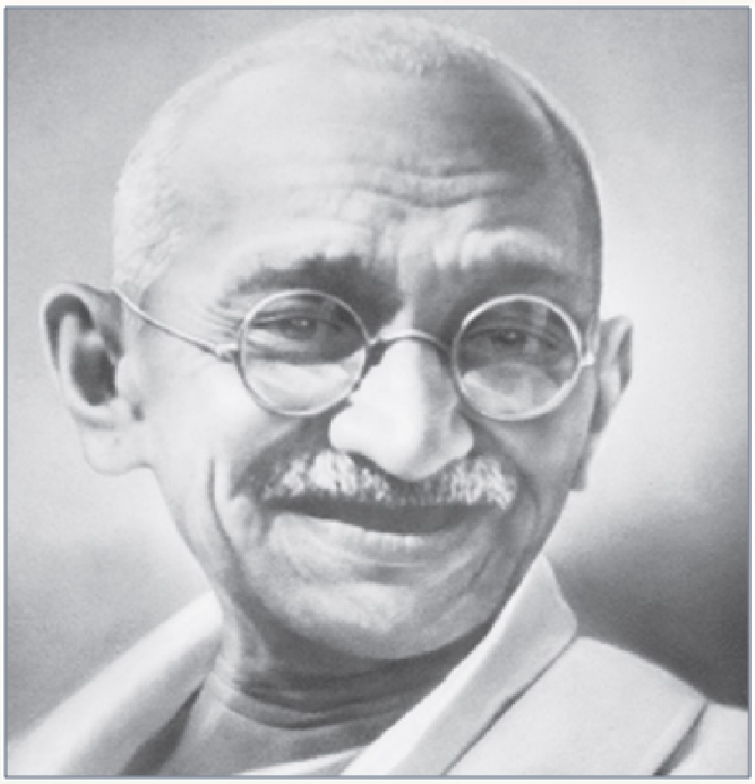
புவி மனிதர்களின் அனைத்து தேவைகளை பூர்த்தி செய்யும். ஆனால் பேராசையினை பூர்த்தி செய்யாது.

தேசத்தந்தை

The Earth provides enough to satisfy every man's need but not greed.

Father of the Nation



Be The Change You Wish To See In The World

U.T. OF PUDUCHERRY
ACTION PLAN ON CLIMATE CHANGE

OCTOBER 2013

DEPARTMENT OF SCIENCE, TECHNOLOGY & ENVIRONMENT

ENDEAVORING TO ENRICH THE ECO FRIENDLY TERRITORY

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Abbreviation and Acronyms

AC - Air Conditioner
ARR –AnnualRevenue Requirement
BEE - Bureau of Energy Efficiency
BLY – Bachat Lamp Yojana
BOV - Battery Operated Vehicle
BPL - Below Poverty Line
BU - Billion Units
C&D - Construction and Demolition
CCAP - Climate Change Action Plan
CDM - Clean Development Mechanism
CDRRP - Coastal Disaster Risk Reduction Project
CERC - Central Electricity Regulatory Commission
CFL – Compact Fluorescent Lamp
CGS - Central Generating Stations
CHC - Community Health Centre
CNG – Compressed Natural gas
CPHEEO - Central Public Health and Environmental Engineering Organisation
CSO - Civil Societies Organisation
DPR – Detailed Project Report
DRDA - District Rural Development Agency
DRDM - Divisions of Risk and Disaster Management
DSM – Demand Side Management
DSTE – Department of Science, Technology and Environment
EC – Energy Conservation
ECBC - Energy Conservation building Code
ED - Electricity Department
EEFP - Energy Efficiency Financing Platform
EOC - Emergency Operation Centre
ESCO - Energy Service Company
FAO - Food and Agriculture Organization
FEEED - Framework for Energy Efficient Economic Development
FI – Financial Institutions
FRI - Forest Research Institute
GA - Geographical Area
GCM - Global Circulation Models
GDP - Gross Domestic Product
GHG – Green House gas
GIM - Green India Mission
GIS - Geographic Information System
GoI - Government of India
GoPY – Government of Puducherry
HP – Horse Power
HT – High Tension
HTL - High Tide Line
HVAC – Heating, Ventilation and Air Conditioning
ICZM - Integrated Coastal Zone Management
IGEA – Investment Grade Energy Audit
IMD - India Meteorological Department
INCCA - Indian Network for Climate Change Assessment
INM - Integrated Nutrient Management
IPCC - Intergovernmental Panel on Climate Change
IRS - Incident Response System
ITI – Industrial Training Institute
JERC - Joint Electricity Regulatory Commission
JNNSM - Jawaharlal Nehru National Solar Mission
JNNURM - Jawaharlal Nehru National Urban Renewal Mission
JPD – Joint Project Director
KAPS - Kaiga Atomic Power Station
KSEB - Kerala State Electricity Board
LAD – Local Administrative Department
LED – Light Emitting Diode
LPD – Litre per Day
LPG – Liquid Petroleum Gas
LT – Low Tension
LTL – Low Tide Line
MAPS - Madras Atomic Power Station

MDF - Moderately Dense Forest
MIS - Management Information System
MNRE - Ministry of New and Renewable Energy
MoEF – Ministry Environment & Forests
MoP - Ministry of Power
MoUD – Ministry of Urban Development
MRT - Mass Rapid Transit
MSL - Mean Sea Level
MSW - Municipal Solid Waste
MTEE - Market Transformation for Energy Efficiency
MTOE - Million Tonnes of Oil Equivalent
MU - Million Units
NAMA - Nationally Appropriate Mitigation Action
NAPCC - National Action Plan on Climate Change
NBC - National Building Code
NBMMP - National Biogas and Manure Management Programme
NCL - Neyveli Lignite Corporation
NF - Non-Forest
NGO - Non-governmental organization
NIT-K - National Institute of Technology
NMEEE - National Mission for Enhanced Energy Efficiency
NPC - National Productivity Council
NPO - Non Profit Organisation
NSDP - Net State Domestic Product
NTPC - National Thermal Power Corporation
O&M – Operation & Maintenance
OECD - Organisation for Economic Co-operation and Development
OF - Open Forest
PAT - Perform, Achieve and Trade
PCA - Principal Components Analysis
PCS&T - Puducherry Council for Science and Technology
PCZMA - Puducherry Coastal Zone Management Authority
PED - Puducherry Electricity Department
PGCIL - Power Grid Corporation India Ltd.
PHC - Public Health Center
PIA – Project Implementation Agency
PIPDIC - Puducherry Industrial Promotion Development and Investment Corporation Limited
PMU - Project Management Unit
PNG - Piped Natural Gas
PPA - Power Purchase Agreements
PPA - Puducherry Planning Authority
PPCC - Puducherry Pollution Control Committee
PPCL - Puducherry Power Corporation Limited
PPP – Public Private Partnership
PUDA - Puducherry Urban Development Agency
PV – Photovoltaic
PWD - Public Works Department
R&D – Research & Development
RDF - Refused Derived Fuel
RE – Renewable Energy
REAP - Renewable Energy Agency of Puducherry
REDD - Reducing Emissions from Deforestation and Forest Degradation
RPA – Regional Planning Authority
RPO - Renewable Purchase Obligation
S&L - Standards and labelling
SAPCC – State Action Plan on Climate Change
SC – Schedule Cast
SCI - System of Crop Intensification
SERC - State Electricity Regulatory Commission
SME – Small & Medium Enterprises
SOP - Standard Operating Procedure
SRI - System of Rice Intensification
STP – Sewage Treatment Plant
STPS – Super Thermal Power Station
SWH - Solar Water Heating
T & CP – Town & Country Planning
T & D – Transmission and Distribution

TDEF - Tropical Dry Evergreen Forest
TNEB - Tamil Nadu Electricity Board
UI - Unscheduled Interchange
ULB - Urban Local Body
UNDP - United Nations Development Programme
UNFCCC - United Nation's Framework Convention on Climate Change
UT – Union Territory
UTOPHO - Union Territory of Puducherry Hydrology Organization
VAT – Value Added Tax
VDF - Very Dense Forest
W_p – Watt Peak
WPR - Work Participation Rate

Executive Summary

Introduction

Climate projections for India suggest that impacts are likely to be varied and heterogeneous, with some regions experiencing more intense rainfall and flood risks, while others encountering sparser rainfall and prolonged droughts including spatial shift in the pattern of rainfall. The coastal areas are likely to suffer from higher tides, more intense storm rising from warmer oceans and further erosion of coastline due to sea level rise. Climate variability or climate change manifests through alteration in frequency, intensity, spatial extent, or duration of weather and climate extremes, including climate and hydro-meteorological events such as heat waves, heavy precipitation events, drought and tropical cyclones which would pose greater risks to human life, endanger the sustainability of the economy.

Regional climate change model has projected warmer climatic conditions with increase in average temperature, rainfall variability and incidence of extreme weather events that might have far reaching impacts on climate sensitive sectors such as agriculture and tourism and underpin the economic development. Yanam area adjacent to East Godavari district (Andhra Pradesh) with a coast line of 177 km is prone to cyclones and depressions. A study by Anna University with analysis of data from 1972 to 2010 has found that low to medium erosion occurs along a km of the total 24 km coast of Puducherry.This is about 4.2% of the total Puducherry coast. The union territory of Puducherry and specially the Puducherry and Karaikal region have in its recent past witnessed the increased incidence of natural hazards such as storm surge, tsunami and cyclone. The tsunami in December 2004 along the coastline of Puducherry and the Thane cyclone in 2011 have resulted in extensive economic and losses of life. The problem of soil erosion in the coastal region and possibility of salt water ingression into coastal aquifers has emerged as a pressing issue. Indeed the projection of the hydro-meteorological and geophysical hazardswould jeopardize the current growth strategy and deepen poverty amongst the vulnerable coastal communities through discouraging engagement of communities in farm and nonfarm sector. The impacts of extreme climate-induced events resulting in loss of life, livelihoods, assets and infrastructure could affect the UT's economic growth and nullify the effectiveness of macroeconomic policies and pro poor initiatives. Given its profile, climate change is an important concern for the UT as it is presently on a carbon-oriented development path and at the same time, it is vulnerable to climate variations.

Process of Formulating CCAP

Post to the National Consultation Workshop convened on 19thAugust 2010 in New Delhi,Government of Puducherry initiated framing of the CCAP (Climate ChangeAction Plan)under the supervision of a Steering Committee. The State Steering Committee (SSC) was constituted under the chairmanship of Chief Secretary with Secretaries of the line departments as members and director DSTE as convener initiated formulation of the CCAP. 19 administrative departments and 5 autonomous bodies were selected as implementing agencies for development of theCCAP (Climate ChangeAction Plan). Puducherry Climate Change Action Plan was formulated with an objective of identifying and prioritizing strategies that simultaneously advance the UT's developmental goals while yielding co-benefits of climate change mitigation and adaptation effectively. It envisages mainstreaming climate change strategies into developmental planning and exploring development of low carbon–climate resilient pathway.From the eight fold national mission the steering committee in turn picked up and strategized actions for the six missions that are relevant to

Puducherry Union Territory. The initial CCAP[1] framed was modified as per the guidelines of the common framework by MOEF with support from PIA under CDRRP programme of The World Bank. Coastal Disaster was later added based on the suggestion in course of the consultation workshop.A consultation was convened towards obtaining the view of the stakeholders from amongst public, government agencies, researchers, NGOs, civil societies and academicians.The series of adaptation and mitigation actions developed in consultation with the Nodal Department were vetted in course of the stakeholder's consultation process.

The structure of the steering committee responsible for the preparation of the CCAP

1. Chief Secretary, GOP - Chairman.
2. Secretary to Government (Animal Husbandry) - Member
3. Secretary to Government (Agriculture) - Member
4. Secretary to Government (Power)- Member
5. Secretary to Government (Fisheries) - Member
6. Secretary to Government (Forest & Wild Life)- Member
7. Secretary to Government (Health) - Member
8. Secretary to Government (Local Administration) - Member
9. Secretary to Government (Planning & Research) - Member
10. Secretary to Government (Public Works) - Member
11. Secretary to Government (Revenue & Disaster Management)- Member
12. Secretary to Government (School Education) - Member
13. Special Secretary to Government (Industries & Commerce) - Member
14. Special Secretary to Government (Transport) - Member
15. Special Secretary to Government (Science, Technology & Environment) - Member
16. Director Dept. of Science, Technology & Environment – Convener

Vulnerability

There are three kind of vulnerability (a) bio-physical impacted by shoreline and other meteorological factors (b) environmental largely impacted due to pollution and (c) socio-economic. Social vulnerability was computed for the four regions by placing socioeconomic variablesin a principal components analysis (PCA), using the varimax rotation option. The analysis suggests Mahe and Yanam region to be relatively less vulnerable as compared to Puducherry and Karaikal considering all the socio-economic factors. Puducherry is most vulnerable (high vulnerability and low adaptive capacity) amongst the four regions. Karaikal has high adaptive capacity (as social capital in rural areas is relatively more and activities are comparatively more resilient than the urban areas) and has high vulnerability.Mahe has low vulnerability and high adaptive capacity (higher literacy and high population density), so also Yanam. The composite vulnerability of the four regions as per their rank is as follows:

Table 1: Composite Vulnerability index and ranking of the four regions of Puducherry

Location	Composite Vulnerability Index	Rank
Puducherry	17.64	1
Karaikal	16.70	2
Yanam	9.87	3
Mahe	5.28	4

[1] CCAP- Climate Change Action Plan

Climate projections reveals an increase in summer temperature by 3-4 °C in moderate emission A1B scenario. Since temperature is projected to increase and there is also likelihood for increase in rainfall with most likely scenario of climate being hot and humid in the near term requiring temperature adaptive agronomic practice and even varieties to withstand water logging and salinity in some low lying areas to reduce vulnerability.Yanam area adjacent to East Godavari district (Andhra Pradesh)with a long coast line is prone to cyclones and depressions. The villages viz. Chollangi, Chollangipeta, G.Vemavaram, Patavala, Coringa, Polekurru, Neelapalli and P.Mallavaram falling under Tallarevu Mandal and Bhairavapalem and Gokullanka falling under Ipolavaram Mandal are highly cyclone/ storm prone. Coastal part of this area is also flood prone.Environmental impacts of flood include soil erosion, silting, water pollution, denudation of land, ingress of saline water in cultivable land will make the coastal communities more vulnerable in case of incidence of the climate extreme events.

State GHG Inventory

Approach was made to develop an inventory of the GHG emission across the union territory considering the fossil fuel and electricity consumption across industrial, domestic, agriculture, and transport sectors whereas emission of methane and nitrous oxide from agriculture and waste(including both solid and liquid waste) sector was estimated. However due to lack of availability of information relating to actual consumption of the fuel oil in the road transport sector a two way approach was assumed. In first case (Case I) Tier 1 method of IPCC relating to the total fuel being sold is used to estimate the GHG inventory. However considering the fact that a considerable proportion of the oil sold to the transportation sector in UTis used by vehicle of adjacent state due to the lower price of the fuel oil in the UT and the boundary being very adjacent the per capita based approach (Case II) is considered. The per capita emission from transportation sector is arrived at from Submission by MOEF in 2007. The total GHG emission is estimated at 4.7435 Million tonnes of CO_2e (considering Emission from transportation sector estimated under Case I) and 3.4641Million tonnes of CO_2e (considering emission from transportation sector estimated under Case II).

The sector wise GHG emission profile in the UT is as follows:

Sectoral Emission	Amount	Unit
Industrial	2.354	Million tonnes of CO_2e
Domestic	0.663	Million tonnes of CO_2e
Transport (Case II)	0.134	Million tonnes of CO_2e
Municipal Solid Waste & Sewage	0.181	Million tonnes of CO_2e
Agriculture	0.132	Million tonnes of CO_2e
Net Emission	**3.4641**	Million tonnes of CO_2e

Considering the total emission of 3.46 million tonnes of CO_2e and population of 1.247 million the per-capita emission is estimated at 2.7 tCO_{2e}as compared to national per capita emission of 1.7tCO_2e (2007)[2].

Solar Mission

The Energy demand in the UT is mostly met using grid based power and fossil fuel. The demand of both the primary and secondary form of energy has grown several folds. Not only the over use of energy is resulting into environmental degradation and contribute substantially to the climate change cause but also enhancing the concern over energy

[2]The national per capita emission hasincreased at a CAGR of 3.3% from 1994 to 2007

security. Out of the total estimated potential of 160 MW of grid interactive renewable energy potential, the cumulative capacity of renewable energy potential being harnessed is 0.02 MW.

The Solar Mission is strategized in line with the National Solar Mission with objectives to meet the country's development goals and energy security of the nation while simultaneously yielding co-benefits for addressing climate change effects. Apart from solar energy technology the CCAP (Climate ChangeAction Plan)has emphasized over promotion of other renewable energy technology including policy action of bringing about grid parity.

The Key actions proposed under solar mission are:

Key Priorities: Solar Mission
1. Harnessing renewable energy potential scenario of the UT by Assessment of Solar energy potential across the UT & preparation of solar potential map
2. Mandatory use of solar water heating systems in domestic sector through policy action and demonstration
3. Promotion and facilitation of Renewable energy application in Govt. schools & central kitchens of UT.
4. Enhancement of solar lighting application in public places through demonstration projects
5. Strengthening technical competency of various stakeholders of RE technology including O&M service providers, technicians, installers, manufacturer & others
6. Promotion of Solar water heating system application in health sectors
7. Mandatory use of Solar Water Heating system in hotel sectors
8. Promotion of grid interactive solar power generation in PPP/IPP mode through policy measures and facilitating setting up of 20 MW rooftop and small solar power plants of up to 2 MW capacity.
9. Promotion of solar application in public buildings for lighting and hot water generation through demonstration project of 50 kW solar power and 1,000 LPD SWH installation in two govt. buildings

Promoting Renewable Energy technology is one of the multipronged strategies planned to achieve the key goals in context of climate change and at the same time addresses the concern over energy security, commercial exploitation of renewable power potential, eradication of energy poverty, ensuring availability and affordability of energy supply and preparing the nation for imminent energy transition.The actions proposed for promotion of renewable technology are outlined as follows:

1. Assessment of Wind Energy Potential & mapping of potential wind sites.
2. Assessment of Biomass Energy Potential & preparation of Biomass Resource Map.
3. Promotion of biomass gasifier to meet up electrical and thermal energy requirement.
4. Incorporation of Renewable Energy Obligation (RPO) in building By-Law applicable to major building projects (> 20,000 sq. ft).
5. Renewable Power Obligation fixed at 2% of the power purchase from Renewable Energy Source to be scale up to 10% by 2020.
6. Formulation of Renewable Energy, Energy Conservation and Energy Efficiency policy.
7. Facilitating waste to Energy Projects.
8. Promoting private investment in setting up of projects for power generation from renewable energy sources through an attractive mix of fiscal and financial incentives.

Enhanced Energy Efficiency Mission

The power demand of the Union Territory including that of the four regions of Puducherry, Karaikal, Mahe and Yanam is around 349.97 MW (Megawatt). A part of it is met from the UT ownedGas based Power Plant of 32.0 MW and power drawn from other state and central sector power plant or southern regional grid. The total consumption of power across the UT considering all segments of consumer is 2364 million units.

The issue of the energy efficiency in this context becomes more pertinent as the saving of energy use will lessen the dependency of the UT to procure power from the neighboring state or from regional grid over and above the central sector allocation. A considerable potential of energy saving lies agriculture, industry, domestic and municipal sector. An estimated annual saving of 248 million units of electrical energy is possible through incorporation of energy conservation measures as against the total electricity consumption of 2,225MU. The average energy saving potential estimated at 11%. Considering the projected energy demand of 2,435 million units for 2013-14 the saving potential will range to around 272 million units. The key priority actions proposed under Enhanced Energy Efficiency Mission are:

Key Priorities: Mission on Enhanced Energy Efficiency
1. *Provisioning of LED/CFL distribution to household and replacing incandescent lamp*
2. *Development and promotion of Policy measures towards up-gradation of existingproduction/manufacturing process across the industrial facilities to energy efficient one.*
3. *Enforcing Energy Audit and its implementation across the industrial facilities*
4. *Incorporate conditions as a part of building permit to adopt star rated energy efficient electrical appliances and use of CFL*
5. *Institution of Energy Conservation Award*
6. *Enforcement towards use of Energy Efficient Lighting in all Govt. & commercial building*
7. *Facilitating energy audit across all large (in terms of energy consumption) government offices and retrofitting of existing energy inefficient system with efficient and star rated products.*
8. *Promoting and Adapting Energy Efficient technology measures and practices in new building*
9. *Creation of Green Corpus fund*

Sustainable Habitat Mission

Climate change is expected to have multifarious impacts on Puducherry. Overall, this Union Territory is expected to be warmer with increase in maximum and minimum temperature, experience a large degree of rainfall variability and extreme weather events which would have far reaching effects on climate sensitive sectors such as agriculture and tourism underpinning the economy of Puducherry. Urban Heat Island (UHI) effects were concluded to be real local phenomena with negligible impact on large-scale trends. UHI and land-use land-cover change (LULC) effects arise mainly because the modified surface affects the storage and transfer of heat, water and airflow. For single discrete locations these impacts may dominate all other factors. Further, the coastal setting of this Union Territory also adds to the vulnerability of the region.30.3% of the coastline along Puducherry region and 11.5% of the coastlines along Karaikal Region are already under threat of coastal erosion. Sea level rise would also result in acceleration of Sea water intrusion into the fresh water aquifers. At the same time, better urban planning and policies can reduce energy use and Green House Gas (GHG) emissions and improve the resilience of urban infrastructure to climate change, thereby shaping future trends. The key priorities proposed are:

Key Priorities: Sustainable Habitat
1. Adopting ECBC code for residential apartments and commercial centers
2. Waste water recycling & Strengthening/ modifications of exiting STPs
3. Promotion of Green buildings and green building certificate
4. Municipal solid waste management
5. Establishment of modern slaughter house within Puducherry Municipality
6. Capacity building programmes of Urban Local Bodies (ULBs)/ stakeholders of the coastal towns on potential climate change impacts (Tsunami, cyclone, flooding of low-lying coastal areas, land loss and

displacement) and additional preparedness requirements.
7. *Construction of Flyover and laying of bypass road*
8. *Providing/ renewing underground sewerage systems to urban areas*
9. *Promotion of eco-friendly road construction methods and capacity building of stakeholders*
10. *Climate friendly transport management and promotion of Public transport*
11. *Promotion of use of cooking gas from kitchen waste in bio-digester*

Green Puducherry Mission and Sustainable Agriculture

Increased atmospheric carbon dioxide (CO_2) concentration and its impact on global climate are likely to alter forest ecosystems. In this context it is also worthwhile to mention that increased concentration of CO_2 in the atmosphere might favor the plant growth and especially the C4 variety. On one hand where it is possible that increase of sea level might favor the biodiversity across the coastal line specifically the mangroves that tolerate high salinity provided the ecosystem can tolerate the amplitude of sea level rise on the other hand any rise of the sea level or the increase in sea temperature might impact the coral reef ecosystem. Irrespective of the impacts it render either positive or negative it is imperative to mention that the impact of climate change will result into abiotic and ecological stress at regional level on the forest ecosystem. The quantum of forest in the UT is however considerably low due to higher population density and lower geographical area. The forest cover of Puducherry is spread over 50.06 sq. km which is 10.43% of the UT's geographical area

Agriculture is the mainstay of rural livelihood providing direct employment to around 50% and indirect employment to 20% of the rural population. Irrespective of the sector providing livelihood opportunity to a considerable percent of the population the contribution of the agricultural and its allied sector to the UT economy is substantially low. Out of the total area of 48651ha covering all the four regions across the UT the net shown area is 18,129 ha comprising around 37% of the land area. The fisheries encompass coastal fishery across 45 km of coast line and inland fishery. Total amount of marine and inland fish catch in 2011 is 42,347 MT and that of prawn is around 3,809.7 MT.

The primary sector comprising of agriculture, animal husbandry, forestry, fishing, mining and quarrying contributes to around 5% of Net State Domestic Product (NSDP at current price). The contribution of agriculture and its allied sector to UT's income has declined substantially from 11.35% in 1994-95 to around 5% across 2011-12 irrespective of the continual effort by the agriculture department of the government of UT.

The Key priority actions proposed are:

Key Priorities: Mission for a Green Puducherry& Sustainable Agriculture	
1.	*Enhancing productivity through introduction of genetically superior seedlings*
2.	*Eco-restoration of coastal areas by bio shelter plantations*
3.	*Wildlife and biodiversity conservation by insitu & exsitu methods*
4.	*Enrichment of existing forest density*
5.	*Promotion of farm forestry and agro forestry*
6.	*Consolidationand protection of forests*
7.	*Watershed development through vegetative means*
8.	*Development of ecotourism and involving local communities*
9.	*Identification and propagation of adaptive species through modern nurseries*
10.	*Study on REDD & REDD + Feasibility for Afforestation in Puducherry*

11. Capacity building of staff
12. Protection of Mangrove forests
13. Monitoring critical faunal habitats [turtles/ littoral birds]to assess impact of climate change
14. Drip Irrigation for 30% of land area under Horticulture
15. Promotion of solar pumps for irrigation purpose by replacing 5 nos. diesel pumps with solar pumps
16. Educating farmers on better cropping systems, drought resistance crop, minimization of chemical fertilizer and encouraging organic farming and soil reclamation program
17. Replacing existing pumps by foot valve motor pumps in Karaikal region

Water Mission:

The water resources continue to be undervalued and overused without regard to current costs and future requirements. Traits of growing economy like urbanization and industrialization are taking toll on the water bodies causing large scale pollution. Demand of water for domestic needs, livelihood, industrial and agricultural use; have certainly led to unplanned and over-extraction of ground water. Neglect of tanks and water bodies, discharge of effluents, contaminated water from hatcheries have caused water pollution which have gradually snowballed into severe water resource problems in the UT. As against the total available water of 200 MCM the demand of water across various sectors area:

Sector	Quantity (MCM)	Percentage
Domestic	35.35	16
Agriculture	174.40	81
Industries and Others	7.02	3

Ground water contributes in meeting up the major share of the required water i.e around 174.6 MCM with remaining demand being met from surface source including river and tanks. Added to the burden of rapid and unplanned urbanization, the consequences of climate change are manifested through variability in river flow, increased frequency and intensity of natural weather events, ground water table depletion in alluvial aquifers due to variation in rainfall.

The Key priority actions proposed under water mission are:

Key Priorities: Water Mission
1. Rain water harvesting pond creation of 10% of land area by 2013 and 50% by pipeline irrigation by 2015
2. De-siltation of all the temples and village/ farm ponds by 2015
3. Channelizing storm water into village pond or ground water recharge by 2015
4. Promotion of percolation pits in housing colonies and in urban areas
5. Rainwater harvesting for all type of new and existing buildings (Residential, Commercial and Industrial buildings) by 2013 and 2015 respectively

Strategic Knowledge Mission:

Enhancing coping capacity is a way towards reducing vulnerability and enhancing the resilience of the community. Enhancing technical knowhow, assessment of vulnerability, creating awareness as well as building the capacity of the vulnerable population is the measures towards enhancing the coping capacity and reducing the vulnerability of the population. Measures to generate strategic knowledge and develop understanding of the population, policy makers, decision makers and stakeholders towards disaster risk reduction. The knowledge strategy developed should be comprehensible and executable by the stakeholders at large. The knowledge networks should operate in a hub-and-spoke

model with nodal institutions linked to a wider range of knowledge partners linking to both intra-mural and extra mural research support system. This should minutely address the issues and at the same time support the need for economic and livelihood growth of the UT. While in theory this is desirable, in practice many institutions and bodies operate on silos and this paradigm needs a change.Climate Change Cell proposed to be formulated under DSTE will be the nodal agency responsible for implementation of the strategic knowledge mission.

The key priority actions proposed under the mission are:

Key Priorities: Strategic Knowledge Mission
1. *Creating awareness on water and energy conservation, composting, source segregation of House hold waste, plantation Rain water harvesting pond creation of 10% of land area*
2. *Educating farmers on better cropping systems, drought resistance crop, minimization of chemical fertilizer and encouraging organic farming and soil reclamation programme channelizing storm water into village pond or ground water recharge*
3. *Advocating clean development mechanism, resource conservation and waste minimization through seminar/ workshop Rainwater harvesting for all type of new and existing buildings (Residential, Commercial and Industrial buildings)*
4. *Capacity building on mitigation/adaptation of Green House Gases among the officers and establishment of a climate change cell*
5. *Inventorisation of GHG generation from industries and other sectors*
6. *Setting up of Energy Bench Mark for all government buildings/ institutions*
7. *Establishing a network of knowledge institutions, location specific research on climate science, setting up of an effective mechanism for data sharing and access and organizing conferences/ workshops on climate change and related issues*
8. *Evaluation of action plan programmes and providing budget support to implementing departments/ authorities*

Mission on Coastal and Disaster Management

Coastal and Disaster Management is not a mission conceived from the National Action Plan of Climate Change. Conceiving the experience of disastrous impact in the past across the regions mostly due to the hydro meteorological and geophysical hazards and based on the input in course of the consultation the sector has been provided with additional importance under the CCAP and conceived as separate mission.

Coast lines of Puducherry subjected to hydro-meteorological and geophysical hazards are most likely to impact life, livelihood and infrastructure of the coastal communities by virtue of the devastation it results into during and after its occurrence. Flooding, storm surges, coastal erosion and shoreline retreat are the disasters across the coast line.The projection of sea level rise (IPCC 5thAssessment Report, The Physical Science Basis), observed increase in sea surface temperature and projection towards increased frequency of climate extreme events might result in serious ramification for the coastal community by resulting into geomorphic changes along the coastline, damage coastal ecosystems and resources thereby undermining social and economic development. The climate change action plan assess the vulnerability of the coastal community in light of the projected variation in climate, weather variability and climate extremes and strategize measures towards effective disaster risk reduction and promote the conceptof disaster resilience. The adaptive measures planned under the CCAP as on one hand is intended to enhance the coping capacity and resilience of the vulnerable coastal communities so that they can respond promptly and effectively during crisis situation as well as quickly recover and transit to a sustainable ways of living

on other hand strategies for climate proofing of the livelihood of the communities. The Action proposed under the mission specifically intends to focus on developing disaster resilient infrastructure and societies, capacity building of the communities, improvise system in place for early warning through incorporating the climate change concern as part of effective coastal zone management plan. The key priority actions proposed as part of the mission are:

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Key Priorities of Mission on Coastal and Disaster Management
1. *Integrated Coastal Zone Management Plan Preparation*
2. *Study on Micro level vulnerability assessment due to climate change on coastal ecosystem*
3. *Integration of Climate change risk in the State disaster Management policy*
4. *Establishment of an integrated training and Capacity building protocoland knowledge management for better assessment of climate risks and best management practices*
5. *Study on Impact of Climate change on Marine Biodiversity with special emphasis on Flagship species and coastal flora and fauna*
6. *Development of Sustainable aquaculture*
7. *Strengtheningdelivering and monitoring system and preparedness in disaster prone coastal area*
8. *GIS based mapping along the selected vulnerable coastal area of Puducherry*
9. *Flood Mapping and Development of Climate change projection Model and its impact on coastal ecosystem in Puducherry*
10. *Assessment of Erosion prone Area with the help of Digital elevation model and strengthen coastal protection method through improved technology*
11. *DPR on flood shelters, multipurpose cyclone shelters in vulnerable location in Coastal line and construction of flood shelters, multipurpose cyclone shelters and climate resilient buildings that can withstand multiple hazards*
12. *Development of a techno legal regime for construction of Disaster resilient housing and public infrastructure*
13. *Demarcation of HTL or LTL along the coastal stretches*

Cross Cutting

There are several cross-cutting issues in the climate change debate.It requires co-ordination amongst different sectors and commitment of multiple stakeholders. The issues impeding the collaboration among the sectors—private, public and civil society is not new. 'Convergence' is a more complex form of collaboration involving multi-stakeholder coalition seeking to influence systemic changes on wide-ranging issues, focused on outcomes than inputs to deliver scalable and sustainable change.Few of the Cross cutting themes and actions proposed under are as follows:

Health and Climate Change

Weather and climate variability has a profound influence on human health. The impact of climate change over human health is likely to be multifaceted involving increased incidence of vector, water and food borne diseases, malnutrition and undernourishment, injuries and death caused by extreme hydrogeological events and thermal stress. Key actions proposed to be taken up are as follows:

1. Monitoring high resolution weather and climate data and develop health impact model to study the regional pattern of diseases.
2. Mapping of geographic areas based on epidemiological data and extent of vulnerability to adverse impact of climate change.

3. Gap analysis and making region wise provision of primary, secondary and tertiary health care facilities, implementation of public health measures including vector control, sanitation and clean drinking water supply.
4. Identify extrinsic and intrinsic drivers of malaria and dengue and identifying immunity intervention measures towards control of incidence of malaria/ dengue.
5. Up gradation of health policy to through including of climate change related health hazards.
6. Study and documentation of diseases caused by water (water borne) and development of institutional mechanism to reduce the incidence/outbreaks of such diseases along with Awareness generation.
7. Development of institutional framework and infrastructural facilities for early detection of vector borne diseases, including managing outbreaks
8. Assessment of health impacts due to malnutrition

Strategic Knowledge

Enhancing knowledge and capacity of the department towards addressing the climate change concern and minimizing the risk of life and livelihood of the community is identified as a matter of utmost relevance. The needs and requirement are outlined as follows:

Geography Strategies	Local	State level	Activity to be undertaken
Awareness	Creating local level awareness is a first step, e.g. barefoot workers, framer field schools may promote descaled climate change concerns	Building awareness of legislators, policy makers on socio-economic and socio-political cost of climate change	Participation in national networks, interface with the national knowledge network and research systems
Capacity	Monitoring, observation Awareness/assessment at state/ district/ community levels	Scientific assessment,measurement, models, with State level technical institutions like PCZMA, DSTE, Regional Centers of National Institution, Universities	Special regional modeling and assessments, best practices study and resource leveraging from various missions and mission resource centers and technical secretariats
Generation of Knowledge/ Information	Locale specific databases, scenarios and assessment, local monitoring networks, rapid assessmentfor input to State inventory	Research networks, Compilation of State level GHG inventory, scientific and policy models, State-wide and area specific scenarios, technology inventory	Interface with IPCC assessments, interfacing with regional/global databases, scenarios and assessments, technology inventory database

Gender and Climate Change

Women are affected disproportionately and differently, due to climate change and associated natural disasters such as floods, droughts, cyclones and storms. This is largely because men and women are bound by distinct socio-economic roles and responsibilities

that give rise to differences in vulnerability and ability to cope with these climate change consequence. Therefore it is important that issues relating to gender safety, violence against women during climate stressed scenarios and adaptation options which are gender segregated need to be worked upon and friendly policies for women need to be incorporated.

Budget

The proposed budgetary estimations for implementation of Climate Change Action Plan in different sectors are only a rough estimate. The total budget has been estimated at INR 13172.10Million for a 5-year period.

Sl. No	Name of the Mission	Number of High Priority Actions	Budget (in Million INR)		
			Existing	Additional	Total
1	Solar Mission	9	1791.06	512.80	2303.85
2	Enhanced energy efficiency	8	1.00	555.30	556.30
3	Sustainable Habitat	11	205.35	2684.95	2890.30
4	Green Puducherry and Sustainable Agriculture	17	0.00	306.15	306.15
5	Water Mission	6	0.00	1040.00	1040.00
6	Strategic Knowledge Mission	8	0.00	87.50	87.50
7	Coastal Disaster Management	13	0.00	5988.00	5988.00
		72	1997.41	11174.7	13172.10

A break up of the budget as per the type of actions (Adaptation and Mitigation) is as follows:

Sl. No	Name of the Mission	Type of Action		Adaptation Budget (in Million INR)		Mitigation Budget (in Million INR)	
		Adaptation	Mitigation	Existing	Additional	Existing	Additional
1	Solar Mission		9	0.00	0.00	1791.06	512.80
2	Enhanced energy efficiency		9	0.00	0.00	1.00	555.30
3	Sustainable Habitat	3	8	202.50	502.50	2.85	2182.45
4	Green Puducherry and Sustainable Agriculture	5	12	0.00	19.25	0.00	286.90
5	Water Mission	6		0.00	1040.00	0.00	0.00
6	Strategic Knowledge Mission	4	4	0.00	72.50	0.00	15.00
7	Coastal Disaster Management	13		0.00	5988.00	0.00	0.00
		31	42	202.50	7622.25	1794.91	3552.45

A break up of the budget as per the time frame (Short Term, Medium Term and Long Term) is as follows:

Sl. No	Name of the Mission	Time Frame			Short Term ActionBudget (in Million INR)		Medium Term ActionBudget (in Million INR)		Long Term ActionBudget (in Million INR)	
		Short Term	Medium Term	Long Term	Existing	Additional	Existing	Additional	Existing	Additional
1	Solar Mission	3	6	0	7.56	30.14	1783.50	482.66		
2	Enhanced energy efficiency	8	1	0	1.00	515.30	0.00	40.00		
3	Sustainable Habitat	6	5	0	205.35	102.45	0.00	2582.50		
4	Green Puducherry and Sustainable Agriculture	4	13	0	0.00	17.00	0.00	289.15		
5	Water Mission	2	4	0	0.00	0.00	0.00	1040.00		
6	Strategic Knowledge Mission	4	4	0	0.00	15.00	0.00	72.50		
7	Coastal Disaster Management	9	3	1	0.00	5716.00	0.00	22.00	0.00	250.00
		36	**36**	**1**	**213.91**	**6395.89**	**1783.50**	**4528.81**	**0.00**	**250.00**

Parts of the Action Plan based on the availability of resources of the departments and additional funds which might have to be provided for certain activities. As the implementation activities progress, the exact situation would be more prominent.

Stakeholders' Consultation

In consultation with the nodal departments, education institute and civil society, a stakeholders' consultation was conducted at Puducherry on 24th September 2013 with representation from all four regions. As a part of the consultation meeting the draft action plan was presented to the stakeholders both in English and regional language (Tamil)along with a copy of the proposed actions to all stakeholders.Apart from the respective actions under each sector each stakeholder was also briefed about the issues of climate change, its projected variability and the probable vulnerability. Around140 participants attended the workshop (includingCTRAN team, organizing team members of DSTE and PIA). Each of the actions proposed under the CCAP were debated and validated apart from the main frame issues like vulnerability and institutional framework. The stakeholder feedback revealed that all the identified priority actions were considered appropriate. Additional issues were raised and suggestions made by the stakeholders during the consultation meeting were incorporated as part of the action plan. The stakeholders were also given a provision to put across their comments vide email or hard copy directly to DSTE or CTRAN. However no such comments were received in the stipulated time period assigned for the purpose (2 weeks).

The major concerns that were highlighted as a part of the consultation programme were land use policy and conversion, water level depletion and damage of existing water bodies, coastal erosion, lack of energy efficiency measures, waste management, vehicular pollution, increase in traffic due to interstate vehicular movement, conservation of coastal biodiversity and ecosystem management.

1 Introduction

1.1 Background

The fifth assessment report of Intergovernmental Panel on Climate Change (IPCC) indicates that warming of the climate system is unequivocal, and many of the observed changes since 1950s, are unprecedented over decades to millennia[3].This is now evident from observations through global increasein temperature of atmosphere[4] and ocean[5], melting of snow and ice, rise in sea level[6] and increased concentration of greenhouse gases[7]. The fifth assessment report has also indicatedthe strong human influence as a major cause for the adverse impact on climate system.

Climate projections for India suggest that impacts are likely to be varied and heterogeneous, with some regions experiencing more intense rainfall and flood risks, while others encountering sparser rainfall and prolonged droughts including spatial shift in the pattern of rainfall. The coastal areas are likely to suffer from higher tides, more intense storms resulting from warmer oceans and further erosion of coastline due to sea level rise. Climate variability or Climate change manifests through alteration in frequency, intensity, spatial extent, or duration of weather and climate extremes, including climate and hydro-meteorological events such as heat waves, heavy precipitation events, drought and tropical cyclones which would pose greater risks to human life and endanger the sustainability of the country's economy.

Though India is the third largest emitter in terms of cumulative volume of GHG emission after US and China[8], it is not the major emitteron a per capita basis. The per capita CO_2eemissions calculated at 1.1 tonnesin India is substantially lower when compared to over 20 tonnesin the US and in excess of 10 tonnesin most OECD countries. However India has pledged to play a constructive role in international climate diplomacy by emphasizing the need for implementing a comprehensive domestic response to reduce the emissions intensity of GDP by20-25% by 2020 (base year 2005). Without adequate adaptation and mitigation strategies, the climate change impacts would further exacerbate vulnerabilities, place human health and security at risk and impede sustainabledevelopment. India's immense geographic diversity adds to the complexity of developing and implementing an adaptation strategy. It is also important to note that the community are not only the victims

[3] *Approved Summary for Policymakers - Twelfth Session of Working Group I, IPCC WGI AR5, 27 September 2013*

[4] *Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. The globally averaged combined land and ocean surface temperature data as calculated by a linear trend, show a warming of 0.85 [0.65 to 1.06] °C, over the period 1880–2012. The total increase between the average of the 1850–1900 period and the 2003–2012 period is 0.78 [0.72 to 0.85] °C.*

[5] *On a global scale, the ocean warming is largest near the surface, and the upper 75 m warmed by 0.11 [0.09 to 0.13] °C per decade over the period 1971–2010*

[6] *Over the period 1901–2010, global mean sea level rose by 0.19 [0.17 to 0.21] m*

[7] *The atmospheric concentrations of the greenhouse gases carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) have exceeded the pre-industrial levels by about 40%, 150%, and 20%, respectively.*

[8] *The Road To Copenhagen: India's Position on Climate Change Issues*

of negative impacts of climate change but also are the drivers of climate change. It is therefore essential that mitigation action be planned so as to reduce the anthropogenic contribution of greenhouse gas to the atmosphere.

It is well evident that the impactsof climate change on the natural resource will undermine the development trajectories by affecting livelihood, health, housing/assets, drinking water, food security and nutrition, gender equality and human rights of a large section of the society. Impacts of climate change are expected to impose higher stress on those living in poverty, partly due to their more prevalent dependency on the natural resources and also because of their lower coping capacity to protect themselves, adapt or recuperate losses.This context makes the framing of policies and measures that helpto address their vulnerability as well as reduce greenhouse gas concentration especially when the social and economic relations contribute to the vulnerability of the population for a given range of climate variability and sensitivity.

The Union Territory (UT) of Puducherry known for its rich ecosystem and French heritage comprises four isolated geographical regions viz. Puducherry, Karaikal, Mahe and Yanam extending over an area of 479sq. km Karaikal, part of the fertile Cauvery delta is situated on the East Coasts ofTamil Nadu, Yanam skirted on the east and south by the Godavari River lies nearthe state boundary of Andhra Pradesh, Mahe bounded in the south west by the Arabian Sea and in the north by the Ponniyam River lies on the West Coast of the country nearthe state boundary of Kerala and Puducherry lying on the east coast of Tamil Nadu is also the capital of the Union Territory. Since the merger of the four distinct regions with Indian Union in 1962, Puducherry has witnessed development in most of the sectors with education and health sector demonstrating remarkable stride. Education, both school and higher education, health and social security aspects have been making noticeable progress due to the measures undertaken by the proactive government machinery.

Though agriculture has not shown much development in consonance with other sectors, the industrial sector and service sectors have been growing exponentially. Infrastructure has been perceptibly well developed to the growing needs of the economy.The level of forestry across the UT is considerably low without any reserved forest. The water resource in the UT is adequate to meet its internal demand but is however subjected to risk of sea water intrusion and over exploitation. Agricultural sector with rice as the major produce is sufficiently irrigated. The long coastline providing livelihood opportunity to considerable percentage of rural population is prone to climate risks such as cyclones and coastal erosion.

Regional climate change model has projected warmer climatic conditions with increase in average temperature, rainfall variability and incidence of extreme weather events that might have far reaching impacts on climate sensitive sectors such as agriculture and tourism and underpin the economic development. Yanam area adjacent to East Godavari district (Andhra Pradesh) with a coast line of 177 km is prone to cyclones and depressions. A study by Anna University that assessed data from 1972 to 2010 has found that low to medium erosion is found to occur along a km of the total 24 km coast of Puducherry.This is about

4.2% of the total Puducherry coast.The union territory of Puducherry and specially the Puducherry and Karaikal region have in its recent past witnessed the increased incidence of natural hazards such as storm surge, tsunami and cyclone. The tsunami in December 2004 along the coastline of Puducherry and the Thane cyclone in 2011 have resulted in extensive economic and life losses. The problem of soil erosion in the coastal region and possibility of intrusion of salt water into coastal aquifers has emerged as a pressing issue. Given its profile, climate change is an important concern for the UT as it is presently on a carbon-oriented development path and at the same time, it is vulnerable to climate variations.

Government of Puducherry recognizes that the climate change has the potential to erode the progress achieved and to be achieved through economic growth. Given its importance, Government of Puducherry is committed to demonstrate continued leadership in this new and important area of intervention beside the fact that the total area under forestry is low due to high population density and scarcity of land.

1.2 Methodology

A National Consultation Workshop was convened on 19thAugust 2010 in New Delhi to develop the common framework/approach for preparing State level action plans on climate change. States were requestedto formulate mitigation/adaptation strategies towards development of Climate Change Action Plan (CCAP). To this effect Government of Puducherry framed the State[9] Action Plan on Climate Change under the supervision of aSteering Committee. TheState Steering Committee (SSC) was constituted under the chairmanship of Chief Secretary and Secretaries of the participating Departments as members for providing overall policy guidance for preparation and implementation of the action plan. DSTE acted as the Nodal Department for formulating the action plan. Adaptation and mitigation strategies were finalized in course of several consultation meetings with the line departments. Actions and period of implementation of the proposed actions under the missions were drafted. Nineteen administrative departments and five autonomous bodies selected as implementing agencies for the CCAP (Climate ChangeAction Plan) are as follows:

Departments:

1. AdiDravidar Welfare
2. Agriculture
3. Animal Husbandry
4. Commercial Taxes
5. Electricity
6. Fisheries and Fishermen Welfare
7. Forest and Wild Life
8. Health & Family Welfare Services
9. Hindu Religious Institutions
10. Industries & Commerce

[9] *To be read as UT*

11. Local Administration
12. Planning & Research
13. Public Works
14. Revenue and Disaster Management
15. School Education
16. Science, Technology &Environment
17. Social Welfare
18. Town & Country Planning
19. Transport

Autonomous Bodies

1. Regional Planning Authorities (RPAs : PPA, KPA, MPA & YPA)
2. Puducherry Pollution Control Committee (PPCC)
3. Puducherry Council for Science and Technology (PCS&T)
4. Puducherry Coastal Zone Management Authority (PCZMA)
5. Renewable Energy Agency of Puducherry (REAP)

Composition of the Steering committee

1. Chief Secretary, GOP - Chairman.
2. Secretary to Government(Animal Husbandry) - Member
3. Secretary to Government(Agriculture) - Member
4. Secretary to Government (Power)- Member
5. Secretary to Government(Fisheries) - Member
6. Secretary to Government (Forest & Wild Life)- Member
7. Secretary to Government(Health) - Member
8. Secretary to Government(Local Administration) - Member
9. Secretary to Government(Planning & Research) - Member
10. Secretary to Government(Public Works) - Member
11. Secretary to Government (Revenue & Disaster Management)- Member
12. Secretary to Government(School Education) - Member
13. Special Secretary to Government(Industries & Commerce) - Member
14. Special Secretary to Government(Transport) - Member
15. Special Secretary to Government(Science, Technology & Environment) - Member
16. DirectorDept. of Science, Technology & Environment – Convener

Principles of Plan[10]:

The Puducherry Climate Change Action Plan will be guided by the principles identified inthe National Climate Change Action Plan in order to achieve sustainable development of thesociety by increasing the standard of living of the people and reducing their vulnerability toclimate change hazards. The key principles are:

[10] *Puducherry Draft Action Plan on Climate Change*

- Protecting the poor and vulnerable sections of society through an inclusive andsustainable development strategy, sensitive to climate change.
- Achieving UTs growth objectives through a qualitative change in direction that enhancesecological sustainability, leading to further mitigation of greenhouse gas emissions.
- Devising efficient and cost-effective strategies for end use Demand Side Management.
- Deploying appropriate technologies for both adaptation and mitigation of greenhouse gases emissions extensively as well as at an accelerated pace.
- Engineering new and innovative forms of market, regulatory and voluntary mechanisms topromote sustainable development.
- Effecting implementation of programmes through unique linkages, including with civilsociety and local government institutions and through public private-partnership.
- Welcoming international cooperation for research, development, sharing and transfer oftechnologies enabled by additional funding and a global IPR regime that facilitatestechnology transfer to developing countries under the UNFCCC.

Objective of the Plan[11]

Puducherry Climate Change Action Plan identifies and prioritizes strategies that simultaneously advance the UTs developmental goals while yielding co-benefits of climate change mitigation and adaptation effectively. It envisages mainstreaming climate change strategies into developmental planning of the U.T. and exploring development of low carbon – climate resilient pathway. The document reveals the commitment of Puducherry UT as a responsible member of the global community and in line with the policies and principles of the National Government for combating climate change. The purpose of the document is also to create awareness among the public, government agencies, researchers, NGOs and all other stakeholders about the threats of climate change and the measures to counter it.

Identified Missions for UT of Puducherry [12]

From the eight national missions,the Steering Committee felt that the following missions that are relevant to Puducherry UT be taken up and are as follows:

1. Solar Mission
2. Mission on Enhanced Energy Efficiency
3. Mission on Sustainable Habitat
4. Mission for a Green Puducherry and Sustainable Agriculture
5. Water Mission
6. Mission on Strategic Knowledge on Climate Change

[11] *Puducherry Draft Action Plan on Climate Change*
[12] *Puducherry Draft Action Plan on Climate Change*

Both agriculture and forestry is considered as primary sector in UT's economy and therefore also considered under a single mission.

1.3 Structure of the CAP Report

The CAP document begins with this background chapter, which introduces the context, provides the methodology and outlines the structure of the document. The second chapter gives an overview of the National Action Plan on Climate Change, eight missions and other initiatives. The third chapter describes the vulnerability assessment of Puducherry and highlights climate sensitivity from both biophysical, environmental and socio economic perspectives. The fourth chapter indicates the greenhouse gas emission.

The next chapter highlights a detailed overview of the Climate Change Issues relevant to Puducherry. This covers all the 6 sectors (Solar Energy, Energy Efficiency, Water, Agriculture & Green Mission, Sustainable Habitat, Strategic Knowledge mission). Based on inputs from stakeholders, Coastal Disaster Management has also been included as separate mission because of its relevance to the natural hazards and vulnerability it can lead to. The report also includes a section that identifies the issues that are cross cutting (addresses issues relating to health, renewable energy technology and Disaster risk reduction) in nature. The subsequent chapter analyses and synthesizes the sector information to arrive at the key findings. The last chapter provides the conclusions and recommendations.

The Annexes include minutes of stakeholder consultations heldon and comprehensive list of activities considered.

2 National Action Plan on Climate Change

2.1. Introduction

The National Action Plan on Climate Change (NAPCC) emphasized on the overriding priority of maintaining high economic growth towards eradicating poverty, promote gender equality and ensure environmental sustainability. The NAPCC lays down measures to promote development objectives with co-benefits for addressing climate change effectively. It also advocates strategies that promote, firstly, the adaptation to Climate Change and secondly, further enhancement of the ecological sustainability of India's development measures.

The National Action Plan on Climate Change emphasizes on promoting inclusive and sustainable development strategy sensitive towards climate change so as to protect the poor and vulnerable section of the society. Eight National Missions form the core of the National Action Plan representing multipronged, long term and integrated strategies for achieving key goals in the context of climate change. The focus is to promote understanding of Climate Change, framing adaptation and mitigation strategy and promoting energy efficiency and natural resource conservation. While many of these programmes are already a part of the current actions, the Action Plan seeks to enhance them in scope and effectiveness and implement them in an accelerated manner through time bound plans.

2.2. National Action Plan on Climate Change

On June 30, 2008, Prime Minister Dr. Manmohan Singh released India's first National Action Plan on Climate Change (NAPCC) outlining existing and future policies and programmes addressing climate related mitigation and adaptation measures along with identification of eight core missions— running through 2017. The various missions are presented in the following diagram.

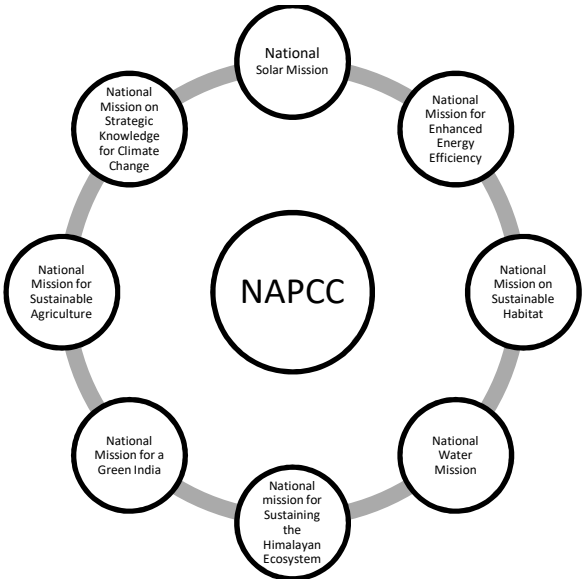

Figure 1: NAPCC Missions

The following table gives an overview of the Eight National Missions, the objectives and the responsible entity for the same:

Table 2: NAPCC Objectives and Responsible Entities

Mission	Goal	Link with Development Goal[13]
National Solar Mission Responsible Entity: MNRE	• Enabling environment to deliver 20 GW of solar power by 2022 • Grid-connected solar power capacity of 1 GW by 2013 • Additional 3 GW through mandatory purchases backed with • preferential tariff by 2017 • Favourable conditions for solar manufacturing capabilities • Off-grid applications: 1 GW by 2017, 2 GW by 2022 • 15 million sq. m solar thermal collector area by 2017 and 20million sq. mby 2022 • 20 million solar lighting systems for rural areas by 2022	Capacity addition of 16,553 MW hydro, 3380 MW nuclear (out of thetotal of 78,577 MW capacity addition) Ensuring electricity connection to all villages and below poverty line(BPL) households by 2009 and reliable power by the end of the plan[56% electrification rate (2000–05), 487.2 million population withoutelectricity (2005)} 20% rise in real wage rate of unskilled workers [Youth literacy rate of 76.4% (for ages 15–24)] Reduction in head-count ratio of consumption poverty by 10 percentage Points
National Mission for Enhanced Energy Efficiency **Responsible Entity**: Ministry of Power	• Specific energy consumption (SEC) reduction targets for energy-intensive units • Incentivizing action through Energy Savings Certificates (ESCerts) – traded and used for compliance • National energy efficiency Clean development Mechanism(CDM) roadmap • National energy efficiency financing platform • Creating markets for energy efficient products and services	Increase energy efficiency by 20% by 2016/17
National Mission for Sustainable Habitat Responsible Entity: Ministry of Urban Development	• Increasing energy efficiency in buildings: building bye laws and standards, energy performance monitoring, national standards for construction and recycling of construction waste • Urban transport: norms integrating congestion charges, parking, etc., norms	Develop minimum standards of education at elementary level, to ensureQuality To attain WHO quality of air standards in all major cities by 2011/12 Provide homestead sites to all by 2012

[13]*Planning Commission; UNDP (2007); NAPCC (2008)*

Mission	Goal	Link with Development Goal[13]
	for pedestrian and cycling, integrating transport planning with spatial planning • Water supply: mandatory rainwater harvesting, water and energy audits	and step up the pace of house construction for rural poor to cover all the poor by 2016/17
National Water Mission Responsible Entity: Ministry of Water Resources	• Comprehensive water database in public domain and assessment of impact of climate change on water resources • Promotion of citizen and state action for water conservation, augmentation and preservation • Focused attention to vulnerable areas including over –exploited areas • Increasing water use efficiency by 20% • Promotion of basin level integrated water resources management	Ensuring water security and food security (MDG 1: Eradicate extremepoverty and hunger) through efficient use of water and adaptation toclimate change Ensure integrated water resources management (MDG 7: Ensure environmentalsustainability)
National Mission for Sustaining the Himalayan Ecosystem Responsible Entity: Ministry of Science & Technology	• Continuous monitoring of Himalayan ecosystems • Identification of desirable adaptation and development policies(sustainable urbanization, water security: rejuvenation of springs, infrastructure development: green roads)	Ensure all- weather road connection to all habitations with population1,000 and above (500 and above in hilly and tribal areas) by 2009, and allsignificant habitations by 2015
National Mission for a Green India **Responsible Entity**: Ministry of Environment & Forests	• 2 Mha of moderately dense forests • 4 Mha of degraded forests regenerated/afforested • 0.10 Mha of mangroves restored, 0.1 Mha wetlands conservation • 0.20 Mha urban/peri-urban forests, 1.50 Mha degraded land under agro-forestry	Increase forest and tree cover by 5 percentage points [22.8% of forestcover of the total land area with an annual change of 0.4% between 1990 and 2005]
National Mission for Sustainable Agriculture Responsible Entity: Ministry of Agriculture	• Use of genetic engineering to produce carbon responsive crops • Low input sustainable agriculture: enhanced water use efficiency • Micro-irrigation for efficient use of water • Water conservation in rain-fed areas	Average GDP growth rate of 9% [between 1990 and 2005, 34.3% ofpopulation earning US $1/day, while 80.4% earning US $2/day] Agricultural GDP growth rate on average of 4%
National Mission on Strategic Knowledge for Climate Change **Responsible Entity:** Ministry of Science & Technology	• Climate change research and fellowship programme • Climate Change Professor Chairs • National Research Chairs Climate Research Institute • Network of climate change research institutes and scientists	

The idea of a sub-national action plan emerged to address the local issues and ascertain high degree of ownership. This would generate better awareness rising from experiences on climate related issues leading to corrective actions, better preparedness and strategic priorities at the Sub-National level.These priorities would enable the leaders in the union territory to plan for the resources and also to monitor the savings in terms of long run cost associated with climate change.

2.2.1. National Solar Mission

The NAPCC aims to popularize the use of solar energy for power generation and other purposes over other fossil-based energy options. The plan includes:

- Specific goals for increasing use of solar thermal technologies in urban areas, industry, and commercial establishments
- A goal for increasing production of photo-voltaic power to 1,000 MW/year and
- A goal for deploying at least 1,000 MW of solar thermal power generation.

Other objectives include the establishment of a solar research centre, increased international collaboration on technology development, strengthening domestic manufacturing capacity, and increased government funding and international support.

2.2.2. National Mission for Enhanced Energy Efficiency

Current initiatives are expected to yield savings of 10,000 MW by 2012 through buildings adhering to the Energy Conservation Act 2001 which recommends:

- Mandating specific energy conservation options decreases consumption in large energy-consuming industries, with a system for companies to trade energy-saving certificates
- Energy incentives, including reduced taxes on energy-efficient appliances and
- Financing for public-private partnerships to reduce energy consumption through demand-side management programmes in the municipal, buildings and agricultural sectors.

2.2.3. National mission on Sustainable Habitat

The National Mission on Sustainable habitat comprises of three components, viz.

- Promoting energy efficiency in the residential and commercial sectors
- Management of municipal solid waste and
- Promotion of urban public transport.

2.2.4. National Water Mission

Some of the major areas of intervention identified in the Water Mission are to increase the efficiency of water use, to explore options to augment water supply in critical areas and to ensure more effective management of water resources. With projected increase in water scarcity as a result of climate change, the Mission sets a goal of a 20% improvement in water use efficiency through pricing and other measures.

2.2.5. National Mission for sustaining the Himalayan Ecosystem

Sustainable Himalayan Mission aims to conserve biodiversity, forest cover and other ecological assets in the Himalayan region which has been impacted by ecological stress including glacial retreat thereby impeding the perennial river flow.

2.2.6. National Mission for a Green India

The Mission aims at addressing climate change by enhancing carbon sinks in forests and other ecosystems, enhancing the resilience and ability of vulnerable species/ecosystems to adapt to the changing climate, and enabling the adaptation of forest dependent local communities in the face of climatic variability. Goals include afforestation of 6 million hectares of degraded forest lands and expanding forest cover from 23to 33% of India's territory

2.2.7. National mission for Sustainable Agriculture

The Sustainable Agriculture Mission aims to focus on four areas crucial to agriculture for adapting to climate change, viz. dry land agriculture, risk management coupled with weather insurance, access to information and use of Biotechnology. The Mission aims to support climate adaptation in agriculture through the development of climate-resilient crops, expansion of crop insurance mechanisms and agricultural practices.

2.2.8. National Mission on Strategic Knowledge for Climate Change

To gain a better understanding of climate science, impacts and challenges, the plan envisions a new Climate Science Research Fund, improved climate modeling and increased international collaboration.It also encourages private sector initiatives to develop adaptation and mitigation technologies through venture capital funds.

2.3. Institutional Mechanism

The National Missions are to be institutionalized by the respective Ministries and will be organized through inter-sectoral groups. Appropriate mechanisms including public/ private partnership and civil society actions would be devised, as suited, for effective delivery of each individual Mission's objectives.

After the launch of NAPCC in 2008 (in August 2009)the states and UT's were suggested to develop their own climate change action plan to address the state specific context under the overarching guidelines of NAPCC. This was re-emphasized by the Union Minister of State; Environment & Forests (MoEF), at the meeting of the Chief Secretaries in February 2010. In line with the Govt. of India decision, the Union Territory of Puducherry has formulated the state level action plan on climate change.As a part of the action plan, a Steering Committee was established under the chairmanship of Chief Secretary and membered by the Secretaries of the participating departments for development of CCAP (Climate ChangeAction Plan). The steering committee comprising nineteen departments and five autonomous institutions is designated to supervise and coordinate activities related to the development of climate change adaptation and mitigation strategies. DSTE (Department of Science, Technology and Environment) is selected as the nodal department by the steering committee to convene and facilitate the development of CCAP (Climate ChangeAction Plan). The Climate

ChangeAction Plan was developed in line with the '*National Action Plan on Climate Change*' with six fold missions. The climate change action plan aims to develop climate resilient policies, knowledge management mechanisms for informed decision making and undertake effective monitoring and evaluation to identify entry points for climate proof actions and also to identify the existing lacunae. The following are the six missions that are relevant to the Puducherry Climate Change Action Plan:

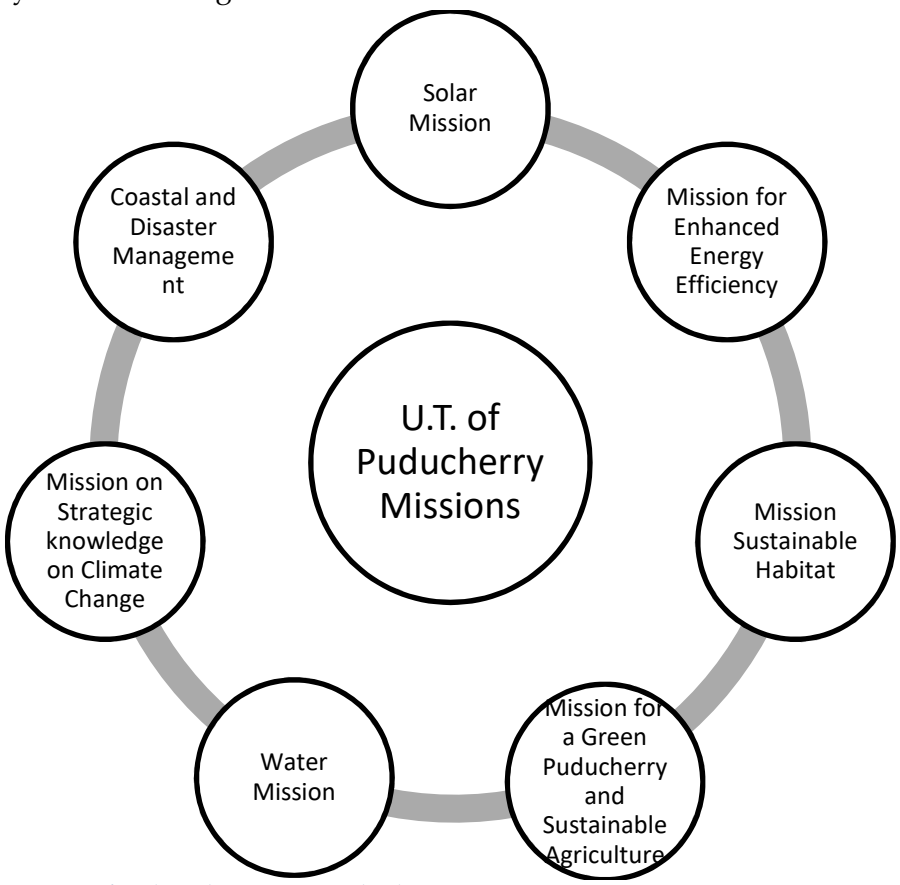

Figure 2: Mission Conceived under CCAP Puducherry

The following section maps the State missions according to the National Action Plan. Therefore it would have the following kind of linkages as detailed out in the table below:

Table 3: Missions under CCAP (Climate Change Action Plan)

National Mission	State Mission	Department Responsible	Key Issues addressed
Solar mission	Solar Mission	REAP, Electricity Dept., PWD, T&CP, Directorate of School Education	• Promoting Solar PV technology for electricity generation (both grid interactive and off grid technology) • Promoting Water Heater Technology option • Promoting Solar Concentrator • Undertaking Mapping of Solar Energy Potential • Policy draftingtowards promotion and mandating of Solar energy technologyon case to case basis
Enhanced Energy Efficiency Mission	Enhanced Energy Efficiency	REAP, Electricity Dept., LAD, T&CP, Directorate of Industries & Commerce	• Promoting Energy Efficiency across building (domestic), commercial and industrial facilities • Mandating of Energy Audit across industrial sector • Develop and promote institutional mechanism • Implementation of ECBC, GRIHA • Promoting of Star rated product
Sustainable habitat Mission	Mission on Sustainable Habitat	Transport Dept., PWD, Health Dept., Revenue and & Disaster Management , LAD, PPCC	• Promotion of Green Building and Green Building Code • Solid Waste Management; Waste water recycling • Promotion of public transport; use of clean fuel, phasing out of old and energy inefficient mode of transport • Eco friendly road construction methods • Providing/Renewing underground sewerage systems • Environmental sustainability through mandating of biomedical waste management, banning of use of thin plastic bag
Water Mission	Water Mission	PWD, Dept. of Agriculture	• Water management and water use efficiency • Agricultural water use efficiency through promotion of system of crop intensification technique, Drip irrigation • Rain water harvesting • Ground water recharge • Di-siltation and conservation of tanks
Green India Mission	Mission for a Green Puducherry and Sustainable Agriculture	Forest Dept., Agriculture Dept., Fisheries Dept., Animal Husbandry Dept., PPCC	• Increase Plantation/Forestation • Awareness creation towards forest conservation • Promoting farm and agro forestry
Sustainable Agriculture Mission			• Developing crop variety tolerant to salinity • Promotion of genetic engineering and biotechnology • Conservation of marine turtles • Providing Veterinary health service to farmer and livestock owner
Strategic Knowledge for Climate Change	Mission on Strategic knowledge on Climate Change	School Education Dept., Dept. of Agri., Transport Dept., PSC&T,	• Enhanced research onClimate modelling • Capacity building and awareness generation both on adaptation and mitigation issue • Introduction of climate change information at school curriculum • Establish network of knowledge solution • Setting up mechanism for data sharing

National Mission	State Mission	Department Responsible	Key Issues addressed
		PPCC, REAP, Planning and Research Department	
Other Initiatives	Coastal Disaster	PIA Revenue and & Disaster Management , PCZMA	• Preparation of HTL/LTL along the coastal stretches • Integrated coastal zone management
	Cross Cutting including Renewable Energy Technology , Disaster Management and Health	REAP, Electricity Dept., Revenue and & Disaster Management , Health Dept.,	**Renewable Energy Technology** • Promoting use of wind, biomass (bio gas, biomass gasifier) for electrical and thermal energy requirement. • Policy regime (RPO, preferential tariff) and tax holiday for promoting Renewable Energy Technology **Disaster management** • Disaster management planning and infrastructure development • Awareness creation amongst the community on climate related vulnerability and preparedness • Preparation of Hazard mapping to identify the vulnerable zone **Health** • Research over the possibility of climate induced health impact • Improving health infrastructure • Early warning system of health related stress • Reduce surface water contamination and prevention of water borne diseases • Reduce the impact of vector borne diseases

The CCAP (Climate ChangeAction Plan)is framed under the broad framework of NAPCC including the following steps:

1. Assessmentofsocio economic and climate profile and mapping the vulnerability
2. Preparation of the inventory of greenhouse gas emission
3. Identification of the applicable missions
4. Identification of adaptation and mitigation strategies considering ongoing programmes and projects in the UT and analysis of the resource and capacity gap in implementation of the programme
5. Prioritizationof adaptation and mitigation strategies dependent upon the level of vulnerability it addresses or mitigation it results into, the barriers in implementation, time frame and other indicators through multi-stakeholder consultations and interactions

6. Assessfinancial requirement and the viability gap for implementation of the actions andsource of finance
7. Strategize and develop the institutional framework as well as monitoring indicators for implementation.

3. Vulnerability Analysis

3.1. Introduction

Puducherry is a coastal UT in Indiawhich is disaster prone.Many of the vulnerabilities are driven by three important factors (1) socio-economic, (2) bio-physical and (3) climate sensitivity. They have their unique manifestation in the coastal region.Therefore the vulnerability with respect to climate change has to be examined more carefully in case of Puducherry. It has many contradictions as well.For example in terms of demography high population density exposes more people to climate change related events.But in the case of Puducherry low density pockets far from administrative units without requisite infrastructure makes them morevulnerable as compared to high density pockets(unique case is Mahe where the population density is high even though it is far from mainland). The Scheduled Caste population is about 16 per cent and majority are below poverty line from this segment. While increased densities of people and structures along the coast certainly account for a portion of these losses, other explanations include increased storm activity and the decreased ability of communities to rebound from disasters making them more vulnerable especially if they are very poor.The bio-physical factors have been extensively studied and vulnerability pockets have been identified in Puducherry. Some parameters include storm surge, erosion, mangrove loss, etc. In terms of climate sensitivity it also has only a single monsoon season and the reduction of rainfall coupled with urbanisation and tourist surge puts a lot of pressure on the groundwater.

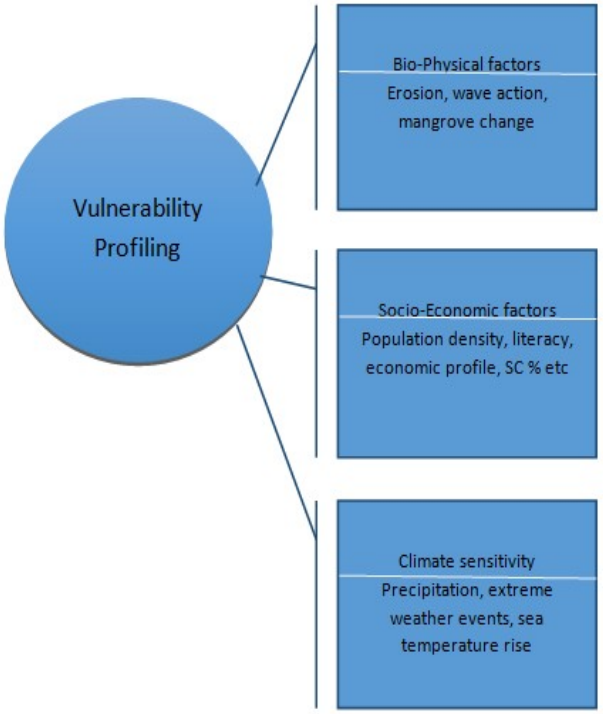

Figure 3: Vulnerability Profiling

3.2. Biophysical Factors

Climate change and associated sea-level rise changes the coastline. Not only ocean front but also shoreline dynamics around sheltered estuaries and minor ports make coastal infrastructure equally vulnerable.

3.2.1. Erosion and shoreline change

A study by Anna University that assessed data from 1972 to 2010 has found that low to medium erosion is found to occur along 1 km of the 24 km coast of Puducherry.This is about 4.2% of the total Puducherry coast except in Puducherry town area.

Table 4: Low to medium erosion

Classification of coast	Extent (km)	Percent Coast	Cumulative (%)	Locations
Length of coastline including river mouth and ports	23.62			From North of Puducherry port to Tingattittu.
High erosion zone				Bommaiyapalayam and Puducherry Old Port: some stability due to dune formation along a stretch near B. Palayam
Medium erosion zone	0.52	2.20		From North of Puducherry port toTingattittu.
Low erosion zone	0.46	2.00		
Artificial coast, sea-wall / riprap	6.18	26.20	30.30	
Stable Coast	9.27	39.20	39.20	Kirumambakkam in North to River Mouth of Gadilam river in South
High Accretion Zone				Sivanthpuram in north to Manapattu in south
Medium Accretion Zone	2.19	9.30		Podukuppam and Periyamudaliyarchavadi (coast is stable)
Low Accretion Zone	5.00	21.20	30.40	
No of Ports/harbours	2.00			
No of Fish landing centres	21.00			
No of Groynes and backwaters	7.00	100.00		

(Source: National Assessment of Shoreline Change:Puducherry Coast by Ramesh et.al (2011))

Figure 4: Status of Shoreline change Puducherry Coast
(Source: National Assessment of Shoreline Change:Puducherry Coast by Ramesh et.al (2011))

The Karaikal coast is about 17.3 km including river mouth; 3.98 km or 23% of the coast is "stable" where there is no shoreline change.About 46% of the total coast is accreting. Low erosion zone is about 11.5%.There is also no shoreline protection structure or ripraps.

The shoreline change also occurs due to littoral drift and shore structures. But the warming of the sea surface and resultant wave action, expedites the erosion rate.The entire coastal extent between Muthiapet and Kirumampakkam as well as the northern part of Kalapet is designated as the high vulnerability zone which constitutes 50% of the coastline. The region between the southern coastal extent of Kalapet and Lawspet is the medium vulnerability zone and the rest 25% is the low vulnerability zone based on this shore dynamics that include (slope, geomorphology of the coast, elevation, shoreline change, sea level rise, wave action).

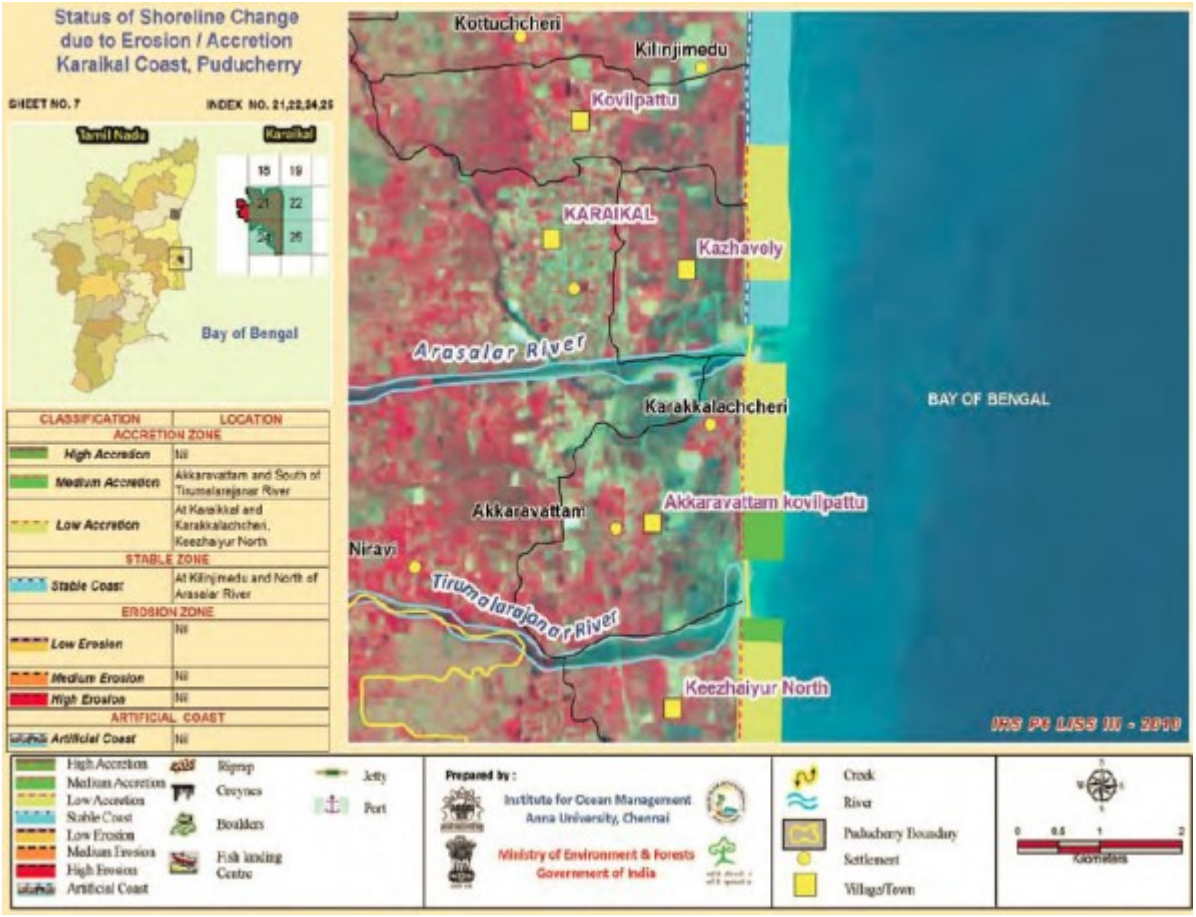

Figure 5: Status of Shoreline change Puducherry Coast
(Source: National Assessment of Shoreline Change:Puducherry Coast by Ramesh et.al (2011))

In summary Puducherry coast is stabilised artificially and not all points due to shoreline change is at risk.In Karaikal protection structures are not there and many parts are low to medium erosion zones and may have high littoral drift. However, protection structures also can cause both active and passive erosion of the beach. An unstable coast and highly eroded beach causes the maximum vulnerability.

The major causes of shoreline change are anthropogenic in nature:
(a) Construction in eco-sensitive zone
(b) Pollution through unregistered hatcheries
(c) Loss of bio-diversity due to agricultural land use change to aquaculture and loss of mangroves.

The vulnerable points identified in the high and medium erosion zones need attention for the future planning while effort is needed to maintain the shore stability in other areas (low accretion zone).

3.2.2. Forest and land use change

As per the Forest Survey of India (2011) the forest cover in Puducherry is 50.06 sq. km which is about 10.43% of the geographical area of the UT.Low forest cover and rapid land use change is a major factor that contributes to the vulnerability in this region.

Table 5: Forest Area of Puducherry

District	Geographical Area	2011 Assessment				Percent of GA	Change	Scrub
		Very Dense Forest	Mod. Dense Forest	Open Forest	Total			
Karaikal	161	0	7.39	1.56	8.95	5.56	0.00	0.00
Mahe	9	0	1.36	3.54	4.90	54.44	0.00	0.00
Puducherry	293	0	24.62	8.59	33.21	11.33	0.09	0.00
Yanam	17	0	2.00	1.00	3.00	17.65	0.00	0.00
Grand Total	480	0	35.37	14.69	50.06	10.43	0.09	0.00

(Source: FSI (2011))

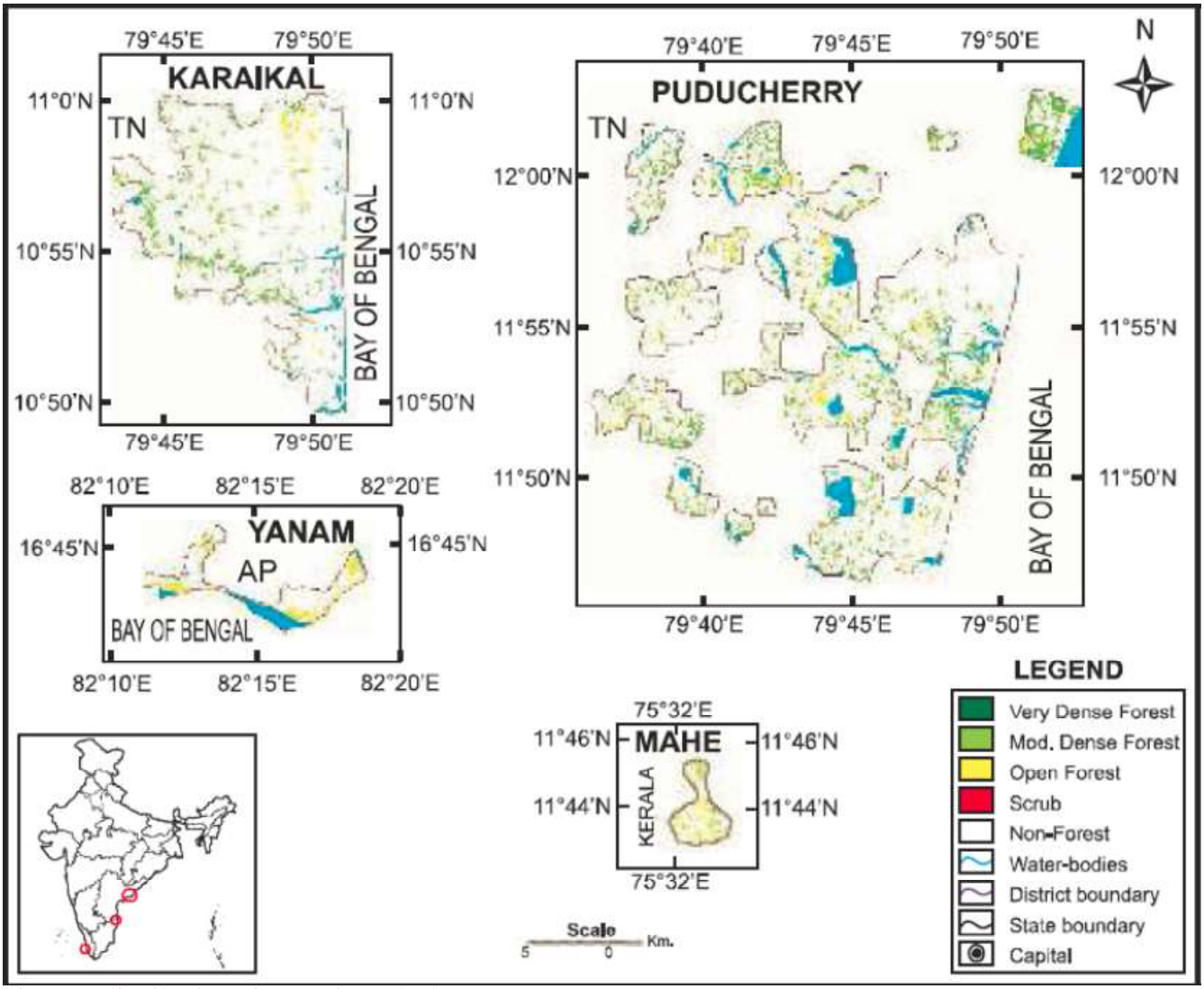

Figure 6: distribution of Forest in Puducherry

(Source: FSI (2011))

The change matrix shows that the change is only in Puducherry and in the category of open forest category (1.18 sq. km decrease) and gain of 1.27 sq. km in moderately dense forest category.

The land use pattern for Puducherry and Karaikal are given below.

Table 6: Land use pattern Puducherry

Sl.No.	Classes	Area (sq. km)	Percentage
1	Agriculture	15.25	10.80
2	Airport	0.10	0.10
3	Aquaculture	0.20	0.10
4	Dune with Vegetation	1.74	1.20
5	Dune without Vegetation	0.86	0.60
6	Fallow Land	4.99	3.50
7	Land with Scrub	6.45	4.60
8	Land without Scrub	4.49	3.20
9	Mudflat	0.33	0.20
10	Plantation	43.53	30.70
11	River	8.52	6.00
12	Sand	0.04	0.00
13	Sandy Beach	2.65	1.90
14	Settlement	37.47	26.50
15	Settlement with vegetation	13.03	9.20
16	Tank	1.58	1.10
17	Transportation (Helipad)	0.26	0.20
18	Water Logged Area	0.11	0.10

Table 7: Land use pattern Karaikal

Sl.No.	Classes	Area (sq. km)	Percentage
1	Agriculture	5.19	6.60
2	Dune with Vegetation	0.07	0.10
3	Dune without Vegetation	0.15	0.20
4	Fallow Land	10.71	13.60
5	Industry	0.17	0.20
6.	Land with Scrub	0.14	0.20
7	Plantation	37.78	47.80
8.	Port	1.34	1.70
9.	River	2.45	3.10
10	Salt affected Land	0.27	0.30
11.	Sand	0.59	0.80
12	Sandy Beach	1.21	1.50
13	Settlement	3.62	4.60
14	Settlement with vegetation	14.39	18.20
15	Tank	0.55	0.70
16	Water Logged Area	0.33	0.40
	Total	78.99	100%

From the land-use/land cover map (tables above) it can be seen that the agricultural area and fallow land comprising of mainly cropland, plantation dominates this region. The forest land is almost nil in Puducherry and most of the vegetation (approx. 3% of the total land) comprises of those which are along the settlements. Only 3-4% of the total area comprises of the sandy beaches. The urban area covers about 9.8% of total land-use/land-cover. The main areas of urban agglomeration are Puducherry, Kalapet and hence have a very high to high vulnerability. Other areas have been ranked as low vulnerability as they have less urban built-up and are not entirely barren.

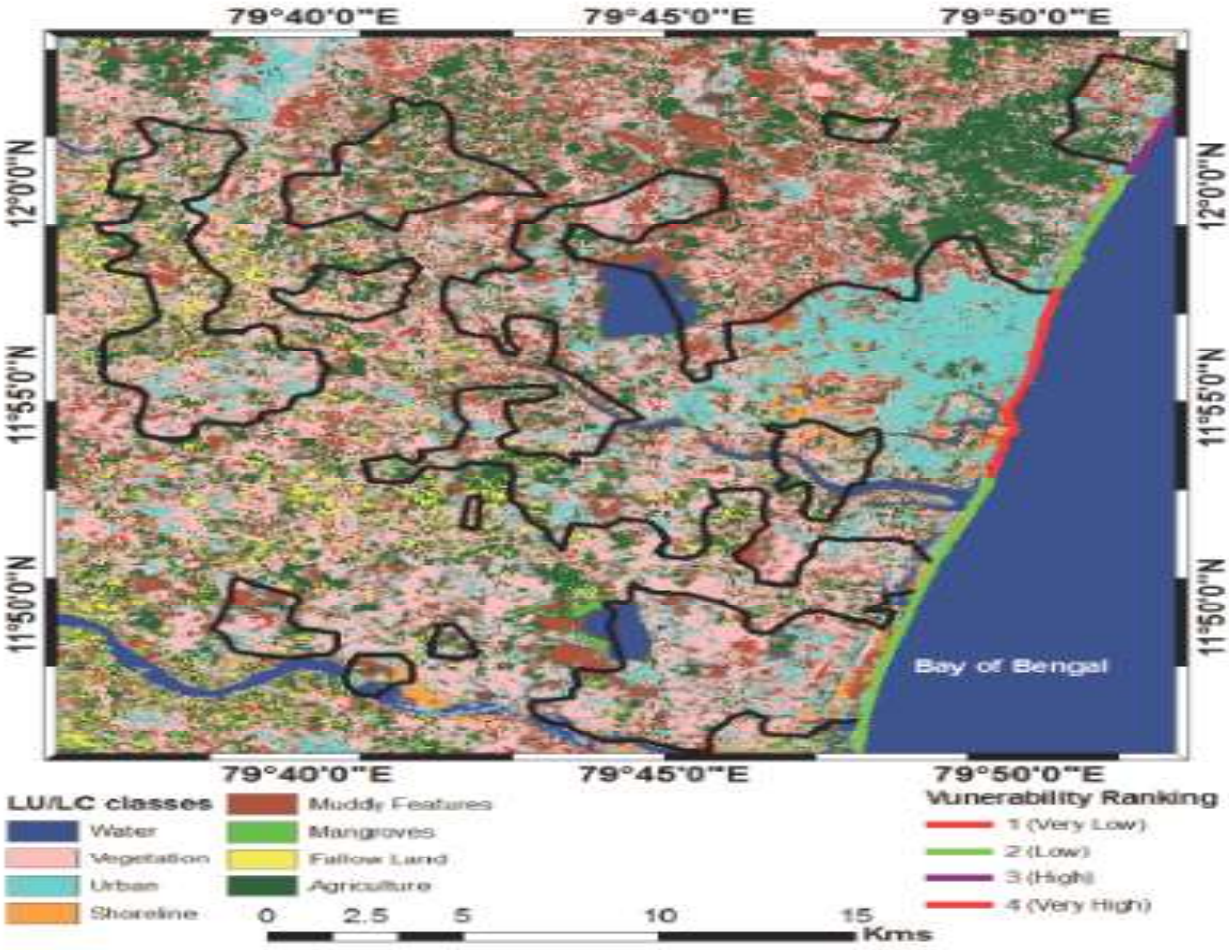

Figure 7: Coastal Vulnerability Puducherry
(Source: R Mani, Murali et.al (2011) Coastal vulnerability assessment Puducherry. p.554)

The above map depictsthe vulnerability from a land use perspective. The composite hazard line[14] when overlaid with the river systems that flow in Puducherry (one fault system near Vellar river (towards Cudallore (TN)-Villipuram coast and other along Yanam along the

[14] *The composite 100 years hazard line incorporates the effects of recurrent coastal hazards, including potential incremental effects induced by climate change (most notably sea-level rise) within the ICZM plans. The composite hazard line helps coastal planners by providing a minimum elevation above sea level to be applied for future development and is a highly effective method of minimizing property damage due to coastal flooding and erosion.*

river mouth and second overlay on the land use/land cover map, suggests that the most dominant land use patterns were:

(1) Plantation
(2) Settlement with vegetation;
(3) Fallow land; and
(4) Sand dunes.
The maximum limits of inundation could be little more than 10 sq. km along this coastal stretch, and our analysis indicates that it is the most vulnerable settlement to flooding.

The combined vulnerability profile of the coast is given in the map below.In this case while computing the social vulnerability the following factors have been included:
(a) Cultural heritage
(b) Road network
(c) Land use and land cover change
(d) Population.
However, we have a separate section of social vulnerability later in this chapter.

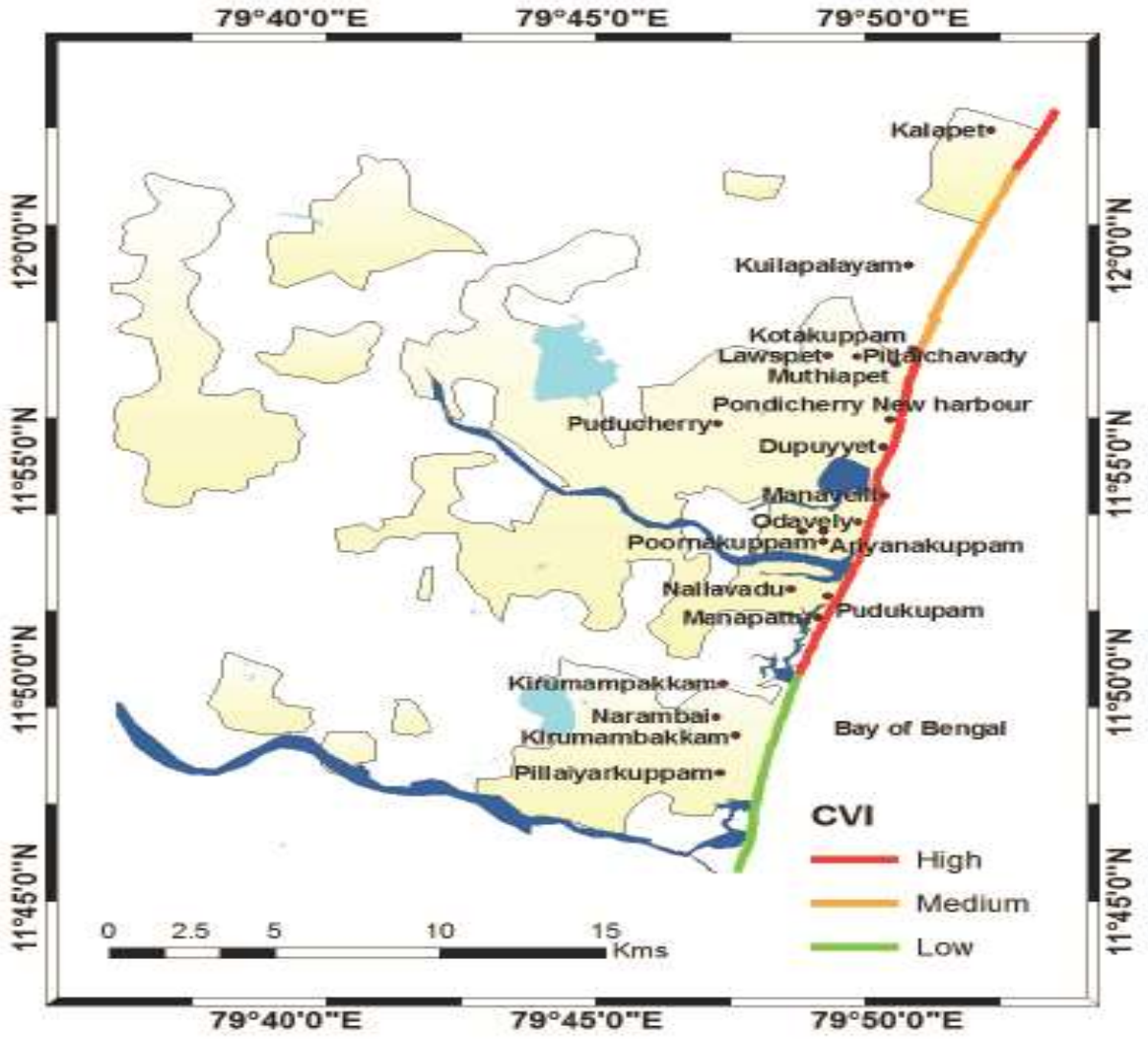

Figure 8: Combine Vulnerability along the coast
(Source: R Mani, Murali et.al (2011) Coastal vulnerability assessment Puducherry. p.554)

Apart from the social vulnerability parameters, the other bio-physical parameters include
(a) Tidal Range
(b) Significant Wave height
(c) Sea level
(d) Shoreline Change (explained in detail in the erosion section)
(e) Elevation
(f) Geomorphology
(g) Slope.

3.3. Socio Economic Factors

The socio economic factors considered for vulnerability mapping are as follows:
(a) Population density
(b) Literacy rate
(c) Percentage of SC
(d) Fisher population
(e) Fish production
(f) Worker Profile and work participation rate

The following table summarises the following parameter while trying to compute a relative combined social vulnerability in four regions of Puducherry.

Table 8: Social vulnerability in four regions of Puducherry

Location	Population Density	Literacy Rate	Marine FishProd.	Inland Fish Prod.	Fishermen population	SC percentage	Worker percentage
Puducherry	3,231.00	86.13	13,873.20	2,219.00	60,620.00	16.45	36.16
Karaikal	1,252.00	87.83	15,663.00	1,594.00	18,462.00	18.07	33.70
Mahe	4,659.00	98.35	5,302.00	-	4,000.00	0.33	25.27
Yanam	3,272.00	80.26	2,780.30	916.00	12,385.00	18.48	31.56

(Source: Statistical Handbook, 2011)

3.3.1. Population density

The empirical studies show that even though higher population density exposes larger number of people to climate change and extreme weather conditions, higher social capital makes them less vulnerable as compared to low density isolated areas.The cost of adaption is more and delivery is poor.In this parameter Mahe region is better than the rest.

3.3.2. Literacy Rate

Higher the literacy, lesser is likely hood of vulnerability as it enhances adaptive capacity. In terms of literacy rate Mahe region outperforms the rest.

3.3.3. Fishermen Population

Puducherry mainland has the largest number of fishermen population, followed by Karaikal. In extreme weather conditions as well as due to climate change these two regions are more vulnerable as the livelihood diversification has not been significant.

3.3.4. Fish production

Fish production both marine and inland is impacted by climate change. Climate change enhances vulnerability of people dependant on fish production.

3.3.5. SC Population

The scheduled caste population is relatively low as compared to the other regions. However, due to the high poverty prevailing in this segment they are considered more vulnerable.

3.3.6. Worker Profile

Work participation rate is an important factor that is associated with the socio-economic vulnerability. The share of primary sector is very low in the UT. A large percentage depends on service sector associated with tourism. This makes them extremely vulnerable in the context of climate change. The change in number of wet days and if it coincides with the tourist arrival and extreme weather conditions it affects the economic conditions of people adversely making them vulnerable. Work Participation Rate (WPR) in Puducherry is 35.2%. This is lesser than the figure for Tamil Nadu but close to the All India and Kerala figures. Female WPR in the UT (17.2%) is lesser than a third of the male WPR (53.1%). Among the districts, Puducherry, Karaikal and Yanam have male WPRs which are close - 53.6%, 52.6% and 52.3% respectively. Male WPR in Mahe is 44.7%. Female WPRs in the districts are at significant variance. The lowest female WPR obtain is in Mahe (8.2%) following Yanam (10.3%).

3.4. Social Vulnerability

Attempt was made to compute the social vulnerability due to climate change and the relative impact in the four regions of the UT. The socioeconomic variables were placed in a principal components analysis (PCA), using the varimax rotation option, all the scores were standardised.Two components explained 87% of the variance. Since the variables are scaled the positive scores indicate higher vulnerability and negative scores indicate that lower or reduced vulnerability.Component one is strongly associated with the fisheries sector (both in terms of workers and fishery production) whereas component two is associated with population density, literacy and work participation rates. The regression scores were put in the graph below.This shows the Mahe region to be relatively less vulnerable as compared to Puducherry and Karaikal and Yanam is moderately vulnerable considering all the socio-economic factors. Though many socio-economic variables determine the relative vulnerability the reason to use PCA was to determine the number of common factors needed to adequatelydescribe the correlations between the observed variables, andestimating how each factor is related to each observed variable. The correlation has been attempted through Kaiser Normalisation and it converged in three rotations. The limitation of this method is the auto-colinearity amongst the variables.

Table 9: Correlation Matrix Rotated

Normalised scores	Component	
	1	2
Population Density	0.480	0.594
Literacy rate	0.023	0.981
Marine Fish Production	0.941	0.048
Inland Fish Production	0.837	0.531
Fisher Population	0.821	0.205
SC %age	0.335	0.940
Worker percentage	-0.728	-0.675
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.a. Rotation converged in 3 iterations.		

This gives a fair idea about the spatial distribution of vulnerability in Puducherry. The scatter diagram below shows the relative distribution of factors when regressed and how the combined social vulnerability is mapped out. This has been presented in the table below:

Table 10: Composite Vulnerability Index of Puducherry

Location	CVI	Rank
Puducherry	17.64	1
Karaikal	16.70	2
Mahe	5.28	4
Yanam	9.87	3

The composite vulnerability index for the socio economic factor shows Puducherry is most affected and Mahe is least affected.If we plot the vulnerability and adaptive capacity, this would be as below:

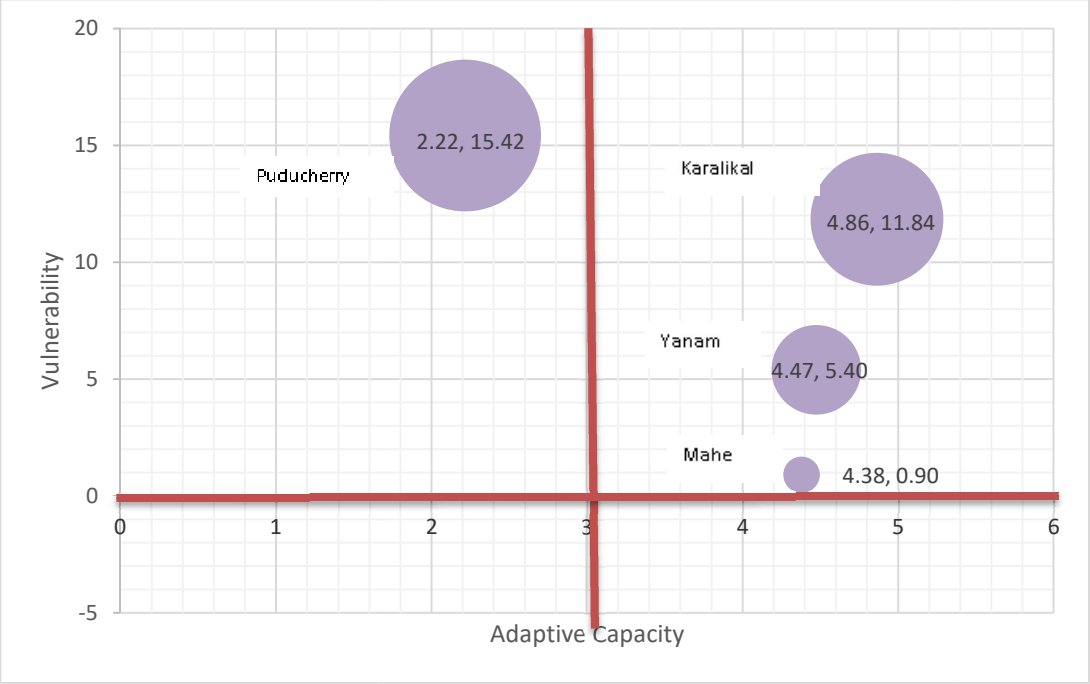

Figure 9: Spatial distribution of social vulnerability

From this figure it is evident that Puducherry is having the worst scenario (high vulnerability and low adaptive capacity. Even though Puducherry has higher population, when combined with urbanisation, resource congestion, it has higher vulnerability as compared to other areas.Karaikal has high adaptive capacity (as social capital in rural areas is relatively more and activities are comparatively more resilient than the urban areas) and high vulnerability and Mahe is low vulnerability and high adaptive capacity (higher literacy and high population density), so also Yanam.

3.5. Climatic Factors

Three distinct regions with unique climatic condition are there in Puducherry. Karaikal is part of the fertile Cauvery delta. Yanam region is skirted on the east and south by the Godavari River. The region is divided into two parts by the separation of the Godavari and Coringa Rivers. The Mahe Region is divided into two parts by the Mahe River flowing towards west. It is bounded in the south west by the Arabian Sea and in the north by the Ponniyam River. While Puducherry and Karaikal regions receive rainfall mainly from the North East monsoon, Mahe and Yanam regions receive rainfall from the South West monsoon.

3.5.1. Projected rain-fall and temperature under A1B scenario

INCCA report relying on global circulation models (GCM) indicates an increase of2.5–4°Crise in temperature from the current levels over the Indian subcontinent.Regional climate model (RegCM3) for developing future scenario on the Indian sub-continent in Cauvery Delta Zone that covers vast stretches of Tamil Nadu and delta facing part of Puducherry with horizontal resolution of0.22° × 0.22° or 25 km × 25 km, with a sufficient buffer zone reveals the following picture. It shows a summer temperature rise of 3-4°C in moderate emission A1B scenario.

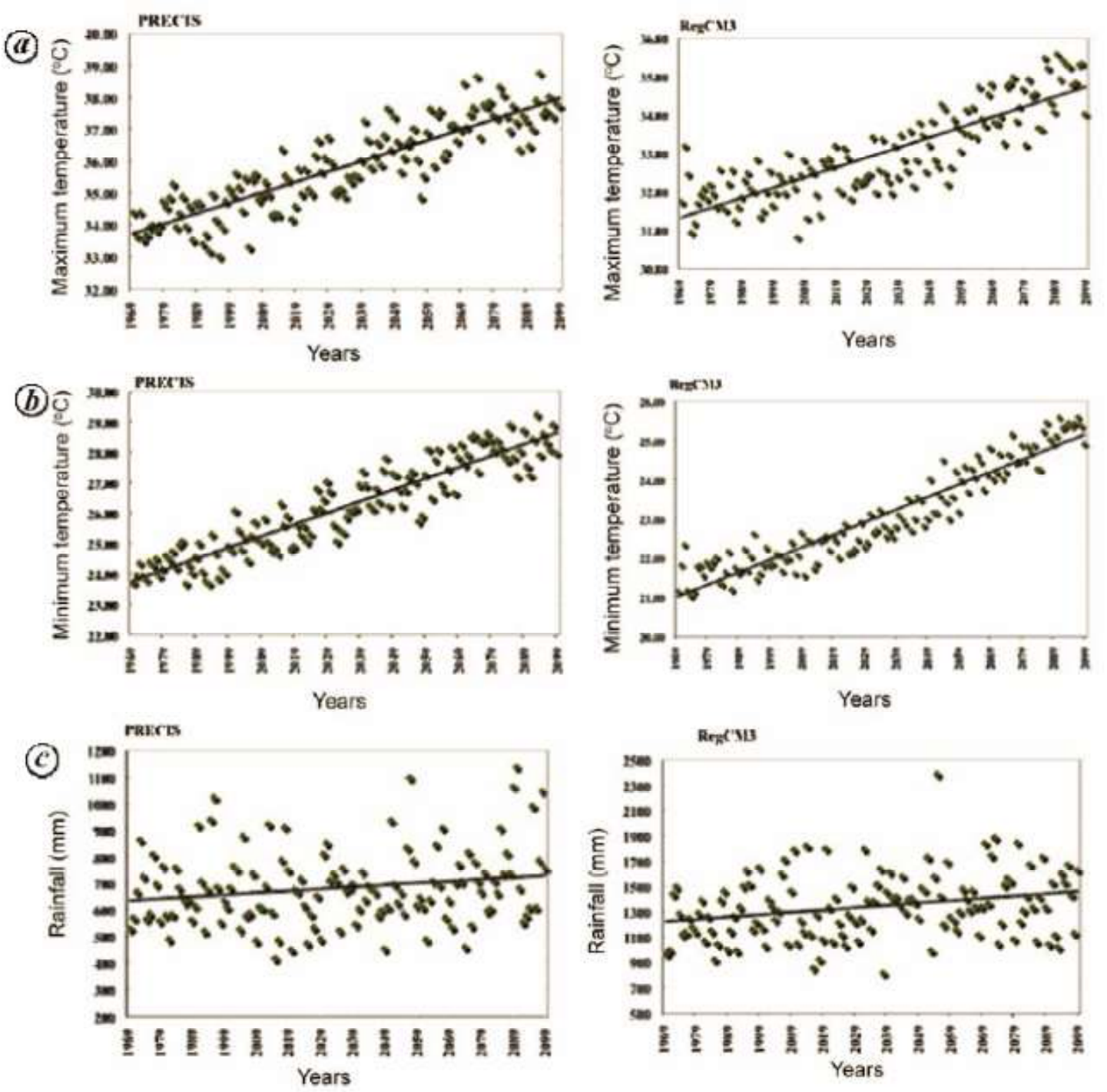

Figure 10: Temperature and rainfall projections for A1B scenario using PRECIS and RegCM3 models. a, Mean annualmaximum temperature (°C). b, Mean annual minimum temperature (°C). c, Mean annual rainfall (mm/year.).

(Source: Geethalaxmi et.al (2011) inCurrent Science, Vol. 101, No. 3, 10 August 2011)

3.5.2. Monsoon Rainfall pattern

The monsoon rainfall has shown high degree of variability in Puducherry.The map by IMD shows the pattern of south west monsoon.

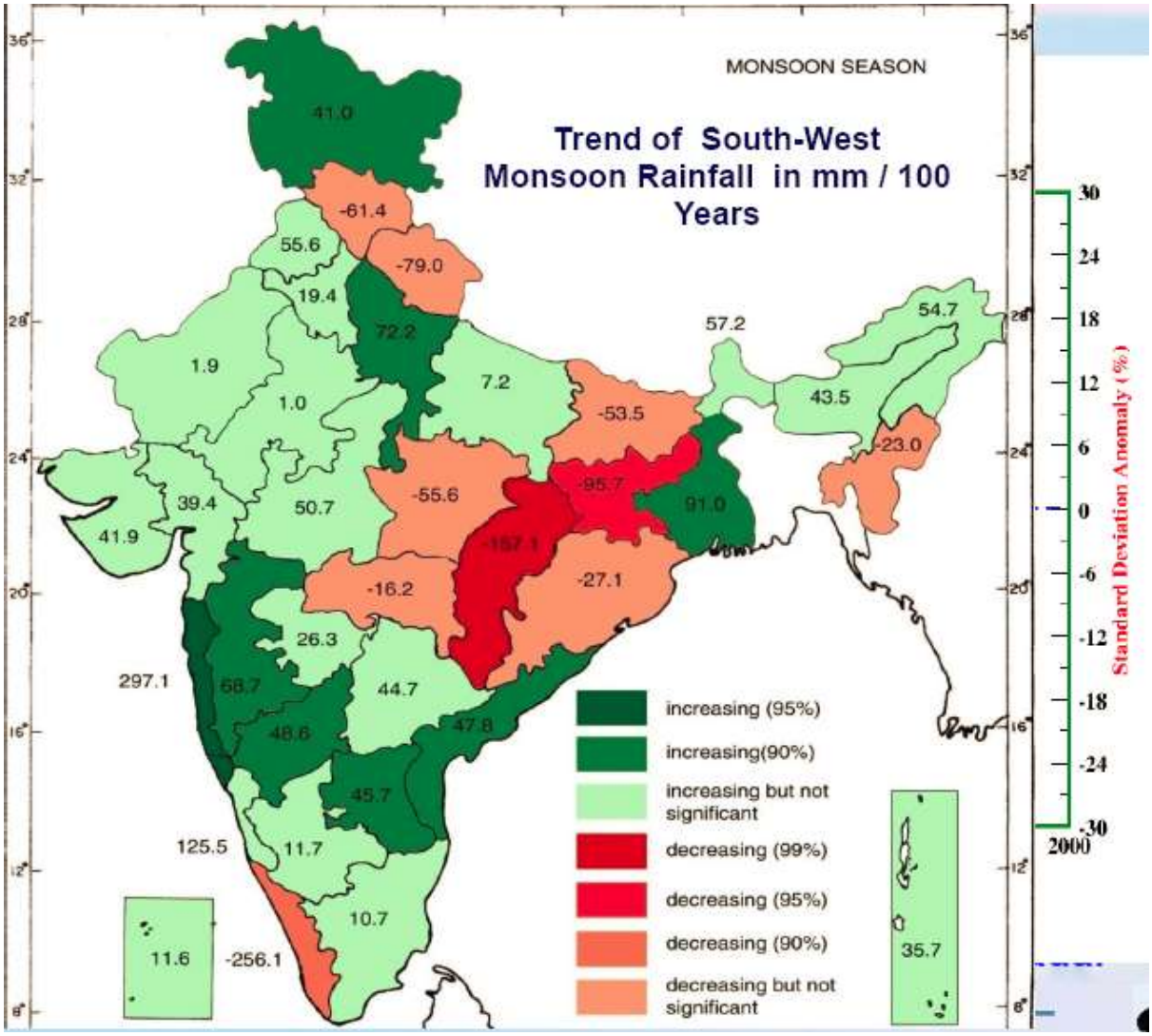

Figure 11: Monsoon rainfall pattern

The figure shows, that the monsoon rainfall is increasing but is not significant in this region.Since temperature is increasing and there is also increase in rainfall the climate would be hot and humid in the near term, requiring temperature adaptive agronomic practice and even varieties to withstand water logging and salinity in some low lying areas to reduce vulnerability.

3.5.3. Cyclonic storm and Flood Hazard

Yanam area adjacent to East Godavari district (Andhra Pradesh)with a coast line of 177 km is prone to cyclones and depressions. The villages viz. Chollangi,Chollangipeta, G.Vemavaram, Patavala, Coringa, Polekurru, Neelapalli and P.Mallavaram falling under TallarevuMandal and Bhairavapalem and Gokullankafalling under IpolavaramMandal are highly cyclone/ storm prone. Coastal part of this area is also flood prone.Environmental impacts of flood include soil erosion, silting, waterpollution, denudation of land, ingress of saline water in cultivable land.

3.5.4. Tsunami

Tsunami devastated several parts of Puducherry and Karaikal and added additional dimension to the vulnerability of the region.

The map below shows the situation report 2005:

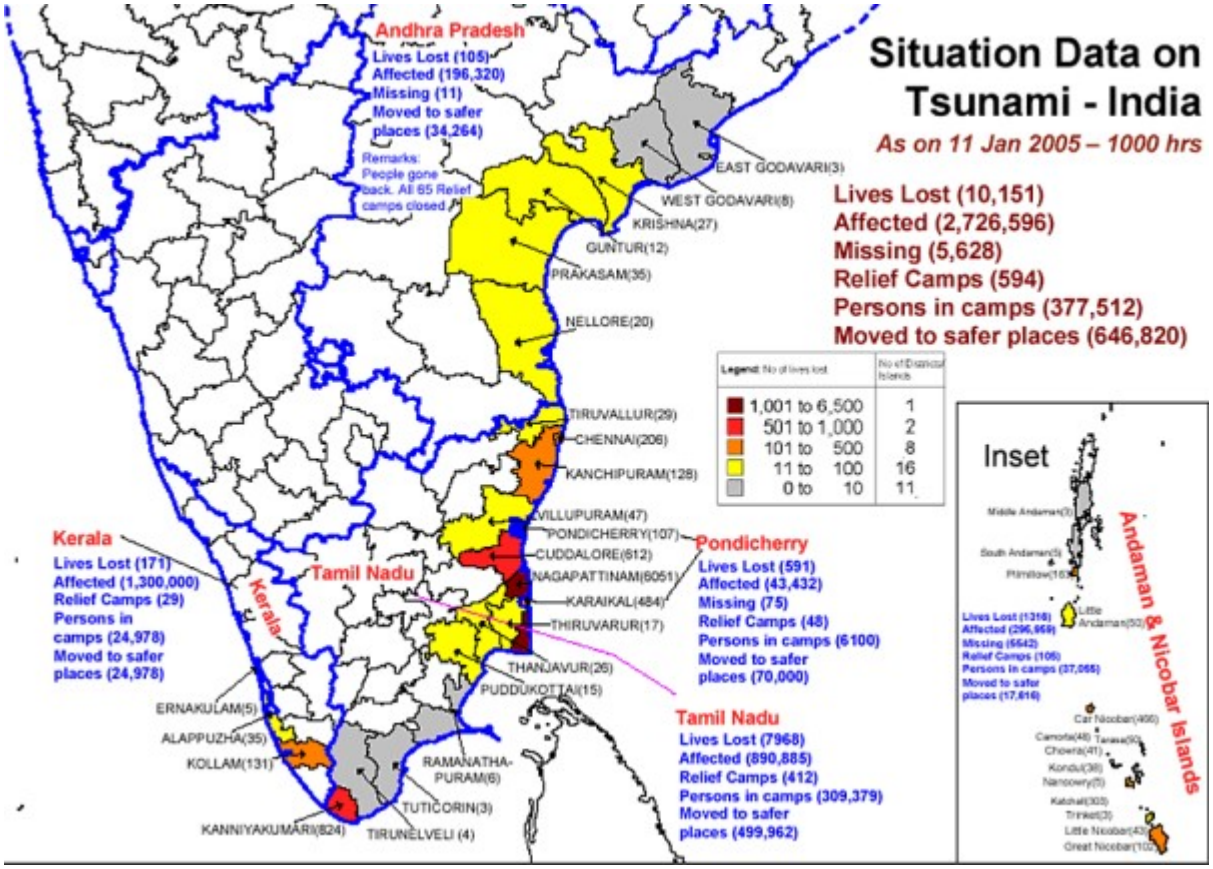

Figure 12: Situation data on Tsunami India
(Source: WHO)

3.6. Pollution

While pollution is not strictly a direct outcome of climate change the over-drawal of ground water in many areas of Puducherry and industrial units in Mahe and Yanam affects the water quality. Large number of unregistered aquaculture units discharge pesticides into water and also there is methane emission.

Puducherry being in a fragile coastal ecosystem is highly disaster prone and extremely vulnerable.It has been scientifically established that climate change enhances the occurrences of extreme events.The UT has been impacted by several bio-physical, socio-economic and environmental factors and some of these factors may worsen due to climate change. Some areas are more vulnerable than others. Areas like Puducherry and Yanam are multi-hazard points.Karaikal has some high erosion zones and a fragile coast line. Mahe even though it is far from the mainland has relatively better adaptive capacity. To enhance resilience the UT has to invest in physical infrastructure, build adaptive capacity of the community to enhance resilience and reduce vulnerability.

The good sign of it can be seen in the CDRP project conceived by the UT which has already recognised the vulnerability of the UT due to climate change and heavily invests in climate proofing infrastructures, building capacity of the community, strengthening the early warning systems, etc.

4. Green House Gas Inventory

4.1. Introduction

While finalizing the Climate Change Action Plan, it was felt that knowledge of baseline emission is needed to monitor the progress. The exercise was taken up to estimate the emission from various activities across the UT.

For the purpose of computing GHG emission from various sectors like domestic, transport, waste,industry, agriculture, etc.; approach outlined in**IPCC 2006 Guidelines** and **India Second National Communication to the United Nations Framework Convention on Climate Change** published in **2012** by **Ministry of Environment & Forests, Govt. of India** is followed.

4.2. Methodology

The IPCC 2006 Guideline suggests a three tier approach for estimation of GHG emission, while Tier - 1 approach needs less complex data and depends mostly on default emission factors; thehigher tier approaches will require data in greaterdetails and specific emission factors. The uncertaintiesin estimation however, are reduced when itmoves up the tier ladder. For the purpose of GHG emission estimation;the following six Green House Gases were considered:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Per fluorocarbon (PFC)
- Hydro fluorocarbon (HFC)
- Sulphur Hexafluoride (SF_6)

Due to unavailability of detailed baseline data and information during estimation process; it was decided to follow the quickestimation process using Tier 1 methodology and in mostcases with default emission factors. The estimation under Tier 1 is considered to beadequate for the Climate ChangeAction Plan as of now.

The key sectors relevant to Puducherry were selected and the extent of these activities in the UT was determined. The sectors are –

- Domestic
- Transport
- Waste
- Industrial process
- Agriculture

This estimation in the domestic sector includeselectricity, kerosene and LPG[15] consumption by domestic users whereas thetransportsector emission includes UT wide emission from road transport.

For estimation GHG emission from industry sectorfossil fuel and electricity consumption by all category and numbers of industries located inPuducherryare considered. The GHG estimation from fossil fuel consumption by the industries is done on the projected fuel consumption information provided by the industries to the SPCB relating to their production capacity. For industry sector, estimation of fossil fuel consumption is notdone on the basis of actual production, but on the basis of the projected production capacity and specific fossil fuel consumptionsince collection of actualdata would require more time. GHG emission for electricity consumption by industries is calculated based on the cumulative amount of electrical energy consumed by the industries based on the information from the electrical utility.

The GHG sources categorized for estimation in waste sector is as follows –

- Municipal solid waste disposal
- Domestic waste water disposal

The main greenhouse gases emitted from waste management sector is methane which is produced and released into the atmosphere as a by-product of the anaerobic decomposition of solid waste, whereby methaneo-genic bacteria break down organic matter in the waste. Similarly, wastewater becomes another source of methaneemission when treated or disposed anaerobically.

Inventory of GHG emission from agricultural sector is carried out considering the following source categories:

1. Enteric fermentation
2. Manure management
3. Rice cultivation

Though soil carbon and field burning of agricultural residues are sources of agricultural emission, they are however eliminated from calculations. Specific emission factor used for national GHG inventory is considered for the estimation of inventory for the agriculture sector.

The product of activity data and corresponding emission factor is used to determine the emission of GHG. The emissions of the GHGs were then multiplied with the corresponding Global Warming Potential (GWP) to express the emission in terms of CO_2 equivalent (CO_2-eq). The basic equation involved in estimating the emission is thus;

Emission $j = \sum AD_i * EF_{ij}$

Where AD is activity data of i^{th} activity and

EF is emission factorsof i^{th} activity for j^{th} GHG emission.

[15]*Liquefied Petroleum Gas*

The GHG emission from domestic sector was estimated by multiplying the total amount of electricity, kerosene and LPGconsumed by the domestic users with respective emission factors (as per 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter I for kerosene and LPG and CO_2 Baseline Database, Version 8.0 published by CEA for electricity).

Table 11: Energy consumption and Specific GHG emission factors for different energy source in Domestic sector

Energy Type	Consumption (Metric Tonne/ year)	Emission Factor (tonnes of CO_2e/TJ)
LPG	33,074.00	63.10
Kerosene	12,276.00	71.90
Southern Regional Grid Emission Factor	578 (Million units)	0.91 (tCO_2e/MWh)

Similarly for transport sector, the GHG emission is estimated based on the total diesel and petrol sold in the UT multiplied by emission factor. (Case I)

Table 12: Energy consumption and Specific GHG emission factors for different energy source used in Transport sector

Energy Type	Consumption (Metric Tonne/ year)	Emission Factor (tonnes of CO_2e/TJ)
Petrol	83,971.00	69.30
High Speed Diesel	3,54,002.00	74.10

It is worthwhile to note thatbecause of the low price of the Diesel/Petrol in the UT, vehicle from adjacent state get the fuel from the UT. However due to the lack of information with regard to the distances travelled by the vehicle across all the four regions of UT, the national per capita emission from the transportation sector multiplied to the population of union territory is done to arrive at the emission figure (Case II).

As per the publication by MOEF "India: Greenhouse Gas Emissions 2007" INCCA: Indian Network for Climate Change Assessment the total emission from Road transportation sector is 1,23,554.00 (thousand tons) of CO_2ein 2007. Considering the population of 1.15 billion the per capita GHG emission from transportation sector is estimated to be 0.107tCO_2e/capita/annum. Considering current population of Puducherry the total emission of GHG from transport sector is 0.134Million tonnes of CO_2e.

The emission from industry sectors includes emission due to energy consumption only. Electricity, coal, diesel, furnace oil, etc. are being used in the industries and the GHG emission is based on the total quantum of each fuel type multiplied by respective GHG emission factors as available in 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter I and CO_2 Baseline Database, Version 8.0 published by CEA.

Table 13: Energy consumption and Specific GHG emission factors for different energy source used in Industry sector

Energy Type	Consumption (Metric Tonne/ year)	Emission Factor (tonnes of CO_2e/TJ)
Coal	4,89,600.00	95.81
Diesel	31.688	74.10
Furnace Oil	26,127.69	77.40
Electricity	1,523 (million units)	0.91

For wastesector (Municipal Solid waste and Sewage), the equation as per UNFCCC ***"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" Version 5*** is as below:

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j(y-x)} \cdot \left(1-e^{-k_j}\right)$$

Where:

$BE_{CH4, SWDS, y}$ Methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)

Emission from Municipal Solid waste and Sewage waste whether industrial or domestic contributes considerably to the GHG emission in a geographic region. Basically the waste comprising organic components result in emission of methane which has a global warming potential of 21 times that of carbon-dioxide. For the purpose of estimation of net GHG emission the waste generated from the domestic sector is only considered.

Emission due to Municipal Solid Waste Disposal: Based on the total population of the Union Territory as 12,47,953 nos. and solid waste generation at the rate of0.00045 tonne/capita/day; average greenhouse gas emission is estimated at 88,725 Tonnes of CO_2e per annum.

Emission due to Sewage: Methane is emitted from waste water due toanaerobic treatment or disposal of it. Wastewater originating from a variety of domestic, commercial and industrial sources has significant contribution in GHG emissions of the UT. The GHG emission from sewage for the UT is considered for both domestic and industrial wastewater generated. Further, emissions from domestic wastewater handling are estimated for both urban and rural centres. Emission due to sewage is estimated considering the above mentioned population and waste water generation potential of120 litre/capita/day; the annual greenhouse gas emission is estimated at 92,779 tCO_2e.

The method of emission due to enteric fermentation, manure management and rice cultivation is detailed below-

Enteric Fermentation: Methane is produced in herbivores as a by-product of enteric fermentation, a digestive process by which carbohydrates are broken down by micro-

organisms into simple molecules for absorption into the bloodstream. The amount of methane that is released depends on the type of digestive tract, age, weight of the animal and the quality and quantity of the feed consumed. Ruminant livestock (e.g., cattle, sheep) are major sources of methane with moderate amounts produced from non-ruminant livestock (e.g., pigs, horses). The ruminant gut structure fosters extensive enteric fermentation of their diet.

The specific emission factor was calculated by NATCOM as a part of preparing the GHG inventory towards national submission is used for calculation of UT specific sectoral emission:

Table 14: Specific emission factors for different livestock

Category of livestock	Emission Factor (kg CH_4/head/year) – Enteric Fermentation
Dairy cattle - Indigenous	28±5
Dairy cattle - Cross-bred	43±5
Dairy buffalo	50±17
Sheep	4±1
Goat	4±1
Horses and ponies	18
Donkeys	10
Pigs	1

Since, the latest statistics present for the livestock population was based on 2007 census in UT; the same is used for calculation.

Table 15: Livestock population

Category of livestock	Number of livestock
Dairy cattle - Indigenous	6,134
Dairy cattle - Cross-bred	79,062
Dairy buffalo	3,325
Sheep	4,694
Goat	69,567
Horses and ponies	32
Donkeys	60
Pigs	728

Based on the total population of livestock in each category and the specific emission factor pertaining to enteric fermentation, the total methane emission is calculated at 4,036 tCH_4/year (84,768 tCO_2e/year).

Manure management: Methane is emitted from anaerobic decomposition of animal waste. The emission of methane however depends on the rate of waste production per animal, the number of animals, and on how the manure is managed. When manure is stored or treated as a liquid (e.g. in lagoons, ponds, tanks, or pits), it decomposes anaerobically produce significant quantity of methane. The temperature and the retention time of the storage unit greatly affect the amount of methane produced. When manure is handled as a solid (e.g., in

stacks or piles) or when it is deposited on pastures and rangelands, it tends to decompose under more aerobic conditions,hence less methane is produced.

The specific emission factor was calculated by NATCOM as a part of preparing the GHG inventory towards national submission is used for calculation of UT specific sectoral emission:

Table 16: Specific emission factors for different livestock

Category of livestock	Emission Factor (kg CH_4/head/year) – Manure Management
Dairy cattle - Indigenous	3.50±0.20
Dairy cattle - Cross-bred	3.80±0.80
Dairy buffalo	4.40±0.60
Sheep	0.30
Goat	0.20
Horses and ponies	1.60
Donkeys	0.90
Pigs	4.00

Based on the total population of livestock in each category and the specific emission factor pertaining to manure management the total methane emission is calculated at 354 tCH_4/year (or 7,452 tCO_2e/year).

Rice Cultivation:Methane is emitted from cultivation of rice mainly due to anaerobic decomposition of the organic matter, as rice cultivation in India is majorly done through water logging. The emission of methane pertaining to rice cultivation however depends upon the type of irrigation and also the type of application of water.
The specific emission factor was calculated by NATCOM as a part of preparing the GHG inventory towards national submission is used for calculation of UT specific sectoral emission:

Table 17: Specific Methane emission from different water application

Type of irrigation	Type of water application	Specific Methane emission (kgCH_4/ha)
Irrigated	Continuously flooded	162.00
	Single aeration	66.00
	Multiple aeration	18.00
Rain-fed	Drought prone	66.00
	Flood prone	190.00
Deep water	Deep water	190.00

Based on the total 20,926 ha[16] of land area under Paddy cultivation with 80% of land under irrigation and considering single aeration and 20% of the area under non irrigated flood prone area the total methane emission is calculated at 1,900 tCH_4/year (39,901tCO_2e/year).
The inventory of GHG emission from agriculture sector is presented as follows:

[16] *2009-10*

Table 18: GHG emission from Agriculture sector

Category	Total Emission (tCH_4/year)	Total Emission (tCO_2e/year)
Enteric Fermentation	4,036.00	84,768.00
Manure Management	354.00	7,452.00
Rice Cultivation	1,900.00	39,901.00
Total	**6,290.00**	**1,32,121.00**
Total Equivalent GHG emission		**0.132 million tCO_2e**

4.3. Result

The estimation of major industrial,domestic, agriculture, transport and waste management sectors are made using Tier 1 methodology as perIPCC 2006 Guidelines and available data. Theemissions of industry sector were calculated on the basis of installed capacity of the industry sector,as credible data on plant availability, plant utilisation, and production efficiency werenot available. These assumptions might have resulted in slight over-estimation than the actual. It is thus necessary that this estimation process may be carried forward along the IPCC tier ladder for a more accurate GHG estimation. For completeness estimation of emissions from other sectors may also be considered to be incorporated.

In domestic sector, emission calculated on the basis of total kerosene, LPG and electricity consumedwhereas in case of the transport sector;itwas calculated onthe basis of actual fuel sold throughretail selling of petroleum products. The emission estimation from municipal solid waste and sewage was done on basis of total population and not on actual generation due to unavailability of data during estimation time.
Thesummarized emission details are presented inTable below.

Table 19: Details of CO_2e emission

Sector	CO_2e emission(Million Tonnes of CO_2e/year)
Domestic	**0.6630**
LPG Consumption	0.0987
Kerosene Consumption	0.0386
Electricity Consumption	0.5260
Transport (Case I)	**1.4120**
Petrol Consumption	0.2647
High Speed Diesel Consumption	1.1476
Transport (Case II) Considering on the basis of population	**0.1337**
Industry	**2.3540**
Coal	0.8866
Diesel	0.0001
Furnace Oil	0.0817
Electricity	1.3859
Waste	**0.1810**
Municipal solid waste disposal	0.0887
Domestic Waste Water disposal	0.0927

Agriculture	**0.1321**
Enteric Fermentation	0.0848
Manure Management	0.0075
Rice Cultivation	0.0399
Total Considering(Considering Case I)	**4.7435**
Total Considering(Considering Case II)	**3.4641**

The sector wise GHG emission is represented below with two cases of emission from transportation sector (Case I: GHG emission estimated for the transportation sector based on actual fuel oil being sold net of the consumption from industry and Case II: GHG emission from transportation sector is estimated based on per capita GHG emission from transportation sector in 2007 across India. However for case II estimation emission from road transportation is considered)

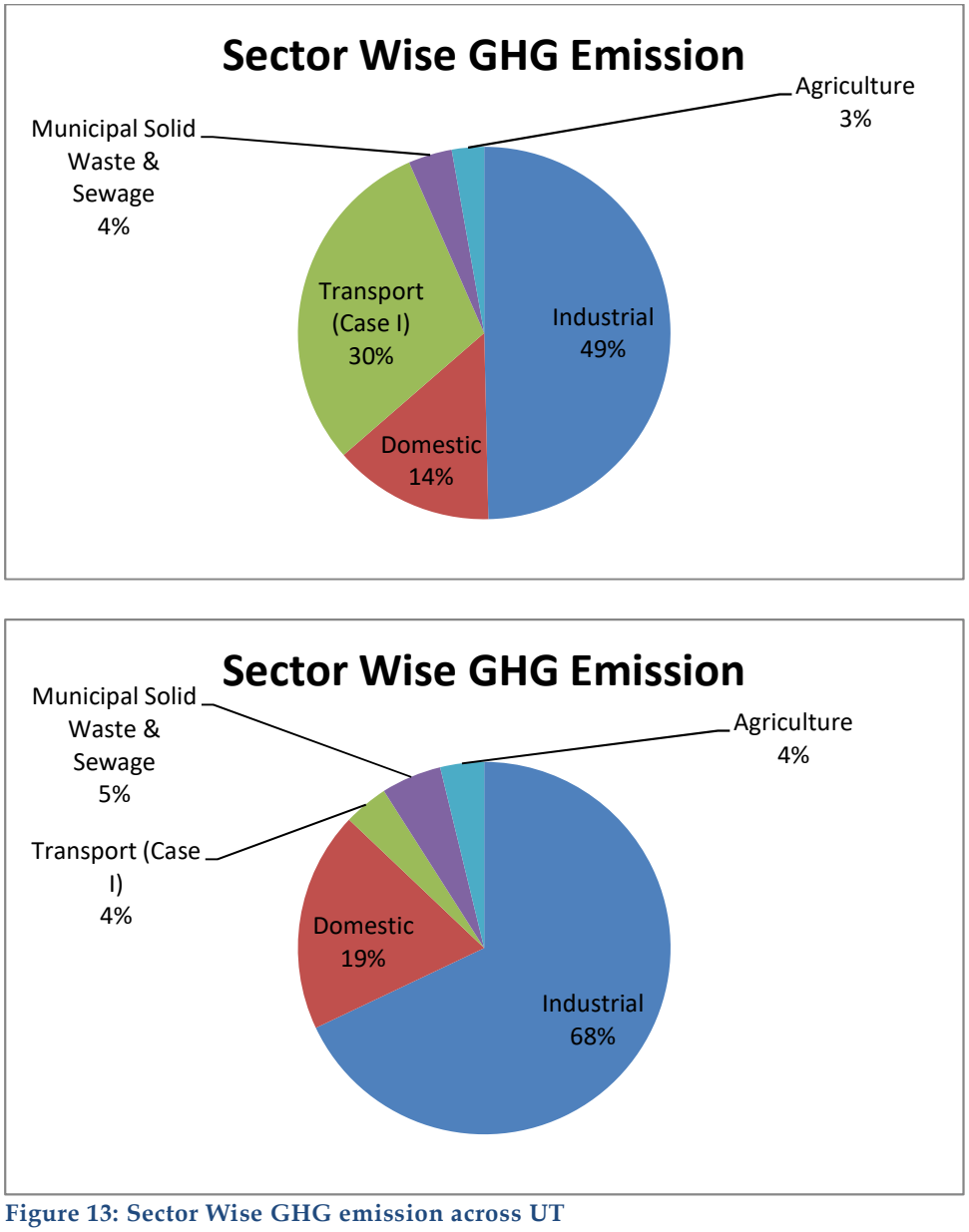

Figure 13: Sector Wise GHG emission across UT

4.4. Summary of GHG Emission

The following is the summary of the GHG emission across the UT.

Table 20: Summary of the GHG emission

Sectoral Emission	Amount	Unit	Remark
Industrial	2.3540	Million tonnes of CO_2e	Annualized adding the CO_2e emission
Domestic	0.6630	Million tonnes of CO_2e	Annualized CO_2e emission for 2009-10
Transport (Case I)	1.4120	Million tonnes of CO_2e	Annualized adding the CO_2e emission
Municipal Solid Waste & Sewage	0.1810	Million tonnes of CO_2e	Annualized adding the CO_2e & CH_4 emission
Agriculture	0.1321	Million tonnes of CO_2e	Annualized CH_4 emission
Net Emission	**4.7435**	**Million tonnes of CO_2e**	

Table 21: Summary of the GHG emission

Sectoral Emission	Amount	Unit	Remark
Industrial	2.3540	Million tonnes of CO_2e	Annualized adding the CO_2e emission
Domestic	0.6630	Million tonnes of CO_2e	Annualized CO_2e emission for 2009-10
Transport (Case II)	0.1340	Million tonnes of CO_2e	Annualized adding the CO_2e emission
Municipal Solid Waste & Sewage	0.1810	Million tonnes of CO_2e	Annualized adding the CO_2e & CH_4 emission
Agriculture	0.1320	Million tonnes of CO_2e	Annualized CH_4 emission
Net Emission	**3.4641**	**Million tonnes of CO_2e**	

The results have been obtained using the Tier I approach of IPCC and approved methodology of UNFCCC which can serve as a crude estimate of GHG profile of the UT.

4.5. Comparison of per-capita GHG emission

Considering the total emission of 3.46 million tonnes of CO_2e and population of 1.247 million the per-capita emission in Puducherry is estimated at 2.7 tCO_2e in compared to national per capita emission of 1.7tCO_2e (2007)[17].

[17]The national per capita emission hasincreased at a CAGR of 3.3% from 1994 to 2007

5. Solar Mission

5.1. Introduction

Uncontrolled rate of urbanisation, industrialisation and change in lifestyle in today's world are the factors contributing to the widening energy demand–supply gap. Even though, the requirement of energy to meet the demands of social, economic development, human welfare and health cannot be compromised but strategy needs to be designed for low carbon inclusive growth.

The Solar Mission under CCAP Puducherry is strategized in line with the **National Solar Mission** with objectives to meet the country's development goals and energy security while simultaneously yielding co-benefits to address climate change effects. Various off-grid renewable energy projects have been installed so far in Puducherry. The Union Territory (UT) of Puducherry has 160 MW of grid interactive renewable energy potential, but only 0.02 MW has been explored so far.

The population growth of the UT has immensely led to increased demand of electricity. The population of the UT has increased by 28% in the period of 2001- 2011 which is much higher than the national decadal growth rate of 17%. Urban population growth at 31% had major contribution to the decadal population growth of the UT in the last decade and has certainly increased the annual per capita electricityconsumption by 45%[18]in the period of 2000- 2011.

Table 22: Population distribution of Puducherry[19]

Sl. No.	Union Territory	Population 2011	Percentage decadal growth rate
		Total	2001-2011
1	Rural	3,95,200	21
2	Urban	8,52,753	31
	Total	**12,47,953**	**28**

The UT's power generation capacity is lesser than 10% of its annual power demand. The UT's power demand estimated at 349.97 MW[20] is mainly met through the allocated power from various Central Generating Stations (CGS), power purchased from neighbouring States' Electricity Boards and power generated by the 32.5 MW gas based power plant of Puducherry Power Corporation Ltd. (PPCL), the only power plant of the UT located at Karaikal. The power demand of Puducherry and Yanam regions are met through allocated power of Central Generating Stations supplied through the Southern regional grid whereas demand of Karaikal region is met through power procured from Tamil Nadu Electricity Board and power generated by PPCL. Mahe gets the power supply from Kerala State Electricity Board.

[18] Source: http://www.indiastat.com/
[19]Census 2011, Govt. of India
[20]*Source: Power Scenario and Availability as published by Electricity Dept. of Puducherry*

5.2. Key Trends in the Sector

Puducherry is highly dependent on thermal power sources which majorly contribute to Green House Gas emission, environmental degradation through fly ash generation, air pollution, depletion of natural resources like water, fossil fuels, etc. Apart from 0.02MW[21] grid interactive solar power plants, Puducherry has no other solar energy based power projects of its own.

Table 23: Demand Mix

Demand Mix	Quantum
Peak Power Demand[22]	349.97 MW
Gas based Power plant at Karaikal region	32.50 MW
Per capita energy consumption[23]	2,250.00 kWh

Table 24: Energy consumption profile of the UT[24]

Consumer Category	Consumption Share in %(Out of total electricity consumption)
Industrial	63%
Domestic	20%
Commercial	7%
Municipal Utilities and others	7%
Agriculture	3%

Energy consumption by the Industries ranks highest among all the sectors due to a higher level of industrialisation in the region. 8,444 small-scale Industries, 187 medium scale industries and 77 large scale industries are located in the UT. Per capita industrial power consumption is given below:

Table 25: Power Consumption

Industrial Power Consumption	Per Capita Power Consumption (in kWh)
LT[25]	31,454
HT	27,70,545

Second highest bulk electricity consumer in the UT is the domestic sector accounting for 20% of total electricity consumption. The share of domestic load is higher owing to 68% share of urban population as compared to national average of 31%. Per capita energy consumption of

[21] *Source: Energy Statistics of 2013 published by Central Statistics Office, Ministry of Statistics and Programme Implementation, Govt. of India*

[22] *Source: http://electricity.puducherry.gov.in/power/pondy.htm*

[23] *Source: Indicators of Socio-Economic Development by Planning & Research Department, Govt. of Puducherry -July 2012*

[24] *Draft Renewable Energy Vision-2010 and Renewable Energy, Energy Conservationand Energy Efficiency Policy 2011-2020 published on 2nd February 2011 with Ref. No. REAP/RE/Policy/TA-III/2010-11*

[25] *Ref: LT - Low Tension and HT – High Tension*

Puducherry has also increased by 48% in a short span from 2007 to 2011 and has reached 2,250 kWh, much higher than India's per capita consumption figure (879.22kWh[26]).

The Union Territory of Puducherry with 6 towns and 263villages is already fully electrified. Due to the hot and humid climatic condition through most of the year, the domestic sector needs power primarily for lighting and cooling systems. The scenario of rural and urban energy consumption for lighting purposes is almost similar accounting for 95% and 98%[27] respectively. Dependency on kerosene in rural areas has reduced drastically from 18% in 2001 to 3% in 2011.

LPG & PNG are the predominant fuels for cooking in both rural and urban areas of Puducherry. Around 52% of the population uses LPG and next major share of cooking fuel is occupied by firewood at 35%. The scenario is slightly different in urban areas as 78% of households are using LPG & PNG and kerosene is seldom used in only 10% of the households.

5.3. Vulnerability of the sector

Climate change can adversely impact different components of solar energy sector as outlined below:

Table 26: Possible Climate Change Impacts on the Solar Sector

Climate Change Indicators	Impacts on Solar Sector
Variation in Hydrological cycle (Greater seasonal and year to year variability in precipitation, more frequent and prolonged extreme events like drought or heavy rainfall, shift in rainfall timing)	• Variability in water availability could impact solar thermalenergy generation potential
Increased Temperature	• Enhanced need of energy in domestic & commercial sector for cooling. • Could impact renewable energy generation potential, especially solar due to decrease in solar panel efficiency
Extreme events (Tsunami, storm, cyclone, cloudbursts, Sea level rise, Coastal erosion, flood, etc.)	• Effect on power plant infrastructure including transmission and distribution network • Solar power generation can be affected due to grid downtime and frequency disturbance, cloudy days can affect Rooftop solar systems and Solar Home Systems

Strategies for linking climate change and solar sector are usually centred on mitigation efforts because the fossil fuel based energy generation method majorly contributes to GHG

[26]*Source: Executive summary of Monthly Review of Power Sector Reports prepared by Coordination Division of CEA at http://www.cea.nic.in/reports/monthly/executive_rep/jul13.pdf*
[27]*Source: Census 2011*

emission. Developing options for low carbon inclusive growth and reducing carbon footprint are important to limit the degree of climate change in future. Regions with higher temperature would face rise in electricity demand because of higher use of cooling. This would thereby enhance the pressure on electricity distribution network through increased seasonal demand. Assessing the vulnerability of energy sector to climatic events and longer term climate change needs a strategic approach to ensure that timely and effective adaptation measures are adopted for coherence across the sectors.

5.4. Key issues in the sector

Though all towns and villages of the Union Territory are electrified but they are largely dependent on external sources i.e. other State Electricity Boards and share of Central Generating Stations which are beyond UT's control and subject to availability. Awing to the law in the UT, power generation capacity the electricity used is mostly generated from non-renewable energy sources which are highly vulnerable to climatic conditions and depends upon availability of coal, gas, nuclear energy. These enhance GHG emission in to the atmosphere.

Per capita energy consumption of the UT is 2,250 kWh, more than three times the national average. Factors like the existing power sourcing scenario, projected power demand growth rate of 7%, high per capita consumption and decadal population growth rate of 28% are likely to jeopardize energy security in the long run.

India is a tropical country and receives intense sunshine for prolonged period. Further, all the four regions of the Union territory of Puducherry are located close to the equator and receive more sunshine than the national average taking the untapped off-grid solar power potential to 303 MW_p. Still 35% of rural population in the UT uses firewood for cooking which causes forest degradation. The Govt. of Puducherry is promoting solar energy generation in the UT by facilitating implementation of projects under the Jawaharlal Nehru National Solar Mission (JNNSM) of Govt. of India.Only 0.02 MW grid interactive solar energy generation has been exploited out of total potential of 160 MW due to scarcity of land, resource constraint, lack of infrastructure support and interest in project investment among local entrepreneurs.

5.5. Programmes and Policies in the sector

REAP (Renewable Energy Agency of Puducherry) since its inception in 2005has been making stride in promoting renewable energy technology across the UT and meeting the decentralised energy demand of dispersed locations through decentralised renewable energy generation under various schemes and programmes of the Ministry of New and Renewable Energy (MNRE).The renewable energy project implementation is undertaken under following programmes-

1. Jawaharlal Nehru National Solar Mission (JNNSM) –
    a) Off-grid Rooftop Solar Power Plants
    b) Grid connected Rooftop Solar Power Plants
    c) Solar Lanterns

d) Solar Home Lighting
e) Solar Street Lighting
f) Solar Water Heating
g) Solar Air heating
h) Solar steam cooking system
i) Solar Water Pump

5.6. Achievements:

JNNSM:

- **Solar PV:**
  A rooftop grid interactive solar PV power plant of 25 kWp has been installed at the Chief Secretariat building of Puducherry as a demonstration initiative. A 20 kWp rooftop Solar PV power plant has been installed by the Fisheries Dept. of Puducherry in Tsunami Rehabilitation Quarters. An industry named M/s Grace Industries has established 145 kWp grid connected solar PV power project in Puducherry.

- **Off-grid Solar projects:**
  Apart from grid interactive solar power projects, REAP has already distributed and installed various other solar energy technologies to meet decentralised energy demand in Puducherry.

Table 27: No. of off-grid solar power systems and solar thermal systems distributed from 2006 to 2012

Sl. No.	Technology	Distributed (2006 -2012)
1	Solar Lantern	302 Nos.
2	Solar Street lights	330 Nos. (400 street lights in total).
3	Solar Cooker	6 Nos.
4	Solar Water heating systems	36,700 LPD

- **Solar Steam Cooking system:**
  REAP has already set up a solar steam cooking system in Central kitchen of Central Prison at Kalapet for reducing LPG and other fuel usage in cooking.

- **Solar Home Lighting System:**
  Solar home lighting systems have been distributed and installed at various homes operated by Social Welfare Dept. and Navodhya School.

- **Solar Air heating/dryers:**
  M/s TTK Industries and L&T industries have installed solar air heating system, solar power projects and solar street lights.

- **Solar Water Pump:**
  Solar water pumps used for irrigation for vegetable and fruit cultivation havebeen installed in Karaikal and Puducherry region.

5.7. Renewable Energy Technology and Climate Change

India is faced with a formidable challenge of economic growth, poverty alleviation to be met from limited resources. The growth objective of 12th five year plan considers the sustainable

development paradigm to ensure development activities balancing the needs of the present as well as the future generations (WCED, 1987).The National action Plan on climate change apart from the eight missions, has laid emphasis on numerous other climate-friendly measures. At the COP-15 to theUnited Nations Framework Convention on Climate Change(UNFCCC) in Copenhagen, Denmark, during 7–18 December 2009, India has pledged to continue a constructive role in international climate diplomacy while emphasizing the need for implementing a comprehensive domestic response to reduce the emissions intensity of Gross Domestic Product (GDP) in 2005 by 20–25% in 2020. Promoting Renewable Energy technology is one of multipronged strategies planned to achieve the key goals in context of climate change and at the same time addresses the issues of over energy security, commercial exploitation of renewable power potential, eradication of energy poverty, ensuring availability and affordability of energy supply and preparing the nation for imminent energy transition.Major Renewable Energy Programme facilitated by Government of India includes the following features:

Table 28: Major Renewable Energy Programmes

Programme	Features
National Biogas and Manure Management Programme(NBMMP)	To provide clean biogas fuel for reducing use of liquefied petroleum gas (LPG) and other conventional fuels; mitigation of climate change by preventing black carbon and methane emissions
Accelerated Programme on Energy Recovery from Urban Wastes – Sanction for the Year 2005/06	To accelerate the promotion of setting up of projects for recovery of energy from urban wastes; to create an enabling environment to develop, demonstrate, and disseminate utilization of wastes for recovery of energy; to harness the available potential of municipal solid waste (MSW)-to-energy by the year 2017
Scheme on Biogas Based Distributed/Grid Power Generation Programme	To promote biogas-based power generation, especially in the small capacity range (based on the availability of large quantity of animal wastes and wastes from forestry, rural based industries, kitchen wastes)
Programme on Recovery of Energy from Industrial Wastes	Central financial assistance in the form of capital subsidy and grants-in-aid in respect of the following activities.(i) Industrial waste to biogas(ii) Power generation from biogas(iii)Power generation from solid industrial waste (iv) Promotional activities (v) R&D, resource assessment and technology upgradation

Some of the strategies and actions planned under the Puducherry Action Plan on climate Change are outlined as follows:

1. Assessment of Wind Energy Potential & mapping of potential wind sites
2. Assessment of Biomass Energy Potential & preparation of Biomass Resource Map
3. Promotion of biomass gassifierto meet up electrical and thermal energy requirement
4. Incorporation of Renewable Energy Obligation (RPO) in building By-Law applicable to major building projects (> 20,000 sq. ft).
5. Renewable Power Obligation fixed at 2% of the power purchase from Renewable Energy Source to be scaled up to 10% by 2020.
6. Formulation of Renewable Energy, Energy Conservation and Energy Efficiency policy.
7. Facilitating waste to energy projects.

8. Promoting private investment in setting up of projects for power generation from renewable energy sources through an attractive mix of fiscal and financial incentives.

5.8. Key Priorities

With the vision of the **National Solar Mission** "Enhancement of the solar energy share in the total energy mix", key elements for mitigation and adaptation were identified after detailed deliberation with the nodal officers. The UT is highly carbon intensive due to high per capita consumption and usage of grid electricity, fossil fuel to meet energy demand which has increased manifold due to steep growth in energy consumption.

To promote low carbon sustainable growth, the Government of Puducherry has planned to promote green energy by increasing share of renewable energy in generation mix, scaling up decentralised renewable energy application, etc. The priorities are in line with the concerns raised due to impact of climate change and the UT's response.

Key Priorities: Solar Mission
1. *Harnessing renewable energy potential scenario of the UT by Assessment of Solar energy potential across the UT & preparation of solar potential map*
2. *Mandatory use of solar water heating systems in domestic sector through policy action and demonstration*
3. *Promotion and facilitation of Renewable energy application in Govt. schools & central kitchens of UT.*
4. *Enhancement of solar lighting application in public places through demonstration projects*
5. *Strengthening technical competency of various stakeholders of RE technology including O&M service providers, technicians, installers, manufacturer & others*
6. *Promotion of Solar water heating system application in health sectors*
7. *Mandatory use of Solar Water Heating system in hotel sectors*
8. *Promotion of grid interactive solar power generation in PPP/IPP mode through policy measures and facilitating setting up of 20 MW rooftop and small solar power plants of up to 2 MW capacity.*
9. *Promotion of solar application in public buildings for lighting and hot water generation through demonstration project of 50 kW solar power and 1000 LPD SWH installation in two govt. buildings*

1. ***Harnessing renewable energy potential scenario by Assessment of Solar energy potential across the UT & preparation of solar potential map***

The main objective of the action is to improve the productive potential of natural and renewable energy sources and reduce the dependency on conventional thermal power supply. Each of the renewable energy sources can be eco-sustainable and less carbon intensive. Hence this needs to be effectively managed for increased supply of electrical and thermal energy and achievement of consequent economic and social growth.

Puducherry has tremendous solar energy potential due to high incident solar radiation. But, due to a long coastline vulnerable to projected sea-level rise, cyclone, storm surge etc. and scarcity of land, identification of the solar project sites and assessment of energy generation potential of the sites are difficult. 1 MW of solar power plant can replace around 1.8 million units of fossil fuel intensive grid power consumption and help in 1,700 tCO_2e of GHG emission reduction. Therefore, the activities planned are -

i. Assessment of Solar irradiation, temperature, wind speed at regional level across the union territory for solar mapping
ii. Risk assessment of solar energy sources in anticipated climate change situations (variable rainfall, temperature, extreme events)
iii. Risk Assessment of solar energy infrastructure in climate change situations including extreme events
iv. Projection and risk assessment of energy demand
v. Identification of appropriate sites for solar energy projects.
vi. Awareness programmes and capacity building of nodal agency on technological and regulatory aspect.

2. Mandatory use of solar water heating systems in domestic sector through policy action and demonstration

The govt. of UT in line with the objective of National Solar Mission wanted to promote and mandate the use of solar water heating system. Use of solar energy for water heating has high potential owing to high incident solar radiation and longer daytime. A large amount of energy is consumed by the domestic sector. Enhancing usage of solar water heating systems in households will replace use of inefficient electric heaters, geysers and reduce the power demand and green-house gas emission. A solar water heater of 100 LPD can prevent 1.5 tCO_2e[28] GHG emission reductions. Annual use of 400 nos. SWH (Solar Water Heater) of 100 LPD (Litre per Day) can contribute to a peak load saving of 0.4 MW. The activities planned are –

A. *Policy for mandatory use of solar water heating systems in all houses and apartments of area more than 150 sq. m. area by 2016*
B. *Maximizing Solar water heating system usage in households with more than 1,500 sq. ft. area through promotion & facilitation for setting up of Solar Water Heating(SWH) systems by undertaking pilot projects –*
   i. Pre-feasibility study, identification and preparation of project proposals.
   ii. Arrangement and management of project fund for implementation.
   iii. Facilitating deployment of SWH system in households with more than 1,500 sq. ft. –
      - Installation of 100 LPD system in 100 households by 2014
      - Installation of 100 LPD system in 300 households by 2016
   iv. Training to users on operation and maintenance of the system

3. Promotion and facilitation of Renewable energy application in Govt. schools & central kitchens of UT.

The food provided in the Midday Meal scheme is cooked in 12 Central Kitchens of the UT; out of which, 9 are located at Puducherry, 2 at Karaikal and 1 at Yanam region. 86 School Canteen Centres are also operational where Central Kitchens are not available. Around 0.126 million students studying in Govt. or Govt. aided private schools, are benefitted under Midday Meal Scheme from the above canteens.

[28] *Source: FAQ_MNRE*

Apart from the Midday Meal scheme, canteens are also used to benefit around 0.105 million students under Shri Rajiv Gandhi Evening Milk Scheme. Only two central kitchens are use LPG whereas diesel and firewood are used in the rest. Renewable energy application particularly solar concentrator based cooking could be a viable option considering the climatic condition. This would reduce fossil fuel consumption for cooking leading to greenhouse gas emission reduction. The activities proposed to achieve the objectives are –

A. *Installation of solar concentrator based cooking system in central kitchens* –
   i. Pre-feasibility study
   ii. Bankable DPR and proposal preparation
   iii. Arrangement and management of project fund for implementation
   iv. Facilitating implementation of solar concentrator based cooking system in 3 central kitchens of Puducherry region by 2014 and
   v. Installation in all 12 central kitchens of UT by 2016

B. *Installation of solar power technologies in 50 schools to convert those to Green schools by 2016*

The students of around 709 schools in Puducherry are benefitted under Mid-day Meal Scheme, Shri Rajiv Gandhi Breakfast Scheme and Shri Rajiv Gandhi Evening Milk scheme. Thus the schools consume bulk energy for cooking and lighting purpose. To reduce bulk electricity consumption for lighting and fuel (LPG, PNG and fossil fuels) and kerosene consumption for cooking, 50 green schools would be developed by installing 25 kW_prooftopsolar power projects. Approximately, 48,000 units of electricity can be saved and thus, 44 tonnes of CO_2e of annual GHG emission reduction can be achieved from each Green school through rooftop solar power project.

   i. Pre-feasibility study, identification and selection of schools
   ii. Bankable DPR and proposal preparation
   iii. Arrangement and management of project fund for implementation.
   iv. Facilitating implementation of rooftop solar power project and solar concentrator based cooking system in 50 schools
   v. Training to users on operation and maintenance of the system

4. Enhancement of solar lighting application in public places through demonstration projects

To ensure energy security, reduce local pollution and increase access to energy in areas where distributed and decentralized forms of energy production would be economically convenient renewable energy technology should be popularise. 1,000 LED based solar street light of 40 W_p capacity can save around 44,000 units of electricity which in turn can reduce 40 tonnes of CO_2e generated annually. Hence, renewed efforts to set up decentralised renewable energy solutions, would be undertaken primarily through solar street lighting. The activities to be undertaken are –

A. *Installation of 1,000 solar street lights in Thattanchavady & Mettupalayam Industrial Estates by 2015*
B. *Installation of solar street lights in 9 Govt. parks and 4 grounds by 2015*

C. *Installation of 5,000 solar street lights in remote/ internal roads of Puducherry region by 2016*

Following sub-activities to be undertaken for achieving above targets -

i. Pre-feasibility study, identification and selection of project locations
ii. Bankable DPR and proposal preparation
iii. Arrangement and management of project fund for implementation.
iv. Facilitating implementation of solar street lighting systems
v. Training to users on operation and maintenance of the system

5. Strengthening technical competency of various stakeholders of RE technology including O&M service providers, technicians, installers, manufacturer & others

Even though the Govt. of India is running several promotional programmes and schemes to popularise renewable energy, one of the main issues is the lack of technical support in terms of proper and adequate installation, maintenance and repair of renewable energy systems, technicians due to insufficient technical competency. The population of UT being distributed over four non-connected regions, the renewable energy technology manufacturer, distributors has low interest level for the UT of Puducherry. Therefore, introduction of training courses in all ITI's, engineering colleges would be beneficial for successful implementation, operation and maintenance of renewable energy projects and reduce dependency on external technical experts for operation and maintenance, repair, etc. The activities designed are –

A. *Introduction of subject or paper on Renewable Energy technology, system installation, Operation & Maintenance, repair, etc. in all ITIs of the UT to meet the local demand of technician and installer for RE.*
B. *Introducing technical course on Renewable energy technology at Polytechnic/Engineering colleges of the UT to achieve increase in availability of technically qualified manpower.*
C. *Conducting certificate courses for strengthening of technical competency of the existing solar and other renewable energy technology service providers.*

6. Promotion of Solar water heating system application in health sectors

Puducherry has around 9 hospitals including JIPMER[29], 39 Primary Health Centres, 81 Sub-centres, and 4 Community Health Centres[30] across the UT. Presently majority of the hospitals are using fossil fuels and electricity for hot water generation which in turn is leading to GHG emissions. Use of solar water heating systems due to availability of high solar radiation would ensure energy security, reduce local pollution and reduce the power procurement burden of the UT.A solar water heating system of 100 LPD can prevent 1.5 tCO_2e[31] GHG emission reductions annually.

The activities planned are –

A. *Installation of Solar water heating systems in 8Govt. Hospitals by 2014*

[29]*Jawaharlal Institute of Postgraduate Medical Education & Research*
[30]*Indicators of Socio-Economic Development by Planning & Research Department, Govt. of Puducherry -July 2012*
[31] *Source: MNRE*

On an average 25,000 LPD solar concentrator based water heating systems is required to be installed in each Govt. hospitals to cater to the daily requirement of hot water which in turn can reduce approximately 2,000 tons of CO_2e annually.

To achieve the above mentioned targets following sub-activities is planned-

i. Pre-feasibility study, identification and selection of project locations
ii. Bankable DPR and proposal preparation
iii. Arrangement and management of project fund for implementation.
iv. Facilitating implementation
v. Training to users on operation and regular maintenance of the system

B. *Installation of Solar Water Heating systems in 39 Public Health Centers (PHC) and 4 Community Health Centre's (CHC) by 2016*

In order to reduce dependency on fossil fuel and grid power based hot water generation in 39 Public Health Centres (PHC) and 4 Community Health Centres (CHC) to caterto regular demand of hot water; approximately 1,000 LPD capacity of SWH systems is needed to be installed in each Health Centres.

To achieve the above mentioned targets following sub-activities is planned-

i. Pre-feasibility study, identification and selection of project locations
ii. Bankable DPR and proposal preparation
iii. Arrangement and management of project fund for implementation.
iv. Facilitating implementation
v. Training to users on operation and regular maintenance of the system

C. *Mandate use of Solar Water Heating systems in all private hospitals, medical colleges and hostels by 2017 through policy measures*

Daily requirement of hot water in hospitals is around 80 litre/bed.Hospitals generally use conventional energy sources either fossil fuel or grid power to heat water which in turn emits greenhouse gases. To reduce dependency on conventional energy sources and ensure energy security in the UT; use of Solar Water Heating systems in all health care facilities including private hospitals, medical colleges and hostels is necessary. Therefore, policy would be developed to mandate use of Solar Water Heating systems in all private hospitals, nursing homes, medical colleges and hostels etc. by 2017.

7. Mandatory use of Solar Water Heating system in hotel and Guest house

Around 53 hotels and guest houses[32] exist in Puducherry and more than 0.85 million tourists with average growth rate of 23% visit Puducherry every year[33]. Apart from this, approximately 25,000 to 30,000 day visitors visit Puducherry per day leading to rise in numbers of restaurants and food joints. Hotels, guest houses, restaurants and food courts are consuming bulk quantum of hot water daily and are depending on electric geysers, LPG or PNG for this purpose which in turn increases depletion of fossil fuel sources, GHG emission, etc. Use of renewable energy sources particularly solar water heating systems would ensure energy security and can be easily implemented because of the sufficient availability of solar

[32] *http://tourism.puducherry.gov.in/hotels.html*
[33] *http://tourism.puducherry.gov.in/statistics.html*

radiation; reduce power procurement burden and GHG emission. Solar water heating systems of 0.1 million LPD can reduce peak power demand of 1 MW.

The activities planned are –

A. *Installation of Solar concentrator based water heating systems in all-star rated hotels by 2014*
B. *Installation of Solar Water Heating systems in all hotels, guest houses of more than 150 sq. m. by 2016*

Following sub-activities will be undertaken to achieve the above targets –

i. Pre-feasibility study, identification and selection of project locations
ii. Bankable DPR and proposal preparation
iii. Arrangement and management of project fund for implementation.
iv. Facilitating implementation
v. Training to users on operation and regular maintenance of the system

8. *Promotion of grid interactive solar power generation in PPP/IPP mode through policy measures and facilitating setting up of 20 MW rooftop and small solar power plants of upto 2 MW capacity.*

Urbanization and economic development leads to a rapid rise in energy demand in the UT particularly in urban areas leading to increase in greenhouse gas emission. The UT is also experiencing rapid growth in peak electricity demand leading to power demand-supply gap. The current practice of procuring power from external sources may create massive problem in future. Moreover, even though all villages and towns of Puducherry are electrified but approximately 4.5% of rural population still uses kerosene for lighting and 0.5% doesn't have lighting systems in their households. Since, the UT of Puducherry does not have adequate power generation capacity to meet the annual power demand growth rate of 7%, capacity addition through renewable energy particularly solar energy needs to be considered. Though grid connected solar power project with more than 291 MW capacity is already installed in almost all states of India but, grid connected solar power project is not yet initiated in the UT.

Implementation of grid connected solar power projects would address the livelihood concerns of related stakeholders, strengthening supply chains of solar energy products, reduce fossil fuel depletion, GHG emission.

i. Identification of project sites
ii. Bankable DPR preparation
iii. Identification and selection of project investor and fund
iv. Undertake project clearances, grid connectivity
v. Implementation of solar power plant

9. Promotion of solar application in public buildings for lighting and hot water generation through demonstration project of 50 kW solar power and 1000 LPD SWH installation in 2Govt. buildings

Around 39 departments/directorates, 8 Govt. undertaking organisations, institutions exists in Puducherry. All the govt. offices are running on electricity and Govt. buildings, guest or rest houses, prisons/jails, police stations, Govt. training academies are bulk electricity

consumers. Use of decentralised renewable energy technology would ensure energy security and reduce local pollution. Utilisation of rooftop solar installations at Govt. buildings for solar power generation for lighting systems and solar water heating system for daily chores would be both economically feasible and sustainable.

The activities planned are –

i. Identification of two project sites
ii. Bankable DPR and proposal preparation
iii. Identification and selection of project investor and fund mobilisation
iv. Implementation of 50 kW off-grid solar power plants and 1000 LPD SWH system installation in two govt. buildings.
v. Training to users on operation and regular maintenance of the system

Key Priorities

Table 29: Key Priority List Solar Mission

Sl. No.	Title	Organizations	Budget (In Million INR)			Source of funding
			Existing	Additional	Total	
1	**Harnessing Solar Energy potential scenario of the UT by assessment of Solar Energy potential & preparation of Solar Map**	REAP	**Nil**	**5.00**	**5.00**	GoI[34], GoPY[35], EFA [36]
2	**Mandatory use of Solar Water heating systems in domestic sector through policy action and demonstration projects**	REAP				GoI,GoPY, EFA
A)	Mandatory use of Solar water heating systems in all group houses and apartments of more than 150 sq. m. by 2016	T&CP [37]				
B)	Maximizing use of Solar water heating systems in households of more than 1500 sq. ft. through demonstration project by 100 LPD SWH in 100 Nos. households by 2014 100 LPD SWH in 300 Nos. households by 2016	T&CP	2.40	8.60	11.00	
3	**Promotion & facilitation of RE application in govt. schools & central kitchens of UT by**					GoI,GoPY, EFA
A)	Installation of solar power & solar cooking technologies in 50 schools to convert those as Green schools by 2016	DSE[38]	75.00	180.00	255.00	
B)	Installation of solar concentrator based cooking system in 3 central kitchens of Puducherry region by 2014 and in all central kitchens of UT by 2016	DSE	4.74	11.06	15.8	
4	**Enhancement of solar lighting application in public places through demonstration projects**					GoI,GoPY, EFA
A)	Installation of 1,000 solar street lights in Thattanchavady&Mettupalayam Industrial Estates by 2015	REAP, I&C[39]	9.60	23.40	33.00	
B)	Installation of solar street lights in 9 govt. parks and 4 grounds by 2015	REAP, LAD[40]	4.88	12.88	17.75	
C)	Installation of 5,000 solar street lights in remote/ internal roads of Puducherry region by 2016	REAP, LAD	48.00	114.00	162.00	
5	**Strengthening technical competency of various stakeholders of RE technology including O&M person, technician, installer, manufacturer & others by**		**Nil**	**5.00**	**5.00**	GoI,GoPY, EFA

[34] GoI : Government of India
[35] GoPY: Government of Puducherry
[36] EFA: External Funding Agencies
[37] T&CP – Town and Country Planning
[38] DSE: Directorate of School Education
[39] I&C: Industries and Commerce
[40] LAD: Local Administrative Department

Sl. No.	Title	Organizations	Budget (In Million INR)			Source of funding
			Existing	Additional	Total	
A)	Introduction of subject or paper on RE technology, system installation, O&M, repair, etc. in all ITIs of the UT.	REAP, H&TE[41]				
B)	Introducing technical course on Renewable energy technology at Polytechnic /BE Engineering colleges.	REAP, H&TE				
C)	Conducting certificate courses for strengthening of technical competency of the existing solar and other RE technology service providers.	REAP, H&TE				
6	**Promotion of Solar water heating application in health sectors by**					GoI,GoPY, EFA
A)	Installation of Solar Water Heating systems in 8 Govt. Hospitals by 2014	H&FWS[42], REAP, PWD	12.30	28.70	41.00	
B)	Installation of Solar Water Heating systems in 39 Public Health Centers (PHC) and 4 Community Health Centre's (CHC) by 2016	H&FWS, REAP	2.58	11.02	13.60	
C)	Mandate use of Solar Water Heating systems in all private hospitals, medical colleges and hostels by 2017 through policy measures	H&FWS REAP				
7	**Mandatory use of Solar Water Heating system in hotel sector through**					GoI,GoPY, EFA
A)	Installation of Solar Water Heating systems in all star rated hotels by 2014	REAP, Tourism Dept.	9.00	23.00	32.00	
B)	Installation of Solar Water Heating systems in all hotels, guest houses of more than 150 sq. m. by 2016	REAP, Tourism Dept.	15.00	40.00	55.00	
8	**Promotion of grid interactive solar power generation in PPP/IPP mode through policy measures and facilitating setting up of 20 MW rooftop and small solar power plants of up to 2 MW capacity.**	REAP, Electricity Dept.	1,600.00	30.00	1,630.00	GoI,GoPY, EFA
9	**Promotion of solar application in public buildings for lighting and hot water usage through demonstration project of 50 kW solar power and 1000 LPD SWH installation in two govt. buildings**	PWD, REAP	7.56	20.14	27.70	GoI,GoPY, EFA
TotalBudget (in Million INR)			**1,791.06**	**512.80**	**2,303.85**	

[41] H&TE: Directorate of Higher & Technical Education
[42] H&FWS: Department of Health & Family Welfare Services,

6. Mission on Enhanced Energy Efficiency

6.1. Introduction

Puducherryis mainly dependent on Central Generating Stations (CGS) of NTPC (Ramagundam Stage I, II & III and Talcher Stage II), Neyveli Lignite Corporation (TS I Expn. and TS II Stage I & II) and Madras & Kaiga Atomic Power Stations for its power supply. Other than CGS, UT purchases power from Tamil Nadu Electricity Board (TNEB) and Puducherry Power Corporation Limited (PPCL) for Karaikal region and Kerala State Electricity Board (KSEB) for Mahe region on drawl basis.

Govt. of Puducherry (GoPY) has signed Power Purchase Agreements (PPA) with all CGSs to generate and supply powerin proportion to the allocated share. GoPY also has an agreement with KSEB to supply 3,250 kVA of energy to Mahe region as High Tension service. However, GoPY does not have any formal agreement with TNEB to supply energy to Puducherry and Karaikal regions.

The present power demand of the UT including that of the four regions of Puducherry, Karaikal, Mahe and Yanam is 349.97 MW (Megawatt) during peak period. There is no power generation source in the Union Territory except that a 32.0 MW Gas based Power Plant operated by the PPCL in Karaikal region.

- Total no of domestic consumer for FY 2012-13 is 2,89,479[43]No.
- Total energy sells to domestic consumer for FY 2012-13 is 578 MU
- Per capita consumption in domestic sector for FY 2012-13 is 1,996.69 kWh

To meet continuously growing power demands, the Puducherry Electricity Department has identified renewable sources of energy as a major option to enhance power availability in the UT. Joint Electricity Regulatory Commission for The State of Goa And Union Territories has specified a RPO of 3% in FY 2012-13 including 0.40% for Solar and 2.60% for Non-Solar. The same has been considered as the Renewable Purchase Obligations (RPO) for FY 2013-14.

In order to promote renewable energy (Solar, Wind, Biomass, etc.) in the UT of Puducherry the Government under its 'Renewable Energy Vision-2010 and Renewable Energy, Energy Conservation and Energy Efficiency Policy 2011-2020' has taken initiatives which include giving incentives viz. generation based incentive, special incentives for biomass /bio gas power generation projects, single window clearance., VAT exemption, fiscal incentives from Green Energy Fund, etc.

The government has taken important measures on the demand side management and energy efficiency in different sectors along with steps to popularize use of renewable energy. However, one of the challenges is that of low energy efficiency mainly in industrial sector. Based on several studies & energy audits, the electrical energy saving potential in industry sector varies from 7-10%. The energy savings potential for the sector is estimated at 0.11 Billion Unit[44](BU).

[43]ARR & Tariff for FY 2013-14, Review for FY 2012-13, Provisional true-up FY 2011-12 and True-up for FY 2010-11 & FY 2009-10 for EDP, JERC for the State of Goa and Union Territories, 10thApril 2013

[44]*State-wise Electricity Consumption & Conservation Potential in India, BEE, Prepared by NPC*

Some of the activities include promoting use of energy efficient lights for street and domestic lighting systems,use of energy efficiency pump sets, providing tariff concession on solar water heaters, minimizing distribution losses, using new and efficient technologies, cogeneration, etc. There is also a need to strengthen the on-going programmes and policies which would not only address the developmental objectives of the UT but also ensure mitigation of climate change risks.

6.2. Key Trend in the sector

6.2.1. Power Scenario in Puducherry

The Electricity Department (ED), GoPY currently services more than 0.407 million customers across four non-contiguous regions of the UT: Puducherry, Karaikal, Yanam and Mahe. The UT has a mix of domestic, commercial, and high-tension (HT) industrial customers.In FY 2012-13, Puducherry Electricity Department (PED) sold 2,364 Million Unit (MU) energy to its consumers. The Commission has considered the gross power purchase of 2,909.94 MU as per the projections of the Commission for FY 2013-14. Based on the projections & approved sales of 2,434.79 MU, intra-state losses are considered of about 12.50%.The energy requirement for sale within the UT is approved at 2,782.61 MU for FY 2013-14. The category wise break up of sales indicates that three main consumer categories viz Domestic, HT Cat-I and HT Cat-III together account for almost 80% of the sale in the UT.

Table 30: Category-wise Power Sales by PED

Sl. No.	Sales [MU]	FY 2006-07	FY 2007-08	FY 2008-09	FY 2009-10	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14 (Projected)
1	Domestic	357	393	426	513	519	547	578	564
2	Commercial	130	132	138	150	156	168	180	180
3	Agriculture	101	82	54	77	77	57	57	57
4	Street lighting	16	16	17	17	22	24	26	27
5	Low Tension Industrial	126	133	135	147	150	184	192	213
6	Temporary Supply	0	0	0	0	0	0	0	20
8	HT I	998	1020	954	958	1006	975	970	978
9	HT II	26	26	26	34	35	45	45	50
10	HT III	271	270	249	262	239	308	316	346
11	Total	2025	2072	1999	2158	2204	2308	2364	2435

Out of the total power sold, HT- Category I accounted for almost 41% of the total sales (970 MU)& domestic sector accounted for 24% of the total sales (578 MU) in the year 2012-13.HT industries being the highest contributor in the sale gives an extra advantage to the UT to ensure sustainability of cash flows.

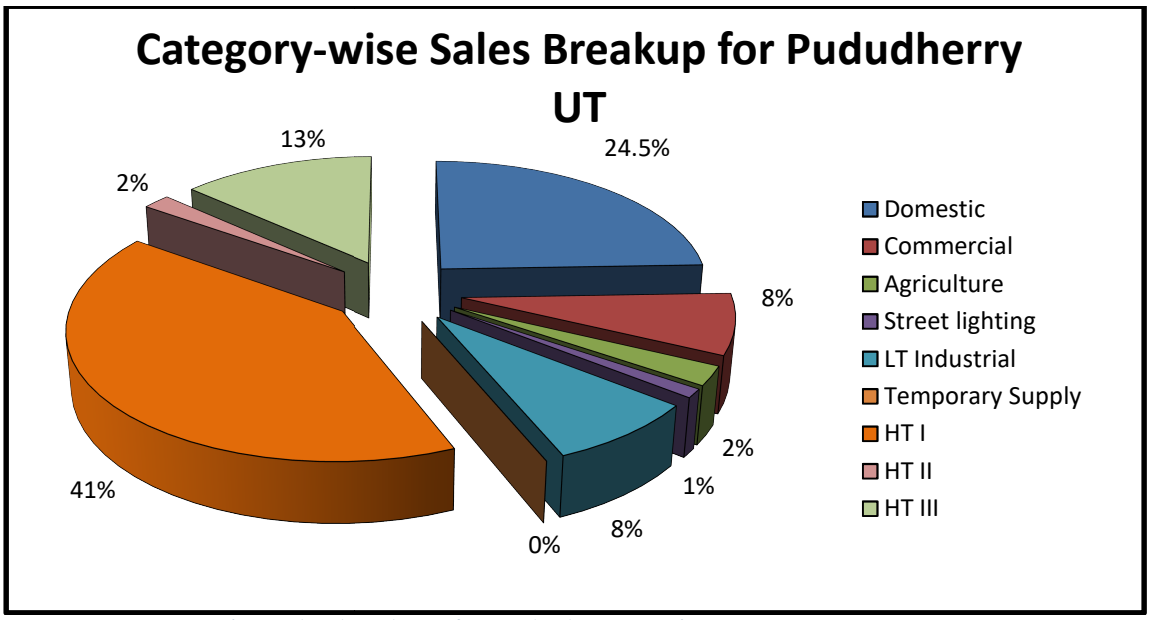

Figure 14: Category-wise Sales break-up for Puducherry UT in year 2012-13

Overall T&D losses, excluding Unscheduled Interchange (UI) sales in the year 2012-13 were 12.5%.

Table 31: T&D Losses in Puducherry[45]

Particulars	Unit	FY 2006-07	FY 2007-08	FY 2008-09	FY 2009-10	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14 (Projected)
Power Purchase (at station end)	MU	2613	2714	2714	2737	2933	3329	2945	2910
Power Grid Corporation India Ltd. (PGCIL) Losses	%	3.80%	3.70%	4.54%	3.80%	5.00%	4.47%	3.90%	4.38%
Power Purchase (at UT end)	MU	2513	2614	2591	2633	2786	3180	2830	2783
Power Sale (excluding UI sale)	MU	2025	2072	1999	2131	2182	2317	2348	2435
Transmission & Distribution (T&D) Losses	%	14.79%	14.80%	14.00%	14.00%	13.50%	13.00%	12.50%	12.50%

6.3. Key issues in the sector

6.3.1. Energy Efficiency

Enhancing energy efficiency is one of the key challenges faced by the Union Territory. In order to improve energy efficiency and address the energy security concerns, National Productivity Council (NPC) had conducted a study focused on estimation of the total electricity consumption and saving potential in different sectors (e.g. agriculture, industry,

[45] *ARR & Tariff for FY 2013-14, Review for FY 2012-13, Provisional true-up FY 2011-12 and True-up for FY 2010-11 & FY 2009-10 for EDP, JERC for the State of Goa and Union Territories, 10th April 2013*

domestic, municipalities, etc.) of Puducherry as per the guidelines of Bureau of Energy Efficiency (BEE).

Agriculture

According to the study, the annual electricity sale to agriculture sector is 81.634 MU with major energy consumption for running agriculture pumps with energy efficiency varying from 25–35%. By adopting BEE star labeled agricultural pump sets, the efficiency can be enhanced upto 50-52%. It is estimated that, by replacement of existing pumps with the BEE star labeled pumps, the achievable saving potential would be 30-40% and sectoral saving potential would be 24.4 MU per year.

Commercial Sector

In Puducherry, the commercial sector mostly constitutes of Small office buildings, restaurants, shops, institutes etc. Energy consumption of this sector is 132 MU per annum among 36,000 consumers with around 54,000 kW connected load which accounts for5.93% of the total electricity sold. In domestic sector, a 20% energy saving potential can be achieved with adoption of Energy Efficiency Techniques & BEE star rated appliances, which would work out to 26.4 MU per year.

Municipalities

Annual electricity sale for public lighting and public water supply is estimated at 42.38 MU. For 4 major circles/divisions considered, annual electricity consumption for street lighting is 16.17 MU. The annual consumption for public water supply works is 26.09 MU for 32 major pumping stations. Based on the studies, the energy savings potential for street lighting in municipalities & corporations is assessed to be 25% which equals to 4.04 MU per annum. While, the energy saving potential for public water supply works in four circles is assessed to be 20% or an estimated equivalent of 5.22 MU per annum, the aggregate sectoral saving potential of the above equals to 9.26 MU.

Industries

The annual electricity sales to the industrial sector including low & medium voltage consumers (SME) and high voltage consumers (large industries) is 1.576 BU and accounts for 70.8% of the total electricity sold. While the larger industries segment is covered for energy efficiency under the mandates of EC Act as designated consumers, SME segment is being addressed for energy efficiency through cluster based initiatives by Bureau of Energy Efficiency. The electrical energy saving potential in industry sector varies from 7-10%. The energy savings potential for the sector as a whole is assessed to be 0.11 BU.

Domestic

The annual electricity sale to domestic sector in Puducherry is 393 MU which accounts for 17.6% of the total. Electricity consumption in domestic sector varies with respect to rural and urban segments and climatic seasonal variations. In the rural segment major consumption of electricity is for lighting and cooling systems. In the urban segment the typical energy consumption pattern includes consumption for AC and refrigeration (56%), lights and fans (28%), TV, washing machines, etc. (12%) and others (4%). The energy used in air

conditioners also varies significantly with seasons and climatic conditions. The major avenues for energy saving in rural domestic sector include replacement of GLS bulbs with CFLs, adoption of star rated domestic appliances like ceiling fans, refrigerators, AC units, tube lights etc. The saving potential through adoption of CFLs and BEE star rated products is 40%–50%in rural segment, 15%–20% in urban segment and 20%–25% in domestic segment estimated to be around 78.6 MU per year.

Sector-wise analysis of electricity consumption in 2007–08 shows that the industry sector (LT & HT) is the largest consumer at (70%) followed by Domestic (18%), Commercial (6%), Agriculture (4%), Public Water Supply Works & Sewage Pumping (1%) and public lighting (1%).The study results show that the demand side measures should be targeted towards the industries and domestic agriculture sector.

Table 32: Total Energy Saving Potential in Puducherry (2007-08)[46]

Sl. No	Sector Reference	Estimated annual Saving Potential (MU)	In MWh	Emission Factor (tCO_2/MWh)[47]	tCO_2
1	Agricultural	24.4	24,400	0.91	22,204
2	Commercial	26.4	26,400		24,024
3	Municipalities	9.26	9,260		8,427
4	SME	*			0
5	Domestic	78.6	78,600		71,526
6	Industries	110	1,10,000		1,00,100
Total		**248.66**	**2,48,660**		**2,26,281**

** SME clusters electrical energy savings potential is already included in Industrial sector.*

6.4. Programmes and Policies in the sector

6.4.1. Energy Conservation Act 2001

The Act provides for a legal framework, institutional arrangement and a regulatory mechanism at the Central and State level to embark upon energy efficiency drive in the country. Under this act the Bureau of Energy Efficiency was established in 2005 with an objective to promote energy efficient practices among end-users particularly in the manufacturing and building sectors

6.4.2. National Mission for Enhanced Energy Efficiency (NMEEE)

The Ministry of Power (MoP) and BEE entrusted with the task of preparing and implementation of the National Mission for Enhanced Energy Efficiency (NMEEE). NMEEE envisioned towards saving of about 23 million tonnes of oil equivalent (MTOE) of fuel by the end of 5 years, avoided capacity addition of over 19,000 MW and avoided emissions of carbon dioxide by 98.55 million tonnes annually. NMEEE would enforce the following four initiatives, in addition to the policies and programmes for energy efficiency being implemented by BEE. These initiatives are as follows:

[46] *State-wise Electricity Consumption & Conservation Potential in India, BEE, Prepared by NPC*
[47] *CO_2 Baseline Database for the Indian Power Sector, Central Electricity Authority Version 8.0, January 2013*

- Perform, Achieve and Trade (PAT), a market-based mechanism for improved energy efficiency and cost effectiveness in energy-intensive large industries and facilities by certification of energy savings that could be traded.
- Market transformation for energy efficiency (MTEE) by accelerating the shift to energy-efficient appliances in designated sectors through innovative measures that make the products more affordable.
- Energy efficiency financing platform (EEFP), a mechanism to finance DSM programmes in all sectors by capturing future energy savings.
- Framework for energy efficient economic development (FEEED), or developing fiscal instruments to promote energy efficiency.

6.4.3. Electricity Act, 2003

The Act promotes implementation of renewable energy technology and co-generation facilities towards decentralization of power generation and reducing both technical and commercial losses.

The main features of the act are as follows;

- Generation has been de-licensed and captive generation has been freely permitted.
- The government of Puducherry is required to unbundle the electricity boards. However, the electricity boards may continue with them as distribution licensees and provider of transmission utilities
- Metering of supplied electricity was made mandatory
- Provisions related to thefts of electricity were made more stringent

6.4.4. National Electricity Policy (NEP), 2005

National Electricity Policy stipulates several conditions for promotion and harnessing of Renewable energy sources. NEP emphasizes on decentralized power generation and distribution which would identify renewable energy and energy efficient distribution systems.

6.4.5. Energy Conservation building Code (ECBC), 2007

The Energy Conservation Building Code (ECBC) launched by the Government of India on 27th May, 2007 towards setting up benchmark energy consumption standards for new or existing commercial buildings having a connected load of 100kW or contract demand of 120kVA in terms of Energy Conservation (Amendment) Act, 2010.

6.4.6. Puducherry Renewable Energy, Energy Conservation and Energy Efficiency Policy 2011-2020, (forth coming)

The vision of the policy seeks to establish Puducherry as a promoter of Clean and Green Sources of Energy, enhanced energy efficiency to ensure environmentally favorable and sustainable growth in all sectors.

The main objectives of the policy are:

- Encourage promoters, development and deployment of Renewable Energy technologies / projects

- Encourage the industries with cogeneration potential to set up co-gen plants on a large scale and realise the potential of cogeneration in industries
- 'Single Window System' for technical consultation, sources of finance and project clearance.
- Distributed / rooftop power generation through renewable energy sources to provide energy supply to agriculture, industry, commercial and household sector
- To establish linkages with national and international institutions for collaborative inputs on development, demonstration and commercialization of new and emerging New and Renewable Energy technologies
- To initiate steps for Energy Conservation and Energy Efficiency and Clean Development Mechanism (CDM) / PCDM
- Initiate ICE measures for promoting Renewable Energy sources.
- Encourage R&D through Technical institutions in the Union Territory

6.4.7. National Standards &Labelling Programme

Govt. of Puducherry has mandated the use of star rated appliances in domestic & commercial sector under the mandate of BEE. The Bureau of Energy Efficiency (BEE) is implementing National Standards & Labeling Programme& appliances and certifying products on the basis of their energy consumption. Some of the star labeled appliances are;Frost free refrigerator, Air Conditioner, Television, Washing Machine, Ceiling fans, Pumps, Motor, etc.

6.5 Key Priorities

The following key priorities for the sector were identified after a detailed deliberation in the working groups. The priorities are in line with the concerns raised over climate change and the desired response from the UT.

Key Priorities: Mission on Enhanced Energy Efficiency
1. *Provisioning of LED/CFL distribution to household and replacing incandescent lamp*
2. *Development and promotion of Policy measures towards up-gradation of existingproduction/manufacturing process across the industrial facilities to energy efficient one.*
3. *Enforcing Energy Audit and its implementation across the industrial facilities*
4. *Incorporate conditions as a part of building permit to adopt star rated energy efficient electrical appliances and use of CFL*
5. *Institution of Energy Conservation Award*
6. *Enforcement towards use of Energy Efficient Lighting in all Govt. & commercial building*
7. *Facilitating energy audit across all large (in terms of energy consumption) government offices and retrofitting of existing energy inefficient system with efficient and star rated products.*
8. *Promoting and Adapting Energy Efficient technology measures and practices in new building*
9. *Creation of Green Corpus fund*

1. Provisioning of LED/CFL distribution to household and replacing incandescent lamp

The major issue preventing wide scale penetration of CFL at the household level is its high price in comparison to incandescent bulbs. Government of Puducherry under its current programme has distributed 18 W CFL at 50% subsidy for each ration card holder so as to

refrain the household from using incandescent lamp. However the capital cost of CFL with 50% subsidized rate is comparatively higher than the incandescent lamp with equivalent luminous output. Moreover the scheme of the Government of Puducherry is limited to 18 W CFL.

DSM Based Efficient Lighting Programme (DELP) is the most prominent options towards wide scale dissemination of energy efficient lighting system. Demand Side Management (DSM) is a regulatory framework promoted by State Electricity Regulatory Commissions (SERCs) as a robust payment security mechanism. Under similar programme LEDs/CFLs can be provided at costs similar to that of ILBs and the balance cost could be recovered over the project cycle from the utility.

Even the existing programme of the Govt. of Puducherry towards distribution of CFL through PDS can also be applied for LED. Moreover it is pertinent that awareness in relation to schemes is created.

2. ***Development and promotion of Policy measures towards up-gradation of existingproduction/manufacturing process across the industrial facilities to energy efficient one.***

Environmental degradation and energy consumption are strongly interrelated. Higher energy intensity resulting from inefficient technology used in the industrial process also enhances the energy demand apart from resulting in higher GHG accumulation in the atmosphere. It is imperative in this context that industrial facilities are correlated with the social, environmental and economic benefit of energy conservation and facilitates implementation of energy conservation measures.

Energy efficiency promotion in industrial process will contribute toward reducing overall company expenses, increases productivity, affect competitiveness and the trade balance of a country. Promotion of Energy efficient technology significantly reduces the Green House Gas (GHG) emissions, waste production & thermal pollution. This creates demand in home market for energy efficient technologies. The annual electricity sale to the industry sector including low & medium voltage consumers (SME) and high voltage consumers (large industries) is 1.5756 BU which equals to 70.8% of the total electricity sold in Puducherry.Implementation of Energy efficiency measures across the industrial facility is planned in two phases;

A. *Promoting up-gradation of existingproduction/manufacturing process to energy efficient process amongst 17 categories of highly polluting unit across the union territory.*
B. *Promoting up-gradation of existingproduction/manufacturing process to energy efficient process amongst all large and medium scale industries.*

3. ***Enforcing Energy Audit and its implementation across the industrial facilities***

Reducing carbon emissions through promotion of energy efficiency measures is a viable proposition for industrial enterprises as reduced energy consumption implies financial

savings. Although the industrial facilities in the UT are highly energy intensive with higher energy intensity but most of the industrial facility do not often strive to ensure high levels of energy efficiency. There seem to be a lot of potential for augmenting energy efficiency in these sectors. The Energy Conservation Act has already provisioned for implementation of energy efficiency measures amongst the industrial facilities however the same has not been mandated. Energy Audit is the first step towards implementation of energy conservation measures as it identifies the core areas and also recommends the possibility of energy conservation. Action is therefore being proposed under Climate Change Action Plan to mandate energy audit amongst the industrial facilities. The Actions are planned in two phases

A. *Conducting/Enforcing Energy Audit across the large scale industries by 2013*
B. *Conducting/Enforcing Energy Audit across the medium scale industries by 2013*

4. *Incorporate conditions as a part of building permit to adopt star rated energy efficient electrical appliances and use of CFL*

Domestic and commercial sector is one of the major consumers of electrical energy across Puducherry. The higher energy consumption across the domestic sector can be attributable to use of inefficient electrical gadget. Use of higher star rated product can reduce the energy consumption across the domestic sector. However penetration of higher star rated product across the domestic sector is regulated by cost dynamics.It is therefore imperative that policy measure be framed and ideally through amendment of Building by-lawleadingtowards improvising conditions as part of building permit mandating resident to use star rated product and refrain from use of incandescent lamp by using CFL.

BEE has launched Standards and labeling (S&L) programme as one of the key activities for improvement in energy efficiency. A key objective of this scheme is to provide the consumer an informed choice about energy saving and thereby enhance the cost saving potential of the relevant marketed product. Rating or labeling of gadgets currently applicable for 12 equipment/appliances, i.e. ACs, Tube lights, Frost Free Refrigerators, Distribution Transformers, Induction Motors, Direct Cool Refrigerator, Geysers, Ceiling fans, TVs, Agricultural pump sets, LPG stoves and washing machines. The other appliances are presently under voluntary labeling phase. The energy efficiency labeling programmes under BEE are intended to reduce the energy consumption of appliances without compromising with the output services. The STAR rating ranges from 1 to 5 in the increasing order of energy efficiency. Higher the rating of the equipment lower is the consumption of energy. The Policy also seeks to reduce capital investment in energy supply infrastructure, enhances the product quality, strengthens the competitive markets, builds position for domestic industries to compete in such markets where norms for energy efficiency are mandatory, removes indirect barriers to trade, reduces carbon emission and helps meet climate change goals.

5. *Institution of Energy Conservation Award*

The Energy Conservation Award would recognize innovation and achievements of energy conservation activities practiced by the Industries, buildings, zonal railways, aviation

sectors, manufacturers of BEE star labeled appliances and municipalities to raise awareness about the importance of energy conservation as a response to reduce global warming through energy savings. The institution for energy conservation award is planned to be facilitated from

A. *Institution of Energy Conservation award for the industry from 2013*
B. *Institution of Energy Conservation award for the commercial establishment from 2013*

6. *Enforcement towards use of Energy Efficient Lighting in all Govt. & commercial building*

Lighting comprises the major share of the energy is consumed in govt. & commercial buildings (e.g. offices, hospital, university, etc.). The demand is certainly on a rise with construction boom especially in Union Territory of Puducherry. This means regulations in energy usage for lighting purposes can make a major contribution in containing the issue of climate change and energy efficiency. There are the key elements to achieve progress:

(i) Creating awareness amongst the users towards the social, economic and environmental benefit ofusing efficient lighting system
(ii) Replacement of all inefficient lighting system (incandescent lamp) in the Government buildings with energy efficient systems (CFL)

Target has therefore been set to

A. *Replace the existing inefficient lighting system in large government department with energy efficient lighting system (including CFL) by 2013.*
B. *Replace the existing inefficient lighting system in large government department with energy efficient lighting system (including CFL) by 2015.*

7. *Facilitating energy audit across all large (in terms of energy consumption) government offices and retrofitting of existing energy inefficient system with efficient and star rated products.*

The building sector plays a critical role in transition to a low-carbon one. Energy audit & adaptation of energy efficient products in large government buildings is a key policy instrument for reducing the energy consumption and improving the energy performance of new and existing buildings. Compliance of the action plan is planned through following sub activities:

(i) Conducting energy audit by the empanelled organization across all large Government office
(ii) Undertaking IGEA in Govt. Buildings, Hospital, Universities, Banks, Residential colonies, Hotels, etc.
(iii) Identifying and empanelling ESCO companies
(iv) Facilitating retrofitting of energy inefficient system with efficient ones through ESCO companies

Target has been set to undertake retrofitting of inefficient government office with efficient and star rated product:

A. *Retrofitting of energy inefficient electrical and thermal system in all government buildings of size more than 10,000 units per month by 2013*

B. *Retrofitting of energy inefficient electrical and thermal system in all government buildings of size more than 5,000 units per month by 2013*

8. Promoting and Adapting Energy Efficient technology measures and practices in new building

Implementation of Energy efficient measures and planning building architecture in manner to reduce per unit area of energy consumption is currently mandated under the provision of Energy conservation Building Code. The Energy Conservation Building Code (ECBC) was launched by the Government of India on 27th May, 2007. The ECBC sets minimum energy standards for new commercial buildings having a connected load of 100kW or contract demand of 120kVA in terms of Energy Conservation (Amendment) Act, 2010. Harmonization of ECBC with National Building Code (NBC) is underway with inclusion of a chapter on 'Approach to Sustainability' in NBC-2005. BEE has developed ECO-nirman conformance check tool with an objective of helping architects and design professionals to assess the conformation of their designs with code requirements.

Apart from the design incorporation measure have to be taken to implement energy efficient and star rated equipment's in the new buildings.

Policy should therefore be framed to include the provision of ECBC building code in all new building. Monitorable actions are planned:

A. *Adapting energy efficient equipment in new Government buildings of area more than 10000 sq.ft.*
B. *Adapting energy efficient equipment in new Government buildings of area more than 5000 sq.ft.*

9. Creation of Green corpus fund

REAP, Puducherry proposes to create a corpus fund to promote Energy Conservation and Renewable Energy Technology promotion and implementation activities across Union Territory.

To meet the following expenditure through State Designated Agency the fund aims:

(i) To create awareness for and disseminating information for efficient use of energy and energy conservation and for undertaking programmes for individual consumers, industries, commercial organizations, students, farmers and others.

(ii) To organize training programmes for employees and specialists pertaining to energy conservation and energy efficiency through the Designated Agency.

(iii) To perform research and development activities under Energy Conservation.

(iv) To develop procedures for testing and certification of energy consuming devices and for creation of facilities for verification, testing and certification of energy consumption in respect of equipment and appliances.

(v) To formulate and facilitate implementation of demonstration projects and pilot projects related to energy conservation and energy efficiency for encouragement and to contribute in the projects of Bureau of Energy Efficiency and the Central Government.

(vi) To promote the use of energy efficient process for equipment, devices, means and systems.
(vii) To meet the matching grant of the centrally sponsored schemes of Bureau of Energy Efficiency and Central Government through Designated Agency in the Union territory of Puducherry.
(viii) To meet the expenditure incurred by the Designated Agency in implementing the provisions of the Act.

Source of Fund

A green energy cess will be levied on all electrical energy consumed and on all fossil fuels consumed. The proceeds of this cess will be used towards funding for renewable energy, energy efficiency and energy conservation projects. The amount of cess to be charged will be decided annually. The fund thus created will be named as the Puducherry green energy fund and will be managed by Renewable Energy Agency Puducherry (REAP).

Key priority action plan on Mission on Enhanced Energy Efficiency

Table 33: Key Priority List Mission on enhanced Energy Efficiency

Sl. No.	Title	Organization	Budget (In Million INR)			Source of Funding
			Existing	Additional	Total	
1	Provisioning of LED/CFL distribution to household and replacing incandescent lamp	REAP, PPCL, Electricity Dept.	Nil	40.00	40.00	GoI[48], GoPY[49], EFA [50]
2	Development and promotion of Policy measures towards up-gradation of existingproduction/manufacturing process across the industrial facilities to energy efficient one.	REAP, PPCL, Electricity Dept., PIPDIC, I&C[51]	Nil	0.50	0.50	GoI, GoPY
3	Enforcing Energy Audit and its implementation across the industrial facilities	REAP, PPCL, Electricity Dept., PIPDIC, I&C	Nil	2.50	2.50	GoI, GoPY, EFA
4	Incorporate conditions as a part of building permit to adopt star rated energy efficient electrical appliances and use of CFL	REAP, PPA, RPA, LAD Electricity Dept.,	Nil	1.50	1.50	GoI, GoPY, EFA
5	Institution of energy conservation award	REAP, PPCL, Electricity Dept., PIPDIC	1.00	Nil	1.00	GoI, GoPY, EFA
6	Enforcement of mandatory use of Energy Efficient Lighting in all Govt. Departments	REAP, PPCL, Electricity Dept., PWD	Nil	5.00	5.00	GoI, GoPY, EFA
7	Facilitating energy audit across all large (in terms of energy consumption) government offices and retrofitting of existing energy inefficient system with efficient and star rated products	REAP, PPCL, Electricity Dept.,	Nil	5.00	5.00	GoI, GoPY, EFA
8	Promoting and Adapting Energy Efficient technology measures and practices in new building	T & CP, RPAs, REAP, Electricity, PWD	Nil	500.80	500.80	GoI, GoPY, EFA
9	**Creation of Green corpus fund**	REAP, ERC	Nil	Nil	Nil	Consumer
Total Budget (in Million INR)			**1.00**	**555.30**	**556.30**	

[48] GoI : Government of India
[49] GoPY: Government of Puducherry
[50] EFA: External Funding Agencies
[51] I&C : Industries and Commerce

7.Sustainable Habitat Mission

7.1. Introduction

Developing a sustainable habitat faces significant challenges due to climate change. Climate change impacts range from increase in extreme weather events, natural calamities, flooding to high temperatures leading to public health concerns. The impacts potentially have serious consequences on human health, livelihood and socio-economic assets, especially for the urban poor, informal settlements and other vulnerable groups. Considering the fact that it is a coastal city it faces multi-hazard scenario from shoreline change, sea level rise to tsunami. As the urban regions of this Union Territory are highly dynamic systems that face unique climate impacts, their adaptation must be location specific and should be tailored to local circumstances.

With a population of over 0.9 million, Puducherry accounts for the biggest region of the UT. Puducherry has witnessed a rapid growth of population in the past three decades. Especially during 1981- 91, the UT has grown at a rate of 33.6% and Puducherry district at a rate 36.8% per annum. The growing urban population in the UT emphasizes the need of more urban infrastructure facilities in all the regions. The decline in the rural population also indicates that there is large scale migration of unskilled and semiskilled labour to the urban areas. This necessitates enough space to be created for alternative livelihood opportunities.
The importance of infrastructure and improvement in living standards of population is crucial to sustained economic development. A detailed analysis of the development process over last four decades shows that one of the major reasons for slow economic and social development is the unplanned population growth within the UT. The capital cities and other district towns of the UT are facing problems of rapid urbanization, expansion of informal settlements, substantial poverty, inadequate infrastructure and environmental degradation. These along with other relevant issues plague cities' ability to grow and prosper in a climate friendly manner. Many of these conditions also limit resilience to current climate variability.
The Government of Puducherry is thus planning to streamline climate change adaptation measures in urban infrastructure development. Creating this new possibility of adaptive resilience would usher in a new future in the face of changing climate.

The concerned department prepared the action plan prioritizing the actions in line with National Climate Change Action Plan for the sustainable habitat sector. The chapter summarizes the strategic plan to reduce the possible impact of climate change over the urban population in the UT as well as introduce measures towards reducing Greenhouses Gas emission that contributes substantially to the climate change cause. The strategy has been drafted to cover various aspects, inter alia, modal shift to public transport, better urban planning (like land use planning, urban waste management, energy conservation and renewable energy promotion, pollution control, etc.).

7.2. Key Trends in the sector

The Union Territory of Puducherry comprises of four regions of erstwhile French establishments viz. Puducherry, Karaikal, Mahe and Yanam. Puducherry and Karaikal are situated on the East Coasts in Tamil Nadu, Yanam on coastalAndhra Pradesh and Mahe on the West Coast in Kerala. Puducherry is the Capital of this Union Territory. It is on the east coast about 162 km south of Chennai (Madras) located on the Coromandel Coast of the Bay of Bengal. Puducherry region (290 Sq.km) is situated along the Bay of Bengal sea coast surrounded by Tamil Nadu. Yanam region (30 sq. km) is situated in Eastcoast bounded on all sides by Andhra Pradesh.The district lies in the delta of Godavari River, the town is situated where the river meets its tributary Koringa River (Coringa River), 10 km from the Bay of Bengal in the Coromandel coast.

Table 34: District wise Demographic details of Puducherry UT[52]

Description	Puducherry	Karaikal	Mahe	Yanam
Actual Population	9,50,289	2,00,222	41,816	55,626
Male	4,68,258	97,809	19,143	27,301
Female	4,82,031	1,02,413	22,673	28,325
Population Growth rate	29.23%	17.23%	13.54%	77.19%
Area Sq. km	294	157	9	30
Coastal Length (in km)	24	20	1	0.40
Density/sq. km	3,232	1,275	4,646	1,854

Source: Census 2011

(http://www.census2011.co.in/census/state/districtlist/puducherry.html)

There are 5 Municipalities (2 in Puducherry, 1 each in Karaikal, Mahe and Yanam regions). Apart from these as a French legacy the UT has 10 communes (5 each in Puducherry and Karaikal regions), which are agglomerations of villages. The urban population is spread across all the districts of Puducherry. The existing infrastructure facilities including core urban public services such as water supply, sanitation and sewerage, urban roads and solid waste management are to be improved to address the challenges led by rapid population increase and urbanization and the consequent increase in volume of Municipal Solid Waste (MSW).

7.2.1. Solid waste

The domestic wastes are collected by local bodies in most of the urban areas on a day to day basis. Solid waste management is emerging as an essential urban and industrial need. The approximate Municipal Solid Waste (MSW) generation in Puducherry Municipality is about 428 tonnes/day. In Karaikal, Mahe and Yanam region MSW collected and disposed in dumping grounds. Proper scientific disposal methods are not followed till date by the respective ULBs. Considering the inadequacy of space, Puducherry municipality has acquired a new site for waste disposal. The major constraints in this regard are lack of

[52]Census 2011 (http://www.census2011.co.in/census/state/districtlist/puducherry.html)

adequate space, objection from the nearby residents for dumping of waste, inefficient or no segregation of biodegradable and non-biodegradable wastes, at point of collection.

7.2.2. Transport

The transport sector contributes majorly to the Green House Gas (GHG) emission in the UT. It is estimated that the number of vehicles in the UT would increase adding significantly to the quantum of emission of GHG. Details of Road & transport of Puducherry UT are given in
Table 35.

Table 35: Roads and Transport details of Puducherry UT[53]

Sl.No.	Item	Unit	2011-12				
			Puducherry	Karaikal	Mahe	Yanam	UT
I	**Roads**						
1	Length of Roads (P.W.D.)	km					
(a)	NationalHighways	km	41.620	21.400	1.988	--	65.008
(b)	(b)StateHighways	km	36.142	0.525	1.478	--	38.145
(c)	(c) Major District Roads	km	178.725	67.736	22.413	--	268.874
(d)	(d) Other District Roads	km	70.951	--	--	26.445	97.396
(e)	(e) Rural Roads	km	177.241	98.756	--	--	275.997
	Total	km	**504.679**	**188.420**	**25.879**	**26.445**	**745.420**
2	**Length of Roads (Municipalities)**	km	**592.186**	**8.890**	**3.146**	**49.339**	**653.561**
3	**Length of Roads (Commune Panchayats)**	km	**729.546**	**306.730**	**--**	**--**	**1,036.280**
II	**Motor Vehicles**						
	No. of Motor Vehicles Registered	Nos.	**65,755**	**15,089**	**1,140**	**489**	**82,473**

7.2.3. Land use

The overall land utilization pattern in Puducherry manifests an ecological imbalance by exhibiting lack of forest area and declining area under miscellaneous trees and grazing and pastures land. Increase in barren and uncultivable land is threatening since the union territory is already facing land scarcity. In addition the disparity between the current fallow and net sown area implies the over dependence on monsoon for cultivation.

7.3. Vulnerability of the sector

Puducherry & Karaikal region are situated on the Coromandel Coast of India (Eastern Coast). Cities and towns of Puducherry have always been vulnerable to natural hazards such as Tsunami, cyclone, storm surge and flood. Puducherry, Karaikal and Mahe region (Western Coast) are most vulnerable to coastal hazards and Yanam region is vulnerable to flooding from Godavari River. Puducherry's average elevation is at sea level and a number of sea inlets, referred to as 'backwaters' are present. The terrain is gently varying from 30 to

[53]Public Works Department, Local Administration & Transport Department, 2011-12

45 m above Mean Sea Level (MSL) towards interior north-west and north-eastern parts of the region. Such events not only disrupt economic activity but also lead to immense hardship for the affected population. The signs of changing climate has already manifested through extreme weather conditions which have been further aggravated by many mal-practices resulting in coastal pollution and environmental degradation.

The Puducherry coastline is facing severe erosion and there is noticeable changes observed during the recent past. These are primarily due to mal practices such as construction of ports, harbors, groins (A low wall or sturdy timber barrier built out into the sea from a beach to check erosion and drifting), unscientific shore protection measures etc. These could have irreversible adverse impact on the coast if such infrastructure is constructed without scientific studies. Along with the natural geological agents like wind, wave, tide & currents, increased urbanized coastal structures along the Puducherry coast have amplified the complexity of the denudation process. Though the structures like groins, seawalls, etc. have been built to protect the Puducherry coast from coastal erosion and to improve the social economy of the Union Territory, it has been observed that these structures act as an obstruction for the natural littoral drift which have made the sedimentation process more complex. The impacts of these changes started at the time of construction phase of the coastal structures (seawall, jetty, breakwater and Groins) and further extending its effects till today as a continuous process to attain its stability by natural processes.

7.3.1. Shoreline erosion

Erosion of shorelines is an ongoing process in the Puducherry coastal area. This rapid and significant loss of land has made the government use various stabilization methods to combat erosion. To preserve the coastal, estuarine and marine resources and maximize human utilization, long term management solutions to shoreline recession must be in harmony with the dynamics of the coastal system. The inherent vulnerability of these habitats along the coastal regions of the UT is amplified as the effects of climate change have become more pronounced.

The signs of climate change at present are mainly visible through rise in temperature or increase or decrease in rainfall. Also frequent rainfall makes urban living highly vulnerable to floods and cyclones. The impact of development and the activities undertaken at Tamil Nadu are also impacting the Shoreline of the UT since the Puducherry and Karaikal districts very closely resemble to the state of Tamil Nadu in terms of geographical boundary.

7.3.2. Floods

The coastal parts of Yanam (Puducherry) and East Godavari district of Andhra Pradesh by virtue of its geophysical condition are prone to frequent cyclones followed by tidal waves, heavy rains and floods during the period from August to November. Coastal mandals in East Godavari are usually more affected by natural calamities. All the 13 coastal mandals of East Godavari district including Tallarevu and Ipolavaram which fall under the Puducherry UT are vulnerable to flood.

7.3.3. Earthquake

Yanam region lies in the low intensity seismic region and falls within Seismic Zone III as per the Seismic Zone Map of India. The region does not have any history of seismicity with any reported major earthquake in the past. However, since earthquake is a natural phenomenon, the possibility of such occurrence cannot be ignored. Though the impact of earthquake along the coastline is likely to be less but the secondary impact of shoring tides may cause significant damage in the form of flashfloods.

7.3.4. Tsunami

The Tsunami which had occurred on 26th December, 2004 and devastated Andaman & Nicobar Islands and parts of India's east coast also had its impact on the coastal part of Puducherry. Tsunami triggered by under-sea earthquakes / landslides / volcanic eruptions, etc. can occur in any part of the oceans or seas. Tsunami causes huge loss to life and property and damage to the environment and socio-economic order. The consequences of tsunami are identical to that of floods and earthquakes.

Projected changes in climate are likely to make the climate sensitive regions of the Union Territory and livelihoods more vulnerable in the future. Continuing climate variation is predicted to alter the sectoral growth, including affecting the ability of the poor to engage in farm and non-farm sector activities. The direct impacts of extreme climate-induced events could include loss of life, livelihoods, assets and infrastructure. Climate Change, if left unchecked has the potential to disrupt the sustainable growth of the Union Territory and ruin the livelihood and security of its population.

7.4. Key issues in the Sector

The issues related to the people's habitat are considered the vital indicators for assessment of the living condition in an identified geographical area.

The sources of MSW when classified into different categories and sub-categories showed domestic waste including kitchen waste, market waste, garden and agricultural waste, hospital waste, road and construction waste, sweeping and sanitary waste within the city. Solid Waste generated from urban household is normally collected and dumped in an unscientific manner at nearby dumping grounds. Absence of proper segregation system and scientific treatment and disposal procedure has led to unhygienic condition near the urban areas across the UT. Different wastes and waste management activities have varied impacts on energy consumption, methane emissions and carbon storage. Recycling reduces Green House Gas (GHG) emissions by reducing methane emissions from landfills/ dumping grounds. Utilization of wastes to generate energy would reduce dependence on fossil fuels as well as GHG emissions. Improper collection and disposal system currently lead to spillage and contamination of soil and surface water as well as groundwater streams. Integrated Solid waste Management facility has not yet been implemented within Puducherry UT region.

Lack of proper sanitation facilities coupled with improper disposal of human and animal wastes are the main factors for the spread of water borne diseases. Discharge of municipal wastes into surface and shore water results in health risks through injecting sewage pathogens into water bodies, eutrophication or oxygen depletion due to nutrients and organic carbon and contamination of the aquatic food chain leading to toxification of marine organisms and humans.Increase in organic load within water bodies will result in methane emissions to the atmosphere from anaerobic degradation. Thus, GHG emissions will increase in the atmosphere.Water contaminated with chemicals as well as biological organisms like bacteria and other germs are responsible for serious health related problems. The cost of treatment to make the water potable would also increase.

Private modes of transport like two-wheelers and cars have increased by 96%whereas the number of public transport like buses has grown by just 35%.The general trend of increasing private (personal) modes of transport contributes majorly to urban air pollutionas well as increase in GHG emissions to the atmosphere from burning of Carbon intensive fossil fuels. An individual bus may emit more pollutants than a two-wheeler or a car, but given the number of passengers it carries, the per capita emission is considerably less. The urban transport sector in the Union Territory is characterized by heavy traffic congestion due to narrow roads, rapid growth in number of vehicles along with highly topographic and concentric development. In order to combat these odds through a sustainable strategy for climate resilience, the UT has envisaged some key priorities in the urban sector. Also, due to low price of fuel in the UT, the neighbouring states often procure fuel from Puducherry. Such interstate transportation enhances the transportation congestion and traffic across the UT.

Table 36: Adaptation Pathways with respect to climate change in UT

Issues	Impact	Pathways
Warm and Humid climate	*Increased demand for cooling and consumption of electricity*	*Create awareness to retrofit building with green design; policy incentive forusage star rated HVAC products*
Increase in natural hazard like Tsunami, storm surge, earthquake, flood, etc.	*Increased loss of human settlement and loss of lives*	*Policy formulation on hazard resistant settlements like Resilient Housing, Restoration of Government Buildings, Bridges and Culvert, Cyclone Resilient Electrical Network, renovation of heritage buildings within populated urban areas and awareness for hazard preparedness to minimize loss of property and lives.*
Energy Usage	*Higher concentration and higher use*	*Utility DSM measuresin street lighting, solar water heating*
Heavy and aberrant precipitation	*Increased storm-water runoff*	*Development of storm water management plan and investment in sewerage; re-assessment of master plans/land use plans of urban agglomerations, policy incentive use of permeable surfaces and incorporation in the PWD codes*
Enhanced waste generation due to urban	*Health hazards, soil contamination through leaching, odor pollution*	*Awareness for waste segregation and policies for landfilling of waste*

Issues	Impact	Pathways
agglomeration by population influx		
Transport system congestion and ageing	*Congestion and higher GHG emission and vehicular pollution*	*Phase out of old vehicles, integrated traffic study, congestion reduction plan and implementation of intelligent transport system.* *Introduction of the clean fuel like CNG and LPG.* *Reduction of traffic congestion and regulating interstate vehicle movement.*
Decline in the forest cover	*Decrease in bio-sequestration of atmospheric carbon dioxide, incur significant adverse soil erosion and frequently degrade into wasteland.*	*Planting heat tolerant trees, city wide programmes for tree watering and maintenance, roadside plantation programme, development of parks*

7.5. Programme and policies in the sector

The following key policies are in place to address the impacts of climate change and reduce the sectoral contribution to climate change. The Public Works Department (PWD), Local Administration Department (LAD), Transport Department, Town & Country Planning (T&CP) are responsible for implementation of these schemes.

7.5.1. Jawaharlal Nehru National Urban Renewal Mission (JNNURM)

The Government of Puducherry has adopted several urban development schemes such as the Jawaharlal Nehru National Urban Renewal Mission (JNNURM). JNNURM was launched by Government of India on 3rd December, 2005 and it was implemented in the State& UT in 2007. It is a reform driven fast track programme to ensure planned development of identified cities. It focuses on efficiency in urban infrastructure/Service delivery mechanism, community participation and on enhancing accountability of the Urban Local Bodies. The main thrust areas of JNNURM are water supply including sanitation, sewerage, solid waste management, road network, urban transport, integrated development of slums, re-development of inner (old) city. Under JNNURM, 8 projects have been approved so far (4 each by MoUD & MoHUPA). Puducherry administration had also inked a Memorandum of Agreement with the Urban Development Ministry which envisages 23 reforms in urban governance.

7.5.2. Slum Up-gradation Programme / Land Acquisition & Development Scheme

Based on the Zero Based Budgeting exercise by the Government of Puducherry, this scheme aims at acquiring sites at different parts of urban areas to construct tenements and provide developed plots to the slum dwellers under 'Sites and Services' concept. Improvement works are being taken up in the existing Slums through Slum Clearance Board. The tenements in storied block are made available to the slum dwellers on rental basis.

7.5.3. Rajiv Awas Yojana

The objective of the scheme is to achieve inclusive and sustainable growth for slum dwellers and urban poor by facilitating development of infrastructure and housing in the slums/rehabilitation of colonies with an integrated approach. The scheme aims at assigning property rights to people living in slum area and to create a slum free India in five years.

7.5.4. Capital Development Project / Town and Regional Planning / Traffic & Transportation Improvement and Management Measures in Urban Areas

Construction of office complexes, improvement of sea-beach, extension of urban amenities to the city and peripheries to decentralize the commercial activities from city centre etc., are being taken up under this scheme. The main emphasis is to develop the Puducherry town with infrastructures befitting a capital city. Improvement of major roads within the urban areas, installation of traffic signals to ease traffic problems/bottlenecks and construction of bus shelters is being undertaken.

7.5.5. National Urban Information System (NUIS) scheme

Karaikal Town has been identified as the NUIS Town by the Town and Country Planning Organization, Ministry of Urban Development, New Delhi to establish a comprehensive information system on urban indicators for planning, management and de-centralized governance. Puducherry Town has been selected for mapping of underground utilities of Water Supply and Sewerage networks in the scale of1:1000 using Ground Penetrating Radars.

7.5.6. Land Acquisition and Development Scheme

The objective of the Land Acquisition and Development Scheme is to make housing plots available to the needy at reasonable price. People who do not own any house or plot in the Union Territory of Puducherry are benefitted under the scheme. This aims at checking spiraling land cost and speculation in urban land values. It is therefore imperative that adequate urban and rural planning be developed across the UT in this context.

7.6. Key Priorities

Climate change is expected to have multifaceted impacts on Puducherry. Overall, this Union Territory is expected to be warmer with increase in maximum and minimum temperature, experience a large degree of rainfall variability and extreme weather events which would have far reaching effects on climate sensitive sectors such as agriculture and tourism underpinning the economy of Puducherry. Urban Heat Island (UHI) effects were concluded to be real local phenomena with negligible impact on large-scale trends. UHI and land-use land-cover change (LULC) effects arise mainly because the modified surface affects the storage and transfer of heat, water and airflow. For single discrete locations these impacts may dominate all other factors.Further, the coastal setting of this Union Territory also adds to the vulnerability of the region.30.3% of the coastline along Puducherry region and 11.5% of the coastlines along Karaikal Region are already under threat of coastal erosion. Sea level rise would also result in acceleration of Sea water intrusion into the fresh water aquifers.

At the same time, better urban planning and policies can reduce energy use and Green House Gas (GHG) emissions and improve the resilience of urban infrastructure to climate change, thereby shaping future trends. Lack of suitable livelihood and employment facilities lead to uncontrolled exploitation of natural resources. Moreover, two major districts Puducherry and Karaikal are situated along the Bay of Bengal coast and Yanam district along the bank of Godavari River and Mahe district along Arabian Sea which are equally

vulnerable to natural coastal disasters. Puducherry already witnessed a devastating Tsunami in 2004 and Thane Cyclonic storm during 2011. This necessitates special attention for initiatives on mitigation and adaptation under sustainable habitat mission.

The UT has identified key priorities with high importance and out of that eight actions are adaptation activities and fourteen are mitigation activities and two actions are both adaptation and mitigation activities. The high priorities identified are based on the basis of cost effectiveness, cost-benefit, feasibility, ease of implementation and overall sustainability. Within the sustainable habitat sector, five key priorities are put under the transport infrastructure sector and eighteen priority actions are under sustainable urban development sector. The total budget proposed for the thirteen key priorities along with sub activities is 2,890.3 million INR or 289.03 Crore INR.Out of this total budget Puducherry UT will contribute about 205.4 Million INR or 20.54 Crore INR and additional fund of 2,685.0 Million INR or 268.5 Crore INR will be sourced from Govt. of India and/or External Agencies.

Under a policy scenario where with theimplementation of national emission reduction strategies, aggregated mitigation costs can be reduced if economy-wise environmental policies are complemented by urban policies, such as congestion charges or increasing spatial density. This is due to complementarities with other policy objectives, such as lesser local pollution and health benefits, and enhancement of city/town attractiveness and competitiveness through lower local pollution levels.

Involvement of Government of Puducherry through ***climate sensitive urban*** planning and management can help achieve national climate goals and minimize imbalance between environmental and economic priorities at local levels. While local authorities can help to achieve national climate goals through urban policies to reduce energy demand and improve resilience to climate change, national governments can help to create a sound institutional foundation and knowledge base to help local decision makers engage with stakeholders to identify and carry out cost-effective actions.

Government of Puducherry is acting on climate change issues through national policies via local regulations, urban services and programme administration. The following action points have emerged out of several rounds of discussions among the working group members.

Key Priorities: Sustainable Habitat
1. *Adopting ECBC code for residential apartments and commercial centers*
2. *Waste water recycling & Strengthening/ modifications of exiting STPs*
3. *Promotion of Green buildings and green building certificate*
4. *Integrated Municipal solid waste management*
5. *Establishment of modern slaughter house within Puducherry Municipality*
6. *Capacity building programmes of Urban Local Bodies (ULBs)/ stakeholders of the coastal towns on potential climate change impacts (Tsunami, cyclone, flooding of low-lying coastal areas, land loss and displacement) and additional preparedness requirements.*
7. *Construction of Flyover and laying of bypass road*

8. *Providing/ renewing underground sewerage systems to urban areas*
9. *Promotion of eco-friendly road construction methods and capacity building of stakeholders*
10. *Climate friendly transport management and promotion of Public transport*
11. *Promotion of use of cooking gas from kitchen waste in bio-digester*

1. Adopting ECBC code for residential apartments and commercial centers

ECBC has been proposed mandatory for all new buildings with a connected load of 500 kW or more or a contract demand of 600 kVA or greater. The code is also applicable to all buildings with a conditioned floor area of 1,000 sq. m(10,000 sq. ft) or greater. The Code sets the minimum energy performance standards for large commercial buildings after taking into account the five climatic zones of the country.

The ECBC sets minimum energy performance standards for the design and construction of non-residential buildings. Studies conducted by National Productivity Council (NPC), reveals that energy savings potential in commercial buildings varies from 20-30%. Department of Town & Country Planning (T&CP) is planning to adopt the ECBC codes for all new residential and commercial building within the Puducherry UT by 2015. This action would reduce the energy consumption in building sectors to a large extent which would ultimately help in mitigating GHG emissions.

2. Waste water recycling & Strengthening/ modifications of exiting STPs

Waste Water Treatment activities would include installation of liquid waste treatment facilities, provision of new sewerage system, including the sewage treatment plant, collection network, outfalls and sewer cleaning equipment, both rehabilitation of the existing water supply and distribution systems and construction of new systems, constitution of water use societies for regular monitoring of services, leak detection and water quality monitoring. Presently there are three 7.5 MLD sewage treatment plant already in operation within Puducherry with old technology and lower efficiency. Under this mitigation activity Government proposed for modification and up gradation of existing Sewage Treatment Plants along with installation of new 18 MLD Sewage Treatment Plants for treatment of city sewage. Government of Puducherry is planning to install additional three STPs of 50 MLD capacity by the year 2015 for treatment of city sewage.Water conservation and enhanced efficiency would help in adapting to water shortage during climate induced dry spells as well as mitigate indirect GHG emission from usage of energy. Saving 1 MW energy would reduce GHG emission of 5,000 ton CO_2 equivalent per annum. It would also lead to energy conservation by reducing energy consumption at pumping stations, wastewater treatment plants and other relevant facilities. Also aerobic treatment of sewage would avoid the uncontrolled emission of methane to the atmosphere. Department of Town & Country Planning (T&CP) is planning to initiate this activity which would include wastewater recycling activities and modification and up gradation of existing Sewage Treatment Plants (STPs) in association with PWD by 2013.

3. Promotion of Green buildings and green building certificate

The Green Building concept has picked up in a short time in India. The Green Buildings are coming up in different parts of the country. There is also a need for construction of more buildings adhering to Green building norms which would use solar energy or other Renewable energy sources both in active and passive manner.

The Government of Puducherry may promote green building concept through policy and regulation measures. Like other States the building bye-laws could be amended by incorporating the above items in the building and providing appropriate incentives for the people. The Architects and Engineers could be properly trained for construction of such types of buildings. All the Government buildings may adhere to green building norms through administrative order. The Town & Country Planning (T&CP) would prepare the new building bye-laws which could be sent to all the Municipalities and Regional Planning Authorities (RPAs) for implementation. MNRE, Govt. of India provides incentives to the Municipalities for amending the Building Bye-laws. Capacity Building in the sector of construction of green building is an important area. The knowledge level of T&CP Engineers, Private Engineers and Architect requires to be enhanced keeping in view the need of climate friendly design of both private and public sector buildings. Significant quantum of emission could be reduced through adoption of Green Building Programme.Government of Puducherry is planning to implement the policy of green building certification of all new buildings of more than 10,000 Sq. ft built up area by 2015.

4. Integrated Municipal solid waste management

Integrated Solid waste management sub-projects include construction and upgrading of landfill sites, transfer station, storage and parking facilities for the collection vehicles and procurement of collection and disposal equipments, as eligible under the sub-project selection criteria for the Investment Programme. The activity is proposed to establish an integrated waste management plan for cities including measures to improve efficiency of existing solid waste and sewerage management systems.

Composting and treatment of Municipal Solid Waste in Puducherry and other district towns are crucial to control the Methane emission. This can generate about 5 MW power from Municipal Solid Waste (MSW) through Refused Derived Fuel (RDF) route. Generating power from waste materials would reduce GHG emission of about 0.142 million tons of CO_2 equivalent in next 5 years while composting of 562 TPD MSW would avoid methane emission of about 0.374 million ton CO_2 equivalent in next 5 years. Measures to reduce Green House Gas (GHG) emissions and adapt to expected climate change impacts would put additional pressure on city budgets and increase the need for additional public resources. These mitigation activities would reduce significant amount of GHG emissions and the revenue flow from the sale of emission reductions would help in sustaining the projects. Government of Puducherry is planning to install common municipal solid waste treatment facilities in Kurumbapet by 2013 and in all other municipalities and commune panchayats by 2015.

5. Establishment of modern slaughter house within Puducherry Municipality by 2015

Puducherry town has only one slaughter house at Dr. Ambedkar Nagar under Puducherry Municipality. Oulgaret Municipality has proposed to establish another slaughter house with all modern amenities by 2015. However, in every locality number of make-shift slaughter houses has increased and animals are mostly slaughtered in vacant plots, road sides or near drainage canals. At present, the slaughter house waste is being let out into municipal sewer, without any treatment. Before disposal the slaughter house wastes should undergo primary treatment such as screening, oil and grease separation etc. Solid Waste generated from slaughtering of goat, pig and large animals from the slaughterhouse is nearly 200 to 250 kg per day. These solid wastes are completely organic in nature and highly biodegradable. Hence, they are collected separately and dumped in the manure pit for production of manure but in unscientific manner. After accumulation of a certain load it is auctioned to the public and used as agricultural manure. It is noteworthy that the make shift slaughter places pose a great health hazard. In the slaughter house, little wastewater is generated. Spillage of body fluids is being washed and cleaned using bleaching powder and discharged into the upper canal. This drainage also carries the domestic sewage and part of the Puducherry wastewater is let out into this canal which drains into the sea.

The wastes from slaughter houses and packaging houses are mostly organic, having dissolved and suspended material. The principal deleterious effect of these wastes on streams and water courses is their deoxygenation. The anaerobic degradation of the waste materials from slaughtering activities would lead to generation of methane, a potent Green House Gas (GHG) to the atmosphere in an uncontrolled manner. Establishment of a modern slaughter house is necessary for management of animal waste and would also reduce the pollution load of the city sewerage.

6. Capacity building programmes of Urban Local Bodies (ULBs)/ stakeholders of the coastal towns on potential climate change impacts (Tsunami, cyclone, flooding of low-lying coastal areas, land loss and displacement) and additional preparedness requirements.

The Government of Puducherry emphasizes the need to enhance capacity of the officials of ULBs, W.D, PIA, Revenue Department and otherrelated departments on climate change implications and possible adaptive and mitigating measures so that they could include climatic considerations in their departmental planning as well as day to day operational and monitoring activities. Beginning with a training need assessment for all relevant departments and agencies, training modules on integrated solid waste management, water management and efficient distribution of supply and delivery and urban management would be conducted and training would be imparted. Capacity building would also be extended for awareness generation of residents on good practices such as source segregation of waste and energy efficiency. A comprehensive capacity building programme on climate change is necessary which would help to build awareness and increase of knowledge base of the officials responsible.

This key priority was identified based on the cost effectiveness, feasible options, sustainable and easy to implement with respect to the present condition of Union Territory. New or reformed institutions are needed to enable Government of Puducherry to facilitate capacity building and decision-making on climate change at the local level. A comprehensive capacity building programme on climate change is necessary which would help to build awareness and increase of knowledge base of the officials responsible by 2015. This activity would help to increase knowledge base and create awareness for the officials, policy makers on better climate change adaptability. This action is necessary before implementing any climate change mitigation initiatives as comprehensive knowledge base is required for better understanding and better implementation of the initiatives.

7. Construction of Flyover and laying of bypass road

The impact of flyover construction to curb traffic congestion problem has been assessed in terms of traffic decongestion, time saving, fuel saving and emission reduction. Three flyovers have been planned by the PWD of Puducherry at essential traffic junctions in Puducherry. Around 5% of the total traffic would be diverted through the flyover, which would result in a reduction of about 32% in the total emission generation. Travel via the flyover would also save 60-70% time, compared to the travel on the main road, particularly when all the four signals are found to be in the red phase. The loss of fuel for combustion and the associated cost would reduce significantly. This activity would reduce the GHG emission from vehicular sources significantly. Public Works Department (PWD) of Government of Puducherry is planning to construct flyovers at Rajiv Gandhi and Indira Gandhi junctions and ROBs at level crossing Aurmabathapuram by 2015.

8. Providing/ renewing underground sewerage systems to urban areas by 2015

In order to provide for unforeseen climatic extremes such as floods in urban areas, building with provisions for storm water flow management, and preventing contamination of water streams due to flooding and other relevantaspects would be incorporated into the urban design. In particular, sewer flooding remains a major issue. Government of Puducherry recognized that sewer flooding has a big impact and can be very detrimental to the affected ones. Flooding can be caused by blockages or collapses in a sewer, or by heavy rainfall which can overwhelm the sewer system and also results in water logging in certain low lying areas. The ageing network of sewers and pumping stations leads to inefficiency in sewerage system and is detrimental to the environment as well. The increase in population over the past few decades, as well as replacing natural drainage with concrete and paving have both impacted the old sewer systems.

Government is planning to initiate the activity on priority basisand planning to implement by 2015 so that the sewer network performs better than before. Public Works Department (PWD) of Government of Puducherry is planning to invest in sewer network up gradation and modernization to improve its capacity and performance. Government of Puducherry is planning to roll out a new sewer network monitoring system which would allow to spot and clear blockages and reduce chances of flooding. Government needs to ensure that the sewerage system is sufficient to cope up with the changing trend in a more sustainable way.

Therefore, PWD would work with local authorities and developers throughout the local planning process.

9. Promotion of eco-friendly road construction methods and capacity building of stakeholders

Bitumen is used in road construction as a binder for the purpose of retaining the cover aggregate, and providing a waterproof seal to the pavement. It is a natural constituent of petroleum obtained from separation of the various fractions (petrol, kerosene, distillate etc.). Bitumen emulsions allow warm and cold mixtures to be used in a large range of pavement solutions. This means much less use of energy to heat aggregates, and far fewer emissions. Cold mix in situ recycling is the best way to recycle properly, avoiding transportation and optimizing the use of existing material. Use of virgin material is thereby minimized as it is planned to be removed as landfill. Flexibility of use comes into the equation: the laying season is extended with cold mixtures. There are none of the health and safety issues that can be associated with heat and fumes. Bitumen emulsions are a large part of the solution for pavement preservation. The technology is proven; and often results in solutions that are less expensive than those achieved by other techniques. Government of Puducherry is planning to implement the usage of bitumen in roads and highway construction. Government is also planning to introduce a Pilot project on Rubberized Bitumen usage in Road Construction.

The construction industry has one of the highest impacts on the environment in regards to energy use, material use and waste products. Construction waste recycling is the separation and recycling of recoverable waste materials generated during construction and remodeling. Packaging, new material scraps and old materials and debris all constitute potentially recoverable materials. Public Works Department (PWD) of Government of Puducherry is planning to implement extensive programmes for recycling and reuse of materials to use waste and end-of-life products for construction of road. While these efforts are strong and have become part of industry practice, this is not sufficient to create sustainable products over entire life cycles. This activity would reduce the energy consumption for production of traditional road construction material in a large scale.

10. Climate friendly transport management and promotion of Public transport

Climate Change poses two fundamental challenges to the transport sector; the sector would have to significantly reduce Green House Gas (GHG) emissions which involves investment. The scale and scope of emission reductions sought by policy makers is a challenging task but there is much that can still be achieved within the sector at low cost while the cost of energy prices are increasing rapidly.

Transport sector contributes substantially to the emission of Green House Gases (GHGs). To mitigate the emissions from transport sector, enforcement measures such as phase-out of old vehicles that have been in use for more than 20 years by 2013 andwith more than 15 years by 2015.Regular checking of pollution control certificates of vehicles would also be carried out. Further policies would be developed to control vehicular emission within the UT.

Government of Puducherry has planned to promote Battery Operated Vehicles (BOVs) under the Alternative Fuel for Transportation primarily in tourist placeswithin Puducherry city limits by 2013 and all areas other than Puducherry city limits by 2015. The objective of the programme is to promote non-polluting Battery Operated Vehicles (BOVs) within the region, which would help in conserving diesel oil and curb environmental pollutions as well.

Governmentof Puducherry would take a major programme on switching over to CNG/ LPG based vehiclesthrough promotion of LPG/CNG in auto, cars by 2013. New vehicles like autos, taxis will be registered only if they use CNG/LPG fuel system after 2013. Government will also promote Electric vehicles in the city of Puducherry and other three district towns. Also by 2015 Government is planning to use CNG in all PRTC buses.This would help significantly in reduction of GHG emission from burning of fossil fuel like petrol and diesel. National Policy on Bio fuels as approved by Government of India may be adopted by the government as a mitigation programme. Government of Puducherry is also planning to implement a systematic and effective periodic monitoring of vehicular emissions within entire region. This would help in control of GHG emission and other potent air pollutants from vehicles within the region.

General public transportation falls into the category of Mass Rapid Transit (MRT), or modes of urban transportation that carry large volumes of passengers quickly. Government of Puducherry is planning and prioritizing their budgets to allocate more funds in order to build new public transportation systems and expand or improve upon old ones by 2015. The improved public transportation systems would encourage use of public transport in place of personal vehicles.

Biofuels are derived from renewable bio-mass resources and, therefore, provide a strategic advantage to promote sustainable development and to supplement conventional energy sources in meeting the rapidly increasing requirements for transportation fuels associated with high economic growth. Biofuels can increasingly satisfy these energy needs in an environmentally benign and cost-effective manner while reducing dependence on import of fossil fuels and thereby providing a higher degree of National Energy Security. Government is thus planning to promote biofuel for transportation sector to reduce the fossil fuel consumption as well as GHG emission.

11. Promotion of use of cooking gas from kitchen waste in bio-digester

The bio-gas produced from food waste, decomposable organic material and kitchen waste, consisting of methane and a little amount of Carbon Dioxide (CO_2) is an alternative fuel for cooking gas. Also, the waste materials can be disposed off efficiently without any odour or flies and the digested slurry from the bio-gas unit can be used as organic manure in the garden or in agricultural purposes. The waste generated in kitchen in the form of vegetable refuse, stale cooked and uncooked food, extracted tea powder, waste milk and milk products can all be processed in this plant. Thus, the efficient disposal of kitchen waste can

be ecofriendly as well as cost effective. While calculating the cost effectiveness of such waste disposal, one has to consider more than monitory aspects.

Government of Puducherry is thus planning to implement ten demonstration projects of bio-digester primarily in Government Guest Houses/ Rest Houses, Office canteens, Government training centers by 2015. Also Government is planning to install 30 bio-digesters in all the central kitchens, temples, Anganwadi centers, Government hostels of Puducherry by 2017. These activities will reduce the consumption of LPG for cooking purposes and also will reduce the GHG emission from the consumption of fossil fuel. About 20% of rural household will use biogas for cooking from kitchen waste by 2015. These activities will reduce the fossil fuel consumption for cooking purposes significantly.

Key priority

Table 37: Key Priority List Sustainable Habitat Mission

No	Title	Organizations	Budget (in Million INR)			Source of funding
			Existing	Additional	Total	
1	Adopting ECBC code for residential apartments and commercial centers	T&CP[54]	Nil	0.80	0.80	GoI[55], GoPY[56], EFA [57]
2	Waste water recycling & Strengthening/ modifications of exiting STPs	T&CP,PWD[58]	Nil	120.00	120.00	GoI, GoPY, EFA
3	Promotion of Green buildings and green building certificate	T&CP	Nil	2.50	2.50	GoI, GoPY, EFA
4	Integrated Municipal solid waste management	LAD[59]	Nil	1,000.00	1,000.00	GoI, GoPY, EFA
5	Establishment of modern slaughter house within Puducherry Municipality by 2015	LAD	Nil	10.00	10.00	GoI, GoPY, EFA
6	Capacity building programmes of Urban Local Bodies (ULBs)/ stakeholders of the coastal towns on potential climate change impacts (Tsunami, cyclone, flooding of low-lying coastal areas, land loss and displacement) and additional preparedness requirements.	LAD	Nil	2.50	2.50	GoI, GoPY, EFA
7	Construction of Flyover and laying of bypass road	PWD	Nil	500.00	500.00	GoI, GoPY, EFA
8	Providing/ renewing underground sewerage systems to urban areas by 2015	PWD	Nil	960.00	960.00	GoI, GoPY, EFA
9	Promotion of eco-friendly road construction methods and capacity building of stakeholders	PWD	202.50	0.00	202.50	GoI, GoPY, EFA
10	Climate friendly transport management and promotion of Public transport	Transport Dept.,	Nil	Nil	Nil	GoI, GoPY, EFA, MNRE
	Phase out old vehicles	Adi Dravirar Welfare, Dept. of	Nil	4.00	4.00	
	Promoting Bijilee (Battery Operated Vehicles)		Nil	4.00	4.00	
	Periodic vehicular emission test		Nil	4.50	4.50	

[54] T&CP : Town & Country Planning
[55] GoI : Government of India
[56] GoPY: Government of Puducherry
[57] EFA: External Funding Agencies
[58] PWD: Public Works Department
[59] LAD: Local Administration Dept.

No	Title	Organizations	Budget (in Million INR)			Source of funding
			Existing	Additional	Total	
	Switching of fuels and promotion of LPG/CNG	Health, BDO/DRDA, Dept. of Education	Nil	5.00	5.00	
	Promotion of public transport and mass transport within the city and town area will help in reducing GHG emissions		Nil	60.00	60.00	
	Promotion of bio fuel		Nil	5.00	5.00	
11	Promotion of use of cooking gas from kitchen waste in bio-digester	REAP, Agriculture Dept.	Nil	Nil	Nil	GoI, GoPY, EFA,
	Demonstration project in 10 Nos. govt. guest/rest house, govt. office canteen, govt. training centers by 2015		0.375	0.875	1.25	
	Implementation of 30 Nos. bio-digesters in all central kitchens, temples, Anganwadi centers, govt. hostels of UT by 2017		2.475	5.775	8.25	
Total Budget (in Million INR)			**205.40**	**2,685.00**	**2,890.30**	

8. Green Puducherry Mission and Sustainable Agriculture

8.1. Introduction

8.1.1. Forest Ecosystem

Increased atmospheric carbon dioxide (CO_2) concentration and its impact on global climate are likely to alter forest ecosystems. Increased concentration of CO_2 might favour the plant growth especially the C4 variety. On the other hand increase of sea level might favour the biodiversity across the coastal line specifically the mangroves that tolerate high salinity. Thus it is well evident that the impact of climate change will result into abiotic and ecological stress on the forest ecosystem at regional level. Conservation of forest ecosystem through adoption of appropriate adaptation measures for both anthropogenic and climatic stress is important not only for ecosystem conservation or natural resource management but also from the point of view of sequestration potential.

Probable variation in the level of precipitation or ambient temperature could lead to increased insect attack and disease outbreak among forest flora species and alteration in the age structure of plant species. Extreme weather events, such as floods and very high or widely fluctuating temperatures could further damage or afflict plant species. Increased CO_2 concentration, weather variability would affect the growth and survival of plants by altering their physiological behaviour. The genetic structure of plant population may be affected by climatic variation resulting from a changed environment, and only species with larger genetic variability are likely to be more adaptable to climate variation and hence more sustainable. However, different migration rates and reactions of individual species to new environmental conditions lead to a new plant species mix. The existing forest management practices thus need to evolve in accordance to the characteristics of the new emerging species.

Adaptation measures like thinning to reduce moisture stress, early harvesting of deteriorating stands and planting of more climatically adaptable population and species could help maintain higher levels of productivity. Climatic adaptation could also be enhanced through tree breeding in order to increase pest and stress tolerance.

Forests are important for their role in neutralising the carbon concentration in atmosphere. Carbon sequestration can be maximized through sustainable silvicultural practices that increase tree growth rates. The forestry sector also results in livelihood opportunity and apart from its benefit it renders towards environmental protection, soil conservation and regulating local micro climatic condition. In lieu it becomes highly essential to conserve the forest ecosystem from the projected impact of climate change and anthropogenic stress. Process-based models of specific elements of forest ecosystems are therefore needed to predict the effects of climate change on the forest ecosystem so as to develop forest management practices that would minimize negative effects climate change.

8.1.2. Agriculture

Agriculture is the mainstay of rural livelihood providing direct employment to around 50% and indirect employment to 20% of the rural population[60]. Irrespective of the sector providing livelihood opportunity to a considerable percentage of the population, the contribution of agricultural and its allied sectors to the UT economy is substantially low. The primary sector comprising of agriculture, animal husbandry, forestry, fishing, mining and quarrying contributes to around 5% of Net State Domestic Product (NSDP at current price). The contribution of the sector to UT's income has declined substantially from around 11% in 1994-95 to around 5%in 2011-12 irrespective of the continual effort by the agriculture department of the Government of UT.Decrease in percentage of agricultural workers can also be attributed to the decline in agricultural productivity. The pattern of land holding majorly due to the law of inheritance has led to fragmentation of the agricultural land thereby changing the status of small farmer to marginal. The decline in share of agriculture in the overall economy is likely to change the social setting in which climate change is likely to evolve and will determine the degree of impact on human development and food security.

The agricultural land is characterized by deep red and alluvial soils of relatively good fertility levels. The major crop in all the four regions of Puducherry scattered over different agro climatic zones is paddy[61].Food crops other than paddy include ragi, cumbu, black-gram, green-gram, sugarcane, palmyrah, fruits and vegetables, condiments and spices while the non-food crops include cotton and oilseeds.The positive part of the agricultural practice that reduces the weather related vulnerability in the UT is the higher rate of irrigation. The proportion of net area irrigated to the net area sown is around 79.6% indicating that the irrigation facility in the Union Territory is highly developed. Tube well is the main source of irrigation in Puducherry region whereas in Karaikal & Yanam regions are mostly irrigated through canals.

The statistics of Agricultural practice in all the four regions represent a higher rate of irrigation[62]:

Table 38: statistics of Agricultural

Parameters	Unit	Puducherry	Karaikal	Mahe	Yanam	Total
Total Area	In ha	29,378	16,012	870	2,391	48,651
Net area Shown	In ha	10,741	6,187	586	615	18,129
Net area Irrigated	In ha	9,561	5,451	28	329	15,369
Food Grain Production	MT	25,632	15,887	--	1,780	43,299
Rice Production	MT	25,217	15,132	--	1,735	42,084

In the context of change it is necessary to mention that agriculture sector which is most vulnerable to the impacts of climate change also contributes to the cause through emission

[60]*Puducherry Development Report*
[61]*Season and Crop report 2010-11,Dept. of Agriculture*
[62]*Puducherry at a Glance 2012, Directorate of Economic and Statistics, Pg 5*

of greenhouse gas (mainly methane and NO_2) to the atmosphere. The direct and indirect emission of greenhouse gas for the UT of Puducherry[63] for the year 2000 cumulates to 0.1 Tera Gram.

8.2. Key trends in the sectors

8.2.1. Forestry

According to the interpretation of satellite data collected over October-December 2008, the forest cover of Puducherryisspread over 50.06 sq. km which is 10.43% of the Total geographical area (Source: Puducherry, State of Forest Report 2011, FRI, Dehradun). In terms of forest canopy density classes, 35.37 sq. km area is covered under moderately dense forest, and 14.69 sq. km under open forest. The forest cover of the UT is shown in Figure below.

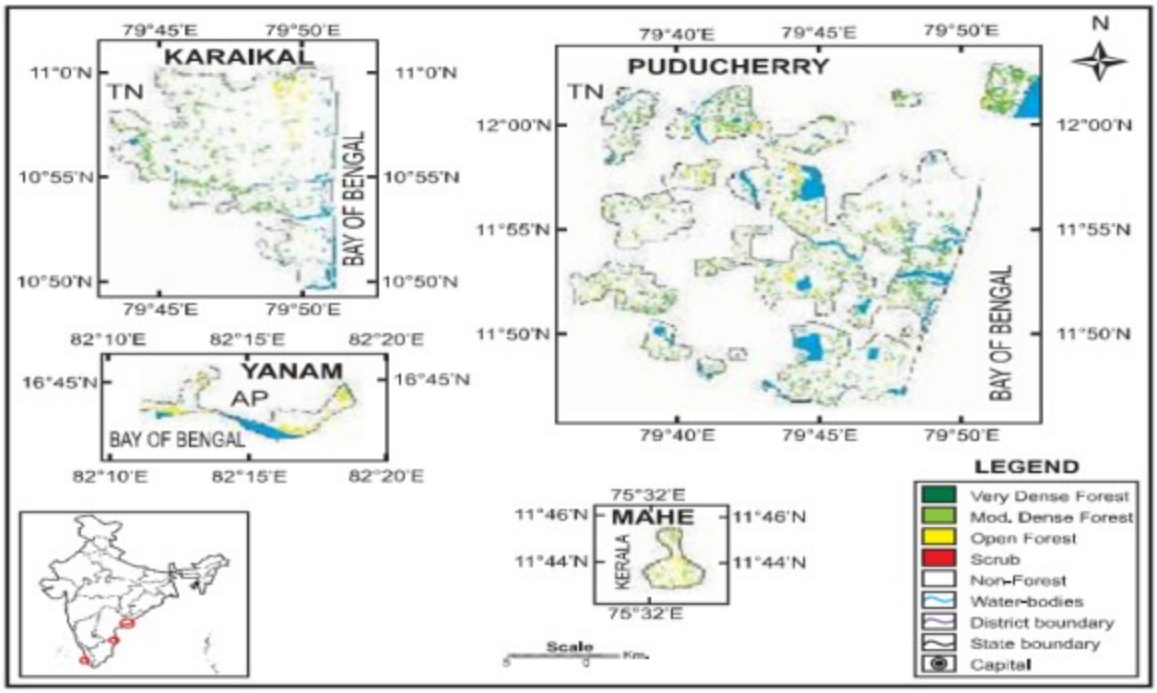

Figure 15: Forest cover distribution of the UT

Table 39: District wise Forest Cover (Area in sq. km)

District	Geographical Area	2011 Assessment				Percent of GA	Change* over 2009 assessment	Scrub
		Very Dense forest	Mod. Dense Forest	Open Forest	Total			
Karaikal	161	0.00	7.39	1.56	8.95	5.56	0.00	0.00
Mahe	9	0.00	1.36	3.54	4.90	54.44	0.00	0.00
Puducherry	293	0.00	24.62	8.59	33.21	11.33	0.09	0.00
Yanam	17	0.00	2.00	1.00	3.00	17.65	0.00	0.00
Grand Total	480	0.00	33.37	14.69	50.06	10.43	0.09	0.00

[63] *Indian Agricultural Research Institute*

According to the 2011 assessment in Puducherry, it is seen that the area under forest cover has increased by 0.09 sq. km, but the net increase in forest cover is 6.19 sq. kmaccording to ISFR 2009. The disparity in data is due to interpretational differences on account of refinement of methodology as well as availability of improved satellite data in appropriate seasons.

Table 40: Forest Cover Change Matrix (Area in Sq. km)[64]

	2011 Assessment					2009 Assessment
	VDF	MDF	OF	Scrub	NF	
Very Dense Forest	0.00	0.00	0.00	0.00	0.00	0.00
Moderately Dense Forest	0.00	33.31	0.00	0.00	0.79	**34.10**
Open Forest	0.00	0.17	13.3	0.00	2.40	**15.87**
Scrub	0.00	0.00	0.00	0.00	0.00	0.00
Non-Forest	0.00	1.89	1.39	0.00	426.75	**430.03**
Total 2011	0.00	**35.37**	**14.69**	0.00	**429.94**	**480.00**
Net Charge	0.00	1.27	-1.18	0.00	-0.09	

Forest Cover variation with Forest Types

Forest Survey on India has undertaken forest type mapping using satellite data with reference to Champion & Seth Classification. The assessment has identified that the UT has only one forest type from the Littoral and Swamp Forest type group. Percentage-wise distribution of forest cover in the forest type group is given in the pie chart below:

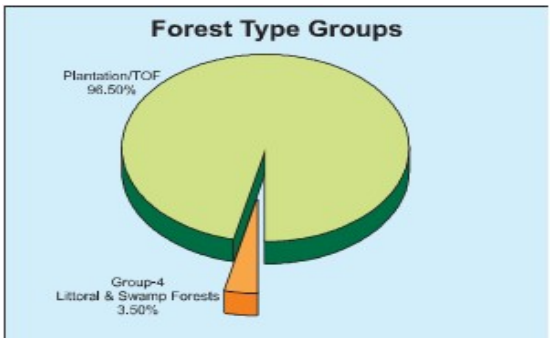

Figure 16: Different Forest types in Puducherry

Puducherry does not have forest resources in abundance, in fact there are no recorded forests in the UT.Therefore the activities of the department include afforestation by means of plantations in urban and rural areas, extension of technology and knowhow to farmers and people engaged in agro forestry practices and creating awareness about conservation of natural resources.

To enhance general quality of environment and improve local micro agro-climatic conditions in particular, local people of Puducherry should be involved to increase tree cover in the region. To share the sustainable benefits of the forests, the UT has taken up afforestation projects on Government waste lands, community lands, temple lands and other Government owned lands like canal tanks, etc. through Joint Forest Management.

[64] ***FSI, 2011***

Odiampet, Thirukanji and Kizhoor villages have been identified by the Department of Forest and Wildlife for the implementation of Joint Forest Management.As per the department, a village Forest Council would be constituted and registered under society act shortly.The microplan for the project would be prepared and tree plantation would be created through Village Forest Council.

The major tree seedlings to be planted are Babul, Subabul, Kodukapuli, Neem, Teak in the offshore areas of Vadhanour Tank Tree Plantation.The plantation thus created would be maintained and handed over to EriSangam Vadhanur.

In the Coastal area Manapet, Govt. land was acquired and plantation was created to an extent of 30 ha.The fruit seedlings such as Cashew, Mango, Sapota, Amala, Guava and miscellaneous tree seedlings, such as rain tree, golden shower, Neem Teak, Tamarind, Naval were planted.

The vegetation cover of Ariyankuppam River and surrounding lands in the revenue villages of Ariyankuppam, Murungapakkam and Thengaithittu is dominated by *Avicennia*s species and*Suaeda* species.The growth of mangrove species is in the form of small thickets scattered over the Ariyankuppam back water stretching from Thengaithettu to Veerampattinam.
Other factors like invasive weeds, unregulated tourist movement through the sacred groves and lack of timely silvicultural operations deter regeneration. Similarly, a marked reduction in population of medicinal plants has been observed. Over exploitation of forests has not only degraded the density but impaired their environmental benefits. The effects of forest degradation are visible through drying up of perennial water sources, accelerated soil erosion, silting of reservoirs loss of biodiversity and reduced forest productivity.

8.2.2. Agriculture:

The predominant crop across all the four regions is paddy thereby creating a need for continuous supply of water. The total requirement of water for agricultural activity in Puducherry and Karaikal region is in the range of 116 and 5.1 million cu. m respectively.Although rainfall is the major source of water supply across the four regions, the higher incidence of irrigation has a positive impact on the agricultural productivity by lowering the dependency on rainfall during a particular period of time. Around 80% of the net area sown is irrigated from various sources like wells, canals, tube-wells and tanks. Irrespective of higher incidence of irrigation facility in the region it is obvious and pertinent that adequate amount of rainfall is an important factor so as to sustain the ground water level.

Table 41: Statistics of Area under agriculture and food grain production

Sl. No.	Item	Unit	2011-12				
			Puducherry	Karaikal	Mahe	Yanam	UT
1	TotalArea	Hectares	29,378	16,012	870	2,391	48,651
2	NetAreaSown	Hectares	10,741	6,187	586	615	18,129

3	Totalcroppedarea	Hectares	17,444	8,547	588	904	27,483
4	Area sown more than once	Hectares	6,703	2,360	2	289	9,354
5	Net Area Irrigated	Hectares	9,561	5,451	28	329	15,369
6	Gross Area Irrigated	Hectares	15,194	6,117	30	499	21,840
7	Food grainsproduction	Tonnes	25,632	15,887	--	1,780	43,299
8	Riceproduction	Tonnes	25,217	15,132	--	1,735	42,084

All the four isolated regions of the UT are characterized by the bimodal distribution of rainfall. A comparison of the annual rainfall across the last decade in all the four regions with the normal rainfall[65] across the region shows an overall increase.

Table 42: Pattern of Rainfall across last decade as against the normal rainfall

Year	Rainfall in mm			
	Puducherry	Karaikal	Mahe	Yanam
2000-01	865	961	3,261	794
2001-02	1,094	1,653	2,709	1,128
2002-03	921	1,012	2,805	847
2003-04	1,282	1,434	3,308	1,037
2004-05	1,184	1,906	2,485	818
2005-06	1,552	1,821	3,421	1,382
2006-07	1,133	986	3,281	1,427
2007-08	1,417	1,568	4,244	1,243
2008-09	1,620	1,445	2,794	947
2009-10	1,480	1,634	3,635	694
2010-11	1,834	1,841	3,005	2,307
Normal rainfall	1,323	1,436	3,344	1,214

All the four regions of Puducherry receive rainfall during South-west Monsoon period (June to September) and North-east Monsoon period (October to December) with some periodic rainfall during winter and summer. The South-west monsoon is the important season as it has great impact on production of Khariff crops. Puducherry receives its highest normal rainfall (average of 30 years) from north east monsoon around 832 mm followed by south west monsoon in the range of 365mm. Unlike Puducherry, Karaikal receives highest rainfall during North-east Monsoon period (around 1003mm) followed by south west monsoon (around 365mm). Mahe and Yanam however receivehighest rainfall from South west monsoon (692 mm for Yanam and 2614 mm in Mahe) followed by north east monsoon (average rainfall at Yanam is around 415 mm and Mahe 403mm). However all these regions receive a small quantum of rainfall during winter and hot period.

An analysis of the temperature (both mean maximum and mean minimum) for last decade does not reveal any major variation in the temperature. The variation in percentage of

[65] *Note: Normal rainfall is the simple arithmetic average of data for 30 years from 1980-81 to 2009-10*

relative humidity from the mean was within the range of 5%. The temperature and relative humidity at Puducherry is presented below.

Table 43: Temperature and relative Humidity at Puducherry

Year	Mean Maximum	Mean Minimum	Pooled Mean	Relative Humidity %	
	°C	°C	°C	8.3 hrs	17.3 hrs
2001	33.4	24.2	28.8	83	77
2002	33.7	24.1	28.9	79	74
2003	33.6	24.2	28.5	79	72
2004	33.1	23.9	28.5	78	70
2005	33.3	24.4	28.9	79	72
2006	33.4	24.1	28.8	79	71
2007	33.1	24.1	28.6	79	72
2008	33.3	24.5	28.9	79	74
2009	33.8	24.8	29.4	79	71
2010	33.0	24.8	289	82	75
2011	33.3	24.2	28.8	81	72

Agricultural Productivity

Paddy is the principal agricultural crop in the region with an average production in range of 51,960 MT tonnes and average yield of 2,596 kg/ha across 2010-11. Analysis of the annual production and average yield of rice has however demonstrated a declining trend. The annual production of rice has declined from 60171 MT in 2006-2007 to 51,960 MT in 2010-11. The decline in productivity is also depicted in terms of the total production of food crops that has declined to 0.34 million MT in 2010-2011 from 0.47 million MT in 2006-07. With the decadal population growth of 27%, the decrease in agricultural productivity may exacerbate the projected vulnerability in terms of food and nutritional security.

Table 44: Comparison of Agricultural productivity across 2006-07 and 2010-11

In MT tonnes

Region	2006-07		2007-08		2008-09		2009-10		2010-11	
	Rice	Food Crops	Rice	Food Crops	Rice	Food Crops	Rice	Food Crops	Rice	Food Crops
UT	60,171	4,77,295	53,324	3,13,948	50,716	24,1950	52,330	325,639	51,960	3,48,403
Puducherry	41,430	4,54,706	36,978	2,94,962	37,382	2,26,026	37,657	309,312	35,010	3,29,091
Karaikal	16,613	19,725	14,331	16,347	11,328	13,303	12,519	13,608	14,710	16,457
Mahe	-	642	--	510	--	528	--	527	--	536
Yanam	2,128	2,222	2,015	2,129	2,006	2,093	2,154	2,192	2,240	2,319

8.2.3. Animal Husbandry

Animal husbandry along with agriculture represents the primary sector in the UT's economy. The animal population in the union territory can broadly be classified under livestock comprising of cattle, buffalo, sheep and goat whereas the poultry includes ducks

and poultry. The animal husbandry sector apart from its contribution to employment and livelihood option contributes substantially to the nutritional value. There has been a declining trend in livestock population the region during 1982-2003 but it has revived in the recent past. Reduction in the area under grazing and dependence on balanced feed from outside the region might have contributed to the decline[66].

Table 45: Decline in the livestock population

Category	Year		
	1982	1992	2003
Cattle	93,526	92,720	78,095
Buffaloes	9,042	7,152	3,887
Sheep	9,030	3,994	2,589
Goat	52,531	44,016	47,539
Total Livestock	1,76,825	1,57,761	1,58,305

Analysis of the meat, Milk and Egg production across the recent past has however exhibited an increase in the productivity.

Table 46: Annual production of the meat, Milk and Egg in Puducherry

Sl. No.	Item	Unit	Year			
			2006-07	2007-08	2008-09	2009 -10
1	Milk	(in tonnes)	44.713	44.929	45.510	45.812
2	Egg	(in million)	10.736	10.830	11.184	11.277
	Meat					
3	Live Stock	(mts)	5.482	5.329	5.532	5.943
4	Poultry	(mts)	3.261	3.136	4.289	5.032

8.2.4. Fisheries:

The Union Territory has 1,347 hectares of inland water and 800 hectares of brackish water. The four regions of Puducherry, Karaikal, Yanam, and Mahe also have access to around 1,000 sq. km of continental shelves. Fisheries contribute to about 30% of the output of the primary sector. There are around 26 fishing village in Puducherry and Karaikal. The marine landform of Puducherry and Karaikal is dominated by backwater, creeks, beach ridges, etc.

Table 47: Estimates of fish production (In MT)

Sl. No.	Region	2006-07		2007-08		2008-09		2009-10	
		Inland	Marine	Inland	Marine	Inland	Marine	Inland	Marine
1	Puducherry	3,300	17,219	3,331	19,060	3,712	21,000	2,335	21,810
2	Karaikal	1,570	11,765	1,311	8,278	839	9,502	2,277	9,746
3	Mahe	-	3,835	-	3,856	-	3,038	-	3,290
4	Yanam	640	973	1,027	2,078	1,199	1,010	1,238	1,254
	Total	**5,510**	**33,792**	**5,669**	**33,272**	**5,750**	**34,550**	**5,850**	**36,100**

[66] *Puducherry Development Report*

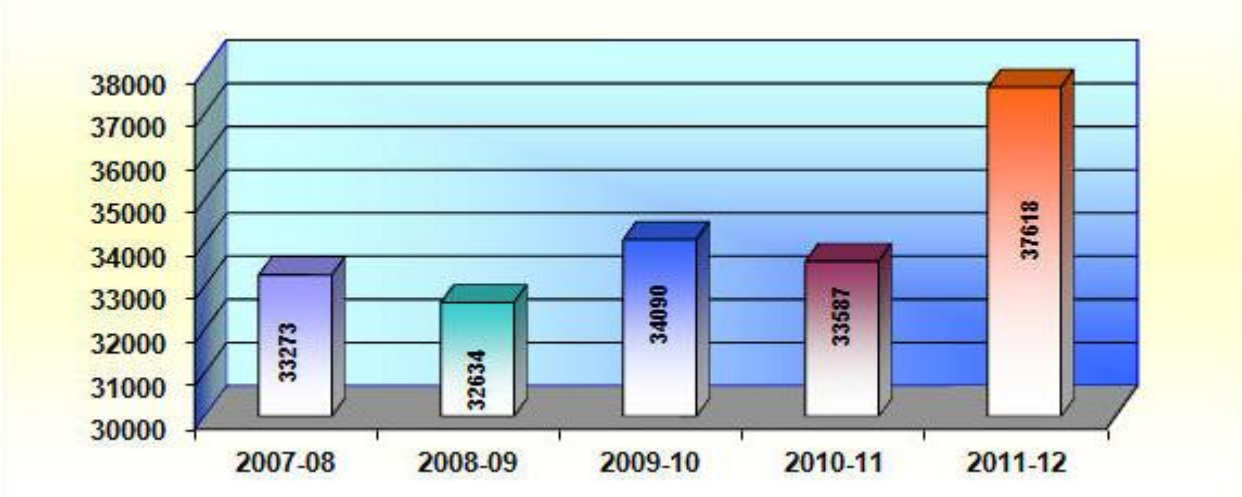

Figure 17: Marine Fish Production in MT

8.3. Key Issues in the Sectors:

8.3.1. Forestry:

Puducherry being a small area should be protected for conservation of the valuable natural resources and created assets and marine faunal elements like Dolphin, Puducherry shark, Dugong, corals and many other endangered faunal elements as the coastline is shared with Tamil Nadu.The Forest Department is initiating and implementing various schemes for the conservation of natural resources.

- **Disruption of Ecological Balance of an Area:** Coastal environments are more biologically diverse and productive compared to upland systems. Changes in sea level, natural calamities, invasive species, freshwater runoff quality and quantity and economic development impose threat to these valued systems and their economics. Coastal margins serve as nursery grounds for fisheries and habitat for wildlife as well as storm buffers and recreation for people. Due to rise in sea level the impact would manifest through damage to sensitive flora and fauna species native to the region. The impact may also slightly alter the breeding habits of animals and flowering cycles of plants due to human intervention in some of the sensitive habitats.
- **Deforestation and Soil Erosion:** Due to high demand for wood and wood products in the construction sector both as a raw material and for construction of hotels and resorts in Puducherry, deforestation is one of the major threats to natural resources. Deforestation would lead to the common consequences like soil erosion and reduction in rainwater retention capacity of the land.
- **Anthropogenic Pressure on Coastal Forest Areas:** The Puducherry coastal forest systems provide critical services for wildlife, forestry, recreation, ecotourism, fisheries, and shoreline protection. Due to human intervention and infrastructural development in the coastal areas, the coastal region is at risk under climate change. Anthropogenic coastal development in Puducherry poses the greatest irreversible threat to forests as well as wetlands, but natural changes and disturbances can also render short and long-term losses.
- **Anthropogenic pressure on forest areas:** Both planted forest areas and grazing lands are under tremendous biotic pressure for timber and firewood extraction/collection.

- **Mangrove degradation:** Due to illegal cutting of mangroves for fuel wood, grazing, fodder for livestock and trampling for fish and shrimp culture, encroachment of land for developmental activities, plantation of horticultural crops in place of mangroves, sand mining, mangrove forests are degrading day by day in Puducherry.

8.3.2. Agriculture

Variation in inter-annual, monthly and daily distribution of climate variables like temperature, radiation, precipitation (including change in rainfall pattern) water vapour pressure in the air and wind speed might pose as a threat to sustainable agriculture by affecting agricultural productivity. Natural and anthropogenic factors like soil erosion, salinization of irrigated areas, over-extraction of ground water and erosion of the genetic resource base, etc. might further exacerbate the climate change concerns. Since a considerable section of the rural population is linked directly to agricultural activity it is pertinent to mention that decline in agricultural income will directly impact the human development and enhance exposure of the vulnerable community to the catastrophic impact of climate change. As per the finding of IPCC, the impact of $CO_2$is envisioned to be relatively greater (compared to that for irrigated crops) for crops under moisture stress. IPCC report also projects the probable benefit in terms of incremental agricultural yield in mid- to high-latitude region in case of small amount of warming (about +2°C), however warming also result in decline of plant health.

The primary focus of analysis of agricultural produce has always been epicentred around food grains and cereals. But it is equally important that analysis of climate change and its impact be focused on the issue of vegetables that not only ensure food and nutritional security but is also one of the major sources of livelihood of the marginal farmers[67]. The study by FAO outlined that the impact of climate change will be more profound on small and marginal farmers depending upon vegetable production[68]. Abiotic stress mainly because of climatic variability (increasing temperatures, reduced irrigation-water availability[69], flooding, and salinity[70]) might impose threat to vegetable production. In addition environmental stress affects the soil organic matter decomposition, nutrient recycling and nutrient and water availability to the plant.

As per fifth Assessment report global warming with increase in sea water temperature may have profound impact on fishing activity as well as the aquaculture industry due to increases in diseases and algal blooms.

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[67] *India is the second largest producer of vegetable in world after China, with total production of 146.56 Mt from 8.50 Mhaarea (NHB, 2011).*

[68] *Selection of Genotypes of Vegetables for Climate Change Adaptation, RK Yadav, P Kalia, SD Singh and RichaVarshney, ICAR*

[69] *Vegetables, being succulent products generally consisting more than 90% water (AVRDC, 1990). Thus, water greatly influences the yield and quality of vegetables; and drought conditions drastically reduce vegetables productivity - Selection of Genotypes of Vegetables for Climate Change Adaptation, ICAR*

[70] *Salinity in the root area sternly inhibits normal plant growth and development, resulting in reduced crop productivity or total crop failure - Selection of Genotypes of Vegetables for Climate Change Adaptation, ICAR*

8.4. Vulnerability in the sector

8.4.1. Forestry

As per the published reports it is seen that climate changes have affected variousaspects of forest ecosystems like tree growth and dieback, existence of invasive species, species distribution, seasonal patternsof ecosystem processes, demographics and even extinctions (IPCC 2007a)[71].Vulnerability to climate change impacts in the Forest sector not only depends on exposure to climate change and other ecosystem-specific factors but also on adaptation capacity. As per Easterling et al. (2007, p. 279), adaptive capacity with respect to current climate is dynamic, and influenced by changes in wealth, human capital, information and technology, material resources and infrastructure and institutions and entitlements.'[72]As per IPCC, the Assessment of recent climate impacts and current vulnerabilities in Forest Sector is discussed in the following table (IPCC 2007a)

Table 48: Current Vulnerabilities in Forest Sector

Sl.No.	Factors	Assessments
1	Exposure to recent climate warming	Generally higher in boreal forests
2	Plausible hypotheses about impact mechanisms	Plausible hypotheses have been described for all forest domains
3	Empirical evidence of ecosystem change consistent with impact hypotheses	Evidence stronger for boreal and temperate domains than other domains. However, this may be due in part to greater investments in research in boreal and temperate domains
4	Deforestation (increases vulnerability by reducing forest resilience and capacity for adaptation)	Deforestation rates generally higher in subtropical and tropical domains
5	Endemic forest types may have relatively high vulnerability to climate change because their limited extent may reduce resilience	Endemic forest types are more common in non-glaciated zones, including tropical and subtropical domains and warmer parts of the temperate domain
6	Adaptive capacity	Human dimensions of adaptive capacity in the forest sector are generally high in boreal and temperate domains; they are more variable in subtropical and tropical domains due to constraints on access to capital, information and technology

[71]*IPCC 2007a. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. & Hanson, C.E. (eds.). Cambridge University Press, Cambridge, UK.976 p.*

[72]*Easterling, W.E., Aggarwal, P.K., Batima, P., Brander, K.M., Erda, L., Howden, S.M., Kirilenko, A., Morton, J., Soussana, J.-F., Schmidhuber, J. &Tubiello, F.N. 2007. Food, Fibre and Forest Products. In: Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. & Hanson, C.E. (eds.). Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK. p. 273–313*

Due to climate change in Puducherry the probable vulnerability of the forestry sector are as follows:

1. Since in Puducherry, 96% of forest land is constituted of plantations and farm forests, the climate change may lead to increased vulnerability to weeds, disease and pests and changes in suitability of plant species for the areas in which they are traditionally grown. Climate change would intensify the existing stress on forest ecosystems through increase in invasive species, insect pests and pathogen attacks and disturbance regimes in urban forests.
2. Climate change would affect the tree phenology too. Changes in phenology can affect ecological relationships, e.g. by creating a mismatch between plant flowering time and presence of insect pollinators.
3. In Puducherry, biological systems of mangrove forests are immune to environmental changes to some extent. This resistance exists at several levels, including genetic diversity, species redundancy, species and ecosystem adaptability and landscape distribution. Due to change in precipitation, temperature and sea level rise mangrove forests would be degraded. Many tree species would have insufficient adaptation rates to keep pace with climate change.
4. Species with small distributions and high potential for range displacement are at a very high risk of extinction as a result of climate change. In Puducherry bigger animals are non-existent, but some of the small animals like mongoose, civets, monkeys, monitor lizards, corals, dolphins, turtles, migratory birds need to be protected.

8.4.2. Agriculture

It is being projected that though the impact of climate change on the food system would be less in the first half of this century but in the long term the negative impacts would aggravate due to a combination of adverse agro-climatic, socio-economic and technological conditions. The level of vulnerability driven by both hazards and contexts relevant to the agricultural sector depends heavily upon exposure and sensitivity to climate conditions. Although a controlled analysis demonstrated an increment of yield in agricultural variety at elevated CO_2 concentration but the same has not been established on a commercial scale. Increase in temperature along with other variations like the incremental concentration of greenhouse gas in the atmosphere may however poses a negative influence on the net yield. The decline in the agricultural productivity as a result of climate variability (coupled with societal issues)may impose the dual challenge of addressing the food security and at the same time protecting natural resources and improving environmental quality.

The climate change is likely to affect all four dimensions of food security namely food availability (i.e., production and trade), stability of food supplies, access to food and food utilization[73]. Apart from variation in temperature (potential for food production is projected to increase with increase in local average temperature over a range of 1 to 3°C, but above this it is projected to decrease) the agricultural productivity is likely to be impacted from

[73] *Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability, IPCC*

climate change extremes such as increased frequency and intensity of droughts and/or flooding. The IPCC also projects an impact of temperature on yield of rice. Simulation indicates that in low-latitude regions a moderate increase of temperature is likely to have negative impacts on yield for major agricultural variety. Increase in temperature shortens crop duration, enhance respiration and reduce time for radiation interception thereby reducing the yield. For temperature increases more than 3°C, average impacts are stressful to all crops assessed and to all regions. Since rice is the major agricultural produce in the region an analysis of the yield under different temperature scenario is established.

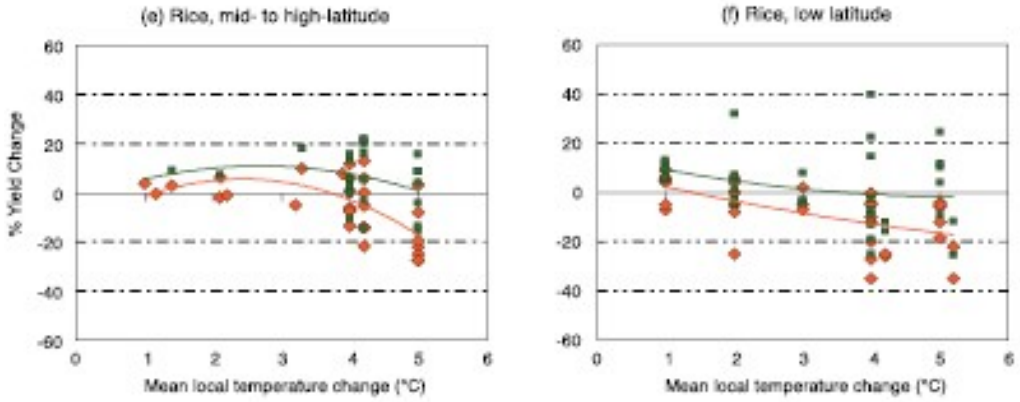


Figure 18: Variation in Agricultural yield with mean temperature

As per the research study (Sinha and Swaminathan (1991)) for 2°C rise in temperature, rice yield is likely to decrease by 0.75 tonne/hectare in high-yielding regions and by about 0.06 tone/hectare in low-yield coastal regions. Moreover since the union territory is coast lying, incidence of extreme events are likely to further exacerbate by the loss of cultivated land because of inundation and coastal erosion. Any negative variation in agricultural yield is likely to exacerbate the current stressed condition of food insecurity and loss of livelihood.
Puducherry has very few numbers of people under BPL (below poverty line) in rural areas (20.55 percent) than urban (22.11 per cent) areas. If we Compare with all India statistics (26.10 per cent) proportion of BPL is slightly lesser (21.67)[74]. According to food deficiency ratio the UT has no food insecurity.

The third assessment report has indicated negative impact on animal productivity because of heat stress. Increase in air temperature and/or humidity has the potential to affect conception rates of domestic animals which are not adapted to those conditions. This is particularly the case for cattle, in which the primary breeding season occurs in the spring and summer months[75]. Moreover climate extremes might result in catastrophic losses in the confined cattle feedlots.

Climate Change and increasing temperature are driving marine ecosystem towards unusual conditions, with an associated risk of fundamental and irreversible ecological

[74] *State development report 2010, academic foundation,*
[75] *IPCC Fourth Assessment Report: Climate Change 2007*

transformation. As per FAO report though there is a global improvement in aquaculture, capture production of fish has suffered globally due to its dependence on the productivity of the natural ecosystem where they are based. They are therefore vulnerable to changes in primary production and this production is transferred through the aquatic food chain[76]. The stress is likely to exacerbate due to:

i) increased temperature and oxygen demand and increased acidity (lower pH)
ii) increased frequency of disease and toxic events

Moreover fish spawning are especially sensitive to temperature and several species of marine fish are known to spawn only at a particular water temperature. Climatic changes have already affected the availability, behaviour and distribution of some commercial fish.

8.5. Review of Programmes and Policies in the sector

Forest Department in Puducherry came into existence during 1997. To achieve the objectives the Department has implemented various schemes namely

- Social Forestry, Forestry Extension and Implementation of Improved Technologies
- Protection, Preservation, Conservation and Development of Forests and Wildlife in the Union Territory,
- Coastal Shelter Belt and Sand Dune Stabilisation.

The first scheme aims at afforestation both by means of departmental plantations over available wastelands and by distribution of seedlings.

The second scheme aims at increasing yield of agro forestry crops by providing improved inputs and knowhow to farmers.

The scheme provides for law enforcement activities.

The UT has one major project titled "Rehabilitation of livelihood of coastal communities in Tsunami affected areas of Puducherry through forestry" worth INR 77.50million (approx). The project aims at providing employment and income generating opportunities to the Tsunami affected village communities through setting up of nurseries and extensive planting of indigenous trees and mangrove species. It also aims at establishment of micro enterprises like Mushroom production, Vermi-compost production etc. and create coastal plantations of indigenous Tropical Dry Evergreen Forest (TDEF**)** species in combination with Casuarina as green protective barriers and restore the existing mangroves in the intertidal areas and estuary mouths by helping the natural re-growth by protecting mangroves from being damaged by people and establish new mangroves in possible areas.

Under the National Action Plan on Climate Change (NAPCC),the Green India Mission (GIM) aims to respond to climate change with a combination of adaptation and mitigation measures, which would help

1) Enhancing carbon sinks in sustainably managed forests and other ecosystems
2) Enhancing adaptability of vulnerable species/ecosystems to the changing climate
3) Enhancing adaptability of forest-dependent communities

[76] *IPCC Fourth Assessment Report: Climate Change 2007*

To achieve the above goals the following objectives are developed under the Green India Mission:

1. Increased forest/tree cover on 5 m ha of forest/non-forest landsand improvedquality of forest cover on another5 m ha(atotal of 10 m ha)
2. Improved ecosystem services including biodiversity, hydrological services and carbon sequestration as aresult of treatment of 10 m ha.
3. Increased forest-based livelihood income for 3 million forest dependent households
4. Enhanced annual CO_2 sequestration of 50-60 million tonnes by the year 2020

In line with the above objective the UT has also developed some objectives as a measure of climate change mitigation and adaptation. These are:

1) Greening Puducherry through Afforestation and reforestation
2) Improvement of Ecosystem services and to enhance carbon sequestration in Puducherry the UT has identified some research study on biodiversity, hydrological services, carbon sequestration etc. they have also decided to implement the measures as a pilot project.
3) To increase the forest based livelihood income the UT has identified some villages to implement Joint Forest management. Through Joint Forest management massive people's movement (with involvement of women) would be undertaken and this would create employment opportunities especially for landless poor.

To achieve the above objectives the UT has identified the following actions, which is necessary for Puducherry green mission as climate change mitigation and adaptation measures.

Table 49: Policies/programmes promoting sustainable development in agriculture sector[77]

Policy/programme	Features
National Policy on Agriculture	Attain output growth rate in excess of 4% per annum based on efficient use of resources
Integrated Watershed Management Programme	Restore ecological balance by harnessing, conserving, and developing degraded natural resources such as soil, vegetative cover, and water
National Watershed Development Project for Rainfed Areas	Sustainable management of natural resources, enhancement of agricultural production, restoration of ecological balance in the degraded and fragile rain-fed ecosystems, reduction in regional disparity between irrigated and rain-fed areas, and creation of sustained employment opportunities for the rural community including the landless
Rashtriya Krishi Vikas Yojana	Assists states/UT in the development and implementation of district-level agricultural plans (based on local agro-climatic conditions) and bring about quantifiable changes in the production and productivity of various components of agriculture and allied sectors

[77] *IndiaSecond National Communication tothe United Nations Framework Conventionon Climate Change, Ministry of Environment & ForestsGovernment of India2012*

National Food Security Mission	Aims at increasing production of rice, wheat, and pulses through area expansion and productivity enhancement in a sustainable manner; restoring soil fertility and productivity at the individual farm level
National Project on Organic Farming	Aims to promote production, promotion, and market development of organic farming in the country
Micro Irrigation Scheme	Increase the area under efficient methods of irrigation like drip and sprinkler irrigation
Weather Based Crop Insurance Scheme	Aims to mitigate against the likelihood of financial loss on account of anticipated crop loss resulting from incidence of adverse conditions
National Horticulture Mission	To provide holistic growth of horticulture sector through regionally differentiated strategies
National Project on Management of Soil Health and Fertility	Facilitate and promote Integrated Nutrient Management (INM)through judicious use of chemical fertilizers in conjunction with organic manures and bio-fertilizers

8.6. Key Priorities

Key priorities are framed to reduce the climate change stress on the sector and enhance the adaptive capacity as well as resilience of the sector and livelihood of the people dependent on the sector.

Key Priorities: Mission for a Green Puducherry& Sustainable Agriculture
1. *Enhancing productivity through introduction of genetically superior seedlings*
2. *Eco-restoration of coastal areas by bio shelter plantations*
3. *Wildlife and biodiversity conservation by insitu & exsitu methods*
4. *Enrichment of existing forest density*
5. *Promotion of farm forestry and agro forestry*
6. *Consolidationand protection of forests*
7. *Watershed development through vegetative means*
8. *Development of ecotourism and involving local communities*
9. *Identification and propagation of adaptive species through modern nurseries*
10. *Study on REDD & REDD + Feasibility for Afforestation in Puducherry*
11. *Capacity building of staff*
12. *Protection of Mangrove forests*
13. *Monitoring critical faunal habitats [turtles/ littoral birds]to assess impact of climate change*
14. *Drip Irrigation for 30% of land area under Horticulture*
15. *Promotion of solar pumps for irrigation purpose by replacing 5 nos. diesel pumps with solar pumps*
16. *Educating farmers on better cropping systems, drought resistance crop, minimization of chemical fertilizer and encouraging organic farming and soil reclamation program*
17. *Replacing existing pumps by foot valve motor pumps in Karaikal region*

1. Enhancing productivity through introduction of genetically superior seedlings

The forest sector plays a crucial role in climate change adaptation and mitigation.In silvicultural research, the department already emphasised on rejuvenation of degraded uplands, stress sites. To improve tree growth and genetic resources, eco-restoration of degraded forests, production of genetically superior fast growing species, the UT wants to introduce genetically superior seedlings in Puducherry. Development of seed bank and survey of forest genetic resources is necessary for the purpose.

2. Eco-restoration of coastal areas by bio shelter plantations

To strengthen Resilience of the local coastal communities Bio-shield establishment is necessary in the disaster prone coastal districts of Puducherry. Plantation of adaptable mangroves species and other tree species act as a bio-shield, for preventing the coastal erosion and damage to infrastructure and loss of life by reducing the force of the winds and waves passing through them. Thus Bio-shield will reduce the inland damage from these destructive forces of nature. The UT would identifythe Panchayats for the implementation. The UT wants to develop a policy on Bio-shield and implement this activity as an effective disaster risk reduction management.

3. Wildlife and biodiversity conservation by insitu & exsitu methods

Climate change has significant effects on species and ecosystems around the world. These are shifting of species distribution, changing phenology of particular species, effects on wildlife demographic rates,direct loss of habitat due to sea-level rise, increase in wildlife disease, extinction of isolated species and populations,increased spread of invasive or non-native species, including plants, animals, and pathogens.To reduce these impacts of climate change on wildlife, the UT has decided to do some research study and implementation on wildlife and biodiversity.

4. Enrichment of existing forest density

Forest regeneration is the process of enrichment of tree density by establishing young trees naturally or artificially, which includes practices such as changes in tree plant density through human-assisted natural regeneration, enrichment planting, reduced grazing of forest land, and changes in tree species. This activity would influence carbon storage in forest through changes in the growth of aboveground and below-ground tree biomass and changes in end use of wood. In this context the UT wants to enrich their forest as carbon sink for climate change mitigation activity.

5. Promotion of farm forestry and agro forestry

As one of the carbon sequestration strategy, Agro forestry provides multiple benefits to the livelihood of farmers and provide fuel wood, which can reduce deforestation and as a consequence it has a huge potential to contribute to climate change mitigation.It is seen that at the local level implementation of agro forestry and farm forestry faces significant challenges. In this context, as a climate change mitigation strategy the UT wants to develop a field-based supportive policiy and incentive mechanism suitable for small scale farmers for promotion of agro forestry and farm forestry and the incorporation of trees in agricultural landscapes.

6. Consolidationand protection of forests

The rapid pace of urbanization in Puducherry and in other districts is leading to shrinkage of open spaces. In this context, the UT is proposing for consolidation of forest lands within the urban areas and semi-urban areas as a climate change mitigation and adaptation strategy.Survey and demarcation of forest areas in Puducherry is important for

consolidation, conservation, protection and management of forests. Forest fire is another major threat for growing stock as well as standing forests.

7. Watershed development through vegetative means

Integrated Watershed Management is an effective approach in supplementing water supply through conservation of rainwater in dry and arid farming systems.Considering the potentiality of integrated watershed Management as an adaptation and mitigation option, which can attempt to strengthen the programme and expand its scope manifold is more important than before. Through Watershed Management Programme the government wants to identify the vulnerable regions to enable priority setting and highlight the adaptation, mitigation strategy of UT.

8. Development of ecotourism and involving local communities

Climate change is an issue that will substantially impact ecotourism and nature-based tourism. The community involvement in eco-tourism began with a focus on rejuvenation of degraded forests.Eco-tourism – is one of the new concepts emerged as an initiative to involve local people to ensure biodiversity conservation. The involvement of local communities not only benefits the community and the environment but also improves the tourist experience. In Puducherry UT, all the four districts have the greattourism potential in uninterrupted and somewhere virgin beach stretches all along its boundary. As a climate change mitigation activity the UT has planned to enhance the tourism through a sustainable participatory model of eco-tourism development.

9. Identification and propagation of adaptive species through modern nurseries

The UT wants to establish some nurseries for preparing climate adaptable speciesby using advanced technology and also wants to plant a much wider variety of species than they are currently planting, and nurseries would prepare for facilitating management responses to climate change by incorporating climate change into their planning. Under this activity some root trainer and clonal nurseries would be established in different climatic zones. The seedlings produced would be utilized for plantations in the land under forest Department and the surplus seedlings would be sold to the public.

10. Study on REDD & REDD + Feasibility for Afforestation in Puducherry

As per IPCC report Deforestation and forest degradation is contributing approximately 15-17% of all greenhouse gases. There will be very minimal cost-efficient solution to climate change in the forestry sector. REDD+ stands for Reducing Emissions from Deforestation and Forest Degradation; the 'plus' denotes the conservation of forests, enhancement of forest carbon stocks and sustainable management of forests. To create a low carbon economy, and ensure sustainable development in the forestry sector the department wants to do a feasibility study on REDD and REDD +. Through this effort the government can get a financial value for the carbon stored in forests.

11. Capacity building of staff

To reduce climate change impact of field implementation of forestry operations, capacity building of forest personnel is one of the major components of climate change action plan. This will also bring good understanding in processing of projects and research work. With the infrastructural advancement capacity development of the frontline staff, field staff and those involved in forestry and wildlife sector is necessary. The training should be given on new nursery techniques, plantation technology, monitoring through GIS/MIS, community organizing, livelihood generation activities etc. so that the department is able to fulfil the livelihood needs of the people.

12. Protection of Mangrove forests

Mangroves have regional and site-specific functions. Based on available evidence around the world, out of all the climate change impacts, relative sea-level rise may be the greatest threat to mangroves. Degradation and deforestation of mangrove forest will increase the threat to human safety and shoreline development from coastal hazards such as erosion, flooding, storm waves and surges, and tsunami, as observed in 2004 at Puducherry.Mangrove destruction can also release huge quantities of stored carbon and exacerbate global warming and other climate change trends.So department of Forest and wildlife, Government of Puducherry wants to develop and protect mangrove forest for reducing the climate change impact.

13. Monitoring critical faunal habitats [turtles/ littoral birds]to assess impact of climate change

Anthropogenic global climate change has deep implications on the survival and productivity of faunal populations, communities and ecosystems. A sea level rise of only 50cm could cause sea turtles to lose their nesting beaches. Since the UT Puducherry has long beaches and is used by turtles during the nesting season,it would be affected. The UT has realized the need for monitoring of fauna where dramatic changes in abundance, distribution and timing are expected.

14. Drip Irrigation for 30% of land area under Horticultureby 2013 and 50% by 2015

Drip irrigation system delivers water to the roots of the crops which helps to boost crop yields while using much less water than traditional flooding of fields. Due to climate change and the rain pattern disturbances, farmers are facing difficulties to estimate the proper time for plantation. Drip irrigation can supply the water needed by the crop, reducing potential negative impacts of drought, which is normally the most important climate risk in agricultural production. The system has efficiency to the order of 95%. Therefore, very little water is wasted and less water is required to produce crops compared to other irrigation methods. This is important during drought periods when water availability is limited. When compared to dry land farming, irrigation can significantly increase and stabilize crop yields and farm income from season to season, reducing farming risk. Crop yield can be increased or less water can yield more quantity, which increases farm profits while protecting the environment.

15. Promotion of solar pumps for irrigation purpose by replacing 5 nos. diesel pumps with solar pumps

Agriculture sector ranks third in terms of per capita energy consumption with per capita electricity consumption at 9,248 kWh. Irrigation pumps in agriculture sector are normally run by diesel and are highly inefficient. Hence, solar pumps can be used to replace inefficient diesel pumps and conserve conventional fuel. The activities to be undertaken are -

i. Pre-feasibility study, identification and selection of project locations
ii. Bankable DPR and proposal preparation
iii. Arrangement and management of project fund for implementation.
iv. Facilitating implementation of 5 nos. 4500 Wp Solar pumps which can replace 5 HP pumps
v. Training to farmers on operation and regular maintenance of the system

16. Educating farmers on better cropping systems, drought resistance crop, minimization of chemical fertilizer and encouraging organic farming and soil reclamation program

Like most states in India, agriculture is a significant support to the economy of Puducherry. The dependence of agricultural sector on weather conditions and precipitation largely determines its vulnerability. The consequences of climate change like temperature and rainfall fluctuation, higher level of atmospheric carbon dioxide and interaction of similar factors largely governs the productivity of agricultural sector. Thus for sustained productivity, farm based communities should be strengthened to adopt technologically advanced stunts like use of improved varieties of seeds, genetically modified seeds, improved irrigation systems like drip irrigation etc, climate resilient seed varieties, drought resistant crops. They should also be made aware of the influence of the sector on the environment. Minimum use of chemical fertilizers should be ensured to decrease the release of harmful gases like methane, carbon dioxide and nitrous oxide into the atmosphere. The Department of agriculture in collaboration with other private promoters should strive to educate the farmers on the same.

17. Replacing existing pumps by foot valve motor pumps in Karaikal region

Agricultural sector in Union Territory of Puducherry accounts for around 4% of the power requirement. Promotion of energy efficientagricultural pump sets would reduce the overall power consumption, improving performance for ground water extraction and reducing the subsidy burden on the UT without sacrificing the service obligation. It can also help in creating access to subsidies for electricity conservation for beneficiary farmers (estimated 30-40%) with replacement of inefficient pump sets with energy efficient ones. Implementation of the action plan is planned through following sub activities:

(i) Preparation of scheme to provide with financial incentive to farmers on use of energy efficient agricultural pumps
(ii) Replacement of inefficient agricultural pumps with improved ones

Key priorities

Table 50: Key priority action list for Green Puducherry& Sustainable Agriculture

Sl. No.	Title	Organizations	Budget (in Million INR)			Source of funding
			Existing	Additional	Total	
1	Enhancing productivity through introduction of genetically superior seedlings	Dept. of F&WL[78]	Nil	5.00	5.00	GoI[79], GoPY[80], EFA [81]
2	Eco-restoration of coastal areas by bio shelter plantations(Area= 20 Ha)	Dept. of F&WL	Nil	6.00	6.00	GoI, GoPY, EFA
3	Wildlife and biodiversity conservation by Insitu &exsitu methods	Dept. of F&WL	Nil	0.25	0.25	GoI, GoPY, EFA
4	Enrichment of existing forest densityArea =20 ha	Dept. of F&WL	Nil	0.40	0.40	GoI, GoPY, EFA
5	Promotion of farm forestry and agro forestry Area = 50 ha	Dept. of F&WL	Nil	2.50	2.50	GoI, GoPY, EFA
6	Consolidationand protection of forests (10million in each year)	Dept. of F&WL	Nil	50.00	50.00	GoI, GoPY, EFA
7	Water shed development through vegetative means	Dept. of F&WL	Nil	2.00	2.00	GoI, GoPY, EFA
8	Development of ecotourism and involving local communities	Dept. of F&WL	Nil	1.00	1.00	GoI, GoPY, EFA
9	Identification and propagation of adaptive species through modern nurseries	Dept. of F&WL	Nil	4.00	4.00	GoI, GoPY, EFA
10	Study on REED & REED +feasibility for afforestation in Puducherry	Dept. of F&WL	Nil	10.00	10.00	GoI, GoPY, EFA
11	Capacity building of staff	Dept. of F&WL	Nil	5.00	5.00	GoI, GoPY, EFA
12	Protection of Mangrove forests	Dept. of F&WL	Nil	15.00	15.00	GoI, GoPY, EFA
13	Monitoring critical faunal habitats [turtles/ littoral birds]to assess impact of climate change	Dept. of F&WL	Nil	3.00	3.00	GoI, GoPY, EFA
14	Drip Irrigation for 30% of land area under Horticultureby 2013 and 50% by 2015	Dept. of Agri, KVK	Nil	40.00	40.00	GoI, GoPY, EFA

[78] F&WL: Forest and Wild Life
[79] GoI : Government of India
[80] GoPY: Government of Puducherry
[81] EFA: External Funding Agencies

Sl. No.	Title	Organizations	Budget (in Million INR)			Source of funding
			Existing	Additional	Total	
15	Promotion of solar pumps for irrigation purpose by replacing 5 nos. diesel pumps with solar pumps	REAP, Dept. of Agri	Nil	2.00	2.00	GoI, GoPY, EFA
16	Educating farmers on better cropping systems, drought resistance crop, minimization of chemical fertilizer and encouraging organic farming and soil reclamation programme	Dept. of Agri	Nil	10.00	10.00	GoI, GoPY, EFA
17	Replacing existing pumps by foot valve motor pumps in Karaikal region	Dept. of Agri, REAP, Electricity Dept.	Nil	150.00	150.00	GoI, GoPY, EFA
Total Budget (in Million INR)			**Nil**	**306.15**	**306.15**	

9. Water Mission

9.1. Introduction

Despite being endowed with favorable rainfall, plentiful water resources, substantial ground water reserves, Puducherry like many other states and UTs does not have a rational water policy.National Water Policy 1987 and the draft policy of 2002 are in place.However these policies are not in full alignment here in the UT. The water resources continue to be undervalued and overused without regard to current costs and future requirements. Traits of growing economy like urbanization and industrialization are taking toll on the water bodies causing large scale pollution. As far as the level of urbanizationis concerned, Puducherry ranks 5th with 68.31% of urban population. The percentage of urban of urban population increased from 66.57% in 2001 Census to 68.31% in 2011. As per Census of India 2011, the following are the Urban Agglomeration and Towns in the Union Territory of Puducherry. The 100% urbanization is registered in Yanam and Mahe districts which are entirely urban followed by Puducherry and Karaikal.

Table 51: Urban Agglomerations & Outgrowths in Puducherry UT (2001-2011)[82]

Year	2001	2011
Urban Agglomerations	1	2
Outgrowths	19	1

The major deterrent for effective water management in Puducherry is the diversity and variation in water use patterns in all four distinct regions: Puducherry, Karaikal, Mahe and Yanam. Demand of water for domestic needs, livelihood, industrial and agricultural use; have certainly led to unplanned and over-extraction of ground water. Neglect of tanks and water bodies, discharge of effluents, contaminated water from hatcheries has caused water pollution which has gradually snowballed into severe water resource problems in the UT.
Added to the burden of rapid and unplanned urbanization, the consequences of climate change are manifested through variability in river flow, increased frequency and intensity of natural weather events, ground water table depletion in alluvial aquifers due to variation in rainfall.

Precipitation contributes majorly to ground water recharge and the surface water reserves of a region. A part of rainfall received in an area, is lost through evapotranspiration, the rest contributes to the surface water reserve while the remaining percolates through the soil levels and accumulates in the alluvial aquifers acting as a ground water recharge source. Thus lesser rainfall intensity impacts recharge of ground water table whereas higher rainfall leads to higher runoff into the water bodies thereby polluting them.

Health of water resources is essential for the economic prosperity of Puducherry, since the major livelihood forms of the UT like fishery and agriculture depends largely on water resources large. Irrigation alone accounts for 83% of the water consumption in the UT.
National Water mission established under National Action plan on Climate Change is designed to ensure conservation of water, minimizing wastage and ensuring more equitable distribution both across and within UT through integrated water resources management.

[82]Census of India, 2011

Promotion of integrated basin level water resources management (Basin Level management strategies are planned to deal with variability in rainfall and water flows), increasing water use efficiency by 20%.Focusing attention on vulnerable areas including over exploited areas and water conservation are few designed initiative under the programme. The mission envisages tooptimize the efficiency of existing irrigation system including rehabilitation of system that has been run down and also to expand irrigation with special efforts to increase storage capacity. Initiatives to reduce fresh water use in urban areas are also planned under the mission. Since water is a UT's subject, the plans and programmes under the mission to be executed fall under the purview of the UT government. It is therefore important that the key priorities proposed under National Water mission are consistent with the UT's plan.
The key priorities are therefore strategized considering the national plan and UT's policies towards meeting up the overall objective of the Climate Change Action Plan.

9.2. Key Trends in the sector

The Union Territory of Puducherry consists of four constituent regions –Puducherry, Karaikal, Mahe and Yanam.Although all the four regions are coastal location, issues related to water resources in each of these regions are different because of the regional variation in water usage pattern. All the villages and towns in the Union Territory of Puducherry are connected with potable water supply.Puducherry region relies totally on ground water resource. Karaikal, Mahe and Yanam regions depend both on surface and ground water.
The UT is mainly dependent upon groundwater for agriculture. The groundwater potential in the Puducherry region is shown in the figure below.

Figure 19: Ground water resources

In some places of Puducherry region tank irrigation (Ousteri & Bahour tanks) is popular. These tanks are in turn fed by Gingee and Pennaiyar rivers. In Karaikal region during favourable monsoon years Cauvery water is available for irrigation. For industrial use the

main source of water supply is ground water. Puducherry Pollution Control Committee (PPCC) is encouraging adoption of zero discharge technology to minimize wastewater discharge and promote recycling/ reuse of the treated wastewater.

9.2.1. Surface water

The two major rivers draining this region are:

(1) The Gingee River, which traverses the region diagonally from North-west to South-east

(2) The Ponnaiyar River, which forms the southern border of the region

Table 52: Source of Surface water

Region	Source of Surface Water
Puducherry	Tanks (86 small and medium tanks in Puducherry region of total capacity 46.36 MCM, which are serving about 6764.6 Ha),ponds and small rivers like Sankaraparani, Pambayar, Malattar, Penniar
Karaikal	Arasalar and distributaries of Cauvery
Yanam	Gouthami
Mahe	Mahe

Water supply system is divided into two major systems namely, the Urban Water Supply and the Rural Water Supply. Under the Urban Water Supply, every urban population receives 135 litre of purified water per head per day. The Urban Water Supply covers a total population of 0.648 million according to 2001 census. About 87.50 million litre of water per day is supplied to the urban population. The Urban Water Supply system consists of Over Head Tanks, Ground Level Reservoirs and well designed distribution grid system as per CPHEEO norms. Under the Rural Water Supply, every rural household receives 70 litre of purified water per head per day. The total number of villages covered is 92 with population coverage of 0.326 million. The increase in rural population led to demand for more water.

Table 53: Tanks in Puducherry region[83]

Sl. No.	Commune/ Municipality	System tanks	Non system tanks	Total Number of tanks	Command area in Ha
1	Puducherry	2	0	2	230.80
2	Ozhukarai	0	2	2	589.80
3	Villianur	4	11	15	1,399.20
4	Mannadipet	19	8	27	1,291.70
5	Nettapakkam	11	4	15	976.00
6	Bahour	22	0	22	1,784.20
7	Ariankuppam	1	0	1	320.90
	Total	59	25	84	6,592.60

[83]*Dhan Foundation (2002).*

Table 54: Ponds in Puducherry region[84]

Sl. No.	Name of Taluk	No. of Ponds
1	Bahour sub taluk	173
2	Puducherry taluk	174
3	Villianur sub taluk	151
	Total	498

9.2.2. Ground Water

Puducherry is endowed with substantial groundwater resources. The utilisable ground water resources (at 85% of the gross recharge potential) are assessed at 151 MCM. Since alluvial aquifers cover about 90% of the Puducherry region, water level in the wells is fairly shallow ranging between 12 to 14 m below ground level. In the tank command areas alone there are 70-80 shallow wells and around 1,000 tube wells. Overall, there are some 8,000 tube wells in the Puducherry region which extract water for agriculture, industry and domestic purposes.

Table 55: Ground water resources[85]

Total Replenishable Ground water resources (in MCM)	174.60
Provision for domestic, industrial & other sources (in MCM)	26.20
Available for Irrigation (in MCM)	148.40
Projected Net draft (in MCM)	115.50
Balance for future use (in MCM)	32.90
Level of Ground water development (in %)	77.85%

The total annual availability of water for all uses in the Puducherry region is about 200 MCM per year. Annual per capita availability is roughly 200 cu.m per person which indicates that the Puducherry region is an area of water scarcity.

Table 56: Total annual Water requirement for various sectors (in 2020)[86]

Agricultural Use	150 MCM	74%
Industrial Use	20 MCM	10%
Domestic Use	33 MCM	16%
Total	203 MCM	100%

The total availability of 200 MCM is likely to be fully utilised by 2020, and some of the water currently used in agriculture will have to be diverted for domestic and industrial use. Furthermore, some of the coastal aquifers will have to be artificially recharged to prevent the wall of seawater from moving further in.There will also be a loss of availability of water, particularly for drinking due to the salinity in the ground water in the coastal areas. The Puducherry region is therefore likely to face serious water shortages in the next two decades.

[84]*Dhan Foundation (2002).*
[85]Central Groundwater Board, (CGWB)
[86]Dhan Foundation (2002).

9.2.3. Rainfall & Climate

The region receives rain under the influence of both southwest and northeast monsoons. Most of the precipitation occurs in the form of cyclonic storm caused due to depressions in Bay of Bengal chiefly during Northeast monsoon period. Rainfall data analysis shows that the normal annual rainfall in the Puducherry region is 1,272.7 mm. 62% of the annual normal is received during northeast monsoon season and about 26% during the southwest monsoon season, with November being the rainiest month.The heaviest rainfall in 24hours recorded in Puducherry was 167.0 mm on 23rdOctober 1990.

The region enjoys a hot and tropical climate characterized by little variation of temperature along with humid weather. The summer season, which is very oppressive, extends from March to May. From January till end of February is comparatively cooler. The relative humidity is generally high, around 80% during October to April. The minimum hovers around 70 to 73% in June and July. Winds are moderately strong throughout the year, except during the months from July to October. During May to September, south westerly blows in the mornings. May and early part of June constitute the hottest period of the year, with the mean daily maximum temperature of about 37°C and the mean daily minimum temperature of about 27°C. On individual days, the maximum temperature may even reach 43°C. The lowest temperature recorded is of the order of 11.1°C.

9.3. Vulnerability of the sector

The physiographic map of the area shows a more or less flat land with an average elevation of about 15 m above MSL Puducherry's average elevation is at sea level, and a number of sea inlets, referred to as "backwaters" are present. Erratic rainfall patterns are expected to cause significant changes with global warming in near futures. Highly erratic and concentrated rainfalls lead to high levels of surface run-off. Monsoons will be even less reliable and excessive runoff, thus reducing the groundwater recharge potentials. Also increase in rainfall is likely to increase occurrence of flood and might impact livelihood sectors like agriculture and tourism to a great extent. Increase in temperature rise will result in excessive evaporation from soils and surface water reservoirs. It is projected that soil moisture will increase by 15-20% over southern India during monsoon, but decline throughout the rest of the year *(Lal and Singh 2001).* At the same time, water requirement of plants are expected to increase with rising temperatures. The general impact of increase in precipitation is reflected in the increase in sediment yield also. The other major factors that enhance sediment yield are the intensity of rainfall, land use and soil type of the area.

9.3.1. Floods

Proper drainage systems are not in place during flood season. The French designed rain water / flood drainage system, as a result of encroachment by different sections, has shrunk. During extreme rainfall or rainfall resulting from cyclonic activities leads to the flooding of the coastal settlements of Puducherry UT. The signs of climate change at present are mainly visible through rise in temperature or increase or decrease in rainfall. Also frequent shower makes urban living highly vulnerable to floods and cyclones.

9.3.2. Cyclones

Puducherry and Karaikal regions are exposed to cyclones and floods. The coast of Puducherry and Karaikal are affected by westerly and northwesterly cyclones originating from Bay of Bengal. The highest and lowest wind speed recorded across Puducherry is 189 km/hr and 83 km/hr respectively.

Projected changes in climate are likely to make the climate sensitive sectors of the Union Territory and livelihoods of its inhabitants more vulnerable in future. Continuing climate variation is predicted to alter the sectoral growth, including the ability of the poor to engage in farm and non-farm sector activities. The direct impacts of extreme climate-induced events could include loss of life, livelihoods, assets and infrastructure. Climate Change, if left unchecked has the potential to disrupt the sustainable growth of the Union Territory and ruin the livelihood and security of its population.

9.4. Key issues

The issues related to the water resources are considered the vital indicators for assessment of the living condition in an identified geographical area.

9.4.1. Ground Water Depletion

The excessive extraction of ground water has caused a drop in the water table at a number of locations such as Katterikuppam, Krishnapuram, Sorapet and Ariyur.The declining trend over last decade is of the order of 15 to 30 m in the west and about 7 m in the eastern part of Puducherry.Urban sprawl has also contributed to lower recharge through reduction of vegetation cover and wetlands.In the agricultural areas, open wells are now replaced by tube wells with submersible pump sets.Extraction has gone to 35-50 m and up to 100 m in some places. A regular decline in the water table level clearly indicates uses exceeding recharge i.e. there is unsustainable extraction of groundwater. This situation can be reversed by either ensuring greater storage for recharge or by decreasing the amount extracted.

9.4.2. Seawater Intrusion

Coastal aquifers of the Puducherry UT constitute an important source of fresh water supply but are often confronted with the problem of seawater intrusion.South-westernside of the study area near Ponnaiyar river andmouth of the creeks (near Ariyankuppam river andMalatar) are affected by seawater intrusion. This cause the unavailability of ground water for domestic usage as the salt content with respect to the drinking water standards becomes too high for use.Excessive extraction of groundwater in coastal areas also creates pressure in the form of saltwater intrusion.In a coastal region like Puducherry, groundwater is vulnerable to sea water ingression. The shallow aquifers along the coast show signs of salinity.Due to over pumping, there has been a reversal of gradient in certain areas like Kalapet, Muthialpet, Mudaliarpet, Kirumambakkam, and Panithittu. Salt water has intruded up to 5 to 7 km from the coast.Any further extraction of groundwater has to be done only beyond this distance.

9.4.3. Sewage Pollution

Puducherry generates a huge amount of sewage which is dispensed through irrigation canal acting as the main sewer. About 30% of the municipal area does not have proper drainage system. Most of the sewage reaches the sea without treatment and the urban waterways,

tanks and ponds have become severely polluted. Lack of sanitation facilities and improper disposal of human and animal wastes contribute to poor surface water quality and thus lead to spread of water borne diseases.

9.4.4. Industrial Pollution

Surface water and ground water have been affected by industrial pollution. The wastes generated from Mettupalayam industrial estate have contaminated the surrounding ground water with heavy metals, salts and fluoride. Ground water in Pillayarkuppam – Kirumambakkam has also been contaminated with heavy metals. Liquid effluents, generated from certain industries may contain toxic pollutants.

All the four regions of the Union Territory are coastal areas with relatively good rainfall and shallow groundwater. Thus rainwater harvesting and other measures for ground water recharge are well feasible. Despite high rainfall, Mahe is facing serious drinking water problems. Mahe gets its drinking water supply from a dedicated pipeline provided by the Kerala Water Authority but funded by the Union Territory.Rainwater and roof water harvesting systems should be encouraged in Mahe to augment the local ground water level. Karaikal is located in the deltaic region of the Cauvery, and is dependent on the releases of water in to the river. De-silting of ponds and feeder canals is to be undertaken. Yanam is located on the delta of Godavari and could receive surplus flows from the river.Water quality monitoring is to be taken up at Mahe and Yanam. The water problems of Karaikal and Yanam are not as serious as those in the Puducherry and Mahe.

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

Table 57: Adaptation Pathways with respect to climate change in UT

Issues	Impact	Pathways
Higher variability in monsoon	Landslide, affecting systematic crop planning	Diversification of cultivars, improved soil-water management practices,
Higher Precipitation and Evapo-transpiration	Climate change extremes like flood, impact on agricultural production	Improvising Disaster management technique, capacity building of the communities
Reduction water quality due to heavy siltation downstream	Water-logging, uneven hydrology and diseasesand pest incidence	Integrated water resource management; Payment for eco-system services or lost bio-diversity, requisite compensation mechanism and green cover in buffer areas of the mines and sustainable mine closure plan

9.5. Programmes and policies

The National Water Policy 1987 was reviewed and updated by the Ministry of Water Resources and the revised policy titled 'National Water Policy 2002' was adopted in the 5thMeeting of the National Water Resources Council held on 1stApril 2002. Subsequently, draft National Water Policy, 2012was unveiled during January 2012 and as recommended by National Water Board in its 14thMeeting held on 7thJune, 2012.Revised draft National Water Policy, 2012 was released by the Ministry of Water Resources, Government of India.

In line with the draft National Water Policy, 2012, Government of Puducherry has decided to formulate a Water Policy for the UT with an operational action plan in order to achieve the desired objectives.

9.5.1. Integrated Scheme for Development, Harvesting, Recharging and Conservation of Ground Water (BNP)

In order to meet the rapid increase in the demand of water for various purposes, achieve the goal of optimal use and sustainability and to derive maximum benefits through development, storage, conservation, distribution and reuse, water resource development has become imperative. This scheme has been implemented through the Department of Agriculture. This can be achieved by implementing a comprehensive integrated scheme with the following objectives:-

(i) *Rainwater harvesting and recharging ground water*
(ii) *Water conservation and Management*
(iii) *Construction of rain water harvesting structures like mini lakes and ponds in Karaikal region*
(iv) *Assessment of ground water potential and monitoring of ground water quality*
(v) *Stabilization of irrigation command To regulate the exploitation of ground water in the Union Territory of Puducherry, the "Puducherry Ground Water Authority" will be created during 2004 under the Puducherry Ground Water (Control and Regulation), Act 2002.*

9.5.2. Hydrology Project Phase-II with World Bank Loan Assistance (EAP)

The Government of Puducherry through its Project Implementing Agency (PIA) is implementing a project titled 'Hydrology Project Phase-II" with loan assistance of World Bank since the year 2005-06 with an outlay of Rs. 131.8 million and for a period of 6 years. The main objective of the project is to create water information system comprising exhaustive information on surface water, groundwater and hydrometeorology data along with water quality for better water resources planning in future. State of the art data center and a Level-II plus laboratory for water quality analysis are to be established under the project. Besides, full climatic stations and network of observation tube wells and current meters across the rivers for measurements of surface water flow are to be established at strategic locations and data to be generated from this observation points are to be computerized in a standardized format. The project is under inception stage and funds for the project are being provided from the Minor Irrigation sector. For the sake of sustainability of the project, funds would have to be provided as grant-in-aid after completion of the project during the year 2011. By implementing all the above programmes, the dependence

on ground water would be reduced, and water table would facilitate efficient irrigation for sustained agricultural production and generation of higher farm income.

9.5.3. Union Territory of Puducherry Hydrology Organization (UTOPHO)

The Hydrology Project under implementationby Department of Agriculture, which ended by June 2012, will continue under a separate organization 'Union Territory of Puducherry Hydrology Organization' (UTOPHO) which was created under Societies Registration Act. The organization would involve creation of an exhaustive water information system and creation of a Decision Support System (DSS) for better future water resources planning and management in Puducherry. Additionally, the society would take up research studies on the augmentation of water resources of Puducherry in an intensive scale.

9.5.4. Accelerated Rural Water Supply Programme

The Accelerated Rural Water Supply Programme (ARWSP) was introduced in 1972-73 by the Government of India to assist the States and Union Territories (UTs) to accelerate the pace of coverage of drinking water supply.The Central Government supplements the efforts of the State/UT by providing assistance under this programme for providing drinking water to all. Powers have been delegated to the States/UT to plan, sanction and implement the schemes. Apart from the 55,067 villages, 0.28 million villages which have been estimated by the Planning Commission as slipped-back villages would also be covered under this programme. Factors like lowering of underground water table and degrading quality of water sources are cited as reasons for the slipping back of villages.Special initiatives are also under way for coverage of rural schools with drinking water supply.

9.6. Key Priorities

Water resource management is critical for addressing poverty. Equity issues, perceived conflicts in availability, usage, distribution, intra sectoral and inter sectoral distribution also need to be addressed. The anticipated impacts of climate change are likely to aggravate the challenges and may further jeopardize the poverty reduction efforts. It is, therefore, important to increase the efficiency of water use, explore options to augment water supply in critical areas and ensure more effective water resource management. Therefore, an integrated approach to water management needs to be instituted to also take into account the constraints posed by climate change.

The UT has identified key priorities with high importance and out of those six actions are adaptation activities. The high priorities identified are based on the basis of cost effectiveness, cost-benefit analysis, feasibility, ease of implementation and overall sustainability. Within the Water mission sector, two key priorities are put under the Agriculture sector, two priority actions under Local Administrative Department (LAD) and two under Public Works Department (PWD) and Town & Country Planning. The total budget proposed for the thirteen key priorities along with sub activities is 1,040 Million INR or 104 Crore INR.

Government of Puducherry is acting on climate change issues through national policies via local regulations, urban services and programme administration. The following action points have emerged out of several rounds of discussions among the working group

members under Water Mission. The key priorities have been identified with a focus on conservation of water to meet the rapid increase in demand and consumption along with wastage of water.

Key Priorities: Water Mission
1. *Rain water harvesting pond creation of 10% of land area by 2013 and 50% by pipeline irrigation by 2015*
2. *Desiltation of all the temples and village/ farm ponds by 2015*
3. *Channelising storm water into village pond or ground water recharge by 2015*
4. *Promotion of percolation pits in housing colonies and in urban areas*
5. *Rainwater harvesting for all type of new and existing buildings (Residential, Commercial and Industrial buildings) by 2013 and 2015 respectively*

1. Rain water harvesting pond creation of 10% of land areaby 2013 and 50% by pipeline irrigation by 2015

The water required for irrigation, drinking and industrial purposes in Puducherry region are mainly met from ground water resources. The irrigation water requirement accounts to the order of around 80% of the total consumption for all sectors. The surface water bodies supplement irrigation to some extent. But, the use of tube wells for irrigation has increased from 55% in pre-independence period to 98% at present. Puducherry is facing an alarming situation due to stress on its finite and fragile water resources while sectoral demands are growing rapidly. Due to the excessive load on ground water, there is steep decline of water level in the aquifers up to a depth of 15 to 40 m, which has resulted in seawater intrusion along the coast. Under this activity, construction of ponds has been proposed for rain water harvesting to reduce stress on surface water and also to recharge the depleted ground water. This would result in improvement of storage capacity for ground water, development of surface water by storing rain water during monsoon season which is supplied for irrigation purposes through feeder canals, de-silting and deepening of tanks, ponds and kulams and acquisition of lands for formation of rain water harvesting ponds at various places. Government of Puducherry is planning to utilize about 10% of the irrigation land area by 2013 and 50% by pipeline irrigation by 2015 for this activity and is considered a high importance activity in the climate change context.

2. De-siltation of all the temples and village/ farm ponds by 2015

Ponds are the main water conservation bodies and facilitate irrigation either through surface water flows or by enhancing groundwater recharge. Ponds also support other livelihood activities including fisheries and livestock rearing. These shallow water bodies are abandoned in most of the cases and as a result they are vulnerable to pollution due to shallow depth and distinctive hydrology. Ponds available in Puducherry would be de-silted for rain water harvesting in a phased manner. Recharge wells would be constructed in all the de-silted ponds to increase artificial recharge of the sub-surface aquifers. This activity would restore the existing ponds and other small water bodies and can be utilized for rainwater harvesting. This would also result in water conservation and help in minimizing ground water depletion and environment protection. Therefore the Government of Puducherry is planning to rehabilitate and restore the existing temple ponds and village/farm ponds through de-siltationby 2015. Government of Puducherry is also planning to rehabilitate about 84 identified tanks all over the UT under this activity.

3. Channelizing storm water into village pond or ground water recharge by 2015

Channelizing Storm water to village ponds is one of the preferred options to mitigate the environmental effects of storm water runoff to streams and receiving water bodies. The other option is to use the storm water for ground water recharge thereby minimizing ground water depletion and sea water intrusion. The village ponds can be used as receiving and settling units for the storm water which can be utilized for agricultural activities. This would reduce the water consumption and help to adapt to extreme climatic conditions like draught. Dry ponds are not usually approved because they generally have higher maintenance costs and poorer performance than wet ponds. Ground water recharge has also been planned by the Government of Puducherry considering the depleting level of ground water due to over exploitation and extraction. The ground water in the aquifers is often rendered unusable due to saline water intrusion. Government is making efforts to channelize the storm water to the nearest village ponds and install recharge facilities for better utilizations of the water by 2015.

4. Promotion of percolation pits in housing colonies and in urban areas

Percolation pits, one of the easiest and most effective means of rainwater harvesting, are pits dug generally of dimensions not more than 60 x 60 x 60 cm (designed on the basis of expected runoff as described for settlement tanks), filled with pebbles or brick jelly and river sand, covered with perforated concrete slabs wherever necessary.

Rainwater may be channelized into groundwater aquifers through any suitable structures like dug wells, bore wells, recharge trenches and recharge pits. There are many kinds of recharge structures – some of which promote the percolation of water through soil strata at shallower depth (e.g. recharge trenches, permeable pavements) whereas others which carry water to greater depths from where it joins the groundwater (e.g. recharge wells). At many locations in Puducherry, existing structures like wells, pits and tanks can be modified to recharge structures. In recent years, farm lands have been converted to real estate lands. There is a major shift in land-usage pattern. Agricultural lands utilized for Construction purposes that has adversely affected the water usage for farming and percolation into the ground, Government of Puducherry would promote installations of percolation pits in housing colonies and residential complexes in urban areas to taper the surface runoff from the paved areas and roads as well as overflow from the overhead tanks all throughout the year.

5. Rainwater harvesting for all type of new and existing buildings (Residential, Commercial and Industrial buildings)by 2013 and 2015 respectively

Large scale extraction of ground water beyond the permissible depth in many cases has led to sea water intrusion turning ground water saline. Effluents from many chemical industries licensed and set up early in the region have turned the ground water alkaline and acidic at some places. Along with industrial wastes, Bio-medicalwastes village and urban liquid wastes and solid wastes have aggravated ground water pollution in recent times.

The Puducherry building bye-laws and zoning regulations 1972 have been amended to make rainwater harvesting compulsory for new residential or commercial buildings and educational and health institutions. The amendment was made to meet growing public

demand for water, protect against drought and to ensure reuse or recycling of domestic waste water for appropriate purposes after primary, secondary and tertiary treatment. Government of Puducherry thus planned to formulate policies for providing rainwater harvesting arrangements for all new residential, commercial and Industrial buildings with a rooftop area of more than 100 sq.m. or plot area more than 200 sq.m. in phased manner by 2013 and in existing residential, commercial and Industrial buildings with a rooftop area of more than 100 sq.m. or plot area more than 200 sq.m. in phased manner by 2015. Rain water harvesting should be implemented by individual households, Govt. Departments and Private enterprises as a plan of action to check sea water intrusion and ground water intrusion.

Key priorities onWater Mission

Table 58: Key priority list water mission

Sl. No.	Title	Organizations	Budget (in Million INR)			Source of funding
			Existing	Additional	Total	
1	Rain water harvesting pond creation of 10% of land area	Dept. of Agriculture	Nil	40.00	40.00	GoI[87], GoPY[88], EFA [89]
2	Desiltation of all the temples and village/ farm ponds	LAD[90]	Nil	500.00	500.00	GoI, GoPY, EFA
3	Channelising storm water into village pond or ground water recharge	LAD	Nil	500.00	500.00	GoI, GoPY, EFA
4	Promotion of percolation pits in housing colonies and in urban areas	PWD[91]	Existing budget are there for taking up actions	Nil	Nil	GoI, GoPY, EFA
5	Rainwater harvesting for all type of new and existing buildings	PWD, T&CP, PUDA	Existing budget are there for taking up actions	Nil	Nil	GoI, GoPY, EFA
	Providing Rain water harvesting arrangements as per building by-laws in all new Public buildings of terrace area more than 200 sq.m or Plot area more than 300 sq.m					
	Providing Rain water harvesting arrangements as per building by-laws in all existing Public buildings of terrace area more than 200 sq.m or Plot area more than 300 sq. m in phased manner					
	Providing Rain water harvesting arrangements as per building by-laws in all new Residential buildings of terrace area more than 100 sq.m or Plot area more than 200 sq. m					
	Providing Rain water harvesting arrangements as per building by-laws in all existing Residential buildings of terrace area more than 100 sq.m or Plot area more than 200 sq. m in phased manner					

[87] GoI : Government of India
[88] GoPY: Government of Puducherry
[89] EFA: External Funding Agencies
[90] LAD: Local Administrative Dept.
[91]PWD: Public Works Department

Sl. No.	Title	Organizations	Budget (in Million INR)			Source of funding
			Existing	Additional	Total	
	Providing Rain water harvesting arrangements as per building by-laws in all new Commercial buildings of terrace area more than 100 sq.m or Plot area more than 200 sq. m					
	Providing Rain water harvesting arrangements as per building by-laws in all existing Commercial buildings of terrace area more than 100 sq.m or Plot area more than 200 sq.m in phased manner					
	Providing Rain water harvesting arrangements as per building by-laws in all new Industrial buildings of terrace area more than 100 sq.m or Plot area more than 200 sq.m					
Total Budget (in Million INR)			**Nil**	**1040.00**	**1040.00**	

10. Strategic Knowledge Mission

10.1. Introduction

Coastal areas are in fragile ecosystem and are traditionally vulnerable. Climate change induces more extreme weather events and the coastal regions are more adversely impacted. Devastating weather events like the Tsunami of 26thDecember 2004 was a grim reminder of the need to ensure protection of coastal ecosystems and its people through legal and policy frameworks governing them. Along with the topography of coastal regions of India like Puducherry, it permanently altered the marine and human ecosystems, coastal tourism patterns of these areas.

Owing to the coastal location, the human habitats along with other ecosystems are highly vulnerable to climate change effects manifested through extreme events like earthquakes, floods, storm surge, high tides, tsunami, inundation of low lying areas due to sea level rise and coastline erosion among others. Both coastal and inland ecosystems are ecologically fragile and extremely sensitive to the natural and anthropogenic activities affecting them.

The impacts of climate change marked with natural calamities are taking toll on the sectors which are lifeline to the economy of the coastal regions like fishing and tourism. The 2006 tsunami had washed away scores of lives and put multiple live forms at stake. It washed away around 45,000 lives in 33 villages. However the death toll in Karaikal was four times that of Puducherry.

In such a scenario, other than the damage caused by the calamity itself, the reconstruction and restoration job poses a major challenge to the concerned authorities and also to the ecological equilibrium and balance of the region. While it is accepted and appreciated that humanitarian needs should be the primary concern during implementation of plans and activities, but shortsighted and unsound plans can aggravate the vulnerability of coastal habitats and communities. Many of these events require some kind of early warning system and better knowledge of prediction. Thus improved modeling and formation of a climate research centre is essential to harness knowledge and disseminate so that better preparedness would help maintaining the equilibrium between the ecological balance, urbanization, livelihood and development imperatives.

Though calamities like Tsunami and others have come as a wakeup call to the Government, Non-Government and voluntary organizations to initiate activities towards safeguarding the environmental resources from climate change impacts, yet there exists uncertainties about the nature, timing and spatial distribution and severity of the particular impacts in coastal regions like Puducherry. This has necessitated UT Level sector specific Climate Change impact studies and subsequent formation of an action plan to lead the Adaptation and Mitigation measures.

10.2. Mission Objective

The CCAP (Climate Change Action Plan)is a tool developed in line with the National Action plan on Climate Change to help the implementation of various actions/missions at the UT level. At the same time, they consider particular regional and local characteristics and specific concerns of vulnerable sectors and communities within the UT.

The CCAP through vulnerability and risk assessment provides a scientific basis for decision making at the policy level.The sub national plan seeks to build a vibrant and dynamic knowledge system that would inform and support state/UT level and local actions for responding effectively to the objective of ecologically sustainable development. The plan should emerge out of expert contributions and stakeholder inputs. CCAP Puducherry takes into consideration the vulnerability and challenges faced by the UT due to the coastal location, immense population growth and subsequent development pressures, existence of multiple climate sensitive zones, shoreline change rate, rate of sea level change, coastal slope, tidal range, coastal geomorphology etc.

The principal objectives of the mission can be listed as below:

- To monitor climate variability and make climate change projections for the UT
- To build GHG inventory and identify the dominant GHG/CO_2 emitting sectors, industries, districts, municipalities in order to enable selection of mitigation opportunities
- To model and make area/sector specific plan for the climate sensitive sectors and regions, assess the impacts of climate change, analyze the vulnerability of regions/districts, sectors and population groups and evaluate the traditional adaptation practices to climate variability and extremes
- To integrate the processes of assessment of vulnerability, knowledge and data on natural resources, institutions and capacities with the bottom up approach for planning of adaptation and mitigation projects for the benefit of climate sensitive sectors, regions and population groups
- To create knowledge base to enable government including its policymaking bodies for climate resilient policy-formulation
- To inform and assist the development agencies to evolve suitable management of adaptation and mitigation measures
- To empower and upgrade the capabilities of people and administrative officers to take appropriate steps at their own level for the reduction of risk and vulnerability due to climate change
- To strengthen regional cooperation through the establishment of mechanisms for exchanging information with regions sharing the borders and ecology of the UT

10.3. Key issues

Measures to generate strategic knowledge should carefully include perspectives, knowledge and understanding of the population, policy makers, decision makers and stakeholders. The knowledge strategy developed should be comprehensible and executable by the

stakeholders at large. The knowledge networks should operate in a hub-and-spoke model with nodal institutions linked to a wider range of knowledge partners linking to both intra-mural and extra mural research support system. This should minutely address the issues and at the same time support the need for economic and livelihood growth of the UT. While in theory this is desirable, in practice many institutions and bodies operate on silos and this paradigm needs a change.

Other than core research institutions, few other organizations with expertise in research and advocacy related activities should also be engaged for providing information and training support to other NGOs for the creation of an effective knowledge base for climate change. Few NGOs in the Union Territory are also operating to undertake social awareness training for the elected Panchayat representatives in Puducherry and Karaikal.

The main identified UT specific constraints are:

- Insufficient observational and scientific information data base
- Weak and fragmented knowledge base for impact assessment and selection of technology choices
- Knowledge gaps in respect to the impacts of climate change in different sectors of economy
- Absence of a system of technology watch
- Lack of institutional mechanisms for collating, synthesizing and delivering knowledge products for decision making
- Lacking in organized multidisciplinary research capabilities

10.4. Approach

The proposed approach for addressing the knowledge gaps and mobilization of strategic knowledge in the areas related to climate change are as follows:

- Introduce Climate change and Global Warming issues and concerns in school curriculum
- Environment/energy auditing by empanelled and accredited firms
- Awareness campaigns on conservation of natural resources to be conducted in villages of Puducherry region and in villages of Karaikal region
- Develop the UT level capacity in distributed form through establishing network of knowledge institutions through involvement of existing delivery structures for knowledge dissemination and application like Department of Environment and Ecology of Puducherry university, National Institute of Technology (NIT-K), Non Government Organisations (NGOs), Non Profit Organisations (NPOs) and Civil Societies Organisations (CSOs)
- Use extramural research system to undertake location specific research on climate science
- Setting up of an effective mechanism for data sharing and access through an easy accessible interface like a web portal

- Organise national/ international conference/ workshops on climate change in period of two and four years respectively
- Generation of awareness on GHG emission reduction and use of Alternate Energy Sources
- Conduct mass awareness programmes for promotion of renewable energy resources
- Strengthen and prioritize ongoing and planned programmes in respect of developing adaptation and mitigation activities
- Develop and provide knowledge and information services and products for use at specific and different levels, for example, develop internal knowledge alert system, risk assessment reports, regular reports on base line information and indicators, policy briefs, discussion papers on scenarios and choices, etc

10.5. Key priority

Key Priorities: Strategic Knowledge Mission
1. *Creating awareness on water and energy conservation, composting, source segregation of House hold waste, plantation Rain water harvesting pond creation of 10% of land area*
2. *Educating farmers on better cropping systems, drought resistance crop, minimization of chemical fertilizer and encouraging organic farming and soil reclamation programme Channelising storm water into village pond or ground water recharge*
3. *Advocating clean development mechanism, resource conservation and waste minimization through seminar/ workshop Rainwater harvesting for all type of new and existing buildings (Residential, Commercial and Industrial buildings)*
4. *Capacity building on mitigation/adaptation of Green House Gases among the officers and establishment of a climate change cell*
5. *Inventorisation of GHG generation from industries and other sectors*
6. *Setting up of Energy Bench Mark for all government buildings/ institutions*
7. *Establishing a network of knowledge institutions, location specific research on climate science, setting up of an effective mechanism for data sharing and access and organizing conferences/ workshops on climate change and related issues*
8. *Evaluation of action plan programmes and providing budget support to implementing departments/ authorities*

1. *Creating awareness on water and energy conservation, composting, source segregation of House hold waste, plantation*

Growing urbanization and its fallouts like generation of untreated wastes, ruthless exploitation and large scale contamination of natural water and energy resources, emission of untreated effluents and similar activities contribute majorly to climate change. Identification of vulnerable communities and awareness generation among them would help generate a knowledge database about climate change and its effects on human livelihood, health and sustainability of multiple ecosystems. Awareness among the communities would help them work for minimization of the activities leading to climate change through water and energy conservation, composting, waste management and climate resilient plantation.

2. ***Educating farmers on better cropping systems, drought resistance crop, minimization of chemical fertilizer and encouraging organic farming and soil reclamation program***

Like most states in India, agriculture is a significant support to the economy of Puducherry. The dependence of agricultural sector on weather conditions and precipitation largely determines its vulnerability. The consequences of climate change like temperature and rainfall fluctuation, higher level of atmospheric carbon dioxide and interaction of similar factors largely governs the productivity of agricultural sector. Thus for sustained productivity, farm based communities should be strengthened to adopt technologically advanced stunts like use of improved varieties of seeds, genetically modified seeds, improved irrigation systems like drip irrigation etc, climate resilient seed varieties, drought resistant crops. They should also be made aware of the influence of the sector on the environment. Minimum use of chemical fertilizers should be ensured to decrease the release of harmful gases like methane, carbon dioxide and nitrous oxide into the atmosphere. The Department of agriculture in collaboration with other private promoters should strive to educate the farmers on the same.

3. ***Advocating clean development mechanism, resource conservation and waste minimization through seminar/ workshop***

The prescribed protocols which help taper with signs and causes of climate change like Clean Development Mechanism under United Nation's Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, resource conservation and waste minimization could be advocated and promoted among the industrial sector, municipal and civic bodies and other key stakeholders through regular seminars and workshops conducted by the Department of Industries or Puducherry Pollution Control Committee.

4. ***Capacity building on mitigation/adaptation of Green House Gases among the officers and establishment of a climate change cell***

The nodal agency should enhance the capability of administrative department officials through training sessions or designing training modules. **A dedicated climate change cell** would help to enhance the technical capacity of DSTE in supporting the climate change related policies and programme development, to integrate climate change considerations into existing development interventions and also to support the Government in its role in coordination and negotiation efforts.

5. ***Inventorisation of GHG generation from industries and other sectors***

Indian industry is highly GHG emission intensive, contributing close to 31% of India's total GHG emissions. Inventorisation, quantification of emissions, is the first step in mitigating the emissions. Besides tangible benefits, inventorisation shows the social commitment towards environment. Industrial sector and other carbon dioxide intensive sectors like

transport, etc. should be strengthened for a macro level approach on energy conservation through different equipment, latest techniques and advancements in the field of energy management, information on latest energy saving ideas with actual implemented case studies and information on GHG Inventorisation& how to carry out GHG inventorisation.

6. ***Setting up of Energy Bench Mark for all government buildings/ institutions***

The imbalance between supply and demand of energy foretells a major power reliability problem and creates an unfavorable scenario for consumers and businesses in need of power. To maximize energy conservation in government buildings and institutions, conservation methods have to be promoted through implementing efficiency into design and construction of Government buildings and institutions. The BEE prescribed Energy Conservation Building Code (ECBC) could be adopted as a standard guideline for energy effective designs for all Government buildings and institutions till UT specific guidelines are put in place. Another approach to quantify the efficiency of a building or portfolio of buildings is benchmarking – comparing the performance of one building to other similar ones. When similar buildings are compared on a normalized basis it is possible to establish rating systems and labels that communicate energy efficiency attributes to owners, occupants, investors and other stakeholders through the key Department of Electricity.

7. ***Establishing a network of knowledge institutions, location specific research on climate science, setting up of an effective mechanism for data sharing and access and organizing conferences/ workshops on climate change and related issues***

A strong data management strategy could be planned through integration of universities, NGOs, NPOs, CSOs coordinated by the Puducherry Council of Science and Technology to undertake location specific research on climate science through involvement of extra mural research institutes. Climate change related knowledge could be propagated through web-based communication approach. For effective data sharing and data access, regular conferences or workshops could be organized for the key officials and vulnerable community representatives. A data management website could also be adopted as part of the UT Level Mission on Knowledge Management.

8. ***Evaluation of action plan programmes and providing budget support to implementing departments/ authorities***

The actions proposed under the climate change action plan are strategized with monitorable targets and timeline. It is therefore essential that the climate change cell with support of the nodal department prepare the detailed project report/proposal for each of the actions for budgeting either through internal approved budgetary provision or from external funding agencies. The DPR as against each action should set up process and outcome indicator as against which the implementation of the action be monitored. The climate change cell should in this context take up evaluation of the implementation of the climate change action plan.

Key priority on Strategic Knowledge Mission

Table 59: Key Priority List on Strategic Knowledge Mission

Sl. No.	Title	Organizations	Budget (in Million INR)			Source of funding
			Existing	Additional	Total	
1	Creating awareness on water and energy conservation, composting, source segregation of House hold waste, plantation	DSTE[92]	Nil	7.50	7.50	GoI[93], GoPY[94], EFA [95]
2	Educating farmers on better cropping systems, drought resistance crop, minimization of chemical fertilizer and encouraging organic farming and soil reclamation program	Dept. of Agri.	Nil	10.00	10.00	GoI, GoPY, EFA
3	Advocating clean development mechanism, resource conservation and waste minimization through seminar/ workshop	DSTE	Nil	5.00	5.00	GoI, GoPY, EFA
4	Capacity building on mitigation/adaptation of Green House Gases among the officers and establishment of a climate change cell	DSTE	Nil	5.00	5.00	GoI, GoPY, EFA
5	Inventorisation of GHG generation from industries and other sectors	DSTE	Nil	3.00	3.00	GoI, GoPY, EFA
6	Setting up of Energy Bench Mark for all government buildings/ institutions	Electricity Department	Nil	2.00	2.00	BEE, EESL, GoI, GoPY, EFA
7	Establishing a network of knowledge institutions, location specific research on climate science, setting up of an effective mechanism for data sharing and access and organizing conferences/ workshops on climate change and related issues	DSTE and Puducherry Council for Science and Technology	Nil	50.00	50.00	GoI, GoPY, EFA
8	Evaluation of action plan programmes and providing budget support to implementing departments/ authorities	DSTE and Planning and Research Department	Nil	5.00	5.00	GoI, GoPY, EFA
Total Budget (in Million INR)			**Nil**	**87.50**	**87.50**	

[92]DSTE: Department of Science, Technology and Environment
[93] GoI : Government of India
[94] GoPY: Government of Puducherry
[95] EFA: External Funding Agencies

11. Mission on Coastal and Disaster Management

11.1. Introduction

Coast lines of Puducherry subjected to hydro-meteorological and geophysical hazards are most likely to impact life, livelihood and infrastructure of the coastal communities by virtue of the devastation it results into during and after its occurrence. Flooding, storm surges, coastal erosion, shoreline retreat and Tsunami inundation are the common coastal disasters.The projection of sea level rise (IPCC 5th Assessment Report, The Physical Science Basis), observed increase in sea surface temperature and projection towards increased frequency of climate extreme events might result in serious ramification for the coastal community by resulting into geomorphic changes along the coastline, damage coastal ecosystems and resources thereby undermining social and economic development.

Though Puducherry has a coastline of only 41 km, it suffers from multiple risks.The terrain is gently undulating with high grounds 30-45 above Mean sea level and also comprises back waters. Sparse Mangrove vegetation is seen in the estuaries and along the sides of Ariyankuppam River (in Puducherry region), Gouthami River near Guirempeta (in Yanam region).Some of the important mangrove species in Puducherry are *Rhizophora apiculata*, *Rhizophora mucronata*, *Avicennia marina*, *Bruguiera Cylindrical*, *Bruguiera gymnorrhiza* (Rhizophoraceae), *Acanthus ebracteotus*, *Acanthus illicifolius* (Acanthaceae) etc.

The link between climate change and disaster is very clear in this case as compared to some other states.The climate change action planning will not be complete unless these issues are addressed in a holistic manner.The key principles for CCAP and DRR integration are as follows:

- Building disaster risk reduction into development planning process (e.g infrastructure that supports and secures the livelihood of coastal community)
- Linking relief, reconstruction and development (this is attempted mostly as a response)
- Facilitating risk reduction legislation (e.g. master planning, zone delineation, etc.)
- Supporting local and people centred interventions (community based disaster reduction planning)

There is also a tighter linkage that has been established under the bank supported Coastal Disaster Risk Reduction Project(CDRRP)with an objective of disaster risk reduction and mitigation including capacity building of Government institutions and vulnerable coastal communities.Some of the tools and techniques that normally apply for implementing DRR project also apply for climate change action planning. In that sense Puducherry has in fact implemented some part of climate change adaptation and mitigation action under this project.Tools and techniques used for DRR such as early warning systems, hazard, risk and vulnerability analysis, risk assessment and monitoring, risk mitigation as well as response strategies can be integrated with CCA strategies in the critical sectors like human health, food, water and environmental security, agriculture, forestry, tourism, etc. in the context of Puducherry.

The climate change action plan assesses the vulnerability of the coastal community in light of the projected variation in climate, weather variability and climate extremes and strategizes measures towards effective disaster risk reduction and promotes the concept of disaster resilience. The adaptive measures planned under the CCAP on one hand is intended to enhance the coping capacity and resilience of the vulnerable coastal communities so that they can respond promptly and effectively as well as quickly recover from the crisis situation. The actions proposed under the missions is so planned that it integrates preparedness and proactive measures towards disaster risk reduction as reactive measures are widely covered under existing Disaster management programme. The Action proposed under the mission specifically intends to focus on developing disaster resilient infrastructure and societies, capacity building of the communities, improvise system in place for early warning through incorporating the climate change concern as part of effective coastal zone management plan.

Table 60: Key component of Coastal Disaster Risk Reduction Projects

Key Issues	Adaptation/ Mitigation	Key Actions under CDRRP
Natural disaster/ hazards (both hydro-meteorological and geophysical) including high frequency and intensity of cyclones, storm surges, coastal floods and tsunamis	Adaptation	Climate resilient housing construction (Construction of multi hazard resilient permanent houses),stable electricity and communication network (cyclone resilient electrical network), improving road network, climate proofing of the livelihood sector like agriculture, fishing (sustainable fisheries management) and forestry, securing water and sanitation sector, improving health and social services facilities. Development and Improvement of evacuation centre and early warning centre.
Frequent and wide spread flooding from north east monsoon	Adaptation	Building storm water draining, disilting of tanks
Shoreline erosion, sea level rise	Adaptation	Conservation of Mangroves and shelterbelts, Preserving of sand dunes
Depletion of ground water	Adaptation	Ground water recharging, water use efficiency

11.2. Key Trends in the sector:

11.2.1. Key Natural Hazards

Cyclone: Puducherry is commonly impacted by Cyclone. The data since 1891 indicates that the UT is largely hit by cyclones originating in the Bay of Bengal and moving from west to north westerly direction causing extensive damage (moderate to severe) almost every two years.

Table 61: Cyclone Parameters

Cyclone Parameters	Puducherry	Karaikal	Yanam
No. of severe cyclones	3.00	3.00	4.00
No. of cyclones	3.00	10.00	17.00
Wind speed in knot	77.00	90.00	125.00
Maximum Storm surge in m	3.50	4.50	4.50
Probable maximum precipitation in cm	68.00	52.00	52.00

Tides: Puducherry coast is not a high tide zone, it hardly varies between± 0.8 m.However due to the climate change influences, changes in shoreline are observed in several parts of Puducherry and Karaikal coasts.

Tsunami: The Tsunami of 2004 affected almost 43,000 people in the UT of Puducherry, causing around 599 deaths incurring an economic loss to the tune of $52 millions.

11.2.2. Natural Hazards and Livelihood

The coastal ecosystem imparts pressure on the natural resource base livelihood in the UT. The Key linkages outlined are as follows:

Table 62: Other pressure points in the coastal region of Puducherry

Driver	Pressure	Impact
Agriculture	• Reclamation of coastal wetlands • Use of fertilizers and pesticides • Abstraction of water / large irrigation schemes	• Water quality impairment due to nutrients resulting in eutrophication • Loss of biodiversity • Reduction in freshwater flow
Aquaculture	• Conversion of mangroves, agricultural lands into aquaculture farms • Use of biocides, nutrients	• Loss of biodiversity • Water quality impairment due to nutrients resulting in eutrophication
Fisheries	• Coastal and deep-sea fisheries	• Reduction in catch due to over-exploitation of resources
Forestry	• Mangrove forest products harvesting; • Large-scale upland deforestation	• Loss of biodiversity • Increased erosion during rains and higher sediment load in water
Energy	• Coastal and offshore oil and gas exploration and operation • Coastal power generation • Large inland hydroelectric dams	• Oil pollution • Impaired water quality due to water release at higher temperatures from power plants • Reduction in freshwater flow • Reduction in sediment load
Industry	• Coastal industrial plants • Coastal and marine mining (e.g., sand) • Salt extraction • Industrial waste disposa	• Impaired water quality due to release of untreated/partially treated effluents containing metals and other chemicals
Tourism	• Coastal hotels and recreation facilities • Sewage and waste disposal	• Waste discharges and microbial pollution • Change in land use due to constructions, changes in drainage patterns • Loss of biodiversity due to land use changes
Transportation	• Waste discharges and microbial pollution • Change in land use due to constructions, changes in drainage patterns • Loss of biodiversity due to land use changes	• Water quality impairment due to disposal of dredging spoils • Increased water turbidity • Water quality impairment due waste disposal • Shoreline changes, changes in land use patterns

The UT has constituted a disaster management cell to coordinate preparedness, response, relief and recovery in the event of any disaster.Though NAPCC does not constitute a separate national mission on coastal protection and disasters, this is extremely important for Puducherry.A large part of structural measures are being addressed through the World Bank supported Coastal Disaster Risk Reduction project. The proposed Coastal Disaster Risk Reduction Project (CDRRP) will address the multiple hazard exposure related challenges faced by the UT of Puducherry, with a focus on risk reduction and mitigation. The broad activity focused under the programme can be categorised and outlined as follows:

1. Developing Climate resilient infrastructure – Resilient housing, Evacuation Shelter, cyclone resilient electrical network
2. Effecting Management system in place- development and implementation of Integrated Coastal Zone Management
3. Early warning and Capacity building in Disaster risk management

4. Promoting Sustainable livelihood – Climate resilient fishing infrastructure, Fishing management

11.3. Vulnerability of the sector

'Cyclone Thane', a very severe cyclonic storm with wind speed of 140 km/h (85 mph) to 150 km/h (90 m/h) hit Puducherry in 2011 following Tsunami of 2004. Cyclone Thane hit on 30th December 2011, and resulted in extensive damage of life and property in Puducherry. Thus, the vulnerability of Puducherry to natural hazards and weather variability and their consequences shows the need for a vulnerability assessment to assist the administration (UT and district level) for better disaster planning and mitigation.

Due to extreme weather events, natural disasters and their impacts on ecosystems throughout the world, human development has also suffered globally (UNDP, 2007). According to research reports and IPCC, the average global temperature could rise by 2°–3°C in next 50 years, which may lead to many severe impactson water regime. Since Puducherry has a long coast line, the impacts would likely show in the coastal and marine environment through rise in the sea level, violent storm surges, ocean acidification, coral bleaching and heat stress. Degradation of ecosystems, declining crop yields, food and drinking water supply are other possible impacts.

The natural balance of ecosystem and species distribution of coastal Puducherry is likely to be disturbed due to fluctuation in weather pattern. As a consequence, the availability of goods and services will be affected severely. Invasive species, with shorter life span and higher reproductive capacities, are more likely to survive climate change, leading to increase in their population at the cost of native species. Changes in the distribution of species will increase occurrence of vector borne diseases, such as mosquitoes, that can have adverse implications for human health.

Change in sea level is one of the most important consequences of climate change. It is calculated that the sea level changes using the tide gauge data of Chennai for a period of 54 year and estimated a value of 0.085mm/year. Thus the coastline of Puducherry region comes under high vulnerability

A common methodology would be followed as the basis of vulnerability assessments in Puducherry. Common Methodology implies a preparatory assessment of coastal vulnerability, and identification of priority regions and testing the feasibility of actions.

Table 63: Coastal vulnerability mapping

Sl. No.	Indicator	Descriptions
1	People affected	The people living in the hazard zone affected by sea-level rise
2	People at risk	The average annual number of people flooded by storm surge
3	Capital value at loss	The market value of infrastructure which could be lost dueto sea-level rise

4	Land at loss	The area of land that would be lost due to sea-level rise
5	Wetland at loss	The area of wetland that would be lost due to sea-level rise
6	Adaptationcosts	The costs of adapting to sea-level rise, with an overwhelmingemphasis on protection
7	People at risk	The average annual number of people flooded by storm surge, assuming the cost adaptation to be in place

11.4. Key Issues in the Sector

- **Shoreline erosion:** Erosion of shorelines is an ongoing process in Puducherry. Due to shoreline erosion, rapid and significant loss of land has become common. This has led the government to use various stabilisation methods to combat erosion. However little is known of either the short term or long term ecological impacts that these structures might have on the existing system's equilibrium.
- **Unplanned Dredging:** Improper and unplanned dredging has severely impacted the natural sand movement in the port area, as a result of which Puducherry has lost sandy beach areas.
- **Coastal Pollution:** Puducherry has six major manufacturing industries such as paper, alcoholic beverages, chemicals and pharmaceuticals etc. One of the important threats to the health and productivity of the Puducherry coastal waters is land-based source of pollution. The coastal stretch of Puducherry has been identified as one of the pollution hotspots along the east coast of India.
- **Anthropogenic Pressure:**Puducherry coastal water degradation has become a major concern because of its importance for socioeconomic development and human health. Rapid urbanisation and growth in human population and commercial industries in Puducherry, are directly affecting UT's coastal ecosystem.Marine water has been polluted due to different sources such as recreational activities, fish culture, toilet flushing and the assimilation and transport of pollutants. Human activities also have some negative influence on water quality and aquatic ecosystem functions intensifying pressure on these ecosystems leading to water quality degradation and loss of biodiversity.

11.5. Programme and Policies in the sector

Coastal Regulation Zone (CRZ) Regulations, 1991 (amended upto 2002)

Issued under the Environment (Protection) Act, 1986, coastal stretches have been defined as Coastal Regulation Zone and restrictions have been imposed on industries, operations and processes within the CRZ. For regulating development activities, the coastal stretches within 500 m of High Tide Line on the landward side are classified into four categories, namely:

- CRZ-I: (i) Areas that are ecologically sensitive and important,such as national parks/marine parks, sanctuaries, reserve forests, wild life habitats, mangroves, corals/coral reefs, areas close to breeding and spawning grounds of fish and other marine life, areas of outstanding natural beauty/historically/heritage areas, areas rich

in genetic diversity, areas likely to be in undated due to rise in sea level consequent upon global warming and such other areas, and (ii) Area between Low Tide Line and the high Tide Line.

- CRZ-II: The areas that have already been developed upto or close to the shoreline. For this purpose, "developed area" is referred to as that area within the municipal limits or in other legally designatedurban areas which are already substantially built up and which have been provided with drainage and approach roads and other infrastructural facilities, such as water supply and sewerage mains.
- CRZIII: Areas that are relatively undisturbed and those which do not belong to either CRZ-I or CRZII. These will include coastal zone in the rural areas (developed and undeveloped) and also areas withinMunicipal limits or in other legally designated urban areas which arenot substantially built up.
- CRZIV: Coastal stretches in the Andaman & Nicobar, Lakshadweep and small islands, except those designated as CRZ-I, CRZ-II or CRZ-II

The development or construction activities in different categories of CRZ area shall be regulated by the concerned authorities at the State/Union Territory level, in accordance with norms stipulated in the CRZ regulation and in the state / UT coastal zone management plan

In keeping with the GoI's commitment to disaster risk mitigation at the national and state level, the World Bank financed the Coastal Disaster Risk Reduction Project' (CDRRP) in Puducherry. The project will focus on new initiatives in risk reduction and mitigation integrating lessons from the previous Emergency Tsunami Reconstruction Project (ETRP) along with lessons from other disaster events faced by this coast and emphasizing the need for capacity building of Government institutions and vulnerable coastal communities.

The Coastal Disaster Risk Reduction Project (CDRRP) has the following five components, with each of the component details varying as per the specific needs of Puducherry.

1. Vulnerability Reduction;
2. Sustainable Fisheries;
3. Capacity building in Disaster Risk Management;
4. Implementation Support; and
5. Contingency Emergency Response.

11.6. Key Priority

Key Priorities of Mission on Coastal and Disaster Management
1. *Demarcation of HTL or LTL along the coastal stretches and preparation of revised coastal Zone Management Plan*
2. *Integrated Coastal Zone Management Plan Preparation*
3. *Flood Mapping and Development of Climate change projection Model and its impact on coastal ecosystem in Puducherry*
4. *Assessment of Erosion prone Area with the help of Digital elevation model and strengthen coastal protection method through improved technology*
5. *Study on Micro level vulnerability assessment due to climate change on coastal ecosystem*
6. *DPR on flood shelters, multipurpose cyclone shelters in vulnerable location in Coastal line and construction of flood shelters, multipurpose cyclone shelters and climate resilient buildings that can withstand multiple hazards*
7. *Development of a techno legal regime for construction of Disaster resilient housing and public infrastructure*
8. *Integration of Climate change risk in the disaster Management policy of the UT*
9. *Establishment of an integrated training and Capacity building protocoland knowledge management for better assessment of climate risks and best management practices*
10. *Study on Impact of Climate change on Marine Biodiversity with special emphasis on Flagship species and coastal flora and fauna*
11. *Strengtheningdelivering and monitoring system and preparedness in disaster prone coastal area*
12. *GIS based mapping along the selected vulnerable coastal area of Puducherry*
13. *Development of Sustainable aquaculture*

1. Demarcation of HTL or LTL along the coastal stretches and preparation of revised Coastal Zone Management Plan

High tide line (HTL) in the coastal regulation zone notification is defined as the line up to which highest high tide reaches in spring tides and the Low tide line (LTL) is the limit up to which the lowest low tide recedes during spring tide. It is delineated by walking over or remote sensing data. During delineation, the geographic attribute of all-important landmarks is important. The Chief Hydrographer to the Government of India is the authority to demarcate the high tide line and low tide line. The UT wants to demarcate HTL and LTL and prepare a climate friendly coastal zone management plan.

2. Integrated Coastal Zone Management Plan Preparation

Integrated Coastal Zone Management (ICZM) is basically a process by which the Government, the communities, science and management technologies, sectoral and public interests are addressed in an integrated manner to prepare and implement a plan for the protection and development of coastal ecosystems and resources. To improve the quality of life of communities dependent on coastal resources and maintaining the biological diversity and productivity of coastal ecosystems, government wants to establish ICZM as climate change adaptation activity. This network can be linked to the existing institutional set up under the CDRRP by the Project Implementation Agency (PIA) in the Department of Revenue & Disaster Management (DR&DM).

3. ***Flood Mapping and Development of Climate change projection Model and its impact on coastal ecosystem in Puducherry***

The Tsunami and the Cyclone Thane has left the UT highly vulnerable, in terms of coastal ecology.To update its projections on Climate Change and develop future coastal flood risk maps and to provide updated scientific information and analysis on climate risks for use in the Special Initiative, the UT wants to develop a flood mapping and climate projection model for Coastal Zones in Puducherry.This information will be designed to inform community about rebuilding plans, and help them to increase current and future resiliency of communities

4. ***Assessment of Erosion prone Area with the help of Digital elevation model and strengthen coastal protection method through improved technology***

The shoreline change has been identified in several parts of Karaikal and Puducherry. The vulnerable areas require further surveillance due to accentuation of shore dynamics caused to climate change.

5. ***Study on Micro level vulnerability assessment due to climate change on coastal ecosystem***

Study on Micro level vulnerability is very essential to enhance the preparedness of the dependent communities. Productive assets and infrastructures and socio-economic implications on the communities need to be assessed. A composite index can be computed to prioritise the resources.

6. ***DPR on flood shelters, multipurpose cyclone shelters in vulnerable location in Coastal line and construction of flood shelters, multipurpose cyclone shelters and climate resilient buildings and infrastructure including electrical network that can withstand multiple hazards***

Flood shelters, cyclone shelters can be established as part of adaptation measures at vulnerable locations of the UT. This will include both in situ owner driven construction, as well as outsourced construction of dwelling units and protection renovation of heritage houses along the coast.

The assessment part can be can be linked to the existing institutional set up under the CDRRP programme that is developing resilient housing, restoration of government buildings, bridges and culverts and developing Cyclone Resilient Electrical Network. The DPR prepared could be thereafter be used by Project Implementation Agency (PIA) in the Department of Revenue & Disaster Management (DR&DM) for implementation under support of the CDRRP programme.

7. ***Development of a techno legal regime for construction of Disaster resilient housing and public infrastructure***

Re-evaluation of building codes, work norms, etc. are crucial to manage the impacts of climate change, and include them in the policy framework for enhancing feasibility of adaptation and mitigation strategies.

8. ***Integration of Climate change risk in the disaster Management policy of the UT***

Tsunami, cyclones have prioritised disaster risk management on the public policy agenda in Puducherry over the last two decades. As the climate changes aggravate, the number of these weather-related disasters is likely to increase in intensity, duration, and/or frequency (IPCC 2012). In this backdrop the UT has realized the requirement of an integrated policy across all levels of government that makes the best use of public resources to reduce public expenditure.

9. ***Establishment of an integrated training and Capacity building protocol and knowledge management for better assessment of climate risks and best management practices***

Addressing Climate change issues requires not only detailed investigation but also time bound adaptation plan.Therefore, climate friendly practices (waste management, community based early warning system, coordinated response in emergency, etc.) need to be included into various programmes and policies.

A multi-stakeholder platform needs to be created involving academic institutions, civil society organisations and relevant departments of the government to achieve the above objective. This network can be linked to the existing institutional set up under the CDRRP and can focus upon improving of the decision support system for disaster response planning and integrating with Community Based Disaster Risk Management Programme. Professional support can be provided by agencies to assimilate best practices, contract modelling and other studies, coordinate and disseminate the knowledge to stakeholders.

10. ***Study on Impact of Climate change on Marine Biodiversity with special emphasis on Flagship species and coastal flora and fauna***

To assess Climate change impacts on both flora and fauna, modelling studies will be required to examine the vulnerability of the species and prepare effective management plan.

11. ***Strengthening delivering and monitoring system and preparedness in disaster prone coastal area***

Active participation of local communities is essential for successful disaster reduction policy and practice. Vulnerable communities should have proper experience and resources to minimise losses caused by disasters. Coastal communities are rich in experiences to cope with natural disasters both in preparedness and emergencies. The UT has faced tsunami and cyclone and has witnessed the intensity of disaster. In this backdrop the UT wants to run a community based disaster preparedness and monitoring system and mitigation activities for

reducing disaster vulnerability.Few of the actions that are planned as part of disaster management plan are:

- Strengthening risk reduction and response capacity of the disaster management unit
- Installation of early warning system and developing effective communication network towards imparting information to the communities in regard to the possibility of disaster

12. GIS based mapping along the selected vulnerable coastal area of Puducherry

The UT would undertake GIS Mapping and assessments with other latest instruments for reasonable and accurate collection of associated Master Data inclusive of Legacy Data as per Standard Operating Procedure (SOP) prescribed by Coastal Zone Management authority.GIS Mapping would provide accessibility to a variety of geospatial layers available including thematic information, topographic maps and satellite images. It would also provide access to important documents relevant to the geospatial layers shown on the map. The Mapping of selected vulnerable coastal area would help to develop adaptation and mitigation strategy for coastal ecosystem in the Puducherry.

13. Development of Sustainable aquaculture and fisheries

The table outlining "Other pressure points in the coastal region of Puducherry" above showsthe reduction in catch of some of the species due to the warming of the sea surface, wave dynamics, loss of mangrove and pollution. A comprehensive management plan needs to be formulated that should address the climate change issues along the entire value chain. The component of sustainable fisheries can be linked with the existing institutional set up under the CDRRP that emphasises over developing climate and hazard resilient fishing infrastructure.

Few of the actions that are planned as part of sustainable aquaculture practices are:

- Improving sustainability of the fishery sector by developing Work shelter for keeping the Out Board Motor and fishing gears safely to reduce the periodical loss due to adverse climatic conditions, modernisation of fishing harbours and fish markets.
- Construction of Chiller Plant, Fish Processing Unit and solar dryer
- Construction of solid and liquid waste management facilities
- Developing market linkage towards economic development of fisherman community
- Capacity building and Knowledge management of the fisherman community relating to marine fisheries

Key Priority Action Plan on Coastal and Disaster Management Mission

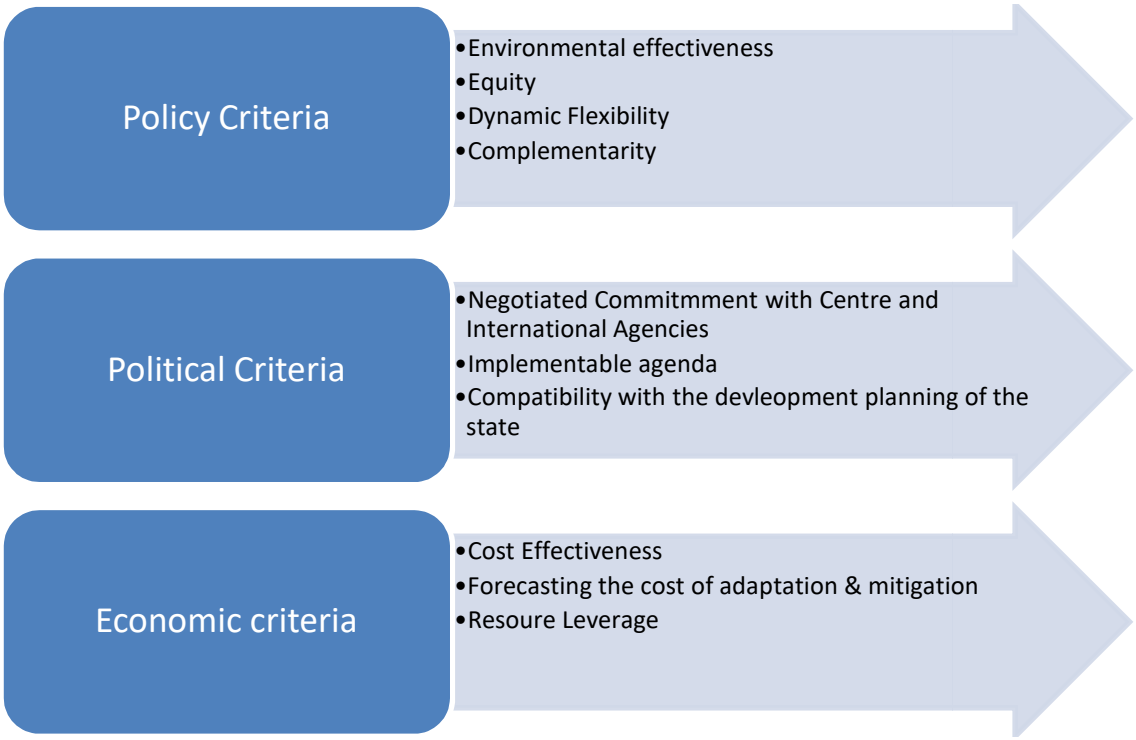
Sl. No.	Key Priorities	Departments/Organisation	Budget (in Million INR)			Source of funding
			Existing	Additional	Total	
1	Demarcation of HTL or LTL along the coastal stretches and preparation of revised coastal Zone Management Plan	DSTE, PIA, TCP, PCZMA, Anna University	Nil	10.00	10.00	GoI[96], GoPY[97], EFA [98]
2	Integrated Coastal Zone Management Plan Preparation	TCP, PWD, LAD, Fisheries, Dept. Agr, DSTE	Nil	2,500.00	2,500.00	GoI, GoPY, EFA
3	Flood Mapping and Development of Climate change projection Model and its impact on coastal ecosystem in Puducherry	DRDM, PIA, DSTE	Nil	50.00	50.00	GoI, GoPY, EFA
4	Assessment of Erosion prone Area with the help of Digital elevation model and strengthen coastal protection method through improved technology	PWD, Port,	Nil	2,500.00	2,500.00	GoI, GoPY, EFA
5	Study on Micro level vulnerability assessment due to climate change on coastal ecosystem	PCZMA, DRDM, Fisheries	Nil	10.00	10.00	GoI, GoPY, EFA
6	DPR on flood shelters, multipurpose cyclone shelters in vulnerable location in Coastal line and construction of flood shelters, multipurpose cyclone shelters and climate resilient buildings and infrastructure including electrical network that can withstand multiple hazards	PIA, DRDM,	Nil	250.00	250.00	GoI, GoPY, EFA
7	Development of a techno legal regime for construction of Disaster resilient housing and public infrastructure	DRDM, PIA, PWD, TCP	Nil	2.00	2.00	GoI, GoPY, EFA
8	Integration of Climate change risk in the disaster Management policy of the UT	DRDM, DSTE	Nil	2.50	2.50	GoI, GoPY, EFA
9	Establishment of an integrated training and Capacity building protocoland knowledge management for better assessment of climate risks and best management practices	DRDM, DSTE	Nil	1.00	1.00	GoI, GoPY, EFA
10	Study on Impact of Climate change on Marine Biodiversity with special emphasis on Flagship species and coastal flora and fauna	Forest, DSTE	Nil	10.00	10.00	GoI, GoPY, EFA

[96] GoI : Government of India
[97] GoPY: Government of Puducherry
[98] EFA: External Funding Agencies

Sl. No.	Key Priorities	Departments/Organisation	Budget (in Million INR)			Source of funding
			Existing	Additional	Total	
11	Strengtheningdelivering and monitoring system and preparedness in disaster prone coastal area	DRDM, DSTE, PIA, PWD	Nil	2.50	2.50	Government of India, External Agencies
12	GIS based mapping along the selected vulnerable coastal area of Puducherry	DRDM, DSTE, TCP, Agriculture	Nil	500.00	500.00	Government of India, External Agencies
13	Development of Sustainableaquaculture	DSTE, Fisheries	Nil	150.00	150.00	Government of India, External Agencies
Total Budget (in Million INR)			**Nil**	**5,988.00**	**5,988.00**	

12. Cross-Cutting Issues

There are several cross-cutting issues in the climate change debate.It requires co-ordination amongst different sectors and commitment of multiple stakeholders. The issues impeding the collaboration among the sectors—private, public and civil societyis not new. 'Convergence' is a more complex form of collaboration involving multi-stakeholder coalition seeking to influence systemic changes on wide-ranging issues, focused on outcomes than inputs to deliver scalable and sustainable change.To understand the cross cutting issue the following process was adopted.The following diagrams give the details.



While looking at the environmental effectiveness of priority actions one has to consider the reach of the localized action (area specific, state-wide, national or global). Additional costs will have to be taken into account and additional investments are to be negotiated with the non-local stakeholders, if the UT opts for a clean technology. The union territory also has to address the issues of complementarities to avoid duplication of efforts or resource deployment.It has to negotiate with multiple players and the implementation agenda has to be designed based on the development priority of the Union Territory. The priority actions where dilemma exists have been treated as a cross-sectoral issue.

The table below gives some idea about cross-sectoral relevance of the contemplated actions.

Table 64: Cross-sectoral relevance of the some contemplated actions

Cross-Sectoral challenge	Sectors-Involved	Actions	Typology of action
Damage to housing, industry, coastal hotels and storage infrastructure due to shoreline changes and changes in land use pattern	Housing, Agriculture, Water,Transportation, Tourism, Industry	Change in crop storage structure and raised plinth	Adaptation
Loss due to soil erosion	Agriculture, Forestry, Rural Development, Tourism, Housing	Raised Plinth	Adaptation
Damage due to loss of biodiversity due to land use changes	Tourism, Agriculture, Aquaculture, Forestry		Adaptation
Food Insecurity during extreme weather conditions and weather variability	Agriculture, Horticulture, Rural Development	Food preservation, seed bank, homestead garden	Adaptation
Management of water scarcity	Agriculture, Rural Development, Water, PHED, Health	Raising the plinth of tube-wells	Adaptation
Alternate livelihood during extreme weather conditions	Agriculture, Animal Husbandry, Fishery	Duck rearing, seed storage, Banana cultivation	Adaptation
Flood Management	Water, Agriculture, Industry, Energy	Integrated water resource managementshould determine the apportionment of waterdifferent sectors	Adaptation
Promoting sustainable agricultural practices	Agriculture, Rural Development, Forestry	Better agro-sylvicultural pattern, use of organic fertilizer and promotion of the practice of Systematic crop intensification	Adaptation and Mitigation
Preserving the bio-diversity	Forest, Fishery, District autonomous councils	Requires a holistic action to preserve the flora as well as the fauna including the aquatic ones of a specific area	Adaptation
Institutionalizing Energy use efficiency	Energy, Industry, Works, Agriculture	A multi-layered approach to change the mindsets, methods and appliances to improve end-use efficiency and process efficiency	Mitigation
Promoting green infrastructure	Energy, Works, Urban, Transport	Green topped road, promotion of renewable and energy saving measures in the housing sector	Mitigation

12.1. Health and Climate Change

Weather and climate variability has a profound influence on human health. The impact of climate change over human health is likely to be multifaceted involving increased incidence of vector, water and food borne diseases, malnutrition and undernourishment, injuries and death caused by extreme hydrogeological events and thermal stress[99]. Temperature, precipitation and humidity have a strong influence on the reproduction, survival and biting rates of the mosquitoes that determine the malaria and dengue fever, and temperature effects on the life-cycle of the infectious agents themselves. The same meteorological factors also influence the transmission of water and food-borne diseases such as cholera and other forms of diarrhoeal diseases[100]. Increased intensity or prolonged heat waves are likely to heighten health risks such as hypothermia, influenza, cardiovascular and respiratory diseases, dehydration and many others[101]. Climate and weather related hazards on the contrary results in destruction of social and economic infrastructure and degradation of fragile ecosystems. The vulnerability due to incidence of diseases or hazards will however depend upon the level of exposure, sensitivity and the coping capacity of the populace.

Short term impacts of climate change are likely to magnify the existing socio-economic threats due to rapid urbanization, population growth, poverty, health infrastructure, contamination of air and water, unplanned urbanization, issues of solid and liquid waste management resulting in increasing the risks of diseases in terms of morbidity and mortality. Long term climate change impacts will exacerbate the existing stress while undermining growth and development. Irrespective of the fact that the Health Care Delivery Services in Puducherry has been adjudged as the best in the country, it needs to frame the adaptation strategies to undermine the impact of climate variability on human health. The adaptive strategies should be both anticipatory and reactive and are outlined as follows:

1. Monitoring high resolution weather and climate data and develop health impact model to study the regional pattern of diseases.
2. Mapping of geographic areas based on epidemiological data and extent of vulnerability to adverse impact of climate change.
3. Gap analysis and making region wise provision of primary, secondary and tertiary health care facilities, implementation of public health measures including vector control, sanitation and clean drinking water supply.
4. Identify extrinsic and intrinsic drivers of malaria and dengu and identifying immunity intervention measures towards control of incidence of malaria/ dengu.
5. Upgradation of health policy to through including of climate change related health hazards.
6. Study and documentation of diseases caused by water (water borne) and development of institutional mechanism to reduce the incidence/outbreaks of such diseases along with Awareness generation.

[99] *IPCC 2007: McMicheal, Campbell- Lendrum, Kovats, et al. 2004*
[100] *Climate Atlas (WHO)*
[101] *Faunt, Wilkinson, Aplin et,al 1995.*

7. Development of institutional framework and infrastructural facilities for early detection of vector borne diseases, including managing outbreaks
8. Assessment of health impacts due to malnutrition

12.2. Gender Issues and Climate Change

Women are affected disproportionately and differently, due to climate change and associated natural disasters such as floods, droughts, cyclones and storms. This is largely because men and women are bound by distinct socio-economic roles and responsibilities that give rise to differences in vulnerability and ability to cope with these climate change consequence.

Women usually, are in contact with firewood, or even modern fuel and water for cooking.Thus any constraintposed by lack of access or contamination, of these leaves them more vulnerable.The work participation rate of male and female vary significantly. In post disasterrecovery period, the females mostly stay in hostile terrain whereas males migrate.

Therefore it is important that issues relating to gender safety, violence against women during climate stressed scenarios and adaptation options which are gender segregated need to be worked upon and friendly policies for women need to be incorporated.

12.3. Common Cross-cutting needs and capabilities:

The following are the common crosscutting needs and capabilities that have emerged from the working group deliberations.Through careful analysis of the sectoral needs, the Government of Puducherry has proposed several mechanisms at local level and UT level to move forward

Table 65: Cross cutting Strategies

Geography Strategies	Local	UT level	Linkages to national programmes/missions
Awareness	Creating local level awareness is a first step, e.g. barefoot workers, framer field schools may promote descaled climate change concerns	Building awareness of legislators, policy makers on socio-economic and socio-political cost of climate change	Participation in national networks, interface with the national knowledge network and research systems
Capacity	Monitoring, observation Awareness/assessment at UT/ district/ community levels	Scientific assessment,measurement, models, with UT level technical institutions like SPCB, Watershed Mission, Regional Centers of National	Special regional modeling and assessments, best practices study and resource leveraging from various missions and mission resource centers and technical secretariats

Geography Strategies	Local	UT level	Linkages to national programmes/missions
		Institution, Universities	
Generation of Knowledge / Information	Locale specific databases, scenarios and assessment, local monitoring networks, rapid assessmentfor input to UT inventory	Research networks, Compilation of UT level GHG inventory and input to National databases (e.g. NATCOM), scientific and policy models, State-wide and area specific scenarios, technology inventory	Interface with IPCC assessments, interfacing with regional/global databases, scenarios and assessments, technology inventory database
Institutions / Partnerships	Community initiatives, Early warning networks, Disaster management teams	Stakeholders networks, public/ private programs	Standardized Climate impacts assessment both academic as well more applied ones for result based management and programming
Policy/ Instruments	Local specific adaptation plans, community based adaptation programs	Science-policy linkage,mainstreaming climate change agenda in sectoral policies of the UT (agriculture, mining, industry, energy, water, forestry, etc.) economic instruments (e.g. insurance, R&D funds), integration with national development/ planning process	Adaptation funds,Interface with private sector participants for fund under market mechanisms like CDM, REDD&REDD+
Technology	Local specific technology adaptation	Targeted R&D, Technology transfer protocols, demonstration/ pilot projects	Scientific exchange, technology transfer

13. Analysis and Synthesis

This chapter summarises various adaptation and mitigation options in the state climate change action plan. It also emphasizes four important aspects for the implementation of the SAPCC (a) need for capacity building of sectoral departments to look at regular sectoral activities in a climate change lenses (b) a strong emphasis on knowledge management network to harness best practices on adaptation and mitigation and create a multi-stakeholder platform with industry, academia and private sector (c) use of appropriate technology be it automated weather station to monitor micro-climate data or using low carbon technology in different sectorsand (d) provision of additional finance from center, state plan schemes, bilateral and multi-lateral sources to implement the plan.For example the UT has already been taking up several climate proofing measures in the CBDRP project supported by the World Bank.The chapter also suggested adequately staffed climate change cell for the facilitation, coordination and development of M&E system for climate change adaptation by sectoral departments.

13.1. Changes in policies, organizations and practices

The detailed analysis of each sector shows a clear indication for the need of climate responsive development of policies and regulations. Integration of climate change with the existing development policies can be a fruitful effort towards implementation of climate change action plan. To build a case it is important to have a clear image of the effects of climate change on the sectors as elucidated in different chapters and this should be provided to senior policy makers in form a briefing note so that adequate institutional and regulatory framework is put in place for their implementation.

13.2. Awareness generation and capacity building

There is also a need of awareness generation, capacity development and skill development of human resources at the organizational and institutional level. The concept of climate change and its adverse impacts on local habitats and livelihoods and scopes for adaptation and mitigation initiatives are relatively new. The limited awareness on the issues related to vulnerability, climate proofing, climate resilience may restrict the degree of successful implementation of CCAP or may offer hindrance to the implementation. The outcome of CCAP is largely dependent on developing the required capacities at all levels of administration and other authorities responsible for implementation. This should include the stakeholders from all sectors, Non-Government Organisations (NGOs), Civil Society

13.3. Integrated and carbon conscious development

For effective realization of the initiatives taken towards successful implementation of the proposed key priorities, it is vital to have integrated plans that are focused on low carbon technology and processes. Transitioning to a low carbon climate resilient development pathway means the UT fully acknowledges the implications of climate change for sustainable development objectives and is committed to adopting the necessary corrective actions. The pathway would take into consideration future risks, and thus improve Puducherry's ability to prosper under a changing climate while reducing the emissions

intensity of a growing economy. The different climate change adaptation initiatives being planned would ensure better preparedness to climate-induced changes, including extreme weather and disaster events.

13.3.1. Carbon-conscious development

The various mitigation initiatives being planned under the six missions specified under the CCAP (Climate Change Action Plan)would ensure that Puducherry adheres to a carbon-conscious development path. This requires technologies and processes that need to be put in place else it will stay at aspirational level.

13.3.2. Green Jobs

Implementation of the adaptation and mitigation strategies would ensure environmentally sustainable form of production and consumption, which include designing green buildings, utilization of renewable sources of energy, use of star rated equipment, installing water recycling systems, fuel efficient transport system, development of sewerage system and solid waste management etc. As a consequence this would lead to the creation of thousands of 'Green Jobs' thus redefining business in favour of more sustainable practices. The sectoral and vocational curriculum needs to undergo change and participation with industry will also be key to see that the pace is faster.

13.4. Governance &Institutional Arrangements

A Steering Committee has been established under the chairmanship of Chief Secretary and Secretaries of the participating departments as members, which will supervise and coordinate activities related to the climate change adaptation and mitigation strategies. Under this steering committee, there are 19 departments and 5 autonomous bodies with the respective administrative heads as advisor and convenor for implementation of the CCAP. The nodal agency for the preparation of CCAP of Puducherry is DSTE (Department of Science, Technology and Environment).

13.4.1. Climate Change Cell

The DSTE **will establish a climate change cell. The governing body of the cell or council will be** headed by the Chief Secretarywho will provide support to this cell for execution of the CCAP. Inclusion of various departments in a group will ensure strengthening of inter sectoral and interdepartmental coordination. This Climate Change Cell will be a single-window contact for dealing with Government of India and other external funding agencies for issues pertaining to climate change. This Climate Change Cell will act independently for smooth functioning and execution of various roles, responsibilities and duties in time and in effective manner which will be helpful to manage interdepartmental conflicts. The functioning of this cellis collaborative and inclusive, not only within Departments of the Government of Puducherry but also with the different external stakeholders. For providing support to the Nodal Agency (DSTE), a Project Management Unit (PMU) will be established.

This PMU will be consisting of sectoral experts to provide support to the implementation activities of the CCAP. The main role of the PMU will be developing project proposals, detailed project reports of the action plans, annual reports, annual plans and managing database by Management Information System.

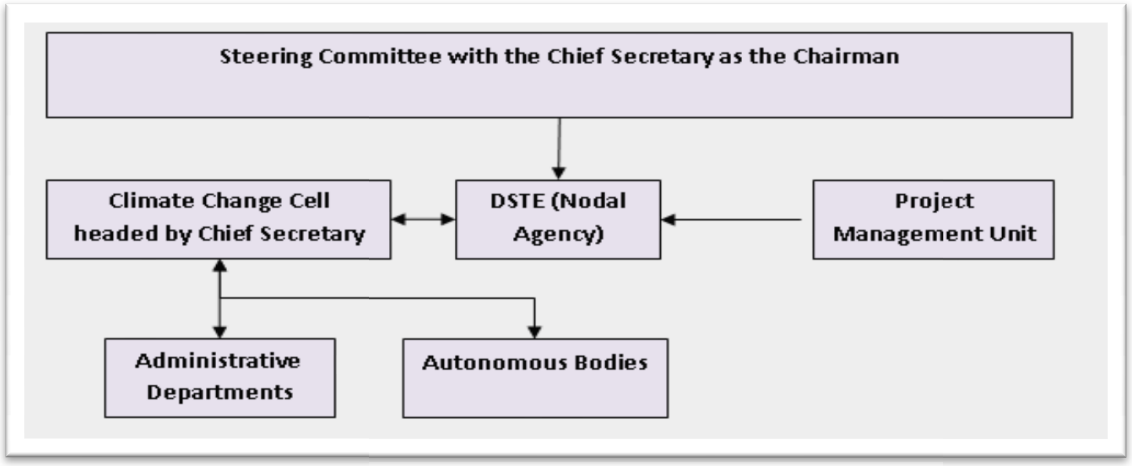


Figure 20: Governance &Institutional Arrangements

13.5. Budgets

The proposed budgetary estimations for implementation of Climate Change Action Plan in different sectors are only a rough estimate. The estimated budget for the CCAP of Puducherry for the key identified priorities is summarized below. Parts of the Action Plan can be planned to be implemented based on the availability of existing financial resources of the departments and additional funds may have to be provided for certain activities by external aid or centre. As the implementation activities make progress, the exact situation will be more easily visualized.

Table 66: Sector wise estimated budget

The total budget has been estimated at INR 13172.10Million for a 5-year period.

Sl. No	Name of the Mission	Number of High Priority Actions	Budget (in Million INR)		
			Existing	Additional	Total
1	Solar Mission	9	1,791.06	512.80	2,303.85
2	Enhanced energy efficiency	8	1.00	555.30	556.30
3	Sustainable Habitat	11	205.35	2,684.95	2,890.30
4	Green Puducherry and Sustainable Agriculture	17	0.00	306.15	306.15
5	Water Mission	6	0.00	1,040.00	1,040.00
6	Strategic Knowledge Mission	8	0.00	87.50	87.50
7	Coastal Disaster Management	13	0.00	5,988.00	5,988.00
		72	1,997.41	11,174.70	13,172.10

A break up of the budget as per the type of actions (Adaptation and Mitigation) is as follows:

Table 67: Budget Proposed under CCAP for the UT of Puducherry

Sl. No	Name of the Mission	Type of Action		Adaptation Budget (in Million INR)		Mitigation Budget (in Million INR)	
		Adaptation	Mitigation	Existing	Additional	Existing	Additional
1	Solar Mission		9.00	0	0	1,791.06	512.80
2	Enhanced energy efficiency		9.00	0	0	1.00	555.30
3	Sustainable Habitat	3.00	8.00	202.50	502.50	2.85	2,182.45
4	Green Puducherry and Sustainable Agriculture	5.00	12.00	0	19.25	0	286.90
5	Water Mission	6.00		0	1,040.00	0	0
6	Strategic Knowledge Mission	4.00	4.00	0	72.50	0	15
7	Coastal Disaster Management	13.00		0	5,988.00	0	0
		31.00	42.00	202.50	7,622.25	1,794.91	3,552.45

A break up of the budget as per the time frame (Short Term, Medium Term and Long Term) is as follows:

Table 68: Breakup of the Budget Proposed as per the Time Frame under CCAP for the UT of Puducherry

Sl. No	Name of the Mission	Time Frame			Short Term ActionBudget (in Million INR)		Medium Term ActionBudget (in Million INR)		Long Term ActionBudget (in Million INR)	
		Short Term	Medium Term	Long Term	Existing	Additional	Existing	Additional	Existing	Additional
1	Solar Mission	3.00	6.00	0	7.56	30.14	1,783.50	482.66		
2	Enhanced energy efficiency	8.00	1.00	0	1.00	515.30	0.00	40.00		
3	Sustainable Habitat	6.00	5.00	0	205.35	102.45	0.00	2,582.50		
4	Green Puducherry and Sustainable Agriculture	4.00	13.00	0	0	17.00	0	289.15		
5	Water Mission	2.00	4.00	0	0	0	0	1040.00		
6	Strategic Knowledge Mission	4.00	4.00	0	0	15.00	0	72.50		
7	Coastal Disaster Management	9.00	3.00	1.00		5716	0	22.00	0	250.00
		36.00	**36.00**	**1.00**	**213.91**	**6,395.89**	**1,783.50**	**4,528.81**	**0**	**250.00**

13.6. Conclusion

Strategic analysis of the key priorities recommended in the various sectors, the implications and the required administrative roles and responsibilities has concluded the need of a region specific and local perspective in the implementation of the CCAP (Climate ChangeAction Plan). The vulnerability of the local people and livelihood bear an important role in the decision making process. The balance between the adaptive and mitigation strategies while still ensuring the continuance of activities essential for the economic prosperity of the union territory is inevitable. The CCAP (Climate Change Action Plan)thus highlights the vulnerability of the crucial sectors of Puducherry like fisheries, coastal vulnerability, tourism, urban, water resources, agriculture and others which are likely to witness substantial impacts and influence due toclimate change. The sectoral recommendations were synthesised through the active facilitation by climate change specialised consultants (CTRAN) with the key nodal bodies for the administrative departments.Consultation was also held with CSOs from all the regions of Puducherry to take their input to facilitate the effective implementation of theCCAP (Climate ChangeAction Plan). The Climate Change Action Plan would lead Puducherry to move towards a GHG emission conscious and climate resilient development path. The key conclusions of this Climate Change Action Plan are as follows:

For the implementation of the CCAP, a multidisciplinary, integrated and co-ordinated approach is to be adopted. A proactive, preventive and preparedness oriented approach is what the Government should adopt rather than a reactive approach. The sectors involved in the CCAP have different key priorities to be addressed through different initiatives over different timeframe. All these sectors will implement its initiatives relevant to their key priorities within themselves and in close integration with different departments and stakeholders involved. In the implementation period of the Climate Change Action Plan, Government of Puducherry will demonstrate, promote and encourage different initiatives through policy changes, adaptation of new policies and implementation actions as a response to climate change.

13.6.1. Involve stakeholders

The stakeholders, particularly climate dependent communities, should be involved by the Government of Puducherry in a proactive way in the Climate Change Action Plan implementation. This involvement will facilitate a multidisciplinary response through

(i) promoting climate change awareness within community in an enhanced manner
(ii) identifying critical issues in connection with climate change
(iii) support monitoring of climate-induced problems
(iv) ensuring higher accountability to the people on climate change issues Stakeholders play a significant role in formulating strategic solutions to climate change related problems. With the involvement of stakeholder, the accessibility of their knowledge and preparedness in climate change context would be easier. If stakeholder involvement as is not initiated, then the Government of Puducherry should act as an advisory to the stakeholders and not as a partner.

13.6.2. Going beyond environmental & climate change professionals

It is evident from the range of issues / concerns that originate from the non-environmental professionals are equally essential for formulation of CCAP (Climate ChangeAction Plan) even if climate change is an environmental challenge. To arrive at a final conclusion regarding the climate change issues both the environmental, non-environmental and climate change fraternity should work together. Exclusion of the interdependent and interlinked sectors would negate the effectiveness of the strategies. The issues/problems in association with climate change are very fundamental and extend to all sectoral contexts. Therefore, the respective sector professionals would have to address these problems to reach a sustainable solution. Policy-makers, economists, planners, engineers, scientists, development programme specialists and others have to be encouraged for their dedicated contribution towards resolving climate change problems in a structured way.

13.6.3. Dynamic document

This is not a static document and must evolve as the progress in various areas of intervention moves ahead.Dynamic documentation bears significant roles in the approaches to respond to climate change issues as the nature of the problems are changing with the evolving research works across the world. To address the issues effectively, this 5-year Climate Change Action Plan should be seen as a dynamic document rather than one off or static one. A guideline in the form of key priorities is provided for the implementation of a flexible climate change action plan where the strategies can be revised according to time specific evidences. These should be used strategically to ensure that these are in line with latest concepts and developments.

13.6.4. Monitoring of CAP

There are 19 departments and 5 autonomous bodies working in close connection with the climate change action planning process in Puducherry. The monitoring and evaluation of the CCAP will be done in association and coordination with the implementing agencies and sectoral departments of Puducherry U.T. The monitoring process of the CCAP will be through quarterly or half yearly monitoring reports of priority actions in respective sectors. The progress report would be compiled and reported to the concerned authority.

The CCAP (Climate ChangeAction Plan) provided quantifiable targets in each sector and this can be monitored. Monitoring of adaptation is a medium term issue and a result framework can be developed for each sector at a later stage for monitoringand tracking along with developing a base line scenario. A list of monitoring target towards each mission is presented as annex to this report.

14. Annexure 1- Stakeholders Consultation Meeting

Government of Puducherry is in process for finalizing the CCAP (Climate ChangeAction Plan) in line with the National Action Plan on Climate Change. The CCAP (Climate ChangeAction Plan) is a strategic document developed to address the climate change related vulnerability by enhancing the coping capacity of the populace and reducing the concentration of greenhouse gas in the atmosphere. The dispersed and isolated locations, long coast line prone to cyclone and storm, projection of sea level rise and salt water intrusion has made the union territory more vulnerable and susceptible to the projected variance of climate change or related disasters. High rate of urbanization, increased population density, industrial and infrastructural growth have put pressure on the environment as well as the ecology.Conversion of agricultural land, depletion and contamination of ground water and pollution are other pressing issues for the Union territory. Government of Puducherry has always initiated actions to combat environmental degradation, promoting low carbon sustainable and inclusive growth and protecting the livelihood as well as the ecosystem. However to address the issues of climate variability and extremes considering the social dimension in an holistic manner, a high level steering committee is formed under the Chairmanship of Chief Secretary and with Director Department of Science, Technology and Environment acting as a Convener.

To initiate a process for recommending measures taken towards actions identified for each priority sector a stakeholder meeting was held on 24thSeptember 2013. The stakeholder's consultation meeting was the second round meeting post to the internal consultation programme organized by the Government of Puducherry. Rounds of discussion took place between the working group members and members of CTRAN consulting.The aim of the workshop was to create a common baseline for subsequent discussions with the Working Groups andfinalize the CCAP (Climate ChangeAction Plan).

The draft Climate Change Action Plan was also shared with the other stakeholders like Civil Society, Grassroots Agencies, industries and academic bodies in order to get their feedback and make the plan more inclusive.

Post the inaugural deliberation by JPD, PIA presented an overview of the Climate Change Action Plan and the involvement of the stakeholders.Director DSTE briefed the backgroundof the CCAP (Climate Change Action Plan),the strategic initiative undertakenby the steering committee and the nodal department and the way ahead.

Detailed technical session was followed after the inaugural session wherethe background, modalities of finalizing and prioritizing strategies in each sector and the budgetary requirement for the priority actions as against each of seven selected mission were presented to the stakeholders in the workshop.The stakeholders were also briefed about the issues of climate change, its projected variability and the likely vulnerability.

A total of 140 participants were present in the workshop including organizing team members of DSTE and PIA (who did not signed for the workshop). Participants from all sectors and regions were invited. It was also ensured that all sectors are represented and the consultation sessions were designed to cover all priority sectors.
The workshop format followed for Stakeholders consultation Programme was as follows:

Table 69: Workshop format followed for Stakeholders consultation Programme

Session Plan	Content
Inaugural Session	Introduction to Workshop objective, background of formulation of CCAP, context and process of CCAP formulation
Technical Session 1	Presentation on the Vulnerability and GG inventory
Discussion Session 1	Discussion over the issues of vulnerability
Technical Session 2	Presentation on the priority sector and priority actions • Presentation on Energy Mission • Presentation on Green Puducherry and Sustainable Agriculture Mission • Presentation on Mission of Enhanced Energy Efficiency • Presentation on Water Mission • Presentation on Sustainable Habitat • Presentation on Coastal Disaster • Presentation on Sustainable Knowledge mission • Summing up ofCCAP, Cross cutting sectors and Way Forward Plan
Discussion Session 2	Feedback about the sectors and the action Plan, this was done after completion of each technical session and also after the completion of the entire technical session
Wrap up Session	Describe over the way forward Plan and institutional arrangement, involvement of the stakeholders

Following are the inputs from different stakeholders on the priorityaction on the CCAP (Climate ChangeAction Plan).
In total the draft Climate Change Action plan validated 171 priority actions in 7 sectors

Table 70: No. of priority actions

Sector	No of High Priority Action Deliberated	Total No of Priority Action Deliberated
Solar Mission	9	22
Enhanced Energy Efficiency	8	14
Sustainable Habitat	19	43
Green Puducherry and Sustainable Agriculture Mission	17	45
Coastal	13	14
Water Mission	12	23
Strategic Knowledge Management	7	10

In terms of spatial break up; 90 are related to adaptation, 71 related to mitigation and 10 are linked to strategic knowledge Management and rest could not be classified either way. Most of the actions had UT-wide repercussions with a few actions related to specific area/clusters. The stakeholder feedback revealed that all the identified priority actions were considered appropriate. Additional issues were raised and suggestions were made by the stakeholders during the consultation. The following section captures this feedback as cross cutting issues and sector-specific issues.

Sector Specific Issues

Solar Mission

a. Information network to be strengthened in regard to disbursement of subsidy
b. Emphasize towards operation and maintenance of existing Solar Water Heater.
c. Promotion of Solar concentrator based system to meet up the institutional as well as commercial thermal energy requirement.
d. Promotion of grid connected and off grid solar PV system

Enhanced Energy Efficiency

a. Since the Carbon Credit market is already bottomed out, hence the penetration of the CFL through BLY route is not possible and therefore it is necessary to think of an alternate route.
b. Promoting use of Organic LED
c. Instead of distribution of CFL through Ration, Government should promote distribution of LED.
d. Promoting auto sensor in domestic household, office building and complex to prevent water loss as well as energy due to over flow of water from overhead pump.

Sustainable Habitat

a. Action pertaining to the transport sector to be time bound
b. Phasing out of old vehicles
c. Vehicular Emission monitoring
d. Sewerage treatment before being disposed off to sea

Green Puducherry and Sustainable Agriculture Mission

a. Since fishery forms the mainstay of rural economy it is therefore important that the fishery should be considered as a separate mission
b. Plan for introducing carbon credit opportunity for plantation
c. Encouragement for re-plantation, farm forestry and agro forestry
d. Regulatingreal estate and prevention encroachment of land under forest/ plantation
e. Prevent diversion of agricultural land for non-agricultural use and ensure groundwater management
f. Implementation of conservation technique and preventing degradation of agricultural land
g. Promoting gender parity while determining agriculture wages

h. Promoting organic farming and creating market linkage for organic product
i. Reduction in the usage of chemical fertilizer.
j. Early warning systems and contingency planning processes

Coastal

a. Establishment of Drainage mapping – Existing drainage infrastructure does not have the capacity of sea water intrusion.
b. Study towards seas level rise.
c. Preservation of sand dunes.
d. Preservation of coastal flora
e. Measures relating to drainage, dredging and mangrove management to be prioritized
f. Promoting climate resilient infrastructure

Water Mission

a. The problem of ground water level depletion and aquifer is emerging as a pressing problem across Puducherry mainly because of the over exploitation and un-sustainable use. Packaged water industry is further exacerbating the problem. Suggestion was also made towards imposing measures in providing license to similar type of industry based on the ground water level.
b. There are around 84 numbers of tanks across Puducherry. Despite adequate water in the tank bore well is used due to lack of coordination..
c. Establishment of water resource department.
d. Promoting SRI (System of Rice Intensification) and SCI (System of crop intensification)
e. Management of tank is highly essential including distillation of tanks
f. Subsidy to be provided for less water intensive crops
g. Maintenance of existing rain water harvesting infrastructure

Strategic Knowledge

a. The role of NGO including civil societies in imparting knowledge should be clarified.
b. Research should be promoted in the domain of climate change and associate vulnerability.

General and Cross cutting

a. Suggestions were also made towards detailed location wise vulnerability analysis. Suggestions were also made to incorporate the vulnerability analysis made by Anna University in the report.
b. Explanation was sought on the number of department being consulted and the process of prioritization.
c. Since Yanam was described as the center for cyclone and storm, suggestion were made to include Puducherry and Karaikal region.
d. Impact of climate change on bird needs to addressed

e. Exploration of other renewable energy sources apart from solar needs to figure out as part of the action plan.
f. Establishing gender parity and involvement in all kind of project

Way forward

The feedback was sought from stakeholders through emails or submission to DSTE for further consideration within the time frame.


GOVERNMENT OF PUDUCHERRY
PROJECT IMPLEMENTATION AGENCY
COASTAL DISASTER RISK REDUCTION PROJECT
Stakeholders' Consultation Workshop:
STATE ACTION PLAN ON CLIMATE CHANGE, PUDUCHERRY.
On 24th September, 2013 at 09.30 AM at Hotel MASS, Puducherry.
Organized by:

ATTENDANCE LIST OF GOVERNMENT DEPARTMENTS AND AUTONOMOUS BODIES
FORMULATION OF CLIMATE CHANGE ACTION PLAN FOR PUDUCHERRY BY M/S CTRANCONSULTING UNDER CDRRP-WORKSHOP HELD ON 24.09.2013 IN HOTEL MASS, PUDUCHERRY

SL.NO.	NAME OF THE OFFICER	NAME OF THE DEPARTMENT
1	DR. AL NARAYANAN	ASSOC. PROFESSOR PAJAN COA KARAIKAL
2	DR. GPOXXAMOLI	ASSOUAK PNJU DEP OF EULXENU
3	R. SRIDHAR ANAND	ASST PROFESSOR SVCE KARAIKAL
4	V. MANIKANDANE	N E F, P S F, KARAIKAL
5	S SEGAR	P S F, PUDUCHERRY
6	S.CHITRA	PRESIDENT (KKL. DT.), PSF, KARAIKAL
7	K. DHANASEKARAN	BDO (A)
8	K RAJAMANIKRON	PONLAIT
9	J. PRESEAN	INDIRA GANDHI COLLEGE OF ASST & SCEINCE
10	K. SIVASSAMY	ADI DRAVIDAR WELFALE
11	M. LATHA	ADI DRAVIDAR WELFALE
12	DR. SM.SUWDARAPANDIAN	DEPT. OF ECOLOGY,PONDICHERRY UNIV
13	V.BHUVANESWARAN	TCPD,PUDUHENY
14	S.DANASSEGARANE, PROJECT OFFICER	DEPT. OF FISHERES & FISHERMAN WELFARE SOCIETY
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22	DR. R. ARUN PRASAF CGET, PONDICHERRY UNIVERSITY	CENTRE FUR GREEN TECH
23	D. GURUMURTHY	DEPT. OF FISHERES, PUDUCHERRY
24	K.THIRUMULAN	K.V.K., PUDUCHERRY
25	ROLLIN BASKAR	K.V.K., PUDUCHERRY
26	K.IVATGUMAR AG OFFICE	FORES DPET
27	DR.K.SANTHIMAGRI	HEAUA
28	DR.SITANSHU KAR	JIPMER
29	M.RISHNARAO	Do
30	R.KRISHNAVAJU	PONDIUER CO.OP.DOIY
31	S.SUDALAI	CENRA FOR POLLN CHT EM.ENSS
32	DR.A.RAMAMMRURTY	DIRCTUR OF AGRCNUM
33	L.S.SUVBRAMAWIAN	PROFURSON PEC
34	S.PAARREE	PROJET
35	SCB MOHAN	P I A
36	A.	P I A
37	T.VAUADAUAJAU	P I A
38	G.SARAVANAN AE	KARNIKAL MVMIUPAHT
39	DR.V.ROUCEYYNY	K M C P G J
40	V.THENMOZHY BABU C D P O	DEPT. OF WOMEN & CHILD DEV DEPT.
41	J.VIJAYALAKSHMI	DEPT. OF WOMEN & CHILD DEV DEPT.

SL.NO.	NAME OF THE OFFICER	NAME OF THE DEPARTMENT
42	DR.S.SABESAN	V C R C
43	DR.M.A.SIVASANKARAN	PEOF OF CE / P E C
44	R.KARIJARASAA	ASST DIROTR
45	DR.S.GOVINDARAJANE	ASSOUT PRGISS
46	DR.S.AMADASS	ASSUU
47	DR.B.GITANJALI	PROFCSSON OF PHANMACOLOGY
48	C.RAJAN	JIPMER EXECVTIVE EORGIRT PWD PVPVURTN
49	SREEPULHIY KALKU S	A G M. NABARW BOUDY
50	I.PRCUOUAUD	KEYILCO PLOUUING ANLTIONTY
51	V.RAMANTHRN	A.E
52	T.THIRUMUNGAYAN	KARNIKAL PLANNI AUAOW
53	P.BOOPATHI	STSTE TRAINING CENTRE,
54	N.MOHANRAJ	ENVIRONMENT EDUCATION ULL,STC.EDUCATION DEP PUDUCH
55	R.BALUN	P I A.
56	D.RAVI	SVDCN
57	KWOHUALUCNY	J E
58	DR.R.MANOHAVA M.V SC	J.D, A.H.D
59	DR.V AYACHRNDRAN	O.V AS,DAH $AW PUDUCHCRRY
60	V.VRIYEA NRHRU	MEUHER SECULEY
61	M.NAMACHIVAYAM	AE PUDUCHURY MURNIUP
62	K.MALLIGARJUNAN	AE MAHE MUNICIPACIY
63	K.SVIDHAR	COMML.TAXPS DEPT
64	R M P R RAHRAWJUIN	SEAC
65	K.DHANAGOVIND,T.O	INDUSTRIES DEPARTMENT
66	A.JEAUPIENE	INDUTNR AND ONMMRO
67	VIPUNBABU	PPCC
68	K.V.AVGVSZINE	KEAP
69	T.HOUANATHAN	KEAP
70	S.SEKAR	ASRI DYA
71	K.KANAGASAGI	J.E,P I A
72	N.JAYARAMAWAW	JE.PIA
73	M.SAMBATH	JE PIA
74	PROF. G CHANDRA SEKHAR	CHEMJCAL,ENGG
75	R.VID,	AELE
76	DR.R.SAGAYA ALFUD	DSTC
77	DR.N.RAMESH	DSTC
78	RURUMANI	DSTC
79	SELVANAYASI	DSTC
80	VIPIN BABU.P	DSTC
81	NAGALLA SRINIVAS RAO	DSTC
82	L.XAVIER KENNEDY	DSTC
83	P.SATHISH KUMAR	DSTC
84	E.SIVAKUMAR	DSTC
85	G.SIVASUBRAMANIAN	DSTC
86	PRABU	DSTC
87	DR.K.COUMARANE	DSTC
88	VASANTH	DSTC
89	VISHAL	DSTC
90	MOHANDASS	DSTC

ATTENDANCE LIST OF NON-GOVERNMENTAL ORGANISATIONS FORMULATION OF CLIMATE CHANGE ACTION PLAN FOR PUDUCHERRY BY M/S CTRANCONSULTING UNDER CDRRP-WORKSHOP HELD ON 24.09.2013 IN HOTEL MASS, PUDUCHERRY

SL. NO.	NAME OF THE OFFICER	NAME OF THE NGO
1	P. SANTHAMURTHY	MSSRF
2	V. VELUZILI	MULLAI
3	T. RANIJITAN	VAIGAI
4	R. DAJANGINI	BHALANI
5	VIVEK COCLHO	TISS, MUMBAI
6	DR. BIDYA RAMKUMAR	MSSRF
7	MR.C.VICTOR SLOMONRAJ	PMSSS
8	RAJARAMJI	GREEN MOVEMENT FORUM
9	RAGHAVNATHT.P.	PANDICHERY SLWI FOROM
10	T. KASTURI	KOOTU-K-KURAD VILIANGI
11	P.LACIDA	ADECOM NETWORK
12	R. DAKSHINA MOORTHY	PSE
13	D.SIVA	MGRTPERASWAMI
14	M. PRABAVATHY	PUSPAMA SHG
15	I.POORARI	PUSHPAM
16	S.RAJESWARI	JAYAM SHG
17	D.SMRUTHI	JAYAM SHG
18	A.KAITA	VANMATHI
19	D. BHABANI	HNNAI SHG
20	B.MALATHI	JARSI SHG
21	RINKI RAY	PANDYCAN
22	M. SCHAMAIRADAN	PEMFODER
23	K. RAJA	PEMFODER
24	R.J. LEMDAVED	DES
25	H. RAJA	GME
26	D. AMIT CHELIS	GREEN PATH
27	SUDERSAN	PSF
28	D. SURASU	SHG
29	RAMESH. P	ANCHITECH
30	C.H. BOLASUAR	NGO PPPC
31	THAMIJARASSY	ANBALUM
32	THAMANAIKKD	SEMORGER MEMORIAL
33	RAMESH R.	PORVAIDERY SCIENCE FOROM
34	PROBIR BANERSEE	PENDY CAN
35	K.VIJANRTHY	CARE

15. Annexure - 2: Comprehensive list of Actions Plan

15.1. Solar Mission

Sl. No.	Title	Organizations	Priority	Type	Scale	Nature	Time Frame
1	Harnessing Solar Energy potential scenario of the UT by assessment of Solar Energy potential & preparation of Solar Map	REAP	H	MI	S	RS	ST
2	Mandatory use of Solar Water heating systems in domestic sector through policy action and demonstration projects	REAP	H				
A)	Mandatory use of Solar Water Heating systems in all group houses and apartments of more than 150 sq. m. by 2016	T&CP		MI	S	PA	MT
B)	Maximizing use of Solar Water Heating systems in households of more than 1500 sq. ft. through demonstration project by 100 LPD SWH in 100 Nos. households by 2014 100 LPD SWH in 300 Nos. households by 2016	T&CP		MI	S	DP	ST
3	Promotion & facilitation of RE application in govt. schools & central kitchens of UT by		H				
A)	Installation of solar power & solar cooking technologies in 50 schools to convert those as Green schools by 2016	Directorate of School Education		MI	S	IP	MT
B)	Installation of solar concentrator based cooking system in 3 central kitchens of Puducherry region by 2014 and in all central kitchens of UT by 2016	Directorate of School Education		MI	D	IP	MT
4	Enhancement of solar lighting application in public places through demonstration projects		H				
A)	Installation of 1,000 solar street lights in Thattanchavady&Mettupalayam Industrial Estates by 2015	REAP,Department of I&C		MI	PA	IP	MT
B)	Installation of solar street lights in 9 govt. parks and 4 grounds by 2015	REAP, LAD Puducherry		MI	D	DP	MT
C)	Installation of 5,000 solar street lights in remote/ internal roads of Puducherry region by 2016	REAP, LAD		MI	S	IP	MT
5	Strengthening technical competency of various stakeholders of RE technology including O&M person, technician, installer, manufacturer & others by		H				
A)	Introduction of subject or paper on RE technology, system installation, O&M,	REAP, H&TE		MI	S	CB	ST

Sl. No.	Title	Organizations	Priority	Type	Scale	Natu re	Time Frame
	repair, etc.in all ITIs of the UT.						
B)	Introducing technical course on Renewable energy technology at Poly-technic /BE Engineering colleges.	REAP, H&TE		MI	S	CB	ST
C)	Conducting certificate courses for strengthening of technical competency of the existing solar and other RE technology service providers.	REAP, H&TE		MI	S	CB	ST
6	Promotion of Solar water heating application in health sectors by		H				
A)	Installation of Solar Water Heating systems in 8 Govt. Hospitalsby 2014	Dept. of Health & Family Welfare Services, REAP, PWD		MI	S	DP	ST
B)	Installation of Solar Water Heating systems in 39 Public Health Centers (PHC) and 4 Community Health Centre's (CHC) by 2016	Dept. of Health & Family Welfare Services, REAP		MI	S	IP	MT
C)	Mandate use of Solar Water Heating systems in all private hospitals, medical colleges and hostels by 2017 through policy measures	Dept. of Health & Family Welfare Services, REAP		MI	S	PA	MT
7	Mandatory use of Solar Water Heating system in hotel sector through		H				
A)	Installation of Solar Water Heating systems in all star rated hotels by 2014	REAP, Puducherry Tourism Dept.		MI	S	IP	ST
B)	Installation of Solar Water Heating systems in all hotels, guest houses of more than 150 sq. m by 2016	REAP, Puducherry Tourism Dept.		MI	S	IP	MT
8	Promotion of grid interactive solar power generation in PPP/IPP mode through policy measures and facilitating setting up of 20 MW rooftop and small solar power plants of up to 2 MW capacity.	REAP, Electricity Dept.	H	MI	S	PA & IP	MT
9	Promotion of solar application in public buildings for lighting and hot water usage through demonstration project of 50 kW solar power and 1000 LPD	PWD, REAP	H	MI	PA	DP	ST

Sl. No.	Title	Organizations	Priority	Type	Scale	Nature	Time Frame
	SWH installation in two govt. buildings						
10	Promotion of off-grid solar power plants by facilitating deployment of 5 MW stand-alone off-grid solar power plant of capacity within 50 - 100 kW in 12th plan period in PPP mode.	REAP	M	MI	S	PA & IP	MT
11	Promotion of Solar Water Heating Application in Institutional sector through demonstration project		M				
A)	Installation of Solar Water heating systems in govt. hostels 9 hostels of Puducherry region by 2014 9 hostels of outlying regions by 2016	REAP, Adi Dravidar Welfare Department		MI	S	DP	MT
B)	Installation of Solar Water Heating systems in special schools for differently abled children at Pillaichavady and Ariyankuppam of Puducherry Region	REAP, SW		MI	PA	DP	MT
12	Undertake research & development activity on solar technology through establishment of solar energy resource institute in the UT under National Solar Mission for R&D programmes.	REAP	M	MI	PA	RS	LT
13	Amendment of Building Bye Laws through incorporation of Renewable Power Obligation (RPO) for buildings of more than 20,000 sq. ft.	T&CPRPAs, REAP, Electricity Dept.	M	MI	S	PA	MT
14	Awareness in regard to the subsidy disbursement and information about channel partner	REAP	M	MI	S	CB	ST
15	Emphasise towards operation and maintenance of existing solar water heater	REAP	M	MI	S	OM	ST

Priority ***H – High, M – Medium, L – Low;***
Type ***MI - Mitigation, AD – Adaptation;***
Scale ***S – State-wide, A – Particular/Focused Area***
Nature ***RS - Research Study, PA - Policy Action, PS - Pre-investment Study, DP - Demonstration Project, IP - Investment Project, CB - Capacity Building, OM - Regular Operation & Maintenance;***
Timeframe ***ST – Short-term, MT - Medium Term, LT – Long term***

15.2. Mission on Enhanced Energy Efficiency

Sl. No.	Title	Organization	Priority	Type	Scale	Nature	Time Frame
1	Provisioning of CFL distribution to household and replacing incandescent lamp	REAP, PPCL, Electricity Dept.	H	MI	S	IP	MT
2	Development and promotion of Policy measures towards up-gradation of existing production/manufacturing process across the industrial facilities to energy efficient one.	REAP, PPCL, Electricity Dept., PIPDIC, I&C	H	MI	S	PA	ST
3	Enforcing Energy Audit and its implementation across the industrial facilities	REAP, PPCL, Electricity Dept., PIPDIC, I&C	H	MI	S	PA & IP	ST
4	Incorporate conditions as a part of building permit to adopt star rated energy efficient electrical appliances and use of CFL	REAP, PPA, RPA, LAD Electricity Dept.,	H	MI	S	PA	ST
5	Institution of energy conservation award	REAP, PPCL, Electricity Dept., PIPDIC	H	MI	S	PA & RO&M	ST
6	Enforcement towards use of Energy Efficient Lighting in all Govt. & commercial building	REAP, PPCL, Electricity Dept., PWD	H	MI	S	PA	ST
7	Facilitating energy audit across all large (in terms of energy consumption) government offices and retrofitting of existing energy inefficient system with efficient and star rated products	REAP, PPCL, Electricity Dept.,	H	MI	S	PA, DP	ST
8	Promoting and Adapting Energy Efficient technology measures and practices in new building	T & CP, RPAs, REAP, Electricity, PWD	H	MI	S	PA, IP	ST
9	Creation of green corpus fund	REAP, PPCL, Electricity Dept	H	MI	S	PA	ST
10	Enlist Certified Energy Auditor and Energy Manager with State Designated Agency (Nodal Department) under BEE for implementation of Energy Conservation Act	REAP	M	MI	S	PA	MT
11	Implementation of Energy Efficient Street light, Public /Community Lighting facility and Traffic Light system.	REAP, Electricity Dept., Urban Local Bodies	M	MI	S	PS, IP	MT

Sl. No.	Title	Organization	Priority	Type	Scale	Nature	Time Frame
12	Provisioning of Property Tax concession for building implementing energy conservation measures.	REAP, Finance Dept, Planning Dept, Commercial Tax	L	MI	S	PA	MT
13	Extending Debt service concession by FI of Government to GRIHA certified building	REAP, Finance Dept, Planning Dept, FI	L	MI	S	PA	MT
14	Commissioning of UT Level Energy Education Park	REAP	L	MI	A	DP,IP	LT
15	Creation of Green corpus fund to abate over exploitation of fossil fuel and encourage energy conservation	REAP	L	MI	S	PA, PS	MT
16	Promotion of Organic LED	REAP, Electricity Dept.	L	MI	S	CB	LT
17	Promoting auto sensor in domestic household, office building and complex to prevent water loss as well as energy due to over flow of water from overhead pump	REAP, Electricity Dept.	L	MI	S	IP	LT

Priority	***H – High, M – Medium, L – Low;***
Type	***MI - Mitigation, AD – Adaptation;***
Scale	***S – State-wide, A – Particular / Focused Area***
Nature	***RS - Research Study, PA - Policy Action, PS - Pre-investment Study, DP - Demonstration Project, IP - Investment Project, CB - Capacity Building, OM - Regular Operation & Maintenance;***
Timeframe	***ST – Short-term, MT - Medium Term, LT – Long term***

15.3. Sustainable Habitat Mission

Sl. No.	Title	Organizations	Priority	Type	Scale	Nature	Time Frame
1	Adopting ECBC code for residential apartments and commercial centers	T&CP	H	MI	S	PA	ST
2	Waste water recycling & Strengthening/ modifications of exiting STPs	T&CP	H	MI	S	PA	MT
3	Promotion of Green buildings and green building certificate	T&CP	H	MI	S	PA	MT
4	Integrated municipal solid waste management	LAD	H	MI	S	IP/OM	MT
5	Establishment of modern slaughter house within Puducherry Municipality	LAD	H	MI	A	IP	ST
6	Capacity building programmes of Urban Local Bodies (ULBs)/ stakeholders of the coastal towns on potential climate change impacts (Tsunami, cyclone, flooding of low-lying coastal areas, land loss and displacement) and additional preparedness requirements.	LAD	H	AD	S	CB	ST
7	Construction of Flyover and laying of bypass road	PWD	H	AD	A	IP	MT
8	Providing/ renewing underground sewerage systems to urban areas	PWD	H	MI	A	IP/ OM	MT
9	Promotion of eco-friendly road construction methods and capacity building of stakeholders	PWD	H	AD	S	PA/CB	ST
10	Climate friendly transport management and promotion of Public transport	Transport	H	MI	S	PA	ST
11	Promotion of use of cooking gasfrom kitchen waste in bio-digester	REAP	H	MI	S	DP	ST
12	Strengthening/ modifications of exiting STPs	PWD	M	MI	A	IP/ OM	ST
13	Installation of Bio Medical Waste Management facilities in public sector hospitals	Health Dept.	M	MI	A	IP	LT
14	Capacity building and training of health care facilities personnel on biomedical waste management	Health Dept.	M	AD	S	CB	MT
15	Developing climate- responsible master plans for selected city/towns (CDP)	T&CP	M	AD	A	RS/PS	MT
16	Adapting preventive and mitigation measures to contain spreading of contagious diseases during natural calamities	Health Dept.	M	AD	S	IP	LT
17	Compliance of all the Hospitals, Medical college, Health Care facilities and all Veterinary care centers with provisions of BMW Rule, 1998	Health Dept.	M	MI	S	OM	MT

Sl. No.	Title	Organizations	Priority	Type	Scale	Nature	Time Frame
18	Promotion of urban tree plantation with a view to realize the co-benefits with respect to climate change effects as well as carbon sinks on a pilot basis and to establish a plan to scale-up across the UT	Forestry Dept.	M	MI	S	PA/ DP	MT
19	Recycling and Reuse of the Building and road constructionmaterials	PWD	M	MI	S	DP	LT
20	Installation of CNG dispensing centers	Transport	M	AD	S	IP	LT
21	Periodic vehicular emission test	Transport	M	AD	S	OM	ST
22	Implement a demonstration project of bio-fuel extraction &utilisation for transportation	Transport Dept.	M	MI	A	DP	MT
23	Assessment and inventorisation of climate change impact on urban sector will help to quantify the share of Urban Sector in the pollutant levels in the city/towns	LAD	L	AD	S	RS	MT
24	Urban poor Mapping to Identify vulnerable urban population	LAD	L	AD	S	PS	MT
25	Tax concessions for eco friendly vehicles	Transport	L	AD	S	PA	MT
26	Effective enforcement of Motor Vehicles Act to discourage use of old vehicles	Transport	L	AD	S	PA	MT
27	Quantitative assessment of the impact of climate change	Transport	L	AD	S	RS	ST
28	Initiate the implementation of the energy-efficiency initiatives in urban street lighting in Puducherry and other district towns	REAP	L	MI	S	PA/IP	MT

Priority	***H – High, M – Medium, L – Low;***
Type	***MI - Mitigation, AD – Adaptation;***
Scale	***S – State-wide, A – Particular/Focused Area***
Nature	***RS - Research Study, PA - Policy Action, PS - Pre-investment Study, DP - Demonstration Project, IP - Investment Project, CB - Capacity Building, OM - Regular Operation &Maintenance;***
Timeframe	***ST – Short-term, MT - Medium Term, LT – Long term***

15.4. Mission for a Green Puducherry &Sustainable Agriculture

Sl. No.	Title	Organizations	Priority	Type	Scale	Nature	Time Frame
1	Enhancing productivity through introduction of genetically superior seedlings	Dept. F&WL	H	MI	S	IP	MT
2	Eco-restoration of coastal areas by bio shelter plantations	Dept. F&WL	H	MI	S	IP	MT
3	Wildlife and biodiversity conservation by Insitu &exsitu methods	Dept. F&WL	H	AD	S	IP	MT
4	Enrichment of existing forest density	Dept. F&WL	H	MI	A	IP	MT
5	Promotion of farm forestry and agro forestry	Dept. F&WL	H	MI	S	IP	MT
6	Consolidationand protection of forests	Dept. F&WL	H	MI	S	PA	MT
7	Water shed development through vegetative means	Dept. F&WL	H	MI	S	IP	MT
8	Development of ecotourism and involving local communities	Dept. F&WL	H	AD	S	IP	ST
9	Identification and propagation of adaptive species through modern nurseries	Dept. F&WL	H	MI	S	RS	ST
10	Study on REED & REED +feasibility for afforestation in Puducherry	Dept. F&WL	H	MI	S	RS	ST
11	Capacity building of staff	Dept. F&WL	H	AD	S	CB	MT
12	Protection of Mangrove forests	Dept. F&WL	H	MI	S	PA	MT
13	Monitoring critical faunal habitats [turtles/ littoral birds] to assess impact of climate change	Dept. F&WL	H	AD	S	OM	MT
14	Drip Irrigation for 30% of land area under Horticulture	Dept. of Agri., KVK	H	MI	S	IP	MT
15	Promotion of solar pumps for irrigation purpose by replacing 5 nos. diesel pumps with solar pumps	REAP, Dept. of Agri.	H	MI	A	DP	ST
16	Educating farmers on better cropping systems, drought resistance crop, minimization of chemical fertilizer and encouraging organic farming and soil reclamation program	Dept. of Agri.	H	AD	S	RS, CB	MT
17	Replacing existing pumps by foot valve motor pumps in Karaikal region	Dept. of Agri. REAP, Electricity Dept.	H	MI	A	IP,	MT
18	Marine Biodiversity conservation through Artificial coral reef	Dept. F&WL	M	AD	S	IP	MT
19	Promotion of Integrated weed management (IWM) and Integrated pest	Dept. of Agri.	M	AD	S	PA	MT

Sl. No.	Title	Organizations	Priority	Type	Scale	Nature	Time Frame
	management (IPM))						
20	Study and commercialization of Combined use of remote sensing, GIS (Geographic Information System) and GPS (Global Positioning System) towards detecting, mapping and monitoring the spread of weeds over inaccessible areas and disease intensity for risk mapping and epidemiological purposes.	Dept. of Agri.	M	AD	S	RS	MT
21	Studies towards selection of adaptable genotypes, genetic manipulation to overcome extreme climatic stresses.	Dept. of Agri.	M	AD	S	RS	MT
22	Promoting drip irrigation since drip irrigation minimizes water losses due to run-off and deep percolation and water savings of 50-80% are achieved when compared to most traditional surface irrigation methods.	Dept. of Agri.	M	AD	S	IP	MT
23	Training of farmers over simple, affordable and accessible technologies like, mulching and use of shelters and raised beds[102] help to conserve soil moisture, prevent soil degradation, and protect vegetables from heavy rains, high temperatures, and flooding. The use of mulch helps reduce evaporation, moderate soil temperature, reduce soil runoff and erosion, protect fruits from direct contact with soil and minimize weed growth.	Dept. of Agri.	M	AD	S	CB	MT
24	Development of heat and/or drought and/or salt tolerant genotypes.	Dept. of Agri.	M	AD	S	IP	ST
25	Undertaking research over planting dates (early or late showing) to avoid heat stress during flowering and maturity of crop.	Dept. of Agri.	M	AD	S	RS	ST
26	Promoting crop insurance as a strategic intervention for covering risks of climatic extremes.	Dept. of Agri.	M	AD	S	IP	MT
27	Promotion of use of organic sources of nutrients and avoiding use of chemical pesticides and conservation of agricultural land from degradation	Dept. of Agri.	M	AD	S	IP	MT
28	Facilitating the concept of precision farming, improved nutrient management, use of efficient microbes, inter cropping/mixed cropping, agro horticulture,	Dept. of Agri.	M	AD	S	PS	MT

[102] *Planting vegetables in raised beds can ameliorate the effects of flooding during the rainy season*

Sl. No.	Title	Organizations	Priority	Type	Scale	Nature	Time Frame
	agro forestry and indigenous technological knowledge.						
29	Use of genetic engineering to convert C-3 crops to the more carbon responsive C-4 crops to achieve greater photosynthetic efficiency for obtainingincreased productivity at higher levels of carbon dioxide in the atmosphere or sustain thermal stresses.	Dept. of Agri.	M	AD	S	IP	LT
30	Creation of database to record collection and dissemination of information on fish availability status up to 12 nautical miles and climatic changes of the ocean.	Dept. of Fishs.	M	AD	S	DP	MT
31	Conservation of genetic resources of marine flora and fauna	Dept. of Fishs.	M	AD	S	PS	MT
32	Conservation of marine turtles	Dept. of Fishs.	M	AD	S	IP	MT
33	Promotion of sustainable coastal tourism	Dept. of Fishs.	M	AD	S	IP	MT
34	Providing veterinary health services to farmers, livestock owners and pet owners	Dept. of Animal Husbandry	M	AD	S	IP	LT
35	Promoting Soil solarization technique (Soil solarization plays a big role in the management of weeds, nematodes and pathogens under the conditions of increased temperature)	Dept. of Agri.	L	AD	S	IP	MT
36	Prediction of Probable Distribution of Crop Diseases under Climate Change Scenario for Long-term Strategic Decisions.	Dept. of Agri.	L	AD	S	IP	MT
37	Developing crop varieties tolerant to salinity, long dry spell and suitable to rain fed agriculture.	Dept. of Agri.	L	AD	S	IP	LT
38	Research over the possible options of grafting of susceptible plant (scion) on tolerant plant.	Dept. of Agri.	L	AD	S	RS	ST
29	Undertaking research over use of biotechnology in plant breeding.	Dept. of Agri.	L	AD	S	RS	MT
40	Field testing and assessment of viability of conservation agriculture across the four isolated regions.	Dept. of Agri.	L	AD	S	RS	ST
41	Demarcation of eco protected areas	Dept. of Fishs.	L	AD	S	IP	MT
42	Setting up marine Oceanarium	Dept. of Fishs.	L	AD	S	IP	MT
43	Creation of green belt in and around the industries to abate pollution	Department of	L	MI	S	IP	LT

Sl. No.	Title	Organizations	Priority	Type	Scale	Nature	Time Frame
		Forest					
44	Concept of City Forest, Biodiversity Park, Orchid garden, Botanical garden, Rose Garden.	Department of Forest	L	MI	S	IP	LT
45	Enhancing productivity through introduction of genetically superior seedlings	Dept. F&WL	L	MI	S	IP	ST
45	Enhancing productivity through introduction of genetically superior seedlings	Dept. F&WL	L	AD	S	IP	ST
46	Regulatingreal estate and prevention encroachment of land under forest/ plantation/ agriculture	Dept. F&WL, Dept. of Agriculture	L	MI	S	PA	ST
47	Promoting gender parity while determining agriculture wages	Dept. F&WL, Dept. of Agriculture	L	AD	S	PA	ST
48	Introduction of Early warning system at agriculture department to support farmer in cropping and contingency planning	Dept. of Agriculture	L	AD	S	IP	MT

Priority	***H – High, M – Medium, L – Low;***
Type	***MI - Mitigation, AD – Adaptation;***
Scale	***S – State-wide, A – Particular/Focused Area***
Nature	***RS - Research Study, PA - Policy Action, PS - Pre-investment Study, DP - Demonstration Project, IP - Investment Project, CB - Capacity Building, OM - Regular Operation & Maintenance;***
Timeframe	***ST – Short-term, MT - Medium Term, LT – Long term***

15.5. Water Mission

Sl. No.	Title	Organizations	Priority	Type	Scale	Nature	Time frame
1	Drip Irrigation for 30% of land area under Horticulture	Dept. of Agri, KVK	H	AD	S	IP	MT
2	Rain water harvesting pond creation of 10% of land area	Dept. of Agri.	H	AD	S	IP/OM	MT
3	Desiltation of all the temples and village/ farm ponds	LAD	H	AD	S	IP	MT
4	Channelising storm water into village pond or ground water recharge	LAD	H	AD	S	IP/OM	MT
5	Promotion of percolation pits in housing colonies and in urban areas	PWD	H	AD	A	DP	ST
6	Promoting Rain water harvesting arrangements as per building by-laws in all new Public buildings of terrace area more than 200 sq.m or Plot area more than 300 sq. m, in all existing Public buildings of terrace area more than 200 sq.m or Plot area more than 300 sq. m in phased manner, in all new Residential buildings of terrace area more than 100 sq.m or Plot area more than 200 sq. m,in all existing Residential buildings of terrace area more than 100 sq.m or Plot area more than 200 sq. m in phased manner, in all new Commercial buildings of terrace area more than 100 sq.m or Plot area more than 200 sq. m, all existing Commercial buildings of terrace area more than 100 sq.m or Plot area more than 200 sq. m in phased manner, all new Industrial buildings of terrace area more than 100 sq.m or Plot area more than 200 sq. m, all existing Industrial buildings of terrace area more than 100 sq.m or Plot area more than 200 sq. m in phased manner	PWD. T&CP, Dept. of Industries, PPCB	H	AD	A	DP	ST
7	Integrated Water Resources Management	LAD	M	AD	S	CB	MT
8	Capacity building of communities on adaptation options required for integrated demand side as well as supply side strategies during climate stressed condition	LAD	M	AD	S	CB	ST
9	Impact assessment study of climate change on aquatic ecosystem	LAD	M	AD	S	RS	ST
10	Promotion of dual flash type toilet in all new households/ new constructions	PWD	M	AD	S	PA/IP	ST
11	Promotion of water less urinals, auto flushing group urinals, electronic sensor taps etc. in public buildings, hospitals, commercial spaces to consume less water	PWD	M	AD	S	PA/DP	ST
12	Recycling of waste water for toilet flushing in new households	PWD	M	MI	A	IP/OM	ST
13	Fixation of water pricing based on rate of consumption	PWD	L	AD	S	PA	MT

Sl. No.	Title	Organizations	Priority	Type	Scale	Nature	Time frame
14	Increasing the water use efficiency, bench marking and water audit in irrigation project	Dept. of Agri.	L	AD	S	DP/OM	LT
15	Establishment of water Resource Department	PWD	M	AD	S	PA	MT
16	Promoting SRI and providing financial benefit for cultivation of less water intensive crops	Dept. of Agri., PWD	M	AD	S	PA	MT
17	Maintenance of existing rain water harvesting structure	PWD	M	AD	S	OM	MT
18	License to be provided to package water industry after through study of the ground water level in the region	PWD	L	AD	S	PA	MT

Priority	***H – High, M – Medium, L – Low;***
Type	***MI - Mitigation, AD – Adaptation;***
Scale	***S – State-wide, A – Particular/Focused Area***
Nature	***RS - Research Study, PA - Policy Action, PS - Pre-investment Study, DP - Demonstration Project, IP - Investment Project, CB - Capacity Building, OM - Regular Operation & Maintenance;***
Timeframe	***ST – Short-term, MT - Medium Term, LT – Long term***

15.6. Strategic Knowledge Mission

Sl.No.	Title	Organizations	Priority	Type	Scale	Nature	Time Frame
1	Creating awareness on water and energy conservation, composting, source segregation of House hold waste, plantation	DSTE	H	AD	S	CB	MT
2	Educating farmers on better cropping systems, drought resistance crop, minimization of chemical fertilizer and encouraging organic farming and soil reclamation program	Dept. of Agri	H	AD	S	RS, CB	MT
3	Advocating clean development mechanism, resource conservation and waste minimization through seminar/ workshop	DSTE	H	MI	S	CB	ST
4	Capacity building on mitigation/adaptation of Green House Gases among the officers and establishment of a climate change cell	DSTE	H	MI	S	CB	ST
5	Inventorisation of GHG generation from industries and other sectors	DSTE	H	MI	S	RS	ST
6	Setting up of Energy Bench Mark for all government buildings/ institutions	Electricity Department	H	MI	S	PA, CB	ST
7	Establishing a network of knowledge institutions, location specific research on climate science, setting up of an effective mechanism for data sharing and access and organizing conferences/ workshops on climate change and related issues	DSTE(DSTE) and Puducherry Council for Science and Technology	H	AD	S	PS, IP, CB	MT
8	Evaluation of action plan programmes and providing budget support to implementing departments/ authorities	DSTEand Planning and Research Department	H	AD	S	RS	MT
9	Studies on impact of climate change on disease incidence, surface and ground water resources. Establishment of forecasting arrangement for agricultural and health sector	DSTE	M	AD	S	RS	MT
10	Climate mandate Hazards risks vulnerability assessment and mapping for the coastal regions	DSTE	M	AD	S	RS	ST
11	Framing up e-governance related to climate Change action plan	DSTE	M	AD/ MI	S	IP	LT

Priority	*H – High, M – Medium, L – Low;*
Type	*MI - Mitigation, AD – Adaptation;*
Scale	*S – State-wide, A – Particular / Focused Area*
Nature	*RS - Research Study, PA - Policy Action, PS - Pre-investment Study, DP - Demonstration Project, IP - Investment Project, CB - Capacity Building, OM - Regular Operation & Maintenance;*
Timeframe	*ST – Short-term, MT - Medium Term, LT – Long term*

15.7. Coastal Mission

Sl.No.	Title	Organizations	Priority	Type	Scale	Nature	Time Frame
1	Demarcation of HTL or LTL along the coastal stretches and preparation of revised coastal Zone Management Plan	DSTE, PIA, TCP, PCZMA, Anna University	H	AD	A	RS, PS	MT
2	Integrated Coastal Zone Management Plan Preparation	TCP, PWD, LAD, Fisheries, Agriculture, DSTE	H	AD	A	RS, PS	ST
3	Flood Mapping and Development of Climate change projection Model and its impact on coastal ecosystem in Puducherry	DRDM, PIA, DSTE	H	AD	S	RS, PS	ST
4	Assessment of Erosion prone Area with the help of Digital elevation model and strengthen coastal protection method through improved technology	PWD, Port,	H	AD	A	PS	ST
5	Study on Micro level vulnerability assessment due to climate change on coastal ecosystem	PCZMA, DRDM, Fisheries	H	AD	S	RS,	MT
6	DPR on flood shelters, multipurpose cyclone shelters in vulnerable location in Coastal line and construction of flood shelters, multipurpose cyclone shelters and climate resilient buildingsand infrastructure including electrical networkthat can withstand multiple hazards	PIA, DRDM,	H	AD	A	PS, IP	LT
7	Development of a techno legal regime for construction of Disaster resilient housing and public infrastructure	DRDM, PIA, PWD, TCP	H	AD	S	RS,	MT
8	Integration of Climate change risk in the disaster Management policy of the UT	DRDM, DSTE	H	AD	S	PA	ST
9	Establishment of an integrated training and Capacity building protocoland knowledge management for better assessment of climate risks and best management practices	DRDM, DSTE	H	AD	S	CB	ST
10	Study on Impact of Climate change on Marine Biodiversity with special emphasis on Flagship species and coastal flora and fauna	Forest, DSTE	H	AD	S	PA	ST
11	Strengtheningdelivering and monitoring system and preparedness in	DRDM, DSTE, PIA,	H	AD	S	OM,	ST

Sl.No.	Title	Organizations	Priority	Type	Scale	Nature	Time Frame
	disaster prone coastal area	PWD				CB	
12	GIS based mapping along the selected vulnerable coastal area of Puducherry	DRDM, DSTE, TCP, Agriculture	H	AD	S	RS, PS	ST
13	Development of Sustainable aquaculture	DSTE, Fisheries	M	AD	S	IP, PS	ST
14	Preservation of sand dunes, mangroves undertaking dredging and creation of drainage	PCZMA	M	AD	A	IP	MT
15	Study on sea level rise	PCZMA	M	AD	A	RS	MT

Priority	***H – High, M – Medium, L – Low;***
Type	***MI - Mitigation, AD – Adaptation;***
Scale	***S – State-wide, A – Particular / Focused Area***
Nature	***RS - Research Study, PA - Policy Action, PS - Pre-investment Study, DP - Demonstration Project, IP - Investment Project, CB - Capacity Building, OM - Regular Operation & Maintenance;***
Timeframe	***ST – Short-term, MT - Medium Term, LT – Long term***

16. Annexure - 3: Mission wise M&E Target

16.1. Solar Mission

Sl. No.	2014	2015	Organizations
1	Installation of Solar water heater in 100 Nos. households of size more than 1500 sq. ft.	Installation of Solar water heater in 300 Nos. households of size more than 1500 sq. ft.	REAP
2	Installation of Solar Water Heating systems in all star rated hotels, medical colleges and hostels	All the Hotels	REAP Electricity, RPAs,
3	Installation of Solar Water Heating in hospitals, hotels, guest house, schools, group houses, apartments of more than 150 sq.mt		REAP Electricity, RPAs,
4	Installation of Solar Water heating systems in all 9 hostelsin govt. buildings of Puducherry	Installation of Solar Water heating systems in all 9 hostels in govt. buildings in all outlying regions	REAP Adi Dravidar Welfare
5	Installation of solar concentrator based cooking system in3 central kitchens	Installation of solar concentrator based cooking system in all central kitchens of UT	REAP Directorate of School Education
6	Installation of Solar Water Heating systems in Govt. Hospitals, Maternity Hospitals	Installation of Solar Water Heating systems in all Public Health Centers (PHC)	REAP Health
7	Installation of Solar Water Heating systems in special schools for differently abled children at Pillaichavady and Ariyankuppam of Puducherry Region		REAP Social Welfare
8	Providing1,000 solar street lights in Thattanchavady&Mettupalayam Industrial Estates	Providingsolar street lights in all Industrial Estates	REAP Industries
9	Installation of solar street lights in 9 govt. parks and 4 grounds (subject to availability of Fund)	Installation of 5,000 solar street lights in remote/ internal roads of Puducherry region by 2016	REAP LAD

16.2. Mission on Enhanced Energy Efficiency

Sl. No.	2014	2015	Organizations
1	Provisioning of CFL distribution to household and replacing incandescent lamp in all new buildings	Provisioning of CFL distribution to household and replacing all incandescent lamp	REAP, PPCL, Electricity Dept.
2	Development and promotion of Policy measures towards up-gradation of existing production/manufacturing process across the industrial facilities to energy efficient one in 17 categories of highly polluting units	Development and promotion of Policy measures towards up-gradation of existing production/manufacturing process across the industrial facilities to energy efficient one in all large and medium industries	REAP, PPCL, Electricity Dept., PIPDIC, Industries & Commerce
3	Enforcing Energy Audit and its implementation in large scale industrial facilities	Enforcing Energy Audit and its implementation in medium scale industrial facilities	REAP, PPCL, Electricity Dept., PIPDIC, Industries & Commerce
4	Incorporate conditions as a part of building permit to adopt star rated energy efficient electrical appliances and use of CFL		REAP, PPA, RPA, LAD Electricity Dept.,
5	Institution of energy conservation award for industries	Institution of energy conservation award for commercial establishments	REAP, PPCL, Electricity Dept., PIPDIC
6	Enforcement of mandatory use of Energy Efficient Lighting in all Govt. Departments of area more than 10,000 sq. ft.	Enforcement of mandatory use of Energy Efficient Lighting in all Govt. Departments of area more than 5,000 sq. ft.	REAP, PPCL, Electricity Dept., PWD
7	Facilitating energy audit across all large (in terms of energy consumption) government offices and retrofitting of existing energy inefficient system with efficient and star rated products		REAP, PPCL, Electricity Dept.,
8	Promoting and Adapting Energy Efficient technology measures and practices in new building of area more than 10,000 sq. ft.	Promoting and Adapting Energy Efficient technology measures and practices in new building of area more than 5,000 sq. ft.	T & CP, RPAs, REAP, Electricity, PWD

Sl. No.	2014	2015	Organizations
9	Enlist Certified Energy Auditor and Energy Manager with State Designated Agency (Nodal Department) under BEE for implementation of Energy Conservation Act		REAP
10	Implementation of Energy Efficient Street light, Public /Community Lighting facility and Traffic Light system		REAP, Electricity Dept., Urban Local Bodies
11	Provisioning of Property Tax concession for building implementing energy conservation measures.		REAP, Finance Dept, Planning Dept, Commercial Tax
12	Extending Debt service concession by FI of Government to GRIHA certified building		REAP, Finance Dept, Planning Dept, FI
13	Commissioning of UT Level Energy Education Park in Puducherry		REAP
14	Creation of Green corpus fund to abate over exploitation of fossil fuel and encourage energy conservation		REAP

16.3. Sustainable Habitat Mission

Sl. No.	2014	2015	Organizations
1	Adopting ECBC code for residential apartments and commercial centers in Urban areas	Adopting ECBC code for residential apartments and commercial centers in rural areas	Town & Country Planning (T&CP)
2	Waste water recycling in commercial establishments generating 10,000 LPD and industries generating more than 50,000 LPD	Waste water recycling in commercial establishments generating 5,000 LPD and industries generating more than 10,000 LPD	Town & Country Planning (T&CP)
3	Promotion of Green buildings and green building certificate for all new buildings of area more than 10000 sq. ft.		Town & Country Planning (T&CP)
4	Developing climate- responsible master plans for selected city/towns (CDP)		Town & Country Planning (T&CP)
5	Integrated Municipal solid waste management: Establishment of integrated common municipal solid waste treatment facility at Kurumbapet	Municipal solid waste management: Establishment of integrated common municipal solid waste treatment facility in other municipalities and common Panchayats	Local Administration Dept. (LAD)
6	Establishment of modern slaughter house within Puducherry Municipality		Local Administration Dept. (LAD)
7	Capacity building programmes of Urban Local Bodies (ULBs) of the coastal towns on potential climate change impacts (Tsunami, cyclone, flooding of low-lying	Capacity building programmes of all stakeholders of the coastal towns on potential climate change impacts (Tsunami, cyclone, flooding of low-lying coastal areas,	Local Administration Dept. (LAD)

Sl. No.	2014	2015	Organizations
	coastal areas, land loss and displacement) and additional preparedness requirements.	land loss and displacement) and additional preparedness requirements.	
8	Assessment and inventorisation of climate change impact on urban sector will help to quantify the share of Urban Sector in the pollutant levels in the city/towns		Local Administration Dept. (LAD)
9	Urban poor Mapping to Identify vulnerable urban population		Local Administration Dept. (LAD)
10	Installation of Bio Medical Waste Management facilities in public sector hospitals		Health Dept.
11	Capacity building and training of health care facilities personnel on biomedical waste management		Health Dept.
12	Adapting preventive and mitigation measures to contain spreading of contagious diseases during natural calamities		Health Dept.
13	Compliance of all the Hospitals, Medical college, Health Care facilities and all Veterinary care centers with provisions of BMW Rule, 1998		Health Dept.
14	Promotion of urban tree plantation with a view to realize the co-benefits with respect to climate change effects as well as carbon sinks on a pilot basis and to establish a plan to scale-up across the UT		Forestry Dept.
15	Construction of Flyover and laying of bypass road	Construction of Flyover and laying of bypass road	Public Works Dept. (PWD)
16	Providing/ renewing underground sewerage systems to urban areas	Providing/ renewing underground sewerage systems to semi urban areas	Public Works Dept. (PWD)
17	Strengthening/ modifications of exiting STPs	Providing 3 additionalSTPs to treat 50 MLD in Puducherry	Public Works Dept. (PWD)
18	Promotion of eco-friendly road construction methods and capacity building of stakeholders		Public Works Dept. (PWD)
19	Recycling and Reuse of the Building and road constructionmaterials		Public Works Dept. (PWD)
20	Phase out old vehicles more than 20 years	Phase out old vehicles more than 15 years	Transport

Sl. No.	2014	2015	Organizations
21	Installation of CNG dispensing centers within Puducherry city limit	Installation of CNG dispensing centers in all areas other than Puducherry city limit	Transport
22	Tax concessions for eco friendly vehicles		Transport
23	Effective enforcement of Motor Vehicles Act to discourage use of old vehicles		Transport
24	Promoting Bijilee (Battery Operated Vehicles) within Puducherry city limit	Promoting Bijilee (Battery Operated Vehicles) in all areas other than Puducherry city limit	Transport
25	Periodic vehicular emission test : Setting up 50 nos. of automobile emission testing centres	Periodic vehicular emission test : Setting up 100 nos. of automobile emission testing centres	Transport
26	Switching of fuels and promotion of LPG/CNG in auto, new cars, new autos, taxis	Switching of fuels and promotion of LPG/CNG in PRTC buses	Transport
27	Promotion of public transport and mass transport within the city and town area will help in reducing GHG emissions within Puducherry city limit	Promotion of public transport and mass transport within the city and town area will help in reducing GHG emissions in all areas other than Puducherry city limit	Transport
28	Quantitative assessment of the impact of climate change		Transport
29	Using cooking gas from kitchen waste in 10 Nos. govt. guest/rest house, govt. office canteen, govt. training centers by 2015		REAP
30	Implementation of 30 Nos. bio-digesters in all central kitchens, temples, Anganwadicenters, govt. hostels of UT by 2017 and promotion of Community biogas plant in Dairies, village Panchayats, hostels, special schoolsetc.		REAP, Adi Dravidar Welfare, Dept. of Health, BDO/DRDA, Dept. of Education
31	Initiate the implementation of the energy-efficiency initiatives in urban street lighting in Puducherry	Initiate the implementation of the energy-efficiency initiatives in urban street lighting in other district towns	Renewable Energy Agency Puducherry

Sl. No.	2014	2015	Organizations
			(REAP)
32	Promotion of Bio-fuel and conducting research and development study		Renewable Energy Agency Puducherry (REAP)
33	Implement a demonstration project of bio-fuel extraction &utilisation for transportation		Transport Dept.

16.4. Mission for a Green Puducherry &Sustainable Agriculture

Sl. No.	2014	2015	Organizations
1	Enhancing tree cover in urban areas through afforestation	Enhancing tree cover in semi urban areas through afforestation	Dept. of Forest and wildlife
2	Enhancing productivity through introduction of genetically superior seedlings		Dept. of Forest and wildlife
3	Eco-restoration of coastal areas by bio shelter plantations		Dept. of Forest and wildlife
4	Wildlife and biodiversity conservation by Insitu & exsitu methods		Dept. of Forest and wildlife
5	Enrichment of existing forest density in Puducherry city limit	Dept. of Forest and wildlife	Department of Forest and wildlife
6	Promotion of farm forestry and agro forestry		Dept. of Forest and wildlife
7	Consolidationand protection of forests		Dept. of Forest and wildlife
8	Water shed development through vegetative means in Puducherry city limit	Dept. of Forest and wildlife	Department of Forest and wildlife
9	Development of ecotourism and involving local communities in Puducherry city limit	Dept. of Forest and wildlife	Department of Forest and wildlife
10	Installation of 5 Solar Pumps as demo for irrigation		REAP, Agriculture
11	Identification and propagation of adaptive species through modern nurseries		Dept. of Forest and wildlife
12	Study on REED & REED +feasibility for afforestation in Puducherry		Dept. of Forest and wildlife
13	Capacity building of staff		Dept. of Forest and wildlife

Sl. No.	2014	2015	Organizations
14	Protection of Mangrove forests		Dept. of Forest and wildlife
15	Marine Biodiversity conservation through Artificial coral reef		Dept. of Forest and wildlife
16	Monitoring critical faunal habitats [turtles/ littoral birds] to assess impact of climate change		Dept. of Forest and wildlife
17	Drip Irrigation for 15% of land area under Horticulture	Drip Irrigation for 30% of land area under Horticulture	Dept. of Agriculture, KVK
18	Educating farmers on better cropping systems, drought resistance crop, minimization of chemical fertilizer and encouraging organic farming and soil reclamation program		Department of Agriculture
19	Replacing existing pumps by foot valve motor pumps in Karaikal region	Replacing existing pumps by foot valve motor pumps inthe UT	Department of Agriculture, REAP, Electricity Dept
20	Promoting Soil solarization technique (Soil solarization plays a big role in the management of weeds, nematodes and pathogens under the conditions of increased temperature)		Department of Agriculture
21	Promotion of Integrated weed management (IWM) and Integrated pest management (IPM))		Department of Agriculture
22	Study and commercialization of Combined use of remote sensing, GIS (Geographic Information System) and GPS (Global Positioning System) towards detecting, mapping and monitoring the spread of weeds over inaccessible areas and disease intensity for risk mapping and epidemiological purposes.		Department of Agriculture
23	Prediction of Probable Distribution of Crop Diseases under Climate Change Scenario for Long-term Strategic Decisions. .		Department of Agriculture
24	Studies towards selection of adaptable genotypes, genetic manipulation to overcome extreme climatic stresses.		Department of Agriculture
25	Promoting drip irrigation since drip irrigation	Promoting drip irrigation since drip irrigation	Department of

Sl. No.	2014	2015	Organizations
	minimizes water losses due to run-off and deep percolation and water savings of 50% are achieved when compared to most traditional surface irrigation methods.	minimizes water losses due to run-off and deep percolation and water savings of 80% are achieved when compared to most traditional surface irrigation methods.	Agriculture
26	Training of farmers over simple, affordable and accessible technologies like, mulching and use of shelters and raised beds[103] help to conserve soil moisture, prevent soil degradation, and protect vegetables from heavy rains, high temperatures, and flooding. The use of mulch helps reduce evaporation, moderate soil temperature, reduce soil runoff and erosion, protect fruits from direct contact with soil and minimize weed growth.		Department of Agriculture
27	Research over the possible options of grafting of susceptible plant (scion) on tolerant plant.		Department of Agriculture
28	Development of heat and/or drought and/or salt tolerant genotypes.		Department of Agriculture
29	Undertaking research over use of biotechnology in plant breeding.		Department of Agriculture
30	Field testing and assessment of viability of conservation agriculture across the four isolated regions.		Department of Agriculture
31	Undertaking research over planting dates (early or late showing) to avoid heat stress during flowering and maturity of crop.		Department of Agriculture
32	Promoting crop insurance as a strategic intervention for covering risks of climatic extremes.		Department of Agriculture
33	Promotion of use of organic sources of nutrients and avoiding use of chemical pesticides.		Department of Agriculture
34	Facilitating the concept of precision farming, improved nutrient management, use of efficient microbes, inter cropping/mixed cropping, agro horticulture, agro forestry and indigenous technological knowledge.		Department of Agriculture

[103] *Planting vegetables in raised beds can ameliorate the effects of flooding during the rainy season*

Sl. No.	2014	2015	Organizations
35	Developing crop varieties tolerant to salinity, long dry spell and suitable to rain fed agriculture.		Department of Agriculture
36	Use of genetic engineering to convert C-3 crops to the more carbon responsive C-4 crops to achieve greater photosynthetic efficiency for obtainingincreased productivity at higher levels of carbon dioxide in the atmosphere or sustain thermal stresses.		Department of Agriculture
37	Creation of database to record collection and dissemination of information on fish availability status up to 12 nautical miles and climatic changes of the ocean.		Department of Fisheries
38	Demarcation of eco protected areas in Puducherry city limit	Demarcation of eco protected areas in all areas other than Puducherry city limit	Department of Fisheries
39	Conservation of genetic resources of marine flora and fauna		Department of Fisheries
40	Conservation of marine turtles		Department of Fisheries
41	Promotion of sustainable coastal tourism		Department of Fisheries
42	Setting up marine Oceanarium		Department of Fisheries
43	Providing veterinary health services to farmers, livestock owners and pet owners in Puducherry city limit	Providing veterinary health services to farmers, livestock owners and pet ownersin all areas other than Puducherry city limit	Department of Animal Husbandry
44	Creation of green belt in and around the industries to abate pollution		Department of Forest
45	Concept of City Forest, Biodiversity Park, Orchid garden, Botanical garden, Rose Garden.		Department of Forest

16.5. Water Mission

Sl. No.	2014	2015	Organizations
1	Drip Irrigation for 15% of land area under Horticulture	Drip Irrigation for 30% of land area under Horticulture	Dept. of Agriculture, KVK
2	Rain water harvesting pond creation of 5% of land area	Rain water harvesting pond creation of 10% of land area	Dept. of Agriculture
3	Increasing the water use efficiency, bench marking and water audit in irrigation project		Dept. of Agriculture
4	Desiltation of all the temples and village/ farm ponds in Puducherry city limit	Desiltation of all the temples and village/ farm pondsin all areas other than Puducherry city limit	Local Administrative Dept. (LAD)
5	Channelising storm water into village pond or ground water recharge	Channelising storm water into village pond or ground water recharge	Local Administrative Dept. (LAD)
6	Integrated Water Resources Management		Local Administrative Dept. (LAD)
7	Capacity building of communities on adaptation options required for integrated demand side as well as supply side strategies during climate stressed condition		Local Administrative Dept. (LAD)
8	Impact assessment study of climate change on aquatic ecosystem		Local Administrative Dept. (LAD)
9	Promotion of dual flash type toilet in all new households/ new constructions in Puducherry city limit	Promotion of dual flash type toilet in all new households/ new constructionsin all areas other than Puducherry city limit	Public Works Department (PWD)
10	Promotion of water less urinals, auto flushing group urinals, electronic sensor taps etc. in public buildings, hospitals, commercial spaces to consume less water in Puducherry city limit	Promotion of water less urinals, auto flushing group urinals, electronic sensor taps etc. in public buildings, hospitals, commercial spaces to consume less water in all areas other than Puducherry city limit	Public Works Department (PWD)
11	Recycling of waste water for toilet flushing in new	Recycling of waste water for toilet flushing in new	Public Works

Sl. No.	2014	2015	Organizations
	households in Puducherry city limit	households in all areas other than Puducherry city limit	Department (PWD)
12	Fixation of water pricing based on rate of consumption	Fixation of water pricing based on rate of consumption in rural households	Public Works Department (PWD)
13	Promotion of percolation pits in housing colonies and in urban areas	Promotion of percolation pits in rural areas	Public Works Department (PWD)
14	Providing Rain water harvesting arrangements as per building by-laws in all new Public buildings of terrace area more than 200 sq.m or Plot area more than 300 sq. m	Providing Rain water harvesting arrangements as per building by-laws in all new Public buildings of terrace area more than 200 sq. m or Plot area more than 300 sq. m in phased manner	Public Works Department (PWD)
15	Providing Rain water harvesting arrangements as per building by-laws in all existing Public buildings of terrace area more than 200 sq. m or Plot area more than 300 sq. m	Providing Rain water harvesting arrangements as per building by-laws in all existing Public buildings of terrace area more than 200 sq. m or Plot area more than 300 sq. m in phased manner	Public Works Department (PWD)
16	Providing Rain water harvesting arrangements as per building by-laws in all new Residential buildings of terrace area more than 100 sq. m or Plot area more than 200 sq. m	Providing Rain water harvesting arrangements as per building by-laws in all new Residential buildings of terrace area more than 100 sq. m or Plot area more than 200 sq. m in phased manner	Town & Country Planning (T&CP)
17	Providing Rain water harvesting arrangements as per building by-laws in all existing Residential buildings of terrace area more than 100 sq. m Plot area more than 200 sq. m	Providing Rain water harvesting arrangements as per building by-laws in all existing Residential buildings of terrace area more than 100 sq. m Plot area more than 200 sq.m in phased manner	Town & Country Planning (T&CP)
18	Providing Rain water harvesting arrangements as per building by-laws in all new Commercial buildings of terrace area more than 100 sq. m or Plot area more than 200 sq. m	Providing Rain water harvesting arrangements as per building by-laws in all new Commercial buildings of terrace area more than 100 sq. m or Plot area more than 200 sq. m in phased manner	Town & Country Planning (T&CP)
19	Providing Rain water harvesting arrangements as per building by-laws in all existing Commercial buildings of terrace area more than 100 sq. m	Providing Rain water harvesting arrangements as per building by-laws in all Plot area more than 200 sq. m in phased manner	Town & Country Planning

Sl. No.	2014	2015	Organizations
			(T&CP)
20	Providing Rain water harvesting arrangements as per building by-laws in all new Industrial buildings of terrace area more than 100 sq. m or Plot area more than 200 sq. m	Providing Rain water harvesting arrangements as per building by-laws in all new Industrial buildings of terrace area more than 100 sq. m or Plot area more than 200 sq. m in phased manner	Town & Country Planning (T&CP)
21	Providing Rain water harvesting arrangements as per building by-laws in all existing Industrial buildings of terrace area more than 100 sq. m or Plot area more than 200 sq. m	Providing Rain water harvesting arrangements as per building by-laws in all existing Industrial buildings of terrace area more than 100 sq. m or Plot area more than 200 sq. m in phased manner	Town & Country Planning (T&CP)

16.6. Strategic Knowledge Mission

Sl. No.	2014	2015	Organizations
1	Creating awareness on water and energy conservation, composting, source segregation of House hold waste, plantation		Climate Change Cell, -Department of Science, Technology and Environment (DSTE)
2	Educating farmers on better cropping systems, drought resistance crop, minimization of chemical fertilizer and encouraging organic farming and soil reclamation program		Department of Agriculture
3	Advocating clean development mechanism, resource conservation and waste minimization through seminar/ workshop		Climate Change Cell, -Department of Science, Technology and Environment (DSTE)
4	Capacity building on mitigation/adaptation of Green House Gases among the officers	Establishment of a climate change cell	Climate Change Cell, -Department of Science, Technology and Environment (DSTE)
5	Inventorisation of GHG generation from industries	Inventorisation of GHG generation from other sectors	Climate Change Cell, -Department of Science, Technology and Environment (DSTE)
6	Setting up of Energy Bench Mark for all government buildings/ institutions in Puducherry city limit	Setting up of Energy Bench Mark for all government buildings/ institutions in all areas other than Puducherry city limit	Electricity Department
7	Establishing a network of knowledge institutions, location specific research on climate science, setting up of an effective mechanism for data sharing and access and organizing conferences/ workshops on climate change and related issues		Climate Change Cell, -Department of Science, Technology and Environment (DSTE) and Puducherry Council for Science and Technology
8	Evaluation of action plan programmes and providing budget support to implementing departments/ authorities		Climate Change Cell, -Department of Science, Technology and Environment (DSTE) and Planning and Research Department
9	Studies on impact of climate change on disease incidence, surface and ground water resources. Establishment of forecasting arrangement for agricultural and health		Climate Change Cell, -Department of Science, Technology and Environment

Sl. No.	2014	2015	Organizations
	sector		(DSTE)
10	Climate mandate Hazards risks vulnerability assessment and mapping for the coastal regions		Climate Change Cell, -Department of Science, Technology and Environment (DSTE)
11	Framing up e-governance related to climate Change action plan		Climate Change Cell, -Department of Science, Technology and Environment (DSTE)

16.7. Coastal and Disaster Management Mission

Sl. No.	2014	2015	Organizations
1	Demarcation of HTL or LTL along the coastal stretches and preparation of revised coastal Zone Management Plan		DSTE, PIA, TCP, PCZMA, Anna University
2	Integrated Coastal Zone Management Plan Preparation		TCP, PWD, LAD, Fisheries, Agriculture, DSTE
3	Flood Mapping and Development of Climate change projection Model and its impact on coastal ecosystem in Puducherry		DRDM, PIA, DSTE
4	Assessment of Erosion prone Area with the help of Digital elevation model and strengthen coastal protection method through improved technology		PWD, Port,
5	Study on Micro level vulnerability assessment due to climate change on coastal ecosystem		PCZMA, DRDM, Fisheries
6	DPR on flood shelters, multipurpose cyclone shelters in vulnerable location in Coastal line and construction of flood shelters, multipurpose cyclone shelters and climate resilient buildings that can withstand multiple hazards		PIA, DRDM,
7	Development of a techno legal regime for construction of Disaster resilient housing and public infrastructure		DRDM, PIA, PWD, TCP
8	Integration of Climate change risk in the disaster Management policy of the UT		DRDM, DSTE
9	Establishment of an integrated training and Capacity building protocoland knowledge management for better assessment of climate risks and best management practices		DRDM, DSTE
10	Study on Impact of Climate change on Marine Biodiversity with special emphasis on Flagship species and coastal flora and fauna		Forest, DSTE
11	Strengtheningdelivering and monitoring system and preparedness in disaster prone coastal area		DRDM, DSTE, PIA, PWD
12	GIS based mapping along the selected vulnerable coastal area of Puducherry		DRDM, DSTE, TCP, Agriculture
13	Development of Sustainable aquaculture		DSTE, Fisheries