demarcation, de-silting and removal of aquatic weed and their connecting channels		200.00	VH	
3	Productivity enhancement and utilization of potential areas	Dept of Fisheries			
	-Pen/cage culture for production of fish and fish fingerlings -Introduction of re-Circulatory water management system for fish production		45.00	M	
			25.00	M	
	period production system -Fish stock enhancement of the closed natural water bodies with dominant species (10.000 ha)		10.00	H	
	Construction of new ponds in low lying areas. Two each in all 219 blocks	Dept of Fisheries	1.75	H	
	Large-scale adoption of integrated fish farming in potential areas such as paddy-cum-fish culture in low-lying areas and pig-cum-fish culture in pig rearing belts in existing ponds on cluster basis and (five each in 10 Districts)	Dept of Fisheries	0.25	H	NABARD, DoF
4	Availing Quality fish seed available	Dept of Fisheries			
	-Brood fish farm, one in each 27 district -Construction of fish seed	Fisheries	2.60	H	
	Establishment of fish seed hatcheries @ 10 million fry production capacity, both in private and government sector (33 no., one each in all districts)	Dept of Fisheries	9.00	L	
	-Replenishment of brood fish		0.10	M	
	from brood farms in the		0.10	H	
	hatcheries (100 no.) -Development of seed rearing areas (500 ha) -Strict implementation of legal provisions		0.10	VH	
4	Conservation of indigenous fish	Dept of Fisheries			
	species -Cataloguing and year wise updating of indigenous	Fisheries	0.10		
	aquatic flora and fauna along with conservation Status - Ecosystem based		1.00	VH	
	conservation of threatened species and indigenous		2.00	H	
	species and riverine system -Declaring parts of beels as		0.10	M	
	protected areas (1000 beels) -Declaring closed seasons in natural waters -Establishment of State level gene banks in lower, upper,		0.40	H	
	central Assam and in Barak valley (4 nos) - Preparedness/precautionary measures for probable disease outbreak (26 districts)		1.30	VH	
5	Reclamation of ponds and beels wherever possible (5000 ha)	Dept of Fisheries	50.00		
	Rain water Harvesting at HH level for small tank fisheries especially in hilly areas (5000 HH)	Dept of Fisheries	25.00	H	
6	Developing packages of practices for farmers to sustain their production in a climate change context	Dept of Fisheries	2.00	VH	

7	Develop and disseminate weather indexed insurance for fisheries sector-to benefit small and marginal farmers and link it to disaster risk reduction	Dept of Fisheries. ASDMA, Insurance agency	0.50	VH	
8	Community mobilisation for embracing State of the Art package of practices	Dept of Fisheries	0.60	VH	
9	Establish block level kiosks for fishery related information dissemination including SMS	Dept of Fisheries	10.05	VH	
10	Climate change Cell in department of Fisheries -Will develop road map to deal with CC, -MIS, Data management, -launching studies for strategic knowledge, -developing IEC material, -imparting training for capacity building – staff, farmers; seminars and workshops)	Dept of Fisheries	1.77	VH	
	TOTAL		436.72		

Forest and Biodiversity: Forests essentially play a key role in providing different ecosystem services that include its role in conditioning the microclimate in and around forests, conservation of watersheds originating from within forests, and providing timber and biodiverse NTFPs that are harvested to sustain livelihoods of forest dependent communities. In Assam, forests are increasingly getting degraded due to population pressure and associated drivers. Further, climate change is influencing the biodiversity, thus affecting forest produce and hence dependent livelihoods. The State is also endowed with extensive biodiversity rich wetlands that are increasingly being threatened by anthropogenic drivers and climate change Strategies identified to combat the impacts of climate change are as follows.

S. N.	Action- Forestry	Department Responsible	Costs (INR CR)	Priority	Sources of Fund
1	Reducing degradation of forests by closure of areas with promising regeneration and root-stock of natural species (Secured ANR); 4000 ha	Dept. of Forests	70.00	VH	GIM/
2	Improving density of cover in degraded forest areas-Open forests (artificial regeneration with fencing); 200 blocks of 25 ha each - Moderately dense forests; 5000 ha	Dept. of Forests	120.00 62.50	H M	GIM/ CAMPA APFBC / GIM
3	Safeguarding against encroachment in RFs and PAs RFs - Highly sensitive areas (Inter-State borders / City RFs); 2,00,000 RM -Other sensitive areas; 2,00,000 RM PAs-Highly sensitive areas (Inter-State borders); 50,000 RM -Other sensitive areas; 1,00,000 RM	Dept. of Forests	170.00 170.00 42.50 85.00	VH H VH H	GoI / Fin. Comm. GoI CAMPA CAMPA
4.	Building climate resilience of forest-based livelihoods-	Dept. of Forests			
	NTFP focused forest management to help forest-dependent communities adapt to CC through emphasis		5.00	H	GIM
	on multiple utility species; 1000 ha - Developing Nurseries for providing quality planting material including that of Bamboo/ indigenous		3.50	H	GIM

S. N.	Action- Forestry	Department Responsible	Costs (INR CR)	Priority	Sources of Fund
	Fruit trees / Medicinal Plants and other multi-utility trees; 35 nurseries of 1.5 ha		12.50	VH	APFBC
	each-Promotion of Agroforestry for improving livelihood: Bamboo / Fruit Trees / Medicinal Plants; 1000 ha -Skill Development of Forests communities in sunrise sectors for reducing pressure on forests; 1 lakh beneficiaries		300.00	H	GIM / APFBC
5	Promoting alternate sources of energy for wood substitution as fuel.	Dept of Forests			
	-Energy plantations; 1500 ha-Solar Plants (8KVX3; 5 KVX5; 3 KV X10); 35 units -Bio-gas plants; 400		7.50 2.00 1.00	VH M M	GIM / APFBC GIM / Collateral GIM / Collateral
6	Providing LPG connectivity to Forest Villagers and to fringe dwellers reducing fuel-wood dependencies; 5000	Deptt of Forests	5.00	H	APFBC/ Collateral
7	Securing identified wildlife corridors and improving their habitat status by compensating the communities for conservation; 2500	Deptt of Forests	125.00	VH	GIM
8	Procuring crucial areas surrounding Protected Areas for extended protection to threatened and endangered species (e.g. various additions to the Kaziranga NP); 300 sq. km	Deptt of Forests	600.00	VH	GIM
9	Improving Protected Area Management	Deptt of Forests			
	-Control and eradication of		5.00	VH	GIM / APFBC
	Invasive species -Enrichment planting,		5.00	H	GIM/ APFBC
	200 -Micro-ecosystem improvement; 1000 (wetlands/ grasslands/ breeding grounds etc), 20 projects		5.00	H	GIM/ APFBC/ GoI
10	Intensive Management of Wetlands for achieving -Conservation of wetland biodiversity -Recharge of ground water (20) - Collateral benefits to communities (Eco-tourism)	Deptt of Forests	5.00 2.00 -	H H H	GIM/ APFBC/ GoI GIM/ APFBC/ GoI GIM/ APFBC/ GoI
11	Creating Gene Banks (Ex-situ) -Conservation for Biodiversity of the State / Specimen Lab / Herbarium/Multilocation repositories of germplasm 2 central facilities and 35 site banks	Deptt of Forests	11.50	M	GIM
12	Strengthening Biodiversity Conservation Institutional Mechanism State	Deptt of Forests			
	Biodiversity Board -Mobilizing Community and developing peoples Biodiversity Registers for		6.00	H	GIM / GoA / NBA/APFBC

S. N.	Action- Forestry	Department Responsible	Costs (INR CR)	Priority	Sources of Fund
	documenting local bio-resource diversity and associated traditional knowledge - strengthening of Biodiversity Management Committees (200 BMCs) -Awareness Generation amongst stakeholders - Documentary/TV Show/ Theatre / Workshops)		3.00	H	GIM/ NBA/ GoA
13	Conserving biodiversity in a changing climate scenario -Developing State Biodiversity Strategy & Action Plan and BMC Management Plans -Biodiversity Inventory and documentation with inputs on present conservation needs -Assessment of past management practices / biotic pressures / CC for developing new strategies -Species based research on conservation needs, strategies and conservation actions	Deptt of Forests	0.05	VH	APFBC/
			10.00	VH	GIM/ NBA
			0.05	H	GIM
			25.00	M	GIM / GoA
14	Improving Tree cover outside Forest areas: Avenue, city forests, Panchayat Forests, Homestead, Gardens, Parks, Institutional lands etc	Deptt of Forests	100	H	GIM
15	Plantation on special / difficult sites: <i>Jhoom</i> lands for soil conservation and in <i>Char</i> areas (river islands) for preventing erosion of banks during heavy floods- Plantations / Protection --Community participation in rehabilitation	Deptt of Forests	20	H	GIM
			5	H	GIM
16	Protection against Forest Fires specially in Hill areas -Central Monitoring Unit/Field (2 central units) -Stations/Field gears (20 field stations)	Deptt of Forests	20	VH	SSS/CAMPA/CSS
17	Integrating criteria and indicators of SFM into Working Plans	Deptt of Forests	6	VH	GIM
18	Commissioning of Preservation Plots: studies into change in vegetation is response to CC – genetic resource preservation	Deptt of Forests	5	H	GIM
19	Pilot Studies on Carbon stocking in forests: establish the protocol for measuring, reporting and verification systems for forest carbon.	Deptt of Forests	10	H	GIM
20	Vulnerability Study of Forest Ecology to Climate Change including assessment of changes in Forest Types / subtypes	Deptt of Forests	100	H	GIM
21	Policy Review / Developing Policy: State Forest Policy, Bamboo & Cane Policy, Wetland Policy, Eco-tourism Policy	Deptt of Forests	5	VH	GIM /APFBC
22	Linking of Micro-plans with Working Plans	Deptt of Forests	5	H	GIM

S. N.	Action- Forestry	Department Responsible	Costs (INR CR)	Priority	Sources of Fund
23	Reducing carbon footprints of forestry infrastructure - Eco-friendly; buildings/gadgets etc; 800	Deptt of Forests	960	H	GIM/CAMPA
24	Develop a Manual for disaster risk reduction vis-à-vis for averting - landslides in forests; - for averting forest fires; - for avoiding mortality; of wildlife during floods	ASDMA & Deptt of Forests	0.50	VH	CAMPA
	TOTAL		19826.50		

Forests provide monetary and non-monetary benefits to both men and women in forest communities and they both often have different roles in managing forests, different knowledge about them, different access to forests and different ways of using forest resources. Forestry tends to be perceived as male dominated although women are heavily involved in forest work such as gathering fuelwood, medicinal plants and other non-timber forests products, collecting food for family consumption as well as for income, and in processing secondary wood products. In fact, women in forest communities can generate more than 50 percent of their income from forests compared to about a third for men.

Thus, the impact of climate change in forestry sector affects women more and accordingly strategies related to climate adaptation in the forestry sector and resource allocation should provide targeted budget, to the tune of 40-45% of the total above-mentioned budget towards women and account for it in there monitoring tools. Specific strategies should be designed to engage women along the forestry value chain.

Habitats: As the population is rising in urban areas, and the changing climate is causing higher temperatures in cities, flash floods due to extreme rains amongst others, multiple challenges related to the following are compounding

- Drinking water availability,
- Solid waste management,
- Sewerage disposal,
- Adequate transportation and
- Managing Human Health

The strategies to combat the above are as follows.

S. N.	Strategies: Potable Water Supply	Department Responsible	Costs (INR CR)	Priority	Sources of Fund
1	Ensuring water availability in a changing climate scenario				
	Roof top rain water harvesting; 5000 numbers (emphasizing in southern Assam cities)	PHE	105	H	JNNURM –Part of already existing Building by-laws
	Check dam, 30 numbers (in Southern Assam cities)	PHE	4.0	M	
	Pond HRF (horizontal roughing Filter-Geo membrane line masonry); 50 numbers	PHE	1.00	M	
2	Ensuring potable water during floods				
	Board mounted WTP (water treatment plants) for flood effected areas; 5 numbers	PHE	5.00	M	
	Speed boat for distribution of WATSAN	PHE	2.50	M	

S. N.	Strategies: Potable Water Supply	Department Responsible	Costs (INR CR)	Priority	Sources of Fund
	material during climate change induced floods				
3	Facilitating ground water recharge even in extreme rainfall condition				
	Artificial recharge with pit/trench; 4000 numbers (ongoing)	PHE	40.00	VH	
4.	Enhance water use efficiency				
	Metering of water supply connections in at least 13 major cities-to cover at least 5 cities in 5 years (ongoing)	PHE	100.00	VH	
5	Increasing solar energy penetration and reducing load on conventional source				
	Solar pumping in PWSS; 2000 numbers	PHE	200.00	VH	Solar mission –on going 134 have been completed
6	Research			H	
	Assessing risk due to climate change and designing required Infrastructure and System Operation for water supply systems in four key cities in Assam	PHE	1.00	VH	Bilateral funding/ Multi-lateral funding
7	Capacity building				
	Developing capacity of government officials towards assessing the vulnerability of water resources in their districts and drafting strategies for ensuring water availability (for all 27 districts) and disaster risk reduction	PHE and ASDMA	1.00	VH	Bilateral/Multilateral funding
	Training and skill development of Govt. functionaries on climate change resilient WATSAN system	PHE	5.00	VH	Bilateral/Multilateral Funding
	Exposure visit of Govt. functionaries on climate change resilient WATSAN system	PHE	1.00	H	Bilateral/Multilateral funding
	TOTAL		465.50		
S. N.	Strategies: Waste Management	Department Responsible	Costs (INR CR)	Priority	Sources of Fund
1	Wastewater treatment				
	Community Waste Management System in peri-urban areas (approx. 4 nos in each block)-1000 in number	PHE	50	VH	JNNURM
	Trailer mounted community Bio-toilet for areas affected with climate change resulted flood-45 in number	PHE	0.50	VH	JNNURM
	Colony based sewage treatment plants-recycled waste water will be used for parks, gardens and other uses in all cities (at least cover 2 cities in 1st 5 years and after that all cities in next five years)-60 in number	Department of Urban development	2.00	VVH	JNNURM
2	Solid waste management				
	Feasibility studies in 14 major cities in Assam, excluding Guwahati for setting up integrated waste management plants	Department of Urban Development	1.00	VH	Swach Bharat Mission
	Feasibility study to set up cluster based MSW management amongst class II and III tier cities in Assam	-do	2.00	VH	Swach Bharat Mission
	Preparation of DPR for MSW and Solid	Do	70.00	H	SBM

S. N.	Strategies: Potable Water Supply	Department Responsible	Costs (INR CR)	Priority	Sources of Fund
	Waste Management (including disposal) for: 2 major cities in two years - Rest 12 major cities in next 3 years All class II and Class III tier cities in next two years				
	Implementation of DPR in all major 14 cities in next 10 years: - DPR implementation for two major cities in 1st four years - DPR implementation in all of the major cities in next three years DPR implementation in rest 2 nd and 3 rd tier cities in next five years	Do	900.00	H	SBM
	Undertake -MSW management -de-silting of drains -sewage treatment In flood prone cities in Assam spread along 14 districts along the banks of Brahmaputra. Cover 2 cities in the 1st 5 yrs.	-do	720.00	VVH	Swachh Bharat Mission
	TOTAL		1895.50		

S. N.	Strategies: Road Transport	Cost (INR Cr)	Sources of Fund	Priority	Department Responsible
1	Installation of CNG pump stations across major cities of Assam; 100 depots	25.00	Franchisee/Vendor Funded	VH	Department of Transport
2	Procurement of CNG enable buses, 1000 buses	250.00	JNNURM	VH	Department of Transport
3	Upgrading of 1253 km of roads to National Highways in the State	15000	Ministry of Transport (Central)	H	MoT
4	Assess requirement of non-motorized transport numbers and Introduce tracks for non-motorized transport along existing roads, 10 major cities	2.00	State Govt./Central Govt.	H	Department of Transport
5	Retrofitting all Public Vehicles with CNG Kit – Policy regulations to be formulated	100.00	State Govt./Central Govt.	VH	Department of Transport
6	Introducing intelligent traffic management systems, 10 major cities	10.00	State Govt./Central Govt.	H	Department of Transport
6	Construct parking slots in Guwahati, Tinsukia, Dibrugarh, Nagaon, Tezpur, Jorhat and Silchar. Partial cost of construction, 7 major cities	35.00	State Govt./Central Govt.	H	Department of Transport
7	Promote better driving practices and maintenance of vehicles among truck, bus and car drivers to enhance fuel efficiency	1.00	State Govt./Central Govt.	H	Department of Transport
8	Study on BRT for 7 major cities other than Guwahati where BRT is already planned	0.50	State Govt./Central Govt.	H	Department of Transport
9	Vulnerability assessment study of transport system of Guwahati and other important cities due to climate change	0.50	State Govt./Central Govt.	VH	Department of Transport
10	Developing manual for building climate resilient roads and bridges and train	14.00	State Govt./Central Govt.	VH	Department of Urban

	engineers on retrofitting old ones and new designs (all Districts)				development
	TOTAL	15,438.00			

S. N.	Strategies: Inland Water Transport	Costs (INR Cr)	Source of Fund	Priority	Department Responsible
1	The IWT vessels rely on fuel oils for most powering needs, but tighter emission regulations and the need to 'go green' and hence conversion of existing Diesel Marine Engines to CNG driven engines proposed. (40 engines in 20 vehicles)	10.00	JJNURM/ IWT/Any other	H	Inland Water Transport Department
2	Solar powered passenger vessel in 10 vehicles	100.00	IWT	H	Inland Water Transport Department
3	CNG Filling Station (Phase: I – Guwahati-02) (Phase: II-all over Assam-04)	10.00	IWT	H M	Inland Water Transport Department
4	Conversion of existing engines of IWT Vessels to CNG, 40 vessels	10.00	IWT	M	Inland Water Transport Department
5	Development of IWT terminal at Karimnagar, Silghat, Dhubri and Nimati Ghat	792	IWT/IWAI	H	World Bank
6	DPR preparation and Operationalization of River Taxi	100 (depending on DPR)	IWT	H	
	TOTAL	1022.00			

S. N.	Strategies: Human Health	Costs (INR Cr)	Source of Fund	Priority	Department Responsible
1	Institutionalize studies to understand the possible impact of Climate change on health in context of Assam	2.00	State/ Central Fund	VH	Dept of Health and Family Welfare
1	Developing disease forecasting system for disease outbreaks on a daily basis in consonance with daily weather forecast	2.00	State/ Central Fund	VH	Dept of Health and Family Welfare
2	Develop mobile based apps on disease outbreak forecast and prevention measures – a to do list	2.00	State/ Central/ Fund	VH	Dept of Health and Family Welfare
3	Study and map new and emerging diseases in consonance with CC projections	3.00	State/ Central Fund	VH	Dept of Health and Family Welfare
4	Extending IDS to urban areas and to private clinics	10.00	State/ Central Fund	VH	Dept of Health and Family Welfare
5	Including heat wave incidences under IDSP in Assam	10.00	State/ Central Fund	VH	Dept of Health and Family Welfare
6	Conduct studies to assess links between climate change and possible malnutrition in the State especially amongst children	2.00	State/Central Fund	VH	Dept of Health and Family Welfare
7	Review and retrofit disaster risk response strategies of the department in view of climate change using CSDRM tool	0.25	State/Central Fund	VH	Dept of Health and Family Welfare

	TOTAL	31.25			
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S. N.	Strategies: Managing Urban Space	Costs (INR Cr)	Source of Fund	Priority	Department Responsible
1	Re-evaluate drainage system of the urban space/city and realign it with the maximum expected volume water that will be received due to extreme rainfall and avenues and outlets required for dissipation. Pilot: 7 cities	3.50		VH	JNNURM
2	Map and Evaluate the landslide prone areas in a hill city and devise and implement adaptation strategies to bind the soil and prevent soil erosion and hence landslides- engineering as well as vegetative measures (take 3 hill cities)	15.00		VH	JNNURM
3	To dissipate heat in open areas built up due to heat island effect design landscapes dotted with greens that can cool the micro climate (focus on 3 cities that have very high temperatures in summers w.r.t. other cities in Assam)	15.00		VH	JNNURM
4	Strengthen disaster response of ULBs through Capacity Building (Cover: Guwahati, Silchar & Dibrugarh and 10 Towns viz. Tinsukia, Sivasagar, Jorhat, Tezpur, Bongaigaon, Nalbari, Nagaon, Mangaldoi, Dhubri & Kokrajhar)	6.5	ASDMA & Adaptation Fund budget	H	ASDMA
5	Training and capacity building of Community, NGOs, CBOs and Govt. Officials, educators, students on Disaster Risk Reduction and Climate Change Adaptation	1.5	State/ Central Fund	H	JNNURM
	TOTAL	41.50			

Energy: Energy generation capacity is not enough to meet the demand in the State, especially in remote areas. The demand is likely to go up as temperature continues to rise. Access to affordable and non-polluting energy services is a prerequisite for achieving economic empowerment and poverty reduction. These inequalities limit economic opportunities, particularly for women and also have considerable negative effects on their families and communities. Renewable energy as an additional source is being promoted in the State for disaggregated generation of electricity. In implementing the same, women's and men's needs and priorities for energy and access will be considered. Walking for long distances to collect firewood, cooking on biomass etc puts huge constraints on women's health and time. Additionally, energy efficiency in conventionally produced fossil fuel-based energy is another area where large potential of energy saving exists, thus reducing existing levels of associated GHG emissions. The strategies suggested by the State to achieve the above-mentioned objectives are as follows.

S. N.	Strategies: Energy	Costs INR in CR	Sources of fund	Priority	Implementing Agency
1	Setting up of 60 MW SPV Power Plant at Amguri, Assam	491.84		H	APGCL
2	Setting up of 2 MW SPV Power Plant at Namrup,	18.25		VH	APGCL

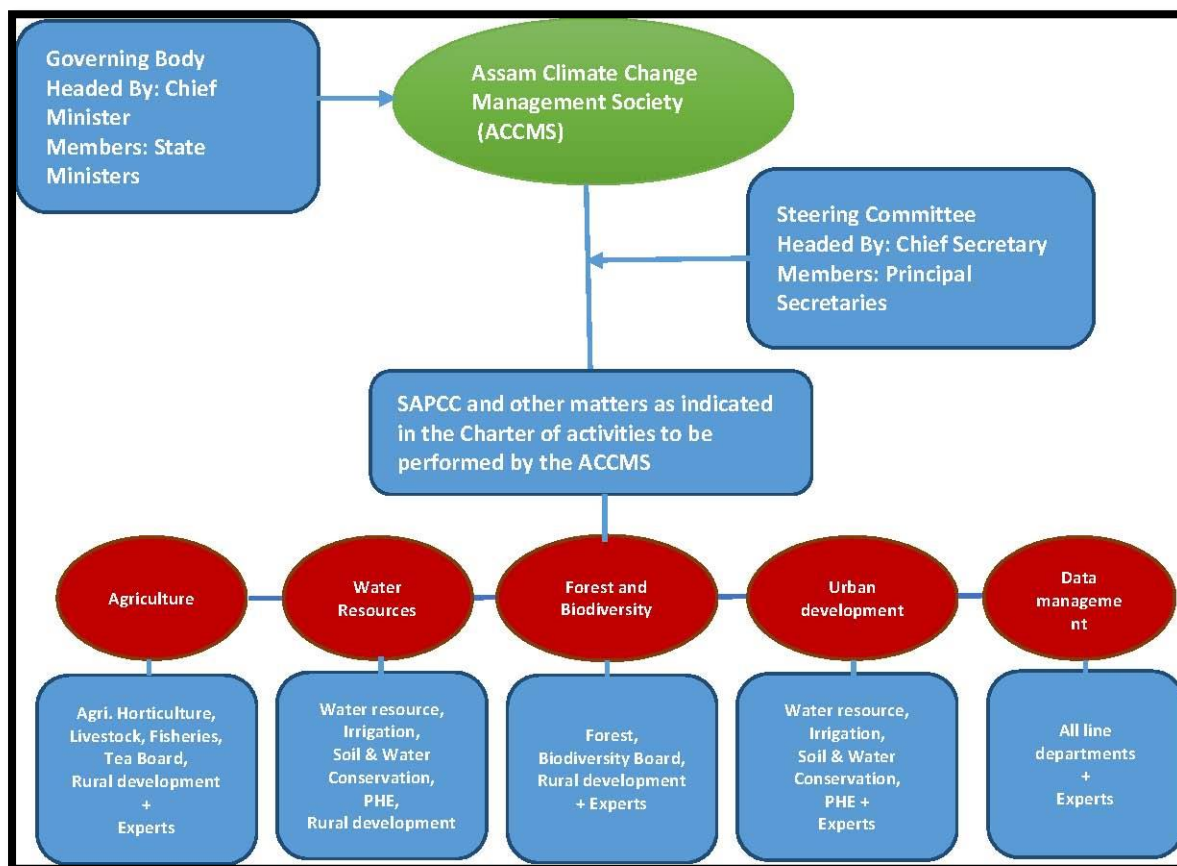
3	Setting up of 2 MW SPV Power Plant at Lakwa,	18.25		VH	APGCL
4	Capacity Building in APDCL	0.15		H	APGCL
5	Master drain system of Lakwa TPS with ETP	0.24		VH	APGCL
6	Crude oil drain pit development for gas intake station at Lakwa TPS & accumulator tank for Gas compressor lubrication drain	0.04		VH	APGCL
7	Lower Kopili Hydroelectric Project (120 MW), Dima Hasao and Karbi Anglong Districts, Assam	0.28		VH	APGCL
8	Development of Small Hydro Electric Projects	0.60		H	APGCL
9	Switchyard illumination at Namrup TPS-LED	0.20		H	APGCL
10	Street lighting at Namrup TPS-LED	0.20		H	APGCL
11	Additional thermal Insulation on GT Unit #1, #2, #3 & #4 at Namrup TPS	0.14		H	APGCL
12	Anti-erosion measure at Dillighat Intake of Namrup TPS	1.0		VH	APGCL
13	Renovation / Repairing of cooling system of Steam Turbine unit-5, splash bar changing at Namrup TPS	1.00		VH	APGCL
14	Research and Development	0.75		H	APGCL
	Sub TOTAL-APDCL	533.92			
15	Installation & Promotion of 25 MW aggregate capacity of Grid Connected Solar Power Plant at different vacant land of APDCL with capacity ranging from 1 MW to 5 MW –Plan to do 100 MW	15.30	100%: GOA	VH	APDCL
16	Installation of Grid Interactive Rooftop/Ground mounted Solar Power Plant (with battery backup) at important Govt. Building of Assam with capacity ranging from 1KW-500KW	73.89	70%: MNRE, GOI 10%: GOA	VH	AEDA
17	Illumination of important towns/historical locations of Assam through Solar Street Lighting System-Talk on going with GoA nothing has been materialised yet.	22.50	100%: GOA	VH	AEDA /APDCL
18	Installation of 1 MW aggregate capacity of Solar Wind Hybrid System with capacity ranging from 600 W to 10 kW	23.33	100%: GOA	M	AEDA
19	Installation & Promotion of 150 nos. of Solar Water Pumping systems for irrigation purpose-Promoted under UNDP Program trying to start with 250 Households	9.00	30%: MNRE, GOI 70%: GOA	H	AEDA
20	Electrification of 75 nos. of remote villages through Solar PV based power plant under DDG – Not doing DDG	52.50	90%: GOI 10%: GOA	VH	AEDA
21	Setting up 80 MW Grid Connected Solar Power Plant through IPP in BOO Mode – They can facilitate but cannot implement on their own	800.00	IPP	M	AEDA
	Sub Total-AEDA	996.70			
	GRAND Total- Energy generation	1530.69			

S. N.	Strategies: Energy Efficiency	Cost (INR Cr)	Sources of fund	Priority	Implementing Agency
1	Explore fiscal mechanisms for supporting energy efficiency activities in the State	0.25		VH	AEDA
2	Ascertain energy efficiency potential in various sectors	0.50		VH	AEDA
3	Energy Conservation in buildings				AEDA

	Customize the ECBC code according to the various climate zones and seismic zones in Assam	0.50		VH	AEDA
	Enforcing BEEs energy conservation building code (ECBC) in all 14 major towns for -efficient lighting systems -Efficient cooling systems -Efficient heating systems	14.00		H	AEDA
	Promote Energy efficiency in religious places through awareness generation	1.00		H	AEDA
	Design fiscal incentives for supporting private owners to follow energy efficiency regulation	0.25		H	AEDA
	Train managers on green building practices and auditing in all the 14 cities	14.00		VH	AEDA
4	Promote energy efficient Household appliances				
	Introduce scheme to replace 4 CFLs with 1 LED-awareness generation. Tie up with LED producer, recycler. Develop fiscal incentive for the by back process	1.65 0.25 0.25		H	AEDA
	Ensure presence of only 3 star and above domestic appliances (ACs, fridge) in markets	0.10		VH	AEDA
	Create a mechanism to extract heavy fine from any seller selling Air Conditioner and Refrigerator with energy efficiency that is rated less than 3 star	0.25		VH	AEDA
	Create awareness through media	1.65		VH	AEDA
5	Energy efficiency in Agriculture				
	Only star rated diesel/electricity driven pump sets to be sold in the market-awareness generation and enforcement	1.00		VH	AEDA
6	Energy efficiency in Industries				
	Identify energy intensive SME clusters and identify energy efficient measures that can be propagated-A study	1.0		VH	AEDA
	Implement the measures through fiscal incentives	0.25			AEDA
7	Promote energy efficiency in street lighting and external lighting in housing societies by introducing LEDs	0.25			AEDA
	TOTAL	37.15			

Way Forward

Implementing SAPCC: Assam Climate Change Management Society (ACCMS) - A Special Purpose Vehicle (SPV) has been created in the State recently in August 2018, which will coordinate all SAPCC and other activities related to climate change with different departments in the State. The Society has a Governing Council headed by the Chief Minister with council of Ministers as its members and supported by a steering committee chaired by Head of Department of Environment and Forest, Government of Assam.



Implementation Arrangement for the SAPCC

Knowledge Management: Knowledge about climate change, its impacts and associated extent of vulnerabilities, is a matter of strategic importance for all countries as they need to preserve and protect their natural resources, adapt to the changing climate and help contain the concentration of greenhouse gases in the atmosphere at a level that does not dangerously alter the climate system and jeopardize the security of human well-being vis-à-vis its food security, economic security and environmental sustainability. The basic elements of the knowledge management would include:

- Capacity Building
- Designing decision support systems
- Research
- Knowledge portal

Some of the knowledge management strategies are listed below.

S. N.	Strategies: Knowledge Management	Implementing Agency	Costs (INR Cr)	Priority
1.	Creating a knowledge management portal-Assam climate change knowledge portal and continuously update for next 10 years Collect gender-segregated data on various	Assam climate management society (ACCMS)	2.50	VH

S. N.	Strategies: Knowledge Management	Implementing Agency	Costs (INR Cr)	Priority
	parameters as mentioned in sector specific strategies			
2.	Build capacity within the state to analyse climate change trends and model projections.	ACCMS	7.0	
3.	Build capacity to run impact assessment models for various sectors	ACCMS	3.0	
4.	Assess district wise climate change vulnerability and hydro meteorological hazard risk and develop adaption plans for all sectors	ACCMS	8.0	
5.	Scan all program and policies of the government and advise the government as to how all can be made climate resilient. Focus on gender-budgeting in all climate-vulnerable sectors and monitor it accordingly	ACCMS	1.0	
6.	Develop advisory manuals on for all infrastructure design requirements to address exacerbated impacts of climate change in the state of Assam in its various regions	ACCMS	1.0	
7.	Study & documentation of ground water level in the piedmont plain of northern Assam-Foot hills of Arunachal and Bhutan	Assam Science and Technology and Environment Council (ASTEC)	0.05	VH
8.	Assessment of alternate agri-practices in highly flood prone district, 19 districts	ASTEC	0.38	H
9.	Study of hill-slope destabilization and urban flood management system (Guwahati City)	ACCMS	0.15	VH
10.	Policy review in the context of climate change – Forest policy, agri-policy, draft water policy, industrial policy, 4	ACCMS	0.20	H
11.	Identification of wetlands for protection and management with proper study on hydrology, flora, fauna and economic value, 4 zones	ASTEC	1.60	VH
12.	Identification and conservation strategies of vulnerable biologically sensitive species, 4 institutions	ASTEC	1.40	M to H
13.	Institutional capacity building to handle climate change programmes (all concerned govt. directorates) *, 10 programmes, each 2-3 days	ACCMS	0.50	VH
14.	Development of core group of climate change scientists in Assam (training for project development, care-support), 6 institutions	ACCMS	0.60	H
15.	Hazard Risk vulnerability including impact of climate change assessment including impact of climate change	ASTEC	2.00	
16.	Capacity building of departments across all levels of governance towards integrating CC in adaption Plans	ACCMS	0.50	VH
17.	Education & Awareness on climate change related issues through educational institutions	ASTEC, ACCMS	1.2	
	TOTAL		31.08	

Integrating Climate Change Finance in Planning: Recent modelling by the Asian Development Bank for South Asia suggested that economic growth would be between 2% and 6% lower by 2050 if climate change adaptation is not factored in development. The entire SAPCC budget estimate is

indicating a total fund requirement of INR 41,690.29 Cr over next 10 years. i.e. each year about 4169 crores will be spent. this is very nominal amount as compared to the state GSDP.

This amount can be availing pieces from various sources. If adaptation is not systematically undertaken, then this cost will go on increasing becoming a significant portion of the total GDP. Therefore, it is imperative that adaption cost be factored in each year within planning. Therefore, the next step is to understand how departments can identify and factor in the adaptation budget requirements within their planning. These will then get funding from new fiscal instruments on a regular basis.

SECTION A: INTRODUCTION, STATE PROFILE AND VULNERABILITY DUE TO CLIMATE CHANGE

1. Background

Records of the Indian Meteorological Department (IMD) assessed over the last 112 years in India, indicate a discernible increase in ambient temperature of the order of 0.60°C ¹, increase in heavy rainfall events and decrease in low and medium rainfall events². Changes in rainfall and temperatures have also been reported by various other researchers^{3,4,5}. Projection indicate that warming is likely to continue, and the impacts are likely to manifest more severely in the tropical countries such as India⁶.

As climate dependent natural resources play a critical role in our socioeconomic development, India drafted its National Action Plan on Climate Change (NAPCC) in 2008. The Action Plan identifies the vulnerabilities of India due to climate change and lays out an overarching approach to adapt to the impacts through:

- National Water Mission,
- National Mission for Sustainable Agriculture
- National Mission for a “Green India” that aims to make forest and biodiversity climate resilient
- National Mission for Sustaining the Himalayan Ecosystem
- National Mission on Sustainable Habitats

The NAPCC also focuses on improving energy efficiency in industry and buildings and lays down the pathway for increasing share of solar power in the total energy mix. In addition, need of developing the strategic knowledge for addressing the climate change was also emphasized by setting up the following missions:

- National Mission for Enhanced Energy Efficiency
- National Solar Missions
- National Mission on Strategic Knowledge for Climate Change

Government of Assam recognizes that Climate Change can throw up challenges, impacting its developmental aspirations. With this in view, it started preparing its State Action Plan on Climate Change (SAPCC). Given the unique physiography and climate vis a vis its location in the North Eastern Himalayas with mighty Brahmaputra flowing through the State, and the fact that it is subjected to recurrent floods, the Stake holder consultations concluded that continued warming of the atmosphere and ensuing changes in precipitation pattern is impacting the State’s water resources, agriculture, forest, its unique biodiversity and the habitats where people live. The emerging pattern of enhanced intensities of rainfall and drought periods are further exacerbating the impacts and thus making the State economically vulnerable.

¹Attri, S.D. and Tyagi, A., 2010. “Climate Profile of India”. Met. Monograph Environmental Meteorology No 1/2010, pp. 1-122

²Goswami, B.N., Venugopal, V., Sengupta, D., Madhusoodanan, M.S. and Xavier, P. K., 2006 “Increasing trend of Extreme Rain Events over India in a Warming Environment”. Science, 314, 5804, 1442-1445

³Guhathakurta, P. and Rajeevan, M., 2008. “Trends in the rainfall pattern over India”. Int. J. Climatol., 28, 1453

⁴Dash, S.K., Kulkarni, M.A., Mohanty, U.C. and Prasad, K., 2009. “Changes in the characteristics of rain events in India”. J. Geophys. Res., 114, D10109, doi:10.1029/2008JD010572

⁵NATCOM, 2012. “India’s Second National Communication to the UNFCCC”. Ministry of Environment and Forests, Government of India, New Delhi

⁶Sathaye, J., Shukla, P.R. and Ravindranath, N.H., 2006. “Climate change, sustainable development and India: Global and national concerns”. Current Science, 90, 3, 314-325

2. Principles

The Strategies identified for adapting to climate change are based on assessment of vulnerability of the State largely based on available scientific literature. The strategies formulated are essentially the various response measures formulated to address the impact of climate change and future expected projections of socioeconomic change, in consultation with concerned departments and experts' advice.

The State Action Plan on Climate Change (SAPCC) had been prepared with the objective of identification of the strategies that will make the State resilient, to the extent possible, to the ongoing climate variability, climate change and associated extreme events. It is perceived that developing climate resilience would not hamper the State's developmental aspirations. It aligns itself with the guidance provided by the missions of the National Action Plan on Climate Change and has been revised in light of Sustainable Development Goals and India's Intended Nationally Determined Contribution (INDCs).

Sustainable Development Goals (SDGs) (or Global Goals for Sustainable Development) are a collection of 17 global goals set by the United Nations General Assembly in 2015. The SDGs are part of Resolution 70/1 of the United Nations General Assembly: "Transforming our World: the 2030 Agenda for Sustainable Development." INDC is a term used under the United Nations Framework Convention on Climate Change (UNFCCC) for reductions in greenhouse gas emissions that all countries that signed the UNFCCC have accepted to publish in the lead-up to the 2015 United Nations Climate Change Conference held in Paris, France, in December 2015. In context of above, principles of adaptation followed while developing the Assam SAPCC are as follows:

1. **Ensuring sustainability of water resources:** Water being essential to all economic activities, the SAPCC looks at how water resource can be augmented and best utilized in a changing climate scenario and what necessary institutional changes will be required to make these strategies come to affect.
2. **Ensuring sustainability of agriculture systems:** Major concerns are sustainability of critical ecosystems including agro-ecosystems (agriculture, fishery, and livestock) to ensure livelihood security in a changing climate scenario.
3. **Protection and conservation of forests and bio resource within:** Focus areas are sustainable management of Forest, Wild Life and biodiversity and developing resilience of eco-system services.
4. **Making habitats climate resilient:** Major concern is the expanding and high density urban human settlements where proving sanitation, drinking water, transportation, health, waste management and other amenities will be a challenge in the future changing climate scenario.
5. **Ensuring 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.
6. **Addressing enhanced impacts of anticipated extreme events:** Adaptation planning in anticipation of intensification of extreme events to ameliorate the exacerbated impacts will be the underlying motto here.

3. Process of Preparation of SAPCC

Figure 1 depicts the chronology of preparation of the SAPCC in Assam. The entire process has been coordinated by the Department of Environment and Forests, Government of Assam which is the nodal for climate change matters in the State. A Steering committee, with members nominated from

various line departments and chaired by the chief secretary oversees the preparation of the Plan during first version. Working groups were formed and supported the process of preparation of the first version. Working groups on **Agriculture, Water Resources and Floods, Forest and Biodiversity, Habitats, Enhanced Energy Efficiency and Renewable Energy** were formed. While preparing the revised version in 2018, the DFID supported project Action on Climate Today (ACT), supported the revision by incorporating the SDGs and INDC related aspect, updated information and new understanding developed after preparing the first version. Experts from IIEC team came up with the ACT team for revision of the document.

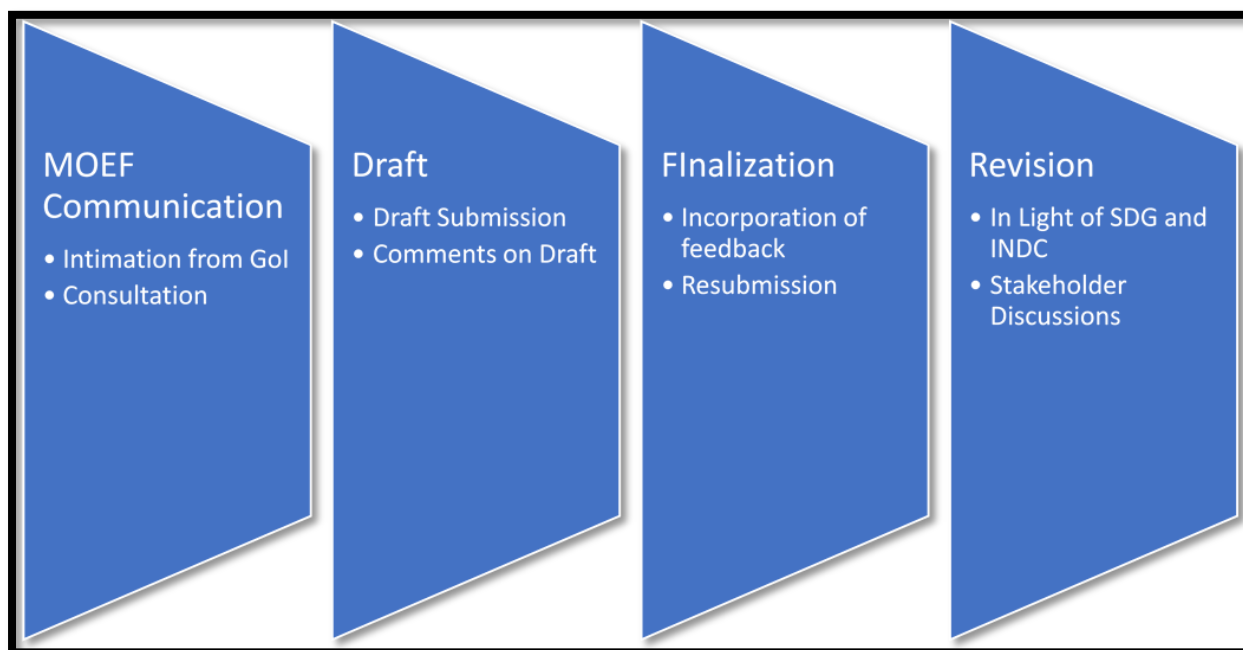


FIGURE 1: PROCESS OF PREPARATION OF ASSAM STATE ACTION PLAN ON CLIMATE CHANGE

4. State Profile

4.1 GEOPHYSICAL SITUATION

Assam, situated at the foothills of the eastern Himalayas, is the largest state in northeast India and lies in the middle reach of the river Brahmaputra and Barak. The State accounts for nearly 2.4% of India's total geographical area. The Brahmaputra basin covers an area of 5,80,000 sq. km out of which 70,634 sq. km falls within Assam. The land has undulating topography. The State is surrounded by Arunachal Pradesh in the east, West Bengal, Meghalaya, Bangladesh in the west, Arunachal Pradesh, Bhutan in the north and Nagaland, Manipur, Mizoram, Meghalaya, Tripura in the south. Its longitude lies at 90°E to 96.0°E and latitude at 24°N to 28.0°N⁷ and temperature varies from 8°C to 32°C⁸. The humidity that is brought into Assam by the southwest monsoons, shower an average annual rainfall of 120 inches or more on the Brahmaputra valley and the surrounding region. The monsoons are Assam's life line; and create a bio-diversity that can compete with the equatorial rain-forests (State profile, Ministry of Health and Family Welfare, 2009). The topography and the warm and humid climate are conducive to plant and vegetation growth. Assam is home to 51 forest and sub-forest types, and the confluence of diverse patterns of vegetation (Assam Human

⁷ <https://des.assam.gov.in/information-services/state-profile-of-assam>

⁸ Source: Environment Information System (asmenvis.nic.in/Database/CLIMATE_1042.aspx)

Development Report, 2003).

The Brahmaputra River flows through Assam from east to west over a length of approximately 650 kilometres. Its main branch originates in the Tibetan plateau, flowing from west to east as the Tsangpo River, and then turns south through the eastern Himalaya as the Dihang River to enter Assam, where it is joined by other branches to form the Brahmaputra. The Barak River rises in the Indian state of Nagaland at an elevation of approximately 2,300 meters and passes through the Manipur Hills of Manipur state over a river length of nearly 400 kilometres. It then flows generally westward from Lakhimpur through the Cachar Plains region of Assam over a river length of approximately 130 kilometers to enter Bangladesh near Bhanga (NHC, Background paper, 2006). Each flood season, the Brahmaputra and its tributaries forsake their earlier channels to cut new swathes through the soil. As the water recedes, alluvial deposits remain in the river, giving rise to sandy islands. Some of these islands are very large, and the annually enriched soil has attracted cultivation and semi-permanent settlement. There is a distinct monsoon season in which a large part of the annual rainfall is concentrated. There are also two months of cyclonic activity preceding the monsoon, and rainfall at other times of the year as well.

4.2 NATURAL RESOURCES

Assam lying in the eastern Himalayas is blessed with fertile soil and a moist tropical climate enabling it to have a treasure trove of biodiversity. This region's lowland and montane moist to wet tropical evergreen forests are considered to be the northernmost limit of true tropical rainforests in the world (Proctor et al. 1998).

The Eastern Himalaya and the Assam plains have been identified as an Endemic Bird Area by the Royal Society for Protection of Birds, (Bibby et al.1992). Assam is also famous for its megafauna including the rhino (*Rhinoceros unicornis*) golden langur (*Trachypithecus geei*), hoolock gibbon (*Hoolock hoolock*) and other highly endangered species like the pygmy hog (*Porcula salvania*), hispid hare (*Caprolagus hispidus*) and the recently rediscovered white winged wood duck (*Cairina scutulata*).

Assam's faunal wealth is matched by the diversity of its plant resources. The North East region has been highlighted by the National Bureau of Plant Genetic Resources (NBPGR) for being rich in wild relatives of crop plants. The North Eastern region has been identified by Indian Council of Agricultural Research (ICAR) center of rice germplasm (Chatterjee et al. 2006) and is a center of origin of commercially important plants such as banana, citrus, Zizyphus and tea (Department of Environment and Forests, Undated). The State is also very rich in medicinal plants. As many as 952 plant species of medicinal value are found in Assam (Department of Environment and Forests, Undated).

Assam's richness of flowering plants is estimated at about 3010 (Chatterjee et al. 2006). About 293 species of orchids have been reported from Assam representing 44.39% of North East species and 24.42% of species occurring in India. Assam also has much bamboo (41 species) and cane species diversity (14 species) as compared to other regions. Broadly speaking the forest resources are divided into the following types Tropical Wet Evergreen forests, Tropical Semi Evergreen forests, Tropical Moist Deciduous forests, Sub-Tropical Broadleaf Hill forests, Sub-Tropical Pine forests, Littoral and Swamp forests and grasslands and savannahs (Champion and Seth, 1968).

Assam harbors at least 3500 freshwater wetlands covering 1012.29 sq km, according to satellite data, that constitute 1.29 per cent of the total geographical area of the state. Most of these wetlands are in the floodplains of the rivers Brahmaputra and Barak and their tributaries and include

beels, swamps and marshes. These wetlands are home to a variety of fishes and other aquatic fauna; they act as ideal natural habitat for both domestic and migratory birds.

The State possesses an estimated 320 million tons of coal reserves, oil and natural gas reserves, sufficient to sustain current production levels for at least another fifty years, and a vast, though largely untapped, potential for power generation.

4.3 DEMOGRAPHIC PROFILE AND ITS SPREAD

According to the 2011 census, Assam's 31.2 million people⁹ account for 2.58% of the country's population with its population density (397 persons/Km²) being higher than the average population density (382) of the country. The growth rate of population between 2001 and 2011 by 17.07 per cent. This is lower than the overall national growth percentage of 17.64. Large scale migration from Bangladesh continues into the State. There had been adverse sex ratio disparities in Assam at the beginning of the 20th century, while, during the recent decades this trend has been improving with 932 females for every 1000 males compared to 933 to 1000 in the country (Assam Human Development Report, 2003).

Assam has the largest urban population of 4.3 million people amongst the North-eastern States, which accounts for 14% of the total States population. The largest urban agglomerates are the cities of Guwahati with 0.9 million people, Nagaon (0.12 million), Dibrugarh (0.04 million) and Silchar (0.17 million).

A brief on Assam population Statistics is given below.

TABLE 1: POPULATION STATISTICS AS PER CENSUS 2011

	Assam ¹⁰	India
Total Population (million)	31.2	1210
Population Density (person/sq km)	398	382
Decadal Growth rate of population (2001-2011)	17.07%	17.64%
Female percentage (Percentage of total population)	48.92%	48.5%
Sex Ratio (females per thousand males)	958	940
Literacy Rate	72.19%	62.5%
Urban population (share in total population)	14.10%	12.9%

⁹ <http://online.assam.gov.in/web/population-census>

¹⁰ Assam at a Glance, 2016, Directorate of Economics and Statistics

4.4 ECONOMIC PROFILE

Assam is the at the seventeenth rank among all the states based on GSDP size. As per quick estimates at constant prices of 2011-12, the GSDP of 2016-17 is Rs1,95,496.93¹¹ Crores and registered the growth of 9.26%.

The GSDP across sectors is shown in the Figure 3. It is reflected that the Agriculture is still the largest contributing sector in the State GDP.

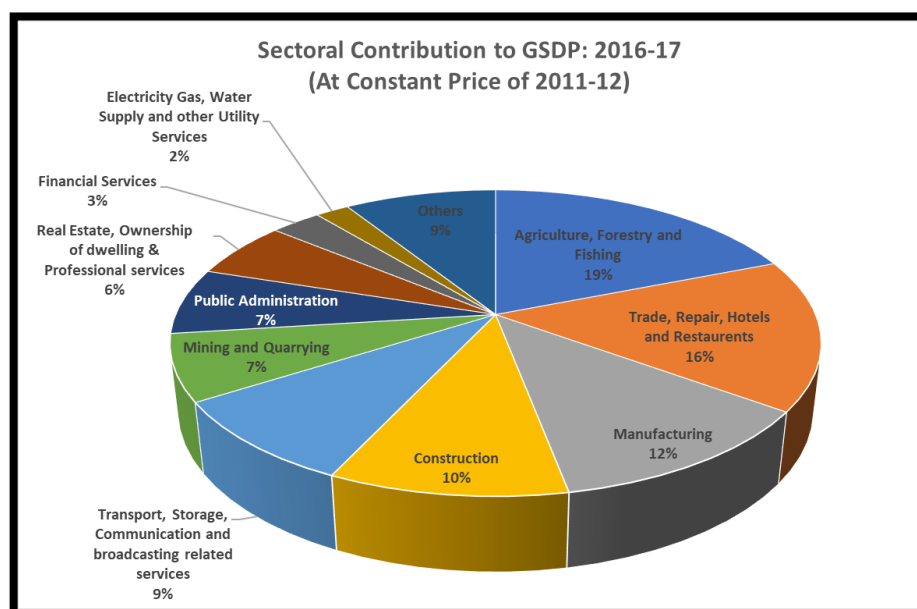


FIGURE 2: SECTORAL CONTRIBUTION TO GSDP 2016-17 (QUICK ESTIMATES)

About 49.34% of the working population is engaged in Agriculture and allied services. Rice is the main staple produced and about 5.13 million tons of rice was produced in 2016-17. The next important crop is sugarcane, the production of which was 1.21 million cans during the same period. The Tea industry plays a vital role in the State as well as in the national economy. The tea production in Assam constitutes more than 50 percent of the total production of the country total production of tea in the State was around 6.76 million Kgs in 2017-18. Assam is also the third-largest producer of petroleum and natural gas in the country and has ample reserves of limestone. Bamboo artefacts, Munga silk, paper is some of the other natural resource-based industries thriving in the State. With its five national parks and 15 wildlife sanctuaries, the state is a biodiversity hotspot and therefore this is a potential area of growth.

Assam has adopted numerous investor-friendly policies to attract investments and accelerate industrial development. Key areas of focus include the IT, tourism and power sector along with several other initiatives such as the North East Industrial and Investment Promotion Policy (NEIIPP) 2007 and the Industrial and Investment Policy 2014.

4.5 PHYSICAL AND SOCIAL INFRASTRUCTURE

The development in the power sector holds the key to it becoming one of the fastest growing States. As per 2017-18 status, Assam provided 8779 MU of electricity against the demand of 9094 MU. About 3.5% deficit in in power was registered in 2017-18 and in peak demand the gap was also of 3.5% (1822 MW demand and 1745 MW supply). Assam has procured US\$ 200 million from Asian Development Bank (ADB) for its Power Sector Enhancement Investment Programme. Besides, ADB

¹¹ Directorate of Economics and Statistics, Assam, <https://des.assam.gov.in/portlets/state-income>

has provided a grant of US\$ 1 million for capacity development of the power-sector utilities in the state¹².

Assam has about 3900 Km of National Highways and around 7547 kms of State highways. The navigable waterways in Assam through which passenger and freight transportation also takes place, extends about 1000 kms covering Brahmaputra and Barak rivers¹³. The river Brahmaputra is known as the National Waterway No 2 (The Ganges is known as the National Waterway No 1). Railway route length covers a distance of 64.6 thousand kms and 6 airports are spread across the State.

According to Telecom Regulatory Authority of India (TRAI)¹⁴, Assam had nearly 16.43 million wireless subscribers and 0.178 million wire-line subscribers, as of December 2014. In 2010-11, the state had 35,065 primary schools, 12,985 middle schools and 5,714 high schools. The State Government is taking several steps to encourage setting up of various educational complexes for skill development.

About 38 government hospitals, 1196 health centers and 4609 sub centers dot the state, with a bed strength of 11,459 beds, i.e., one bed per 2720 persons is available. About 3574 doctors are practicing in the State, i.e., 1 doctor is available for every 8700 persons.

5. Observed Changes in Climate and Projections

5.1 OBSERVED WEATHER AND CLIMATE TRENDS

With the "Tropical Monsoon Rainforest Climate", Assam is temperate (summer max. at 35–39 °C and winter min. at 5–8 °C) and experiences heavy rainfall and high humidity. The climate is characterized by heavy monsoon downpours, which reduce summer temperatures, enable formation of foggy nights and mornings in winters. Spring (Mar– Apr) and autumn (Sept–Oct) are usually pleasant with moderate rainfall and temperature.

For ascertaining long term climate trends, State level climate data for the period 1951 to 2010 has been analyzed by the India Meteorological Department¹⁵. This analysis is based on 282 stations for temperature and 1451 stations for rainfall across the country. In Assam, the analysis is based on data collected from 6 Stations for temperature and 12 Stations for rainfall. The analysis indicates that the mean temperature in the State has increased by +0.01 °C/year. There is also an increase in seasonal temperatures across seasons with pronounced warming in post monsoon and winter temperatures. The annual rainfall has also decreased by -2.96 mm/years during the same period.

TABLE 2: CLIMATE TRENDS IN ASSAM BETWEEN 1951 AND 2010

	Annual	Winter	Summer	Monsoon	Post Monsoon
Mean Max Temp (°C/yr)	+ 0.02	+ 0.01	No trend	+ 0.01	+0.02
Mean Min Temp (°C/yr)	+0.01	+0.02	+0.01	+0.01	+0.02
Mean Temp (°C/yr)	+0.01	+0.01	No trend	+0.01	+0.02

¹² <http://www.ibef.org/download/Assam-110313.pdf>

¹³ Directorate of Inland Water Transport of Assam

¹⁴ <http://www.trai.gov.in/WriteReadData/WhatsNew/Documents/PR-TSD-120315.pdf>

¹⁵ Rathore L S, A D Attari and A K Jaswal, 2013. State Level Climate Change Trends in India. Meteorological Monograph No. ESSO/IMD/EMRC/02/2013. India Meteorological Department. Ministry of Earth Sciences. GoI

Rainfall (mm/yr)	-2.96	+0.08	-0.56	-2.19	-0.75
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Additionally, when station wise data are analysed for a period of 25-30 years at least, significant variations are seen across seasons in number of rainy days and in 24 hr maximum rainfall¹⁶ As per the guidelines of IMD, a rainy day is defined as that day which receives rainfall amount of more than 2.4 mm. The 24 h maximum rainfall is defined as the highest amount of total rainfall (in millimetre) occurring in a day in particular year over a particular station.

It can be seen from Table 2 that both upward and downward trends are experienced in the 24-hr maximum rainfall in Assam. Only two stations witnessed statistically significant trends. The decreasing trends in the 24 h maximum rainfall events at 5% level of significance were observed at Rangia and Haflong. The 24 h maximum rainfall has decreased to 43 mm at Rangia and 68 mm at Haflong for the total period of records available at these two sites. As regards the number of rainy days, on annual time scale, only two stations (Majbat and Mathungari) witnessed statistically significant decreasing trends in the rainy days at 5% level of significance. Similarly, on seasonal time scale, eight and six stations witnessed statistically significant decreasing trends at 5% level of significance in the number of rainy days in monsoon and post-monsoon seasons, respectively. The results of analysis of trends in rainy days in winter and pre-monsoon seasons reveal that the majority of the stations observed statistically non-significant trends obtained through the MK test at 5% level of significance in the rainy days.

Though long-term analysis is not picking up any trends in increase in extreme rainfall events but two extremely intense cloud bursts of unprecedented intensity-one in the western Meghalaya hills and Western Arunachal Pradesh in 2004 produced two devastating flash floods in the Goalpara and Sonitpur districts of Assam bordering Meghalaya and Arunachal respectively causing hundreds of deaths and enormous loss to the animals and agriculture.

TABLE 3: TRENDS OF NUMBER OF RAINY DAYS AND 24 HR MAXIMUM RAINFALL ACROSS ASSAM¹⁶

Region in Assam	S. N.	Station	District	Rain Days					24 hr Max rainfall
				Annual	Winter	Pre-Monsoon	Monsoon	Post Monsoon	
West Assam	1	Dhubri	Dhubri	0.15	1.04	0.10	-0.63	0.35	-1.32
	2	Goalpara	Goalpara	0.03	0.16	-0.93	-0.96	-0.19	-1.62
	3	Goibargaon	Nalbari	0.83	-1.03	0.75	0.32	-1.97	1.19
	4	Guwahati	Kamrup	-0.42	0.06	-0.75	-1.67	-1.67	0.17
	5	Rangia	Kamrup	-0.61	-1.53	0.19	-0.96	-1.02	-2.09
	6	Mathungari	Barpeta	-2.17	-2.53	-0.52	-2.22	-2.25	-0.75
	7	Panbari	Bangaigaon	0.40	-0.66	0.24	-0.24	-1.45	0.01
NC, Assam	8	Dahrmatala	Marigaon	0.04	-0.29	-0.92	0.72	-1.58	0.50
	9	Gohpur	Sanitpur	0.34	-0.12	-0.62	-0.43	0.29	0.55
	10	Golaghat	Golaghat	-1.61	-1.23	-1.30	-1.40	-2.00	-1.23

¹⁶ Jhajharia D, B K Yadav, S Maske, S Chattopadhyay, A K Kar, 2012. Identification of trends in rainfall, rainy days and 24 hr max rainfall over subtropical Assam in NE India. C R Geoscience 344 (2012) 1-13

	11	Majbat	Darrang	-2.80	-1.16	-1.52	-2.82	-1.69	-0.49
	12	Tezpur	Sonitpur	-0.14	-0.34	-0.55	-0.43	-2.65	0.85
Eastern Assam	13	Digboi	Tinsukia	-1.09	-1.20	-0.34	-2.15	-1.68	-0.74
	14	Lilabari	Lakhimpur	-0.06	-0.96	0.13	0.54	-2.12	0.11
	15	Nimatighat	Jorhat	-1.15	0.43	-0.55	-2.02	-2.53	-1.07
	16	Sivasagar	Sivsagar	-1.37	0.11	-0.20	-2.75	-1.44	-1.07
South Assam	17	Halflong	N Cachar Hills	-1.80	0.77	-1.92	-2.28	-0.38	-2.03
	18	Kheronighat	Karbi Anglong	0.02	1.43	-0.04	-0.68	-1.09	0.55
	19	Lumding	Nowgaon	-0.58	0.72	0.39	-2.39	-0.75	-1.75
	20	Silchar	Cachar	-1.12	0.28	-0.75	-2.07	0.69	-1.57

The most recent examples of such flash floods originating from extreme rainfall are two events that occurred in the north bank of the Brahmaputra River and caused significant damage to human life and property. The first of the two events occurred during the monsoon season on June 14th, 2008 due to heavy rainfall on the hills of Arunachal Pradesh north of Lakhimpur District causing flash floods in the rivers of Ranganadi, Singara, Dikrong and Kakoi that killed at least 20 people and inundated more than 50 villages leading to displacement of more than 10,000 people. The other that occurred in the post monsoon season on October 26th, 2008 affected a long strip of area of northern Assam valley adjoining foothills of Bhutan and Arunachal Pradesh causing flash flooding in four major rivers (all are tributaries of the river Brahmaputra) and a number of smaller rivers. This episode of flash floods caused by heavy downpour originated from the Tropical Depression 'Rashmi', (a depression over the West Central Bay of Bengal adjoining Andhra coast) and affected mainly the catchments of the rivers Puthimari (Assam-Bhutan border), Jia-Bharali (Assam-Arunachal Border), Ranganadi (Assam-Arunachal Border), and the Subansiri (Assam-Arunachal Border). 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 this rain shadow zone and absence of effective irrigation systems or water harvesting practices adds to the vulnerability of the people. But what is of immediate concern is that rainfall in this zone is decreasing slowly as found in Lumding where rainfall is on the decline 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.

5.2 CLIMATE PROJECTIONS

District level climate projections are available across Assam¹⁷ driven by A1B scenario¹⁸ for the period 2021–2050 using regional climate model PRECIS, a model developed by the Hadley Centre, UK Meteorological office. The resolution of the model is 50kmx50km.

It is to be noted that such projections are only indicative in the very broadest sense of the changes that are likely in the climate as high level of uncertainties are associated with the projections, indicating the need for further research on these aspects. Table 3 below shows the projected changes in various climate parameters till mid-century. Temperatures continue to rise and may increase by 1.7-2.0 °C w.r.t. to base line (BL). Only the western part of the State will experience slight decrease in rainfall but the rest of Assam is projected to have increase in rainfall. There is likely to be

¹⁷ http://www.mdoner.gov.in/sites/default/files/silo2_content/Kfw/Project_Document_NECCAP31052011.pdf

¹⁸ Parry, M. L., Canziani, O. F., Palutikof, J. P., Van der Linden, P. J. and Hanson, C. E. (eds), *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK, 2007, p. 976

increase in extreme rain fall event by 5% to 38% w.r.t.to base line.

TABLE 4: *PROJECTED CHANGES IN CLIMATE*

Parameters	2021-2050 wrt BL	Remarks
Mean Temperature	1.7-2.0 °C	All across Assam
Annual Rain fall	-5 to 5%	North western districts
	5-10 %	North Eastern districts
	10 – 25%	Central, South Eastern District
Extreme rainfall days	5-38%	Rainfall > 25 to 150 mm
Drought weeks	-25% to > 75%	Southern districts show marginal reduction in drought weeks, but rest of the district show an increase by more than 75 % wrt BL
Floods	Stream flow < 10% to > 25%	Min in north east and max in southern part of the state

Droughts weeks are going to rise, with Southern districts showing marginal reduction in drought weeks but rest of the district show an increase by more than 75% w.r.t. BL. As regards floods, they are going to rise by more than 25% in the southern parts of Assam (see Table 2).

6. Vulnerability of the State

As per the IPCC working group II report vulnerability can be defined as the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt. Therefore, the inability to cope with changing climate conditions is generally contextual and is a characteristic of the existing developmental paradigm, and that of the social and ecological systems amongst others. Keeping this in view we try and assess the developmental gaps to have a feel of the vulnerability of the State to climate change. Also, as economic capacity is the basic driver that ensures adaptation to an extent, this aspect also has been explored here.

6.1 PHYSICAL VULNERABILITY

The reform process initiated since 2003 seems to have contributed to the economic growth of Assam during the 10th plan period, and therefore to an extent, we can say that Assam has developed resilience to cope with climate change. However, still in 2011-12, as 31.98% of the State's population lived below the poverty line against all India average of 21.92%, with majority of the population, especially the people living in interior rural areas, in areas inhabited by Scheduled Caste & Scheduled Tribe population, tea garden areas and far flung "char" (riverine) lack facilities of safe drinking water, sanitation etc. These developmental gaps make the communities vulnerable to climate change.

At a micro scale, as per The Ministry of Development of North Eastern Region (DoNER) and the North Eastern Council (NEC) the people living on the small islands in the Brahmaputra River are the most vulnerable to disease outbreaks. They are isolated from the rest of Assam, have no permanent health care facilities and are prone to frequent flooding as climate change continues, these islands will become increasingly vulnerable and hence public health facilities need to be extended to such areas effectively.

Strategies have been formulated to overcome these developmental gaps. But the phenomenon of climate change provides another dimension to the existing challenges by introducing risks to the inherent resilience of natural systems such rain dependent resources -potable water availability and

accessibility to electricity from hydropower which currently constitutes of 24% of the total electricity produced in the State. Policy making in such a context has to deal with uncertainty and critical gaps in knowledge.

Assam's economy is still agrarian as more than 80% of its rural population is dependent on agriculture and allied activities such as agriculture, fisheries and forests, which together contribute 19% of the GSDP, and combining mining and quarrying the primary sector has a share of 26% in the total GSDP of the State (see Figure 5). This is a large value compared to many States in India, where the secondary and tertiary sectors constituting of construction and services sector respectively are having larger shares, as compared to the primary sector.

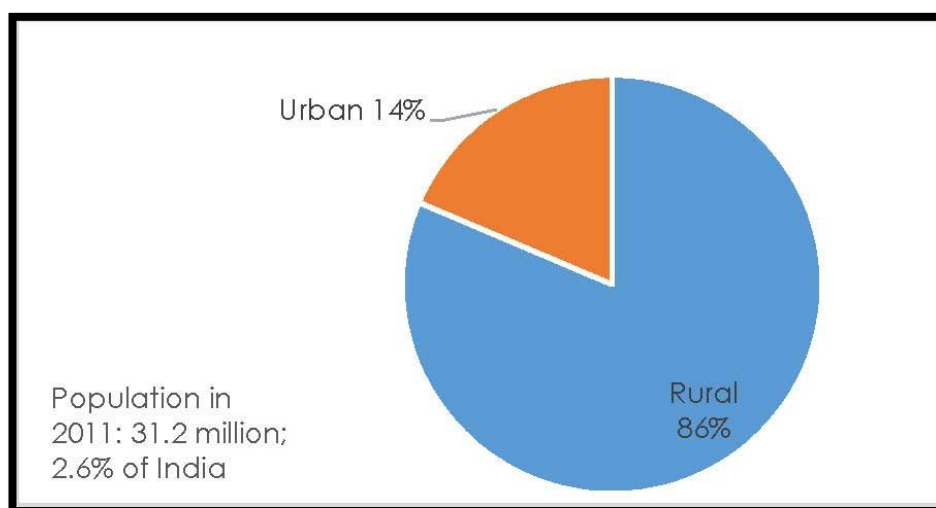


FIGURE 3: RURAL URBAN POPULATION SHARE

In the future agriculture economy will continue to dominate, as Assam would like to ensure its food security through domestic production and create maximum employment in this sector¹⁹.

However, high decadal population growth rate of 17.07% the current practices such as over exploitation of ground water, *Jhum* cultivation in hilly areas, mono cropping etc. and recurrent floods and droughts are putting pressure on the agriculture system. Exacerbation of climate change induced hazards are likely to further make the agriculture production system of the State uncertain, and these issues need to be addressed within the developmental plans of the State.

Climate change will also negatively impact the water resources sector by increasing freshwater scarcity, which is already a problem for Assam in the summer. The predicted increase in average temperature and decrease in the number of rainy days due to climate change will further stress water resources. This problem is compounded by high levels of groundwater extraction, which can be expected to continue given Assam's growing population and reliance on agriculture. Assam's water resource policies are distributive rather than proactive and there is yet a dearth of programs promoting water harvesting and water conservation or storage.

Forests can improve ground water recharge, reduce soil erosion and runoff, regulate flooding and temperature of a place. Assam forest and tree outside forests together cover about 36% of the States geographical area. Recent reports¹⁸ indicate that area is Increasing under moderately dense forests and open forests especially in tribal dominated district lying in the hilly areas adjoining

¹⁹ http://www.agriassam.in/etc/state_agriPolicy.htm

Arunachal Pradesh, Nagaland and Meghalaya, Dependency on fuel wood, mining, logging, urbanisation, encroachment, higher frequency *Jhum* cultivation etc. are some of the developmental factors leading to degradation of forests. As floods and droughts are likely to intensify, it is very likely that a further reduction in forest cover may occur in these areas and may amplify the impacts on agriculture, water resources and the composition of the remaining forestland.

Finally, it is clear that effects of climate change will be felt most strongly by the poor. Poverty is yet a major challenge for Assam as the poverty rate is 36%, higher than the Indian national average of 27% and also one of the highest in the northeast. Apart from economic growth, availability and access to public health services has been a challenge.

6.2 ANTICIPATED ECONOMIC VULNERABILITY

There has been very little analysis of the economic impact of climate change in Assam. However, some assessment is possible, based on the analysis that has been done elsewhere in South Asia. Recent modelling by the Asian Development Bank (ADB) for South Asia suggested that economic growth would be between 2% and 6% lower by 2050, depending on which climate change scenario happens and on the extent to which the wider impact on health and environment is considered. This economic impact is likely to be felt in small gradual steps, each year, but these steps are cumulative, and the combined effect will be that GDP will be only two or three times higher in 2050, rather than five times higher if 5% growth is sustained.

The key sectoral contributions to the economic impact of climate change are as follows.

Agriculture will see the largest economic impact. For South Asia as a whole, the impact of climate change on agricultural is likely to reduce GDP growth by about 2%, partly as a result of temperature trends and partly because of more variable and unpredictable rainfall. In Assam, the net economic damage in the agricultural sector is likely to be roughly similar to the South Asian average. Loss from temperature trends may be lower, because extreme temperatures are less common, but the State is more vulnerable than most states to loss from rainfall variability and because agriculture contributes a higher than average share of State GDP.

Loss and damage in the forestry sector is likely to be higher than average in Assam, because of the large forest area. However, there is limited evidence on the net impact of climate change on forests, even at a South Asian level, and insufficient evidence to provide an estimate of economic impact. If mechanisms could be created to provide payments for mitigation benefits, these could add 5% to 10% to forestry GDP, based on the relative value of net carbon sequestration, compared with commercial benefits from forestry.

There are likely to be some losses in the energy sector, partly from less reliable hydropower generation and partly because of increased losses from distribution in higher temperatures. The net impact on hydro power requires further study, but international evidence on losses from distribution suggests they could amount to up to 0.05% GDP.

Climate change will result in more frequent and severe floods which will increase the costs of reconstruction and maintenance on State infrastructure, including roads, irrigation, water and sanitation. Evidence for South Asia suggest that the total capital value of infrastructure is about 30% of GDP and that annual rehabilitation and maintenance costs are between 1% and 3%. If these costs double, in line with the increased frequency and severity of floods, then the economic cost of climate change on infrastructure would grow to between 0.3% and 0.9% of GDP by 2050.

The increase in flooding will also increase loss and damage to domestic and industrial property and will affect labour productivity and result in increased health burden and loss of life and injury. There is no estimate of the scale of this impact in South Asia, but evidence from South East Asia suggests that flood damage can average about 0.75% of GDP annually in areas that are vulnerable to flooding.

Given the vulnerability of Assam to flooding it seems unlikely that the economic impact in Assam will be lower than this.

The evidence from South East Asia suggests that climate sensitive diseases result in the loss of about 27 Disability Adjusted Life Years (DALYs) per 1000 people, including loss of productivity through ill health and loss of life. International evidence from World Health organisation (WHO) suggests that climate change in tropical areas is likely to increase the incidence of climate sensitive diseases by about 10%. India does not yet have a yardstick for valuing DALYs, but the WHO yardstick is three times per capita GDP, which would suggest that the increase in health burden would impose economic costs of about 0.81% of GDP by 2050.

7. Assam Climate Change Management Society

The Assam Climate Change Management Society (ACCMS) as recommended in the First SAPCC-2015 report, was established in 2016 by the Government of Assam to support the implementation, monitoring and reporting of the Assam State Action Plan on Climate Change (SAPCC). The ACCMS is a Special Purpose Vehicle intended to be the apex body for integrating climate change into all line departments' programs and plans, monitor and report on the government's response to climate change, and manage the flows of climate funds into the state. It was registered in 2018 and the government allocated INR 5 crores as its corpus fund during 2018-19 financial year to start operations.

Objectives

The vision of the ACCMS is to support a resilient, prosperous and sustainable development pathway in Assam by facilitating cross-sectoral convergence across departments in the planning, delivery and monitoring of action on climate change. Following are the objectives of the ACCMS:

- Cross-sectoral strategic planning – preparing and updating the SAPCC, setting out the overall strategy of the Government for managing climate change;
- Coordinating and supporting the delivery of action on climate change across departments – providing technical support and advice to departments to implement the SAPCC and platforms for communication and collaboration across departments;
- Managing climate funds – supporting departments to access national and international climate funds and report on utilization of the funding;
- Monitoring, reporting and evaluation of action on climate change – preparing timely reports on the progress of implementation of the SAPCC and wider action on climate change;
- Knowledge management and awareness raising – carrying out new research on climate change in partnerships with others and providing a platform for accessing information and analysis.

To achieve the objectives, a draft plan has already been prepared and being given on the next page.

Institutional and Management Structure:

ACCMS is a two tier structure, at top tier Governing body is consisting of State Ministers headed by the Chief Minister. The Steering body is consists of heads of the line departments and headed by the Chief Secretary, who also represents the Steering Committee in the Governing Body meetings.

The organogram of the ACCMS is being given below:

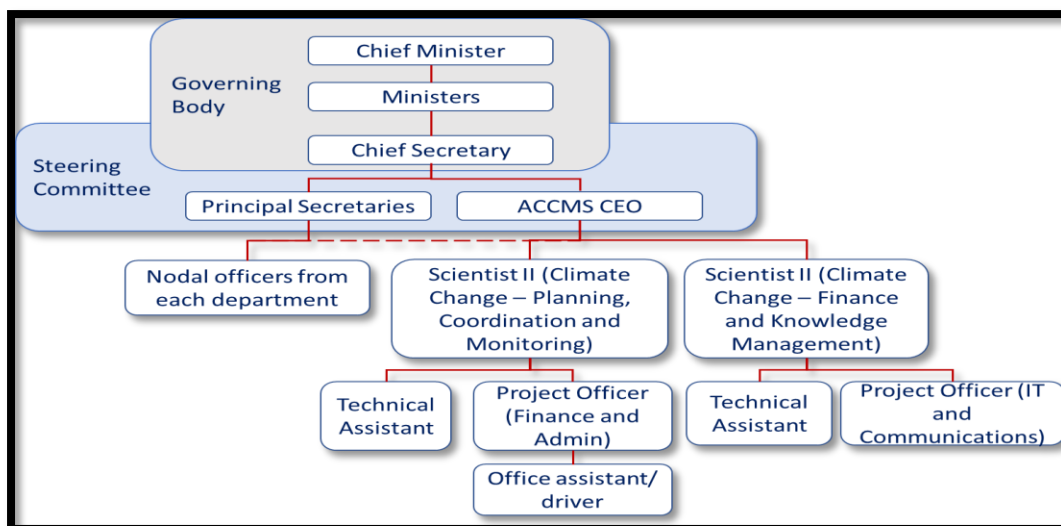


FIGURE 4: FIGURE: ORGANOGRAM FOR STRUCTURE OF THE ACCMS

TABLE 5: FIVE YEAR ACTION PLAN FOR ACMS

Activity	Y 1	Y 2	Y 3	Y 4	Y 5
Revise and update the SAPCC and finalize the M&E framework					
Carry out outreach meetings and workshops of relevant departments on their responsibilities under the SAPCC					
Establish and set the rules of business for Assam Fund for Life					
Organize and document regular meetings of the Governing Body and Steering Committee					
Carry out annual reporting on implementation of the SAPCC					
Establish the online knowledge platform on climate change, and update regularly					
Set up informal platform for sharing learning and knowledge among nodal officers and others across different departments					
Develop a capacity assessment framework and use it to identify capacity gaps within line departments					
Set up and use internal system for tracking and sharing relevant funding opportunities with departments					
Launch a pilot funding window for the Assam Fund for Life and evaluate and refine procedures and systems					
Start at least annual technical dialogues with departments on relevant climate issues					
Start regular and ad-hoc training and mentoring of department officials on climate issues related to their day-to-day responsibilities and work					
Establish regular and/or funding windows for the Assam Fund for Life and manage reporting requirements of funders					
Launch a research project in partnership with other agencies and research institutes on climate change impacts and solutions					
Establish an annual system for assessing and reporting on the state budget for overall climate benefits and expenditure on climate change					
Start publishing regular advisories to different departments on mainstreaming climate change					
Start undertaking planned and random climate audits of development programmes, projects and plans					
Establish the advisory facility for departments on mainstreaming climate issues					

Financial Mechanism & Assam Fund for Life (AFL):

There are lots of international/ national and multi -lateral funds are available to support the climate initiatives. To ensure that climate be leveraged by the relevant line departments, as an enabler, Assam Fund for Life (AFL) is proposed to has been constituted. The AFL will be a financing mechanism under the wider umbrella of the ACCMS, which will have the core mandate of playing the role of an enabler in helping government departments access, manage, and utilize external climate finance in an efficient manner. Proposed functions of the AFL are:

- Providing technical support and advice to departments to prepare funding proposals to access national and international funding sources, for activities aligned with the SAPCC;
- Managing climate funds – supporting departments to manage and utilize national and international climate funds and to report on utilization of the funding;
- Monitoring, reporting and evaluation of expenditure on climate change;

Following is the proposed functional structure of the AFL

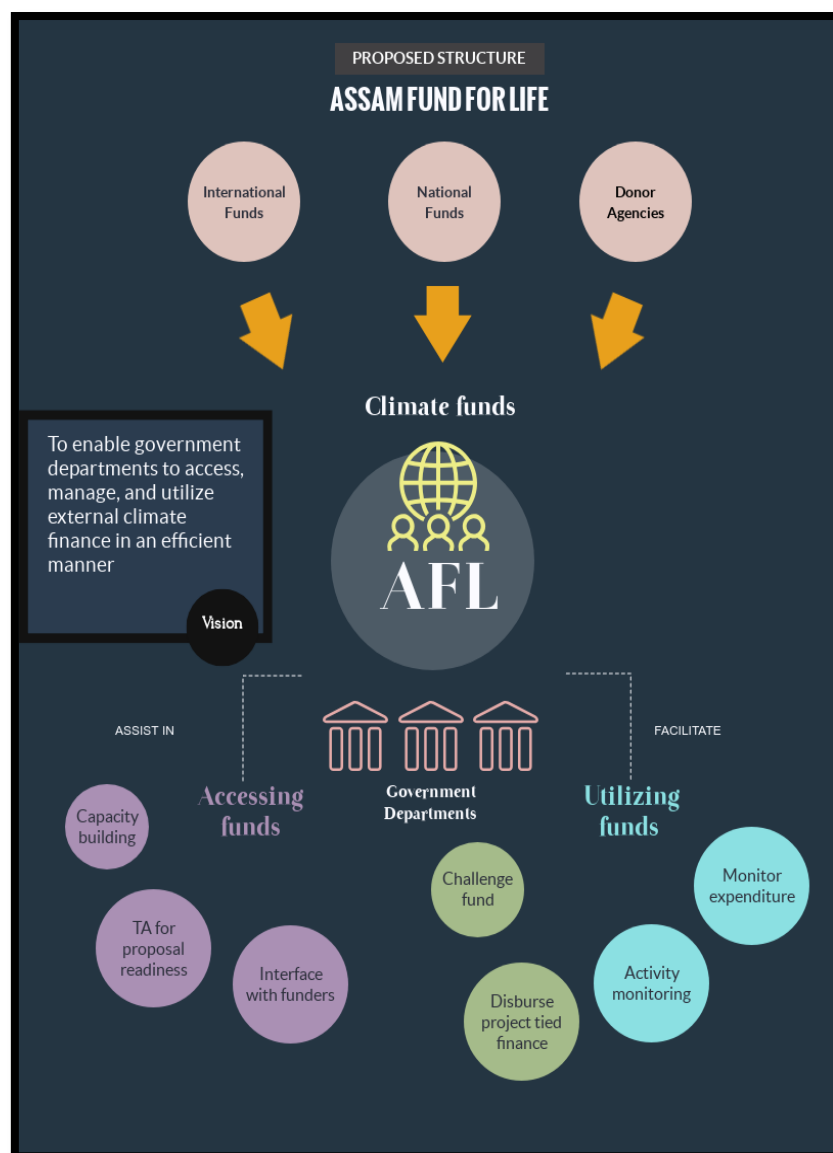


FIGURE 5: PROPOSED FUNCTIONAL STRUCTURE OF THE AFL

To ensure the above functions properly delivered, the proposed organogram is like as follows:

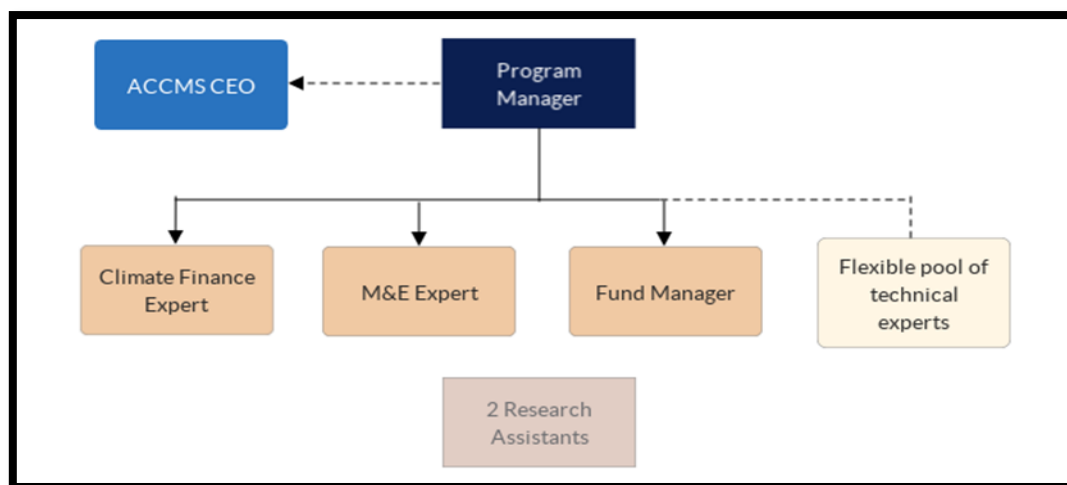


FIGURE 6: PROPOSED ORGANOGAM OF THE AFL

With, the above objectives, financial mechanism (AFL) and the Governing and steering bodies, the ACCMS has set up the following targets against the set performance indicators for next five years. These are being given below:

TABLE 6: FIVE YEAR PLAN AGAINST THE KEY PERFORMANCE INDICATORS

Key Performance Indicator	Annual Target				
	Y 1	Y 2	Y 3	Y 4	Y 5
Percentage of required staff in place with agreed TORs (%)	75	100	100	100	100
Number of meetings (with minutes) of the Governing Body	2	2	2	2	2
Number of meetings (with minutes) of the Steering Committee	4	4	4	4	4
Number of annual reports in public domain on implementation of the SAPCC	1	1	1	1	1
Number of documents and reports on the climate change knowledge portal	>15	>30	>45	>60	>75
Number of members active (sending at least one message a year) on the informal email/social media platform for officials	0	>20	>40	>60	>80
Number of technical dialogues for which the majority of participants rate as 'very useful' in the feedback form	0	>1	>1	>2	>2
Number of training and mentoring sessions for which the majority of participants rate as 'very useful' in the feedback form	0	0	>1	>2	>3
INR of new funding received and disbursed from national and international climate funds and donors	0	0	>3 Cr	>5 Cr	>6 Cr
Number of funding applications from departments for the Assam Fund For Life	0	>2	>5	>7	>9
Number of collaborative research projects underway on climate change	0	0	0	>1	>3
Number of reports published on the overall climate benefits and expenditure on climate change from development budget	0	0	0	1	1
Number of advisories to different departments on mainstreaming climate change	0	0	0	0	>1

Number of climate audits of development programmes, projects and plans	0	0	0	0	>1
Number of requests for information and support from the advisory facility	0	0	0	0	>3

THE ACCMS will also be having full technical team of the scientists/ technical officers and others to support and steer the climate change programme of the State. The Assam Climate Change Management Society, thus will be supporting and coordinating all the line departments to implement the State Action Plan on Climate Change (framed in the current document) and mainstream climate change within their development plans, programmes and systems.

SECTION B: ADAPTING TO CLIMATE CHANGE

8. Water Resources

7.1 BACKGROUND

Water resource is the basic need of life and livelihoods. Unfortunately, it is also the most vulnerable resource which gets affected by climate change in terms of availability, accessibility, and quality. In the state of Assam on one hand, floods are a major problem as vast areas are parts of the flood-plains of large rivers such as Brahmaputra and Barak. On the other hand, most of the districts do not have access to irrigation facilities and are rain-fed. Moreover, despite having many surface water bodies, the potential for fisheries is yet to be utilised fully. Climate change not only affects water availability and accessibility, but also puts stress on the duration and timing of its availability and accessibility, and the distribution. Further, due to increased temperatures and population, the pressure is expected to rise further on the available resources.

Thus, an action plan for ensuring water resource sustainability and management is the need of the time. The Climate Change Action Plan on Water Resources is guided mainly by the National Water Mission (NWM). The main objective of NWM is “conservation of water, minimizing wastage and ensuring its more equitable distribution both across and within States through integrated water resources development and management.” The five identified goals of the NWM are: (a) developing comprehensive water database in the public domain and assessment of impact of climate change on water resource; (b) promotion of citizen and state action for water conservation, augmentation, and preservation; (c) focused attention to vulnerable areas including over-exploited areas; (d) increasing water use efficiency by 20%, and (e) promotion of basin level Integrated Water Resources Management (IWRM).

Assam’s SAPCC and approach to water resources is guided by NWM and is subsequently being updated and aligned with India’s NDCs and the Sustainable Development Goals (SDGs) which came into effect in December 2015 and January 2016 respectively. This chapter will outline the SDGs and NDCs that are directly and indirectly relevant to sustainable water resource management as part of climate action and will then elaborate on the monitoring indicators for the same.

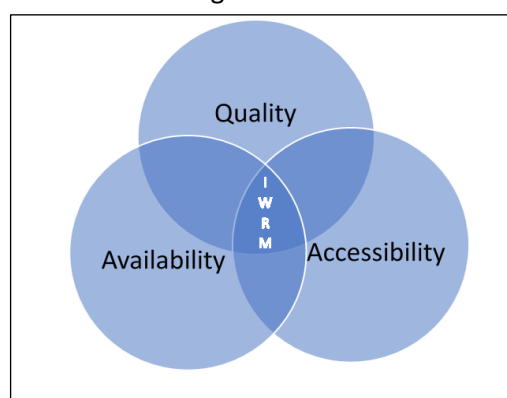


FIGURE 7: INTEGRATED WATER RESOURCE MANAGEMENT

SDGs and NDCs relevant to Water resource management

Relevant SDGs:

TABLE 7: SDGs AND INDCs RELEVANT TO WATER AVAILABILITY AND ACCESSIBILITY

S. N.	Description	Relevant focus
1	Goal 3 Good health and well-being of all	Combat water-borne diseases; equitable access and management of clean water and sanitation for better health of all age-groups and reduce incidences of communicable diseases; promote access to and consumption of safe, clean drinking water for better health and sanitation
2	Goal 6 Clean Water and	Universal & equitable access to safe and affordable potable water; water quality; water use efficiency, IWRM; restoring

	Sanitation	water related ecosystem
3	Goal 12 Responsible Consumption and production	Sustainable management and efficient use of natural resources including water; waste and chemical management to protect pollution of water resources; sustainable patterns of water conservation, consumption and management
4	Goal 13 Climate Action	Combating climate change and its impacts; strengthening resilience and adaptive capacities; mainstreaming climate measure in national policies; improving education and awareness about climate change; building capacities of individuals and institutions
5	Goal 14 Conserve and sustainably use the oceans, seas and marine resources for sustainable development	Combat marine pollution in natural water bodies of Assam, in particular from land-based activities, including marine debris and nutrient pollution; promote sustainable fishing practices; implement science-based fisheries' management plans and restore fish stocks in the shortest time feasible; provide access for small-scale artisanal fishers to marine resources and markets
6	Goal 15 Protect, restore and promote sustainable use of terrestrial ecosystems and halt biodiversity loss	Protect and restore land degraded from floods and droughts; protect and conserve biodiversity of water bodies; take action to reduce degradation of natural habitats, prevent extinction of threatened species; take action to end poaching/ trafficking of protected water based flora and fauna; reduce the impact of invasive alien species on water eco-system; increase capacity of local communities to pursue sustainable water based livelihood opportunities
NDCs		
1	NDC 6	Enhancing investments in water sector to adapt to Climate change
2	NDC 1	Propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation
3	NDC 2	Adopt a climate friendly and a cleaner path than the one followed hitherto by others at corresponding level of economic development

7.2 DETAILS OF RELEVANT SDG'S

Goal 3: Good Health and well-being

Universal and equitable access to clean water for drinking, household and livelihood purpose is one of the key components in maintaining good health and well-being of all and all age-groups. SDG 3 includes 10 targets to be achieved by 2030, of which the following two are most relevant to Assam:

- (i) **End the epidemics of** AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, **water-borne diseases** and other communicable diseases
- (ii) **Substantially reduce** the number of deaths and illnesses from hazardous chemicals and air, **water and soil pollution and contamination**
- (iii) **Strengthen the capacity** of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks

Goal 6²⁰: Ensure availability and sustainable management of water and sanitation for all

The process on indicators and monitoring of SDG 6 is led by UN-Water and it has six main targets to be achieved by 2030:

- (i) achieve **universal and equitable access to safe and affordable drinking water** for all
- (ii) achieve access to **adequate and equitable sanitation** and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situation
- (iii) improve **water quality** by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated waste water and substantially increasing recycling and safe reuse globally
- (iv) substantially increase **water-use efficiency** across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
- (v) implement **integrated water resources management** at all levels, including through transboundary cooperation as appropriate
- (vi) **protect and restore water-related ecosystems**, including mountains, forests, wetlands, rivers, aquifers and lakes

The processes defined to facilitate the attainment of goals is by expanding international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies. In addition, supporting and strengthening the participation of local communities in improving water and sanitation management.

Goal 12²¹: Responsible Consumption and Production

Goal 12 emphasizes that the world's fresh water is under threat and includes 12 targets. Of these, following are the most relevant in Assam's context:

- (i) Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries
- (ii) By 2030, achieve the **sustainable management and efficient use of natural resources**
- (iii) By 2020, achieve the **environmentally sound management of chemicals and all wastes throughout their life cycle**, in accordance with agreed international frameworks, and **significantly reduce their release to air, water and soil** in order to minimize their adverse impacts on human health and the environment
- (iv) Support developing countries to **strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production**
- (v) Develop and implement tools to **monitor sustainable development impacts for sustainable tourism** that creates jobs and promotes local culture and products

Goal 13²²: Climate Action

Climate action SDG focuses on taking urgent action to combat climate change and its impact and has three concrete action to be undertaken, which are most relevant to Assam:

²⁰ <https://www.un.org/sustainabledevelopment/water-and-sanitation/>

²¹ <https://www.un.org/sustainabledevelopment/sustainable-consumption-production/>

²² <https://www.un.org/sustainabledevelopment/climate-change-2/>

- (i) **Strengthen resilience and adaptive capacity** to climate-related hazards and natural disasters in all countries
- (ii) **Integrate climate change measures** into national policies, strategies and planning
- (iii) **Improve education, awareness-raising and human and institutional capacity** on climate change mitigation, adaptation, impact reduction and early warning

Goal 14: Conserve life below water and sustainably use marine resources

SDG 14 focuses on marine resources – its sustainable use, consumption and restoration in order to improve marine health and to enhance the contribution of marine biodiversity to the development. Of its 14 targets, following are relevant in the context of Assam water bodies and resources management:

- (i) By 2025, **prevent and significantly reduce marine pollution** of all kinds, in particular from land-based activities, including marine debris and nutrient pollution
- (ii) By 2020, **sustainably manage and protect marine and coastal ecosystems** to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans
- (iii) By 2020, **effectively regulate harvesting and end unregulated and over-fishing and destructive fishing practices** and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics
- (iv) By 2030, **increase the economic benefits** to Small Island developing States and least developed countries **from the sustainable use of marine resources**, through sustainable management of fisheries, aquaculture and tourism
- (v) **Provide access for small-scale artisanal fishers to marine resources and markets**

Goal 15: Life on land

SDG 15 focuses on restoration of land flora and fauna. It has 10 targets of which the following are most relevant for Assam.

- (i) By 2020, ensure the **conservation, restoration and sustainable use of** terrestrial and **inland freshwater ecosystems** and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements
- (ii) By 2030, **combat** desertification, restore degraded land and soil, including land affected by desertification, **drought and floods**, and strive to achieve a land degradation-neutral world

7.3 DETAILS OF THE MOST RELEVANT NDC'S

- (i) NDC 6: To **better adapt** to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture, water resources, Himalayan region, coastal regions, health and disaster management.
- (ii) NDC 1: To propagate a healthy and **sustainable way of living** based on traditions and **values of conservation and moderation**.
- (iii) NDC 2: Adopt a **climate friendly and a cleaner path** than the one followed hitherto by others at corresponding level of economic development

7.4 STATUS OF WATER RESOURCE

Keeping in consideration the guidance provided by the NWM and in light of the relevant SDGs and

NDCs, this section reviews the water resources situation in Assam, assesses the vulnerabilities of water resources associated with climate change and identifies the adaptation strategies in line with the tenets of the NWM wherever possible.

SURFACE WATER

About 8251 sq. km, which is 10.5% of the total geographical area of the State, is occupied by surface water bodies²³. Of these, about 6503 sq. km is occupied by the river systems including the mighty Brahmaputra and 1748 sq. km by natural wetlands including seasonal and permanent waterlogged and marshy areas and man-made areas.

The Brahmaputra is the 6th largest river in the world. It is amongst the most flood-prone rivers, and with its 41 major and 121 minor tributaries that flow to Assam represents one of the most complex river systems. Another major river in Assam, Barak, originates from Japvo mountain of Manipur hills at an altitude of 3,015 m and flows south through mountainous terrain up to Tipaimukh near the tri-junction of the three states: Assam, Manipur, and Mizoram. Here, the river takes a hairpin bend and plunges into the plains of Cachar district of Assam and forms the border of Assam and Manipur states up to Jirimat, which is upstream of Lakhimpur. The river then flows through the Barak Valley of Assam. From the source to the Indo-Bangladesh border, the Barak River flows for 564 km. In Assam, the Barak river basin covers an area of 7,224 km.

Despite being supported by these two major river systems, the state is having rivers / tributaries which are dying due to silting and encroachments. High rainfall intensities and resulting heavy runoff provides no opportunity to go water inside the soils and support baseflow. The baseflow is the life of rivers. In absence of the baseflow, several rivers/tributaries are dying. The Govt of Assam has inked an MoU with Isha foundation to revive the river systems to bring them back life.

GROUNDWATER

Groundwater is available at low to a moderate depth almost in the entire state. Annual Groundwater in Assam is estimated to be 5.44 billion cubic meters²⁴ of which 4.85 billion cubic meters is for irrigation and 0.59 billion cubic meters is for domestic and industrial uses. The overall stage of Groundwater Development in the State is 22%, with the lowest figure of 2% in Cachar District and highest 56% in Bongaigaon Districts and has been categorized as 'safe'.

Precipitation

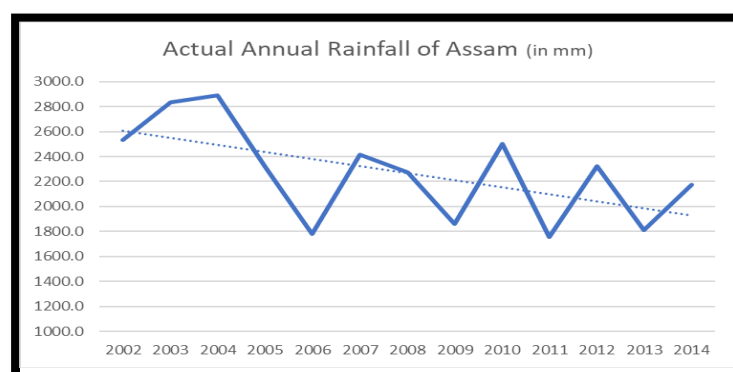


FIGURE 8: TEMPORAL VARIATION OF RAINFALL IN ASSAM

(Source: data.gov.in)

²³ Das Prasenjit, 2012. WATER RESOURCES AND RESERVATION POLICIES IN ASSAM. International Journal of Science, Environment and Technology, Vol. 1, No 1, 19-23

²⁴ Das Prasenjit, 2012. WATER RESOURCES AND RESERVATION POLICIES IN ASSAM. International Journal of Science, Environment and Technology, Vol. 1, No 1, 19-23

Average annual rainfall of the state is 1927 mm. A quick look of the recent past data reflects the downward trend of annual rainfall in the state. A graph reflecting the actual annual rainfall from 2002 to 2014 is being given in the adjacent figure.

ACCESSIBILITY

Although there is seasonal and regional variation in the availability of water resources, the annual availability of water resource remains almost the same. As per Amarsinghe, 2004²⁵,

- Withdrawal of water for irrigation is 81% of the total water withdrawn in the Assam
- For meeting domestic water demand is only 10% of withdrawn water
- For industrial activities, only 9% of withdrawn water is used

An assessment of the impact of climate change on the hydrological regime and water resources using scenarios from IPCC and running on Hadley center regional climate model indicates that by the year 2050, the average annual river runoff of the river Brahmaputra will decline by 14%. However, earlier to this there is a risk of melting of glaciers leading to flash floods.

- 1) Ensuring water for agriculture during long dry spells.** The ratio of gross irrigated area to the gross cropped area has declined over the years and secondary crops are no longer irrigated due to lack of adequate facilities. According to the list of water-stressed areas released and updated by the Ministry of Rural Development, 19 of the 33 districts are the most irrigation deprived districts, reflecting the status of irrigation in the state, despite enough water resource availability, this status has the higher dependency of agriculture on rainfall, uncertainty of which is increased due to climate change.
- 2) Meeting demand for fish:** Considering enough surface water bodies in the state, there is enough untapped potential of fisheries. Efforts are being made in a direction to improve the production and it has been improved by 54% in 10 years from 1.90 lakh tonnes in 2007-08 to 2.94 lakh tonnes in 2016-17²⁶. Assam is the top fish producing state among the North Eastern Indian states. About 95% of the NE population consumes fish, and 85% of the total estimated requirement is produced locally²⁷. The region is aiming for self-sufficiency and the state of Assam possess the highest potential of production enhancement, considering the surface water bodies.
- 3) Meeting the energy and power demand of the industry.** With the increase in proposed capacity generation of thermal power, biomass power, biogas power and increasing the industrial base, meeting demand for the industry might be a challenge
- 4) Meeting potable water demand.** The population is likely to rise continuously and only likely to peak in the 2050s, the rising demand in potable water has to be met by devising strategies that harp on new technologies of water recycling amongst others.

7.5 KEY ISSUES

A vulnerability study has been taken up in 2011²⁸ by *Prof Ravindranath et. al. For North East Indian States*. The study revealed that agriculture production in NE states is vulnerable and subject to climate variability, especially in rainfed areas. To ensure water availability, water conservation, water use, and efficient water utilization need to be taken care of. As described above, the

²⁵ Amarsinghe, 2004. Spatial variation in water supply and demand across the river basins of India. International Water Management Institute, Sri Lanka

²⁶ <https://www.telegraphindia.com/states/north-east/54-increase-in-fish-production-in-assam/cid/1426236>

²⁷ <https://timesofindia.indiatimes.com/city/guwahati/northeast-aims-at-self-sufficiency-in-fish-production/articleshow/58510569.cms>

²⁸ Ravindranath et al., Climate Change Vulnerability Profiles for North East India, *Current Sciences*, August 2011, 384-394. (https://www.researchgate.net/publication/243970955_Climate_change_vulnerability_profiles_for_North_East_India)

maximum water consumed in the state is in the agriculture sector. Thus, efficient utilization in this sector can reduce the water consumption significantly. Adoption of efficient irrigation practices and SRI technology can result into significant water saving. On the other hand, 19 districts out of total 33 districts are irrigation deprived and need focus on strengthening the irrigation system or reduced dependency on unreliable rainfall, in the context of climate change. In addition, conjunctive use of surface and groundwater may be a possibility to address the water issues in long-term. A major hindrance is also a lack of awareness among the primary stakeholders.

STRATEGIES FOR MEETING THE WATER DEMAND

Considering the status as described above, the following action plan has been identified to bridging the gap between demand and accessibility of water for different purposes. As it can be understood from above, that optimum planning is required to provide the adequate irrigation to agriculture and to enhance fisheries production level in the state. This is in addition to water conservation through stream harvesting, enhancing potable water supply security and other objectives.

TABLE 8: STRATEGIES FOR MEETING WATER DEMAND IN A CLIMATE CHANGE CONTEXT

SN.	Strategy	Responsible Agency and time period	Cost (INR Cr)	Priority	Possible Financing Source	Remark	Relevant SDG/INDC
1	Undertake assessments to ascertain the institutional reforms requires to address water distribution, and use issues in a climate change context Collect and analyse gender-segregated related to accessibility to the water resources.	Dept. of Water Resources PHE Irrigation	0.50	VH	Climate change fund mechanism		
2	Set Up Assam State Water Resource Council		-	H	Climate change fund mechanism	Under process	Goal – 13
3	Construction of Data Centre for National Hydrology Project-At Basistha, Guwahati	Dept. of Water Resources	6.60	H	State Specific Scheme- Central government	Added: Work order has been issued and work to commence shortly	Goal 6 and 14
3	Assess the amount of water use efficiency taking place by applying the following in one location wrt baseline and replicate in later years	Dept. of agriculture	1.00	VH	Climate change fund mechanism		Goal – 6
4	Reuse of wastewater (1000 ha) -Water efficient crops (1000 ha) SRI or multiple aerations for rice cultivation (1000 ha)		0.30			ongoing	
5	Improving irrigation through creating a canal irrigation system to bring 150 thousand ha land under cultivation	Irrigation Department/Department of water resource	300			Added	Goal - 15
6	Increased resilience of	Department of	300	H	Rural	Added	Goal-15

	crop by promoting the farm ponds in agriculture farms (30000 farm ponds)	Agriculture/ Department of Rural Development			Development		NDC-6
7	Improve water efficiency through the conjunctive use of surface and groundwater over at a pilot scale covering 1000 ha	Dept of water resources	2.00	VH	Climate change fund mechanism		Goal-6 Goal - 12
8	Undertake a study to explore the possibility of Improving water use efficiency in the industry - Explore the possibility of water markets -Through reuse of wastewater	Dept of Industry	0.50	VH	Climate change fund mechanism	Added	Goal-6
9	Encourage the use of recycled water from domestic wastewater in urban areas (2 wards in one city)	ULBs	1.00	VH	Climate change fund mechanism		Goal-6 Goal - 12
10	Continuous awareness raising on water conservation habits through media	PHE/ULBs	0.10	H	Deptt budget		Goal - 12
11	Enable spring shed development in hilly areas to restore the perennial streams within forests (districts close to Nagaland)	Water Resources Dept.	3.50	VH	Climate change fund mechanism		Goal-13 NDC-1
12	Backyard fisheries in small tanks in the same area where water use efficiency will be piloted in agriculture	Fisheries Dept.	1.00	VH	Climate change fund mechanism		Goal – 14
	TOTAL		610.4				

Source: Assam SAPCC

7.6 MONITORING AND VERIFICATION

To ensure the regular progress on the action plan on climate change, some verifiable indicators have been identified and are given below:

TABLE 9: *MONITORING AND VERIFICATION INDICATORS FOR WATER AVAILABILITY AND ACCESSIBILITY*

Monitoring area	Short term indicators	Medium Term indicators	Long term indicators
State Water Resource Council	Is established and member appointments initiated	Is institutionalised as central agency for water resource management issues in the state; Its inputs are adopted by various departments/sectors for water resources management;	Amount allocated and disbursed as part of water & sanitation related official development assistance that is part of a government-coordinated spending plan; Money allocated and targeted towards women; Proportion of local administrative units with established and

			operational policies and procedures for participation of local communities in water and sanitation management
Baseline study	Baseline study is conducted to assess the water use efficiencies in different SDGs and NDCs highlighted above.	% of water use efficiency improved as compared to baseline	% of water use efficiency improved as compared to baseline
Water use efficiency	Identification of sectors that have water re-use possibilities	% of the potential water reuse achieved	% of the potential water reuse still lacking
		Area under water efficient crops	% of area under water efficient crops
		Area under SRI cultivation	% of rice area under SRI cultivation methodology
		Number of irrigation deprived districts as identified by the MoWR/MoRD	Number of irrigation deprived districts as identified by the MoWR/MoRD
Clean water & sanitation	Proportion of population using safely managed drinking water services; and hand-washing facility with soap and water	% of population having access to safe potable water	% of population having access to safe potable water
Waste water management	Current proportion of waste-water safely treated; and water bodies with ambient water quality	% increase in the proportion	% increase in the proportion
Water stress	Level of water stress: freshwater withdrawal as a proportion of available freshwater resource	% reduction in water stress as compared to baseline	% reduction in water stress as compared to baseline
	Access to water resources would be assessed and factors affecting it. Factors may be technical or social like cast or gender based.	Comparison of access to water accessibility with benchmark	

9. Managing Floods

8.1 CONTEXT

Floods are an annual feature in the Brahmaputra-Barak basin where the maximum flood-prone area is of the order of 4.33 million ha. The losses as estimated by Government of Assam, due to floods and erosion during 1953-2011 was around INR 4659.472 Cr, with 2,753 and 6,73,329 human lives and cattle lost. The social disruption and costs associated with flooding and the erosion of land have been rising. Besides a large number of towns and villages are affected by the erosive action of rivers.

Over the years, changes in river course of the Brahmaputra has been frequent and continuous; resulting in a large amount of land loss due to riverbank erosion (the average annual loss of land is estimated at around 8,000 ha). Since 1954, erosion has destroyed and removed more than 3800 km² of highly productive farmland, leaving thousands of farmers landless and homeless.

8.2 ACTIONS TAKEN AND PROGRESS

The flood control activities in Assam started mainly after the announcement of National Water Policy. Subsequently, "outlined plan for flood control in Assam" along with various comprehensive plans were prepared and the priority areas, which need immediate and urgent attention were identified.

Till date, the Water Resources Department has taken up works primarily for the general development of the rural sector and for the protection of major townships in both the Brahmaputra and Barak valley. Schemes have also been taken up to relieve the drainage congestion in the cities and other important areas.

1. Construction of Embankments and Floodwalls
2. River training and bank protection works
3. Anti-erosion and town protection work
4. River channelization with pro siltation device
5. Drainage improvement/ Sluices`
6. Raised Platform
7. Flood forecasting and warning
8. Flood zoning

The Water Resources Department, Assam has been implementing the above-mentioned flood management schemes from the beginning of 2nd Five Year Plan and is continuing till now. The up to date physical achievements are being given below:

TABLE 10: FLOOD CONTROL MEASURES IN ASSAM

Length of Embankment	...	4473.82 Km.
Raising & Strengthening of Embankment	...	655.502 Km
Anti-Erosion and town protection work	...	911 Nos.
Drainage schemes	...	874.966 Km
Sluices (Major)	...	94 Nos.
(Minor)	...	545 Nos.

Source: Water resource Department (<https://assam.gov.in/web/department-of-water-resource/flood-management-activities>)

Implementation of the above structures have provided reasonable protection to about 16.50 Lakh Hectares of flood-affected areas out of the total 31.05 Lakh Hectare of flood prone area as identified by the R.B.A. for the state. This flood-prone area of 31.05 Lakh hectares comes to about 39.58 % of the total land area of Assam. Whereas the flood-prone area of the country as a whole comes to about 10.2 % of the total area of the country, it signifies that the flood-prone area of Assam is four times the national mark of the flood-prone area of the country.

To address the water-related issues in the state, two organizations have been institutionalized:

1. Flood and River Management Agency of Assam (FREMAA)
2. Assam Water Research and Management Institute Society (AWRMIS)

8.3 FLOOD AND RIVER MANAGEMENT AGENCY OF ASSAM (FREMAA)

The **FREMAA** is a special purpose vehicle set up in 2010-11 as an Executing Agency (EA) under Society Registration Act 1860 for implementation of the **Assam Integrated River Erosion Risk Management Investment Program (AIFRERMIP)** funded (loan basis) by ADB with provision of comprehensive, cost-effective and sustainable structural and non-structural measures in the 3 (three) selected strategic locations of **Palasbari- Gumi, Kaziranga, and Dibrugarh**.

It includes comprehensive riverbank protection works at Dibrugarh, Palasbari-Gumi and Kaziranga. It also includes upgradation and construction of embankment at Dibrugarh, Kaziranga, and Palasbari. The project incorporates the state-of-the-art technology of international standard such as the use of sand-filled Geo-textile bags at the apron of the protection work including concrete blocks at revetment. The project consists of two tranches: Tranche - I and Tranche – II. Tranche - I consist take care of Dibrugarh and Palasbari-Gumi subproject. And Tranche - II of Dibrugarh, Palasbari - Gumi, and Kaziranga subproject.

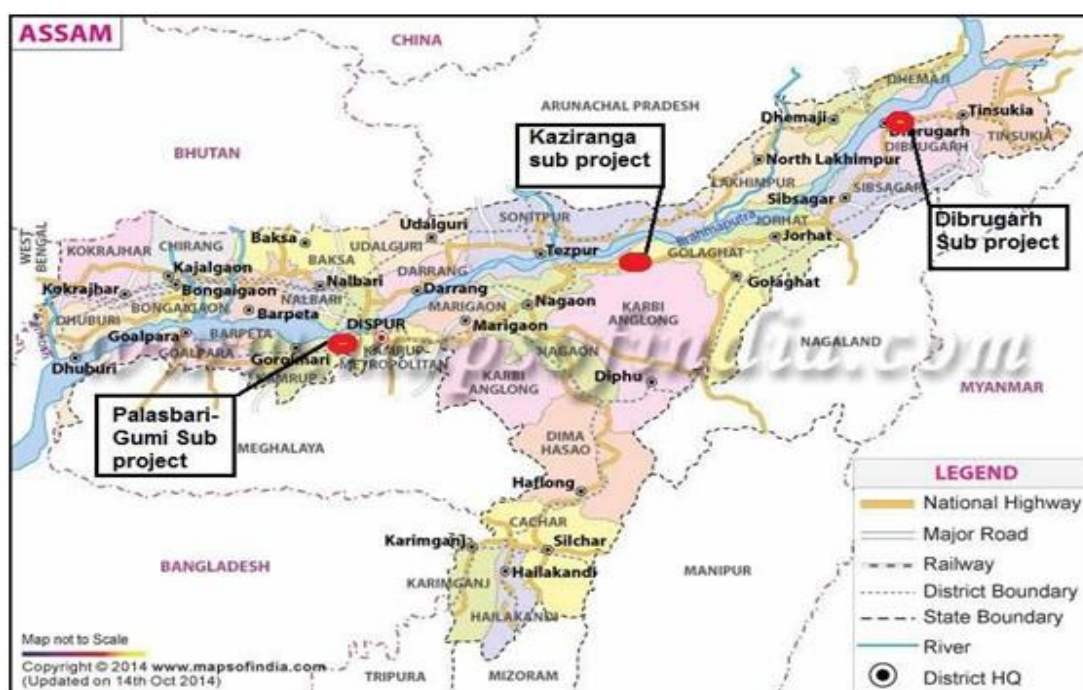


FIGURE 9: FREMAA ADB PROJECT LOCATIONS

Source: Flood and River Erosion Management Agency of Assam (<https://fremaa.assam.gov.in/portlets/project-sites>)

8.4 THE ASSAM WATER RESEARCH AND MANAGEMENT INSTITUTE SOCIETY (AWRMIS)

AWRMIS is broadly managing two important components, **National Hydrology Project** and **Flood Information System (FIS)**. The National Hydrology Project (**NHP**) is Central Govt's effort to improve the planning, development, and management of water resources, as well as flood forecasting and reservoir operations in real-time. Two phases of Hydrology Project (HP-I, 1996-2003, and HP-II, 2006-2014) have already been completed. HP-III (now known as the **National Hydrology Project**) will be implemented across India in all states and union territories. The basic objective of NHP is to strengthen the data, information and knowledge systems to improve water resources planning, operation, and management across India.

NATIONAL HYDROLOGY PROJECT

Project Objective

Improve the data, information and knowledge systems to strengthen water resources planning, operation, and management across India

Project Components

Basically, NHP has four components

- Improving Water Resources Monitoring System (WRMS)
- Improving Water Resources Information Systems (WRIS)
- Water Resources Management Applications (WRMA)
- Improving Institutions and Capacity Building

The total budgetary allocation for the above four components for eight years for the State of Assam has earmarked as **Rs 47.00 Crores**. The project has been approved by the Union Cabinet and has started in Assam. Water Department looks into small schemes nowadays. Once the department approves the scheme they are then implemented by NABARD and AWRMI. The current focus of the Water Resource Department is on short term and medium term to mitigate the flood and erosion problems of the state.

FLOOD INFORMATION SYSTEM

Flood Information System, maintained by the AWRMIS, collects, manages and analyze the flood-related data and information for early warning systems and other purposes.

FUNDING PATTERN OF FLOOD MANAGEMENT WORKS

The flood management works of the state are being funded from the following sources. Due to limitations of fund of its own, the state has to rely more upon the grant of the Central government. At present, the flood management activities are being carried out with the following funding:

1. Flood Management Programme (FMP)
2. Additional Central Assistance (ACA)
3. State Plan
4. North Eastern Council (NEC)
5. Non-lapsable Central Pool of Resources (NLCPR)
6. Joint River Commission (JRC)
7. Assistance from external agencies (NABARD)
8. Externally Aided Project (ADB)

Observed annual trends of peak discharge, example at Pandu (1987 to 2013) and Pagladia (1971 to 2013) along the Brahmaputra show a high inter-annual variability but a distinct decreasing trend in the peak discharges across the years is observed (See Figure 6a and b) ²⁹. Continuous braiding and accompanying erosion, the river bed area has expanded significantly from around 3,870 km estimated between 1916 and 1928 to 6,080 km² in 2006 and continuous load of silt has made the riverbed shallow. As a result, even lower peak discharges cause flooding. In addition, flash floods in major tributaries emanating from hills surrounding Assam cause added misery. Managing erosion and impacts of flooding events are major challenges that the State has to combat annually.

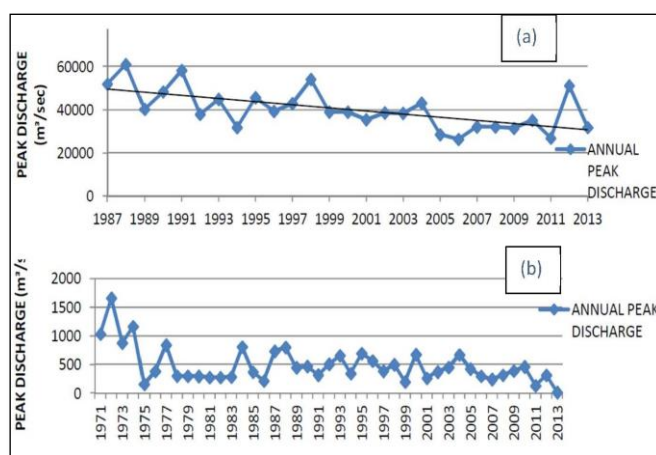


FIGURE 10: ANNUAL PEAK DISCHARGE²⁹ FOR BRAHMAPUTRA RIVER FROM (A) PANDU AND (B) PAGLADIA SITE

KEY ISSUES

Box 1: Steps were taken to contain and adapt to floods and erosion in the Brahmaputra-Barak river basin

River Bank Stabilisation: Work is underway through an ADB-funded project which is piloting out approaches for river bank stabilization at three specific locations, introducing geotextile material for river bank training.

Maintaining embankments for flood protection: Embankments have been constructed at various points across river banks for flood protection. They often breach; therefore, efforts are on to avoid loss of embankments by constructing spurs in some vulnerable location

Flood Early Warning System: FLEWS established in 2008, is an integrated flood warning system that combines actual data and forecasts of rainfall and river water discharge through modeling in association with physical properties of the river system. The IMD, CWC, NEEPCO, Water Resources Department, NESAC and ASDMA together produce the early warning. This has led to a reduction in the loss of human lives.

Housing: The Mishing community in Assam dwell on the floodplains, and they live in traditional stilt houses called 'chang ghar'. These houses are thatched wood and bamboo houses. The average height of the plinth is six to eight feet above the ground, the height, in general, conforming to the highest flood level of the area adjudged from long-term observation, and experience of past floods. The base of the house (floor) made of bamboo and wood is adjustable and can be raised to cope with rising flood waters.

Paddy Cultivation: After the devastation of the crops and cropland in 2008 floods, alternative cultivating "Boro" paddy for perennially flood-affected areas like Bahpora where mainstream paddy like 'ahu' and 'sali' are difficult to grow because of the floods. With the continued success of this cooperative, more and more families are joining the group, making the switch to cultivating 'boro' paddy. In some other areas, such as Majgaon, farmers are doing mixed cultivation of 'ahu' and 'bao' varieties of rice. 'Ahu' can be harvested by the end of May and June, whereas 'bao' ripens in November and December. The logic behind mixed cultivation is that, even if the 'ahu' paddy is damaged by early floods, farmers will still be able to harvest the 'bao' rice. In a normal flood year, both varieties can be harvested.

Issues of concern related to the flood problem in the Assam have been discussed above. The 6th largest river in the world passes across the state and make a lot of area flood prone. Floods in the rivers cause the high scale damage and protection is required to be provided to habitat areas, where people live and the farmlands, where people earn their livelihoods. The loss of fertile land and people and livestock is quite heavy in most of the cases in the State of Assam.

²⁹ Homkala Devi and Pankaj Goswami, 2015. Analysis of Climate change on rainfall, temperature and discharge of Brahmaputra, IJIRAE, issue 4, vol 2, April 2015

STRATEGIES FOR FLOOD MANAGEMENT

As indicated in section 4.2, by the mid-century, the heavy precipitation days are likely to dominate, and the trend will continue until the end of the century¹⁴. If that is the case, containing floods and avoiding damages will be one of the core areas of expenditure for the State. The State of Assam has formulated the following Strategies to adapt to exacerbated impacts of climate change.

TABLE 11: STRATEGIES TO AVERT FLOODS IN A CHANGING CLIMATE SCENARIO

S. N.	Strategy Floods	Responsible Agency and time period	Cost (INR Cr)	Priority	Possible Financing Source	Remark	Relevant SDG/INDC
1	Detailed scientific study to understand the nature of river flow and its impact on erosion to control erosion in the state of Assam and enable land reclamation. Gender-segregated data of will be collected and analysed for any biased due to gender	WRD	0.50	VH		Yet to be taken up	-
2	Undertaking study to assess the intensity and recurrence frequency of floods due to climate change and extent and depth of flooding. In 14 major Urban Agglomerates in the 14 districts prone to floods –Done by ACT. Gender-segregated data will be collected and analysed for all genders to understand gender specific impacts, if any.	WRD	2.8 (@ 0.2 Cr per city)	VH			
3	Develop an integrated flood, erosion, and sediment management Action Plan for the Brahmaputra basin 3 major regions in Assam, namely, for Upper, Middle and Lower Assam and drawing upon knowledge on improved technical standards, global best practices and the technologies-under review will be implemented by Flood and River Management Agency of ASSAM (FREMAA). Gender-budgeting will target financial resources specifically towards women and monitor its usage and impact	Executing Agency: WRD Partners: ASDMA, NESAC, IMD, Research Instt, NGOs	1500 .00	VH	World Bank /any other		Goal - 13
4	Extending River Bank Stabilisation work using geotextile material for river bank training all along the Brahmaputra and Barak river banks. – Under implementation through different small	WRD	750. 00	VH			Goal-15

	schemes						
5	Setting up a North East Hydrology Data Management Centre through basin management approach for managing flash floods. Bidding Process has started for the data center	WRD	2.00	VH			
6	Documenting possible indigenous community based and new adaptation strategies for adapting to floods and implementing the same at pilot scale along with the development of fiscal measures for averting climate-induced risks. Document Indigenous technical knowledge (ITK) /traditional knowledge and wisdom of both genders and gender specific coping mechanisms, if any.	WRD	5.00	VH	Adaptation Fund		
7	Construction of multipurpose flood shelter with an inmate capacity of 500 people / Unit in Dhemaji, Lakhimpur, Barpeta; Morigaon & Majuli	ASDMA	14.0	H			NDC-6
8	Develop district level management plans to deal with multiple hazards including floods in a changing climate context	ASDMA	8.10	H			
9	Infrastructure strengthening Community-based flood early warning system.	ASDMA	8.00				NDC-6
	TOTAL		228 2.40				

SOURCE: ASSAM SAPCC

8.5 MONITORING AND VERIFICATION

To ensure the regular progress on the action plan on climate change, some verifiable indicators have been identified and are being given below:

TABLE 12: MONITORING AND VERIFICATION INDICATORS: FLOOD MANAGEMENT

Monitoring areas	Short term indicators	Medium Term indicators	Long term indicators
River management	Identification of river training and bank stabilization work completed	% length of banks of major identified rivers completed	% increase length of banks of major identified rivers completed
Flood management and land restorations	Documentation of current Community based adaptation strategies (of all genders); Area covered under Flood early warning system	Number of Districts out of flood prone districts have flood management plan	% Reduction in the losses due to floods
Studies	Studies institutionalized to identify the baseline of loss of property and lives due to floods. Gender-segregated data to be collected	% reduction in loss of property and disaster management from baseline, of all genders	% reduction in loss of property and disaster management from baseline- of all genders

10.Agriculture

9.1 BACKGROUND

Like most states of the country, Assam is also an agrarian state. From land use perspective, about 54% of its geographical area pertains to agriculture. Including persons dependent on plantation, about 80% population is dependent on agriculture, in the state. This reflects that agriculture is the primary sector in the state's economy. The socio-economic condition of Assam largely depends on its agricultural production. Different sub-sectors of agriculture, crops, livestock, fisheries also provide the diversification in the livelihood options. Rice is the major

crop of the state and it is being taken in summers, winters as well as in autumn. The state is also the largest tea producer in the country and also has its famous Assam tea, with good international market. Similarly, Fisheries also plays an important role as per an estimate approximate 95% of the state population consumes fish. It can also be noted that Assam has the highest pig population (15.89%) in the country. It reflects that despite being a small state, Assam contribution as well as the potential of contribution is quite significant. In Assam, contribution of agriculture has been reflected in the above figure.

As agriculture is amongst the top sectors vulnerable to the climate change. Realizing this, one among the eight Missions under the National Action Plan on Climate Change is dedicated to agriculture. The National Mission for Sustainable Agriculture (NMSA) seeks to address issues regarding 'Sustainable

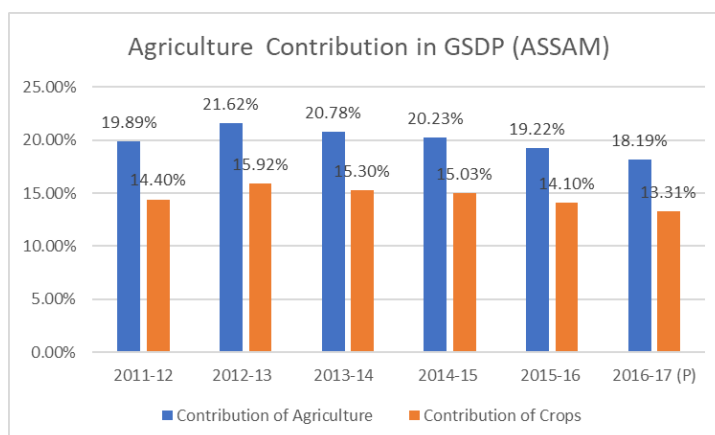


FIGURE 11: CONTRIBUTION OF AGRICULTURE IN GSDP OF ASSAM

Source: Department of Agriculture, Assam

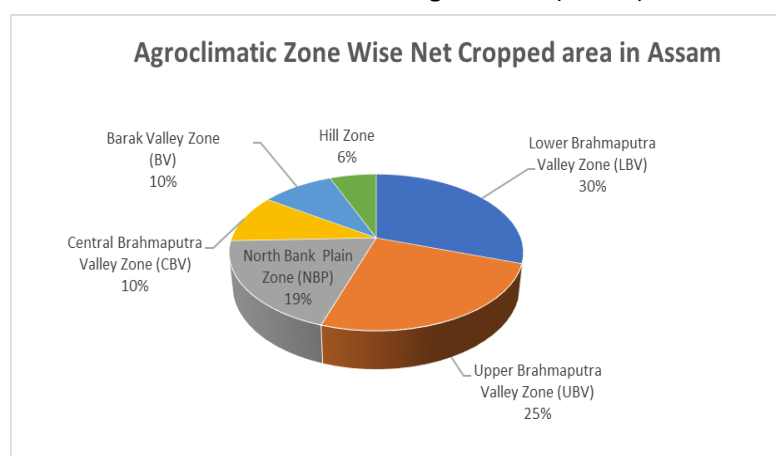


FIGURE 12: NET CROPPED AREA IN DIFFERENT AGRO-CLIMATIC ZONES

Source: Department of Agriculture, Assam

Agriculture' in the context of risks associated with climate change by devising appropriate adaptation and mitigation strategies for ensuring food security, equitable access to food resources, enhancing livelihood opportunities and contributing to economic stability at the national level. Specific technical approaches to address the above issues are not only state specific but also depends on the agroclimatic zones, even within the states. Assam has majorly six Agro-Climatic zones.

Area under different zone has been given in the above figure.

Assam being an agrarian state lays great emphasis on ensuring the livelihood of its people engaged in agriculture activities. Women play important and varied roles in agriculture, but they have

unequal access, relative to men, to productive resources and opportunities. Therefore, integrating climate change adaptation and gendered strategies in planning is the key area of thrust for the government so as to not enforce existing gender biases and stereotypes and develop adaptive capacity of both men and women as per their needs and requirements. At this state in SAPCC formulation and implementation in agriculture, emphasis will be places on collecting gender-segregated data and analyse its impact in all climate change vulnerable areas of agriculture and allied sector. Following the tenets of the National mission for sustainable Agriculture, the Assam SAPCC also focuses on making agriculture climate smart and resilient so as to ensure its sustainability and hence livelihoods of the people associated with it.

State climate actions need to be aligned with the India's NDCs and Sustainable Development Goals which came into effect in December 2015 and January 2016, respectively. The SDGs and INDCs relevant to the water resource are being listed and detailed below:

SDGS AND NDCS RELEVANT TO AGRICULTURE & ALLIED SECTOR

9.1 RELEVANT SDG'S

TABLE 13: SDGS AND INDCS RELEVANT TO THE AGRICULTURE AND ALLIED SECTOR

S. N.	Description	Relevant focus
1	Goal 2 Zero Hunger	Doubling the agricultural productivity and incomes of small-scale food producers; ensuring sustainable food production systems and implement resilient agricultural practices; maintaining the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species; agricultural research and extension services;
2	Goal 12 Responsible Consumption and production	Sustainable management and efficient use of natural resource
3	Goal 3 Ensure healthy lives and promote well-being for all at all ages	Combat water-borne diseases; equitable access and management of clean water and sanitation for better health of all age-groups and reduce incidences of communicable diseases; promote access to and consumption of safe, clean drinking water for better health and sanitation
4	Goal 8 Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Reduce climate induced stress on agriculture produce and ensure better returns on produce; reduce under-employment in the agriculture sector and equal participation of all genders
5	Goal 13 Climate Action	Combating climate change and its impacts; strengthening resilience and adaptive capacities; mainstreaming climate measure in national policies; improving education and awareness about climate change; building capacities of individuals and institutions
6	Goal 15 Life on land	Protect and restore land degraded from floods and droughts; take action to reduce degradation of natural habitats, prevent extinction of threatened species; reduce the impact of invasive alien species on terrestrial eco-system; increase capacity of local communities to pursue sustainable water-based livelihood opportunities
NDC		
1	NDC 6	To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture
2	NDC 1	To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation
3	NDC 8	To build capacities, create domestic framework and international architecture for quick diffusion of cutting-edge climate technology in India and for joint collaborative R&D for such future technologies.

DETAILS OF RELEVANT SDGS

Goal 2: Zero Hunger

SDG 2 is directly relevant to the agriculture and allied sector in Assam. It seeks to "End hunger, achieve food security and improve nutrition, and promote sustainable agriculture" by 2030. It is premised on the idea that everyone should have access to sufficient nutritious food, which will require widespread promotion of sustainable agriculture, doubling of agricultural productivity, increased investments and properly functioning food markets. Eradicating hunger, achieving food security, improving nutrition and promoting sustainable agriculture have a direct bearing on the quality of human life, and are crucial for achieving development with social justice. Ending hunger includes three major aspects - production of food grains, their effective delivery and absorption. Assam government has devised following broad in order to achieve goal 2:

- Food security as well as nutritional security.
- Promoting sustainable agriculture
- Focus on horticulture crops for achieving broad based agriculture growth by raising production and productivity of the crops
- Improve soil health management, rain fed area development and farm water management for sustainability
- Promote and strengthen livelihood promoting sectors such as Fruit cultivation, Animal Husbandry, Dairy, Fisheries, Poultry etc. by suitable policy intervention and infrastructure therein.
- Promoting sustainable production systems through optimal utilization of land, water and labour resources for the best possible crop mix
- Improving water management practices and promote water conserving technology such as drip irrigation

Goal 12: Responsible Consumption and Production

Following targets of SDG 12 are most relevant in the context of Assam climate change adaptation in the agriculture sector.

- (i) Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries
- (ii) By 2030, achieve the sustainable management and efficient use of natural resources
- (iii) By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses
- (iv) By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment
- (v) By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse
- (vi) Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle
- (vii) Promote public procurement practices that are sustainable, in accordance with national policies and priorities

- (viii) By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature
- (ix) Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production
- (x) Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products
- (xi) Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities

Goal 3: Good health and well-being

Agriculture and allied services' produce, soil and livestock health and overall production and distribution has direct bearing on the health of people and biodiversity worldwide. Following SDG 3 targets are relevant to Assam in the context of agriculture and allied services.

- (i) By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination
- (ii) Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks

Goal 8: Decent work and economic growth

Agriculture and allied activities contribute significantly to the state economy of Assam and majority of population is employed in this sector. Following targets are relevant to Assam state action plan for agriculture and allied sector and for population engaged in this sector:

- (i) Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries
- (ii) Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors
- (iii) Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services

Goal 13: Climate action

Agriculture and allied sector are highly vulnerable to climate change and any action taken towards adaptation, capacity and resilience building in this sector are critical in the Assamese context. In particular, following SDG 13's targets are directly relevant to Assam:

- (i) Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
- (ii) Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning

Goal 15: Life on land

Given that Assam has significant biodiversity and huge population is dependent on them for livelihoods as part of allied sector activities, SDG 15 is critical for Assam. Following targets are directly relevant to Assam:

- (i) By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements
- (ii) By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world
- (iii) Promote fair and equitable sharing of the benefits arising from the utilization of genetic resources and promote appropriate access to such resources, as internationally agreed
- (iv) Take urgent action to end poaching and trafficking of protected species of flora and fauna and address both demand and supply of illegal wildlife products
- (v) By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species
- (vi) Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems

9.2 ALIGNMENT TO NDC GOALS

To achieve the adaptation goals related to Agriculture sector, NDC 6, 1 and 8 states the following strategies listed below:

- ❖ Launched Soil Health Card Scheme. Additionally, 100 mobile soil-testing laboratories setup across the country.
- ❖ Paramparagat Krishi Vikas Yojana (PKVY) launched to promote organic farming practices.
- ❖ The Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) launched to promote efficient irrigation practices.
- ❖ To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture, water resources, Himalayan region, coastal regions, health and disaster management.
- ❖ To build capacities, create domestic framework and international architecture for quick diffusion of cutting-edge climate technology in India and for joint collaborative R&D for such future technologies.

NDC 6:

To **better adapt** to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture, water resources, Himalayan region, coastal regions, health and disaster management. Apart from above stated strategies, Government of India has listed following schemes and programmes (in NDC) to achieve the adaptation goals related to Agriculture sector.

- National Mission on Sustainable Agriculture
- National Food Security Mission
- Mission for Integrated Development of Horticulture
- National Initiative on Climate Resilient Agriculture (NICRA)

While preparing the adaptation interventions (in line with NDC goals), the above programmes and schemes were considered.

11. Crops

10.1 STATUS

Agriculture plays a vital role in the economy of Assam as 4082.50 thousand hectares area is under cropping representing 52.05%³⁰ of the total geographical area of the state. It can also be seen that the despite going slightly downwards, total contribution of crops in GSDP of state is significant 13.31%. Total contribution of agriculture sector is 18.19% as per initial estimates for year 2016-17.

The table below also reflects the Rice is the main grain, being produced in the State, occupies the maximum area (2484.98 thousand ha) in 2015-16. Other principle crops are pulses, maize, wheat, sugarcane, jute and oil seeds. The area under principle crops and their production is being given below:

TABLE 14: PRODUCTION AND AREA UNDER PRINCIPLE CROPS IN ASSAM (2016-17)

S. N.	Crop Name	Area under Crop ('000 Hect)	Production ('000 tonne)
1	Autumn Rice	168.04	228.21
2	Winter Rice	1890.96	3767.36
3	Summer Rice	408.31	1131.87
4	Total Rice	2467.31	5127.44
5	Wheat	17.45	23.46
6	Maize	31.34	91.22
7	Other cereals and small millets	4.75	2.93
8	Total Pulses	146.38	107.54
9	Total Food Grains	2667.05	5352.58
10	Total Oil Seeds	317.58	204.31
11	Sugarcane	31.38	1207.17('000canes)
12	Jute	72.13	802.71 ('000 bales)

Source: Agriculture Department

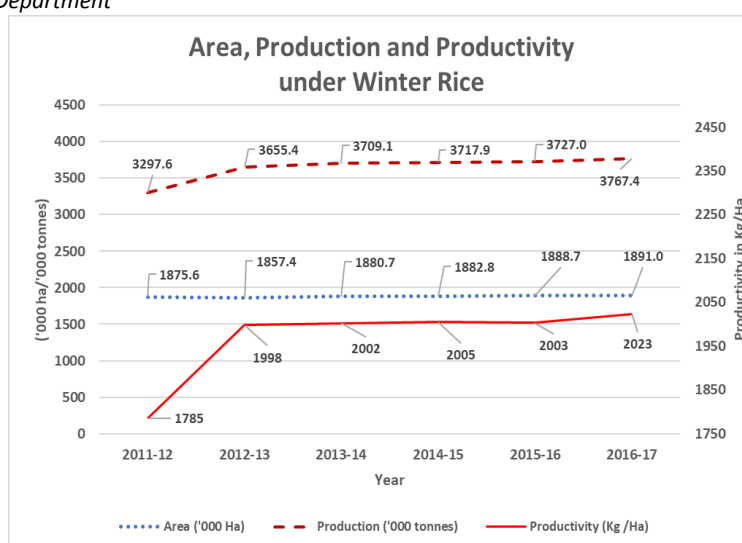


Figure 13: Temporal trend of Area, Productivity and Production of Winter Rice (Source: Agriculture Department, Assam)

³⁰ Assam at a Glance, 2016, Directorate of Economics and Statistics, Assam, Guwahati

As it can be seen that the productivity in the of the winter rice is significantly high as compared to summer and autumn rice, the area under winter rice cultivation is maximum. A trend in the winter rice can be seen in the given figure. As it can be seen that the area under winter rice is almost constant and seems to reach its potential, and the change in production level is due to change in productivity.

KEY ISSUES

Assam's agriculture has yet to experience modernisation in a real sense and is lagging behind³¹. With implications to food security, per capita food grain production has declined in past five decades³². On the other hand, although productivity of crops increased marginally, still these are much lower in comparison to highly productive regions. For instance, yield of rice, which is staple food of Assam, was just 2134³³ kg per hectare against India's average of 2391³⁴ kg per hectare in 2014-2015. The Assam is at 9th rank among top 10 rice producing state in the country. From the productivity perspective the Punjab is having highest yield of rice which is about 3838 kg/ha, about 1.8 times higher as compared to the Assam's average yield. This gap reflects the potential where the efforts need to be made. From National average yield average yield of rice in Assam is about 10.75% lesser. These facts reflect the potential of improvement in rice yield in the state.

Low productivity in many crops is due to low seed and varietal replacement rates, deteriorating soil health, lack of irrigation facilities and ground water. Imbalances in agriculture development across districts; post-harvest losses and inadequate processing facilities for fruits and vegetables are some of the very critical problems for the agriculture sector in Assam. The contribution of agriculture sector in GSDP remained lesser in most of the years since 2008-09, as compared to industry and tertiary sector. The contribution of various sectors in 2011-12 and 2016-17 has shown that though the share of agriculture and its allied activities in GSDP at current price had marginally come down from 19.89% in 2011-12 to 19.34% in 2016-17, yet the agriculture sector continues to occupy a significant place in the state economy and hence any fluctuation in the production of food grains, vegetables and fruits affect the economy.

The challenges that Assam's agricultural sector is likely to face in the future may be anticipated as follows:

Threat to production levels due to rise in ambient temperature: Increase in both frequency and intensity of high temperature, along with its large variability, is emerging as a potential threat to the sustainability of rice production²⁷. This is because rice is a C3 plant and C3 plants growing in hot tropical conditions like in valleys of Assam, photosynthesis becomes inefficient when the temperature rises above long term mean temperatures and deteriorates further when temperature increases beyond this threshold, which is likely to be the case due to global warming.

Reduction in Availability of Water for irrigation: The emerging trends of rain fall indicate that the number of rainy days is decreasing, and number and extreme rainfall days are increasing and so is their intensity, with total rainfall increasing in most of the areas in the Assam in the future. It is likely that runoff will be high and as hardly any time will be there for seepage of water into the ground, ground water recharge will go down, therefore extraction of water will be done from deeper levels,

³¹ Deka, Prof. Bhabananda (1963). *Asomor Arthaniti* (1 ed.). Guwahati, India: New Book Stall

³² UNDP 2004 p33

³³ <https://www.mapsofindia.com/top-ten/india-crops/rice.html>

³⁴ Annual Report 2016-17, Department of Agriculture, Cooperation and Farmers' Welfare, Ministry of Agriculture and Farmers' Welfare, New Delhi, pg 3

making irrigated agriculture vulnerable in Assam. Irrigation is required during summer and in winters. As per the list of water stressed blocks issued by the Ministry of Rural Development, 19 districts out of total 27 are among most irrigation deprived Districts.

Degrading Soil health: Exploitation of ground water continuously at higher degrees would lead to soil health problems like acidity, alkalinity, elemental toxicity, etc. Iron and Arsenic toxicities have already been reported in the state. This would ultimately constrain the ground water exploitation. Therefore, use of surface water and solar electrical pump operated drip / sprinkler irrigation of harvested rain water would remain as the last resort of assured irrigation.

Erratic flood & drought condition: The state would have to tackle untimely flood and drought conditions. Such incidents have been reported since 2003 in Assam. Not only do floods wreak annual havoc, but the accompanying uncertainty prevents farmers from taking risks and making investments in land improvement.

Emergence of new pests and pathogens: Changes in climate would normally shift the host pattern and life cycles of various insects, pests and pathogens. Many non-pest insects of cultivars might turn to be normal pests while many existing ones might perish forever. These would lead to exploring of new resistant varieties and pest controlling chemicals.

10.2 STRATEGY

Making Agriculture climate resilient has the potential of uplifting rural poverty and enhancing the adaptive capacity of the sector as a whole. Concerted efforts are required to realize the untapped potential of this sector. Therefore, an integrated adaptation approach is suggested as way forward for ensuring sustainability of agriculture crops and horticulture in the State. The adaptation pathway is indicated in Figure 8 below. Strategies for Adaptation are listed in Table 5.

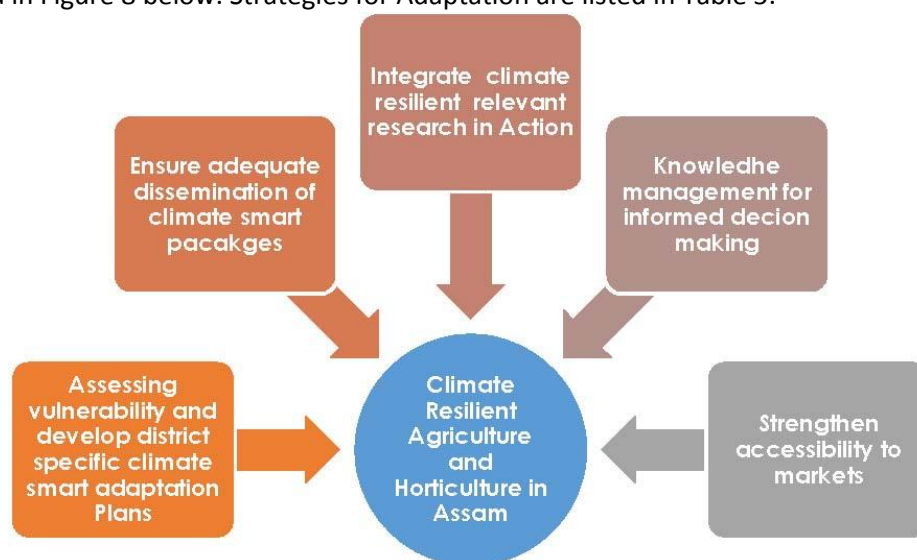


FIGURE 14: ADAPTATION PATHWAY FOR SUSTAINING AGRICULTURE AND HORTICULTURE IN THE STATE.

The Strategy is to focus on research and preparing the district-wise climate action plans, focussing on horticulture and other options while strengthening the irrigation facilities. specific action points are being given in the table below:

TABLE 15: STRATEGIES FOR ENHANCING CROP PRODUCTION IN CONTEXT OF CLIMATE CHANGE

S. N.	Strategy- Crops	Responsible Agency and time period	Cost (INR Cr)	Priority	Possible Financing Source	Remarks	Relevant SDG/INDC
1	Strategy 1: Development district wise climate smart and resilient agriculture adaptation action plans. Have targeted budget allocation for women in agriculture and allied sector and focused monitoring of the same						Goal - 2 Goal – 13
1.1	Assessing District wise exposure and vulnerability of agriculture systems to climate variability and change and developing climate smart and resilient. Collecting gender-segregated data and develop Strategies through stakeholder consultation for all 27 districts taking into consideration the agro-climatic zone in which they are located	DoA	10.00	VH		Cost revised Ongoing more manpower is required	Goal - 12
	Total Strategy 1		10.00				
2	Strategy 2: Develop, disseminate, and practice climate smart, climate resilient agriculture packages specifically for both genders at Pilot scale, Coverage: 90,000 ha	DoA				Needs to be done	
2.1	Preparation of DPR through PRA to record variances in crops/plants, soil types, soil and water conditions, new pest host relationships	DoA	201.00			Ongoing	-
2.2	Application of climate smart and resilient agronomic practices to retain and enhance production to optimum levels	DoA	6.00				Goal-13
2.3	Assessing and broadcasting knowledge on appropriate seed rate, soil moisture conservation activities, water efficient technologies including drip irrigation and village operations	DoA	81.00				Goal - 12
2.4	Restore natural water bodies to conserve run off.	DoA	80.00				Goal -12
2.5	Community vermin-composting	DoA	100.00				Goal-12
2.6	Expansion of area under low water requiring crops	DoA	15.00				Goal-12
2.7	Integrated diseases management practices	DoA	15.00				
2.8	Develop and propagate crop specific weather indexed crop insurance	DoA	60.00				
2.9	Train farmers on disaster risk reduction techniques	ASDMA and DoA	2.00				Goal-13
	Total (Strategy 2):		560.00			Costing changed for scale and period	
3	Research						

3.1	Developing water and temperature stress tolerant varieties with focus on integrating C4 characteristics in C3 Rice to make photosynthesis efficient at higher temperatures and hence make rice plants temperature and water stress resilient	DoA	0.10				
3.2	Identifying the potential of improving the productivity of winter rice to comparable levels of states with high yields of the same	DoA/AAU	1.50			Newly added	Goal – 2
	Total Strategy 3:	DoA	1.60				
4	Knowledge management, training and skill development	DoA	5.0				Goal - 13
4.1	Automatic weather stations (8 in number) at block level	DoA	17.52				Goal – 13
4.2	Sustainable eco-friendly horticulture in hilly areas	DoA	25.00			Costing changed	
4.3	Computerised weather recording and synthesizing centre	DoA	0.10			Costing changed	Goal – 13
4.4	Establishment of Climate Change Agriculture research Centre	DoA	0.20			Costing changed	
4.5	Training of department functionaries on CC adaptation for developing climate resilient agriculture	DoA	2.00			Costing changed	Goal – 13
4.6	Training of farmers on climate smart and climate resilient packages of practices- for both genders	DoA	1.00			Costing changed	Goal – 13
4.7	Documenting indigenous knowledge of both men and women on adaptation for integration with modern techniques	DoA	0.05			Costing changed	Goal - 13
4.8	Publication and dissemination of success stories	DoA	0.05			Costing changed	
4.9	Workshops/seminars on CC resilient agriculture system development	DoA	0.10				
	Total Strategy 4:		46.02			Costing changed	
5	Strengthen accessibility to markets						
5.1	Establish market intelligence cell	DoA	1.00				
5.2	Skill development towards producing beneficiated food products (cover 14 districts in Phase 1)	DoA	14.00				
5.3	Establish farmers' companies (village cluster approach in 14 districts)	NABARD	28.00				
5.4	Strengthen cold storage networks (14 districts)	NABARD	14.00				
	Total Strategy 5		57.00				
6	Strategy 6: Protect irrigation schemes from siltation due to soil erosion						
6.1	Improving irrigation through creating a canal irrigation system to bring 150 thousand ha land under cultivation	Irrigation Department/ Department of water resource	300.00			added	Goal - 2 Goal – 8
6.2	Increased resilience of crop by promoting the farm ponds in	Department of	300.00	H	Rural Developm	Added	NDC – 6

	agriculture farms (30000 farm ponds)	Agriculture/ Department of Rural Developme nt			ent		
6.3	Plant plantation trees every 25 m on both sides of irrigation canals and reservoirs and beside inspection roads- cover 19244 km	Irrigation/Ru ral Dev/Forest Department	124.48				Goal - 15
6.4	Install 10 HP pumps sets in irrigation scheme to offset emission from fuel combustion in motors (10 numbers)	Department of Irrigation	4.00				
	Total Strategy 6		728.48				
	TOTAL AGRICULTURE CROPS		1290.1				

Source: Assam SAPCC

Meteorological information is very important and block wise setting up of the observatories will enrich the data more accurately.

10.3 MONITORING AND VERIFICATION

To ensure the regular progress on the action plan on climate change, some verifiable indicators have been identified and are being given below:

TABLE 16: MONITORING AND VERIFICATION INDICATORS FOR UNDERSTANDING PROGRESS ON CROP RELATED STRATEGIES

Monitoring area	Short term indicators	Medium Term indicators	Long term indicators
Studies (all studies will collect gender-segregated data)	Baseline study for assessment and establishment of exposure and vulnerability;	%age improvement in exposure and vulnerability indicators	Actions towards Climate Smart Agriculture are being implemented and in place
Climate smart and resilient agricultural practices (targeted funding for women in devising and implementing these practices)	Climate Smart Agriculture (CSA) and Climate Resilient Agriculture (CRA) strategies are institutionalized	Action plan for Climate Smart Agriculture and Climate Resilient Agriculture is ready for adoption and implementation	% adoption of CSA and CRA practices in the state
IEC	Communication needs established for both men and women with respect to climate change and adaptation practices for agriculture Targeted communication for both genders given their time and access to various media	Suitable IEC Material for promoting CSA/CRA is in place and being used to promote CSA/CRA packages Targeted communication and its documentation for both genders given their time and access to various media	% improvement in awareness levels of both men and women on climate change threats and adaptation strategies
Natural water bodies and household income	Baseline assessment of functional and dysfunctional natural water bodies that impact agriculture and allied	Strategies to restore natural bodies devised and shared with relevant departments	Restoration strategies are adopted and natural water bodies are functional and contributing to households

	sectors and economy. The data collected will also be gender-segregated		incomes and local economy
Cropping patterns	Cropping pattern are assessed based on agro-climatic regions and re-defined, if required.	Approved cropping patterns are shared by department through all possible mediums	% of farmers who have adopted climate resilient cropping patterns as percentage of all
Irrigation	Baseline established of land under irrigation; rainwater harvesting strategies to be devised	%age decrease in farmers who are dependent on rain-fed agriculture.	% increase land under irrigation compared to baseline
Climate stress tolerant crops	If needed, research studies deployed to develop water and temperature stress tolerant varieties of rice and other crops in Assam	Number of water and temperature stress tolerant varieties available for adoption	Area covered under the water/temperature tolerant rice varieties

12. Horticulture

11.1 STATUS

Assam is traditionally rich in horticultural production due to its diverse and unique agro-climatic condition which is conducive for growing wide range of horticultural crops like various fruits, vegetables, flowers, spices nuts tuber crops and medicinal and aromatic plants. The world citrus belt encompasses Assam within it. Horticultural crops occupy about 15 percent of the gross cultivated area of Assam. Interestingly, in all the agroclimatic regions of the Assam, almost all type of horticulture crops can be taken up.

Horticulture is gaining momentum in the Assam, as the state has very positive conditions for horticulture production. It is important for different reasons in the state. Horticulture is providing nutritional security to rural as well as urban population, it has good potential for generating livelihoods and finally, it facilitates the maximum returns to farmers. In addition, it is the most environment friendly, climate resilient approach and sector, which also contribute towards mitigating the climate change, in addition to contributing towards, nutritional and livelihood security and erosion reduction.

Considering the benefits of the horticulture plantation, the area under the horticulture, especially under tree plantation is increasing continuously. This, despite the reduced productivity, has caused in significant and almost continuous increase in production. The same can be observed in the graph below:

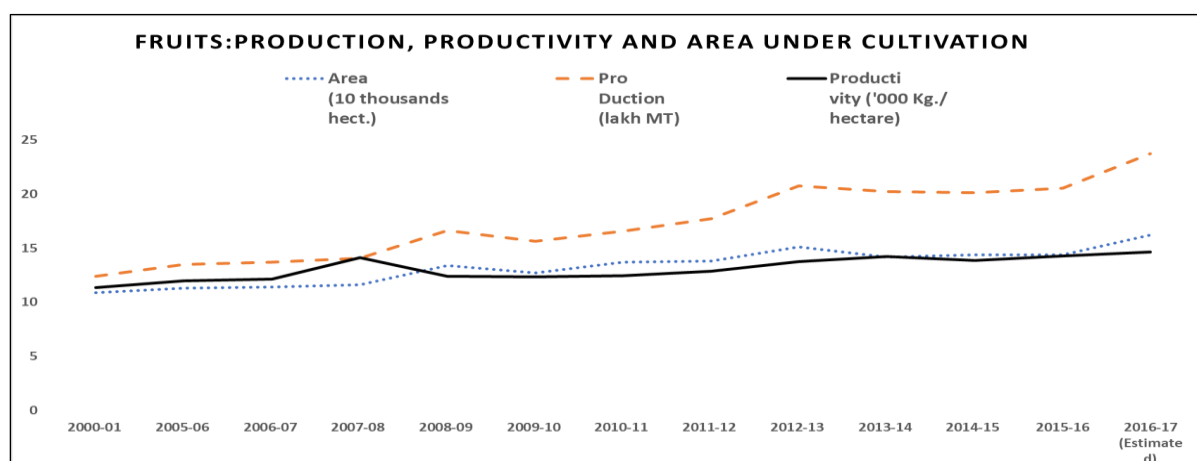


FIGURE 15: AREA, PRODUCTIVITY AND PRODUCTION UNDER FRUIT CROPS IN ASSAM

(Source: Agriculture Department, Assam)

It can also be observed that in case of spices, the area under cultivation is almost constant or increasing marginally, but the productivity is having increasing trend and the total production follows the same pattern.

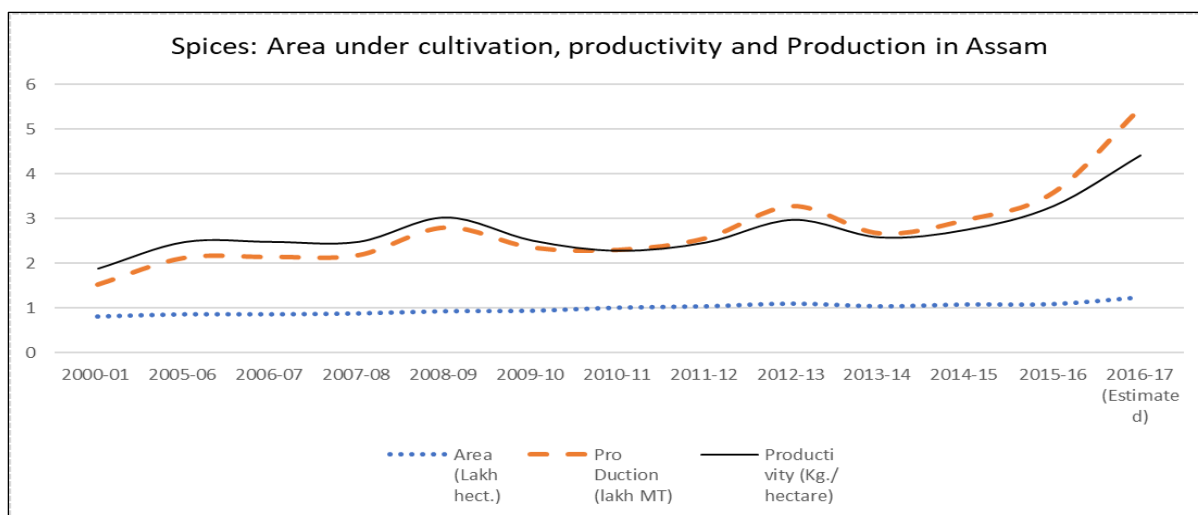


FIGURE 16: AREA, PRODUCTIVITY AND PRODUCTION OF SPICE CROPS IN ASSAM

11.2 CLIMATE CHANGE AND HORTICULTURE

In context of climate change, the possible impact on Assam are the increased flood frequencies, increase in the temperatures and elongated dry spells during Monsoon. Fruit plantation is the least vulnerable to these aspects, but impact of pests/insects and diseases need to be understood and taken care of. Impact of climate change on spice and vegetable production also need to be studied.

At one side, as mentioned above, the fruit plantation is among the least affected (by climate change) agriculture allied activity, on the other side, it also provides resilience to the farmers' households by higher and comparatively reliable returns (long term sustainable incomes), nutritional security, reduced risks, lesser dependency on rainfall.

11.3 KEY ISSUES

Horticulture has enormous potential for employment and income generation through commercial exploitation therefore area expansion and raising productivity is the aim of the Government. However, there are some inherent barriers to achieve the full potential and that includes inadequate extension of scientific horticulture technologies, accessibility to packages of input mixes, road communication, marketing, processing and cold storage facilities.

The changing climate introduces additional problems, unless it is taken into consideration in long term agriculture planning of the State, the projected aspiration for this sector is likely to get hampered. Some of the climate change concerns and opportunities are compiled below³⁵:

Rising ambient temperatures: Production timing is likely to change due to rise in temperature. Photoperiods may not show much variation. As a result, photosensitive crop will mature faster. As the winter regime and chilling duration will reduce it will affect the temperate crops. Pollination will be affected adversely because of higher temperature. Floral abortions flower and fruit drop will be occurred frequently. Higher temperatures will reduce tuber initiation process in some tuber vegetables, however, in areas at higher altitudes potato production may rise by 5%. Anthocyan in production may be affected in apples and capsicum. Tip burn and blossom end rot will be the

³⁵ Datta S., 2013. Impact of climate change on Indian Horticulture, International Journal of Science, Environment ISSN 2278-3687 (O) and Technology, Vol. 2, No 4, pp 661– 671.

Source: http://www.agriassam.in/agriHorti_profile/Profile_ofAgri-HortiSector_ofAssam-June2013.pdf

common phenomenon in tomatoes. The requirement of annual irrigation will increase, and heat unit requirement will be achieved in much lesser time.

Diversification to crops that are thermos-tolerant can be encouraged in plains and new varieties that require longer chilling time may move to higher heights.

Heavier precipitation events and floods: This is a concern in the plains as floods devastate horticulture produce. In hilly areas flash floods due to heavy precipitation will lead to heavier soil erosion.

Erratic rains: Unseasonal rains and heavy dew during flowering and fruiting period is likely to aggravate the incidence of pests and diseases.

Long dry periods: This condition would require arrangements that would ensure water for irrigation for horticulture produce, or else horticulture during long dry periods is likely to be jeopardised. The indigenous genetic resources provide a buffer in times of drought, heat and biotic stresses, and genetic resources with bio-alternatives may reduce the vulnerability of production systems to climate change. Additionally, water efficient technologies need to be embraced far and wide.

Strategies

TABLE 17: STRATEGIES FOR SUSTAINABLE HORTICULTURE IN A CHANGING CLIMATE SCENARIO

Sl. No	Strategy Horticulture;	Responsible Agency	Budget (INR Cr)	Priority	Source of Funding	Remarks	SDGs/INDC goals
1	Sustainable horticulture in hilly areas through plantation crops like cashew nut – Focus: Jhum areas and others. Coverage: 5000 ha.	Directorate of Horticulture Assam	25.00	VH	Horticulture mission	Ongoing Costing modified	Goal – 15
2	Popularisation of indigenous thermal and water stress resistant varieties – black Jamun (<i>Polnia</i>), Sapida (<i>Leteku</i>), Jackfruit, Hog plum (<i>Amara</i>) etc. Coverage: 1000 ha,	-do	2.50	H	RKVY	Ongoing	NDC-6
3	Growing vegetables in protected condition through Crop diversification and thus facilitating off season production	-do	4.00	H	Horticulture mission/RKVY	ongoing	NDC - 6
4	Promoting water use efficiency-Construction of water harvesting structures, promotion of drip and sprinkler irrigation: Coverage: 100 ha.	-do	20.05	VH	Horticulture mission	ongoing	Goal- 9
5	Ensuring soil health – promotion of integrated nutrient management in hilly areas prone to soil erosion: Coverage: 2500 ha.	-do	4.0	H	Horticulture mission		NDC - 6
6	Managing emerging pests and disease management-Integrated pests and disease management. Coverage: 2500 ha	-do	4.0	VH			
7	Developing disease prevalence maps and tracking the same across the years in the entire State Developing disease forecasting systems and disseminating it to farmers through SMS and other media	-do	0.25	VH			Goal - 13
8	Treat micro water sheds for soil and water conservation (16 thousand ha) in hilly Jhum areas	Department of soil and water conservation	20.00	VH			Goal – 15
9	Develop and propagate weather indexed crop insurance	-do- with insurance agency	1.00	VH			INDC-6

10	Farmers training on climate change adaptation and disaster risk reduction packages of practices for different agroclimatic zones	ASDMA with Directorate of Horticulture	2.00	H			Goal – 13 INDC-6
	TOTAL		82.8				

Source: SAPCC

11.4 MONITORING AND VERIFICATION

To ensure the regular progress on the action plan on climate change, some verifiable indicators have been identified and are being given below:

Monitoring area	Short term indicators	Medium Term indicators	Long term indicators
Climate resilient horticulture crops	Indigenous thermal and water stress resistant varieties of horticulture crops identified and being promoted	%age increase in area under climate resilient horticulture crop varieties	%age increase in area under climate resilient horticulture crop varieties
Weather indexed crop insurance	Weather indexed crop insurance initiated; Area under drip and sprinkler irrigation system; Farmers being benefitted under weather linked crop insurance	% increase in weather indexed crops; %age increase in area under drip and sprinkler irrigation system; Farmers being benefitted under weather linked crop insurance	% increase in weather indexed crops; %age increase in area under drip and sprinkler irrigation system; Farmers being benefitted under weather linked crop insurance
Economic returns from horticulture crops (should be minimum)	Horticulture crops current and potential value suitable to agro-climatic zone identified and disbursed for adoption	%age increase in returns from horticulture crops	%age increase in returns from horticulture crops
Capacity building of farmers	Male and female farmers are trained in CC adaptation and DRR packages	%age increase in farmers trained	%age increase in farmers trained
Land restoration and management	Current area affected by jhoom treated with watershed management	%age decrease in land affected by jhoom	%age decrease in land affected by jhoom

13. Assam Tea

12.1 STATUS

The undulating physiography, subtropical climate with hot, humid summers, severe monsoons and mild winters, high soil fertility and preferential climatic conditions is conducive to production of tea in Assam. It was in 1823, when the tree plants were discovered growing in wild in Assam. By the 1839, a new company, Assam Company was formed to takeover control and management of tea production from East India Company. This makes the tea industry the oldest about 180 years old industry in the State.

Tea gardens cover an area of 307.08³⁶ thousand ha (See Figure 14) for distribution of tea growing area in Assam). Assam is one of most globally important tea-producing regions of world manufacturing high-end graded tea which contributes to around 17% of world tea. Assam produces annually more than 50% of India's total tea production. In 2017-18 the production of tea in Assam was around 676.31 million kgs out of the total tea production of 1325.05 M Kgs across the country. Out of the total tea production in the Assam, significant component (391.07 M Kg or 57.8%) was produced by the organized sector and rest about 285 M kg was produced by the small growers.

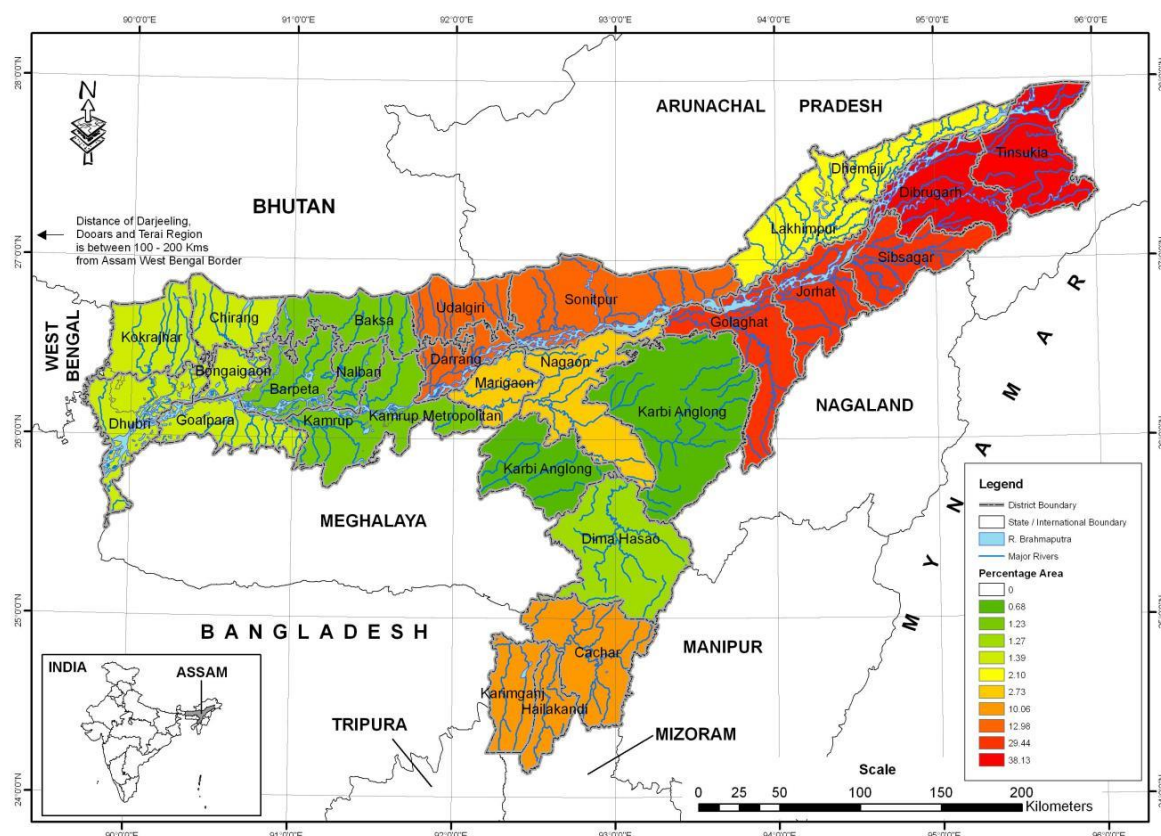


FIGURE 17: DISTRIBUTION OF TEA PRODUCTION IN ASSAM (SOURCE: [HTTPS://TEACLIMATE.COM/GROWING-TEA-IN-ASSAM/](https://teacclimate.com/growing-tea-in-assam/))

³⁶ As on 31.12.2015 according to Tea board document

http://www.teaboard.gov.in/pdf/Area_Production_2015_16_pdf4832.pdf

The tea industry has a major economic importance in this region. Around 7 lakh persons are employed in the tea industry in Assam. Approximately 75% of tea crops are cultivated in plantations and 25% through smallholder plots. Large-scale monoculture tea plantations (also called estates or gardens) generally supply commercial cultivation. Contrastingly, local-scale smallholder production is traditionally used to supplement subsistence agriculture. In the context of economic growth and development both these activities hold importance.

12.2 TEA BOARD OF INDIA

Tea is one of the industries, which by an Act of Parliament comes under the control of the Union Govt. The present Tea Board is functioning as a statutory body of the Central Government under the Ministry of Commerce and is reconstituted every three years. The Board is constituted of 31 members (including Chairman) drawn from Members of Parliament, tea producers, tea traders, tea brokers, consumers, and representatives of Governments from the principal tea producing states and trade unions.

Following are the major functions of the Tea Board

- Aiding Research and Development activities for augmentation of tea production and improvement of tea quality
- Rendering financial and technical assistance for cultivation, manufacture and marketing of tea
- Export Promotion
- Extend financial assistance in a limited way to the plantation workers and their wards through labour welfare schemes.

The relationship between tea yield and climatic factors implies that long-term climate change will impact the key physiological and developmental processes that determine the yield of tea.

12.3 CLIMATE CHANGE AND TEA PRODUCTION

Tea is a rain-fed perennial crop. The eco-physiology of tea plants is closely linked to external environmental and climatic factors (elevation, precipitation, temperature, soil moisture, temperature and fertility, light duration and intensity, humidity, shelter, shade and CO₂ concentration) and any adversity in these conditions can significantly impact yield, revenue and livelihood security. The tea bush grows in a specific climatic niche.

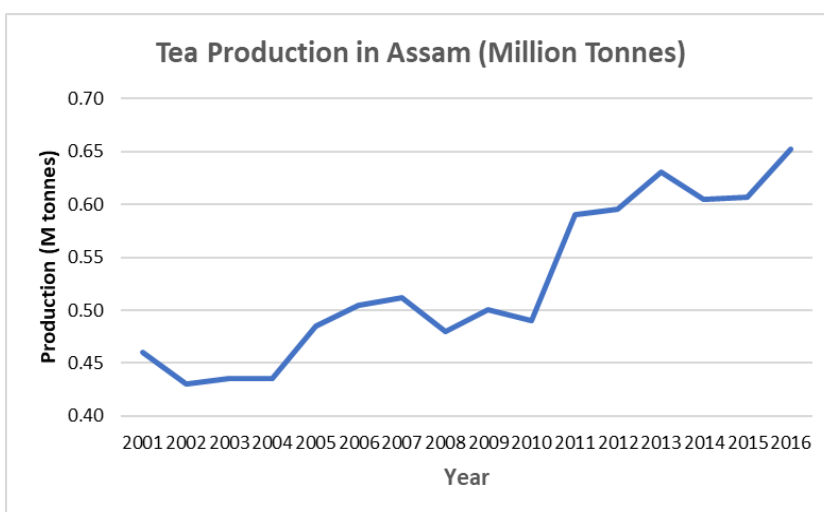


FIGURE 18: TEA PRODUCTION IN ASSAM

The relationship between tea yield and climatic factors implies that long-term climate change will impact the key physiological and developmental processes that determine the yield of tea. This makes the tea industry vulnerable to climatic variability and climate change. Given the importance of the tea crop to the economy in northeast India, understanding its sensitivity to climatic variation is of paramount importance.

However, due to organized industry, its growth and considering the consistently increasing demand, it provides a considerable safer option to farmers. On the other hand, due to increased climatic variability, planters are using the micro irrigation options despite it being a rainfed crop.

Increase in the attack of insects/pests and diseases have also been observed in recent times. The overall impact and associated future risks of climate change on the tea industry needs to be studied. As of now, climate change stresses have not affected the tea production level. The cost of cultivation has slightly increased due to use of micro irrigation systems and measures have been undertaken to control the insects/pests and diseases attack.

In addition, use of pesticides/and other chemicals also reduce the export potential of the tea due to stringent norms applicable in several importer countries. The total production has an increasing trend due to small growers, who are moving towards the tea production. In this context, it is important to understand the possible climatic variations and climate change impact on the tea industry to offset the possible negative impact on large number of small growers, in case of extreme climatic conditions/ other extreme impacts on the tea industry who do not have the capacity to build climate resilient on their own.

Future projections of production due to climate change: Modelling results indicate that tea yields in north-east India are expected to decline by up to 40 per cent by 2050 due to climate change³². As yield is directly associated with revenue, changing climate is also likely to impact economic structures of those reliant on tea, particularly the smallholders given their increased vulnerability to changes in the system. Poverty is a major social challenge in Assam and with the majority of the population reliant on rural livelihoods, socioeconomic changes in the tea industry, driven by changes in enviro-climatic factors, will have a severe adverse impact on livelihood security.

12.4 KEY ISSUES

The total tea production in Assam is having increasing trend. But the main cause of the increasing production is the increasing number of small growers moving in. In addition, climatic variability is also causing the cost of production of the tea. As models revealed that the production might reduce by 40% by 2050, the future of number of small growers is on stake. As per the production levels of 2017-18, 42.2% of the production was from small growers, reflecting a good chunk is being produced by this section. This, at one side increases the number of growers, dependent on this industry, on the other hand, need of management of large number of farmers and ensuring optimum production/productivity levels has also increased.

12.5 STRATEGY

The tea production needs to be done on scientific basis using technological tools available to take up the appropriate measures. Future risks and current crop requirements need to be taken care of. The specific action points are being given below:

TABLE 18: STRATEGIES FOR SUSTAINABILITY TEA IN A CHANGING CLIMATE SCENARIO

S. N.	Strategy Horticulture;	Responsible Agency	Budget (INR Cr)	Priority	Source of Funding	Remarks	Relevant SDGs/INDC
1	Real time remote-sensing based soil moisture mapping to help in crop planning along with validation at field level; Coverage: All Tea growing areas	Tea Board	10.00	VH	ISRO/Tea Board/	Ongoing	Goal - 13

2	Assessing soil carbon across all tea Stations.	Tea Board	10.00	VH	Tea Cess	Costing changed	
3	Identifying, procuring and broadcasting thermal and water stress resistant tea varieties,	Tea Board	10.00	VH	Tea Research Station		Goal – 8
4	Dissemination of water efficient technologies – sprinkler and drop irrigation Coverage: small holders in 1/4th of area under small holders	Tea Board	10.00	VH	Tea Cess		Goal – 13 NDC – 8
5	Creating water harvesting structures for small tea growers	Tea Board	15	VH	Tea Cess	Ongoing	Goal – 8
6	Developing pest and disease forecasting systems for tea related pests and planters	Tea Board	2.50	VH			Goal – 13 NDC – 8
	TOTAL		88.00				

Source: Assam SAPCC

Following are recommended

1. Weather stations for all necessary critical parameters (Humidity, soil quality, PH, SOC etc) per unit tea garden at least 100 more are needed
2. Robust Forecasting systems at high resolution
3. Popularising climate adaptable clones- TRA has carried out an experiment where already 15 TRA released clones have been tested and their response to its impacts on quality, elevated temperature and CO2 sequestration has been studied and they have screened out some clones which show good response under elevated conditions. Thus, those clones should be recommended further
4. Replacement of energy inefficient machinery with more efficient machines example: diesel powered motors to electricity
5. Soil moisture map has stopped but this should be a priority
6. Integrated robust decision support system for tea garden management (integrated surface data + climate data MIS+GIS)
7. Implementation of UAV for tea estate management

12.6 MONITORING AND VERIFICATION

To ensure the regular progress on the action plan on climate change, some verifiable indicators have been identified and are being given below:

Short term indicators	Medium Term indicators	Long term indicators
Soil carbon testing system for all tea stations established and functioning	Real time remote sensing/GIS based soil moisture mapping system established to facilitate the tea growers to adopt better management practices	Area under tea plantation, which is being benefitted by the information available
Water and thermal stress varieties of tea are identified/ developed and are being promoted	Pest and disease forecasting system established, and farmers are taking benefits of it	Area covered under the thermal and water stress tolerant varieties
Water harvesting structures are planned where required and possible	Water harvesting structures completed as per the plan	

14. Animal Husbandry and Dairying

13.1 STATUS

Although cereals dominate the cropping pattern, livestock and poultry are considered as one of the important homestead activities in the farm households of Assam. Livestock and poultry, as a source of milk, meat, egg, manure, draught and transportation form an integral part of rural farming system in Assam. Livestock and poultry sector have immense contribution toward rural household economy, employment, food and nutritional security. The contribution of livestock sector to GSDP is estimated at 7.7%, only second to crop agriculture. Assam contributes 3.83% and 3.73% to the total livestock and poultry population of the country. Assam has the largest pig population in the country accounting for 15.89% of the country's total pig population. In addition, Assam is among few states, where the livestock population is increased in the 19th Census as compared to the previous census in 2007³⁷.

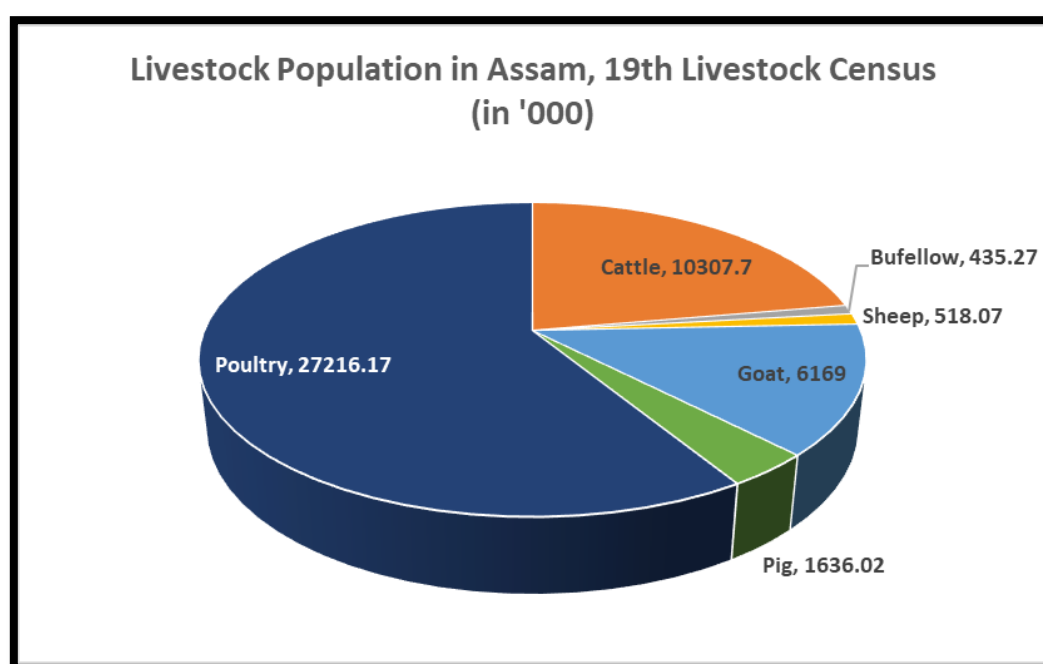
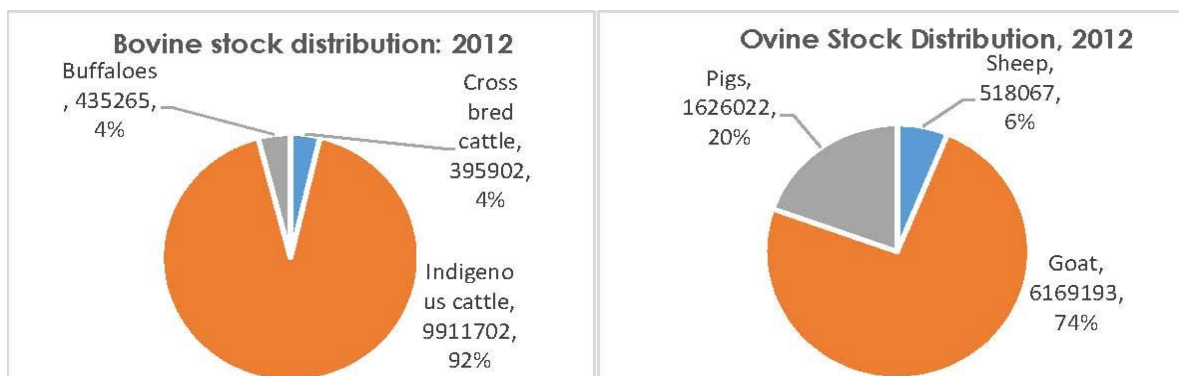


FIGURE 19: LIVESTOCK POPULATION IN ASSAM (SOURCE: 19TH LIVESTOCK CENSUS, 2012)

The bovine stock comprising sheep and goat have registered very high growth rates (about 43%) between 2007 and 2012. The number of cattle between the both censuses increased by 1.91%, and number of buffalo and number of exotic /cross bred cattle population decreased by 12.93% and 3.55% respectively. However, during this period the milk production increased by more than 6% as per NDDDB records. The distribution of bovine population and the milk production trend is being given below:

³⁷ Borah, Monisha; Halim, RA: Dynamics of livestock and poultry sector in Assam: A critical Analysis, Economic Affairs: Vol. 59 Special Issue: 773-782: 2014



The population of bovine stock comprising of cattle and buffaloes were 10.3 million in 2012 in Assam. 2012 Assam produced 8 million tons of milk in 2012. As per the Economic Survey of Assam, 2015-16.

Per person milk the per capita consumption in the state is only 71g per day per person which is about 1/3rd of the recommendation of ICMR which 208g/day is.

13.2 KEY ISSUES

BREEDS

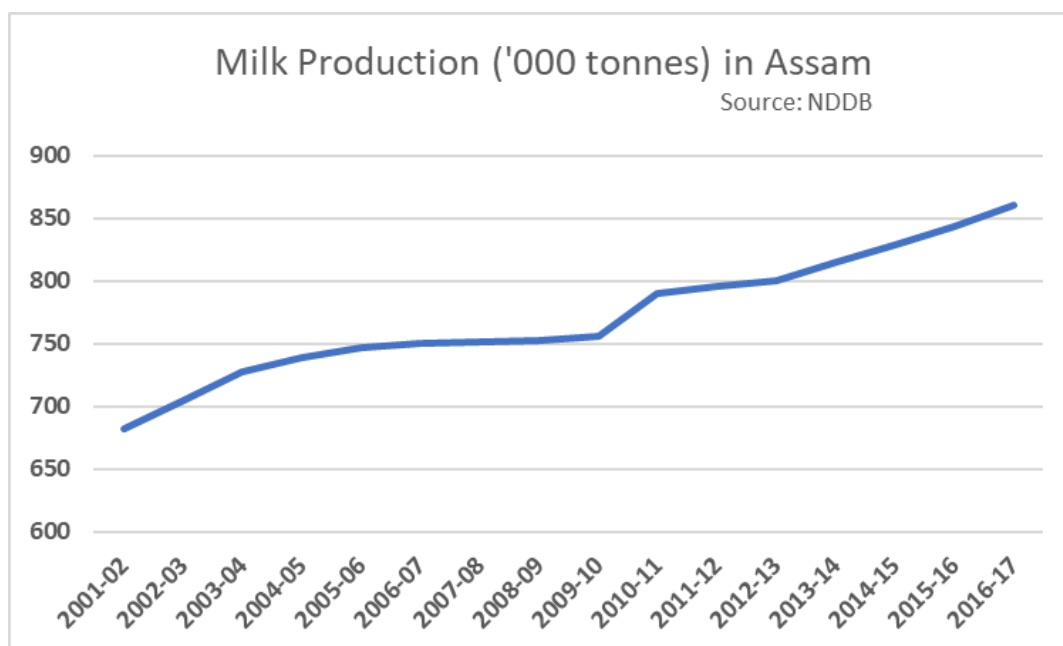


FIGURE 20: BOVINE & OVINE POPULATION IN ASSAM AND MILK PRODUCTION

Assam does not have any economically important breeds of livestock except the indigenous bullock on which most of the agricultural operations depend. The indigenous cows are of poor reproductive efficiency. Most of the breeds of livestock are native to Assam. Efforts are necessary to upgrade the indigenous cattle, goat and pigs through infusion of exotic/Indian breeds of cattle, goat and pigs. There are lakhs of crossbred cattle (Jersey x local) in Assam, which is a negligible proportion of the total cattle population. The buffaloes in Assam are mostly of swamp type. Male buffaloes are used for cultivation of paddy, drawing carts and logs of timber. Swamp buffaloes are poor in milk

production and are good source of buffalo meat production, but this has not yet been exploited commercially. Goat is very popular all over the state. It adapts quickly to harsh environment and has high reproductive efficiency, fair milk yield and excellent meat quality. Pigs are reared predominantly by the tribal and pork meat is popular. The 'desi' pigs are poor in productive and reproductive efficiency. There is tremendous scope of improvement of this 'desi' pigs by crossing with exotic pigs like Hampshire, Berkshire etc. in the region.

LIVESTOCK REARING

In rural areas, normally, traditional livestock rearing, and management is followed. The animals are let open during day time to graze in open. In evening they are put under the animal-shed prepared locally with local materials. The design and construction of the animal-sheds has a significant potential of improvement from the management perspective. Due to increasing population, the grazing fields are being eliminated even in rural areas, this again calls for improving the livestock management.

PER CAPITA LIVESTOCK PRODUCTS

As mentioned earlier, the per capita milk availability in Assam is only 71gm/ per day against the Indian average of 355 gm/per day per person (2016-17), as per the data of NDDB. Per capita egg availability in Assam is only 15 eggs per year per person, against the country average of 58 eggs per year (2012-13). Meat availability per capita is about 930 gm (2012) against the ICMR recommendation of about 10.8 kg per person per year. This quantum of availability, in Assam, despite having a good livestock population, calls for breed improvement for production enhancement.

Reduced availability of the fodder due to high pressure on the productive land, higher temperatures due to GHG emissions are expected to cause the reduced weight gain, reproductive efficiencies and lower feed conversion efficiencies resulting into reduced livestock production. On the other hand, reduced agriculture production may lead to higher demand of animal proteins.

13.3 STRATEGIES

Genetic improvement of the indigenous non-descript animals through crossbreeding with superior germplasm is the most important aspect, which need to be focussed. To promote stall feeding and to provide the facility to small farmers, scientifically designed community cattle-shed also need to be promoted, disease forecasting system, weather-based insurance index to compensate loss in milk yield will also be developed. Considering, the dung also contributes to GHG emissions, alternative use of dung is also a priority. The following strategies should allocate at least 25-30% of overall budget targeted towards women and account for it as a regular monitoring process. Specific action plans are being given below:

TABLE 19: STRATEGIES TO ADDRESS THE LIVESTOCK RELATED ISSUES

S. N.	Strategy Livestock	Responsible Department	Budget (INR Cr)	Priority	Source of funding	Remarks	Relevant SDG/INDC
1	Grading up of local cattle and buffalo stock with suitable high milk yielding Indian indigenous varieties such as Murrah/Sahiwal through Artificial Insemination-Cover at least 13 districts Assam, including remote districts	Animal Husbandry	10.00	VH	GoA, ICAR, Multilateral funding		Goal – 2 Goal- 13
2	Undertake Anoestrus management in buffalos simultaneously in the above chosen districts	Animal Husbandry	10.00	VH	GoA, ICAR, Multilateral		
3	Creation of gene bank for conservation of threatened breeds (Five)	Animal Husbandry	5.00				
4	Establish scientifically designed community-based shelters in all 219 blocks to accommodate at least 300 cattle of small and marginal farmers-with plantations around for reducing temperature of the surrounding microclimate, and water harvesting structure	Animal Husbandry	21.90	VH	Rashtriya Gokul Mission		Goal – 13
5	Harness energy from dung and produce 1000 cum of biogas in each of the 219 blocks	Animal Husbandry	219.00	H	Entrepreneur based		Goal – 12
6	Undertake fodder cultivation using hydroponic technique-in the shelters in 219 blocks	Animal Husbandry	10.95	VH	ICAR/Entrepreneur		

7	Develop and propagate Weather indexed insurance for loss in milk yield due to heat stress. Coverage: All crossbred and genetically upgraded indigenous cattle and buffalo in 219 blocks	Animal Husbandry	5.00	VH	AHD, Insurance company, Any other		Goal – 13
8	Develop disease forecasting system	Animal Husbandry	1.00	VH	AHD		Goal – 13
9	Disease Management – vaccination, fumigation etc.	Animal Husbandry	233.68	VH	AHD		
10	Disease diagnostic (DDL) (Contractual Doctor, TA and other recurring expenses) in 33 districts	Animal Husbandry	99.00	H	AHD	Costing changed	
11	Training / capacity building of technical and nontechnical male and demale personnel on adaptation to climate change and relevant technologies-219 blocks	Animal Husbandry	21.90	VH	AHD		Goal – 13
12	Safe, quick and effective transfer of milk from producer to chilling plants to avoid spoilage of milk in all 33 districts	Dairy Development	180	VH	Revised, Costing changed		
13	Establishment of new and refurbishment of existing Milk collection Centres with required technical infrastructure in all 33 districts	Dairy Development	60	VH			
14	Setting up of chilling plants to stop bacterial growth at higher temperatures in all 33 districts	Dairy Development	140	VH			
15	Capacity Building of Dairy farmers in all 33 districts on - Scientific dairy cow management - Improved milk hygiene and quality	Dairy Development	40	VH		revised	

	• Transfer and practice of quality milk production • Capacity building of farmers on climate change adaptation						
16	Develop and disseminate package of practices amongst farmers for mitigating disaster risk reduction such as during floods and droughts (in all 33 districts)	Animal husbandry and dairy development	33.00	VH			Goal – 2
	TOTAL		1090.43				

Source: Assam SAPCC

13.4 MONITORING AND VERIFICATION

To ensure the regular progress on the action plan on climate change, some verifiable indicators have been identified and are being given below:

TABLE 20: MONITORING AND VERIFICATION INDICATORS TO TRACK THE PROGRESS OF LIVESTOCK RELATED ACTIONS

Short term indicators	Medium Term indicators	Long term indicators
Breed improvement facilities are scaled in at least 13 districts including remote districts	% of low yielding cattle (against the benchmark) become the part of breed improvement programme	Drop in % age of livestock affected from different disease from the benchmark
Scientific and customized designs available for cattle shed for adoption by individuals and communities	Gene bank established for protection of threatened breeds	Increase in milk yield as compared to the benchmark
Design of Biogas plants design for harvesting the energy from dung Is available	Minimum 3 community cattle sheds are constructed in each of the 219 Blocks	Rank of milk yield of the State against rest of the states in the country
Disease forecasting system for livestock in place	Disease forecasting system actively feeding disease management and vaccination	Rank of the meat production and meat productivity against other states
Benchmark studies completed to understand the % of livestock affected by different diseases, livestock with low yielding breeds etc	% of milk produced, which is being distributed through cold chain	
	Contractual doctors and other requirements to control diseases are available in all 33 districts	

15. Fisheries

14.1 STATUS

Assam is majorly a fish consuming state. About 95% of population of the state consumes fish. Thus, it has large demand of fish. According to estimates, total demand of the state for the fish in a year is about 3.36 lakh tonnes. Even though there is significant jump in fish production since 2008 to 2017, but still there is enough gap between the production and demand, which, currently is being bridged by the import of fish from other States. Though the North-east region as well as the Assam is well endowed by the water bodies, but these are not being used at full potential, especially in case of fisheries production. Currently, 86% of local fish requirement of north east is met by local production.

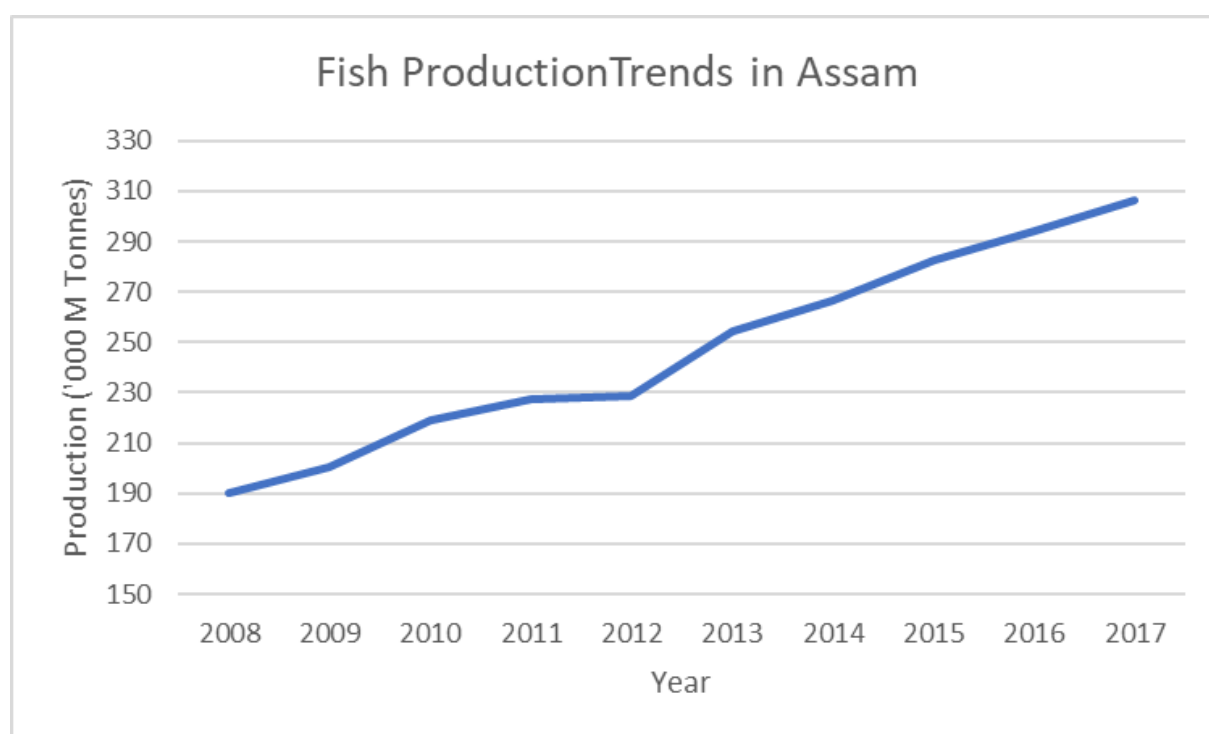


FIGURE 21: FISH PRODUCTION IN ASSAM WITH TIME

(Source: <https://www.statista.com/statistics/735842/fish-production-volume-assam-india/>)

In general, the alignment with the SDG and NDC has already been covered. Out of the 17 SDG Goals, two Goal namely the Goal-1: No Poverty, Goal-2: Zero Hunger, Goal 6 – clean water and sanitation and Goal 14 – life below water have significant relevance in the States' fishery sector because lakhs of rural livelihoods could be created in fishery sector to minimize poverty and hunger by adopting community-based development approach in fisheries. Keeping in view the SDGs and NDCs, the Government of Assam has decided to implement the SDGs in the State with effect from 1st January 2016, and to launch an initiative titled "Assam -2030 in light of SDGs" from that date. Department of Fisheries, Government of Assam also proposes to incorporate the idea of SDGs for overall development of Fisheries Sector of Assam.

14.2 CLIMATE CHANGE AND FISHERIES

The climate change affects the temperature, humidity etc. the increased temperatures at one side provide the wider time window for breeding of fishes, thus may facilitate the increased production, however, on the other hand, the increased temperature, which may have more impacts on the

freshwater aquatics due to shallow waterbodies, dissolved oxygen in the water may reduce, which can negatively impact the fisheries production.

14.3 KEY ISSUES

Despite the continuous increase in the fish production, it is not yet able to fulfil the local demand. In addition, there is shortage of quality seeds, feed and other inputs required for fisheries. Seed production and rearing infrastructure is also not available in enough capacity. Non-availability of credit facilities, poor species diversification etc are a few of the important issues.

14.4 STRATEGIES

The Department is promoting the culture-based fisheries in ponds and tanks, wastelands/beels etc. Understand and document the status of the current water bodies and conservation/restoration of natural/existing water resources, capacity building of stakeholder is among the few strategies, which are adopted for promotion of fisheries in context of climate change and in light of the SDGs and INDCs. Specific action points are being given below:

TABLE 21: STRATEGIES FOR SUSTAINING FISH PRODUCTION IN ASSAM IN A CHANGING CLIMATE CONTEXT

S. N.	Strategy	Responsible Dept	Estimated Cost (INR Cr)	Priority	Source of Funding	Remarks	Relevant SDG/INDC
1	Creation of up-to-date state level GIS based database on water and fish & fishery resources; water resources and their potential users (data accessible for each gender)	Dept of Fisheries	15.00	VH	State Fund-work to be done by research Institutions	Costing changed	
2	Restoration of natural fish breeding and feeding grounds	Dept of Fisheries				Revised	Goal – 2
	Establishment of small and medium size feed mills (one each in all 33 Districts)	Dept of Fisheries	33.00	H		Costing changed	
	natural water resources - Demarcation, de-silting and removal of aquatic weed of beels and their connecting channels		200.00	VH		Costing changed	
3	Productivity enhancement and utilization of potential areas	Dept of Fisheries				Revised	Goal – 2 Goal – 8
	-Pen/cage culture for production of fish and fish		45.00	M			
	fingerlings -Introduction of re-Circulatory water management system for fish production		25.00	M			
	period production system -Fish stock enhancement of the closed natural water bodies with dominant species (10.000 ha)		10.00	H			
	Construction of new ponds in low lying areas. Two each in all 219 blocks	Dept of Fisheries	1.75	H			
	Large-scale adoption of integrated fish farming in potential areas such as paddy-cum-fish culture in low-lying areas and pig-cum-fish culture in pig rearing belts in existing ponds on cluster basis and	Dept of Fisheries	0.25	H	NABARD, DoF		

	(five each in 10 Districts)						
4	Availing Quality fish seed available	Dept of				Revised, Costing changed	Goal – 8
	-Brood fish farm, one in each 27 district -Construction of fish seed	Fisheries	2.60	H			
	Establishment of fish seed hatcheries @ 10 million fry production capacity, both in private and government sector (33 no., one each in all districts)	Dept of Fisheries	9.00	L			
	-Replenishment of brood fish		0.10	M			
	from brood farms in the		0.10	H			
	hatcheries (100 no.) -Development of seed rearing areas (500 ha) - Strict implementation of legal provisions		0.10	VH			
5	Conservation of indigenous fish species -Cataloguing and year wise updating of indigenous	Dept of Fisheries	0.10			Costing changed	Goal – 2 INDC – 1
	aquatic flora and fauna along with conservation Status -Ecosystem based		1.00	VH			
	conservation of threatened species and indigenous		2.00	H			
	species and riverine system - Declaring parts of beels as		0.10	M			
	protected areas (1000 beels) - Declaring closed seasons in natural waters -Establishment of State level gene banks in lower, upper,		0.40	H		Costing changed	
	central Assam and in Barak valley (4 nos) - Preparedness/precautionary measures for probable disease outbreak (26 districts)		1.30	VH		Costing changed	
5	Reclamation of ponds and beels wherever possible (5000 ha)	Dept of Fisheries	50.00				Goal – 13
	Rain water Harvesting at HH level for small tank fisheries especially in hilly areas (5000 HH)	Dept of Fisheries	25.00	H			
6	Developing customised packages of practices for male and female farmers to sustain their production in a climate change context	Dept of Fisheries	2.00	VH			
7	Develop and disseminate weather indexed insurance for fisheries sector-to benefit small and marginal male and female farmers and link it to disaster risk reduction	Dept of Fisheries. ASDMA, Insurance agency	0.50	VH			Goal – 13
8	Community mobilisation for embracing State of the Art package of practices	Dept of Fisheries	0.60	VH			Goal – 13 NDC – 8
9	Establish block level kiosks for fishery related information dissemination including SMS	Dept of Fisheries	10.05	VH			

10	Climate change Cell in department of Fisheries -Will develop road map to deal with CC, -MIS, Data management, -launching studies for strategic knowledge, - developing IEC material, - imparting training for capacity building – staff, farmers; seminars and workshops)	Dept of Fisheries	1.77	VH			Goal – 13 NDC – 8
	TOTAL		436.72				

Source: Assam SAPCC

14.5 MONITORING AND VERIFICATION

To ensure the regular progress on the action plan on climate change, some verifiable indicators have been identified and are being given below:

Short term indicators	Medium Term indicators	Long term indicators
GIS based web enabled database (data segregated for all genders) prepared and available to be used for better planning and investing resources	Potential areas are being restored/prepared/constructed for fish breeding in planned way	Large scale Integrated fish farming is being adopted by fish farmers
Potential for fish breeding identified, in terms of new waterbodies, existing waterbodies, appropriate fish species etc	Large scale integrated fish farming initiated as demonstration purpose in 10 districts	The rank of Assam in fish production against the states in the country
Sources of quality fish seeds identified and prepared within state	Production of indigenous fish is increased by how much % as compared to benchmark	% of local need fulfilled by the local production/ % of export market captured by the fish sourced from Assam
Climate change cell constituted and functioning in the Agriculture/fisheries department		

16. Forests and Biodiversity

15.1 BACKGROUND

As per the assessment of forest cover in 2017 (India State of Forest Report, 2017), the out of total geographical area of 78,438 sq km, total forest cover is 28,105 sq km which consists about 85.8% of total geographical area, however majority of it (15,116 sq km) is under the category of other forest, very dense forest are only 2797 sq km. Rest 10,192 sq km is the moderately dense forests. Despite the total forest cover is just above 33%, the dense and moderately dense forest, together, are only 17%. The above forest cover is further endangered due to the climate change. State climate change actions need to address the concern. It can be observed that the most important component from the carbon sequestration perspective is very dense forest, which is very small component (<10%) of whole forest cover and only 4% of the total geographical area of the state.

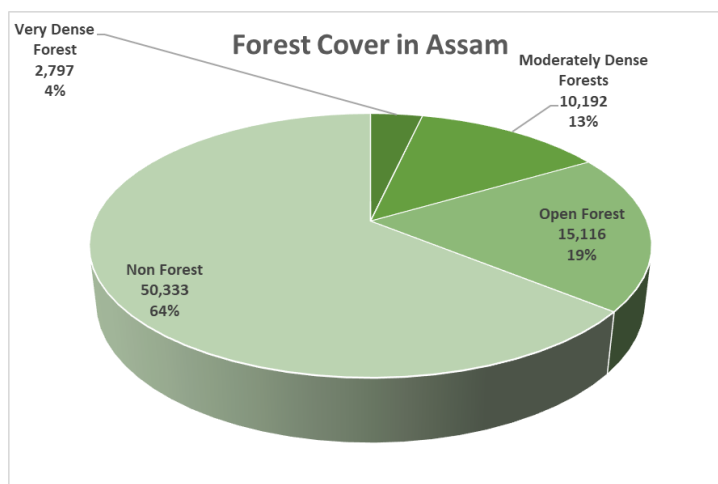


FIGURE 22: AREA UNDER FOREST COVER IN ASSAM

Source: India State of Forest Report 2017

Simultaneously, the state climate change action needs also to be aligned with the relevant SDG goals and INDC commitments. Following are the SDGs and INDCs, relevant to the forests:

15.2 SDGS AND INDCS RELEVANT TO FORESTS AND BIODIVERSITY

TABLE 22: SDGs AND INDCs, RELEVANT TO THE FORESTS AND BIODIVERSITY

S No	Description	Relevant focus
1	Goal 15 Life on Land	Conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands; maintaining the biodiversity, mobilizing resources for forest management; sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation
2	Goal 6 Clean Water and Sanitation	Restoring water-related ecosystem including forests, wet lands, rivers, aquifers and lakes
3	Goal 12 Responsible Consumption and production	Sustainable management and efficient use of natural resources;
4	Goal 13 Climate Action	Combating climate change and its impacts; strengthening resilience and adaptive capacities; mainstreaming climate measure in national policies; improving education and awareness about CC; building capacities of individuals and institutions

	NDC	
1	NDC 5	Creating additional carbon sink through additional forest and tree cover
2	NDC 6	To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change,
3	NDC 1	To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation.

Programmes and schemes of forest sector to achieve adaptation goals of NDC:
Green India Mission (GIM)

GIM was launched in February 2014 aimed at protecting, restoring and enhancing India's diminishing forest cover and responding to climate change by a combination of adaptation and mitigation measures. The goals of the mission are:

- To increase forest/tree covers to the extent of 5 million hectares (mha) and improve quality of forest/tree cover on another 5 mha of forest/non-forest lands; Separate sub-targets exists for different forest types and ecosystems (eg. Wetland, grassland, dense forest etc.).
- To improve/enhance eco-system services like carbon sequestration and storage (in forests and other ecosystems), hydrological services and biodiversity; along with provisioning services like fuel, fodder, and timber and non-timber forest produces (Minor forest produces or MFPs) etc which are expected to result from the treatment of 10 m ha
- To increase forest-based livelihood income for about 3 million households in and around these forest areas
- Enhanced annual CO₂ sequestration by 50 to 60 million tonnes in the year 2020.

National Afforestation Programme

National Afforestation Programme (NAP) was initiated as per the 10th Plan document. NAP is being operated as a 100% Central Sector Scheme. The overall objective of the scheme is to develop the forest resources with people's participation, with focus on improvement in livelihoods of the forest-fringe communities, especially the poor. NAP Scheme aims to support and accelerate the on-going process of devolving forest protection, management and development functions to decentralized institutions of Joint Forest Management Committee (JFMC) at the village level, and Forest Development Agency (FDA) at the forest division level.

15.3 STATUS

Assam is a part of Biodiversity Hotspot exhibiting rich floral and faunal diversity. Apart from an elaborate network of Protected Areas (PA) i.e. National Parks and Sanctuaries, the State also has two World Heritage Sites, a Ramsar Site, two Biosphere Reserve and most importantly, the only thriving population of Asiatic one-horned Rhino in the world. As indicator of natural resource sustainability, water body coverage of 87 sq km area has been observed to be increased water within forests between 2005 and 2015. The total area under waterbody in 2015 has been observed to be 387 sq km within forest areas.

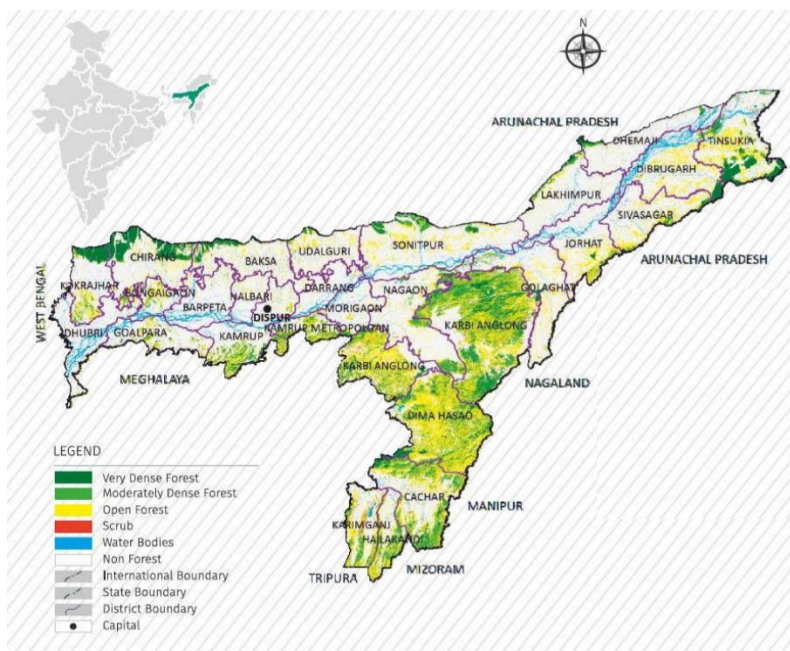


FIGURE 23: GEOGRAPHICAL DISTRIBUTION OF FORESTS IN ASSAM (SOURCE: INDIA STATE OF FOREST REPORT 2017)

Apart from providing a variety of products for daily needs, such as, firewood, fodders, medicinal plants, bamboos, fruits, essential oils and so on, the forest also are the recharge zone of rain water in the spring sheds in the mountain/hilly areas. Further, they also provide livelihood opportunities to over a million people in the State, who trade in various timber and non-timber products.

Forests are home to biodiversity, including some very rare, threatened and endemic species. It is believed that several of the commercial crops, such as

paddy, tea and lemon originated from wild stock of these forests. A good number of species/varieties of these wild-stock still flourish in Assam.

However, currently, the forest area in the state is suffering from habitat degradation, encroachments, fuel wood extraction etc. This is especially occurring in northern hilly areas bordering Arunachal Pradesh, in the eastern hilly areas bordering Nagaland, and along the south western hilly areas bordering Meghalaya. This is becoming a double jeopardy for wildlife, their home-range is depleted and conflicts with man are on the rise. Plantation raised in degraded areas, especially in the Jhum areas, face immense biotic pressures. Cattle grazing and removal of saplings as fodder and fuel pose serious threat to natural as well as assisted regeneration in the forest areas. Productivity of the forests is rapidly decreasing, thus, eroding sustainability of yield. However, dependencies on forests are on the rise. There is not much diversification in livelihood options for the forest-dwellers or fringe-dwellers.

15.4 CLIMATE CHANGE AND FORESTS

Model projections: Projections into the future using IBIS model run with climate inputs derived from regional climate model PRECIS with the IPCC A1B scenario, further point towards increase in vulnerability in 2050s in the areas that are currently vulnerable, i.e. hilly areas bordering Arunachal, Nagaland and Meghalaya. Though uncertainties are associated with these projections, but can be used as indicative directions in which things are likely to move.

Extreme Rainfall in Hilly areas: Extreme rain fall events are likely to lead to heavier run off along the hills, thus the potential ground water recharge in the spring sheds is likely to reduce, along with heavy soil erosion.

Longer Dry periods: With longer drought periods, biodiversity- both floral and faunal are likely to be affected and forest fires may become the norm, with increasing man-animal conflict. Thus, affecting

the various types of timber and NTFP produce and hence the livelihood of the people dependent on the same. This situation calls for anticipatory actions beyond the business-as-usual approach.

The Forestry component of the State Action Plan for Climate Change (SAPCC) has been so designed as to effectively mitigate climatic changes and adapt to new situations, for maintaining a healthy and productive human-environment interface. Further, women are disadvantaged by insecure access and property rights to forest, tree and land resources, by discrimination and male bias in service provisions like credit and technology, and by being excluded from policy formulation and decision making at the household, community and national levels. Women realize only a fraction of the benefits and tend to be involved in decision making only when forest and tree resources are already degraded. Moreover, women's lack of formal education, employment and personal networks inhibits their ability to influence resource allocation or research. The forestry strategy component of the SAPCC should also allocation at least 40-45% of the overall resources targeted towards women and account for the same to address the inherent barriers faced by women.

15.5 STRATEGIES

Keeping in view the Green India mission and the vulnerability of the State, the strategies thus focus on:

- Reducing Degradation and Deforestation;
- Improving carbon sequestering capacities of forests by
 - Improving the area under Very Dense Forest (VDF) and also Moderately Dense Forest (MDF)
 - Improving resilience of wildlife
 - Empowering local communities to take charge and benefit from biological diversity
 - Improving adaptability of forestry-ecosystems and dependent communities through research, innovations and use of appropriate technologies

This is in line with the Green India mission, which aims to protect, restore and enhance India's depleting forest resources through increase forest/tree cover; improve/enhance eco-system services like carbon sequestration and storage (in forests and other ecosystems), hydrological services and biodiversity; along with provisioning services like fuel, fodder, and timber and non-timber forest produces (NTFPs); and increase forest-based livelihood income of about 3 million households.

Specific action points are being given below:

TABLE 23: STRATEGIES FOR ADDRESSING THE FOREST RELATED ISSUES

S. N.	Strategies: Forests	Department Responsible	Costs (INR CR)	Priority	Sources of Fund	Remarks	Relevant SDG/INDC
1	Reducing degradation of forests by closure of areas with promising regeneration and root-stock of natural species (Secured ANR); 4000 ha	Dept. of Forests	70.00	VH	GIM		Goal – 15 NDC – 5
2	Instituting studies for identifying the causes for forest cover degradation like creepers or water table depletion or other reasons and strategies for addressing the same	Dept. of Forests	5.00	VH	GIM		

3	Improving density of cover to upgrade forest areas - Moderately Dense Forest and Open forests (artificial regeneration with fencing); 200 blocks of 25 ha each - Moderately dense forests; 5000 ha (targeting improving area under Very Dense Forest and Moderately Dense Forest)	Dept. of Forests	120.00 62.50	VH H	GIM/ CAMPA APFBC / GIM	revised	Goal – 15 NDC – 5
4	Safeguarding against encroachment in RFs and PAs RFs - Highly sensitive areas (Inter-State borders / City RFs); 2,00,000 RM -Other sensitive areas; 2,00,000 RM PAs-Highly sensitive areas (Inter-State borders); 50,000 RM -Other sensitive areas; 1,00,000 RM	Dept. of Forests	170.00 170.00 42.50 85.00	VH H VH H	Gol / Fin. Comm. Gol CAMPA CAMPA		
5.	Building climate resilience of forest-based livelihoods-	Dept. of Forests					Goal – 13
	NTFP focused forest management to help forest-dependent communities adapt to CC through emphasis		5.00	H	GIM		
	on multiple utility species; 1000 ha -Developing Nurseries for providing quality planting material including that of Bamboo/ indigenous		3.50	H	GIM		
	Fruit trees / Medicinal Plants and other multi-utility trees; 35 nurseries of 1.5 ha		12.50	VH	APFBC		
	each-Promotion of Agro-forestry for improving livelihood: Bamboo / Fruit Trees / Medicinal Plants; 1000 ha -Skill Development of Forests communities in sunrise sectors for reducing pressure on forests; 1 lakh beneficiaries		300.00	H	GIM / APFBC		
6	Promoting alternate sources of energy for wood substitution as fuel.	Dept of Forests					
	-Energy plantations; 1500 ha-Solar Plants (8KVX3; 5 KVX5; 3 KV X10); 35 units – Bio-gas plants; 400		7.50 2.00 1.00	VH M M	GIM / APFBC GIM / Collateral GIM / Collateral		

7	Providing LPG connectivity to Forest Villagers and to fringe dwellers reducing fuel-wood dependencies; 5000	Dept of Forests	5.00	H	APFBC/ Collateral		
8	Securing identified wildlife corridors and improving their habitat status by compensating the communities for conservation; 2500	Dept of Forests	125.00	VH	GIM		
9	Procuring crucial areas surrounding Protected Areas for extended protection to threatened and endangered species (e.g. various additions to the Kaziranga NP); 300 sq. km	Dept of Forests	600.00	VH	GIM		
10	Improving Protected Area Management -Control and eradication of Invasive species -Enrichment planting, 200 -Micro-ecosystem improvement; 1000 (wetlands/ grasslands/ breeding grounds etc), 20 projects	Dept of Forests	5.00 5.00 5.00	VH H H	GIM / APFBC GIM / APFBC GIM / APFBC/GoI		
11	Intensive Management of Wetlands for achieving - Conservation of wetland biodiversity -Recharge of ground water (20) -Collateral benefits to communities (Ecotourism)	Dept of Forests	5.00 2.00 -	H H H	GIM/ APFBC/ GoI GIM/ APFBC/ GoI GIM/ APFBC/ GoI		
12	Creating Gene Banks (Ex-situ) -Conservation for Biodiversity of the State / Specimen Lab / Herbarium/Multilocation repositories of germplasm 2 central facilities and 35 site banks	Dept of Forests	11.50	M	GIM		
13	Strengthening Biodiversity Conservation Institutional Mechanism State Biodiversity Board -Mobilizing Community and developing peoples Biodiversity Registers for documenting local bio-resource diversity and associated traditional knowledge -strengthening of Biodiversity Management Committees (200 BMCs) - Awareness Generation amongst stakeholders - Documentary/TV Show/ Theatre / Workshops)	Dept of Forests	6.00 3.00	H H	GIM / GoA / NBA/APFBC GIM/ NBA/ GoA		Goal – 15
14	Conserving biodiversity in a	Dept of	0.05	VH	APFBC/		Goal – 15

	changing climate scenario - Developing State Biodiversity Strategy & Action Plan and BMC Management Plans - Biodiversity Inventory and documentation with inputs on present conservation needs - Assessment of past management practices / biotic pressures / CC for developing new strategies - Species based research on conservation needs, strategies and conservation actions	Forests	10.00	VH	GIM/ NBA		
			0.05	H	GIM		
			25.00	M	GIM / GoA		
15	Improving Tree cover outside Forest areas: Avenue, city forests, Panchayat Forests, Homestead, Gardens, Parks, Institutional lands etc	Dept of Forests	100	H	GIM	Ongoing	
16	Plantation on special / difficult sites: <i>Jhoom</i> lands for soil conservation and in <i>Char</i> areas (river islands) for preventing erosion of banks during heavy floods- Plantations / Protection -- Community participation in rehabilitation	Dept of Forests	20	H	GIM	Added	
			5	H	GIM		
17	Protection against Forest Fires specially in Hill areas - Central Monitoring Unit/Field (2 central units) - Stations/Field gears (20 field stations)	Dept of Forests	20	VH	SSS/CAMPA/CSS		
18	Integrating criteria and indicators of SFM into Working Plans	Dept of Forests	6	VH	GIM		
19	Commissioning of Preservation Plots: studies into change in vegetation is response to CC – genetic resource preservation	Dept of Forests	5	H	GIM		
20	Pilot Studies on Carbon stocking in forests: establish the protocol for measuring, reporting and verification systems for forest carbon.	Dept of Forests	10	H	GIM		
21	Vulnerability Study of Forest Ecology to Climate Change including assessment of changes in Forest Types / subtypes	Dept of Forests	100	H	GIM		Goal -13
22	Policy Review / Developing Policy: State Forest Policy, Bamboo & Cane Policy, Wetland Policy, Eco-tourism Policy	Dept of Forests	5	VH	GIM /APFBC		Goal – 13

23	Linking of Micro-plans with Working Plans	Dept of Forests	5	H	GIM		
24	Reducing carbon footprints of forestry infrastructure - Eco-friendly buildings/gadgets etc; 800	Dept of Forests	960	H	GIM/CAMPA		
25	Develop a Manual for disaster risk reduction vis-a-vis for averting - landslides in forests - for averting forest fires - for avoiding mortality of wildlife during floods	ASDMA & Dept of Forests	0.50	VH	CAMPA		Goal – 13
	TOTAL		3,100.60				

Source: Assam SAPCC

Following will be added to the action strategy after due assessing the same:

1. Climate Change has major impact on animal migration leading to increased man-wildlife conflict
2. Urban forestry for Carbon sequestration based on carbon stocking potential to prevent urban heat islands
3. Conservation of fragile biodiversity rich riverine island and chars to conservation reserve
4. Focus on capacity building for vulnerable, marginal and forest dependent communities towards climate resilience
5. Water shed management
6. Mapping of wildlife corridors and securing food using GIS and satellite technology

15.6 MONITORING AND VERIFICATION

To ensure the regular progress on the action plan on climate change, some verifiable indicators have been identified and are being given below:

TABLE 24: MONITORING AND VERIFICATION INDICATORS TO TRACK THE PROGRESS OF FOREST RELATED ACTION PLAN

Monitoring area	Short term indicators	Medium Term indicators	Long term indicators
Forest area as proportion of total land area	Identification of the areas where reforestation/afforestation need to be done	Afforestation/reforestation of degraded area	Improvement in forest cover (%of total geographical area)
Sustainable use of Forest produce	Benchmarking of the household's dependent on the forests for livelihoods and number of days of employment being received from forests. Amongst these, bench-marking women-headed households and women-dominated livelihoods	%of households using improved fuel instead of wood. Collected data will be gender-differentiated to account for improvement observed for all genders.	Upgradation of forest land (like open forest to moderate to dense forest or from moderate forest to dense forests Establishing gender-sensitive measures in forest enterprises and institutions
Proportion of important sites for terrestrial forest biodiversity	Forest biodiversity cover and hotspots identified including those that have degraded and need maintenance	% increase and restoration of terrestrial forest biodiversity	% increase and restoration of terrestrial forest biodiversity
Progress towards	% reduction in deforestation and % increase in restoration of degraded	% reduction in deforestation and % increase in restoration of	% reduction in deforestation and %

sustainable forest management	forests. Qualitative and quantitative documentation of women's contribution (financial and non-financial) in agroforestry, watershed management, tree improvement and forest protection.	degraded forests Targeted budget-allocation for women in forest-linked sectors where their contribution is the highest	increase in restoration of degraded forests Monitoring and reporting of impact of of budget-allocated to women
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17.Habitat

16.1 BACKGROUND

As per Census 2011, 86% of Assam's population lives in 26395 villages as compared to only 14% that are spread across its 214 towns⁵⁵. Other than Assam, Himachal Pradesh, Bihar and Odisha are the only other Indian States, who have less than 20% of their total population living in urban spaces. At all India level, 68.84% of the India's population lives in rural areas and 31.16% in cities. Like elsewhere, the decadal growth rate of rural population in Assam is declining. It has decreased from 17.29% in 2001 to 15.23% in 2011. Around 4.3 million of Assam's population lives in cities⁵⁷. The urban population growth rate has risen from 12.72% in 2001 to 14% in 2011.



FIGURE 24: MAJOR CITIES OF ASSAM

Guwahati, Nagaon, Dibrugarh and Silchar spread across length and breadth of Assam are the most prominent cities (see the locations in the figure alongside). Guwahati is the largest Urban agglomerate with a population of 0.9 million. As the population is rising in urban areas, multiple challenges related to the following are likely to be encountered

- drinking water availability,
- solid waste management,
- sewerage disposal,
- adequate transportation and
- Managing Human Health

In the present context examination of public service delivery in the most prominent 13 cities in Assam indicates that the public service delivery of the water supply, sewage disposal and Solid waste management (SWM) coverage is lower than the National average (see Table 11).

18. Water Supply

17.1 BACKGROUND

The region has an abundance of natural water resources. The region has 34% of total surface water of the country. The Annual average rainfall of the NE region is about 2,500 mm. The region faces a contradictory situation as monsoon months often see devastating floods, but during non-rainy season many areas face water scarcity. In hilly terrains there is not much water retention. Rain water runoff is quick and many of springs and streams dry off in non-rainy season. The region needs proper management of its rich water resources and also development of required infrastructure. One aspect of water management is providing drinking water to the population.

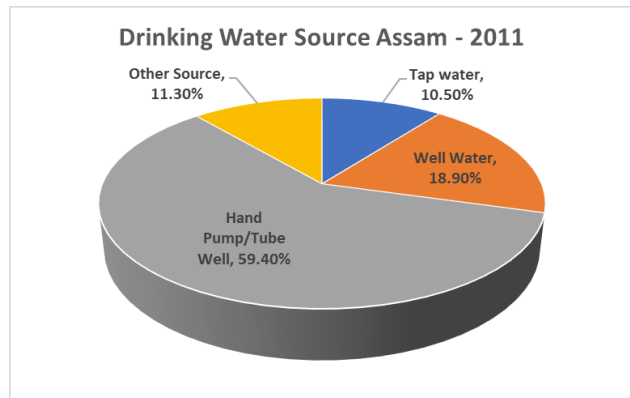


FIGURE 25: DRINKING WATER SOURCES IN ASSAM (SOURCE: CENSUS: 2011)

17.2 KEY ISSUES

Based on the census 2011, the status of the drinking water in the state is improved as compared to last census, but need more attention. In the state tap water connections have slightly improved as compared to previous census (9.2% to 10.5%). Distribution of households in Assam is being given through a pie chart.

There are numerous sources of drinking water (see Figure below) in Assam, but they are minimum in Karbi Anglong and in further down south.

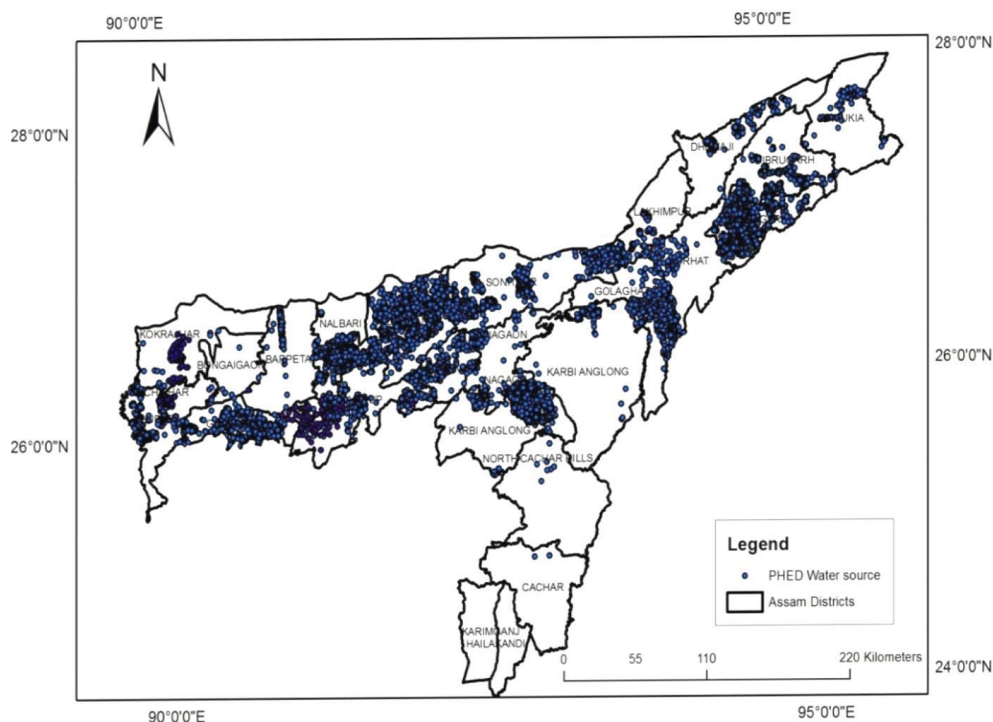


FIGURE 26: LOCATIONS OF PHED DRINKING WATER SOURCES IN ASSAM

The dearth in infrastructure for reaching out to entire population can get more complicated due to climate change. Some of the concerns due to climate change can be as follows:

- (a) Increasing temperature: Water demand for human consumption as well as agriculture and industry use is likely to rise in the future as temperatures increase all around due to global warming. Higher temperatures mean higher evapotranspiration and hence lesser availability of surface water. Warmer temperatures can also indirectly cause more severe weather (Cotton and Pielke, 2006) exacerbated by urban heat islands that could, in turn, result in additional convective thunderstorms, hail, and higher wind speeds that may exceed the design capacity of infrastructure. Urban water supplies. Warming trends may also lead to increased demands for power production that, in turn, require power-plant cooling waters in competition with other water uses.
- (b) Increased water demands associated with warming trends and, in some areas, reduced precipitation and runoff may lead to reliance on overdrafts from groundwater resources, and land subsidence. Increased overdraft and lower groundwater levels, in turn, can reduce or endanger the ability of wells to supply water without well retrofits such as lowering pumps and deepening wells. Finally, land subsidence can contribute to increased flooding as well as destruction of infrastructure resulting in additional leakage and reduced efficiency of distribution systems.
- (c) Extreme precipitation: Heavier rainfall events replacing continuous low or normal rainfall across monsoon in the future, may lead to high runoff, flash floods and therefore ground water recharge may reduce. This may also cause flooding in low land areas. Further, some of the reservoirs may require structural changes to accommodate extreme rainfall events and flooding conditions.

Therefore, augmentation and minimizing evapo-transpiration is a key strategy for ensuring availability of potable water. In case of Assam, addressing water shortages and water contamination during floods is another area of concern.

17.3 SDGS AND NDCS RELEVANT TO WATER RESOURCE

The relevant SDGs and INDCs have already been mentioned in the Water component of the current document. Major SDG relevant to the current component is SDG 6.

S. N.	Description	Relevant focus
Directly Related SDGs		
1	Goal 6 Clean Water and Sanitation	Universal & equitable access to safe and affordable potable water; water quality; water use efficiency, IWRM; restoring water related ecosystem
NDCs		
1	NDC 6 (Directly Related)	Enhancing investments in water sector to adapt to Climate change.

STRATEGY

These concerns have been raised in the mission on Sustainable Habitats which is a part of the National Action Plan on Climate Change India's. The mission aims to promote energy efficiency as a core component of urban planning, the plan calls for extending the existing Energy Conservation Building Code; A greater emphasis on urban waste management and recycling, including power production from waste; Strengthening the enforcement of automotive fuel economy standards and using pricing measures to encourage the purchase of efficient vehicles; and Incentives for the use of public transportation. Additionally, we believe that urban spaces are vulnerable to climate change as

is the human health. These together therefore form the core areas where strategies have been suggested to build resilience to Climate change (see Table below).

TABLE 25: STRATEGIES TO ADDRESS CLIMATE CHANGE IMPACTS FOR SUSTAINABLE POTABLE WATER AVAILABILITY

Sl. No	Action	Department Responsible	Costs (INR CR)	Priority	Sources of Fund	Remarks	Relevant SDG/INDC
1	Ensuring water availability in a changing climate scenario						Goal – 6
	Roof top rain water harvesting; 5000 numbers (emphasizing in southern Assam cities)	PHE	105	H	JNNURM –Part of already existing Building by-laws	Ongoing	
	Check dam, 30 numbers (in Southern Assam cities)	PHE	4.0	M		Ongoing	
	Pond HRF (horizontal roughing Filter-Geo membrane line masonry); 50 numbers	PHE	1.00	M			
2	Ensuring potable water during floods						Goal – 6 NDC – 6
	Board mounted WTP (water treatment plants) for flood effected areas; 5 numbers	PHE	5.00	M		Ongoing	
	Speed boat for distribution of WATSAN material during climate change induced floods	PHE	2.50	M			
3	Facilitating ground water recharge even in extreme rainfall condition						Goal – 6
	Artificial recharge with pit/trench; 4000 numbers (ongoing)	PHE	40.00	VH			
4.	Enhance water use efficiency						Goal – 6
	Metering of water supply connections in at least 13 major cities-to cover at least 5 cities in 5 years (ongoing)	PHE	100.00	VH			
5	Increasing solar energy penetration and reducing load on conventional source						
	Solar pumping in PWSS; 2000 numbers	PHE	200.00	VH	Solar mission –on going 134 have been completed	Ongoing	
6	Research			H			Goal – 13
	Assessing risk (for all genders) due to climate change and designing required Infrastructure and System Operation for water supply systems in	PHE	1.00	VH	Bilateral funding/ Multi-lateral funding		

	four key cities in Assam						
7	Capacity building						Goal – 13
	Developing capacity of government officials towards assessing the vulnerability of water resources in their districts and drafting strategies for ensuring water availability (for all 27 districts) and disaster risk reduction	PHE and ASDMA	1.00	VH	Bilateral/Multilateral funding	Costing changed Ongoing	
	Training and skill development of Govt. functionaries on climate change resilient WATSAN system	PHE	5.00	VH	Bilateral/Multilateral Funding	Costing changed	
	Exposure visit of Govt. functionaries on climate change resilient WATSAN system	PHE	1.00	H	Bilateral/Multilateral funding	Costing changed	
	TOTAL		465.50				

Source: Assam SAPCC

Following are recommended as a strategy

1. Solid Waste Management is also an important aspect to ensure reduction in the GHG emissions and reducing the chances of polluting of underground water
2. Maintaining Open defecation free (ODF) status
3. Awareness generation on environment and sanitation aspect like waste burning/ pit composting

17.4 MONITORING AND VERIFICATION

To ensure the regular progress on the action plan on climate change, some verifiable indicators have been identified and are being given below:

TABLE 26: MONITORING AND VERIFICATION INDICATORS FOR TRACKING WATER AVAILABILITY ACTION PLAN

Short term indicators	Medium Term indicators	Long term indicators
Number of Projects focusing on water conservation like roof top rainwater harvesting taken up	Change in status of groundwater development	Groundwater level are maintained at optimum level
Number of Projects focusing on water conservation like check dams/ stop dams have been taken up		
Systems/tools/equipment are in place to ensure potable water supply during floods	% of flood affected population having access to safe potable water. Data monitored for men and women separately	Reduced number of fatalities due to poor quality water during floods
Metering system initiated in at least 5 cities	Metering system for water supply adopted in all major cities	

19. Municipal Waste Management and Sewage Treatment in Cities

18.1 BACKGROUND

Considering that 4.3 million people live in urban areas in Assam and they produce on an average 300 tons of solid waste per day³⁸, the annual solid waste generated is around 471 Giga tons. Though door to door collection of MSW has been introduced in some cities in Assam but still scientific treatment and management of solid waste is not the norm anywhere. India's first integrated waste management is being implemented in Guwahati, where the facility would develop mechanisms for waste collection, segregation, recycling and improved solid waste collection, transportation, treatment, disposal and energy generation. However, as the pace of the population pressure increases in urban areas, development of MSW management infrastructure development has to be sped up, as unscientific management of MSW leads to many issues.

Unscientific management of solid waste may lead to ground water contamination by the leachate generated by the waste dump; surface water contamination by the run-off from the waste dump; bad odour, pests, rodents and wind-blown litter in and around the waste dump; generation of inflammable gas (e.g. methane) within the waste dump; bird menace above the waste dump which affects flight of aircraft if the dump areas are nearby the airports; fires within the waste dump leading to emission of toxic materials; erosion and stability problems relating to slopes of the waste dump; epidemics through stray animals; acidity to surrounding soil; and release of greenhouse gases. These are likely to escalate in the future as more and more population moves into the urban spaces, unless arrangements are made to avoid the situation.

Domestic waste water constitutes of human excreta, urine and the associated sludge, (collectively known as black water), and waste water generated through bathing and kitchen (collectively known as grey water). Untreated waste water percolates into the soil and goes into water streams, ponds and rivers, as a result of which it poses a huge public health problem.

18.2 KEY ISSUES

In Assam, management of domestic waste water (sewerage) is absent in the State. Per capita waste generation in India is estimated to be 121 liters/capita/day. Considering that the urban population in Assam is around 4.3 million, the urban Assam produces around 189910 million liters of domestic waste water. Even if the population rises in a business as usual scenario, at the end of the next 10 years, the waste water generation is likely to be at least 1.14 times more than what is generated now. Without creating waste water treatment facilities, the public health problem can become a menace.

18.3 STRATEGY

Some of the Strategies suggested to ensure solid waste management and waste water treatment in the State, at least in the urban space are as follows:

Strategies to ensure waste water treatment and solid waste management within urban habitats impacted by climate change

³⁸ Based on "Manual on Solid Waste Management" prepared by Central Public Health & Environment, Engineering Organization (CPHEEO), Ministry of Urban Development, Govt. of India.

TABLE 27: STRATEGIES TO ADDRESS WASTER MANAGEMENT RELATED ISSUES IN CONTEXT OF CLIMATE CHANGE

S. N.	Action	Department Responsible	Costs (INR CR)	Priority	Sources of Fund	Remarks	Relevant SDG/INDC
1	Wastewater treatment						Goal – 6
	Community Waste Management System in peri-urban areas (approx. 4 nos in each block)-1000 in number	PHE	50	VH	JNNURM		
	Trailer mounted community Bio-toilet for areas affected with climate change resulted flood-45 in number	PHE	0.50	VH	JNNURM		
	Colony based sewage treatment plants-recycled waste water will be used for parks, gardens and other uses in all cities (at least cover 2 cities in 1st 5 years and after that all cities in next five years)-60 in number	Department of Urban development	15.00	VVH	JNNURM		
2	Solid waste management						
	Feasibility studies in 14 major cities in Assam, excluding Guwahati for setting up integrated waste management plants	Department of Urban Development	1.00	VH	Swatch Bharat Mission		
	Feasibility study to set up cluster based MSW management amongst class II and III tier cities in Assam	-do	2.00	VH	Swatch Bharat Mission		
	Preparation of DPR for MSW and Solid Waste Management (including disposal) for: • 2 major cities in two years • Rest 12 major cities in next 3 years • All class II and Class III tier cities in next two years	Do	70.00	H	SBM	Revised	
	Implementation of DPR in all major 14 cities in next 10 years: • DPR implementation for two major cities in 1st four years • DPR implementation in all of the major cities in next three years • DPR implementation in rest 2nd and 3rd tier cities in next five years	Do	900.00	H	SBM	revised	
	Undertake -MSW management -de-silting of drains -sewage treatment in flood prone cities in Assam spread along 14 districts along the banks of Brahmaputra. Cover 2 cities in the 1st 5 yrs.	-do	720.00	VVH	Swatch Bharat Mission		
	TOTAL		1895.50				

PHE is doing feasibility in 33 districts in the rural areas. Also, most of the cities and townships in Assam do not have appropriate infrastructure for sewage treatment and this is a key issue for the sustainability of water resources on which the urban areas are dependent.

18.4 MONITORING AND VERIFICATION

To ensure the regular progress on the action plan on climate change, some verifiable indicators have been identified and are being given below:

TABLE 28: MONITORING AND VERIFICATION INDICATORS TO UNDERSTAND PROGRESS OF WASTE MANAGEMENT STRATEGIES

Short term indicators	Medium Term indicators	Long term indicators
% of the blocks covered with Water management system	% of waste water is being treated before disposing it into the natural drainage/river system	% of the solid waste generated in all major cities is being treated through SWM system
% of Major cities started the Solid waste management system	% of Major cities, where the Solid Waste management system is operationalized	% reduction in incidence of water and vector borne diseases

20. Road Transport

19.1 BACKGROUND

Transport is very critical in economic and social development. It provides access to economic and social opportunities. Transport facilitates the access to markets, education and health facilities which are critical parameter for development. Different transport modes and services, and the state of domestic and international connectivity can greatly influence the well-being of the people and their environment. At the same time, the transport sector is a major contributor to climate change through GHG emissions. It is one of the top consumers of fossil fuels and generates a variety of emissions. Increasing levels of motorization has also resulted in an increase in traffic fatalities and injuries. Managing the transport sector can make a direct and indirect contribution towards the achievements of the SDGs through well-designed transport policies, initiatives and projects. The relevant SDGs where the transportation is linked are as follows:

19.2 SDGs AND NDCs RELEVANT TO ROAD TRANSPORT

Relevant SDGs:

TABLE 29: SDGs AND INDCs RELATED TO TRANSPORTATION RELATED ISSUES

S No	Description	Relevant focus
1	Goal 9 Industries, Innovation and Infrastructure	Basic infrastructure like roads, information and communication technologies, sanitation, electrical power etc
2	Goal 11 Sustainable Cities and Communities	Safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport,
3	Goal 7 Affordable and clean energy	Enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology
4	Goal 12 Responsible consumption and production	Achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment

5	Goal 13 Climate Action	Integrate climate change measures into national policies, strategies and planning; Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
	NDC	
1	NDC 2	To adopt a climate friendly and a cleaner path than the one followed hitherto by others at corresponding level of economic development
2	NDC 3	To reduce the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level.
3	NDC 8	To build capacities, create domestic framework and international architecture for quick diffusion of cutting-edge climate technology in India and for joint collaborative R&D for such future technologies

19.3 KEY ISSUES

Rapid increase of numbers of motor vehicles on road in Assam has been observed over the past decade. The on-road vehicle population in the State reached 2.16 million in 2014-15 from 0.53 million in 2001-01 (see Figure 19). The growth has been at a compounded annual growth rate of about 12.7%.

Due to lack of adequate public transport system where buses comprise of only 0.5% of the total population of vehicles on road, and due to availability of easy loans, most of the people are aspiring to buy their own vehicles. As a result, two wheelers are 67%³⁹ of the total vehicle mix in the State, and cars & Jeep follow suit with a 19.2% share in 2015.

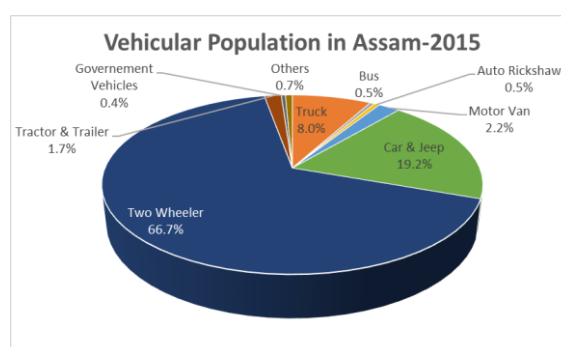


FIGURE 27: DISTRIBUTION OF DIFFERENT TYPE OF REGISTERED VEHICLES IN ASSAM

Source: Office of the commissioner of Transport, Assam and Directorate of Economics and Statistics, Assam

19.4 CLIMATE CHANGE

The road transport sector being a direct consumer of fossil fuel, emits GHG into the atmosphere. With increase in population and per capita rise in number of personal vehicles, GHG emissions are likely to rise. Use of public transport system need to control future emissions in the future and also to ease off the pressure of vehicles on the roads, hence. This would require policy changes in the way lending is done by banks, enabling fuel mix with biofuels, and also behavioural changes of the population whereby they use more and more non-motorized transport at short distances and public transport for long distances. The Guwahati city is already in the process of developing the Bus Rapid Transit System (BRTS), but further development of the public transport system is required. Other major cities also need to embrace the same for an orderly functioning road transportation system in the cities of Assam.

The roads and bridges built for the transport sector are also susceptible to floods and landslides in the State, the intensity of which is likely to increase in the future. In this context therefore roads, bridges need to be built keeping in view the maximum projected intensity of extreme events.

³⁹ Office of the commissioner of Transport, Assam and Directorate of Economics and Statistics, Assam.

19.5 STRATEGY

Under the PIDP vision, the overall length of Road Network including NHs of the state to increase by 50% (from the current length of 55,435 km to 71,000 km) in the next 20 years for providing better and seamless connectivity.

Envisaged status of road network in the state of Assam by 2034-35

- National Highways
 - Length: 10,000 Km
 - 6 lane road network: 4%
 - 4 Lane road network: 96%
 - 2 lane road network: 0%
 - Single lane network: 0%

19.6 FUNDING FOR NATIONAL HIGHWAYS

The investment required for upgrading 1253 km of road network to national highway would be 15000 Cr. Total investment required for National Highways has been estimated at Rs. 23,151 crore INR for the next 20 years for projected NH length of 10,000 Km @5% growth per year from current 3,900 km length. This investment is to be supported directly by the Ministry of Road Transport and Highways under its various schemes like NHDP, SARDP-NE, NH (O) etc.

Major Plans/ Programs under implementation for National Highways

Schemes/ Programs	Funded by
National Highway (Original Works) under Annual Plan	Ministry of Road Transport and Highways, GoI
Special Accelerated Development Program for North east (SARDP-NE)	Ministry of Road Transport and Highways, GoI
M&R Works - Periodical Repair (PR) - Special Repair (SR) - Ordinary Repair (OR) - Flood Damage Repair (FDR)	Ministry of Road Transport and Highways, GoI

19.7 DEVELOPMENT OF CORE ROAD NETWORKS AND BRIDGING OF MISSING LINKS

The Core Road Networks will provide all-weather connectivity to neighbouring states, countries and key growth centres.

Physical infrastructure development will lead to development of Core Road Networks with adequate feeder networks providing connectivity to key urban centres, industrial centres and tourism centres. The Core Road Networks will also provide seamless connectivity to neighbouring countries and neighbouring states thereby making Assam as the preferred gateway.

The major initiatives taken up in the Highway Sector in the State are outlined below:

- Development of NH 153 (Stillwell Road)
- Development of ASEAN Highway

- Connectivity to Bhutan
- Connectivity to Bangladesh through NH-51, NH-40, NH-151, NH-44:
- Connectivity with Republic of China through Arunachal Pradesh:
- Connectivity of NER with rest of the country:

The Strategy for addressing the relevant issues is being given below:

TABLE 30: SUGGESTED STRATEGIES FOR THE TRANSPORT SECTOR

S. N.	Action	Cost (INR Cr)	Sources of Fund	Priority	Department Responsible	Remarks	Relevant SDG/INDC
1	Installation of CNG pump stations across major cities of Assam; 100 depots	25.00	Franchisee/Vendor Funded	VH	Department of Transport		Goal – 7
2	Procurement of CNG enable buses, 1000 buses	250.00	JNNURM	VH	Department of Transport		Goal – 7
3	Upgrading of 1253 km of roads to National Highways in the State	15000	Ministry of Transport (Central)	H	MoT	Added	Goal – 11
4	Assess requirement of non-motorized transport numbers and Introduce tracks for non-motorized transport along existing roads, 10 major cities	2.00	State Govt./Central Govt.	H	Department of Transport		Goal – 11
5	Retrofitting all Public Vehicles with CNG Kit – Policy regulations to be formulated	100.00	State Govt./Central Govt.	VH	Department of Transport		Goal – 3 Goal – 11
6	Introducing intelligent traffic management systems, 10 major cities	10.00	State Govt./Central Govt.	H	Department of Transport		NDC – 8
6	Construct parking slots in Guwahati, Tinsukia, Dibrugarh, Nagaon, Tezpur, Jorhat and Silchar. Partial cost of construction, 7 major cities	35.00	State Govt./Central Govt.	H	Department of Transport		
7	Promote better driving practices and maintenance of vehicles among truck, bus and car drivers to enhance fuel efficiency	1.00	State Govt./Central Govt.	H	Department of Transport		
8	Study on BRT for 7 major cities other than Guwahati where BRT is already planned	0.50	State Govt./Central Govt.	H	Department of Transport		
9	Vulnerability assessment study of transport system of Guwahati and other important cities due to climate change	0.50	State Govt./Central Govt.	VH	Department of Transport		Goal – 13
10	Developing manual for building climate resilient	14.00	State Govt./Central Govt.	VH	Department of Urban		Goal – 13

	roads and bridges and train engineers on retrofitting old ones and new designs (all Districts)				development		
	TOTAL	15,438.00					

19.8 MONITORING AND VERIFICATION

To ensure the regular progress on the action plan on climate change, some verifiable indicators have been identified and are being given below:

TABLE 31: MONITORING AND TRACKING INDICATORS FOR UNDERSTANDING PROGRESS ON STRATEGY FOR TRANSPORT SECTOR

Short term indicators	Medium Term indicators	Long term indicators
KM of roads completed against the target	Number of towns/ cities/ habitats are well connected with good quality roads/highways	Average Km per hour on roads joining different habitats
CNG pumps are being installed		
Vehicles with CNG are being promoted and are available for purchase	% of vehicles running on environment friendly fuels	Reduction in the vehicular pollution levels, especially in big cities
Manual available for creating climate resilient infrastructures and also for retrofitting the old structures		

21. Inland Water Transport

20.1 BACKGROUND

Inland Water Transport is generally accepted as the most efficient mode of transportation from the point of low energy Consumption, Lower capital cost, low maintenance cost and environment friendliness. All that also lead it into the cheapest mode of freight transport as compared to railway and highways. The North Eastern region through which the Brahmaputra flows, has a considerable demand for essential commodities which have to move into the region from the rest of the Country and similarly local products have to move outside the region. Thus, there is a need for developing supplementary mode of transport. In this case Inland Water Transport or IWT is a obvious solution.

SDGS AND NDCS RELEVANT TO INLAND WATER TRANSPORT

Relevant SDGs:

TABLE 32: SDGs AND INDCs RELEVANT TO THE INLAND WATER TRANSPORT

S. N.	Description	Relevant focus
1	Goal 9 Industries, Innovation and Infrastructure	Basic infrastructure like roads, information and communication technologies, sanitation, electrical power etc
2	Goal 11 Sustainable Cities and Communities	Safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport,
3	Goal 13 Climate Action	Integrate climate change measures into national policies, strategies and planning

4	Goal 14 Life below water	Prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution
	NDC	
1	NDC 2	To adopt a climate friendly and a cleaner path than the one followed hitherto by others at corresponding level of economic development
2	NDC 3	To reduce the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level.
3	NDC 6	To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture, water -resources, Himalayan region, coastal regions, health and disaster management.

20.2 KEY ISSUES

In context of Assam, it is a riverine state. As much as 32 percent of the water resource of the country flow down through the river Brahmaputra, Barak and their myriad tributaries that weave a vast network of waterways in the State. The Brahmaputra has 891 Km navigable length of water ways from Sadiya to Dhubri while the Barak has 94 Km length of navigable waterways. The Sadiya – Dhubri stretch of the Brahmaputra River has been declared as the 2nd National waterways of the country in the year 1988 and afterwards the proposals to activate the Commercial service have been moved for overall economic development of the North-eastern Region. Barak also has been declared as 6th waterway of the country. Currently, the Directorate of Inland Water Transport is operating 200 ferry services under division on the river Barak, Brahmaputra and its tributaries for the purpose of public utility goods transport and other purposes.

With 15 National Waterways (NW), Assam has nearly 10% of cumulative navigable length of all 111 NWs in India. IWT caters to about 4 per cent of the total freight tonnage movement to and from the state. 24-hour Night navigation facilities are put in place by IWAI from Dhubri up to Dibrugarh. Govt. of Assam has identified four ports which will be used as immigration checkpoints - Silghat, Pandu, Karimganj and Dhubri. To modernize and transform Inland Water Transport in Assam, the World Bank is assisting the Government of Assam through a phase-wise project which includes upgradation of ferry Infrastructure and last mile connectivity, Fleet Modernization, institutional capacity development etc.

20.3 STRATEGY

The water ways are also a source of GHG emissions, as the leveraging of this source increases, the chances of spillage of fuel also increases affecting the aquatic life in the rivers. This calls for the green vessels to be used for ferry services in waterways. There are investment opportunities in the Assam in fields of, Development of IWT terminals, port townships, river fronts and river taxis.

TABLE 33: STRATEGIES FOR WATER WAYS

S. N.	Action	Costs (INR Cr)	Source of Fund	Priority	Department Responsible	Remarks	Relevant SDG/INDC
1	The IWT vessels rely on fuel oils for most powering needs, but tighter emission regulations and the need to 'go green' and hence conversion of existing Diesel Marine Engines to CNG driven engines proposed. (40 engines in 20 vehicles)	10.00	JJNURM/ IWT/Any other	H	Inland Water Transport Department		Goal – 9 NDC – 6
2	Solar powered passenger vessel in 10 vehicles	100.00	IWT	H	Inland Water Transport		Goal – 11 NDC – 2

					Department	
3	CNG Filling Station (Phase: I – Guwahati-02) (Phase: II-all over Assam-04)	10.00	IWT	H M	Inland Water Transport Department	Goal – 11
4	Conversion of existing engines of IWT Vessels to CNG, 40 vessels	10.00	IWT	M	Inland Water Transport Department	NDC – 2
5	Development of IWT terminal at Karimnagar, Silghat, Dhubri and Nimati Ghat	792	IWT/IWAI	H	World Bank	Added NDC – 6
6	DPR preparation and Operationalization of River Taxi	100 (depending on DPR)	IWT	H		Added
TOTAL		1022.00				

20.4 MONITORING AND VERIFICATION

To ensure the regular progress on the action plan on climate change, some verifiable indicators have been identified and are being given below:

TABLE 34: MONITORING AND VERIFICATION INDICATORS TO TRACK PROGRESS ON IWT

Short term indicators	Medium Term indicators	Long term indicators
CNG pumps are available for IWT vessels	Planned IWT terminals are ready as per the requirement (travel and freight purposes)	% of the travellers choosing the IWT mode of transport, wherever available
% of IWT vessels converted into green fuel / solar powered vessels	River Taxis are available and is preferred mean of transportation, wherever available	Speed of the IWT mode increased

22. Human Health

21.1 BACKGROUND

The health of human populations is sensitive to shifts in weather patterns and other aspects of climate change. These effects occur directly, due to changes in temperature and precipitation and occurrence of heat waves, floods, droughts, and fires. Indirectly, health may be damaged by ecological disruptions brought on by climate change (crop failures, shifting patterns of disease vectors), or social responses to climate change (such as displacement of populations following prolonged drought). Variability in temperatures is a risk factor in its own right, over and above the influence of average temperatures on heat-related deaths. Biological and social adaptation is more difficult in a highly variable climate than one that is more stable. Assam having an undulating physiography, moist tropical climate is endemic to malaria. Malaria incidences reported in the state go upto many other climate related diseases are being routinely reported despite control measures being taken. Some of the other diseases occurring at a large scale i.e. incidences reported in excess of 30,000 include Acute Respiratory Infection (ARI) and influenza, Pyrexia related to ticks, Japanese Encephalitis (see Figure below⁴⁰).

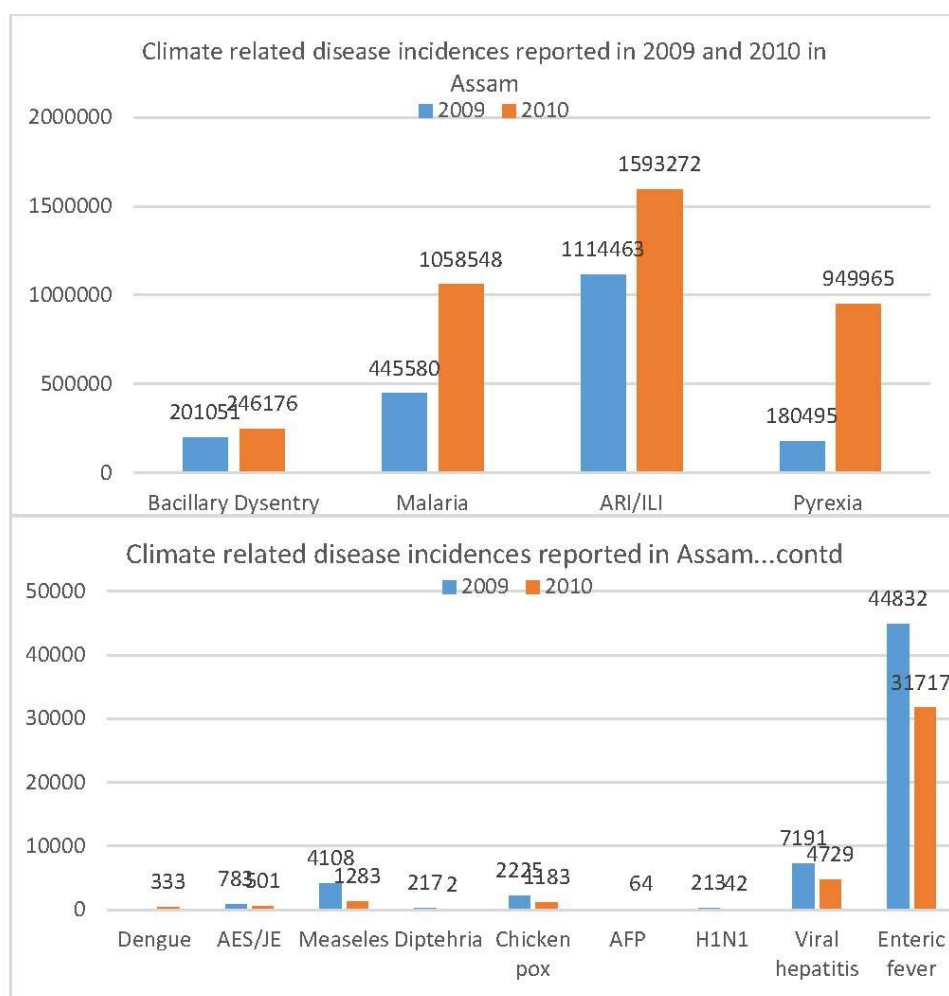


FIGURE 28: CLIMATE RELATED DISEASE INCIDENCES REPORTED IN 2009 & 2010

⁴⁰ Integrated Disease Surveillance Programme of Gov of Assam, 2009-10, Available at: http://www.nrhmassam.in/state_pip/idsp.pdf

21.2 SDGs AND INDCS RELEVANT TO HUMAN HEALTH

Relevant SDGs

TABLE 35: SDGs AND INDCS RELEVANT TO THE HEALTH SECTOR

S. N.	Description	Relevant focus
1	Goal 3 Good Health and Well Being	Ending the epidemics of malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases
2	Goal 2 Zero Hunger	End hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round; end all forms of malnutrition
3	Goal 5 Gender Equality	Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate; Ensure universal access to sexual and reproductive health and reproductive rights; Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources, in accordance with national laws
4	Goal 6 Clean water and sanitation	Universal and equitable access to safe and affordable drinking water for all; access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations;
5	Goal 7 Affordable and clean energy	Ensure universal access to affordable, reliable and modern energy services; expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries
6	Goal 8 Decent work and economic health	Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors; achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value; immediate and effective measures to eradicate forced labor, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labor
7	Goal 12 Responsible consumption and production	Ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature
8	Goal 13 Climate Action	Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
	NDC	
1	NDC 1	To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation
2	NDC 2	To adopt a climate friendly and a cleaner path than the one followed hitherto by others at corresponding level of economic development
3	NDC 6	To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture, water resources, Himalayan region, coastal regions, health and disaster management

21.3 KEY ISSUES

Disease prevalence in Assam continues to be high as it is one of the 18 states in India which have poor health service delivery systems. Thus, the focus is only on the delivery of primary health solutions.

It is clear from the above figure that ARI/ILI disease incidence are the highest followed by Malaria in the State. ARI is related to pollutant levels in the atmosphere which originate from various anthropogenic activities that use fossil fuel such as transport vehicles, industries, power plants etc. ARI incidences are likely to increase with continued increase in anthropogenic activities into the future and increase in ambient temperature.

On the other hand, malaria which is not dependent directly on fossil fuel burning but is a function of temperature, precipitation and humidity and vegetation cover continues to be one of the major Public Health problems in Assam. Out of total 31.53 million populations in the state, 9.71 million populations (31%) are living in malaria high risk areas. Malaria is particularly endemic in Karbi Anglong, Kokrajhar, N.C.Hills (Dima Hasao), Chirang, Goalpara, Baksa, Hailakandi and in Udalguri.

Malaria, Japanese encephalitis (JE), lymphatic filariasis and dengue, like Mosquito-borne diseases are major public health concerns in the state of Assam. Among these, malaria and JE are the predominant infections and are spread across the state. The incidence of malaria is, however, gradually receding, with a consistent decline in cases over the past few years. JE, which was formerly endemic only in upper Assam, started spreading fast across the state. Lymphatic filariasis is prevalent but its distribution is confined to a few districts and disease transmission is steadily declining. Dengue has recently invaded the state, with a large concentration of cases in Guwahati city that are spreading to suburban areas. Control of these diseases requires robust disease surveillance and integrated vector management on a sustained basis, ensuring universal coverage of evidence-based key interventions based on sound epidemiological Data.

21.4 CLIMATE CHANGE AND HEALTH

Heat waves are already reported in the State and are likely to be more frequent and more intense in the future. Similarly, injuries and deaths due to floods, landslides are also in this list, which will escalate as climate change rolls out into the future.

- If climate change continues as projected, the major changes in ill health compared to no climate change will occur and will be in the form of:
- More number of morbidity and mortality death due to more intense heat waves, cyclonic winds, landslides, mud slides, and flooding events and fires
- Increased risk of under nutrition resulting from diminished food production
- Increased risks of food and water-borne diseases (very high confidence) and vector-borne diseases
- Opening up of windows of transmission of disease-carrying vectors due to exceedance of thermal thresholds at higher altitudes
- More water and food borne disease incidences
- Effects of food and water shortages
- Air pollution-related health effects
- Psycho-social impacts on displaced populations

21.5 STRATEGY

Improving Basic Public Health and Health Care Services, creating policies that help towards prevention of certain diseases related to climate change, developing early warning systems through disease forecasting mechanisms etc. can be some of the adaptation strategies that can be brought in. Table 16 below gives some of the necessary strategies that can be implemented to adapt to climate change vis a vis emerging health issues in a climate change context.

TABLE 36: STRATEGIES FOR PROTECTING HUMAN HEALTH

S. N.	Action	Costs (INR Cr)	Source of Fund	Priority	Department Responsible	Remarks	Relevant SDG/NDC
1	Institutionalize studies to understand the possible impact of Climate change on health in context of Assam. Data collected should be gender-segregated.	2.00	State/ Central Fund	VH	Dept of Health and Family Welfare	Revised	Goal – 5
2	Developing disease forecasting system for disease outbreaks on a daily basis in consonance with daily weather forecast. Special focus on gender vulnerability to specific diseases.	2.00	State/ Central Fund	VH	Dept of Health and Family Welfare		Goal – 3 Goal – 5
3	Develop mobile based apps on disease outbreak forecast and prevention measures – a to do list	2.00	State/ Central/ Fund	VH	Dept of Health and Family Welfare		NDC – 6
4	Study and map new and emerging diseases in consonance with CC projections	3.00	State/ Central Fund	VH	Dept of Health and Family Welfare		Goal – 13
5	Extending IDS to urban areas and to private clinics	10.00	State/ Central Fund	VH	Dept of Health and Family Welfare		
6	Including heat wave incidences under IDSP in Assam	10.00	State/ Central Fund	VH	Dept of Health and Family Welfare		Goal – 13
7	Conduct studies to assess links between climate change and possible malnutrition in the State especially amongst children	2.00	State/Central Fund	VH	Dept of Health and Family Welfare		Goal – 13
8	Review and retrofit disaster risk response strategies of the department in view of climate change using CSDRM tool	0.25	State/Central Fund	VH	Dept of Health and Family Welfare		
	TOTAL	31.25					

21.6 MONITORING AND VERIFICATION

To ensure the regular progress on the action plan on climate change, some verifiable indicators have been identified and are being given below:

TABLE 37: MONITORING AND VERIFICATION INDICATORS TO TRACK THE PROGRESS IN HEALTH SECTOR STRATEGIES

Short term indicators	Medium Term indicators	Long term indicators
Studies taken up for understanding the impact of climate change on human health	Systems are in place for addressing the expected disease outbreaks	% reduction in incidences of different disease
Disease forecasting system for disease outbreak are in place		% reduction in death toll due to different diseases (especially the vector and water borne diseases)

23.Managing Urban Space

22.1 BACKGROUND

In case of Assam, Urban spaces along the flood prone river bank are prone to excessive flooding during extreme rain fall events. Similarly, due to excessive rain fall, urban spaces near foot hills or on hilly terrain are at risk from landslides. Also, the urban spaces are susceptible to enhanced heat island effect due to the continuous warming of the atmosphere. Both lead to disasters leading to morbidity of the population residing in these spaces and sometimes lead to mortality. Morbidity certainly impacts on productivity and their earnings.

22.2 STRATEGY

In view of this, a few strategies suggested to protected urban spaces from consequences excess heat or rainfalls are indicated in the Table below.

Strategies for making urban spaces climate resilient

TABLE 38: STRATEGIES FOR MAKING URBAN SPACES CLIMATE RESILIENT

S. N.	Action	Costs (INR Cr)	Source of Fund	Priority	Department Responsible	Remarks	Relevant SDG/INDC
1	Re-evaluate drainage system of the urban space/city and realign it with the maximum expected volume water that will be received due to extreme rainfall and avenues and outlets required for dissipation. Pilot: 7 cities	3.50		VH	JNNURM		
2	Map and Evaluate the landslide prone areas in a hill city and devise and implement adaptation strategies to bind the soil and prevent soil erosion and hence landslides-engineering as well as vegetative measures (take 3 hill cities)	15.00		VH	JNNURM		
3	To dissipate heat in open areas built up due to heat island effect design landscapes dotted with greens that can cool the micro climate (focus on 3 cities that have very high temperatures in summers w.r.t. other cities in Assam)	15.00		VH	JNNURM		Goal – 12
4	Strengthen disaster response of ULBs through Capacity Building (Cover: Guwahati, Silchar & Dibrugarh and 10 Towns	6.5	ASDMA & Adaptation Fund budget	H	ASDMA		

	viz. Tinsukia, Sivasagar, Jorhat, Tezpur, Bongaigaon, Nalbari, Nagaon, Mangaldoi, Dhubri & Kokrajhar)						
5	Training and capacity building of Community, NGOs, CBOs and Govt. Officials, educators, students on Disaster Risk Reduction and Climate Change Adaptation	1.5	State/ Central Fund	H	JNNURM	Costing changed	Goal – 13
	TOTAL	41.50					

In addition, the following actions are being implemented under the above strategy:

1. Assam Urban Solid Waste Management Policy, 2018 prepared and is in process for approval and implementation
2. Promotion of colony-based/society-based swage sewage treatment plants to share the load and prevent complete failure. This Colony based drum composting and residential based pit composting schemes are on-going for all ULBs with a cost of 10K/Unit and will be complete in 2019
3. Feasibility study of waste management plants is under process and is expected to be completed in 2019.
4. Proposals are being invited from ULBs for feasibility studies to set up cluster based Municipal Solid Waste - Management
5. A DPR has been submitted for MSW Management of Guwahati

Following actions will be assessed and taken up

1. Procurement of equipment for the de-silting of drains
2. Revaluation of drainage system: for 20 to 25 ULBs

22.3 MONITORING AND VERIFICATION

To ensure the regular progress on the action plan on climate change, some verifiable indicators have been identified and are being given below:

Short term indicators	Medium Term indicators	Long term indicators
Issues of concern have been identified for all major cities (like flooding due to high intensity rainfall, heat islands, land slide proneness etc) and benchmarking have been done	Issues of concern have been identified for all habitat areas	% reduction in loss due to the floods/ landslides etc. as compared to benchmark
	Approaches to address the above issues have been identified and being adopted	

24. Energy

23.1 BACKGROUND

The National Electricity Policy (NEP) and Integrated Energy Policy emphasizes the universalization of access to energy and promotes renewable energy source. The Energy Conservation Act has also been enacted to promote energy efficiency in the country. In addition to these policies, the state action plan on energy also need to be aligned with the relevant SDGs and NDCs. The relevant SDGs and NDCs are being given below:

TABLE 39: SDGs AND INDCs RELATED TO ENERGY / POWER SECTOR

S No	Description	Relevant focus
1	Goal 7 Affordable and Clean Energy	Universal access to affordable, reliable and modern energy services, increasing share of renewable energy, improve energy efficiency, expanding infrastructure and facilities for modern and sustainable energy
2	Goal 9 Industries, Innovation and Infrastructure	Developing quality, reliable, sustainable and resilient infrastructure.
3	Goal 12 Responsible Consumption and production	Promoting resource and energy efficiency
4	Goal 13 Climate Action	Combating climate change and its impacts; mainstreaming climate measure in national policies; improving education and awareness about climate change; building capacities of individuals and institutions
	NDC	
1	NDC 3	Reduce emission intensity of GDP
2	NDC 4	Increase in non-fossil fuel-based energy ratio to 40% of total installed capacities
3	NDC 2	To adopt a climate friendly and a cleaner path than the one followed hitherto by others at corresponding level of economic development.
4	NDC 7	To mobilize domestic and new & additional funds from developed countries to implement the above mitigation and adaptation actions in view of the resource required and the resource gap
5	NDC 8	To build capacities, create domestic framework and international architecture for quick diffusion of cutting-edge climate technology in India and for joint collaborative R&D for such future technologies

23.2 DETAILS OF RELEVANT SDGS:

Universal and sustainable access to clean energy is imperative to reducing carbon emissions and thus is a critical part of any action plan to combat climate change. The relevant specific targets of the above-mentioned SDG goals are being given below:

GOAL 7: AFFORDABLE AND CLEAN ENERGY

Energy is central to nearly every major challenge and opportunity the world faces today. Be it water and food security, economic well-being, climate change adaptation and mitigation, food production and/or economic growth, access to energy for all is essential. Working towards this goal is especially important as it interlinks with other SDGs. Goal 7 aims to achieve the following targets by 2030, that are also relevant in the context of Assam:

The relevant targets are

- (i) Ensure universal access to affordable, reliable and modern energy services
- (ii) Increase substantially the share of renewable energy in the global energy mix
- (iii) Double the global rate of improvement in energy efficiency
- (iv) Enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology
- (v) Expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support

GOAL 9: INDUSTRIES, INNOVATION AND INFRASTRUCTURE

Investments in infrastructure – transport, irrigation, energy and information and communication technology – are crucial to achieving sustainable development and empowering communities in many countries. It has long been recognized that growth in productivity and incomes, and improvements in health and education outcomes require investment in infrastructure: relevant targets under the goal:

- (i) Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all

GOAL 12: RESPONSIBLE CONSUMPTION AND PRODUCTION

- (i) Implement the 10-year framework of programs on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries
- (ii) By 2030, achieve the sustainable management and efficient use of natural resources
- (iii) By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse
- (iv) Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle
- (v) By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature
- (vi) Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production
- (vii) Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities

GOAL 13: CLIMATE ACTION

- (i) Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning

- (ii) Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly \$100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible
- (iii) Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities

25. Power Generation

24.1 STATUS

The total power generation capacity in the State in 2017 has been reported as 1505.32 MW as on 31 March 2018. Out of this 68% is thermal based, 29% hydro and 3% is renewable energy that includes biomass and solar. Bifurcation of thermal based power generation and renewable energy sources is shown in figure. It can be seen that about 33% of the installed capacity is non-fossil fuel based. As per the India's NDCs, this need to be minimum 40%.

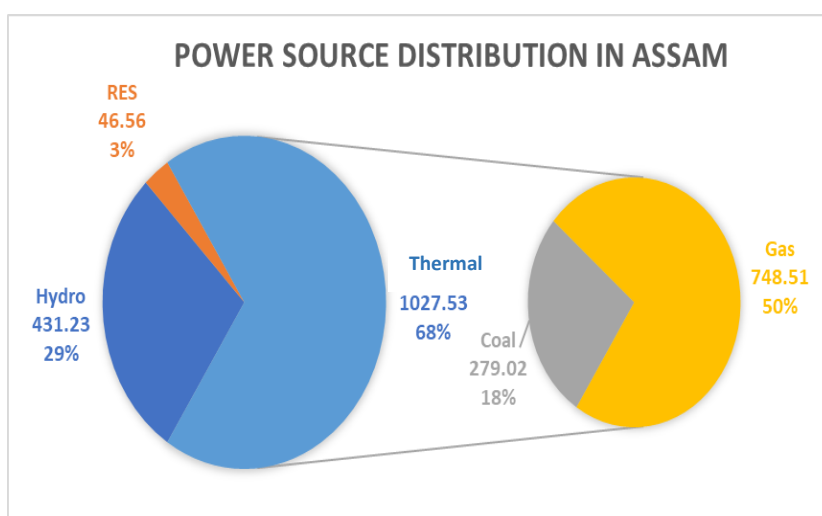


FIGURE 29: INSTALLED CAPACITY DISTRIBUTION BASED ON SOURCE

The energy requirement in 2017-18 was around 9094 MU, and energy supplied was 8779 MU (less by 3.5%). The peak demand was 1822 MW in 2017-18 and in comparison, supply was only 1745 MW- a shortage of about 3.5%. The transmission and distribution losses in 2015-16 were 25.2% in the state, which were reducing year by year, but the losses are higher as compared to the national values for the same. Transmission and Distribution losses in 2015-16 were 21.81%⁴¹.

In addition to inadequacy of generation capacities, the power availability is also severely constrained by network constraints (both inter and intra state). As on 30 Sep 2018, out of the around total 64 lakhs households in the state about 21% are yet to be electrified. Percentage of unelectrified households in rural areas (26% of 33.36 lakhs) is significantly higher as compared to unelectrified urban households (less than 1%)⁴².

On the other side, per capita power consumption in the state is very poor. State-wise status of per capita power consumption reflects that Assam is at the third from bottom position. Gender-sensitive assessments that specifically ask for women's and men's technology requirements constitute an important step in meeting their needs more equally. As far as energy access is concerned, access to energy-based technologies such as low-cost domestic appliances, power water wells, drip irrigation

⁴¹ Response of MoP to unstarred question number 5386; <http://164.100.47.190/loksabhaquestions/annex/11/AU5386.pdf>

⁴² Details available at DDUGJY website: http://www.ddugjy.gov.in/portal/state_wise_summary1.jsp?stateCode=18

systems and labour-saving technologies for agricultural production and post-production, such as grinding and milling, enhances labour productivity and increases the time available for engaging in productive activities outside the household. With access to such technologies, women and men can increase their incomes, and young girls and boys, previously burdened with labour-intensive chores, can attend school. This will go a long way in developing their adaptive capacity and reduce vulnerability to climate change.

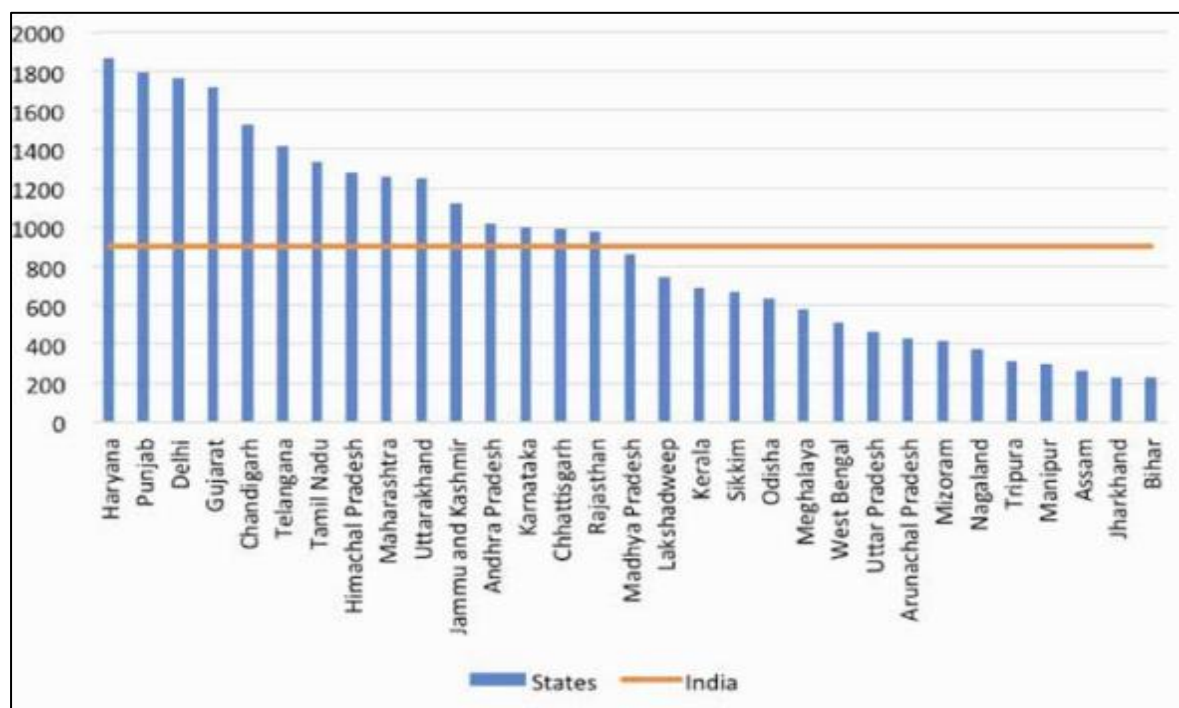


FIGURE 30: STATE-WISE PER CAPITA POWER CONSUMPTION

The above scenario reflects that there is need to emphasize the power production in the state and make it more accessible. There are few more plants which are in pipeline for capacity addition. As per the CEA report following plants are being targeted to complete:

Plant	Capacity	Technology
Bongaigaon TPP (Central)	250 MW	Coal
Namrup CCGT	36.15	Gas

24.2 STRATEGY

To enhance the RE component in the projected power demand, the MNRE has given the following targets to Assam till 2030

Relevant Goals:

Goal – 7

Goal – 12

NDC – 3

NDC – 4

NDC – 2

S. N.	Description of Targets	Subcategory (if applicable)	Capacity
1	Total RE target		2680 MW
2	Solar		1507
3	Non-Solar		
3.1		Wind	1005
3.2		Biomass	144
3.3		SHP	25

Strategies for augmenting power generation capacities include the use of renewable energy sources to complement its current shortfall in power generation. This should be augmented to start to replace conventional fossil fuel generation given the seemingly good potential for utilizing renewable energy, particularly hydro, solar and biomass. This is in line with the aspirations of the National Solar Mission that aims to implement 100,000 MW of solar power by 2022.

Table 40: Strategies to address issues related to Power Sector

S. N.	Action	Costs INR in CR	Sources of fund	Priority	Implementing Agency	Remarks	Relevant SDG/INDC
1	Setting up of 60 MW SPV Power Plant at Amguri, Assam	491.84		H	APGCL	Ongoing	Goal 7
2	Setting up of 15 MW SPV Power Plant at Namrup,	18.25		VH	APGCL	Ongoing	Goal – 7
3	Setting up of 2 MW SPV Power Plant at Lakwa,	18.25		VH	APGCL		Goal – 7
4	Capacity Building in APDCL	0.15		H	APGCL	Ongoing	Goal – 13
5	Master drain system of Lakwa TPS with ETP	0.24		VH	APGCL		
6	Crude oil drain pit development for gas intake station at Lakwa TPS & accumulator tank for Gas compressor lubrication drain	0.04		VH	APGCL		
7	Lower Kopili Hydroelectric Project (120 MW), Dima Hasao and Karbi Anglong Districts, Assam	0.28		VH	APGCL	Ongoing	NDC – 3, NDC – 4, Goal – 7
8	Development of Small Hydro Electric Projects	0.60		H	APGCL	Ongoing	NDC – 3, NDC – 4,

							Goal – 7
9	Switchyard illumination at Namrup TPS-LED	0.20		H	APGCL	Ongoing	
10	Street lighting at Namrup TPS-LED	0.20		H	APGCL	Ongoing	
11	Additional thermal Insulation on GT Unit #1, #2, #3 & #4 at Namrup TPS	0.14		H	APGCL	Ongoing	Goal – 12
12	Anti-erosion measure at Dillighat Intake of Namrup TPS	1.0		VH	APGCL	Ongoing	
13	Renovation / Repairing of cooling system of Steam Turbine unit-5, splash bar changing at Namrup TPS	1.00		VH	APGCL	Ongoing	
14	Research and Development	0.75		H	APGCL		
	Sub TOTAL-APDCL	533.92					
15	Installation & Promotion of 1 MW aggregate capacity of Grid Connected Solar Power Plant at different vacant land of APDCL with capacity ranging from 230 KW	15.30	100%: GOA	VH	AEDA	Ongoing	
16	Installation of Grid Interactive Rooftop/Ground mounted Solar Power Plant (with battery backup) at important Govt. Building of Assam with capacity ranging from 1KW-500KW	73.89	70%: MNRE, GOI 10%: GOA	VH	AEDA		NDC – 3, NDC – 4, Goal – 7
17	Illumination of important towns/historical locations of Assam through Solar Street Lighting System-Talk on going with GoA nothing has been materialised yet.	22.50	100%: GOA	VH	AEDA /APDCL		
18	Installation of 1 MW aggregate capacity of Solar Wind Hybrid System with capacity ranging from 600 W to 10 kW	23.33	100%: GOA	M	AEDA		
19	Installation & Promotion of 150 nos. of Solar Water Pumping systems for irrigation purpose- Promoted under UNDP Program trying to start with 250 Households	9.00	30%: MNRE, GOI 70%: GOA	H	AEDA		NDC – 3, NDC – 4, Goal – 7
20	Electrification of 66 nos. of remote villages through Solar PV based power plant under DDG – Not doing DDG	52.50	90%: GOI 10%: GOA	VH	AEDA	Ongoing	NDC – 3, NDC – 4, Goal – 7
21	Setting up 100 MW Grid Connected Solar Power Plant	800.00	IPP	M	AEDA	Ongoing	NDC – 3, NDC – 4, Goal – 7
	Sub Total-AEDA	996.70					

	GRAND Total- Energy generation	1530.69					
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26. Energy Efficiency

25.1 STATUS

As per the Electricity Act 2001, Assam has requested the designated consumers, to appoint Energy Managers, carrying out of Energy Audit, publication of information relating to Energy Conservation and energy saving tips in local dailies, distribution of informative leaflets for the benefit of public, celebration of National Energy Conservation Day in association with ASEB etc. Cinema halls of Guwahati city were requested to display slides containing Energy Conservation messages during show intervals to propagate the message of energy conservation among public.

The Government of Assam issued Notification in July 2007 to use energy efficient lamps in Government buildings, Institutions, Board, Corporations and promotion of Energy Efficient Building Designs as per the Energy Conservation Building Code published by the BEE (Bureau of Energy Efficiency). Further the National Mission on Enhanced Energy Efficiency (NMEEE) recommends decrease in specific energy consumption in large energy-consuming industries, with a system for companies to trade energy-savings certificates; provide Energy incentives, including reduced taxes on energy-efficient appliances; and generate financing for Public-Private Partnerships (PPP) to reduce energy consumption through demand-side management programs in the municipal, buildings and agricultural sectors.

25.2 STRATEGIES

Keeping this in view some energy efficiency measures have been suggested which can be taken up by the government.

TABLE 41: SOME OF THE STRATEGIES SUGGESTED FOR IMPROVING ENERGY EFFICIENCY INCLUDE:

S. N.	Action	Cost (INR Cr)	Sources of fund	Priority	Implementing Agency	Remarks	Relevant SDG/INDC
1	Explore fiscal mechanisms for supporting energy efficiency activities in the State	0.25		VH	AEDA		Goal – 7
2	Ascertain energy efficiency potential in various sectors	0.50		VH	AEDA		Goal – 7
3	Energy Conservation in buildings				AEDA	Ongoing	
	Customize the ECBC code according to the various climate zones and seismic zones in Assam	0.50		VH	AEDA		
	Enforcing BEEs energy conservation building code (ECBC) in all 14 major towns for -efficient lighting systems - Efficient cooling systems -Efficient heating systems	14.00		H	AEDA		NDC – 3 Goal – 12
	Promote Energy efficiency in religious places through awareness generation	1.00		H	AEDA		Goal – 7
	Design fiscal incentives for supporting private owners to follow energy efficiency regulation	0.25		H	AEDA		
	Train managers on green building practices and auditing in all the 14 cities	14.00		VH	AEDA		
4	Promote energy efficient Household appliances						Goal – 12

	Introduce scheme to replace 4 CFLs with 1 LED-awareness generation. Tie up with LED producer, recycler. Develop fiscal incentive for the by back process	1.65 0.25 0.25		H	AEDA		
	Ensure presence of only 3 star and above domestic appliances (ACs, fridge) in markets	0.10		VH	AEDA		
	Create a mechanism to extract heavy fine from any seller selling Air Conditioner and Refrigerator with energy efficiency that is rated less than 3 star	0.25		VH	AEDA		
	Create awareness through media	1.65		VH	AEDA		
5	Energy efficiency in Agriculture						Goal – 7
	Only star rated diesel/electricity driven pump sets to be sold in the market-awareness generation and enforcement	1.00		VH	AEDA		
6	Energy efficiency in Industries					Ongoing	Goal – 9
	Identify energy intensive SME clusters and identify energy efficient measures that can be propagated-A study	1.0		VH	AEDA		
	Implement the measures through fiscal incentives	0.25			AEDA		
7	Promote energy efficiency in street lighting and external lighting in housing societies by introducing LEDs	0.25			AEDA		Goal – 7
	TOTAL	37.15					

25.3 MONITORING AND VERIFICATION

To ensure the regular progress on the action plan on climate change, some verifiable indicators have been identified and are being given below:

TABLE 42: MONITORING AND TRACKING INDICATORS FOR UNDERSTANDING THE PROGRESS IN ENERGY EFFICIENCY IN THE STATE

Monitoring area	Short term indicators	Medium Term indicators	Long term indicators
Per capita energy consumption (gender - segregated data to be collected)	Percentage of population with access to electricity (men and women) Energy intensity measured in terms of primary energy and GDP	Proportion of population with primary reliance on clean fuels and technology; %change in energy intensity	% increase in population access to clean energy; RE share in total energy consumption
Demand generation gap (seasonal)	Peak Demand vs peak generation; Plant Load Factor		
% of total village electrified	Baseline to be established	%age increase to baseline	%age increase to baseline
% total of Household electrified (i) Rural (ii) Urban	Baseline to be established	%age increase to baseline	%age increase to baseline

Of these female-headed household data to be collected and monitored			
% of RE installed capacity against the total installed capacity	Baseline to be established	%age increase to baseline	%age increase to baseline
% of RE generation against the total power generation	Baseline to be established	%age increase to baseline	%age increase to baseline
T&D Losses & A & TC losses ant rank of Assam against the rest of the states	Baseline to be established	%age increase to baseline	%age increase to baseline
Energy efficiency in the industries based on regular Energy Audits	Baseline to be established	%age increase to baseline	%age increase to baseline
Energy efficient Irrigation pump installed against the target	Baseline to be established	%age increase to baseline	%age increase to baseline
Number of solar irrigation pump against the target	Baseline to be established	%age increase to baseline	%age increase to baseline
Energy Conservation Building Code Adoption	% All new and Government buildings are ECBC compliant	% of the all residential and industrial buildings are ECBC compliant	% of area covered by buildings is ECBC compliant

27. Disaster Management

26.1 OVERVIEW, CHARACTERISTICS AND STATUS

India being geographically located in the climate vulnerable zone, several studies of floods and droughts in the country emphasize on developing action plan for disaster management. Disaster risk reduction cuts across different aspects and sectors of development. The link between Adaptation, Disaster Risk Reduction and Loss and Damage is important. Thus, NDC targets to better adapt to climate change by enhancing investments in development programmes in Disaster Management as one of the key sectors. Disasters are also threat to Sustainable Development Goals. Disasters affect more the vulnerable communities and sections of the community. Less privileged and poor are more affected in case of the disasters. It has been witnessed that due to the climate change frequencies and intensities of all kind of disasters have been increased. In order to achieve these goals, India has set up Disaster Relief Funds at all levels and launched the National Disaster Relief Fund.

Due to its topographic and climatic conditions, Assam is vulnerable to numerous extreme climate events, which may lead to the disasters. The state faces flood, droughts, cyclones/extreme winds etc. The intensity and frequency of the extreme event is also increasing due to climate change. A detailed analysis of the existing hazards in Bihar has been presented in the “Assam State Disaster Management Plan”. The plan has categorised to address assessment, preparedness and responses related gaps for disaster management. The integration has been done from disaster perspectives and from department perspectives.

Evidences show that there is high probability of increase in the frequency and intensity of climate related natural hazards due to climate change and hence increase in potential threat in India, and Bihar is no exception to this. Being geographically, physiologically and ecologically diverse, scenario is expected to get further gripped in the future. Assam is highly vulnerable to floods being in middle of Brahmaputra and Barak river basins. The state is, in addition also vulnerable to Droughts, Erosion and wind / cyclones related disasters. These have been described in reference to the state.

26.2 FLOODS

Assam lies in the between of the Brahmaputra and Barak river basins. The Brahmaputra basin is one of the largest river basins in the northeast region of India. The river Brahmaputra originates from the semi-arid region of south Tibet. The Brahmaputra basin covers an area of 5,80,000 sq.km., out of which 70,634 sq.km. falls within Assam. The Assam basin has a length of about 1540 km in east-west direction and a maximum width of 682 km. in north-south direction. Due to this geo-climatic condition, flood hazard risk is of concern in the Brahmaputra and Barak river basins in Assam.

The Brahmaputra Valley in Assam is one of the most hazard-prone regions of the country, with more than 40% of its land (3.2 million hectares) susceptible to flood damage. This is 9.4% of the country's total flood-prone area. About 7% of land in the state's 17 riverine districts has been lost because of river erosion over the past 50 years (Source: Environment Assessment Report, India: Assam Integrated Flood and Riverbank Erosion Risk Management Investment Program, ADB June 2009).

26.3 POTENTIAL IMPACT OF FLOODS

Flood itself mean the overflow of large amount of water beyond its normal limits. The area beyond normal limit is generally a dry area and not designed to hold/flow this much amount of water. This, depending on the amount and flow of water may cause the following:

- Loss of lives due to drowning
- Disruption of transport (rail/road/air) and other facilities

- Electrocutation due to flooding /wetting of electrical facilities (especially high voltage transmission system)
- Damages of the property (houses and house appliances, industries/machineries and vehicles etc)
- Distress migration
- Capsizing of boats
- Caving in of drainage channels/ large pits
- Increased water borne and vector borne diseases and epidemics (due to humidity, rotten bodies of animals and polluted water) after the flood subsides
- Lack of clean and safe drinking water
- Poor sanitation conditions
- Features like incapability of contributing towards household income; feeling of insecurity due to vulnerability and sexual exploitation; lack of space for safe and secure defecation; compromising personal space to accommodate other displaced family members within limited area; break down of social fabric; loss of stored grains and household assets; increasing loans; health concerns and death have a negative influence on women. As a result, floods get to be the reason for their psychosomatic mess and hence a disaster as well.

26.4 DROUGHT

More rigorous studies are required at regional scale to ascertain intraregional 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 Cr due to crop failure and other peripheral effects. Later on, drought during October 2008 to July 2009 also has severely affected agriculture and production of hydropower in Assam and its neighbouring states.

26.5 POTENTIAL IMPACTS OF DROUGHT

Even though the droughts are the slow oncoming events but considering their geographic coverage its potential impact is at large scale. It can cause the following:

- Lack of accessibility of drinking and irrigation water
- Loss of agriculture productivity
- Loss of lives due to inaccessible water and food and loss of employment/employment opportunities
- Large scale distress migration, due to loss of employment and employment opportunities in agriculture fields

26.6 CYCLONES/WINDS

Assam is situated in the north eastern direction of Bangladesh which is highly prone to cyclone/winds. Every year about 60% of the area affect by cyclone in Bangladesh. Due to the location aspect, districts like Dhubri, Gaolpara, Hailakandi, Chachar and Karbi Anglong are more prone to cyclone/winds. Districts namely Kokrajhar, Bongaigaon, Kamrup, Barpeta, Nalbari, Darrang, Sonitpur, Nagaon, Marigaon, Lakhimpur, Dhemaji, Sibsagar, Jorhat, Golaghat, Dibrugarh, Tinsukia and Karbi Anglong are likely to experience wind speed of 50 m/s whereas districts like Hailakandi, Karimganj and Cachar has wind speed of more than 55m/s and are more vulnerable to cyclonic storms. Occasional cyclones do occur in western Assam their severity is more during monsoon. According

to BMTPC cyclone zonation, north-west districts of Assam lying in zone of high damage where wind speed can reach up-to 47 m/s. District very close to Bangladesh are in very high damage zone due to close proximity of Bay of Bengal (which is a cyclone basin). In this zone wind speed can reach up-to 55 m/s, can resultant into large scale damage. Fig 17 indicates the wind speed zonation of Assam along with the tracks of the recent events of cyclones recorded within the state. According to IMD Cyclone e-Atlas track records for the period 1968-2008 shows two cyclone events passing through the State. According to the Lutheran World Federation/Department for World Service India Program (ACT/LWS India) 2003, a short but devastating storm with torrential rains did occur in areas of Dhubri, Dhemaji, and Sointpur districts of Assam on 22nd April 2003, Mancachar Sub division of Dhubri district situated in the western corner of Assam was affected by this event. Almost 48 people killed, and 1,500 persons were injured in this event. There was also a record of similar event on December 23rd, 2010. During this event, Karbi Anglong, Cachar and Hailakandi were affected by severe winds.

26.6 POSSIBLE IMPACT OF CYCLONES/HURRICANES

There are following possibilities, in which manner high speed wind velocities can affects the lives of people.

- Damage of buildings / infrastructure
- Damage of lives
- Damage of the transmission and communication infrastructure
- Damage to the vehicles/and other property/ trees etc

26.7 SOIL EROSION

The Brahmaputra basin is an example of an extremely heterogeneous watershed with complex topography, high spatial variability in land cover. The elevation profile of the Brahmaputra river is illustrated in Figure 14. Additionally, the climate is complex within the catchment because of the altitudinal range, the geographical location and the influence of the South Asian monsoon systems. Further, the tectono-sedimentary province along the Brahmaputra river valley in the state of Assam is near about 720 km long and 90 km wide with high variation in elevation which is home for nearly 26 million people. It ranges 120 m at Kobo in the extreme east through 50.5 m at Guwahati to 28.45 m at Dhubri in the extreme west (Sarma, 2005). The above factors give rise to riverbank erosion which has been a regular phenomenon in Assam. Erosion history of Assam indicates that between 1912 and 1996 around 868 sq.km. of land was lost to bank erosion; averaging to about 10.3 sq. km. of area lost per year. Further, the research conducted by Sharma et al. (2010) also made evident that significant erosion occurred in Assam due to Brahmaputra river between 1914 to 1975. According to Kotoky et al. (2004), the bank line of the Brahmaputra is extremely unstable consisting mostly of fine sands and silts. Large scale slumping of river banks does take place when the level falls after a flood. Further, the braided nature of the Brahmaputra adds unpredictability to erosion problem making it more serious.

26.7 EXISTING FRAMEWORK FOR DISASTER MANAGEMENT

SENDAI FRAMEWORK FOR DISASTER RISK REDUCTION AT LOCAL LEVEL

- On the occasion of the 50-year anniversary of the devastating Florence floods, the Government of Italy and the City of Florence in partnership with the United Nations Office for Disaster Risk Reduction (UNISDR), United Nations Human Settlements Programme (UN-Habitat) and United Cities and Local Governments (UCLG) had organised a High Level Forum gathering Ministers, Mayors, policymakers, local government authorities, private sector, experts and partners from across the world with interests and engagement in local and urban resilience and disaster risk reduction which aimed to address:

- Highlight the importance of disaster risk reduction at the core of the sustainable development and climate change agendas.
- Provide inputs towards the preparations of Habitat III Conference (Quito, 2016), The Climate Change COP22 (Marrakesh, 2016), and the Fifth Global Platform on DRR (Cancun, 2017).
- Promote coherence in local level implementation of the post-2015 international agreements (i.e. the Sendai Framework for Disaster Risk Reduction, the Sustainable Development Goals –SDGs, and the Paris Agreement on Climate Change)
- The high-level forum challenges policymakers, local government authorities, private Sector, experts and partners to:
 - A set of commitments to actions that will enable the local authorities to risk proof their investments, and keep citizens and businesses informed and aware, so as to address current and future risks that may impact their communities.
 - Real actions addressing the challenge of the implementation and achievement of those targets defined by the international agreements for local authorities with a focus on disaster risk reduction and building resilience.
 - Sharing and spreading knowledge, good practices and non-sensitive data.
 - Identifying plans and actions to be considered in future global forums, such as Habitat III Conference (Quito, 2016), The Climate Change COP22 (Marrakesh, 2016), and the Fifth Global Platform on DRR (Cancun, 2017).

HYOGO FRAMEWORK FOR ACTION (HFA)

Building the Resilience of Nations and Communities to Disasters (HFA) is the first plan to explain, describe and detail the work that is required from all different sectors and actors to reduce disaster losses. It was developed and agreed on with the many partners needed to reduce disaster risk - governments, international agencies, disaster experts and many others - bringing them into a common system of coordination. The HFA outlines five priorities for action and offers guiding principles and practical means for achieving disaster resilience. Its goal is to substantially reduce disaster losses by 2015 by building the resilience of nations and communities to disasters. This means reducing loss of lives and social, economic, and environmental assets when hazards strike

Priority Action 1: Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.

Priority Action 2: Identify, assess and monitor disaster risks and enhance early warning.

Priority Action 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels.

Priority Action 4: Reduce the underlying risk factors.

Priority Action 5: Strengthen disaster preparedness for effective response at all levels.

26.8 NATIONAL POLICY ON DISASTER MANAGEMENT

Launched in 2009, this policy envisages to build a safe and disaster resilient India by developing a holistic, proactive, multi-disaster oriented and technology driven strategy through a culture of prevention, mitigation, preparedness and response. The objectives of the national policy on disaster management are:

- Promoting a culture of prevention, preparedness and resilience at all levels through knowledge, innovation and education.
- Encouraging mitigation measures based on technology, traditional wisdom and environmental sustainability.
- Mainstreaming disaster management into the developmental planning process.

- Establishing institutional and techno-legal frame works to create an enabling regulatory environment and a compliance regime.
- Ensuring efficient mechanism for identification, assessment and monitoring of disaster risks.

Developing contemporary forecasting and early warning systems backed by responsive and failsafe communication with information technology support.

Promoting a productive partnership with the media to create awareness and contributing towards capacity development.

- Ensuring efficient response and relief with a caring approach towards the needs of the vulnerable sections of the society.
- Undertaking reconstruction as an opportunity to build disaster resilient structures and habitat for ensuring safer living.
- Promoting productive and proactive partnership with media in disaster management.

THE DISASTER MANAGEMENT ACT 2005

Act Launched in 2005, it extends to the whole of India. The Act provides for "the effective management of disasters and for matters connected therewith or incidental thereto. The NDMA is responsible for "laying down the policies, plans and guidelines for disaster management" and to ensure "timely and effective response to disaster". Under section 6 of the Act it is responsible for laying "down guidelines to be followed by the State Authorities in drawing up the State Plans.

26.9 ASSAM DISASTER MANAGEMENT PLAN BY ASSAM STATE DISASTER MANAGEMENT AUTHORITY

The Authority as adopted the integrated approach for addressing the Disaster, it can be given as below:

- The Comprehensive risk management approach: the ASDMA focuses on five missions of DM viz. Preparedness, Prevention and mitigation, Response and rehabilitation.
- All Hazard Approach: State of Assam is exposed to range of hazard risks. ASDMA has expanded to address DM planning from "all hazards approach". This arrangement calls in for DM arrangements that can cater to range of possible hazard risks and disasters
- All Agencies Approach: Inter-agency collaboration is essential for DM planning. A range of risk reduction and emergency response options could emerge through collaborative arrangements. It is not possible for any one agency to prepare/deal with the consequences of disaster event. This approach involves coordination of activities across all levels of the government departments required to contribute to ASDMA's principle focus areas
- The resilience Approach: Resilience is the capacity of systems and communities, potentially exposed to hazards, to adapt by resisting or changing, in order to reach and maintain an acceptable level in functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures (UNISDR).
- Enhancing local disaster management capabilities:

26.10 STRATEGY

Following are the goals have been identified as a strategy to address the Disaster Management:

- Hazard identification and arriving at comprehensive Composite Multi-Hazard Risk and Vulnerability Assessment (Atlas) for the State of Assam
- Minimize loss of life and injuries
- Minimize damage, disruption of services
- Minimize loss of livelihood and business interruption
- Minimize damage to environment

To ensure proper coordination among different departments, it has been decided to provide a nodal officer from the ASDMA in 16 departments, who will be coordinating the preparedness of the department and ensure prioritization of the DM related issues within the departments.

Following is the specific action plan for disaster management, as per the ASDMP:

Phasing of Activities			
Description	Planning Phase	Integration Phase	Operational Phase
Preparedness	• Circulation of ASDMP 2013 • Guidelines to Stakeholders for Preparation of Department / Sector Sub-Plans • Development of State HRD Plan by ASDMA • Discussion on Disaster Preparedness Policy for the State • Training and Capacity Building activities by ASDMA • Identification of SDMG and commissioning through formation of expert group	• Conduct / Compilation of detail risk assessment studies across the State by ASDMA • Release of SDMG • State Preparedness Policy • Department wide preparation of DM Plan • Training on DM by department to select staff involved / identified to handle DM tasks • EW protocol fully established in pilot districts and implemented with support of the local communities (End-to-end EWS)	• Department DM Preparedness Plan • State DM Preparedness Plan
Prevention and Mitigation	• Discussion on Disaster Mitigation Policy for the State • Sharing of SOP outline indicated in the Plan and request for resubmission of SOP wrt mitigation guidance note • Discussion on arrangement for protection of Critical Infrastructure Protection	• EE	• Department DM Prevention and Mitigation Plan • State DM Prevention and Mitigation Plan
Response	• Sharing of SOP outline indicated in the Plan and request for resubmission of SOP wrt response	• Response SOP's finalized by all participating departments and other institutions	• Department DM Response Plan • State DM Response Plan

	guidance note	including the Indian Red Cross State Response Plan prepared on the lines of finalized department SOP's for Hazard specific response	
Rehabilitation	- Discussion with departmental lead engaged in recovery role and suggesting plan of action wrt guidance note on recovery - Revisit of rehabilitation policy in light of the ASDMP	Guidance note highlighting principles and phase wise approach for immediate post-disaster recovery phase, rehabilitation and reconstruction issues to all Departments of the State	State Rehabilitation and Reconstruction Plan

SECTION C: WAY FORWARD

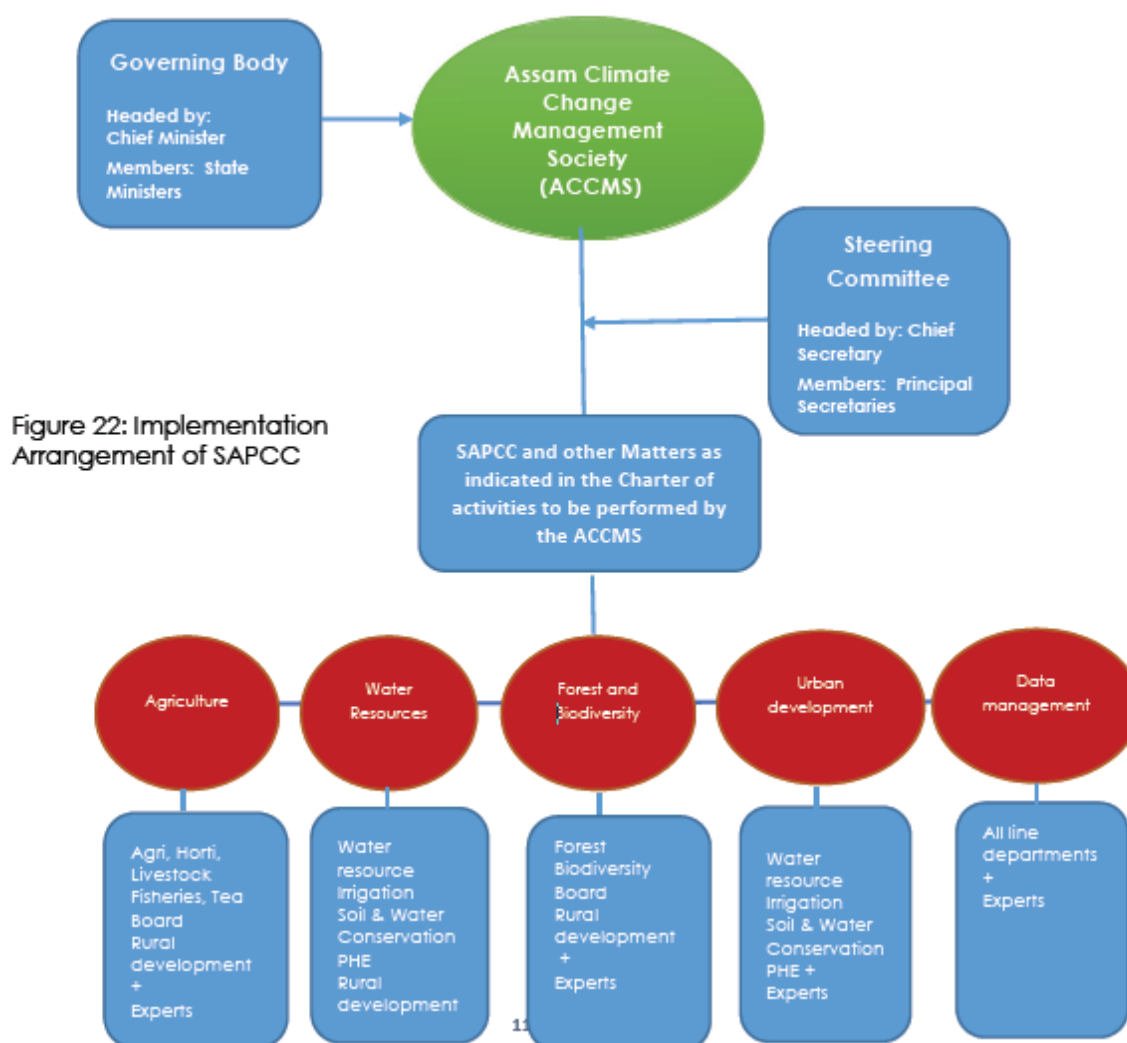
28.Implementing SAPCC and Knowledge Management

27.1 IMPLEMENTING SAPCC

Implementing SAPCC: Assam Climate Change Management Society (ACCMS) -A Special Purpose Vehicle (SPV) has been created in the State recently in August 2018, which will coordinate all SAPCC and other activities related to climate change with different departments in the State. The Society has a Governing Council headed by the Chief Minister with council of Ministers as its members and supported by a steering committee chaired by Head of Department of Environment and Forest, Government of Assam.

The nodal department for coordinating ACCMS is department of Environment and Forest, Government of Assam. Figure below schematically represents the implementation arrangement of all matters related to climate change in the state including implementation of the SAPCC.

The roles and responsibilities of the various components of the Society are briefly mentioned below:



The Assam Climate Change Management Society: the roles and responsibilities of the ACCMS include:

- Implementation of the SAPCC and the projects and programmes emanating from it
- Update it on a regular basis as per the advancement of knowledge on climate change,
- Addressing the requirements of the National Action Plan on Climate Change from time to time
- Facilitate implementation of India's commitment if any to the UNFCCC
- Create Knowledge management platform and data base for informed decision for integrating climate change adaptation in planning in consultation with various agencies in the country
- Liaise with all departments through their climate change nodal officers
- Will formulate Monitoring and Evaluation framework to assess progress of projects and to assess that adaptation is taking place
- Will launch new studies that address mitigation and adaptation with funding from the State Governments/ central government/ various missions of the NAPCC/climate change funds – national and international
- Build capacity of natural resource and energy managers to address climate change within their domain
- Any other

The Governing body: the governing body will be headed by the Chief Minister and is responsible for policy planning and coordination, innovation, resource mobilization and for synergizing the efforts of the various stakeholders. The members of governing body will be the Ministers of various departments in the State and distinguished experts.

The Steering Committee: Will be headed by the Chief Secretary of the State and the members will be the head of departments. The role of the Steering Committee will be to provide guidance on all activities that will be undertaken by the Society.

Technical experts: The technical experts will be subject matter specialist with a knowledge of climate change science, impacts and mitigation. They will ensure implementation of all the envisaged activities mentioned as the role of the Society. The following specialists will be / are part of the team:

- Data Management, GIS and web portal hostile
- Water Resource
- Agriculture
- Forest and biodiversity
- Urban development
- Energy
- Any other

Cost implication for running the Assam Climate Change Management Society will be in the tune of 15.00 Cr in ten years.

27.2 KNOWLEDGE MANAGEMENT

Knowledge about climate change, its impacts and associated extent of vulnerabilities, is a matter of strategic importance for all countries as they need to preserve and protect their natural resources, adapt to the changing climate and help contain the concentration of greenhouse gases in the atmosphere at a level that does not dangerously alter the climate system and jeopardize the security of human well-being vis-à-vis, its food security, economic security and environmental sustainability.

Formulation of integrated data bases is therefore of upmost importance, as this will enable researchers help policy makers to take informed decisions while formulating policies. It is proposed

that knowledge management in the State can be done through support of various projects that explore the interaction of climate with various natural resources, the economy, society etc. and also through collation of knowledge/data products from other agencies which can throw light on these issues.

Producing the knowledge acquired for use of various stakeholders will also be an essential area of activity of the knowledge management component of the SAPCC.

S. N.	Strategies: Knowledge Management	Implementing Agency	Costs (INR Cr)	Priority
1.	Creating a knowledge management portal- Assam climate change knowledge portal and continuously update for next 10 years. Incorporation of Indigenous Technical/Traditional Knowledge (ITKs) in traditional documentation.	Assam climate management society (ACCMS)	2.50	VH
2.	Build capacity within the state to analyse climate change trends and model projections	ACCMS	7.0	
3.	Build capacity to run impact assessment models for various sectors	ACCMS	3.0	
4.	Assess district wise climate change vulnerability and hydro meteorological hazard risk and develop adaption plans for all sectors	ACCMS	8.0	
5.	Scan all program and policies of the government and advise the government as to how all can be made climate resilient.	ACCMS	1.0	
6.	Develop advisory manuals on for all infrastructure design requirements to address exacerbated impacts of climate change in the state of Assam in its various regions.	ACCMS	1.0	
7.	Study & documentation of ground water level in the piedmont plain of northern Assam-Foot hills of Arunachal and Bhutan	Assam Science and Technology and Environment Council (ASTEC)	0.05	VH
8.	Assessment of alternate agri-practices in highly flood prone district, 19 districts	ASTEC	0.38	H
9.	Study of hill-slope destabilization and urban flood management system (Guwahati City)	ACCMS	0.15	VH
10.	Policy review in the context of climate change – Forest policy, agri-policy, draft water policy, industrial policy, 4	ACCMS	0.20	H
11.	Identification of wetlands for protection and management with proper study on hydrology, flora, fauna and economic value, 4 zones	ASTEC	1.60	VH
12.	Identification and conservation strategies of vulnerable biologically sensitive species, 4 institutions	ASTEC	1.40	M to H
13.	Institutional capacity building to handle climate change programmes (all concerned govt. directorates) *, 10 programmes, each 2-3 days	ACCMS	0.50	VH
14.	Development of core group of climate change	ACCMS	0.60	H

	scientists in Assam (training for project development, care-support), 6 institutions			
15.	Hazard Risk vulnerability including impact of climate change assessment including impact of climate change	ASTEC	2.00	
16.	Capacity building of departments across all levels of governance towards integrating CC in adaption Plans	ACCMS	0.50	VH
17.	Education & Awareness on climate change related issues through educational institutions	ASTEC, ACCMS	1.2	
	TOTAL		31.08	

27.3 INTEGRATING CLIMATE CHANGE FINANCE IN ADAPTATION PLANNING

Recent modelling by the Asian Development Bank for South Asia suggested that economic growth would be between 2% and 6% lower by 2050 if climate change adaptation is not factored in development. However, funds required for undertaking adaptation measures need to be available to the governments. It is well known that the international funds are only a fraction of the fund required. Even in the case of Assam, the entire SAPCC budget estimate is indicating a fund requirement of INR 41690 Cr over next 10 years. i.e., each year about 4169 crores will be spent. This is only small part of the State GSDP at current prices.

This amount can be availing pieces from various sources. If adaptation is not systematically undertaken, then this cost will go on increasing becoming a significant portion of the total GDP. Therefore, it is imperative that adaption cost be factored in each year within planning. Now the question is where will this money come from? either it can be through creation of some special fiscal instrument such as creating green cess for the State that will generate enough finance and support annual adaptation activities. However, if the budget is not enough considering the scale of adaptation required, then other mechanisms need to be developed. Therefore, the next step is to understand how every department can identify and factor in the adaptation budget requirements within their planning and develop fiscal instruments that can provide the financial support for undertaking such work on a regular basis.