



# STATE ACTION PLAN FOR CLIMATE CHANGE FOR THE STATE OF GOA

From 2023 to 2033



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level planning for climate preparedness of  
the State of Goa.

**Special Thanks :**  
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## STATE ACTION PLAN FOR CLIMATE CHANGE FOR THE STATE OF GOA

From 2023 to 2033

1. Cabinet approval on 28/10/2020
2. Submitted to MoEFCC-23/02/2021 vide email
3. Revised SAPCC after incorporating suggestions was submitted to MoEFCC on 15/06/2021 vide email
4. 16<sup>th</sup> meeting of the NSC on CC held on 24/08/2022 approved Goa SAPCC in principle and Minutes of the meeting were conveyed by MoEFCC on 26/09/2022

**Launched and published on 26/04/2023  
in the auspicious hands on**

**Shri. Nilesh Cabral**  
Hon. Minister for Environment and Climate Change,  
Government of Goa.



Government of Goa

## Message



It gives me great pleasure to present an important policy level State document, State Action Plan for Climate Change for Goa. This long pending task has been completed by adopting inclusive methods of consultation and awareness for public, scientists, departments, decision makers and other stakeholders. This plan strives to achieve convergence, address overlaps and strengthen the climate resiliency of our State by integrative holistic approach. Although execution is sectoral, the planning is inclusive and integrated. This is a ten-year plan but I am sure that this has laid a very strong foundation for achieving sustainable development based on fair and equitable dividends of adaptation and mitigative actions proposed in this plan. This will be a dynamic plan and reviewed every year by Governing Body headed by myself. We wish to reiterate our preparedness for climate related adaptation, mitigation and emergencies related to climate change. Our approach will be inclusive and balanced keeping interest of all stakeholders and ecological sustenance of our State.

**Dr. Pramod Sawant**  
Chief Minister of Goa



Government of Goa

## Message



I am extremely delighted to launch the State Action Plan for Climate Change for the State of Goa. This plan is perhaps the most comprehensive policy tool made available to all the departments, stakeholders and also general public to understand, implement, review and report the climate change related contribution and performance of the State. It is time that we all become sensitive and responsible toward the future generation and prepare them to face the situations that will arise out of climate change impacts. Rather it is important to ensure climate friendly actions from all the spheres of society to deal with this global issue.

While all the countries across the globe are displaying their actions and commitments, our responsibility being signatory to convention on climate change is far more and we will definitely take the necessary precautions to deal with climate change.

The development and ecological protection have to go hand in hand and on basis of scientifically based checks and balances. SAPCC exactly aims at same and we shall ensure that all our actions will be complimentary and not contradictory to the climate change resilience.

**Shri. Nilesh Cabral**

Minister, Environment and Climate Change,  
Govt. of Goa



Government of Goa

## Message



The State Level Steering Committee (SLSC) for climate change has been striving to have a balanced action plan on climate change for the State of Goa, a plan that will be collectively prepared, executed, and monitored. It is difficult for the State itself to deal with such a multi-divergent issue unless all the stakeholders join hands, get sensitized, participate, and reiterate their commitment to climate change issues. We ensured that unique methodologies would be adopted for the SAPCC and further activities under National Adaptation Funds for Climate Change (NAFCC), which includes consultations with all stakeholders, intellects from institutions, Government departments, People's representatives, and prior and post-sharing of details to the general public after drafting the SAPCC before finalization. The maximum participation of locals in the consultation was appreciable, as this global issue and reflections are at the local level through impacts.

It is remarkable to note that NABARDS Consultancy Services (NABCONS) and the Goa State Biodiversity Board (GSBB) engaged the local experts from our State which included Goa University, Birla Institute of Technology & Science, Pillani, and the CSIR-National Institute of Oceanography, and other local young scientists while preparing the SAPCC which is a visionary decadal policy document with technically assessed vulnerability and climate trends. While we have ensured the local context, the global and national linkages are maintained by linking our goals with the Nationally Determined Contributions (NDCs) and Sustainable Development Goals (SDGs). Achieving these objectives will require collective action, collaboration, and innovation. The State Action Plan is not just a document or a project; it is a vision and a mission of the State of Goa to upkeep our commitment to address climate change issues at all levels. I am sure that all the departments and stakeholders will actively join hands for continuous and consistent efforts in dealing with Climate Change in our State of Goa.

**Dr. Puneet Kumar Goel, IAS**

Chief Secretary, Govt. of Goa



Government of Goa

## Message



The State Action Plan for Climate Change is an elaborate policy document prepared for the state of Goa. This is an example of a multi-sector (viz. transport, power, waste management, agriculture and allied sectors) document that has gone through several stages of refinement after a rigorous process of data assimilation from various departments in Goa, and interpretations sought through the extensive consultation process held on various platforms.

The trends shown in the pictorial graphs of the SAPCC are indicative of the future scenario, but it is heartening to note that an implementation framework to adapt and mitigate the impacts of climate change, is in place. It is time we take responsibility for our actions and promote a culture of sustainable lifestyle and a switch to renewable resources.

There will be circumstances where drastic measures would be necessary, but our multi-sector convergence and teamwork will help us all be better prepared for any eventualities. We aim to make Goa climate-resilient and we are close to setting an example for other States. With organizational arrangements which are inclusive, we will ensure the best possible efforts under the Goa State Climate Change Cell, and by the integration of efforts from multiple agencies.

**Shri. Arun Kumar Mishra, IAS**  
Secretary Environment and Climate Change,  
Chairperson, Goa Climate Change Cell, Member SLSC for NAFCC  
Govt. of Goa



## Message



Goa, being a coastal State, is high on the vulnerability index of climate change, despite good forest cover. Climate change manifests itself in different forms, be it the rise in sea level and intrusion of sea water into the cultivable fields, heat stress in animals adversely affecting their reproductive performance, temperature rise in sea affecting the breeding/migration and harvesting of the fish catch besides loss of bio diversity and increase in pests, weeds and diseases. Concerted efforts are required for adaptation and mitigation to reduce the vulnerability and loss of livelihoods due to adverse effects of climate change. Implementation of the State Action Plan on Climate Change (SAPCC) is the first step in this direction.

I am happy that the SAPCC for the state is approved by Government of India with the help of facilitation support of NABARD Consultancy Services (P) (NABCONS) Ltd. I congratulate Goa State Biodiversity Board (GSBB) which is the nodal agency identified by the State Govt.

Implementation of SAPCC can be effective with the convergence of activities of various State Government Departments and community participation. I am sure, a series of sensitisation programmes would be chalked out in due course to ensure that climate consciousness is built in all projects and programmes implemented by the Govt of Goa. It is also heartening to note that GSBB has promoted around 195 Biodiversity Management Committees, making it easier for ensuring community participation.

NABARD would continue to collaborate with GSBB and other State agencies in all climate change action initiatives.

**Dr. Milind Bhirud**  
General Manager/Officer-in-Charge  
NABARD, Goa Regional Office, Panaji



Government of Goa

## Message



The Goa State Action Plan on Climate Change (SAPCC) is the most consultative form of document, only because the people of Goa were highly proactive and they whole-heartedly participated in the preparation of the SAPCC. I am sure that when we finally commence with the interventions on the ground, we will converge together with all the Biodiversity Management Committees, local bodies, and individuals inclined to the conservation of the environment and its resources to deal with climate change. Our united efforts will result in significant outcomes to tackle climate change in Goa. Our Department of Environment and Climate Change is constantly striving to ensure for the convergence of governance when it comes to execution of the climate change interventions. It is already being noted during our budgetary analyses and consultative processes that several departments are doing many tasks and activities which are important in dealing with climate change. And this has to be further mapped as our climate change contribution for which the experts from the Goa State Climate Change Cell are being trained to support all the departments in this regard. By and large, the SAPCC is a baseline document for the future decade, but it is a foundation for the future centuries and the times to come that will decide and shape the future sustainability of our upcoming generations. Hence we must strive in all directions and take the lead in dealing with climate change.

**Dr. Sneha Gitte, IAS**

Director, Department of Environment and Climate Change,  
Convenor, Goa Climate Change Cell, SLSC for NAFCC  
Govt. Of Goa.

## Foreword

Preparation of State Action Plan for Climate Change for Goa State was one of the most intensive exercise by the State. Especially being such a technical area, which affects everyone but needs analysis of data spread over decades and also projection for future under certain situations. The team of NABCONS had two experts who have driven this report are Dr. Rajiv Chaturvedi and Ms. Shaily Maloo along with others. This document was completed with constant follow-up and initial thrust from Ms Kamakshi Pai, CGM NABARD. She was most instrumental in advocating climate change on all forums of financial institutions and has led to creation of awareness amongst them in Goa. The consultative process by involving ground level biodiversity management committees, several reputed scientists, institutes, Govt. departments, members of various forums and general public have contributed immensely during district-wise consultations. Besides being a dynamic document, this will be open for all time inputs which could be included and upgraded in SAPCC during periodic review.

The data sourced from IMD, NCAOR, National Centre for Polar and Ocean Research several secondary sources, reports etc. have enriched this report and the specially engaged team at BITS also interacted with some of the top institutions and experts to get us the best possible trend analysis. The data, information, graphs and trends could be used by various agencies, departments and stakeholders in taking decisions for their sectors. However, it is important to understand that in addition to periodic review, SAPCC may be also reviewed whenever felt by SLSC for NAFCC if higher resolution data, information and more accurate findings are be available in course of time that could lead to significant impact on understanding the climate change perspective from implementation point of view.

**Team SAPCC**



Government of Goa

## Acknowledgement



Team SAPCC was led from front by Chairperson of SLSC for NAFCC Dr. Puneet Kumar Goel sir, IAS, Chief Secretary, Govt. of Goa, State Nodal Officer Climate Change SLSC for NAFCC- Dr. Pradip V. Sarmokadam, MS GSBB, NABCONS Team - initially by Ms. Kamakshi S. Pai, then by Ms Usha Ramesh both former CGM NABARD and presently by Dr. Milind Bhirud Principal Consultant NABCONS / General Manager NABARD along with Shri N. Narayana Raju, former Senior Consultant NABCONS / AGM NABARD, presently by Ms Sonali Bandekar, NABARD, Shri. Sanjoy Ghosh (Vice President NABCONS – Delhi), Dr. Suraj Pandey, Ms. Shaily Maloo (Consultant, NABCONS team), Dr. Michelle Fernandes, Eng. Gaurav Pednekar, Shri. Sushant Figueredo and the Director NIO namely Dr. Sunil Singh, his team including Dr. Manimurali and others, Dr. M. Ravichandran, Director National Centre for Polar and Ocean Research (ESSO-NCPOR), Dr. Satheesh C. Shenoi, Indian National Centre for Ocean Information Services (INCOIS), Hyderabad, Dr. M. Mohapatra, IMD, Dr. K. S. Hosalikar, Deputy Director General of Meteorology, Scientist – F, IMD - Regional Meteorological Center, Mumbai, Dr. K. V. Padgalvar ( Ex. Director Goa IMD), Climate Monitoring and Analysis Group of Climate Research Division of India Meteorological Department, Shivajinagar, Pune.

Other prominent scientists Dr. Baban Ingole, Dr. Vinod Dhargalkar, Dr. M.V.M. Wafar, Dr. Nandakumar Kamat and other numerous intellects and individuals from Goa who have participated in consultations and have provided their valuable inputs, shared experiences regarding ground level issues and suggested solutions, Chairpersons and members of Biodiversity Management Committees across the State and also general public and peoples representatives at large who have given their valuable inputs to make everyone from this State, owner and creator of this document. The purpose of keeping draft SAPCC for public has main reason to make it people’s plan, perhaps could be exemplary. This SAPCC has been provided with very firm base and backbone by Dr. Rajiv Chaturvedi from BITS Goa, a internationally renowned scientist has selected best model for data analysis, projection, validation, graphical representation by involving his team as well as experts from reputed organizations in our country. He vulnerability assessment has contributed much beyond expectations and deserves special mention.

It is most important to acknowledge the support of present chief minister Dr. Pramod Sawant, Hon. Environment and Climate Change Minister Shri. Nilesh Cabral, Environment and Climate Change Secretary Shri. A. K. Mishra sir, Director Environment and Climate Change

Dr. Sneha Gitte, former Chief Secretary Shri. Parimal Rai, IAS, Former Environment and Climate Change Secretary Shri. Kunal sir, all the directors who were part of this SAPC namely Shri. Johnson Fernandes, Shri. Dasharath Redkar, Dr. Geeta S Nagvenkar and all the team members from NABARD.

It is not possible to acknowledge and thank everyone but this State action plan will be a real success when everyone participates in ensuring that this plan is executed beyond expectations and monitored by everyone. Overall success to deal with climate change needs regional participation including our neighbouring States. Hence, in a holistic way, we aim to set an example of unified climate change efforts initiated by our smallest State of India. Details of consultative process is included in a separate section included in this SAPCC wherein contributions of individuals and institutions have been acknowledged. We are sure that this document would be a base on which many more interventions, detailed budgetary provisions, inclusive planning will be taken up in convergent way and our State though late, will achieve desired results for dealing with climate change.

I am sure that our consultative, participatory, transparent process of preparing SAPCC, availing cabinet approval and nod from MoEFCC is first step that will lead to successful roadmap to deal with the climate change.

### Dr. Pradip Sarmokadam

Nodal Officer, Goa Climate Change Cell, SLSC for NAFCC

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#### Disclaimer :

While all the due care has been taken in ensuring awareness and representative consultations with public, institutions, departments and other stakeholders, primary and secondary relevant research, compiling, editing and reviewing this report, the accuracy of the data included is specific for SAPCC purpose to act at policy level, while using for any other specific purpose shall require necessary validation.

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## Abbreviations

AFOLU	: Agriculture, forestry and other landuse sectors	IWRM	: Integrated water resources management
BAU	: Business as usual	KFD	: Kyasanur Forest Disease
BEE	: Bureau of Energy Efficiency	LULUCF	: Land Use, Land-Use Change and Forestry
CMIP	: Coupled Model Inter-comparison Project	MaaS	: Mobility as a service
CNG	: Compressed natural gas	MoEFCC	: Ministry of Environment, Forest and Climate Change
CO2	: Carbon dioxide	MSW	: Municipal Solid Waste
CORDEX	: Co-Ordinate Regional Downscaling Experiment	NAFCC	: National Adaptation Fund for Climate Change
CRU	: Climate Research Unit	NDC	: Nationally Determined Contribution
DDUGJY	: Deendayal Upadhyaya Grameen Jyoti Yojana	NEMMP	: National Electric Mobility Mission Plan
DEM	: Digital Elevation Model	NIO	: National Institute of Oceanography
DSM	: Demand Side Management	NSDP	: Net state domestic product
EESL	: Energy Efficiency Services Ltd	NTFPs	: Non-timber forest produces
EIA	: Environment Impact Assessment	NTPC	: National Thermal Power Corporation
EMP	: Environment Management Plan	ppm	: Parts per million
ESCO	: Energy Service Company	RCP	: Representative Concentration Pathways
FAME	: Faster Adoption and Manufacturing of Hybrid and Electric vehicles	RKVY	: Rashtriya Krishi Vikas Yojana
GADA	: Goa Automobile Dealers Association	RND	: River Navigation Department
GCF	: Green Climate Fund	SAPCC	: State Action Plan on Climate Change
GEDA	: Goa Energy Development Agency	SAPCC	: State action plan for climate change
GHG	: Greenhouse gases	SECI	: Solar Energy Corporation of India Limited
GMO	: Genetically Modified Organisms	SLNP	: Street Lighting National Programme
GMOC	: Genetically modified organisms and crops	SLSC	: State Level Steering Committee for Climate Change
GSDP	: Gross State Domestic Production	SWMF	: Solid Waste Management Facility
GWMC	: Goa Waste Management Corporation	UNDP	: United Nations Development Program
HH	: Households	UTs	: the States and Union Territories
IMD	: India Meteorological Department		
IPCC	: Intergovernmental Panel on Climate Change		
IPCC	: Intergovernmental Panel on Climate Change		

## EXECUTIVE SUMMARY

Goa is a coastal state with a significant rise in land elevation from sea to 1022 m. It is one of the smallest states in the country and has a coast length of about 105km. It has very high biodiversity both on land and in the marine system. Tourism is one of the most important sectors of the Goan economy. Other important sectors are mining, fishing, and agriculture.

### Climate change scenario

Goa's mean annual temperature has increased by over 1°C since the beginning of the 20<sup>th</sup> century till date (1901-2018), much of it during 1990-2018. The mean annual rainfall in Goa has increased by 68% from 1901-2018. With increasing rainfall the inter-annual rainfall variability in the state has also increased especially since 1970s. While mean annual rainfall in the state has increased, moderate to light rainfall days (IMD category I) in Goa have declined over 1901-2018 period, whereas very heavy and exceptionally heavy rainfall events (IMD category III) in the state have increased by a dramatic more than 100%.

Goa is already experiencing sea level rise. Long-term station data from Mormugao suggests that the sea level at this station in Goa is rising at a rate of 1.45 mm/year.

Mean annual temperatures (model ensemble) in Goa may increase by around 2°C in by the 2030s compared to the 1901-1950 period and further to around about 4°C by 2080s under high emission scenarios. Goa will start experiencing heat waves (>4°C) beyond the 2040s, as maximum temperature increases by about 5°C towards the century end under high emission scenarios. Under the high emission scenarios, minimum temperatures are expected to rise even more by up to 7°C by the century's end. The mean annual rainfall in Goa is projected to decline slightly under high emission scenarios, which under low emission scenarios is projected to increase slightly.

The flood vulnerability analysis from the state reveals that 14.73% of the land is under 15m elevation, much of it in the coastal zones, and is severely vulnerable to flooding from extreme rainfall events and sea-level rise. In terms of vulnerability from floods and sea-level rise the Talukas of Salcete, Tiswadi, and Bardez are most vulnerable.

### Vulnerability to Climate Change:

In the context of Goa, communities living in low-lying areas, informal settlements like slum populations, people with disabilities, and those whose livelihood depends mainly on khazan lands and low-lying ecosystems including riparian ecosystems are in particular the immediate and most vulnerable groups. Also, four coastal Talukas of Bardez, Tiswadi, Mormugao, and Salcete, house about 80% of the population and are hubs of economic activity.

It is the moderate and light rainfall events that nourish life-forms and ecosystems, whereas very heavy and exceptionally heavy rainfall events create devastation and chaos to life-forms and ecosystems. Increasing frequency of very heavy and exceptionally heavy rainfall events in Goa is one of the key impacts of climate change witnessed in the state.

### Mitigation Strategy

The state of Goa does not produce power, it purchases power from National Thermal Power Corporation (NTPC) power plants except for some renewable energy, based power plants like solar power plants. Thus, the state's direct Greenhouse gases (GHG) contribution to the national GHG inventory is in significant. Thus, the transportation sector becomes the most crucial sector in GHG management. A mitigation strategy has been developed for the transportation, demand-side energy management, agriculture, and waste sectors. Priority sectors include Transport, Energy - Power-sector including renewable energy, Water, Agriculture, Forest, Fisheries and allied, Environment and Waste Management Sectors.

### Mitigation in the Transportation Sector

The transportation sector is the major source of emissions in Goa and has the maximum possibility for mitigation as well. Due to the large tourist population, which depends on taxis/motorbikes etc for transportation, there lies an opportunity to relook at the transportation sector from a different lens and identify options for mitigation which will also lead to decongestion and reduced pollution.

Some of the mitigation measures proposed are:

1. Development of a holistic policy for low emission sustainable transport system
2. The state should develop an electric mobility policy
3. Provisions should be made for non-motorized transportation in urban areas to decongest and reduce GHG emissions
4. The Goa State Subsidy for replacement of old Passenger Buses Scheme, 2001
5. Identify Alternate modes of fuel transportation in the mining area
6. Explore the possibility of using Compressed natural gas (CNG) instead of petrol and diesel
7. Solar power vessels for inland waterways
8. Convert existing vessels to CNG vessels (explore the possibility)
9. Make adequate parking space for vehicles
10. Provide the interconnected public and non-motorized system for point-to-point connectivity

### Mitigation in the Energy Sector

In the context of Goa, the energy sector primarily represents the opportunity to reduce demand-side energy consumption and explore new options for renewable energy generation. Some of the mitigation measures which are underway or proposed are provided below:

1. A power sale agreement has been executed with **SECI** to meet the additional 50MW wind power
2. Power is also bought from Saligao Solid Waste Treatment Plant promote the generation of renewable energy
3. Demand Side Management (DSM) measure, all types of conventional Street light fixtures are being replaced by high-quality, efficient smart LED light fixtures under the Street Lighting National Programme (SLNP) of the Government of India through Energy Efficiency Services Ltd (EESL), a joint venture of PSUs of Ministry of Power, Government of India on ESCO model.
4. Under the Deendayal Upadhyaya Grameen Jyoti Yojana (DDUGJY) installation of a digital meter
5. Jyotirmay scheme - distribution of 3 LED bulbs of 9W each to domestic households. 8.2 lakh bulbs have been distributed under the scheme
6. Goa has executed a Bipartite MoU with the Ministry of Power, Government of India and joined the "UDAY" scheme.
7. Goa Solar policy
8. Goa Wind Policy
9. Goa must explore the possibility of tidal energy and further enhance the mini-hydro potential
10. Mandating periodic Energy audits to improve energy consumption and operational efficiency of all government establishments
11. Industrial energy efficiency should be promoted through BEE's programs
12. Incentivization of energy efficiency for commercial and domestic users

13. Programs to develop an awareness of saving energy
14. Training and skill development for renewable energy implementation, maintenance, energy auditors, etc.
15. The present target is 150 MW by 2022 and 300 MW of solar to be set up by 2030
16. 25 MW of renewable energy to be set up by 2030

### Mitigation in the Agriculture Sector

Agriculture and allied sectors contribute to GHG emissions due to the use of machinery, water, fertilizers, etc. Inadequate, utilization of resources increases emissions. Methane is one of the main GHG's emitted in agriculture and cattle rearing activities.

Some of the mitigation measures ongoing and proposed are as under:

1. Focus initiatives to increase vermicomposting at the community level
2. Incentivize the replacement of agricultural pumps with energy-efficient pumps and solar pumps
3. Sensitize farmers on optimal utilization of water to reduce pump usage and reduce water wastage
4. Incentivize optimal utilization of water pumps
5. Promoting organic manure
6. Optimal utilization of fertilizers and pesticides
7. Assist in the utilization of cattle and animal waste as manure and for biogas generation
8. Promoting Biomass residue from agriculture to be used for power generation where it does not have an alternate use

### Mitigation in the Environment and Waste Management Sector

Integrated coastal zone management with various interventions including restoration of bunds and sluice gates, initiatives for erosion control measures coasts and rivers, biodiversity conservation initiatives, wetland conservation and restoration, bold initiatives such as a ban on single use plastic, the mechanism for effective system for extended manufacturers responsibility in the waste sector are some of the measures in the environment sector.

The first major initiative is the collection of all the plastic waste across the National Highways; the second major initiative is the setting up a Solid Waste Treatment Facility in North Goa and South Goa.

A few important items in Goa's waste management strategy should include:

1. Waste minimization in the tourism sector by providing alternate and bio-degradable options for tourist
2. Incentivising disposal of plastic waste by providing ride coupons or other tourist coupons in exchange for disposal or deposition of plastic waste at designated areas

### Sectoral Adaptation Strategy

#### Water Sector

Though Goa is situated in high precipitation zones, it has one of the lowest per capita freshwater availability. The draft State Water Policy 2015 presents various challenges the state faces in utilizing water resources. The rivers are prone to tidal variations up to 40 km inland and seasonal water availability variations. Given these the key adaptation strategies for water sectors are:

1. Adaptation of water-related infrastructure
2. Development of infrastructure to reduce the impact on water availability and enhance water security
3. Developing systems for appropriate planning of water to ensure water supply to all
4. Maintenance of water resources to avoid flooding and to keep related infrastructure functional during peak events and disasters
5. Knowledge management and capacity building (Forecasting and database building)
6. Awareness raising

## Tourism Sector

Tourism is one of the most important economic sectors of the state. It receives tourists, three to four times the state's total population.

Adaptation strategies proposed for the tourism sector are:

1. Promoting community-based agritourism
2. Inland tourism development in a climate-friendly manner
3. Tourism infrastructure climate vulnerability assessment
4. Climate proofing and disaster management for critical tourism infrastructure
5. Develop design standards for new tourist infrastructure and guide modification of existing vulnerable infrastructure
6. Enhance/modify and restructure the insurance for off-coast or water-related tourism activities and infrastructure like boats and ships which are vulnerable to climate change
7. Incentivize the use of eco-friendly, recycle/reuse in the tourism sector by facility providers
8. Single-use plastic to be banned with credible alternates in tourism activity
9. Provide extensive infrastructure and encourage non-motorized transport by tourists - Develop a climate-friendly tourist mobility plan
10. Green skill and capacity development amongst the tourist service providers
11. Environmental Clearance for large tourism projects/hotels in Goa could include a climate mitigation and adaptation plan and a climate disaster preparedness plan
12. RE-consider the coastal development plan or zone for new construction based on the climate predictions on sea-level rise, flooding, and erosion
13. Reducing hotspot vulnerability

## Mining Sector

Mining in Goa is primarily focused on sand and iron ore. The growth of the construction sector directly influences sand mining and increases the coastal system's sensitivity to coastal hazards.

Adaptation strategies for the mining sector:

1. A comprehensive study of Hydro Geology of underground water to be carried out
2. Independent mining audits to ensure compliance with EIA/clearances and other parameters
3. Explore and provide treated water for mines or alternate sources
4. Resource efficiency and the circular economy concept need to be incorporated into the construction sector to reduce pressure on the sand as a resource.

## Agriculture and allied sector

Goa has only one agro-climatic zone, i.e., West Coast Plains & Ghat Region, and the state primarily depends on rain-fed agriculture. The agriculture sector faces challenges like the decline in interest in agriculture, erosion of soil and deterioration of soil quality, very high labour wages, erosion of local germplasm, and introduction of genetically Modified Organisms (GMO) seeds and khazan lands.

Adaptation strategies for the agriculture sector are:

- Maximizing the agricultural land utilization by including fallow land for agriculture
- Climate research in agriculture by the development of regional knowledge, development of climate risk indicators, acceptable coping ranges of the sector and specific crops, which are critical to improving climate risk management
- Increase overall investments in agricultural research and development.
- Technological innovation; and research in agriculture will be promoted.
- Increasing farmer income through credible, certified organic farming and market connections
- Encourage education in agriculture and educate farmers
- Fisheries management to include integrating fisheries and aquaculture management into coastal zone management, to increase the coping ability of small communities to sea-level rise. Breeding fishes that can withstand higher temperatures.

- Livestock management by breeding temperature-tolerant species and providing temperature-resistant livestock shelter.

The ICAR Goa would be the primary research organization which will work in conjunction with and State agriculture department. Similarly, the Fisheries Department, Directorate of Animal Husbandry and Veterinary Services, and associated bodies would work together on the other aspects.

## Forest and biodiversity

Goa is the smallest state with just 3702 sq. km. of the geographical area having a good forest cover with 1,225.12 sq. km of recorded Government Forest, which is over 33% of the total geographical area of the State. Of this, 62% is designated as 7 Protected Areas, 6 biodiversity-rich and ecologically sensitive Western Ghats, and 1 in mangrove forest at Chorao island.

There is no further potential to increase the forest cover of the state; however, there is a possibility to increase the green cover and the quality of the forest by increasing the carbon content.

**The state's first biodiversity heritage site** has been registered at Purvatali Rai in Bicholim Taluka. A dedicated project on biodiversity and livelihood is initiated for 7 years duration, integrated approach for dealing with climate change for developing climate resilient models and various other initiatives are taken through biodiversity management committees constituted at the local body level. The participatory process of chronicling biodiversity and associated traditional knowledge is the scientific process adopted to understand the inventory of biodiversity, ground-level situation, issues associated, and priority conservation focus areas with respect to biodiversity are part of initiatives of Goa State Biodiversity Board. Revival of traditional systems, including proposed seed banks, are initiatives proposed.

Identification and notification of wetlands in the State of Goa, by Goa State Wetland Authority is a significant step towards water security, biodiversity conservation, climate resiliency and also responsible sustainable initiative.

The strategies for Goa are:

1. Enhance the forest quality
2. Restore and increase the coastal defence mechanism
3. Prepare a strategy to prevent and control forest fires
4. Afforestation and plantation outside the forest
5. Support private forest owners in the sustainable management of their forests and derive economic benefit
6. Water and soil conservation
7. Capacity building of field staff
8. Promote ecotourism

## Human Health

Goa has 13 government hospitals with 3000 beds and 29 community/primary health centers, and 30 dispensaries. It has about 2756 beds in private hospitals [1]. The changing climate has increased diseases like dengue and introduced new diseases like Kyasanur Forest Disease (KFD).

Adaptation strategies:

1. Prepare an action plan to reduce climate change related health impacts
2. Develop an IT-enabled system to inform the public on possible and actual disease outbreak
3. Study and map new and emerging diseases in the state concerning climate change
4. Prepare a heatwave action plan
5. Develop a system to predict disease outbreak
6. Assess the adequacy and resilience of health infrastructure to climate change
7. Strengthen the health infrastructure based on the assessment
8. Enhancing the knowledge skills of health workers

## Habitat

**62% of Goa's population lives in cities. About 80% of the state population lives in** four coastal Talukas of Bardez, Tiswadi, Mormugao, and Salcete. To be able to effectively meet the requirements of the growing population and economic activity in these Talukas it is essential to not only prepare an effective land use plan but also to provide and maintain:

- Water and Sanitation Services
- Transportation services
- Solid waste management
- Energy demand
- Health services and health management

Adaptation strategy is as below:

1. Climate-based infrastructure vulnerability assessment of critical services
2. Development of a plan for the resilience of vulnerable structures associated with critical services
3. Redesigning the regional land use planning maps of the most vulnerable areas after considering climatic factors
4. Identifying measures like creating flood control gates etc., for controlling flooding events due to various aspects like the upward flow of water into the rivers
5. Development of a climate-based disaster management plan
6. Implementation of the solid waste management plan
7. Enhancing internal waterways for transportation
8. Strategy to relocate/compensate and identify new means or alternate skills for the owners of khazan lands as the probability of submergence due to climate change increases
9. Identify and explore natural mechanisms like increased mangroves or sea walls to guard against sea level rises.

## Financial and Institutional Arrangement for Implementing the Mitigation and Adaptation Strategies

The total budget required for implementing the SAPCC in Goa has been projected to be ₹ 2341.06 Crores for ten years, which works out to be ₹ 234.106 Crores Per Annum and amounts to approximately 1.1% of the Annual Budget, which is ₹ 21056.35 (estimated for 2020-21) and 0.2538 % of Gross State Domestic Production (GSDP) of Goa State which is ₹ 92260.53 (as per CMs budget speech 2021). The same may get revised or updated over the years based on any additions or modifications to the SAPCC. One of the steps for mainstreaming climate change is to factor the above-identified amount annually into the state budget. In addition to SLSC for NAFCC, Climate Change Cell will be formed under Dept. of Environment to be housed at GSBB, which will serve as the climate change secretariat for the State of Goa. And most importantly State Governing Council is proposed under the Chairpersonship of the Hon. Chief Minister of Goa and Co-Chaired by Hon. Environment Minister and Chief Secretary. The nodal agency shall be allocated a budget or financial assistance from the state for its activities. Each concerned department will appoint a nodal officer on climate change to interact and deal with the climate change secretariat.

People's participation is an essential part of the SAPCC. SAPCC provides a plan for including people from all sections of society. The monitoring and evaluation (M&E) framework consists of the following:

1. Qualitative and quantitative indicators of adaptation
2. Indicators are attempted to be as ambiguous as possible
3. Monitoring, reporting and communication process for departments and the policymakers

# Introduction

1

## 1.1. Background

Climate change and its impacts are no longer a subject of the future. Its impacts are being evidenced globally. Extreme events causing severe impact have been evidenced in the last decade in several places. The UN High Commission on Refugees (UNHCR) has estimated that since 2009, one person every second has been displaced by a disaster as a result of climate change.

Climate change threat varies from country to country and region to region in large countries like India. India has a diverse climate from continental to coastal, from extremes of heat to extremes of cold, from extreme aridity and negligible rainfall to excessive humidity and torrential rainfall. Nearly two-thirds of the country's annual precipitation is received through the southwest monsoon from June to September in most parts of the country. Many parts of India are vulnerable to floods during the monsoons, which cause significant loss of life and damage livelihood systems, property, infrastructure, and public utilities. As per the second BUR of India, flood risk has increased significantly in India during recent decades. India's exposure to natural hazards can be gauged from the fact that it experienced 431 major natural disasters from 1980-2010. The flood events of recent years in the states of Uttarakhand, Jammu & Kashmir, and Kerala are examples of such disasters.

To respond to the threat of climate change in a systematic manner, the government of India announced the National Action Plan on Climate Change (NAPCC) in 2008. NAPCC has eight missions –

- National Solar Mission
- National Mission for Enhanced Energy Efficiency
- National Mission for Sustainable Habitats
- National Water Mission
- National Mission for Sustaining the Himalayan Eco System.
- National Mission for Green India
- National Mission for Sustainable Agriculture
- National Mission for Strategic Knowledge for Climate Change

Due to the country's large diversity and political and administrative structure, the States and Union Territories (UTs) need to understand, identify and develop state-specific responses to climate change. Hence, The Ministry of Environment, Forest and Climate Change (MoEFCC) has encouraged states and UTs to develop their State Action Plan on Climate Change (SAPCC) consistent with the NAPCC.

India is a signatory to the Kyoto Protocol and is committed to the Paris Agreement on climate change. Under the Paris Agreement, India officially submitted its Nationally Determined Contribution (NDCs) on 2<sup>nd</sup> October 2015.

As per the Paris Agreement, all signatories will attempt to limit global mean temperature within 2 degree Celcius and work towards to limit 1.5°C. India has submitted its NDC goals for post-2020 with eight different goals, including three major quantifiable goals related to emission reduction, renewable energy, and forestry.

The following targets form the core of India's NDC:

1. To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation.
2. To adopt a climate-friendly and cleaner path than the one followed hitherto by others at a corresponding level of economic development.
3. To reduce the emissions intensity of its GDP by 33 to 35 % by 2030 from the 2005 level.
4. To achieve about 40 % cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030 with the help of technology transfer and low-cost international finance, including the Green Climate Fund (GCF).
5. To create an additional carbon sink of 2.5 to 3 billion tonnes of CO<sub>2</sub> equivalent through additional forest and tree cover by 2030.
6. To better adapt to climate change by enhancing investments in development programs in vulnerable sectors, particularly agriculture, water resources, the Himalayan region, coastal regions, health, and disaster management.
7. To mobilize domestic and new and additional funds from developed countries to implement the above mitigation and adaptation actions given the resource required and the resource gap.
8. To build capacities, create a domestic framework and international architecture for quick diffusion of cutting-edge climate technology in India and joint collaborative R&D for such future technologies.

To meet the NDC's in addition to the adaptation measures, SAPCCs need to be revised and strengthened further considering the evolving context of climate science, policies, and actions.

## 1.2 Need for State-level action

Goa is a coastal state with a significant rise in land elevation from sea to 1022 m. It is one of the smallest states in the country and has a coast length of about 104km. It has very high biodiversity both on land and in the marine system. Tourism is one of the most important sectors of the Goa economy. Other important sectors are mining and industries, fishing, and agriculture. All the key economic sectors in Goa's economy have the potential to get significantly impacted by climate change.

India has submitted the second national inventory under the BUR report for 2014. According to the report, India emitted 2607.49 million tonnes CO<sub>2</sub>e (excluding Land Use, Land-Use Change, and Forestry (LULUCF)) and 2306.3 million tonnes CO<sub>2</sub>e (including LULUCF) in 2014. Out of the total emissions, the energy sector accounted for 73%, IPPU 8%, agriculture 16%, and the waste sector 3%. LULUCF sector offset about 12% of India's total emissions. GOI has taken various direct and indirect measures to reduce its emissions.

The direct contribution to India's GHG emissions is low as the state does not generate electricity and is relatively small in size and population. However, the state does have the potential to implement demand-side management measures in electricity and contribute to countries' overall effort to meet the NDC.

Goa is exposed to several climate risks like loss of land due to erosion, loss of life and livelihood, the outbreak of disease, damage to buildings, drainage, and other infrastructure. It is also exposed to sea-level rise, storms, high-speed wind, altered runoff, changed wave patterns and sea temperature, and other threats like rainfall and temperature changes. Under these climatic scenarios, Goa's natural and geographical features like rivers, khazan lands, soil type, moisture, and flora and fauna will show unique or varied response.

The Canacona flash flood is one such event experienced by the state of Goa on 2<sup>nd</sup> of October, 2009. It was

found that these flash floods were directly related to about 271 mm of rain that fell in a short span of 7 hrs, resulting in flooding of Talpona and Galjibag Rivers. Due to continuous rainfall in the monsoon season, the soil on the slopes was saturated. As a result, on steep slopes with altitudes above 300 m, the cascading water led to mudslides. At about 50 m or more altitudes, agricultural and horticultural areas were submerged, and cattle were washed away. At lower altitudes (about 50 m or less), where the topography is flatter, accumulation of water submerged buildings, and as the water made its way towards the sea, the flow destroyed houses and commercial establishments, particularly those that were weak (mud houses, for example). No records suggest the precedence of such a rainfall scenario in the past.

Interestingly, the flooding on 2 October 2009 was unprecedented in recorded history, but the total daily precipitation on that day was not. Hence, it implies that similar rainfall can have different risk profiles depending on the month it occurs.

**Thus, the state-specific action plan on climate change is necessary to understand and pave the way forward on climate change in the state of Goa. The present plan envisages wide coverage, including priority sectors, and is based on an inclusive planning approach based on extensive consultation process.**

### 2.1. Location, geography and size

The State of Goa is located between 14° 53' 57"N and 15° 47' 59" N Latitudes and 73° 40' 54" and 74° 53' 11" E Longitudes. It covers an area of 3702 sq. km., accounting for about 1 % of the country's total geographical area. Goa was elevated to the status of the 25<sup>th</sup> State of India Union on 30<sup>th</sup> May 1987. The State's boundaries are well-defined in the north by the Terekhol River, which separates it from the state of Maharashtra. The Western Ghats are protecting the State in east and bordered by the state of Karnataka, and in the west, it is surrounded by the Arabian Sea.

The State consists of 2 administrative districts, i.e., North Goa and South Goa, which are further divided into 12 Talukas viz. Pedne, Bardez, Bicholim, Sattari, Tiswadi, Ponda, Mormugao, Salcete, Sanguem, Dharbandoda, Quepem, and Canacona.

After attaining statehood, the number of towns increased from 15 to 70, and the number of villages decreased from 407 to 334 [1]. The state has 14 municipalities and 320 inhabited villages. The above is indicative of increasing urbanization in Goa and decreasing rural population. Generally speaking, the rural areas of Goa exhibit semi-urban characteristics.

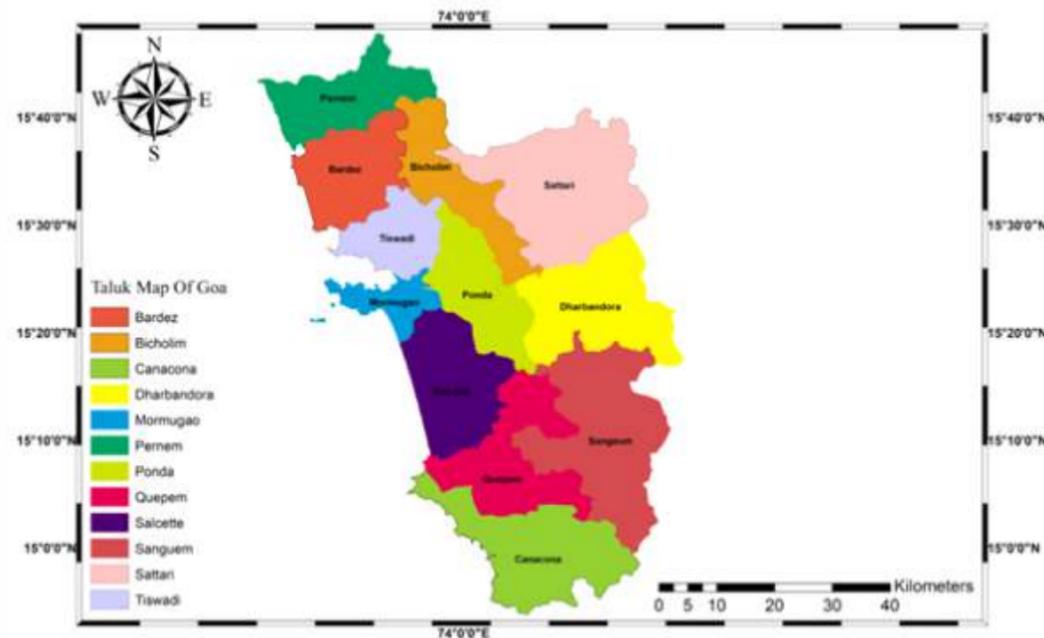


Figure 1: Map of Goa

[1] Goa at a glance 2017-18

### 2.2. Socio-Demographic profile

The State of Goa supports a human population of 14.59 Lakhs (Census 2011), which is about 0.12% of India's population. The average population density has increased in the last 20 years from 272 persons per sq. km to 394 persons per sq. km. The population density of Goa is higher than the national population density of 382 persons per sq. km. While the population density of Goa has increased the decennial population growth rate has reduced significantly from 26% in 1987 to 8.23% as per the Census 2011. The decadal growth rate of the population of the State for the decade 1991-2001 was 15.21%. Thus, indicating that the overall population pressure will decrease further in the coming decades.

Table 1: Year-wise Population and Decadal Growth 1900-2011

Year	Total Population	Decadal variation	Decadal growth (%)
1900	4,75,513	-9289	-1.9
1910	4,86,752	11,239	2.36
1921	4,96,494	-17,258	-3.55
1931	5,05,281	35,787	7.62
1940	5,40,925	35,644	7.05
1950	5,47,448	6,523	4.21
1960	5,89,997	42,549	7.77
1971	7,95,120	2,05,123	34.77
1981	10,07,749	2,12,629	26.74
1991	11,69,793	1,62,044	16.08
2001	13,47,668	1,77,875	15.21
2011	14,58,545	1,10,877	8.23

More than 62 % of the population resides in urban areas and about 38 % in rural areas. The sex ratio stands at 973 females per thousand males against the National sex ratio of 943. As per the 2011 Census, 11,65,487 persons in the State are reported to be literate, constituting 88.70 % of the total population. The State's workforce is about 577548, which constitutes 39.58 % of the total population in the State.

Table 2: Demographic Profile of the State<sup>1</sup>

Item	Value	Unit
Total population	14.59	lakhs
Male	7.39	lakhs
Female	7.2	lakhs
Sex ratio (females per "000" males)	973	
Population Density	394	person per sq.km
Average household size	4.24	persons per household
Decennial growth of population	8.23	%
Urban Population	9.07	lakhs

<sup>1</sup> All information is as per the Census of 2011

Rural Population	5.52	lakhs
Overall Literacy Rate	88.7	%
Overall urban Literacy	89.95	%
Overall Rural Literacy	86.65	%
Urban Women	85.56	%
Rural Women	81.63	%

### 2.3. Geophysical profile

The State of Goa has a hilly terrain, especially on its eastern side, where lies the southern end of the Sahyadri ranges. After skirting a considerable portion of the north-eastern and south-eastern boundaries, these mountains branch off westward across the State with many spurs and ridges. The terrain is interspersed by several rivers flowing westwards, which provide a network of internal waterways. The important rivers are Mandovi (Originates and is known as Mhadeyi in most areas along the course), Zuari, Terekhol, Chapora, Sal, Betul, Talpona, Galjibag, Cumbarjua, Valvanti, Mapusa, Siquerim, Khandepar, and Kushavati. The rivers are navigable for a total length of 256 km. The coast is full of creeks and estuaries formed by these rivers, providing a good shelter for fishing crafts. Goa's 105 km long coastal line is endowed with some of the world's loveliest beaches, which have earned the frame of bearing idyllic beauty spots.

The land elevation ranges from sea level to 1022 m. The highest point is the Wagheri hills in Sattari Taluka. The natural vegetation of Goa consists of dense forest and dry deciduous to moist deciduous types. Moderately sloping lands with laterite outcrops are covered by grass and shrubs. The habitat of the flora is of semi-evergreen type. Evergreen forests are seen only on high hills. The vegetation consists of trees, shrubs, herbs climbers, sedges, and grasses. Palms and mangroves cover the coastal tracts.

Goa receives rains from the South West monsoons. The average annual rainfall of the State, as recorded, is 2776.9 mm. Rainy season is spread over four months, from June to September. Occasional thunder showers are experienced in May and October. Goa experiences a warm and humid tropical climate. The summer temperature ranges from 24°C to 36°C. In winter, the mercury hovers between 21°C to 30°C. Due to the Global Warming effect, the picture seems to be slightly changing.

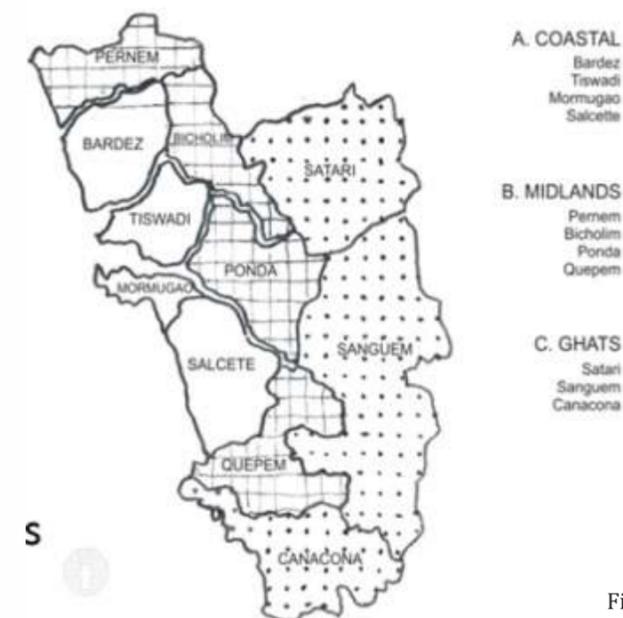


Figure 2: Geographical Zones of Goa

### 2.4. Economic Development of the State

The GSDP at constant (2011-12) prices for the year 2016-17 is estimated at more than INR 51,692 crore as against INR 44,717 crore in the year 2015-16 (Provisional Estimates), thereby reflecting a growth of 15.60 % as against 11.47 % in 2015-16 [3]. About 40 % of the total population in Goa forms its workforce [4]. Per capita income increased from INR 3,19,827 in 2014-15 to INR 4,25,749 in 2016-17. Goa has one of the country's highest per capita net state domestic product (NSDP).

The population of the State primarily depends on agriculture for livelihood. As per the economic survey 2017-18, the growth rate over the previous year under Primary Sector was negative during 2013-14 with -43.83 % due to the impact on the mining sector. Thereafter, from 2014-15 to 2015-16, the growth rate under the primary sector improved to 0.03 % and 15.88 %, respectively. This was mainly due to the resumption of mining and quarrying activity, wherein the growth rate improved from -5.35 % in 2014-15 to 1130.60 % in 2015-16. The growth rate under the Secondary sector registered negative growth during 2013-14, reflecting -20.10 %, and improved to 56.65 % during 2014-15 and 13.77 % during 2015-16. The positive change in the secondary sector continued during 2016-17 and stood at 18.36 %. Similarly, the growth rate under the Tertiary Sector, which was 3.24 % in 2013-14, went up to 9.63 % in 2014-15 and 7.34 % in 2015-16. This was mainly because of the improvement in transport and financial services.

Table 3: Sector wise percentage composition of GSDP at current prices (Percent)

Sector	2012-13	2013-14	2014-15	2015-16(P)	2016-17(Q)
Primary	12.54	9.86	7.29	8.20	9.26
Secondary	49.06	44.06	53.79	53.97	55.18
Tertiary	35.40	46.08	38.92	37.83	35.56
Total	100.00	100.00	100.00	100.00	100.00

## 2.5. Sectoral profile of State<sup>2</sup>

### Primary Sector

Goa's primary sector mainly comprises agriculture, forestry, fishing, mining, and quarrying. For NSDP (at current price), under the sub-sector of the primary sector, forestry and logging have recorded the highest growth rate of 29.23 %, followed by fishing and aquaculture, livestock and crops with growth rates of 26.74 %, 19.88 %, and 13.75 %, respectively. The mining and quarrying sub-sectors have also recorded positive growth rates of 204.09 % in 2016-17 as against the growth rate of 715.43 % in 2015-16(P).

### Secondary Sector

The sub-sectors of the secondary sector, "Electricity, Gas & Water Supply & other Utility Services" recorded a growth of 31.47 %, followed by the sub-sector manufacturing with 23.13 % and construction with 11.18 %.

### Tertiary Sector

Under the sub-sectors of the tertiary sector, transport by means other than railways recorded the highest growth of 33.44 % followed by the sub-sectors transport, storage, communication, and services related to broadcasting (26.87 %), other services (16.92 %) & public administration (12.50 %).

## 2.6. State specific development issues

### Khazan land:

Some of the coastal land in Goa has been reclaimed from the inundation of the tidal waters by constructing embankments. These lands are known as khazan lands and cover an area of about 18,500 ha. The khazan lands of Goa are a unique agro system and are historically and economically important. These lands in Goa are made of saline alluvial soils. They are used to cultivate paddy and form an important part of Goa's agricultural profile. Khazan lands are vulnerable as any sea-level rise or intrusion of salinity upstream can harm the quality of groundwater and soil quality. During 2017-18, up to 31/12/2017 under the State Sector, about 750 ha of khazan paddy land have been protected and about 1.94 km of long bunds are repaired. The state has incurred an expenditure of INR 75.64 lakh for this work.

### Drifting Occupations:

Tourism has become a major industry in Goa and attracts domestic and foreign tourists from all over the globe. It, directly and indirectly, employs about one-third of the state's population. As Goa has a high literacy rate and alternate income options are available, the state is witnessing a drift from agriculture, eventually leading to agriculture being a secondary source of income instead of the primary source. It poses a unique challenge for the state where the inherent knowledge on agriculture and agrobiodiversity of the state is likely to be lost due to economic prosperity.

### Potential Threat to Biodiversity and Agriculture due to changing trends:

Genetically modified organisms and crops (GMOC) are also a cause of concern for the State as the impact of introducing and mainstreaming these is yet to be completely understood. Most of the agriculture and allied activities in the State are at the subsistence level and completely synchronized with the natural system. The introduction of GMOC may threaten the age-old system and might shift the balance from self-sustaining to industry-dependent, intensive input-based agriculture.

<sup>2</sup> Economic Survey of Goa 17-18

### Power Dependency:

Goa does not produce any power and is dependent on NTPC plants in other states for supply of power whereas demand for power due to increased urbanization, industrialization, a boom in construction activity, commercialization, consumerism is constantly increasing. It is a serious issue that plagues the State of Goa.

### Illegal and Non-compliance in Mining Sector:

In all, 38 Mining Leases are in operation during the current year (till December 2017) which have reported production of Iron ore to the tune of 6.08 million Tons. Due to rampant illegal mining, several sectors in the State like water, biodiversity, and environment were getting impacted. Rash and careless driving in and around the mining area increases accidents. To curb the impacts a ban was imposed on mining activities during the year 2013-14, which has been lifted in subsequent years with the more stringent implementation of laws. However, the problem continues to concern the development of the state.

- Effective implementation of CRZ rules for new development in areas sensitive to subsidence. Effective ICZMP plan and its execution by GCZMA and Dept. of Environment.
- Bund restoration, khazan land rejuvenation, riverine ecosystem restoration etc.

## Process of Development of SAPCC

### 3.1. Guiding Principle in development of SAPCC

Common guidelines and principles have been developed by the Ministry of Environment, Forest and Climate Change (MoEFCC) to be followed by all States and Union Territories in India. This SAPCC of the State of Goa is also based on these fundamental guidelines and principles of MoEFCC as mentioned below:

- a) SAPCCs should be a policy document of the States/UTs outlining the major initiatives and strategies reflecting the commitments and proposed actions in the state to tackle the vulnerabilities and impacts of climate change across the socio-economic sectors. It should reflect the policy directions and strategies of the state for climate actions.
- b) It should envisage inclusive, sustainable, and climate-resilient low-carbon development pathways, with a focus on climate change adaptation and mitigation within the key sectors in the States/UTs and should protect the poor and vulnerable sections of society from adverse effects of climate change.
- c) It should consider recent scientific assessments and projections on global warming, vulnerability; and impacts. Climate models and high-resolution downscaled projections must be considered while assessing the vulnerability and preparing sectoral adaptation plans.
- d) It should synergize with the goals of NDCs under the Paris Agreement, though the targets under NDCs are national targets. It should also contribute towards achieving other development goals, including Sustainable Development Goals (SDGs). SAPCC should also complement prevalent national development and policy initiatives inter alia National Forest Policy, Biodiversity Goals, National E-Mobility Programme, and Swatch Bharat Mission to reap greater developmental co-benefits.
- e) It should highlight the links with national missions related to climate change. It should bring out climate actions of the state government from their sources, over and above the Government of India schemes.
- f) The SAPCC should also be built on the state's evolving socio-economic development context and priorities.
- g) SAPCCs should integrate and mainstream climate change concerns in the different sectors and policies/programs of the States in alignment and consistent with the existing schemes and programs within the states/UTs.
- h) It can strengthen existing climate action measures and launch new initiatives in its priority sectors.
- i) The implementation period of SAPCCs should start with the implementation cycle of NDCs, i.e., 2021-2030 and beyond.
- j) Financial resources required for the implementation of the action plan primarily to be leveraged from the existing budget of the State Governments and convergence with the relevant schemes and programs. The SAPCC should also bring out the likely funding from the State's resources over and above from the ongoing schemes and programs of Govt. of India.
- k) It should set out the institutional mechanism for implementation, including stakeholder engagement, ensuring inclusiveness, along with the mechanism for capacity building and monitoring and evaluation with clear indicators for reporting.

### 3.2. Process of development

SAPCC has been developed in line with MoEFCC guidelines through a structured multi-stakeholder consultative approach. The state of Goa has formed a core group, i.e., State level Steering Committee (SLSC), responsible for developing SAPCC. Identifying key departments, research organization and other stakeholders especially from the State of Goa and engaging and receiving their feedback and inputs for the SAPCC is the responsibility of the core group, i.e., SLSC.

Figure 3: Key Activities in the development of SAPCC as defined by MoEFCC

<b>State Governing Council for Climate Change</b>	<ul style="list-style-type: none"> <li>All State Level Steering Committee proposals shall be placed before State Governing Council for final Approval.</li> </ul>
<b>State Level Steering Committee</b>	<ul style="list-style-type: none"> <li>Identification of Key agencies and stakeholders</li> </ul>
<b>Review of Sectoral Strategies</b>	<ul style="list-style-type: none"> <li>Review of existing sectoral strategies in consultation with experts and Line Departments</li> <li>Analysis of gaps with respect to scientific evidence and vulnerability assessments, NDCs, and Paris Agreement</li> </ul>
<b>Identification of Climate Change Strategies</b>	<ul style="list-style-type: none"> <li>Propose prioritised mitigation and adaptation options</li> <li>Assessment of modalities to implement identified actions</li> </ul>
<b>Drafting of SAPCC</b>	<ul style="list-style-type: none"> <li>Preparation of SAPCC by engaging specialised agency under the supervision of Nodal Officer SLSC under the guidance of Chairperson SLSC</li> <li>Stakeholder consultations</li> <li>Approval by State Level Steering Committee</li> </ul>
<b>Approval by MoEFCC</b>	<ul style="list-style-type: none"> <li>Appraisal by Expert Committee</li> <li>Validation by National Steering Committee</li> </ul>

#### The State Governing Council

The State Governing Council shall be the decision-making authority in terms of the implementation of SAPCC.

Table 4: State Governing Council

Sr. No.	Members of State Governing Council	Designation
1.	Hon. Chief Minister of Goa	Chairperson
2.	Minister for Environment and Climate Change	Co-Chairperson
3.	Chief Secretary	Co-Chairperson
4.	Secretary (Forest)	Member
5.	Principal Chief Conservator of Forests	Member
6.	Secretary (Environment & Climate Change)	Member
7.	Secretary (Agriculture)	Member
8.	Secretary (Fisheries)	Member
9.	Secretary (Transport)	Member

10.	Secretary (Water Resources)	Member
11.	Secretary(Non-Conventional Energy)	Member
12.	Secretary ( Town and Country Planning)	Member
13.	Secretary (Finance)	Member
14.	Secretary (Revenue)	Member
15.	Member Secretary, Goa State Biodiversity Board	Nodal Officer
16.	Dr. Lidita Khandeparker, NIO	Expert Member
17.	Dr. Rajiv Chaturvedi, BITS Pilani	Expert Member

Simultaneously, the Steering Committee for the SAPCC has also been formulated at the State level to ensure the appropriateness and coherence of the SAPCC with the state's vision and guidance. Chief Secretary heads the State Level Steering Committee for SAPCC.

Table 5: State Level Steering Committee for SAPCC

Sr. No.	Members of State Level Steering Committee	Designation
1.	Chief Secretary	Chairperson
2.	Secretary (Forest)	Member
3.	Principal Chief Conservator of Forests	Member
4.	Secretary (Environment & Climate change)	Member
5.	Secretary (Agriculture)	Member
6.	Secretary (Health)	Member
7.	Secretary (Renewable Energy Source)	Member
8.	Secretary (Transport)	Member
9.	Secretary (Revenue)	Member
10.	Secretary (Finance)	Member
11.	The Collector, NG (Member Secretary, Disaster Management Cell (North))	Member
12.	The Collector, SG (Member Secretary, Disaster Management Cell (South))	Member
13.	Director, Department of Animal Husbandry & Veterinary Services	Member
14.	Director, Directorate of Health	Member
15.	Director, Directorate of Transport	Member
16.	Director, Department of Science and Technology	Member
17.	Director - Indian Meteorological Department, Panaji	Member
18.	Chief Engineer, Water Resources Department	Member
19.	Member Secretary, Goa State Pollution Control Board	Member
20.	Member Secretary, Goa Coastal Zone Management Authority	Member
21.	Member Secretary, Goa Energy Development Agency	Member
22.	Dean, School of Earth, Ocean and Atmospheric Sciences, Goa University	Member
23.	General Manager, NABARD or his/ her nominee	Member
24.	Director, Department of Tourism	Member
25.	Director, Department of Agriculture	Member
26.	Chief Town Planner, Town and Country Planning Department	Member
27.	Chief Electrical Engineer, Department of Electricity	Member
28.	Director, Department of Fisheries	Member
29.	Head of Nodal Agency, Goa State Wetland Authority	Member
30.	The Member Secretary, Goa State Biodiversity Board	Nodal Officer
31.	Director, Department of Environment and Climate Change	Convenor

To develop the SAPCC following activities were carried out:

- Extensive stakeholder consultation
- Data collection from departments
- Secondary data collection through desk review and research
- Climatic modelling for future projections
- Data analysis using appropriate tools for vulnerability assessment

**Note** - The constitution of above committees and climate change secretariat (Cell) in the Dept. of Environment within Goa State Biodiversity Board will be decided by Govt. and notified from time to time.

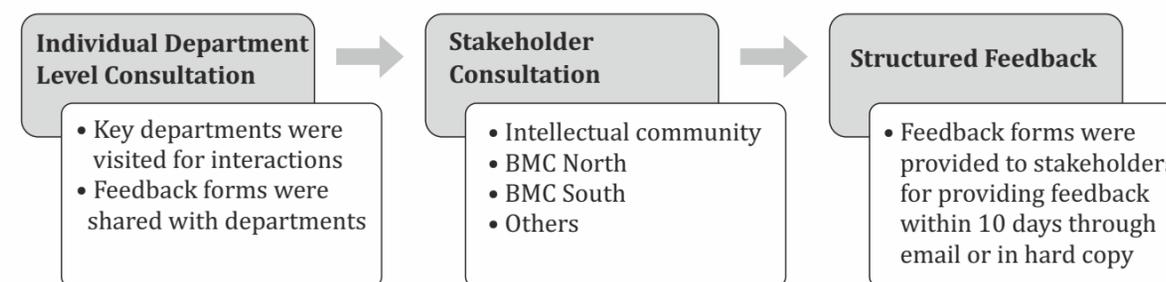
### 3.3. Stakeholder Consultation Process

Climate change in an interdepartmental topic and requires understanding, coordination, and implementation by various departments and stakeholders in the state. Two key types of consultations were conducted for the development of SAPCC:

- Individual-level consultation with concerned departments, institutes, and organizations
- Group stakeholder consultations at various locations with stakeholders from all sections of the society i.e. institutes, NGOs, local community representatives, BMCs etc.

Stakeholder feedback through structured feedback form during the consultation. Additionally, an email ID was created to receive feedback from stakeholders over 60 days during the consultation period. However sufficient time was given to respond even after approval of draft SAPCC by State Govt. and SLSC for NAFFC.

Figure 4: Stakeholder consultation process adopted



The objective of departmental stakeholder consultations was to understand from the departments their activities, policies, budget, resources, and plans for the state. These consultations also provided an understanding of the gaps in understanding climate change, actions aligned to climate change, and the constraints that could be faced due to climate change and in implementing climate adaptation and mitigation strategies and interventions for the state

Stakeholders consulted during the stakeholder consultation process and the public stakeholder consultation are provided below:

Table 6: Stakeholder Consultation for Development of SAPCC

	Stakeholder consultation date and venue	Stakeholder types consulted
1.	21/03/2017; Crown Hotel, Panaji	Members of State Level Steering Committee
2.	28/11/2017; Hotel Orion, Panaji	Members of State Level Steering Committee and core committee members

3.	05/11/2019; Goa International Centre, Dona Paula	Biodiversity Management Committees of North Goa
4.	06/11/2019; Goa International Centre, Dona Paula	Biodiversity Management Committees of South Goa
5.	07/11/2019; Goa International Centre, Dona Paula	Experts from various fields, scientists from NIO, officers from multiple departments, researchers from Goa University, etc
6.	A questionnaire for climate change was circulated and inputs were compiled accordingly	General public
Draft SAPCC approved at State level was further kept for approvals and necessary modifications for about a month		

### 3.4. Key stakeholder feedback

Feedback from group-level stakeholder consultations has been summarized below to reflect the stakeholder understanding of climate change, the impacts experienced, and their views on the response measures needed for climate proofing the State of Goa.

#### a) Awareness on Climate Change

Overall understanding and awareness on climate change issues were high amongst the stakeholder groups. Stakeholders have described it as a very important topic for mankind. According to the stakeholders, climate change affects every human being, including flora and fauna, and the impact of climate change is significant and will continue to increase. They also stressed the need to start preparing and planning on tackling the issue immediately to avoid a major disaster. They have emphasized the need to develop strategies and implement them locally to conserve the existing biodiversity. Information on weather-related warnings is received through the internet and news. Stakeholders described temperature rise, rainfall variation, and sea intrusion as some of the observed climate change phenomena in Goa. Population displacement during adverse climate situations is also being experienced in Goa.

#### b) Impacts of Climate change experienced by stakeholders

##### i. Changes in the ecosystem observed due to pollution and climate change

Some examples of these changes expressed by stakeholders are the disappearance of some bird species like sparrow and parrot, quality of fish harvested from the capture fisheries, invasive fish species leading to biodiversity erosion, and decrease in shellfish at the coast, and a decrease in insects. Some have observed new bird species, the disappearance of foxes and hyenas, the reduction of species like monitor lizards, and varieties of birds and snakes.

##### ii. Changes due to changes in rainfall patterns and other non-climatic stressors

Some of the changes cited by stakeholders are the drying up water bodies (like wells and lakes) during summer, leading to agricultural loss, and over usage of groundwater to serve commercial utilities.

##### iii. An altered monsoon pattern or sequence has been observed

#### iv. Health issues due to changes in the ecosystem and climate change

There has been an increase in vector-borne diseases and various allergies like cold, bronchitis, asthma, bird flu, swine flu, etc. An example expressed during stakeholder consultation was a reduction in the breeding of frogs, which has led to an increase in mosquitoes, resulting in diseases like Malaria, Filariasis, Dengue, and many more.

#### v. Changes due to temperature and other stressors

Some of the examples are eutrophication of water bodies, occurrences of harmful algal species from some of the estuarine systems of Goa suggesting water quality deterioration, unusual shortage of water or good quality of water over the years

#### vi. Impact of Land use change

Erratic rainfall, very low water retention, and change in water holding capacity of soil is leading to dry/arid land from October onwards, finally leading to water shortages by March April, which is shocking. Natural ponds with high water absorption have been concretized, resulting in almost no absorption. This will increasingly reduce the water table.

#### vii. Land-use change has been expressed as a concern that leads to the destruction of forest and mangroves on a large scale and it also impacts agricultural land

#### viii. Rainfall quantum and intensity have changed

a) A daily commuter is impacted by flooding, causing inconvenience in daily activity and overflow of sewers due to the high intensity of rains. Infrastructure most impacted due to weather events are road infrastructure, public health, power availability, food type and quality, internet, and telephone connectivity. A specific example of waterlogging of roads near the creek area of Majorda cultivated fields was cited.

# Sea level rise and associated problems of bund breaching and need for restoration of khazan lands.

It was expressed that sea level rise has been experienced in some areas, leading to soil erosion, impacted access to sea beaches, and disappearance of sea shells and fishes. Flooding of Khazan lands was specifically expressed as a concern, while the water level in creeks was also reported to have increased.

#### Specific observations and concern

The TENANTS ASSOCIATION OF CAMARCASANACHO BUNDH ward no. 8 of Camarcasana, Acoi, Bilou, and Peddem states that a huge stretch of river which connects to the Arabian sea through the river Mandovi. This ward lies at the lowest point in the Mapusa City/Aldona Constituency and therefore finds itself vulnerable and susceptible to the ongoing climate change and the increase of the sea level.

#### b) Response for Climate Proofing Goa

**Community involvement:** Generally, the stakeholders have expressed a need to involve every citizen in implementing climate change response by increasing the awareness level of citizens on climate change. While the stakeholders also expressed the need for government to take overall responsibility for developing and executing strategies to combat climate change, considering the local experiences and practices.

A strong need was expressed to create awareness amongst the citizens on the impacts and actions needed from every individual by introducing the topic in the school and college syllabus.

It was also emphasized that the government should consider creating a Task Force for Climate Change to monitor the effects of climate change involving the local communities. Such communities can assist in overseeing that the laws/activities identified for combating climate change are enforced in the State of Goa. It would help the Government of Goa and the State's people better prepared. Citizen mascots can also create awareness amongst communities on climate change action. Youth mascots were also recommended.

One of the measures suggested was regular meetings by concerned departments with the people affected due to climate change and to involve citizens in climate change activity to increase citizen sensitivity and generate positive attitudes towards biodiversity and climate-friendly practices.

### c) Other proposals

- i. Reduction of pollution and decreasing deforestation and increasing the forest cover through afforestation, improving mangrove management, protection of trees through base mapping and applying micro-climatic changes through increased tree cover
- ii. The 'Manos' or the embankments along the border of our rivers require immediate repair and strengthening to withstand the rising sea levels.
- iii. Timely dredging of rivers to be undertaken
- iv. To reduce pollution and GHG emissions, garbage burning should be stopped, buses older than 15 years should be banned, and availing public transport should be encouraged
- v. Barriers to avoid water logging of agriculture fields and integrated farm management approach to be taken up.
- vi. Revival of community resource systems, enhancing resource management and reducing consumption was also emphasised. Use of humanure toilets has been proposed to reduce water consumption.
- vii. Do not link rivers to de-risk
- viii. Enhancing in ground water protection
- ix. Imposition of heavy fines on violators of rules meant to protect the environment
- x. Illegal mining should be stopped, and development activities in eco-sensitive zones should also be stopped, including cutting hills and land filling with debris.
- xi. Planting more trees
- xii. Protection of water resources through harvesting water, preventing the excessive supply of water through tankers
- xiii. Using products that generate less heat and promote people to change to a diet that is more local
- xiv. Local bodies to have a plan of action – develop models enabling hands-on learning in our State itself was expressed. It has also been expressed that action plans like avoiding commercialization of lake shore and banning plastic use should be considered.
- xv. Using existing methods of creating water-holding bodies, such as being carried out in Canacona, like using live stock to seal the bottom of ponds. In the cheapest possible manner.

## Climate Change in Goa: Observations and Projections

4

Due to the build-up of greenhouse gases (GHGs) in the atmosphere, global temperatures are rising. The atmospheric CO<sub>2</sub> concentration has increased from 285 ppm during pre-industrial times (mid-1700s) to ~410 ppm in 2019. In response to this GHG build-up, the global mean temperatures have already risen by about 1 °C compared to pre-industrial times (Met Office, 2015). Indian sub-continent is also experiencing rapid warming, particularly since the 1980s. As per IMD's (2019) analysis, the annual mean temperature during the 1901-2018 period showed an increasing trend of 0.6 °C/100 years. As per IMD's (2019) assessment significant increasing trend was seen in maximum temperature (1.0°C/100 years) and a relatively lower increasing trend (0.2°C/100 years) in the minimum temperature over India.

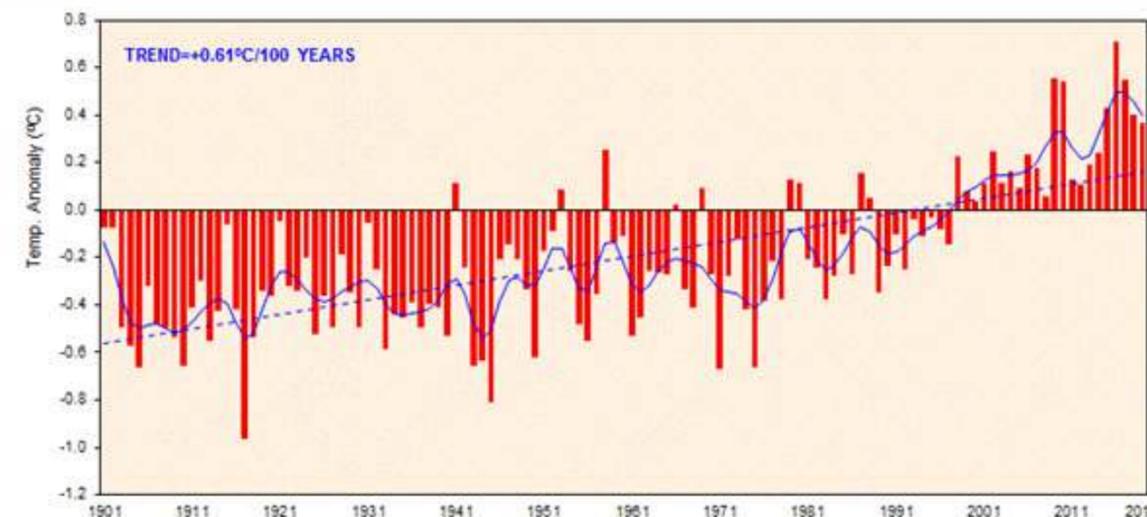


Figure 5 : Observed temperature change (in Deg C) in India (Source: IMD<sup>3</sup>)

As GHG build-up is projected to rise in the 21<sup>st</sup> century, future temperatures are expected to rise even further. The scientific community agrees that global temperatures should be capped below 1.5 – 2 °C, which creates a dangerous threshold for climate change. The Paris Agreement aims to limit warming below these levels. At All-India level Chaturvedi *et al* 2012 projected that “under the business as usual (between RCP6 and RCP8.5) scenario, mean warming in India is likely to be in the range of 1.7 to 2°C by 2030s and 3.3 to 4.8°C by 2080s relative to pre-industrial times”. Further it was project that “All India precipitation under the business as usual scenario is projected to increase from 4 % to 5 % by 2030s and from 6 % to 14 % towards the end of the century (2080s) compared to the 1961-1990 baseline”.

<sup>3</sup> [https://mausam.imd.gov.in/imd\\_latest/contents/cs\\_anomaly\\_timeseries\\_temp\\_rainfall.php](https://mausam.imd.gov.in/imd_latest/contents/cs_anomaly_timeseries_temp_rainfall.php)

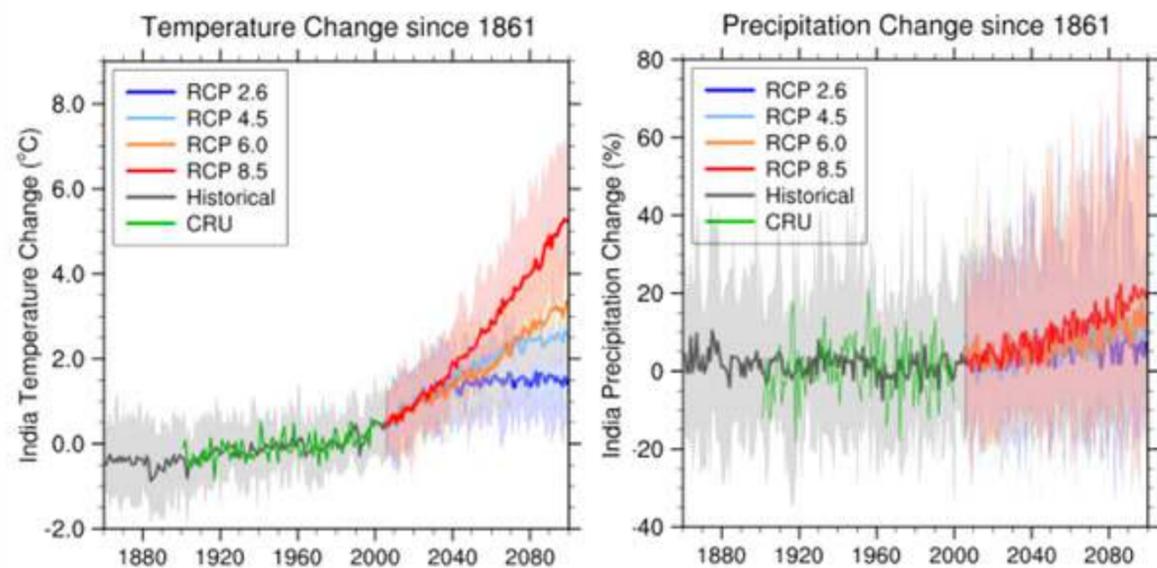


Figure 6: National level projections for temperature and rainfall in the 21<sup>st</sup> century (based on Chaturvedi *et al* 2012)

The global CMIP5 model ensemble-based annual temperature change (°C) projected for 2030s, 2060s and 2080s relative to the pre-industrial baseline (1880s) for the four RCP scenarios. All-India annual mean temperature increases by 1.7–2.02 °C by 2030s under different RCP scenarios and by about 2–4.8°C by 2080s, relative to the pre-industrial base. The above figure projects a consistent warming trend over the country in short-, mid- and long-term scenarios. As expected in each of the three-time slices RCP2.6 generally experiences the least warming, whereas RCP8.5 is associated with the highest warming, with RCP4.5 and RCP6.0 representing the moderate warming scenarios. Generally, the northern part of the country is projected to experience higher warming compared to the southern counterpart.

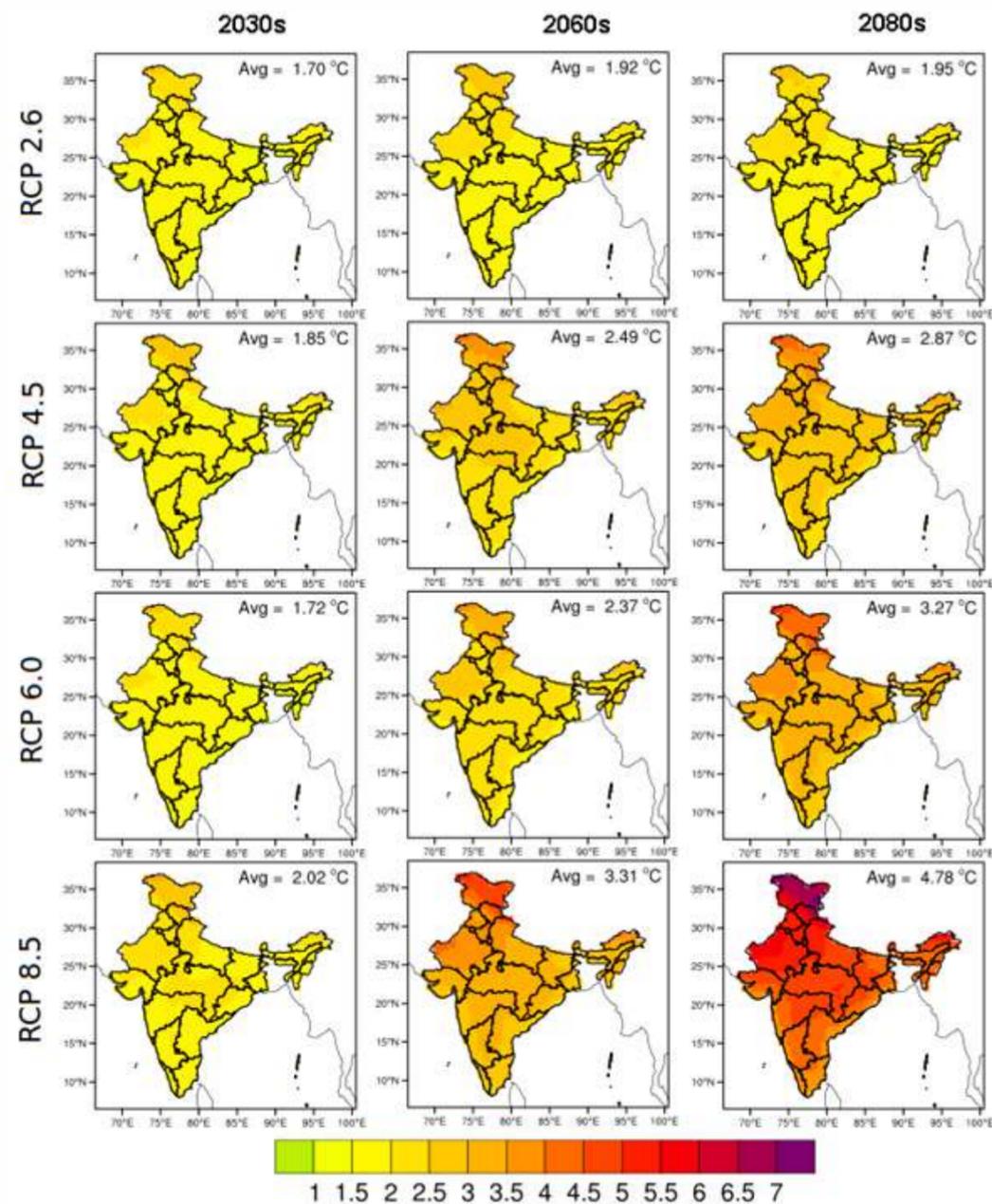


Figure 7: CMIP5 model ensemble mean temperature change (°C) projected for 2030s (2021-2050), 2060s (2046-2075), and 2080s (2070-2099) relative to the pre-industrial period (1880s, i.e., over 1861-1900)

Figure 7 shows the CMIP5 model ensemble-based annual precipitation change (%) projected by 2030s, 2060s and 2080s respectively, compared to the pre-industrial base-line (1880s) for the four RCP scenarios. All-India annual precipitation increases by 1.2–2.4% by 2030s under different RCP scenarios and by 3.5–11.3% by 2080s, relative to the pre-industrial base. Precipitation is projected to increase almost all over India except for a few regions in short-term projections (2030s). As noted in the temperature trends in each of the three-time slices, RCP2.6 experiences the least increase in precipitation, whereas RCP8.5 experiences

the highest precipitation increase, and the precipitation changes are larger for each subsequent period (i.e., short, mid, and long-term)

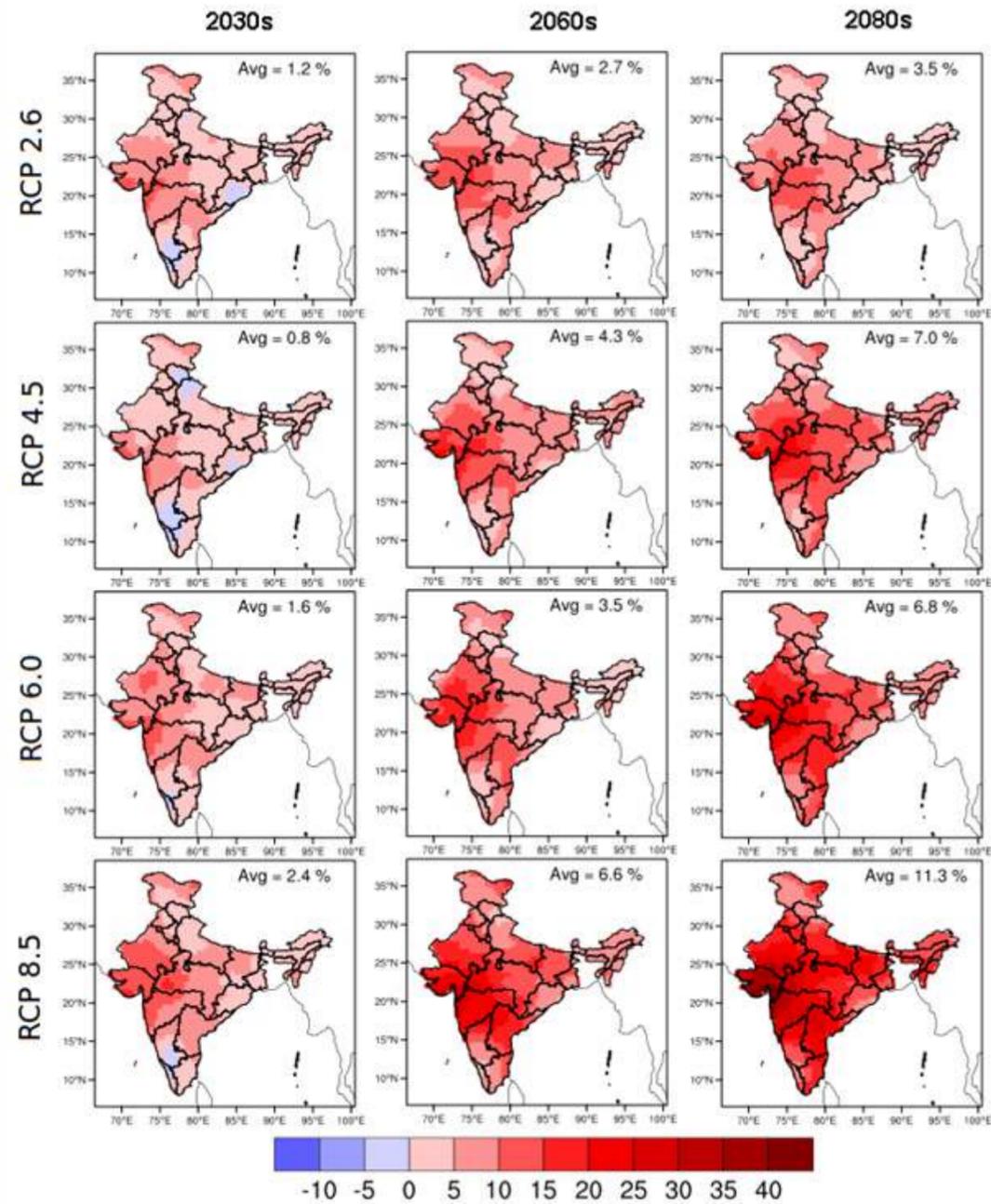


Figure 8: CMIP5 model ensemble mean precipitation change (%) projected for 2030s (2021-2050), 2060s (2046-2075) and 2080s (2070-2099) relative to the pre-industrial period (1880s i.e. over 1861-1900) (Source: Chaturvedi *et al* 2012)

For Goa state climate change projections are not available. Thus, climate projections and historical climate data analysis have been carried out for the SAPCC. The following is achieved by this analysis and presented in this chapter:

1. Updated long-term climate profile for the Goa state based on the 1951-2014 period as per revised IMD methodology
2. It investigates as to what extent changes in mean and extreme climate occurred in the State of Goa during the period of 1901-2015
3. Investigates climate projections in Goa in the 21<sup>st</sup> century based on high resolution regional climate models.
4. Assesses the relative vulnerability of different parts of Goa to inundation and floods

#### Methodology

All analyses carried out in this chapter, including the analysis of climate profile, observed climate change trends, and climate change projections, are carried out using this map.



Figure 9: Taluka Map of Goa for climate modelling

Observed gridded climatology data for temperature and rainfall is obtained from India Meteorological Department, Government of India (Pai *et al* 2014) and the Climate Research Unit (CRU) of East Anglia, UK (Harris *et al* 2014). IMD provides gridded temperature data at a resolution of 1°X1°, which roughly translates into 100 Km in length and 100 Km in width, meaning a single pixel in the IMD covers an area of about 10,000 sq. km. Goa state, on the other hand, is 105 km in Length and 65 km in width and has an area of 3,702 sq. km, which means any given IMD pixel will at least have 63 % of its area outside the Goa state and most probably much of it may lie in the neighbouring ocean which will have a sharp temperature gradient. Hence, it is decided that the coarse IMD observed temperature dataset may not be appropriate for assessing the observed climate change in Goa's landmass. This analysis uses the observed temperature dataset provided by the Climate Research Unit (CRU) of East Anglia, UK (Harris *et al* 2014) for the analysis of temperature profile in the state and assessing the changes in temperature in the state over the period 1901-2018. CRU

dataset (Harris *et al* 2014) is available at a spatial resolution of 0.5°X0.5°, and for a time period of 1901-2018. Gridded rainfall data from IMD is available at a much finer spatial resolution i.e. 0.25°X0.25° (Pai *et al* 2014). This high-resolution observed rainfall dataset (1901-2018) is used to analyze the state's rainfall profile and assess the changes in observed rainfall in the state over 1901-2018.

To project climate in the 21<sup>st</sup> century, the scientific community has developed a set of new emission scenarios termed as Representative Concentration Pathways (RCPs) (<http://www.iiasa.ac.at/web-apps/tnt/RcpDb/dsd?Action=htmlpage&page=welcome>). There are four RCP scenarios: RCP 2.6, RCP 4.5, RCP 6.0, and RCP 8.5 – these scenarios are formulated to represent the full range of stabilization, mitigation, and baseline emission scenarios available in the literature. The naming convention reflects socio- economic pathways that reach a specific radiative forcing by 2100. For example, RCP 8.5 leads to a radiative forcing of 8.5 Wm<sup>-2</sup> by 2100. While four RCP scenarios are available, we have used the RCP scenarios of RCP4.5 and RCP8.5. These are briefly described in the table below.

Table 7: Description of RCP scenarios

RCPs	Description	Developed by
RCP 4.5	It is a stabilization scenario where total radiative forcing is stabilized before 2100 by employing a range of technologies and strategies for reducing greenhouse gas emissions.	MiniCAM modeling team at the Pacific Northwest National Laboratory's Joint Global Change Research Institute (JGCRI) (Wise <i>et al.</i> , 2009)
RCP 8.5	The RCP 8.5 is characterized by increasing greenhouse gas emissions over time representative for scenarios in the literature leading to high greenhouse gas concentration levels.	MESSAGE modeling team and the IIASA Integrated Assessment Framework at the International Institute for Applied Systems Analysis (IIASA), Austria; (Riahi <i>et al.</i> , 2007)

Climate projections for the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) are made using these newly developed representative concentration pathways (RCPs) under the Coupled Model Inter-comparison Project 5 (CMIP5). More than 50 CMIP5 model outputs are now available from different climate modelling groups. Since CMIP5 models outputs are available at coarse resolution, Co-Ordinate Regional Downscaling Experiment (CORDEX) was used to facilitate local and regional adaptation planning. In India Indian Institute of Tropical Meteorology, Pune hosted these experiments and provided multiple dynamically downscaled high-resolution climate model projections for the South Asian domain, including India. CORDEX South Asia model projections should be used for State Action Plan on Climate Change (SAPCC). As such, we downloaded and evaluated the following CORDEX South Asia models.

Table 7: Evaluated CORDEX South Asia models for this report

Model Name	CORDEX SA RCM	Contributing CMIP5 Modeling Center	Model Resolution (in km)
ACCESS1-0	CCAM	CSIRO, Australia	50*50 km
CCSM4	CCAM	National Center for Atmospheric Research (NCAR), USA	50*50 km
CNRM-CM5	CCAM	Centre National de Recherches Me'te'orologiques (CNRM), France	50*50 km

MPI-ESM-LR	REMO2009	MPI-M, Germany	50*50 km
GFDL-CM3	CCAM	National Oceanic and Atmospheric Administration (NOAA)	50*50 km
MPI-ESM-LR	CCAM	Max Planck Institute for Meteorology (MPI-M), Germany	50*50 km
NorESM1-M	CCAM	Norwegian Climate Centre (NCC), Norway	50*50 km
LMDZ4(IPSL)	RegCM4-11	CCCR, IITM, India (Not a CMIP5 contribution)	35*35 km
EC-EARTH	RCA4	Irish Centre for High-End Computing (ICHEC), European Consortium (EC)	50*50 km

However, since the regional climate projections data from most of the models are incomplete/ truncated, the following CORDEX South Asia models for which full time-series till 2100 is available for at least the two climate scenarios of RCP 4.5 and RCP8.5: Access 1.0, CCSM4 and MPI-ESM-LR.

#### Spatial Downscaling:

Goa is a small state; hence even the dynamically downscaled climate projections at 0.5X0.5 resolution are not adequate for analysing the spatial variability in climate. Therefore, spatial downscaling techniques are employed to improve the climate projection datasets. The climate model projections' temperature component, available at a spatial resolution of 50\*50 km, is downscaled to a very high resolution using the elevation-adjusted bias correction method (Gerlitz *et al* 2014). Whereas rainfall projections (available at 50\*50 Km resolution) are downscaled using the high-resolution gridded observed rainfall datasets provided by IMD to 0.25°\*0.25° resolution.

To analyse the flood and inundation risk and vulnerability in Goa under the current climate as well as under future climate, a high-resolution digital representation of orography based on the SRTM Digital Elevation Model (DEM), published by the CGIAR-Consortium for Spatial Information (<http://srtm.csi.cgiar.org>), with cell size (spatial resolution) of 90 m, is used (Farr *et al.* 2007, Reuter *et al.* 2007).

#### Temperature Profile in Goa:

The figure below shows Goa's mean annual temperature map over the long-term period of 1951-2014. The mean temperature in Goa is 26.7 °C, higher than the national average annual temperature of 23.3 °C (Chaturvedi *et al* 2012). While spatial temperature variability is not high in Goa, hilly areas in the eastern parts of the state are generally cooler than the coastal areas in the west.

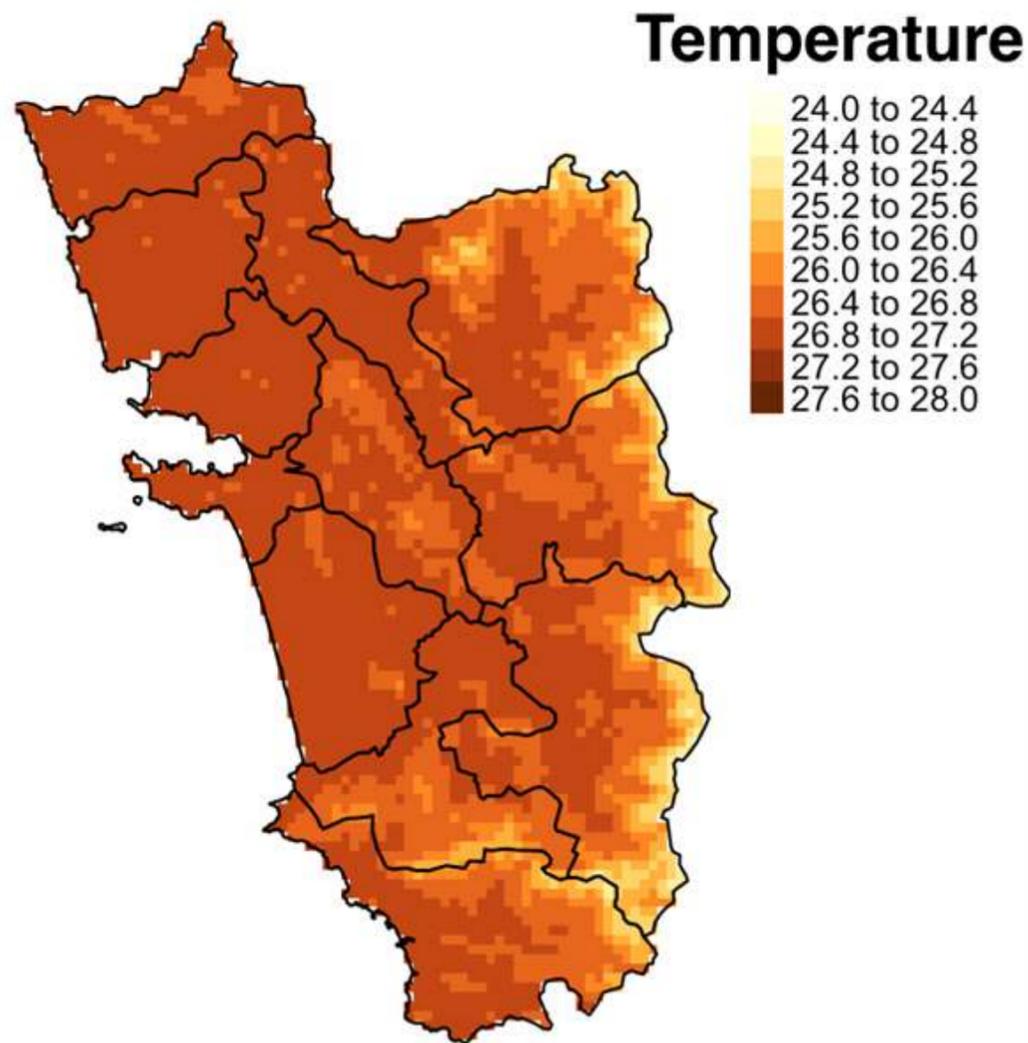


Figure 10: Long period average (1951-2014) spatial distribution of mean temperature (deg C) in Goa

Goa experiences a hot summer (April- June) followed by a pleasant monsoon (June-September) season; temperatures temporarily rise again in the month of October, following pleasant winter months (November - March). Figure 11 shows the seasonal and monthly mean monthly temperature profile in Goa based on the long-period mean temperature average over the period 1951-2014.

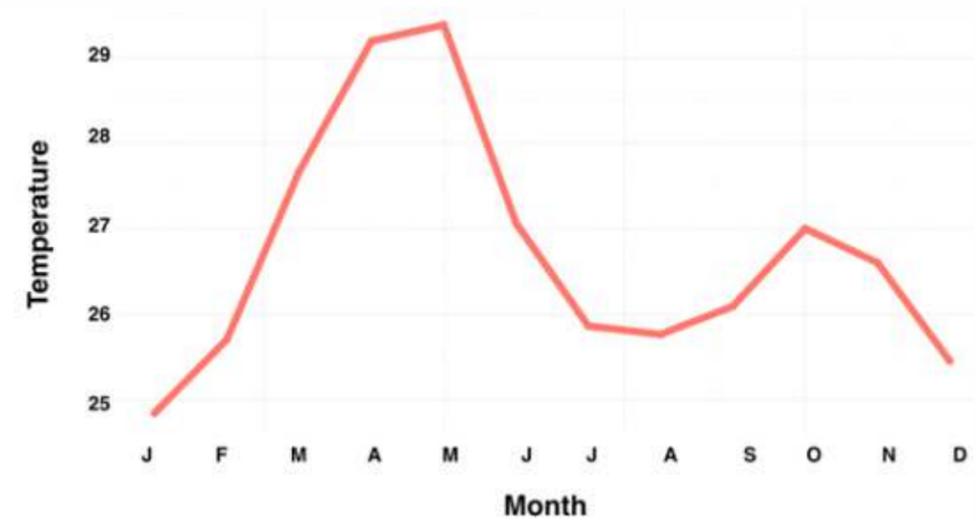


Figure 11: Long-period average (1951-2014) annual temperature profile in Goa

**Rainfall Profile in Goa:**

The average annual rainfall in Goa is about 3000 mm, nearly three times higher than the national average. Figure 12 shows the spatial distribution of annual rainfall in Goa. The analysis in Figure 13 is based on long-period (1951-2014) gridded precipitation data from the Indian Meteorological Department (Pai *et al.* 2014).

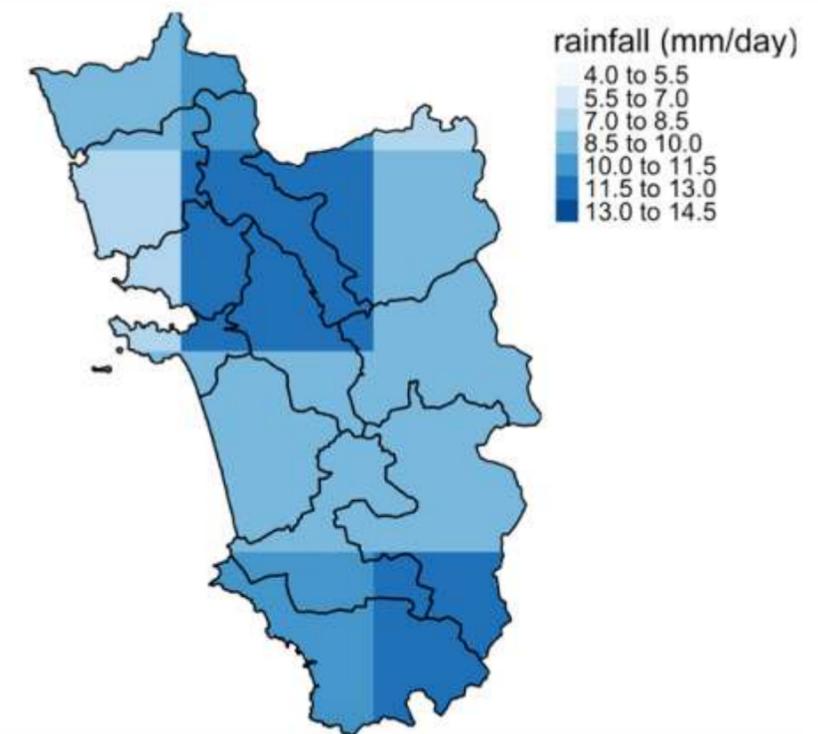


Figure 12: Long period average (1951-2014) spatial distribution of annual rainfall in Goa

Figure 13 shows the state's mean monthly rainfall profile in monsoon, pre-monsoon, and post-monsoon months. It shows that much of Goa's rainfall occurs in the monsoon months, whereas winters are usually dry.

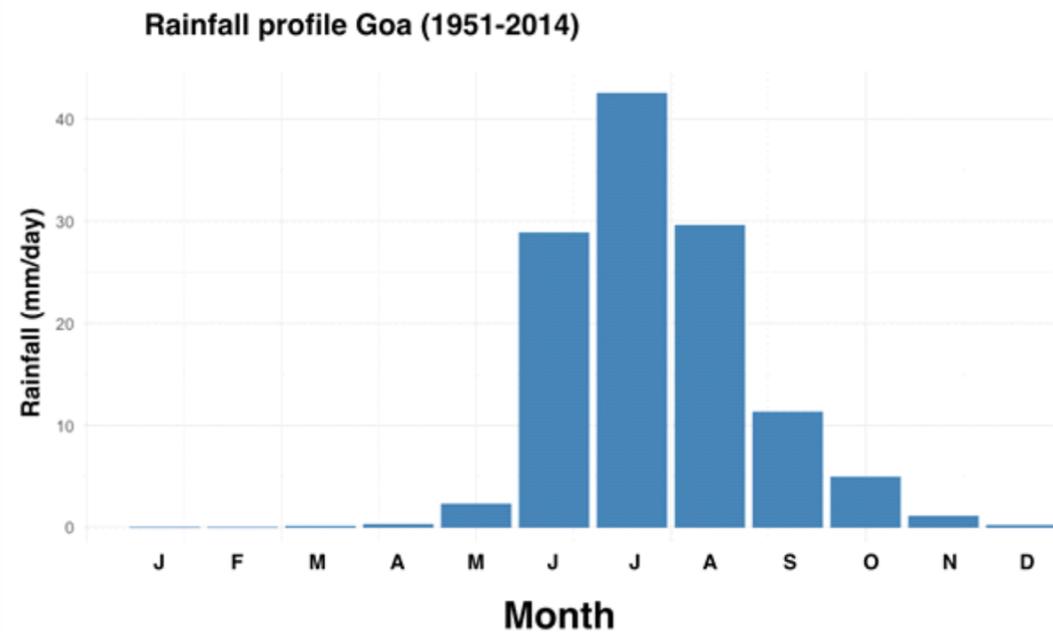


Figure 13: Long-period average (1951-2014) annual rainfall profile in Goa

### Geographical Features that influence climate in Goa

Goa has a peculiar geographic orientation with the Arabian Sea on the West and the Western Ghats (with increased height) on its eastern boundary. This makes the weather pattern very unique for Goa.

### Observed Climate Change in Goa

Due to the build-up of greenhouse gases in the atmosphere, global temperatures are rising. It has been estimated that a warming of 2 °C or even 1.5 °C compared to the pre-industrial times is the threshold for dangerous climate change (IPCC, 2018). The global mean temperatures have already risen by about 1°C compared to pre-industrial times (Met Office, 2015). Indian sub-continent is also been particularly warming since 1980s. As per IMD's (2019) analysis, the annual mean temperature during 1901-2018 showed an increasing trend of 0.6 °C/100 years. Climate change and its impact in Goa have not been fully explored; however, Kamat, 2013 and Kaur et al 2017 have explored some aspects of the observed climate change in Goa. This section aims to investigate to what extent changes in mean and extreme climate have occurred in the State of Goa during the period of 1901-2018

The mean temperature trend in Goa is shown in Figure 14. It suggests that Goa is witnessing higher levels of temperature increase compared to the national average (IMD, 2013), as the mean temperature in Goa has increased by about 1 °C over the period 1901-2018. It also shows that much of the warming in Goa has been witnessed after the 1970s.

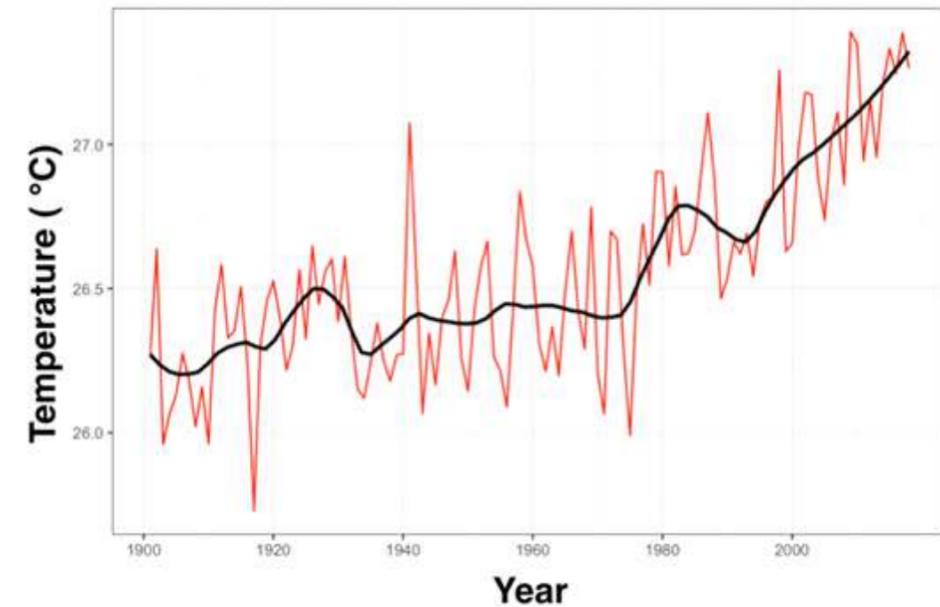


Figure 14: Observed changes in mean annual temperature in Goa (1901-2018)

The mean temperature change could also be represented in terms of temperature anomalies. Change in mean temperature anomaly in Goa compared to the period 1960-1990, as shown in Figure 15. It reiterates the conclusion that the mean temperature anomaly in Goa has increased by 1°C in the last century.

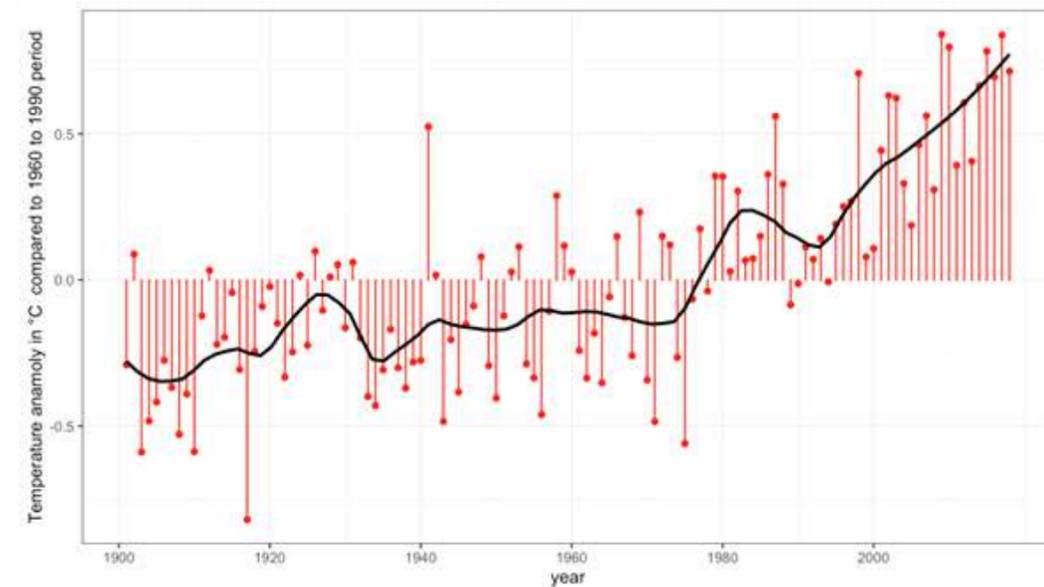


Figure 15: Mean annual temperature anomaly in Goa (1901-2018)

The maximum and minimum temperature trends from station-based data for Panaji, Dabolim, and Margao stations were also analysed. One of the results from the Panaji station is shown below. Station-based data also suggests a large temperature rise in Goa, as analysed from the gridded dataset.

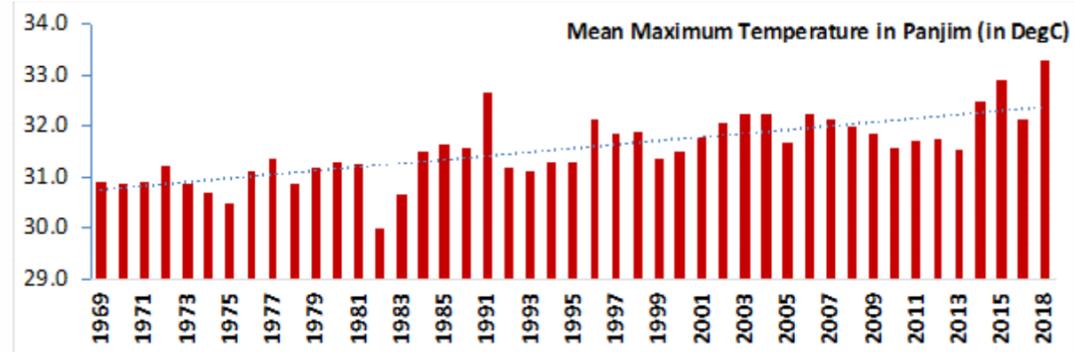


Figure 16: Mean Maximum Temperature trend as available from Panaji station

Similarly, the mean annual rainfall trend in Goa has also been plotted. It shows that mean annual rainfall in Goa has increased by about 68 % over the last century. Results are supported by the mean annual rainfall trend in North Goa as reported by Kaur *et al* 2017, where mean annual rainfall in North Goa is found to have increased from about 3000 mm in 1901 to about 5000 mm in 2015 (an increase of 66 %).

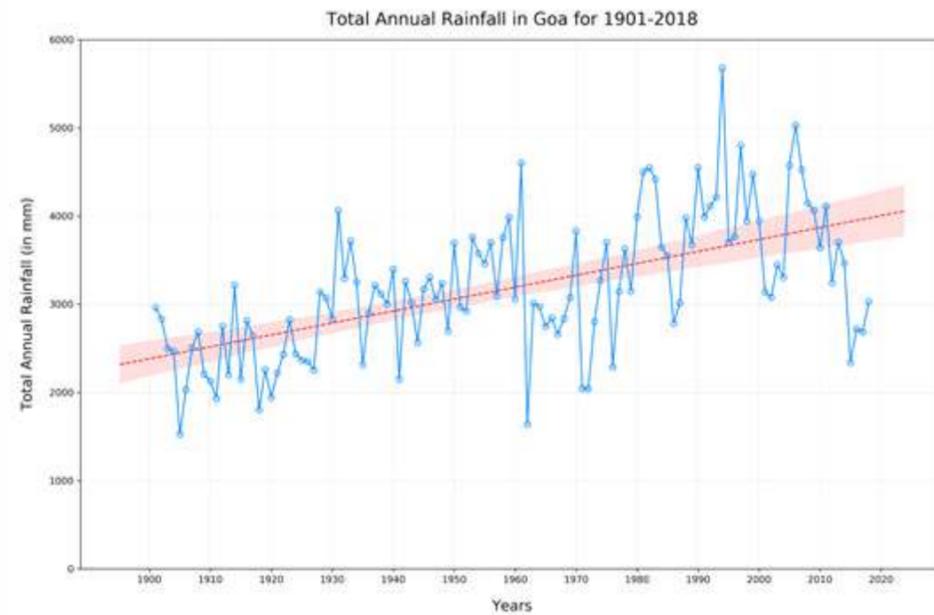


Figure 17: Long-term rainfall trend in Goa (1901-2018)

The rainfall anomaly (percentage departure from the 1960-1990 mean) for 1901-2018 shows that mean annual rainfall in Goa has consistently increased over the last 100 years.

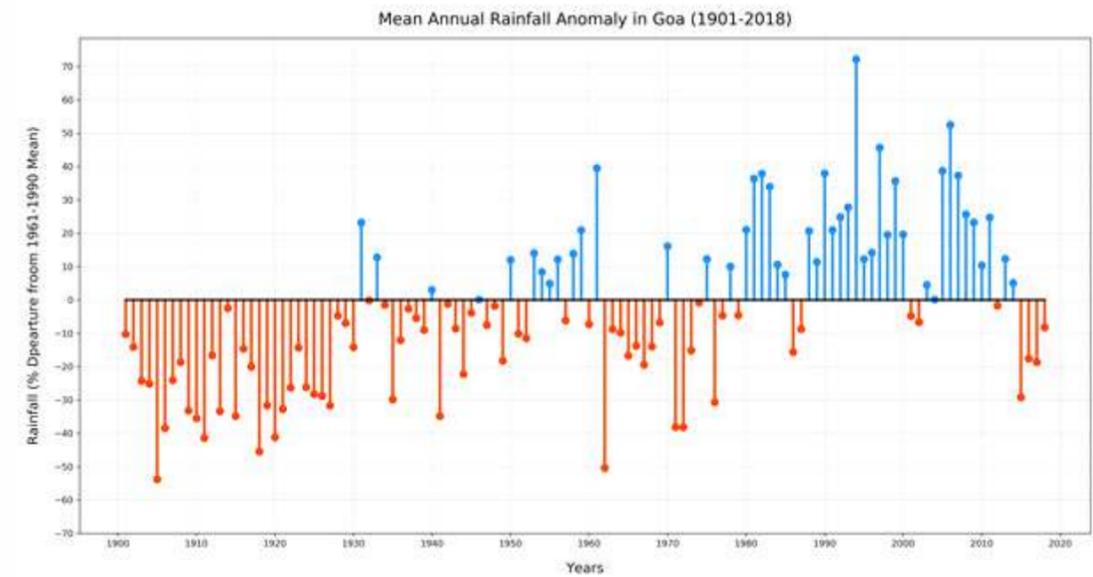


Figure 18: Mean annual rainfall anomaly in Goa (1901-2018)

The annual rainfall trend from station-based data for Panaji, Dabolim, and Margao stations is shown in Figure 18. One of the results from the Panaji station is shown below in Figure 19. Station-based data also suggest a rise in rainfall, as analysed from the gridded dataset.

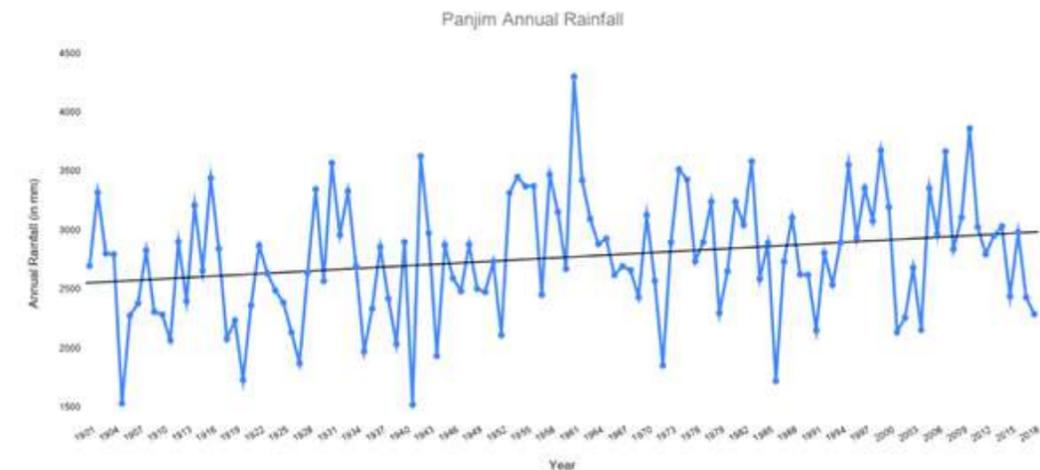


Figure 19: Annual rainfall trend from Panaji station

Studies (Goswami *et al* 2006; Ghosh *et al* 2012) based on the observed precipitation records of IMD have shown that extreme precipitation events and their variability have already increased in many parts of India. To quantify the observed changes in extreme rainfall events over Goa by using the daily precipitation data from IMD. Rainfall in India is categorized as the following categories and these extreme rainfall categories are obtained from Bhatla *et al.*, 2016.

Table 9: Classification of rainfall events based on daily rainfall

IMD Classification		IMD classes regrouped as Bhatla <i>et al</i> 2019, and used for analysis in this report	
Rainfall Categories	Daily Rainfall (mm)	Rainfall Categories	Daily Rainfall (mm)
No rain	0	No rainfall	0-2.4
Very light rain	0.1-2.4	Category 1	2.5-64.4
Light rain	2.5-7.5		
Moderate rain	7.6-35.5		
Rather heavy rain	35.6-64.4	Category 2	64.5-124.4
Heavy rain	64.5-124.4		
Very heavy rain	124.5-244.5	Category 3	>124.5
Exceptionally heavy rain	≥244.6		

Source: Bhatla *et al* 2016

The frequency of light and moderate rainfall events has declined over the last century, whereas the frequency of extreme rainfall events has increased in Goa over the last century. The number of rainy days experiencing category 1, rainfall has declined from 1901 to 2018. Whereas the number of rainy days experiencing heavy rain, i.e., category 2, rainfall has increased by about 60 %. On the other hand, Category 3 rainfall days, which denotes rainy days with extreme rainfalls (very heavy and exceptionally heavy), have increased by an alarming more than 100 %. It is interesting to note that the category 1 and 2 rainfall events (moderate to light heavy rainfall) nourish life forms and ecosystems. In contrast, category 3 rainfall events (very heavy and exceptionally heavy) create devastation and chaos to life forms and ecosystems. The increasing frequency of very heavy and exceptionally heavy rainfall events in Goa is one of the key impacts of climate change witnessed in the state. **Goa state is already vulnerable to flooding, increasing heavy rainfall trend makes the state even more vulnerable to this hazard.**

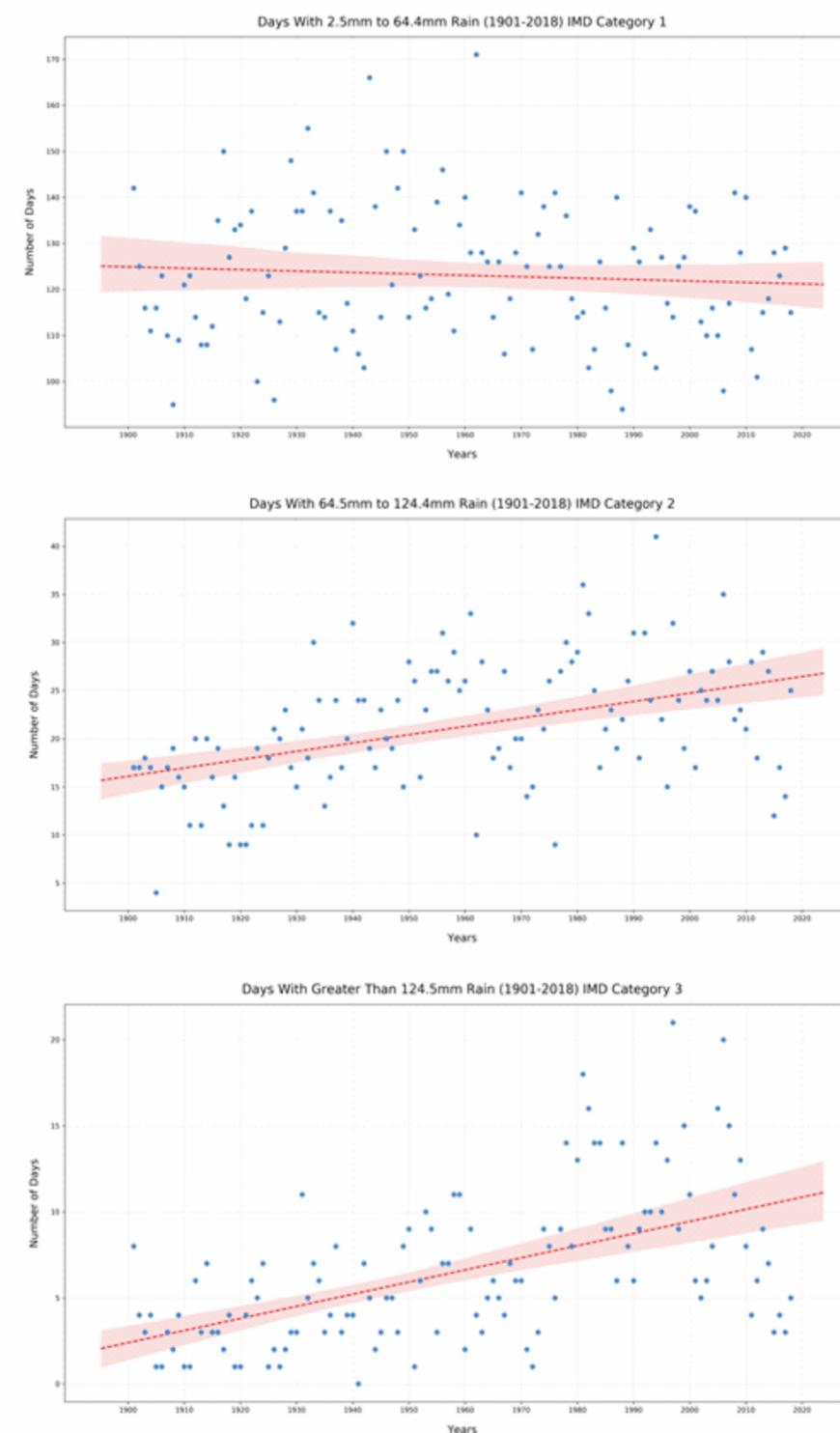


Figure 20: Declining moderate rainfall days and increasing very heavy and exceptionally heavy rainfall days in Goa

Goa state is organized into 12 Talukas; the figure below shows how each of the Talukas in the state are facing the impact of climate change in terms of increasing temperature anomalies over the last century.

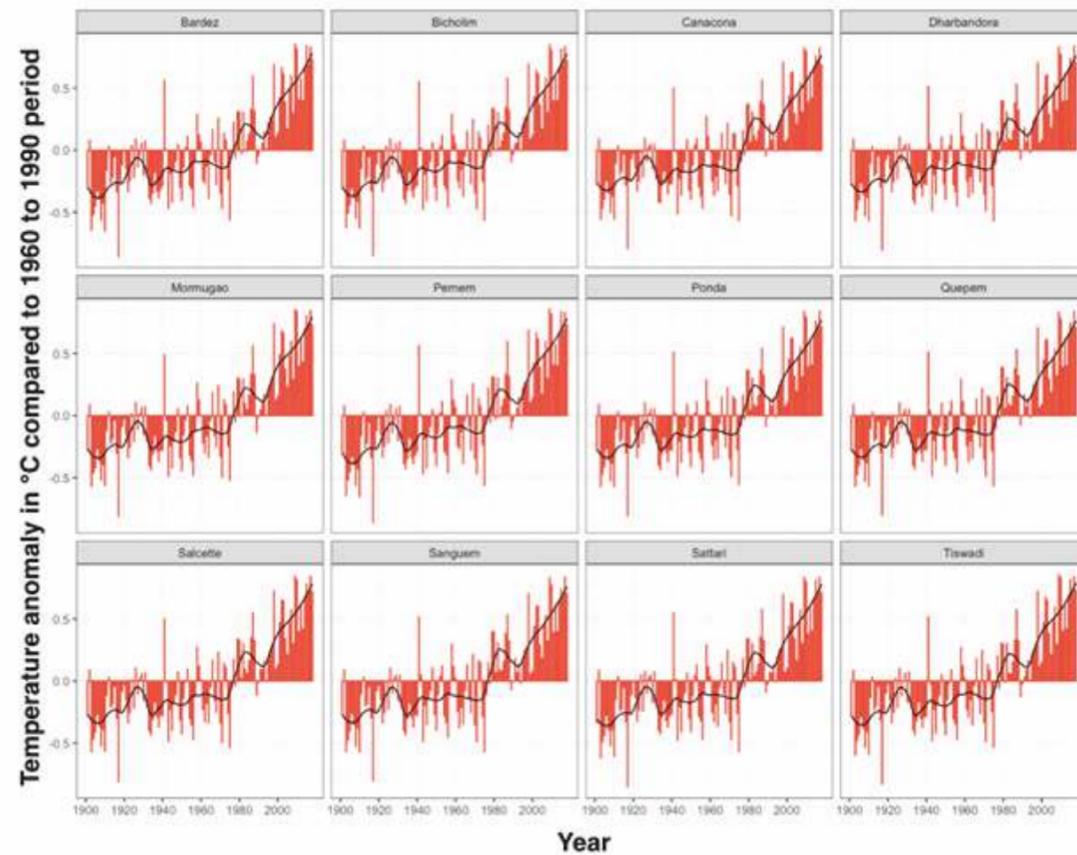


Figure 21: Taluka-wise observed mean annual temperature anomalies (°C) in Goa over 1901-2015

### Projected Climate Change in Goa

Climate change projections in Goa in the 21<sup>st</sup> century based on high-resolution regional climate models (RCPs) have been carried out. The projected climate change scenarios (temperature and rainfall) are for the two scenarios of RCP8.5 and RCP4.5. Under RCP8.5 scenario, atmospheric CO<sub>2</sub> concentration rises to 940 ppm by 2100, whereas under the RCP4.5 scenario, atmospheric CO<sub>2</sub> concentration rises to 538 ppm by 2100.

From the analysis the mean temperature projections for the state of Goa from 1901-2100 under two scenarios of RCP4.5 and RCP8.5 are given below (Figure 22). Under the RCP8.5 scenario, the temperature rises by 4.5°C compared to the base of 1901-1950; however, if the GHG emissions are controlled to RCP4.5 scenario, then Goa witnesses a mean temperature rise of only about 2.5°C compared to 1901-1950 base.

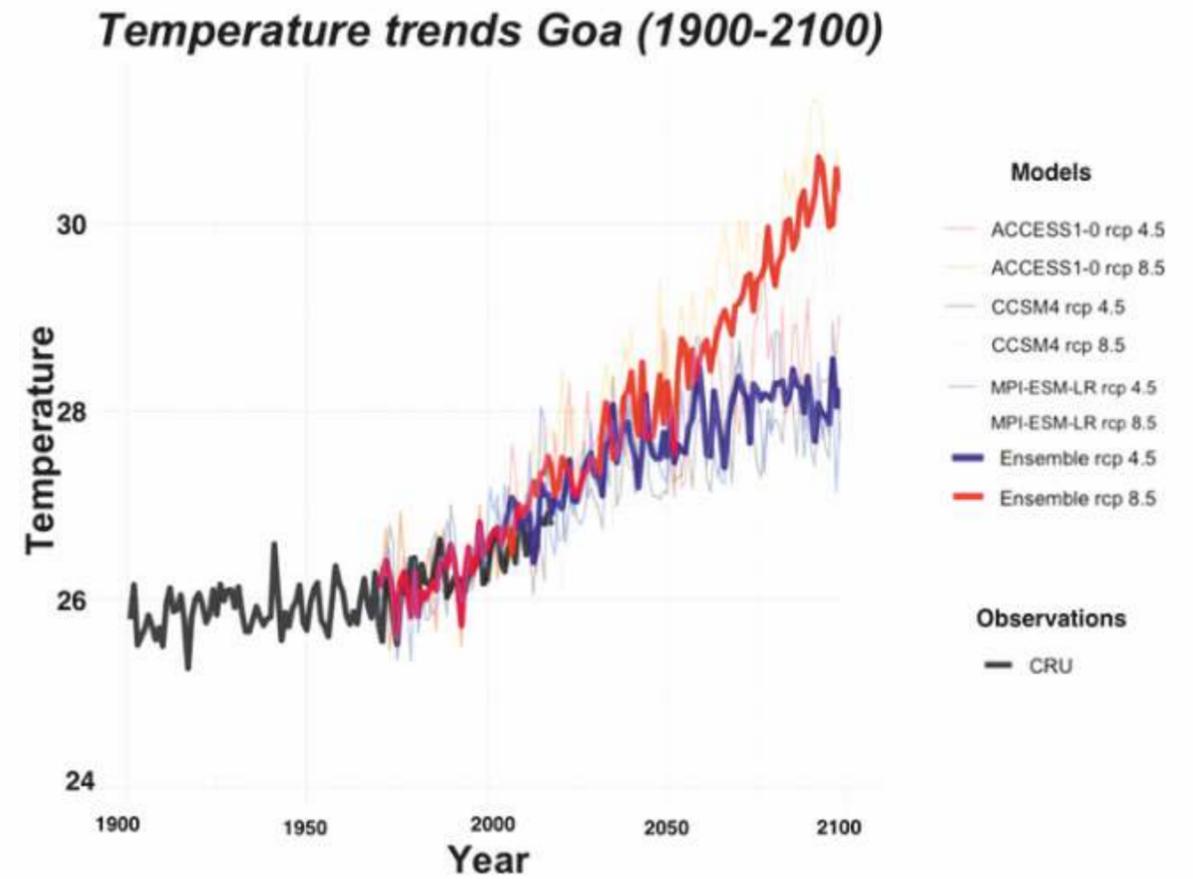


Figure 22: Projected mean temperature trend (deg °C) in Goa under different climate change scenarios

The mean annual rainfall projections for the state of Goa from 1901-2100 show that generally, annual rainfall is projected to decrease in Goa in the 21<sup>st</sup> century; however, the variability in rainfall projections for Goa state is very high.

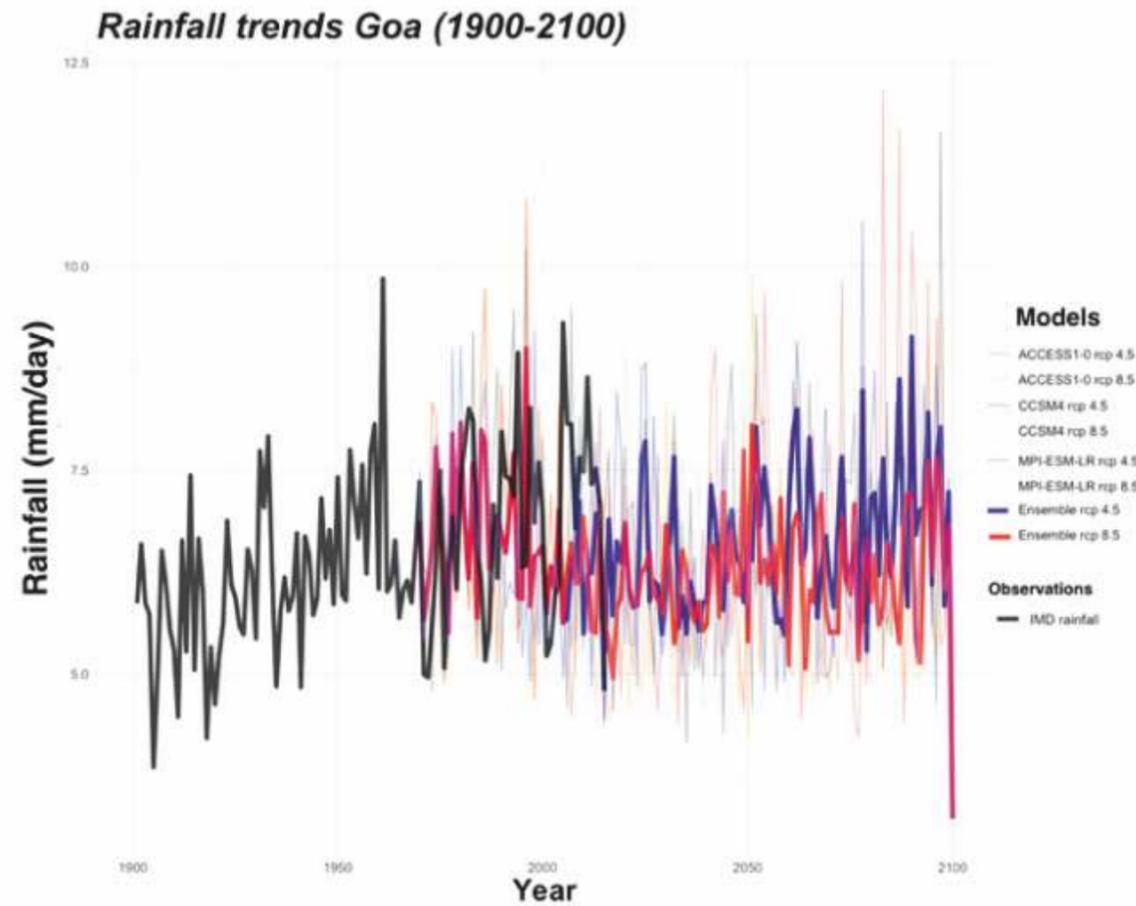


Figure 23: Projected rainfall trend (mm/day) in Goa under different climate change scenarios

Krishnan *et al* (2013) based on simulations from the 20 km ultra high-resolution model projected reduced rainfall over the Western Ghats in the 21<sup>st</sup> century. It is argued that a stabilization (weakening) of the summer monsoon Hadley-type circulation in response to global warming can potentially lead to a weakened large-scale monsoon flow, resulting in weaker vertical velocities and reduced orographic precipitation over the narrow Western Ghat mountains by the end of the twenty-first century. The findings of this modelling are aligned with the same.

It should, however, be noted that precipitation projections in the 21<sup>st</sup> century are less reliable compared to temperature projections. Chaturvedi *et al* 2012 based on their analysis, find that all India precipitation projections have larger uncertainties, as evident from the large spread of the precipitation change projections in the 21<sup>st</sup> century. Further, Taylor diagram analysis suggests higher confidence for the temperature projections and relatively low confidence for the precipitation projections from 21 CMIP5 models (See figure 24).

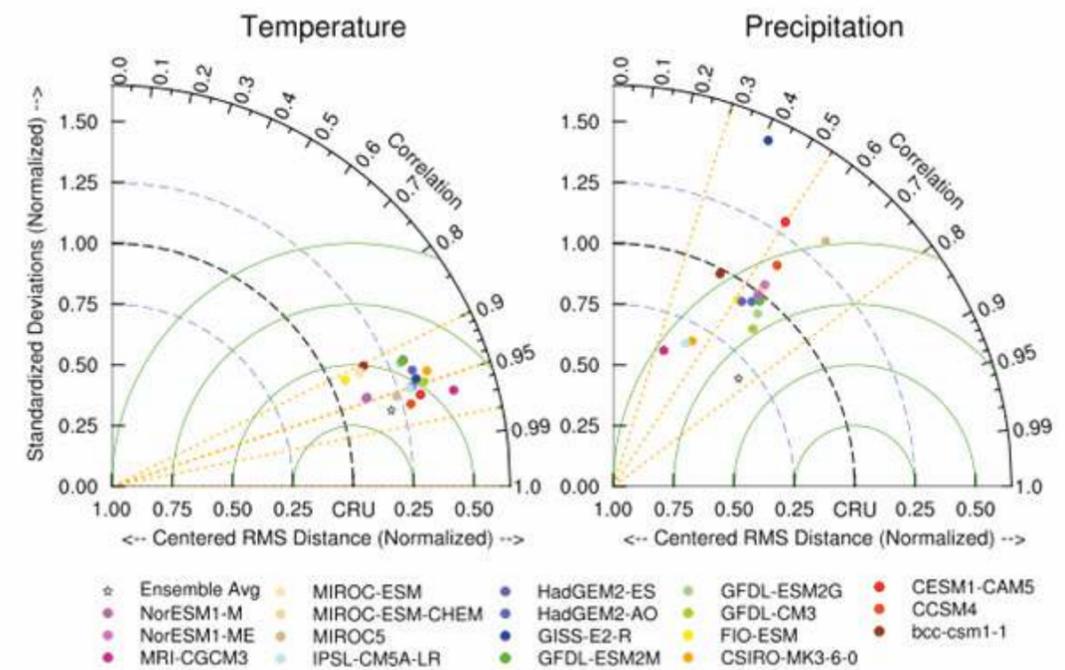


Figure 24: Predictability of temperature variable in the 21<sup>st</sup> century is high whereas the predictability of precipitation variable is lesser

These findings are also supported by the earlier findings involving the CMIP3 model experiments, both at global scales (Solomon et al 2007) and at all India-level precipitation projections (Krishnakumar *et al* 2010).

The following three-time slices have been used for climate change projections: 2021-2050 (Short-term), 2046- 2075 (Mid-term); and 2071-2100 (Long-term).

Figure 25 below shows the future mean annual temperature projections in the short, medium, and long term. As per data, the mean annual temperature in Goa will increase to 28.1 °C by 2035 and 30.3 °C by 2085, compared to the present annual temperatures (1985-2015) of 26.80°C.

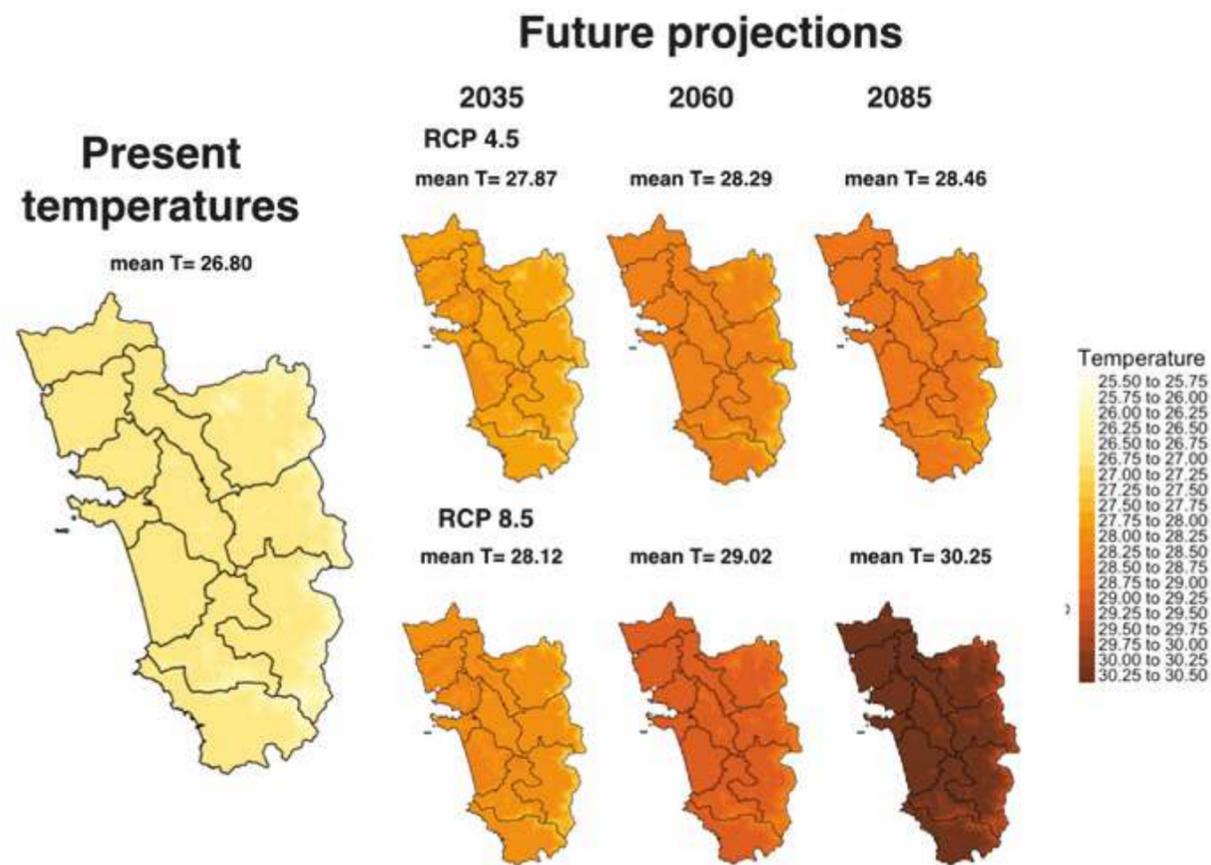


Figure 25: CORDEX model ensemble based mean temperature change (°C) projected for Goa for the year 2030s (2021–2050), 2060s (2046–2075) and 2080s (2070–2099) relative to the present temperatures (1985-2015)

The figure below shows the future mean annual rainfall projections in the short, medium, and long term (Figure 26).. Annual mean rainfall in Goa decreases under high emission scenarios but remains largely stable under moderate emission scenarios.

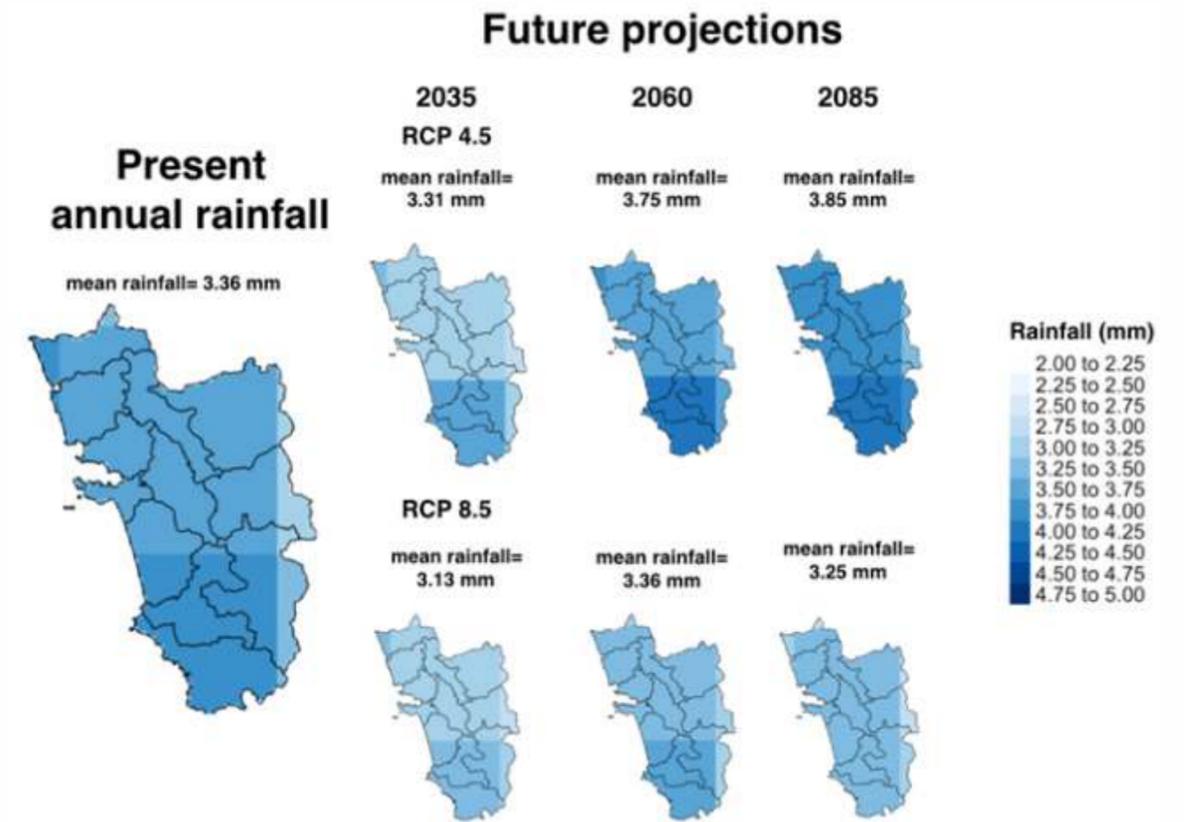


Figure 26: CORDEX model ensemble based mean daily rainfall change (mm) projected for Goa for the year 2030s (2021–2050), 2060s (2046–2075) and 2080s (2070–2099) relative to the present temperatures (1985-2015)

### Projection of Extreme Temperature

Extreme temperatures are projected to increase under climate change scenarios. For Goa, it is projected that by 2040, maximum temperatures of 40 °C or more will become commonplace, and minimum temperatures in Goa are also expected to increase by 3-7 °C.

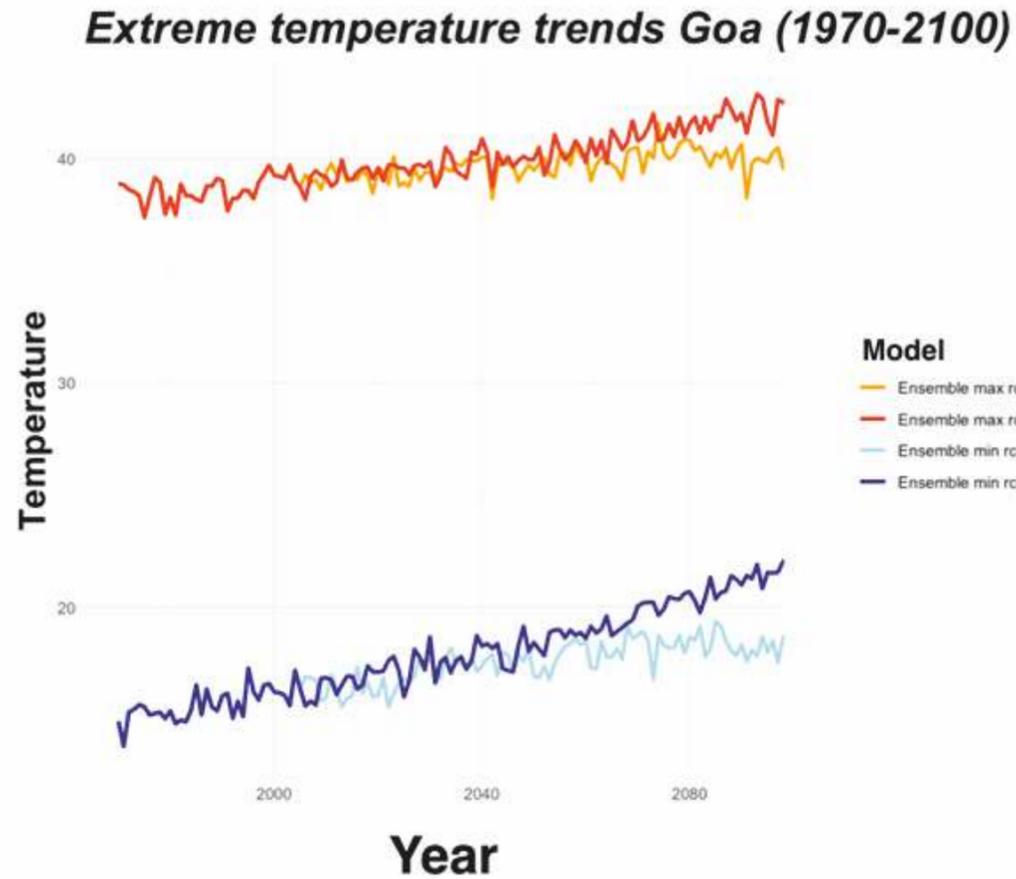


Figure 27: Projected trend in minimum temperature and maximum temperature in Goa in the 21st century

### Projection of Extreme Rainfall

IPCC's special report on weather extremes (IPCC, 2012) projects a likely increase in the frequency of heavy precipitation in the 21<sup>st</sup> century over many areas of the globe. We quantify the expected future change in extreme rainfall events over Goa by using the daily precipitation data from the multiple model ensemble of the CORDEX models. Very heavy rainfall events will increase in Goa in the 21<sup>st</sup> century under RCP4.5 and RCP8.5 scenarios (see Figure 28).

### Number of days with more than 150mm/day rainfall

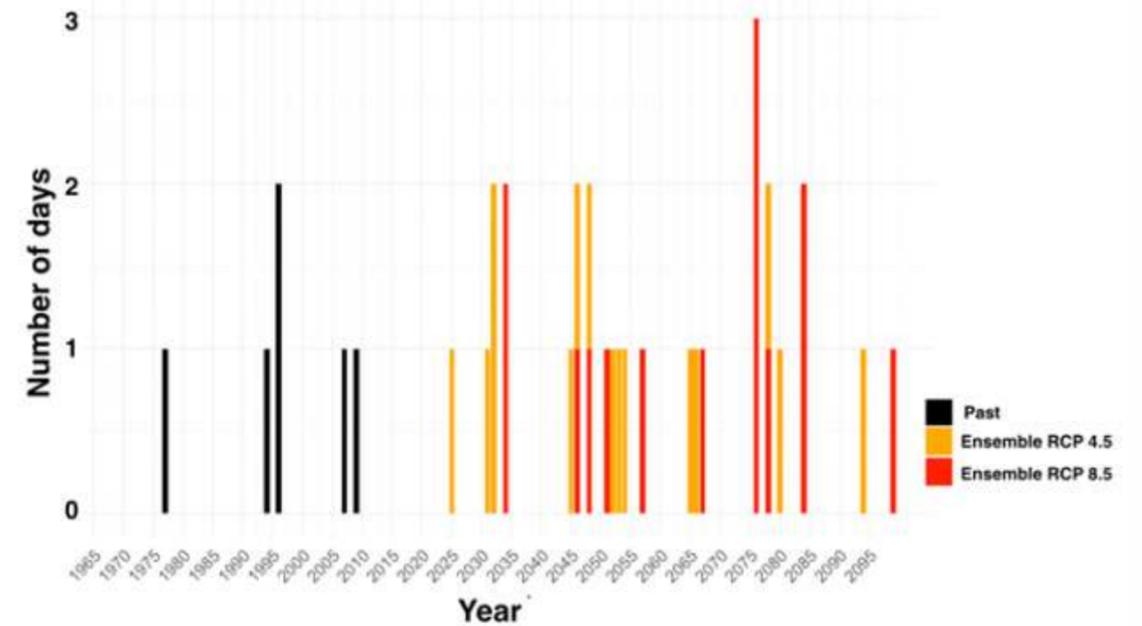


Figure 28: Rising frequency of very heavy extreme rainfall events in climate change scenarios

Similarly, exceptionally (rare) very heavy extreme rainfall events which are rare and exceptional in today's climate will become commonplace in climate change scenarios of RCP4.5 and RCP8.5 (see Figure 29).

### Number of days with more than 200mm/day rainfall

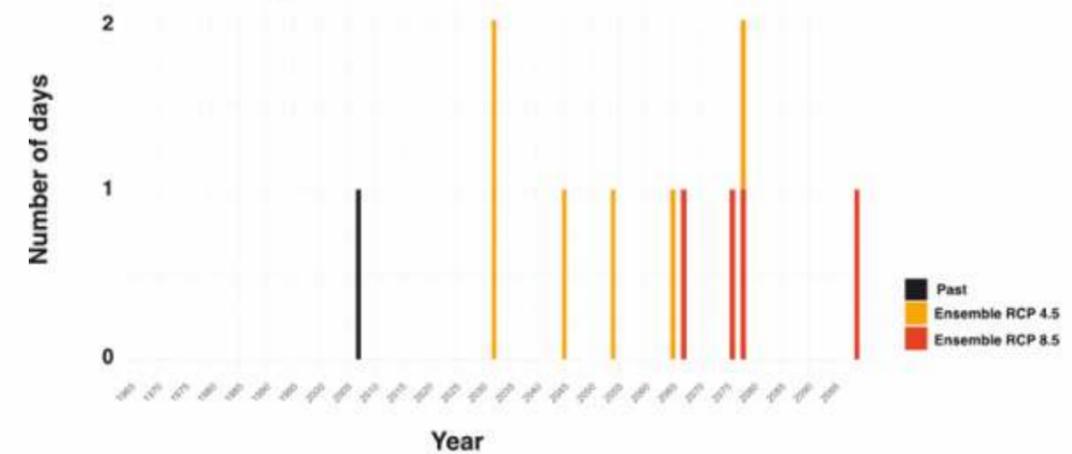


Figure 29: Abundance of exceptionally (rare) very heavy extreme rainfall events in climate change scenarios

### Sea Level Rise in Goa

Goa is already experiencing sea level rise. Long-term station data from Mormugao suggests that sea level at this station in Goa is rising at a rate of 1.45 mm/year with a 95 % confidence interval of +/- 0.46 mm/year from the period 1969 to 2013, the period for which data is available. This suggests that the sea level in Goa has increased by 0.48 ft (or about half a feet) in 100 years (Figure 30) (Source: Source data: monthly mean sea level data from PSMSL).

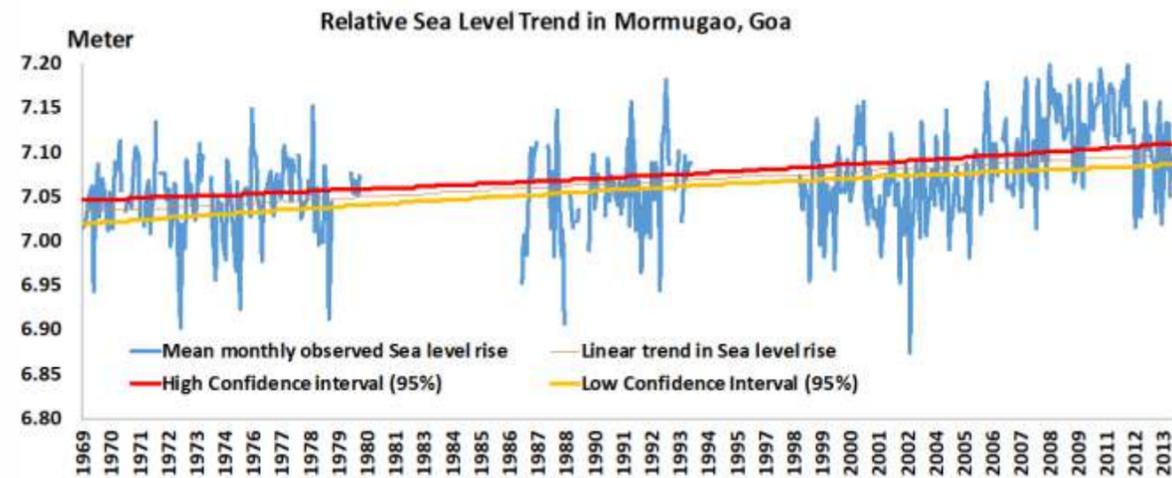


Figure 30: Relative sea level trend in Mormugao

Going forward under climate change scenarios according to Swapna *et al.* (2020): “Steric sea level along the Indian coast is likely to rise by about 20–30 cm at the end of the twenty-first century and the corresponding estimate for global mean steric sea-level rise is 18±5 cm (relative to 1986–2005)” even under moderate emission scenario of RCP4.5 (for a mid-range emission scenario, excluding ice-melt contributions)”

### Analysis of flood vulnerability in Goa

Flood vulnerability in Goa under current climate as well as under future climate is spatially mapped using the high-resolution digital representation of orography based on SRTM Digital Elevation Model (DEM), published by the CGIAR-Consortium for Spatial Information (<http://srtm.csi.cgiar.org>), with a cell size (spatial resolution) of 90 m, is used (Farr *et al.* 2007, Reuter *et al.* 2007). The same exercise is recently updated with a higher resolution data of 30 m as available from the same source. On the basis of elevation, Goa is categorized in multiple elevation zones, elevation zone of 0-5 m is considered to be most vulnerable to flooding from multiple hazards including sea level rise, and extreme precipitation events. Area under each elevation class is provided in the following tables (Table 10 and Table 11).

<sup>4</sup> [https://link.springer.com/chapter/10.1007/978-981-15-4327-2\\_9](https://link.springer.com/chapter/10.1007/978-981-15-4327-2_9)

Table 10: Area in Goa under different elevation classes

Altitude from sea level	Area in sq.km.	Percentage of total geographical area of Goa (%)
<1 m	53.00	1.43
1-2 m	43.50	1.17
2-3 m	40.54	1.10
3-4 m	36.87	1.00
4-5 m	34.73	0.94
5-10 m	170.43	4.60
10-15 m	168.87	4.56
15-35 m	507.45	13.71
>35 m	2442.61	65.98
Waterscape	204.00	5.51
Total Geographical Area of Goa	3702.00	100.00

Table 11: Area in Goa under different elevation classes

Elevation Classes	Area inundated (Sq. Km.)*	Percentage of total area of Goa*
Up to 1 m	53.00	1.43
Up to 2m	96.50	2.61
Up to 3m	137.04	3.70
Up to 4 m	173.91	4.70
Up to 5 m	208.64	5.64
Up to 10 m	379.06	10.24
Up to 15 m	547.94	14.80
Up to 35 m	1055.39	28.51
Up to 1026 m	3702.00	100

\*Please note 204 sq.km. of waterscape is not included in this analysis

Our analysis suggests that Talukas of Salcete, Tiswadi, and Bardez are most vulnerable to flooding-related hazards (see Figure 31).

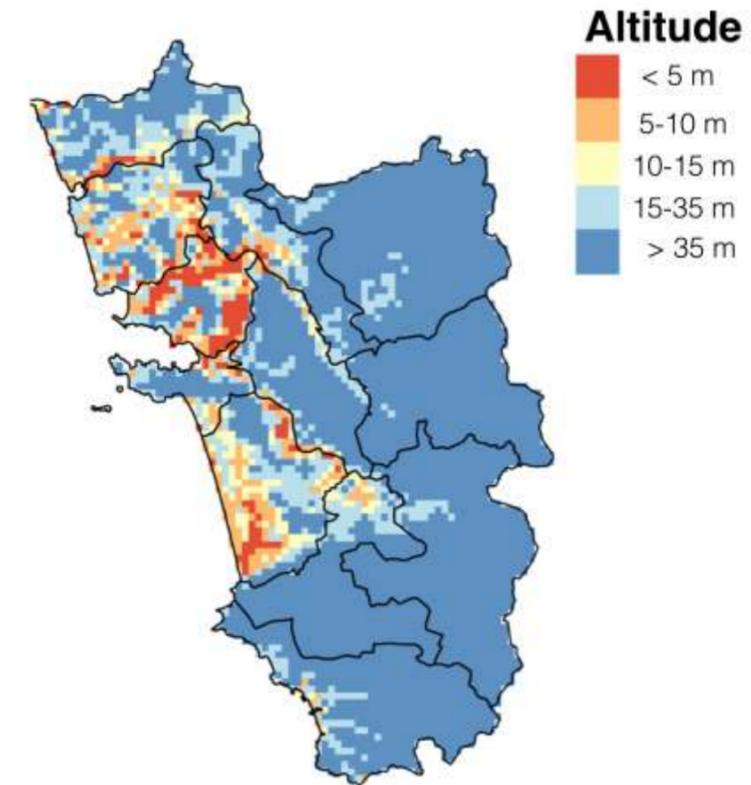


Figure 31: Flood vulnerability map of Goa

Taluka-wise climate change projections for Goa are provided in table below.

Table 12: Taluka wise projection of mean temperature (°C) under different climate change scenarios

Taluka	Present (1985-2015)	RCP 4.5			RCP8.5		
		2035	2060	2085	2035	2060	2085
Bicholim	26.90	27.97	28.38	28.56	28.21	29.12	30.34
Bardez	26.93	27.99	28.41	28.59	28.23	29.14	30.37
Tiswadi	26.94	28.01	28.42	28.60	28.25	29.16	30.38
Pernem	26.90	27.97	28.38	28.56	28.21	29.12	30.34
Ponda	26.86	27.94	28.35	28.53	28.18	29.08	30.31
Sattari	26.70	27.78	28.18	28.36	28.03	28.93	30.15
Canacona	26.77	27.85	28.25	28.43	28.09	28.99	30.22
Salcette	26.93	27.99	28.41	28.59	28.23	29.14	30.37
Quepem	26.79	27.87	28.27	28.45	28.11	29.01	30.24
Mormugao	26.92	27.99	28.40	28.58	28.23	29.14	30.36
Sanguem	26.67	27.75	28.14	28.32	27.99	28.89	30.12
Dharbandora	26.71	27.79	28.19	28.37	28.03	28.94	30.16

Table 13: Taluka wise projection of mean rainfall (mm/day) under different climate change scenarios

Taluka	Present (1985-2015)	RCP 4.5			RCP8.5		
		2035	2060	2085	2035	2060	2085
Bicholim	6.75	6.46	6.86	7.02	6.25	6.53	6.50
Bardez	6.76	6.47	6.87	7.03	6.26	6.53	6.50
Tiswadi	6.75	6.46	6.86	7.02	6.25	6.53	6.50
Pernem	6.80	6.50	6.90	7.02	6.29	6.52	6.46
Ponda	6.75	6.46	6.86	7.02	6.25	6.53	6.50
Sattari	6.73	6.44	6.84	7.00	6.24	6.51	6.48
Canacona	7.16	6.78	7.27	7.25	6.61	6.77	6.52
Salcette	6.94	6.60	7.05	7.13	6.42	6.64	6.51
Quepem	7.15	6.77	7.26	7.25	6.60	6.77	6.52
Mormugao	6.75	6.46	6.86	7.02	6.25	6.53	6.50
Sanguem	6.93	6.60	7.06	7.12	6.43	6.63	6.45
Dharbandora	6.64	6.37	6.77	6.93	6.18	6.44	6.38

# Climate Vulnerability Assessment

5

## 5.1. Vulnerability Assessment

The Intergovernmental Panel on Climate Change (IPCC) defines vulnerability as “the propensity or predisposition to be adversely affected” [1], which encompasses the basic components of exposure, sensitivity, and adaptive capacity. Key sector-specific indicators have been utilized to assess the sensitivity and adaptive capacity of the sector.

The country's coastal areas face grave risks due to climate change. There is the risk of cyclones and tsunamis, the intensity of which is predicted to rise. Rising sea levels, which could flood land (including agricultural land) and cause damage to coastal infrastructure and other property, pose another threat.

### Coastal Vulnerability:

UNDP predicts Goa stands to lose a large percentage of its land area, including many of its famous beaches and tourist infrastructure, which are very significant to the states' socio-economic status. It is estimated that a 1 m rise in sea level will affect 7 % of Goa's population and cause damage to the tune of Rs. 8,100 crore. Because of this, it becomes essential to understand the vulnerability of different parts of Goa's 100 km vast coastline.

The multi-hazard vulnerability assessment of the coastline of Goa carried out by NIO in 2014 provides a reasonable assessment of coastal flooding and inundation for Talukas along the coast. This is accomplished by using seven physical and geologic risk variables characterizing the vulnerability of the coast, including historical shoreline change, rate of relative sea-level change, coastal regional elevation, coastal slope, mean tidal range, significant wave height, and geomorphology using conventional and remotely sensed data, in addition to two socio-economic parameters: population and tourist density data. The results of this composite vulnerability index-based study suggest that<sup>6</sup> the 30 km of the coastline of the Talukas of Salcete, Bardez, and Tiswadi has a coastal regional elevation of fewer than 35 m and is at the highest risk due to sea-level rise and flooding. Bardez and Salcete Talukas have both experienced erosion rates of more than 0.6 m/year while the erosion rate for Tiswadi was found to be above 0.3 m/year. These are also the most populated Talukas and most prominent tourist spots, further increasing the risk of erosion in these Talukas.

<sup>5</sup>Climate change adaptation activities in India: [https://www.undp.org/content/dam/india/docs/climate\\_change\\_adaptation\\_activities\\_in\\_india\\_part\\_i.pdf](https://www.undp.org/content/dam/india/docs/climate_change_adaptation_activities_in_india_part_i.pdf)

<sup>6</sup>Multi-hazards Coastal Vulnerability Assessment of Goa, India, using Geospatial Techniques, NIO, 2014

Table 14: Taluka and district wise population of the State<sup>7</sup>

State/ District/ Taluka	No. of Households	Total Population	% to Total Population	Average Family Size
<b>GOA</b>	343611	1458545	100.00	4.24
<b>North Goa</b>				
Pernem	17248	75747	5.19	4.39
Bardez	57147	237440	16.28	4.15
Bicholim	22414	97955	6.72	4.37
Tiswadi	42241	177219	12.15	4.20
Satari	14367	63817	4.37	4.44
Ponda	38349	165830	11.37	4.32
<b>TOTAL</b>	191766	818008	56.08	4.27
<b>South Goa</b>				
Mormugao	35702	154561	10.60	4.33
Salcete	71717	294464	20.19	4.11
Quepem	19119	81193	5.57	4.25
Sanguem	15068	65147	4.46	4.32
Canacona	10239	45172	3.10	4.41
<b>TOTAL</b>	151845	640537	43.92	4.22

\*\*Source: Office of Registrar General and Census Commissioner, India.

### Other Physical Vulnerability

The riverine water system of Goa and the creeks and backwaters are vulnerable to high-intensity precipitation scenarios predicted for the state. The brackish water areas have very rich ecosystems and exist along creeks and rivers. Some are protected by sluice and gate systems, whereas others are at risk of ingress saline water due to climate change. Groundwater extraction is not well regulated, and saltwater intrusion is likely to increase into the groundwater system. As the sea level rises, this problem will be further exasperated. The high groundwater levels in certain areas challenge the soil's water percolation capacity. Thus, increasing the vulnerability of these areas like Panaji.

Mangroves are an important part of the marine ecosystem, which is under threat due to rising temperatures. The increased seawater temperature is impacting fish availability as well.

### Economic Vulnerability

Quantification of the economic loss due to climate change has not been ascertained so far for Goa, however, based on the national, international and sectoral developments published the economic activities in Goa are certainly vulnerable to climate change.

South Asia on average could lose nearly 2% of its GDP by 2050, rising to a loss of nearly 9% by 2100 under the BAU scenario (Ahmed and Suphachalasai, 2014).

About 4 % of the state lives below the poverty line, which is much lower than many other states in India. Most of its population is urban, with a high literacy rate of about 82 %. Economic activity in the state is dominated by agriculture and the allied sector, tourism, and mining.

<sup>7</sup> Economic Survey 2017-18

In general, and in Goa specifically, tourism is highly dependent on natural resources. Changes in water availability, biodiversity loss, reduced landscape aesthetic, increased natural hazards, coastal erosion and inundation, damage to infrastructure, and the increasing incidence of vector-borne diseases will all impact tourism to a varying degree. Global warming increases the risk of irreversible loss of many marine and coastal ecosystems, especially at 2 °C or more.

## 5.2. Impact and Vulnerability of Vulnerable Groups to Climate Change

The IPCC Special Report on Global Warming of 1.5 °C emphasized that disadvantaged and vulnerable populations, including indigenous peoples and specific local communities, are at disproportionately higher risk of suffering adverse consequences with global warming of 1.5 °C and beyond.

Coastal regions are directly vulnerable to rising sea levels, local and regional land subsidence, storm surges from severe storms, and changing intensities and frequencies of precipitation events (Hoegh-Guldberg *et al.*, 2018; Koop and van Leeuwen, 2017). In the context of Goa, communities living in low-lying areas, informal settlements like the slum populations, people with disabilities, and those whose livelihoods depend mainly on khazan lands are, in particular, the immediate and most vulnerable groups.

Goa has one of the lowest slum populations in the country, about 2 % of which 90 % is found in Mormugao. Mormugao houses the only commercial port of Goa and has been identified to be at moderate risk due to climate change in the study carried out by NIO mentioned above in this section. The coping capacity of the slum population is usually the lowest, increasing the vulnerability to climate change. Notably, 10 % of Goa's population lives in Mormugao, which has the highest population density in the state.

Table 15: Mormugao Statistics

Area smallest	109.13 sq. km
Population	154561
Population density	1416
Population density highest in state	
Percentage of the state population	10.6 %
Literacy rate	85%

Table 16: Distribution of slum population in Goa (Census 2011)<sup>8</sup>

Area	No. of Slum households	Slum Population	% to total slum population
Ponda (MCI)	258	981	3.74
Mormugao (MCI)	4974	23625	90.01
Margao (MCI)	265	1641	6.25
Total	5497	26247	100.00

Health impacts due to climate change can have more significant and severe effects on young children, especially those from vulnerable group. Poor sanitation increases vulnerability to gastrointestinal illnesses, with future rates of diarrheal diseases among children are expected to rise under many climate change scenarios (Cissé *et al.*, 2018, WHO 2014).

<sup>8</sup> Registrar General and Census Commissioner, India

Hence, the most vulnerable population in the state needing immediate attention is the slum population of Mormugao, young children below the age of 10 years, women, and families whose livelihood depends on Kazan lands only.

### Cultivation in the Khazan Lands

Plains running parallel to the coastline. These plains are flooded annually by brackish water from the Rivers and Creeks and hence, are fertile but saline. Most of these Khazan lands are used for the cultivation of salt-resistant species. Runoff collects in these fields (tidal waters also drained these fields earlier). The main crops grown in these fields are rice and vegetables. Most of the cultivation uses manure, and using fertilizers is limited. The soil is very fertile due to backwaters and saline-resistant rice varieties cultivated in Goa.

### 5.3. Prioritization of sectors for SAPCC

Based on the above assessment, the following sectors and regions in the state have been prioritized in the SAPCC.

Sr. No.	Sector
1	Transport
2	Power (Energy) & Renewable energy (GEDA)
3	Water
4	Forest sector
5	Agriculture and Allied (AVHS) sector
6	Fisheries sector
7	Environment & Coastal Management
8	Biodiversity & Wetlands
9	Solid Waste Management
10	Sewage Management
11	Tourism
12	Mining
13	Land use land cover
14	Human Health
15	Disaster management
16	Habitat
17	Infrastructure

## Sectoral Mitigation Strategies

6

### 6.1. GHG Profile of the State

As per India's second Biennial update report, the energy sector contributes 73.2 % of India's total GHG emission, followed by agriculture, industrial processes, and waste contributing 16 %, 7.8 %, and 3 %, respectively. GHG emissions in energy are predominated by the emissions from energy industries (60 %), followed by manufacturing industries and construction (18 %), and transportation (13 %).

The state of Goa does not produce power, and it purchases power from NTPC power plants except for some renewable energy, based power plants like solar power plants. Thus, the direct GHG contribution of the state to the national GHG inventory is not significant.

The major GHG-emitting sectors in the state are transportation, agriculture, waste, construction, and mining. While the power sector does not result in direct GHG emissions in the state, it does contribute to the overall GHG inventory of the country. Hence, it is essential to view the energy sector from the perspective of demand-side power consumption and generation of renewable energy to contribute towards the country's GHG inventory.

On the other hand, land use and land cover change can act as both a sink or an emitter depending upon the state-level activities. About 33 % of Goa's area is under forest cover. Goa's AFOLU emissions have changed from -0.37 million tonnes of CO<sub>2</sub>e in 2003 to -0.22 million tonnes of CO<sub>2</sub>e in 2013. As the state of Goa has limited land available, the potential to increase the forest cover is limited. Therefore, all efforts are focused on intensification, protection, forest preservation, and biodiversity preservation. While these efforts will also contribute to climate change mitigation, they are cross-cutting in nature and are primarily qualified as adaptation measures. Therefore, forests and biodiversity do not find a mention under climate mitigation.

### 6.2. Sectoral GHG mitigation strategies

#### 6.2.1. Transportation Sector

Road Transport: Transportation by road in the State is considered the dominant medium for passenger and freight transport. Initiatives are being taken to provide a secure, integrated, proactive, and pioneering transport system in the State to reduce traffic congestion, road accidents, vehicle pollution, etc. About 14 lakh vehicles have been registered in Goa until FY 18-19. On average, about 78,000 vehicles have been registered annually in the last five years, increasing the vehicle population by approximately 7 %.

<sup>9</sup> GHGPI-PhaseII-Methodology Note-AFOLU-State Level-Sep17.pdf (ghgplatform-india.org)

Year	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Motor Vehicles registered	1009362	1083678	1158241	1238644	1324763	1399833 <sup>10</sup>

About 70 % of vehicles are registered in the two-wheelers category, followed by private cars and jeeps, including taxis which form about 22.06 % of the vehicle population. Goa's traffic profile is dominated by vehicles for tourism-related transport, personal transport, and interstate cargo, as Goa's state highways provide an effective route for transportation between the southern and western states. 54144.10 MT of cargo traffic has been handled in the State in 2017-18<sup>11</sup>.

In some parts of Goa, the demand for public transport is very high. To fulfill the need the KADAMBA TRANSPORT CORPORATION LIMITED (KTCL) operates a nonstop shuttle service on various routes like Panaji - Margao, Panaji - Vasco, Margao - Vasco, Panaji - Ponda, Panaji, Mapusa, and Margao-Curchorem<sup>12</sup>.

Table 17: Vehicles by category<sup>13</sup>

Sr.No.	Type of Motor vehicle	2013-14	2014-15	2015-16	2016-17	2017-18
<b>Transport</b>						
1.	Motorcycle for hire	1399	1688	1788	1746	1266
2.	Goods vehicle	1466	1531	1591	1530	1456
3.	Taxis	1122	1067	813	1269	1192
4.	Buses+ Minibuses including KTC	969	299	279	385	259
5.	Autorickshaws	129	102	118	107	54
6.	Fire Tenders	NOT				2
7.	Ambulance	AVAILABLE				1
	<b>Total</b>	<b>5085</b>	<b>4687</b>	<b>4589</b>	<b>5037</b>	<b>4230</b>
<b>Non-Transport</b>						
1.	Motorcycles+ Scooters	50732	52711	53458	56926	49486
2.	Private cars+ Jeeps	15016	16767	16353	18267	17625
3.	Tractors & Others	144	141	158	168	124
4.	Government vehicles	13	10	5	5	2
	<b>Total</b>	<b>65905</b>	<b>69629</b>	<b>69974</b>	<b>75366</b>	<b>67237</b>
	<b>Grand Total</b>	<b>70990</b>	<b>74316</b>	<b>74563</b>	<b>80403</b>	<b>71467</b>

<sup>10</sup> Source: Goa Economy in Figures

<sup>11</sup> Statistics is up to December 2017

<sup>12</sup> Source: Economic Survey 2017-18

<sup>13</sup> Source: <https://www.goatransport.gov.in/Statistic>

### Water Transport:

Goa has a network of inland waterways, navigable throughout the year. It has a widely spread network of inland waterways comprising two main rivers, Zuari and Mandovi, and other small rivers such as Terekhol, Chapora, Mapusa, Sal, etc. These rivers have a sufficient draft for navigation and are used for transportation. They serve two types of transportation:

- Transportation of passengers and vehicular traffic living in the islands and across the rivers not connected by roads and bridges
- The movement of heavy and bulky mineral ores from interior parts up to the Mormugao Harbour, which is the only major economic port of the State

The River Navigation Department (RND), is mainly engaged in the operation of ferry services in the inland waters of Goa. RND wishes to focus on public transport which is core to its service mission while identifying non-core activities such as fast ferry service across the important towns/cities for public, vehicles and good. Ferry service from Panaji to Vasco has been identified as one of the viable development options for the development of waterways.

River Navigation Department (RND) provides 24-hour ferry transport to commuters at 20 ferry routes all over Goa with a fleet of 39 ferry boats. Every day about 2.5 lakhs commuters and 18000 vehicles use the ferry service. There is a potential to utilize the inland waterways further.

### Initiatives and Schemes to support climate-friendly development in the transport sector:

#### Scheme 1: The Goa State Subsidy for Replacement of Old Passenger Buses Scheme, 2001

<b>Objective:</b> The scheme provides subsidy for replacement of buses older than 15 years with a view to curtail vehicular pollution and to provide an efficient, reliable and comfortable service to the users.				
<b>Scope of the Scheme:</b>		The scheme covers the owners of buses and mini buses of model older than 15 years covered by valid regular permit and which are in operation for a continuous period of past 3 years.		
The scheme also provides for disbursement of subsidy for purchase of new vehicle on replacement of following types of vehicles:				
Sr.No.	Age of the vehicle	Type of vehicle	Seating capacity	Amount of subsidy to be disbursed
1.	Between 10 to 15 years	Bus	49-seater and above	₹6.00 Lakhs
2.	Between 10 to 15 years	Minibus	39-seater and below	₹4.20 Lakhs
3.	Between 15 to 20 years	Bus	49-seater and above	₹3.90 Lakhs
4.	Between 15 to 20 years	Minibus	39-seater and below	₹3.30 Lakhs
5.	Above 20 up to 25 years	Bus	49-seater and above	₹3.30 Lakhs
6.	Above 20 up to 25 years	Minibus	39-seater and below	₹2.70 Lakhs
7.	Above 25 years	Bus	49-seater and above	₹2.70 Lakhs
8.	Above 25 years	Minibus	39-seater and below	₹2.10 Lakhs

<sup>14</sup> Source: <https://www.goa.gov.in/department/river-navigation/>

## Scheme 2: The Goa State Fuel Subsidy to Private Stage Carriage Operators Scheme, 2014

This scheme aims to provide socio-economic support to entrepreneurs in the trade of stage carriage operations on intra-state routes. The scheme covers the owners of private buses/minibusses operating on intra-state routes as "stage carriage" and those intending to enter the trade for the first time. The scheme provides for the disbursement of fuel subsidy of ₹ 3/- (Rupees three only) per kilometer of operational distance.

Under the Goa State Fuel Subsidy to Private Stage Carriage Operators Scheme, 2014 fuel subsidy to 333 bus operators amounting to ₹ 791.72 lakh was disbursed till December 2017.

KTCL has also undertaken several initiatives which improve the efficiency of its fleet:

- Replacement of overage fleet for better cost control and increase in the load factor.
- Energy conservation measures such as smoke control, anti-pilferage device, purchase of fuel-efficient engine, and modification of bus-body design

### BOX 1 - Proposed Policy Measure: GOA State ELECTRIC MOBILITY PROMOTION POLICY – 2020

**This policy envisages providing manufacturing incentives, demand incentives, upfront incentives, tax incentives, and non-fiscal support in addition to innovation. Electric charging stations, including solar-powered stations, are planned.**

**The draft policy has been developed and is under finalization. Below are the key features of the policy relevant to SAPCC.**

Under the National Electric Mobility Mission Plan (NEMMP), the Government of India has envisioned 6-7 million electric and Hybrid vehicles on Indian roads by 2020. Towards this goal, the Department of Heavy Industries, Government of India has launched the Faster Adoption and Manufacturing of Hybrid and Electric vehicles (FAME) scheme. Its target is to save 120 million barrels of oil and 4 million tons of CO<sub>2</sub>, lowering vehicular emissions by 1.3 % by 2020. FAME India scheme has four focus areas—technology development, demand creation, pilot projects, and charging infrastructures.

Based on the recent techno-economic developments in EV sector and vision of the Government of India, a need was felt by the Government of Goa to formulate a policy for promotion of this sector in Goa. Building on indigenous strengths of tourism and IT industries, the Government of Goa envisages building Goa as a model State in EV

Despite the unorganized nature of the transport sector, Goa stands on top in the country in terms of per capita vehicles with 625 vehicles for every 1,000 people in the state, and is also ranked 15 in the world in terms of vehicle density. According to an estimation by Goa Automobile Dealers Association (GADA), every Goan household has about 2 bikes and one car on average. With an urbanization rate of 62%, these numbers are only expected to grow. Hence, there is an eminent need to ensure that the growth of this sector does not further cause environmental degradation. The adoption of new energy vehicles (NEVs) would also be supported by utility growth in the state.

### OBJECTIVES:

1. 30% of annual vehicles registered in Goa, starting from the year 2025, would be electric.
2. To convert 50% of all ferries to electric by 2025.
3. To create 10,000 direct and indirect jobs in the sector by 2025.
4. To encourage start-ups and investment in the field of electric mobility and associated sectors such as mobility as a service (MaaS), autonomous vehicles, data analytics and information technology.
5. To promote service units, including Electric Vehicles and battery repair and maintenance stations.
6. To promote R&D, innovation and skill development within the EV sector.

**Mitigation Measures:**

In addition to the above schemes, there is the further scope and need for the state to take measures to develop a low-carbon transportation system. The Mitigation Measures proposed to be implemented under the SAPCC by this sector are provided below.

Table 18: Mitigation Strategy for Transportation Sector

Sr. No	Intervention	Status	Responsible agency	Barriers and Gaps in Implementation	Intervention Type	NDC Link (Connects to identified NDC items)
1.	Electric mobility policy should be developed by the state	Proposed (Details provided in the box above)	Transport Department	Gap: e-charging stations State does not produce electricity	Policy	To adopt a climate-friendly and a cleaner path than the one followed hitherto by others at corresponding levels of economic development.  To reduce the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level.
2.	Provisions to be made for non-motorized transportation in urban areas to decongest and reduce GHG emissions	To be modified	Transport Department	Unknown	Activity	
3.	Development of a holistic policy for low emission sustainable transport system	Proposed	Transport department	Unknown	Policy	
4.	The Goa State Subsidy for Replacement of Old Passenger Buses Scheme, 2001	Under progress	Transport department	Unknown	Scheme	
5.	Identify the alternate mode of fuel transportation in the mining area	Proposed	TBD	Unknown	Activity	
6.	Explore the possibility of using CNG instead of petrol and diesel	Proposed	Department of Transport	Barrier- Availability of CNG	Scheme	

7.	Solar power vessels for inland water ways	Proposed	RWN	Higher cost	Activity
8.	Convert existing vessels to CNG vessels	Proposed	RWN	Higher cost	Activity
9.	Make adequate parking space for vehicles	To be proposed	TCP		Activity
10.	Provide the interconnected public and non-motorized system for point-to-point connectivity	To be proposed	TBD	Unknown	Policy and activity

The climate change-related budget by the transport sector of the State will be about 25 Crores. The department will submit the details within 6 months.

### 6.2.2 Power Sector

Power today has become indispensable for all users. Goa does not generate its power, and its current energy needs are met by purchasing power from the Central Sector Power Stations of the National Thermal Power Corporation (NTPC) as per the allocation made by the Central Government. Besides this, a small amount of 16 MW of power is generated by Naphtha based power plant operated by Reliance Energy Limited at Sancoale, Mormugoa. This plant supplies power predominantly to private industries, and a small amount of power is sold to the state grid. Power is also bought from Saligao Solid Waste Treatment Plant to promote renewable energy generation. **The Key agency in the electricity sector is Goa State Electricity Department.** The electricity department is meeting its renewable power obligation (RPO) as framed by Joint Electric Regulatory Commission from time to time. **For 2020-21 Goa has proposed to meet 17 % of its Power demand from renewable sources.**

- Goa Energy Development Agency (GEDA) is responsible for promoting and producing renewable energy in the state.** Goa Solar policy was developed in 2017. In addition, a few other initiatives proposed by GEDA for the promotion of renewable energy are Biogas from municipal solid waste, sewage, and cow dung/ animal dung to electricity and compressed biogas.
- Biomass to energy from the aggregation of biomass from the garden, tree cuttings, monsoon shrub cutting, coconut shells, leaves etc.
- Centralized facility for Biomass to the ethanol conversion project
- Wave energy/ tidal energy Project
- Replacement of electricity-based pumps of the farmer to solar energy-driven pumps.
- Introduction of CBG buses in local state transport.

The Electricity Department of Goa provides both low-tension and high-tension power supply to consumers, besides street lights and high masts in public areas. For its future needs, the Power Grid Corporation of India has commissioned a 400 KV transmission system that will enable Goa to draw power to the extent of 500 MW.

Goa has achieved 100% electrification. Goa's per capita power consumption is about 1100 kWh per year. The industrial sector's share in Goa's power pie is much larger. In 2017-18 about 60 % of the power was consumed for industrial purposes, whereas 26 % was consumed for domestic and 11 % for commercial purposes.

Table 19: Energy Demand in Goa<sup>15</sup>

Year	2013-14	2014-15	2015-16	2016-17	2017-18
Energy consumed for Domestic purposes (MKWh)	912.00	730	1010	880.59	924.14
Energy consumed for Commercial purposes (MKWh)	224.00	409	394	368.45	386.03
Energy consumed for Industrial purposes (MKWh)	1411.00	1839	1796	1986.92	2053.75
Energy consumed for Irrigation purposes (MKWh)	21.00	31	18	29.94	29.94
Energy consumed for other purposes (MKWh)	466.00	105	50	86.26	100.86
Total power consumed (MkWh)	3034	3114	3268	3352.16	3494.72

<sup>15</sup> Source: Goa at a Glance.

### Mitigation Measures:

In addition to the above, state of Goa has proposed four key projects for enhancing the energy and electric security of state. These below mentioned projects will directly or indirectly contribute positively to climate mitigation. However, on the other hand, the infrastructure for these projects would also need to be planned to have minimum infrastructure vulnerability to climate change. The projects are as mentioned below:

- Smart metering budgeted at **INR 918** crores
- Underground cabling (HT and ST) budgeted at **INR 4500** crores
- GIS substations for forested areas of 22 substations budgeted at **INR 484** crores
- Underground networking of LTE in forested areas of 500 kms targeted in ten years budgeted at Rs 550 crores

Table 20a: Mitigation Strategies for Energy Sector- Supply Side Interventions

Sr. No.	Intervention	Status	Responsible agency	Barriers and Gap in implementation	Intervention Type	Budget (INR crore)	Source of Finance	Time Frame	Monitoring Mechanism and Frequency	NDC Link (Connect)
1	PPA has been executed with SECI for purchase of 25MW of solar power for a period of 25 years from 2015 onwards	Completed (and is a continuous process)	Electricity Department	25 MW power is flowing w.e.f. 2015.	Activity	Rs.26.4 Crores per Annum	State Govt.	25 years	Internal Departmental Monitoring and Six-Monthly Reporting to Climate Change Secretariat	To achieve about 40 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030 with the help of transfer of technology and low-cost international finance including Green Climate Fund (GCF).
2	Three Power sale agreement (PSA) of 50 MW wind power each have been executed with SECI to meet the additional power requirement	1) and is continuous process 2)Cancelled 3) In Process (and will continuous process)	Electricity Department	1)50MW wind power is flowing from PSA executed on 24/11/2017 w.e.f. May 2019. 2)PSA for 50MW wind power executed on 22/05/2018 has been cancelled by SECI. 3)The commercial operation of 50MW Wind	1)Activity 2)Activity 3)Activity	1)Rs.33.5 crores per annum 2)N.A. as Cancelled 3)Rs.34.8 Crores per annum	State Govt.	1) 25 Years 2) N.A. as cancelled 3) 25 Years	Internal Departmental Monitoring and Six-Monthly Reporting to Climate Change Secretariat	To achieve about 40 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030 with the help of transfer of technology and low-cost international finance including Green Climate Fund (GCF).

					power PSA executed on 16/08/2019 is not yet declared, hence power is not flowing.							
3	Power of about 2MkWh is also bought from Saligao Solid Waste Treatment Plant for promoting generation of renewable energy	Completed	Electricity Department	The power is flowing.	Activity	Rs.1 Crore per annum	State Govt.	10 Years and will be continuous process	Internal Departmental Monitoring			
4	300 MW of solar to be set up by 2030	proposed	GEDA	Creating enough market-based employment	Activity	Rs. 10 crores per annum	Grant in aid By State Government	10 years	Internal Departmental Monitoring			
5	25 MW of renewable energy to be set up by 2030	proposed	GEDA	Creating enough market-based employment	Activity	Rs. 5 crores per annum	Grant in aid By State Government	10 years	Internal Departmental Monitoring			
6	Electrification in rural set up and in hinterlands to be taken up through off grid non-conventional sources like solar rooftop, biogas, kitchen waste etc.	proposed	GEDA	un-electrified houses are identified	Scheme	Rs. 1 crore	Grant in aid By State Government	2 Years	Internal Departmental Monitoring			

7	Goa Solar policy 2017 (amended in February 2019)	completed	Department of Non-Conventional Energy Sources	80 MW to be completed by 2021	Policy	Rs. 5 crores per annum	Grant in aid By State Government	5 years	Internal Departmental Monitoring
8	Goa Wind Policy	proposed	Department of Non-Conventional Energy Sources	10 MW (In Process)	Policy	Rs. 2 Crores per annum	Grant in aid By State Government	5 years	Internal Departmental Monitoring
9	Goa must explore the possibility of tidal energy and further enhance mini-hydro potential	proposed	Department of Non-Conventional Energy Sources	5 MW (In Process)	Policy	Rs. 2 crores per annum	Grant in aid By State Government	10 years	Internal Departmental Monitoring
<p><b>Note - The total expected financial implications for one year is ₹ 120.7 Crores, out of which for GEDA under climate change is broadly ₹ 16 crores, and Dept. of Non-Conventional Energy Sources is ₹ 9 Crores. Hence for the next ten years of SAPCC expected climate change-related contribution could be worked out within the first year of implementation of SAPCC by the respective department.</b></p>									

Table 20b: Mitigation Strategies for Energy Sector- Demand Side Interventions

Sr. No	Intervention	Status	Responsible agency	Barriers and Gap in implementation	Intervention Type	Budget (INR crore)	Source of Finance	Time Frame	Monitoring mechanism and frequency	NDC Link (Connects to identified NDC items)
1	Demand Side Management (DSM) measure - All types of conventional Street light fixtures (i.e. 1.77 lakh) are being replaced by high quality efficient smart LED light fixtures under the Street Lighting National Programme (SLNP) of the Government of India through Energy Efficiency Services Ltd (EESL), a joint venture of PSUs of Ministry of Power, Government of India on ESCO model.	completed	Electricity Department	-	Activity	149.09 crores	State Government Funds	Completed	Internal Departmental Monitoring	To adopt a climate friendly and a cleaner path than the one followed hitherto by others at corresponding level of economic development.
2	Under the Deendayal Upadhyaya Grameen Joyti Yojana (DDUGJY) installation of digital meter	completed	Electricity Department	Already 94184 have been installed but now smart meter project is intended	Scheme	20 crores	State Government- 8 crore and Central Government- 12 crore	Completed	Internal Departmental Monitoring	To reduce the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level.
3	Jyotirmay scheme - distribution of 3 LED bulbs of 9W each to domestic households. 8.2 lakh bulbs have been distributed under the scheme	completed	Electricity Department	-	Activity	6.3 Crores	State Government funds	Completed	Internal Departmental Monitoring	

4	Goa has executed a Bipartite MoU with the Ministry of Power, Government of India and joined the "UDAY" scheme. - AT & C losses controlled to 12% improving feeder efficiency. AMR remote metering for HT consumers, substation feeders and Distribution transformers installed. GIS	Completed (Facility Management Services - is in process)	Electricity Department	-	Scheme	1) Uday - Nil 2) Others - 132 cr.	Others 53.5 Cr State Govt. and 78.5 Central Govt.	Completed	Internal Departmental Monitoring	
5	Mandating periodic Energy audit to improve energy consumption and operational efficiency of all government establishments	Proposed	Electricity Department	Awareness Program	Others	1 Lakh Annual	State Government	1 year	Internal Departmental Monitoring	
6	Industrial energy efficiency should be promoted through BEE's programs	Proposed	State Designated Agency for Electricity Department (SDA)	Awareness and willingness.	Policy	5 lakhs Annual	To be funded by BEE and industries	Continuous process	Internal Departmental Monitoring	
7	Incentivization of energy efficiency for commercial and domestic users	Proposed	State Designated Agency for Electricity Department (SDA)	Consumer awareness and willingness	Scheme	1 lakh Annual	To be funded by BEE	Continuous process	Internal Departmental Monitoring	
8	Programs to develop awareness on saving of energy	Proposed	State Designated Agency for Electricity Department (SDA)	Consumer awareness and willingness	Others	10 lakhs Annual	To be funded by BEE	Continuous process	Internal Departmental Monitoring	

9	Training and skill development for renewable energy implementation, maintenance and energy auditors etc.	Proposed	GEDA	Creating enough market-based employment	Activity	10 lakhs	Grant in aid By State Government	5 Years	Internal Departmental Monitoring
<p><b>Note: Approximate total financial implications on the above sector to meet the climate change plan in one year is 307.66 Crores, of which ₹217 Crores is from the State Govt. ₹ 90.5 Crores is from Central Govt, ₹ 11 lacs is from BEE and ₹5 lacs is from BEE &amp; Industries. Hence for the next ten years of SAPCC expected climate change-related contribution could be worked out within the first year of implementation of SAPCC by the respective department.</b></p>									

### 6.2.3 Agriculture and Allied Sector

Agriculture sectors contribute to climate change through irrigation equipment and other machinery used. Water flooding-based irrigation practices, burning of agricultural waste, or uncontrolled decay of waste also contribute to GHG emission. Interventions and strategies are proposed below to contain the emissions from this sector.

Table 21: Mitigation Strategies for Agriculture Sector

S. No.	Intervention		Status	Responsible agency	Barriers and Gap in implementation	Intervention Type	Budget	Source of Finance	NDC Link (Connects to identified NDC items)
	Intervention	Type							
1	Focus initiatives to increase vermi-composting & conventional composting at community level	Mitigation	Already Existing Scheme & Also under Coconut Development Board	Department of Agriculture	More capacity building, simplification of procedures & need to form organized groups of local turnkey service procedures	Scheme	1.5	State 1 Cr and Central 0.5 Cr	To adopt a climate-friendly and cleaner path than the one followed hitherto by others at corresponding

2	Incentivize replacement of agricultural pumps with energy-efficient pumps and solar pumps	Mitigation	Proposed	Department of Agriculture and Department of renewable energy	Scheme needs to be formulated jointly and single entity for disbursal & state of the art effective technology with better convergence (data and baseline to be provided by Agri. Dept. and execution by the agency under Dept. of renewable energy)	Training, capacity, tools, handholding for existing pumps supplied by the Dept. of Agri. (about 12 lacs per annum), Dept. of Electricity and for solar pumps, separate scheme to be formulated to replace 11000 pumps into 5 star rating or more energy efficient pump	2 Cr for capacity building	State Govt. & Central Scheme	level of economic development.  To reduce the emissions intensity of its GDP by 33 to 35 % by 2030 from 2005 level.
3	Sensitize farmers on optimal utilization of water to reduce pump usage and reduce water wastage	Trainings & Capacity building of Cross Cutting Entities	Existing PMKSY training component	Department of Agriculture	Need for capacity building and handholding	Awareness raising and capacity building	1	Existing Department Budget ^0 % Central & 40 % State	
4	Optimal utilization of fertilizers and pesticides & promote organic manure	Mitigation	Scheme is existing	Department of Agriculture	Need for more awareness and effective soil analysis	Subsidy for organic inputs through empanelled suppliers or dealers	5 Cr. for 10 years	Existing Department Budget	

5	Provide assistance in utilization of cattle and animal waste as manure and for biogas generation	Mitigation	Existing subsidy under biogas scheme	Department of Agriculture	Need for more awareness and effective soil analysis and making as requirement for livestock-related schemes	Subsidy & technical support	1	Own budget and Central Government Contribution
6	Promoting Biomass residue from agriculture to be used for power generation where it does not have an alternate use	Mitigation	Proposed	Dept of renewable energy & GEDA in collaboration with Agri. Dept. for data and information for convergence	Aggregation of farmers and setting up of power plant	Activity	1 Cr	Others

**Note: Approximate financial implications on agriculture and allied sector to meet the climate change plan in ten years is approximately ₹ 50 crores. The above table shows a breakup of 11.5 but there will be additional funds received from SFURTI scheme from the central Govt. of which almost 25 crores are expected for Agri. Dept. clusters and projects submitted for NAFCC through SLSC will ensure that over 50 crores will be spent towards climate change adaptation and mitigation.**

#### 6.2.4 Waste Management Sector

The State of Goa has been proactively working on the issue of solid waste management. To maintain a clean and litter-free environment and to ensure proper Solid Waste Management across the State, various initiatives have been undertaken by the State as follows:

The first major initiative is the collection of all the plastic waste across the National Highways.

#### Highway waste collected by GWMC

HIGHWAY COLLECTION				
Month	Dry	Wet	Tree	Total (Tonnes)
Jan-20	34.62	17.38	1.51	53.51
Feb-20	41.47	36.93	1.59	79.99
Mar-20	84.69	76.06	0.3	161.05
Apr-20	59.86	0	1.28	61.14
May-20	67.43	0	0	67.43
			<b>Total :</b>	<b>423.12</b>

The second major initiative is setting up a Solid Waste Treatment Facility in North Goa and South Goa. The first such state-of-art facility has been already set up in Saligao/Calangute in Bardez Taluka in 2016 and the second one, at Cacora, which is likely to be commissioned during the end of this year i.e. 2018.

GWMC has signed an agreement with e-waste PRO Karo Sambhav to collect all types of e-waste generated. Further, the e-waste condemnation policy for the State is being amended to mandate condemnation only against disposal and not buy-back, which reduces the flow of government e-waste to the informal sector in the State.

The department is setting up the Common Biomedical Waste Treatment Plant at Kundaim Industrial Estate. The Goa Waste Management Corporation formed by the State Government has been entrusted to look after the management of all types of wastes, collection of dry non-biodegradable waste from Village Panchayats, Municipalities, State & Central Government Institutions, Industrial Estates, and other organizations in the State and its safe disposal.

Collecting segregated waste is the first step, followed by composting bio-waste.

A state-of-the-art facility using the latest technology for solid waste management has been commissioned and made operational at Calangute by the Government of Goa, to treat and dispose of the solid waste from coastal villages in North Goa. This modern facility uses the Mechanical Biological Treatment (MBT) process with proper segregation, recycling, and bio-methanation technology. The functioning of the plant and selection of technology has been made to address all issues of odour, unsightly garbage mounds, and leachate generation. Electricity produced in-house from the organic fraction of the waste will be used to power the entire plant operation. The state government is proposing to establish a similar SWM management facility at Bainguinim in North Goa and Cacora in South Goa in their action plan for SWM for Goa<sup>16</sup>. The solid waste management cell of the DST collects segregated nonbiodegradable waste from the village panchayats and bailing it. Details of other SWM facilities planned by the state is provided as an annexure I.

<sup>16</sup> Carrying Capacity of Beaches of Goa for Providing Shacks & Other Temporary Seasonal Structures in Private Areas

**Box- State of the Art Waste Management Facility at Saligao**

The integrated Solid Waste Management Facility (SWMF) at Saligao is a state of art facility set up in 2016 which is scientifically managing waste as per the SWM rules 2016 and is successfully catering to 25 local bodies along the coastal belt of North Goa, additionally, the plant also caters to beach cleaning waste and highway cleaning waste. The plant was designed for 100 Tonnes Per Day (TPD) capacity which has been enhanced to 150TPD. The facility was built on the existing 20-year-old 73,198tonnes waste dump after remediation of the same.

- Facility Treated a total of **186008.3 Tonnes** of Municipal Solid Waste from May 2016 to May-2020.
- **63399 Tonnes** of RDF generated, which is being disposed for coprocessing to the cement factory from the facility.

**277925KW** (277 Mega Watt) power generated from the facility from Aug 2016 to May-2020.

**1) Remediation of existing legacy dumps in Goa**

The works contemplated under this contract consist of “Remediation, providing monsoon cover wherever required and safe disposal of the separated fractions from existing old Municipal Solid Waste (MSW) at various locations (11 identified) in Goa” shall apply to various MSW dumpsites within the state of Goa. GWMC accordingly floated a tender for remediation and issued a work order to 3 bidders to carry out remediation of 11 identified legacy waste sites in the State of Goa.

Other than the 11 sites, till date the State has remediated approximately 1,23,000 tonnes of waste from legacy dumps at Saligao, Cacora and Aradi. Besides till date among the 11 identified sites, waste remediation has been commenced at the following sites

- Sada (Mormugao Municipal Council) ~1,15,000 m<sup>3</sup> waste is remediated
- Sonsodo (Margao Municipal Council) ~1,05000 m<sup>3</sup> waste is remediated
- Assagao (Mapusa Municipal Council) ~32,000 m<sup>3</sup> waste is remediated
- Campal Parade Ground (Corporation of the City of Panaji) ~ 6,800 m<sup>3</sup> waste is remediated

A few important items in Goa’s waste management strategy should include:

1. Waste minimization in the tourism sector by providing alternate and bio-degradable options for tourist
2. Incentivising disposal of plastic waste by providing ride coupons or other tourist coupons in exchange for disposal or deposition of plastic waste at designated areas

**Table – Transport and allied sectors**

Sr. No.	Intervention		Status	Responsible agency	Barriers and Gap in implementation	Intervention Type	Time	Budget	Source of Finance	Monitoring and Frequency
	Intervention	Type								
1	Incentives for replacement of fossil fuel based Vehicles with electric vehicles or any other renewable energy	Mitigation	proposed	Department of Transport	Fund availability	Scheme	1 year to ensure requirements and then implementation for ten years	10 crores	State Government & Other available funds	Within Dept. and reporting to climate change secretariat in 6 months
2	Fixing life of Vehicle	Mitigation	proposed	Department of Transport	Absence of legal mandate	Policy & Guidelines and Execution	1year	10 lakhs	State Government & Other available funds	Within Dept. and reporting to climate change secretariat in 6 months
3	Purchase of Electric Vehicles in all Government Departments	Mitigation	proposed	Department of Transport with GEDA	Fund Availability	Policy & Execution	2 years and continuous	15 crores	State Government	Within Dept. and reporting to climate change secretariat in 6 months
4	Banning Euro 4 Vehicles in city areas	Mitigation	proposed	Department of Transport with ULBs	Actual Execution	Policy & Execution	18 months	5 crores	State Government	Within Dept. and reporting to climate change secretariat in 6 months

Sr. No.	Intervention		Status	Responsible agency	Barriers and Gap in implementation	Intervention Type	Time	Budget	Source of Finance	Monitoring and Frequency
	Intervention	Type								
5	Electric public transport	Mitigation	Under progress	Department of Transport	Collaboration with GEDA & Others	Scheme	6 months	50 crores	Existing Department Budget - State Govt.	Within Dept. and reporting to climate change secretariat in 6 months

Approximate financial implications of transport and allied sector expected to be met from climate change plan for ten years are approximately ₹ 90 crores. Detailed plan for expenditure along with gap analysis will be prepared by the department within 6 months.

# Adaptation Strategies

## 7.1. Water

### Water sources

The State receives a copious annual rainfall of about 2500 to 5000 mm from the southwest monsoon. Four of the seven rivers in the state, namely, Mandovi, Zuari, Galijibag, and Talpona occupy about 77.70% of the State's geographical area. Mandovi and Zuari are the two largest rivers. 'Dynamic Ground Water Resource of India, (March 2013 - June 2017) has estimated the net groundwater availability in the State as 14625 ham<sup>17</sup>. The stage of groundwater development is 37%, which falls in the safe category of groundwater exploitation.

Though Goa is in high precipitation zones, it has one of the lowest per capita freshwater availability. The draft state water policy 2015 presents various challenges the state faces in utilizing water resources. The rivers are prone to tidal variations up to 40 km inland and seasonal water availability variations.

In the mining zones, water scarcity has been increasing due to the withdrawal of groundwater and the non-replenishment of wells.

### Current status of water and associated facilities

The Water Supply in the State of Goa is catered through Regional Water Supply Schemes and Spot Sources. The Public Works Department is looking after the water supply sector, including operation and maintenance in the entire State of Goa in rural and urban areas.

The state has a total water treatment capacity of 601 MLD. Rural areas are supplied with water at the rate of 82LPCD and urban areas with 143LPCD. The state intends to achieve a 24x7 water supply scenario with 100 LPCD supply in rural areas and 150 LPCD in urban areas. By 2025, the state intends to have installed capacity for water at 711 MLD.

All the water treatment plants are equipped with water testing laboratories for regular water testing. The drinking water quality is regularly checked to maintain all service standards, and quality is maintained at all levels. The details of the present water supply schemes are:

Total Installed Capacity is 601.43 MLD

- Regional Water Supply Schemes - 580.22 MLD
- Additional Schemes (Pressure Filter) - 14.42 MLD
- Additional Spot Sources - 6.79 MLD

Details of water supply schemes are provided in annexure II. Most of the population depends on traditional septic tank and soak pit systems for wastewater disposal. As of FY 2016-17, urban areas in the state generate 253 MLD of wastewater, of which 36 % is treated through the sewerage treatment plant. In the near future state intends to improve the sewerage facilities in all uncovered areas.

<sup>17</sup> 1 cubic meter is equal to 0.0001-hectare meter (ham)

that sewerage facilities are provided to the rest of the state in a phased manner in order to achieve total sanitation and zero discharge of wastewater into the environment. In FY17-18, 9% of the government's non-tax revenue came from water supply i.e. **INR 126 crore**.

The state has assessed its total water requirement by 2051 to be 8030mcm. Total water resources that can be conserved have been identified to be worth 1585 mcm. In 2015, Goa's Ground Water Policy was also prepared to develop & regulate groundwater sustainably and manage it professionally to prevent its pollution and degradation.

To support the water policy, groundwater policy and strengthen the water and related systems in the state following are the key items undertaken by the state:

### Schemes and Initiatives

- 'Nital Goem Nital Baim' has been introduced to help promote the conjunctive use of water and also maintain the groundwater structure in the State.
- Master plans have been prepared for optimal utilization of the water resources of the four river basins of the State
- The scheme for post-monsoon water harvesting for groundwater recharge through the construction of a series of bandharas across rivers and nallahs in the sweet water zones.

### Projects and Activities

- Replacement of old AC pipeline by 300mm dia D.I water supply pipeline from Zarowado Chapel up to Navelim church in Navelim Constituency at the cost of **400.00 lakh**
- Providing & laying of conveying main & distribution main and Construction of 800 m3 GLR at Bastora at the cost of **156.81 lakh**.
- Replacement of old 150mm AC pipeline from 800m3 GLR at Desai Nagar to Upper Harvalem in Sankhali Constituency at the cost of **216.99 lakh**
- The National Hydrology Project provides additional financial support and also offers an excellent opportunity to introduce new technologies into water resource sector planning & management.
- Online services like Registration of wells and tankers under the Groundwater Regulation Act, 2002
- Act to charge rates for drawl and transportation of groundwater under different uses and register all the drilling companies who drill borewells in the State.

### Impact of climate change on water resources in the state:

1. Seawater intrusion or saltwater ingress will increase groundwater salinity near the coastal areas rendering it unusable. With sea-level rise due to climate change and indiscriminate use of groundwater, the problem of saltwater intrusion will be exasperated.
2. Increased backflow of water into rivers and drainage channels is an indirect impact. For example, the formation of beaches on Querem and St. Inez is taking place. This is indicative of the sand deposition trends along the Panaji coastline. The formation of this beach has led to blockage of water flow of the St. Inez creek into the Mandovi River and hence, has increased backflows<sup>18</sup>. In the case of climate phenomena like high-intensity, short-duration rainfall, the impact could be an increased impact of floods due to clogged drainage channels.
3. Increased pollution of water bodies and flooding: Due to the high water table, the soaking capacity of the soil is generally poor in Goa. With increased precipitation events, the runoff will increase, and inadequate sewerage networks and sanitation facilities have the potential to mix runoff with sewerage and other contaminants leading to pollution of water bodies like ponds, lakes, tanks, etc.

<sup>18</sup> Urban Vulnerability Assessment Report, Panaji City, India, GIZ, March 2013

4. Increased risk to water-related structures and infrastructure: Directly and indirectly, climate change and other non-climatic stressors increase the risk of infrastructure failure. For example, increased peak rainfall incidents in Goa, where the water table is high and the soil is saturated, can further elevate the chances of landslides, mudslides, etc. Such sliding events can impact the water supply pipeline, sewerage network, etc. Some parts of Goa have experienced the impact of such events in the past years.

### Impact on Mandovi River due to climate change

In Mandovi River, saline water intrudes up to 46 kms. in the river Mandovi up to Ganjem. If the sea level increases, as apprehended on account of global warming, the saline water will intrude even further into the river. When the sea levels rise rapidly, as they have been, even a slight increase can have devastating effects on coastal habitats. As seawater reaches further inland, it can cause destructive erosion, flooding of wetlands, inundation of khazan lands, contamination of aquifers and agricultural soils, and loss of habitat for fish, birds, and plants. Groundwater aquifers will also get impacted. An area of 509 sq. kms at the lowermost end of the Mandovi basin, i.e. about 32 % of the basin area in Goa, is subject to tidal effects, and the water resources in this area are not fit for harnessing for any consumptive uses. Increased salinity due to sea level rise resulting from global warming is bound to enlarge the tidal zone of the basin and thereby progressively reduce the available utilizable freshwater resources.

The climate change scenario will also likely alter the rainfall and cause water shortage. It is likely to have a general overall reduction in the quantity of available run off in rivers originating in the Western Ghats, including Mandovi.

### Synergy with National Water Mission and SDG

#### The adaptation measures outlined below have been developed to align with the National Water Mission (NWM) and SDG6.

NWM's main objective is "Conservation of water, minimizing wastage and ensuring its more equitable distribution across and within States through integrated water resources development and management". The five identified goals of the Mission are: (a) developing a comprehensive water database in the public domain and assessment of the impact of climate change on a water resource; (b) promotion of citizen and state action for water conservation, augmentation, and preservation; (c) focused attention to vulnerable areas including over-exploited areas; (d) increasing water use efficiency by 20 %, and (e) promotion of basin level integrated water resources management (IWRM).

Sustainable development goal (SDG) number 6 focuses on clean water and sanitation. Its goal is to ensure the availability and sustainable management of water and sanitation for all.

#### The targets for SDG 6 are:

- 6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all.
- 6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.
- 6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing the release of hazardous chemicals and materials, halving the proportion of untreated wastewater, and substantially increasing recycling and safe reuse globally.

- 6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.
- 6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.
- 6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.
- 6.7 By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.
- 6.8 Support and strengthen the participation of local communities in improving water and sanitation management.

Hence, the adaptation measures on water for the state of Goa would focus on:

### 1. Adaptation of water-related infrastructure

Several activities to upgrade, augment and supplement water supply and sewage treatment are planned in Goa. These proposed activities will increase adaptive capacity. However, the climate vulnerability of the proposed infrastructure, site, and infrastructure should also be assessed. For example, the probability of a water sump or treatment plant getting submerged or flooded due to changing climatic phenomena will cause financial vulnerability, and the availability of critical resources during disasters will also be compromised.

To avoid such a scenario, it is proposed that:

- Implementable guidelines for climate-proofing water-related infrastructure projects are developed for all water projects. These guidelines must be taken into account at the time of development of project DPRs. Examples of water-related projects where these may apply are water supply, sewerage networks, wastewater treatment structures, etc.
- Climate proofing existing key water supply and sewerage management infrastructure lying in critical zones like low-lying areas. Climate risk and vulnerability assessment of such infrastructure, prioritization and development of remedial action plan.

### 2. Development of infrastructure to reduce impact on water availability and enhance water security

Safeguarding groundwater against salinity and pollution is essential for water security. To achieve this:

- a. There is a need to develop an integrated salinity control mechanism in Goa's coastal areas, which would include measures to reduce groundwater exploitation.
- b. Most of the population still depends on traditional septic tanks and soak pit systems for wastewater disposal. Appropriate fecal sludge management or alternate management strategies to be developed and implemented.
- c. Health hazards such as groundwater contamination or drinking water due to the soil's lack of adequate soaking capacity, and letting wastewater in open drains is growing due to urbanization. It is proposed to cover all the major towns with sewerage networks using appropriate technology to achieve total sanitation and a clean environment in urban areas. Provide sewerage network in all low-lying unsewered areas followed by extension of the network to all unsewered areas.
- d. It is necessary to enforce various measures to make the residents avail sewerage connections in serviced areas.

### 3. Developing systems for appropriate planning of water to ensure water supply to all

- Draft water policy should be finalized after including climate resilience aspects.

There is a need for a system of suitable water pricing to deal with increasing water scarcity in the future due to the adverse effects of climate change. Including recycling and reusing components in the water policy is also essential.

- Treated wastewater can provide additional water resources to water-stressed regions and help meet the growing India's water needs. Therefore, the state needs to invest in wastewater treatment capacity keeping this long-term vision in mind and plan for practical options for introducing recycle and reuse potential in the state by 2030. The policy is missing a complete assessment of existing recycling and reuse potential for treated wastewater and the enablers needed for future capacities to be developed.
- Undertake a pilot on wastewater recycling and reuse before scaling it.
- Carry out a water audit to identify the potential for reducing water loss in the current water supply system
- Modernizing and expanding instrumentation and measurement techniques also enhance the ability to reduce water loss. Systematic investment in critical areas.

### 4. Maintenance of water resources to avoid flooding and to keep related infrastructure functional during peak events and disasters

Major rivers carry away surge water and help reduce surge velocity to flooding; hence nearness to a major river decreases vulnerability, while minor rivers can have the opposite effect, likely because of their low water-carrying capacity. It is essential to maintain the carrying capacity of rivers by desilting. Due to climate change, it is essential to review and revisit the existing maintenance plan for drains, sewerage networks, and key water bodies like rivers and lakes.

- Revisit the maintenance plan of water bodies and conduct desilting accordingly
- Revisit the infrastructure maintenance plan and develop a climate-resilient infrastructure maintenance plan and implement the same

### 5. Knowledge management and capacity building (Forecasting and data base building)

**Interdepartmental interaction:** The different departments of the state government, whose work is related to water and climate change should have a common forum that should meet at frequent intervals to take an integral view of knowledge base and policy options. For this purpose, the Department of Water Resources should have an effective cell headed by a Chief Engineer level officer. The climate secretariat shall be a part of this activity.

- Where feasible GIS-based mapping of the sewer drains for better tracking and management
- Flood forecasting should be envisaged using real-time data acquisition systems and linked to forecasting models. Real-time data acquisition systems should be provided to make flood-level data available to concerned officials.
- The impact of climate change should be analyzed at the sub-basin level such as the Zuari sub-basin,
- High priority should be assigned to strengthening and creating adequate facilities for studies and research on hydrological, hydro-metrological, and geomorphologic aspects related to climate change within the Department of Water Resources, WALMI, Universities, and other institutions

### 6. Awareness Raising

There is a need to take up massive awareness generation programs among people at all levels about the adverse effects of climate change and the need to optimize water usage and conserve water.

Table 22: Adaptation Measures for Water Sector

Sr. No.	Intervention	Status	Responsible agency	Barriers & Gap in Implementation	Intervention Type	Budget (INR crore)	Source of Finance	Time frame	Monitoring Mechanism and Frequency	NDC Link (Connects to NDC)
1	Develop implementable guideline for climate proofing new water-related infrastructure projects	proposed	WRD & Climate Secretariat	Gap: Exact information on climatic variables may not be available	Others	0.15	Own budget by State Govt.	6 Months	By conducting quarterly reviews at Water Resources Department level.	To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change
2	Implementation of guidelines by including them in project planning and DPR stage	proposed	Water Resources Department, Municipal Administration	Educating vendors, including in formats and work orders or tender conditions	Policy	0.75	Existing Department Budget	2 years	By conducting quarterly reviews at Water Resources Department level.	
3	Climate risk and vulnerability assessment of such infrastructure, prioritization and development of remedial action plan.	proposed	Climate Secretariat	Gap: Exact information on climatic variables may not be available	Others	0.2	Own budget and Central Government contribution	6 months		

4	Climate proofing existing key water supply and sewerage management infrastructure	proposed	Water Resource Department, Municipal Administration		Activity	0.1		2 years		
5	Develop and implement an integrated salinity control program	to be modified	Multi department Water Resources Department Municipal Administration etc		Others The Water Resources department has plans to take up river bank protection - water conservation structures constructed for ground water recharge and to arrest the ingress of salinity in major tributaries of the rivers in Goa.	25.00	Own budget	3 years		2. To adopt a climate friendly and cleaner path than the one followed hitherto by others at corresponding level of economic development.
6	Faecal sludge management	proposed	Sanitation department		Activity	0.1	Own budget and Central Government contribution	3 years		

7	To cover all the major towns with sewerage network	under progress	PWD-PHE/Sewerage infra Corporation		Activity	0.1	Own budget and Central Government contribution	1-5 years	
8	Provide sewerage network in all low-lying unsewered area followed by extension of network to all unsewered areas.	under progress	PWD-PHE/Sewerage infra Corporation		Activity	0.1	Own budget and Central Government contribution	1-5 years	
9	Development of measures to make it mandatory to avail sewerage service	under progress	PWD-PHE/Sewerage infra Corporation		Activity	0.05	Existing Department Budget	1-5 years	
10	Draft water policy should be finalized after including climate resilience aspects.	to be modified	Water Resources Department	Gap_ existing water policy does not include important climate change aspects	Policy Goa State Water Policy 2000 is currently being revised to sync with the National Water Policy 2012 and includes various	0.1	Existing Department Budget	6 months	

11	A complete assessment of existing recycling and reuse potential for treated waste water and the enablers needed for future capacities to be developed is missing in the policy.	proposed	PWD-PHE/Sewerage infra Corporation		Policy	0.2	Own budget and Central Government contribution	6 months	
12	Undertake a pilot on wastewater recycling and reuse before scaling it.	proposed	PWD-PHE/Sewerage infra Corporation		Activity	15	State & Central, including NAFCC, to be explored	3 years	
13	Carry out a water audit to identify the potential for reducing water loss in the current water supply system	proposed	PWD-PHE		Activity	0.25	Existing Department Budget	1 year and then every three years	
14	Modernizing and expanding instrumentation and measurement techniques also enhances the ability to reduce water loss	under progress	PWD-PHE		Activity	0.5	Existing Department Budget	continuous	
15	Revisit the maintenance plan of water bodies	proposed	Water Resources Department		Activity	0.50	Existing Department Budget	1 year	

16	Implement revised maintenance plan	to be modified	Water Resources Department	Gap - Not all water bodies are State Owned. May lead to litigations like in case of Bondval lake St Cruz.	Activity	20.00	Existing Department Budget	3 to 5 years	
17	Revisit infrastructure maintenance plan and develop a climate resilient infrastructure maintenance plan	proposed	Water Resources Department/Other depts	GAP- No perceived gap	Activity	0.50	Existing Department Budget	1 year	
18	Implement the plan	to be modified	Water Resources Department/Other depts	GAP- No perceived gap except for codal formalities	Activity	15.00	Existing Department Budget	3 to 5 years	
19	GIS-based mapping of the sewer drains	under progress	PWD- PHE/Sewerage Infrastructure Corporation		Activity	0.10	Existing Department Budget		

20	Flood forecasting should be envisaged using real-time data acquisition systems and linked to forecasting models	proposed	Water Resources / Disaster management Cell	No perceived gap	Activity Equipment is being Procured by WRD under NCRMP scheme	0.50	Multilateral agency Central/World bank	2 year	
21	The impact of climate change should be analysed at sub- basin levels such as the Zuari sub-basin.	proposed	Water Resources	GAP- No perceived gap	Activity EIA of all 9 rivers basins to be carried out	1.00	Others/ State Govt. funds	5 years	
22	Massive awareness generation on water conservation	under progress	Water Resources	GAP- Present gap due to COVID situation for mass assembly of people. Besides this no other perceived gap	Activity Awareness programs for stakeholders and general public	0.25 per year	Own budget and Central Government contribution	Continuous	
23	Reducing the NRM below 25%	proposed				0.10	Departments own budget	5 years by 2025	

Estimates for the next ten years for the water sector arrived at through broader consultation is about ₹ 80.55 crores. Maximum is from State Govt. and some from central funds

## 7.2. Tourism

With a 105 km long coastline, Goa is a well-known tourist destination, primarily for coastal tourism. Four coastal Talukas of Bardex, Tiswadi, Mormugao, and Salcete receive the maximum number of tourists. The annual tourist population in these talukas significantly exceeds the local population. Tourism in the rest of the Talukas is minimal.

International tourists, mainly from Europe, arrive in Goa in winter, while the summer and monsoon seasons see many Indian tourists totaling about 5,00,000 per annum. It is estimated that the total number of tourists visiting Goa has become nearly equal to the population of Goa.

Thus, tourism is one of the key important activities in Goa, contributing to more than one-fourth of the state GDP and one of the largest employment-providing industries in the state.

Due to tourism development, the state has experienced a significant shift in employment activities from traditional fishing and agriculture towards tourism-related employment like water sports, beach shacks, etc. The pressure on infrastructural facilities in the State has also increased significantly due to tourism. While tourism generates revenue for Goa, it is highly dependent on natural resources

### Resource and impact of tourism:

Tourism activities have created an enhanced demand for water in the talukas mentioned above. Groundwater exploitation has increased as a result of the same. On the other hand, in the absence of 100% coverage with a sewerage network and sewerage treatment facility, groundwater and Marine pollution and eutrophication in the coastal waters are observed.

In India, Jeevivek *et al* (2013) noted that sand dunes were destroyed for tourism development, and coastal areas with high population density were causing erosion and decreasing the width of beaches. Goa's sand dunes and coasts are also under pressure and experience disturbance due to tourism-related activities.

Ecological disturbances, traffic congestion, and impact on air quality due to heavy traffic movement are some of the other impacts of tourism experienced by Goa.

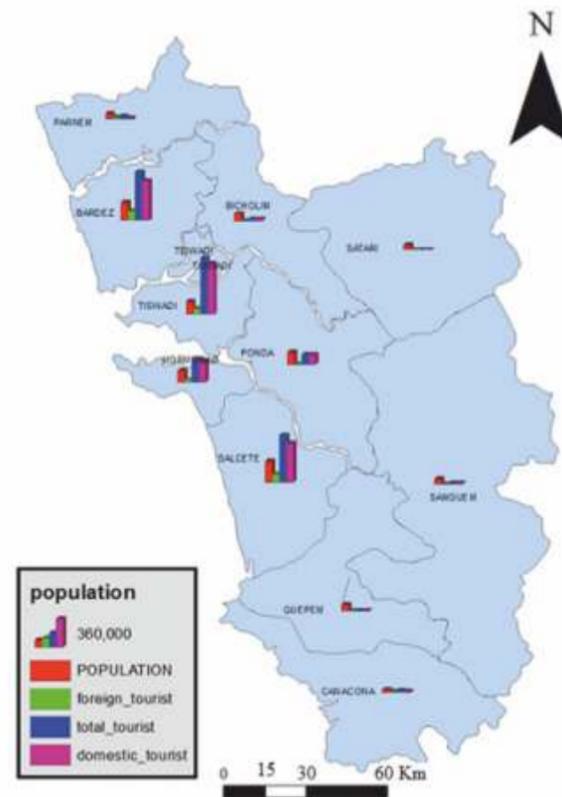


Figure 32: Annual tourist footfall by talukas

Table 23: Sand dunes along the Goa coast within 200m in CRZ Area

Taluk	Panchayat	Area of Sand Dunes within 200m (in sq.m.)
Bardez	Anjuna-Caisua	4183
	Calangute	46009
	Candolim	87949
Canacona	Poinguinim	559886
Salcete	Betalbatim	208409
	Colva	196776
	Cana-Benaulim	123149
	Varca	363438
	Cavelosim	613175
Mormugao	Cansaulim, Arossim, Culim	86217
	Pale-Valsao	31727
<b>Total sand dune area within 200 m</b>		<b>2320918</b>

<sup>1</sup><http://ides.nh.gov/organization/commissioner/pip/factsheets/cp/documents/cp-02.pdf> extracted on 20 December 2016<sup>19</sup>

The regional plan of Goa up till 2021 has been prepared. According to which Tourism Master Plan should be designed keeping in mind the potential of the tourism sector and its sustainability, and proposals of the tourism master plan, including infrastructure, shall conform to the eco-tourism policy. The eco-tourism policy promotes hinterland tourism. The state has taken several measures to provide adequate infrastructure for tourism and mandated large hotels to provide solar panels and treat the sewerage before discharge etc.

The carrying capacity of Goa's beaches has also been assessed to provide structured planning.

<sup>19</sup> Carrying Capacity of Beaches of Goa for Providing Shacks & Other Temporary Seasonal Structures in Private Areas <http://www.dstegoa.gov.in/Beach%20Carrying%20Capacity%20Report.pdf>

### Impact of climate change

Climate change will impact tourism activities, and infrastructural and system deficiencies will only increase the impact.

1. Warmer temperatures, as indicated earlier, can cause heat stress leading to the altered tourist season, tourist time at the beach, etc.
2. Increased sea temperature and acidity levels can impact the ecosystem and reduce the attractiveness of the sea for tourists engaging in certain water sports/activities like snorkeling or diving.
3. Sea level rise will lead to the loss of beaches, coastal erosion and impact the tourist infrastructure.
4. Increased high-intensity rainfall events could cause flooding and damage tourist spots and tourist infrastructure like hotels.
5. Changes in the length and quality could have considerable implications for competitive relationships between destinations and, therefore, the profitability of tourism enterprises. Studies indicate that a shift of attractive climatic conditions for tourism towards higher latitudes and altitudes is very likely.
6. Changes in water availability, biodiversity loss, reduced landscape aesthetic, altered agricultural production (e.g., food and wine tourism), increased natural hazards, coastal erosion and inundation, damage to infrastructure, and the increasing incidence of vector-borne diseases will all impact tourism to varying degrees.

### Adaptation Strategies for Tourism

Table 24: Adaptation Strategies for Tourism Sector

S.No. 1	<b>Intervention</b>	Promoting community based Agro-tourism
	<b>Status</b>	Out of 41 villages selected for development under Atma Nirbhar Swayampoorna Goa scheme, DOT has shortlisted 4 villages viz. Adwalpale, Chandor, Bandora and Gaodongrem for developing them as “Model villages” for developing specialized Agro / eco-tourism products within these villages. DOT along with KPMG is currently conducting ideation sessions along with locals, Self-Help Groups, and Panchayats in these identified villages, essentially to ascertain their awareness and acceptability of introducing “village tourism” in these villages. Based on these discussions, DOT is exploring to introduce various tourism products within these villages like: (1) Agro / Farm tours, (2) Home stays, (3) Tribal / Village cultural hub, (4) Marketing centers for sale of tribal / village products, (5) Experience centers for learning art and craft pertaining to the villages etc. Apart from the above, GTDC, subsequent to a tender process, had selected M/s Vinsan Graphics (brand name: Exclamations Goa) as successful bidder for “Planning and Organizing Experiential Tours in the state”. A LOA has been issued to the successful bidder dated 28.01.2020. On finalization of Model Villages, an itinerary will be developed along with the Experiential Tour operator for kickstarting the Agro/Eco-Tourism in these villages.
	<b>Responsible Agency</b>	Agriculture Department and Tourism Department
	<b>Barriers and Gaps in implementation</b>	The success of the program is dependent on support from locals / Panchayats. Department of Tourism is currently discussing with various villages for their awareness and acceptability of implementing “Village Tourism” with their villages.
	<b>Intervention Type</b>	Awareness raising and capacity building
	<b>Budget</b>	To be decided. Budget will be required for developing necessary infrastructure, as required, within the identified villages such as cultural hub, marketing centers and experience centers.
	<b>Source of Finance</b>	<ul style="list-style-type: none"> <li>• Government funds for Infrastructure development</li> <li>• Tour costs will be borne by the tourists themselves.</li> </ul>
<b>INDC Link (Connect to INDC items)</b>	To adopt a climate friendly and a cleaner path than the one followed hitherto by others at corresponding level of economic development.	

S.No. 2	<b>Intervention</b>	Inland tourism development in a climate friendly manner
	<b>Status</b>	DOT proposes to develop hinterland tourism through: (1) augmentation / development tourist attractions including wildlife sanctuaries, waterfalls, parks / gardens, and other hinterland attractions, (2) developing eco-friendly tourism activities / activity hubs such as nautical tours, eco-trails / walking tours, bird watching tours, fun trails, culinary tours, spice tours etc. (3) creation of wayside amenities, etc. While hinterland tourism zones were identified in Tourism Master Plan (Module-2), various hinterland programs / locations will be identified in Module-6 in Tourism Master Plan – various surveys are currently underway for identification of hinterland programs.
	<b>Responsible Agency</b>	Tourism Department
	<b>Barriers and Gaps in implementation</b>	Hinterland tourism will be introduced, on finalization of Module-6 of Tourism Master Plan .
	<b>Intervention Type</b>	Activity
	<b>Budget</b>	To be estimated in Module-6 of Tourism Master Plan and Policy.
	<b>Source of Finance</b>	
	<b>INDC Link (Connect to INDC items)</b>	
S.No. 3	<b>Intervention</b>	Tourism infrastructure climate vulnerability assessment
	<b>Status</b>	Any project proposed by Tourism Department, if it qualifies the EIA requirements as set out by Ministry of Environment and Forest, GoI, will undertake Environment Impact Assessment (EIA) study along with proposing Environment Management Plan (EMP). Tourism Department will allow projects to initiate development works only after receipt of Environmental Clearance from MoEF or State Expert Appraisal Committee, as the case may be.
	<b>Responsible Agency</b>	Tourism Department
	<b>Barriers and Gaps in implementation</b>	Barrier: Few precedence's and established practices
	<b>Intervention Type</b>	Activity
	<b>Budget</b>	EIA study will be borne by the project proponent itself.
	<b>Source of Finance</b>	
<b>INDC Link (Connect to INDC items)</b>	To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation.	

S.No. 4	<b>Intervention</b>	Climate proofing and disaster management for critical tourism infrastructure
	<b>Status</b>	Before development of critical tourism infrastructure in the state, tourism department shares the plans as per extant building bye-laws of TCP Dept. and /or construction/development norms( including any constraints) as specified by CRZ. Any suggestions from this statutory bodies are duly incorporated before preparing the projects for final construction. The same process will be adopted in neat future too , to ensure adequate climate proofing / disaster management is maintained.
	<b>Responsible Agency</b>	Tourism Department
	<b>Barriers and Gaps in implementation</b>	Barrier: Few precedence's and established practices
	<b>Intervention Type</b>	Activity
	<b>Budget</b>	To be decided and included at policy level and further modalities to be worked out.
	<b>Source of Finance</b>	
S.No. 5	<b>INDC Link (Connect to INDC items)</b>	To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation.
	<b>Intervention</b>	Develop design standards for new tourist infrastructure and provide guidance for modification of existing vulnerable infrastructure
	<b>Status</b>	As per Tourism Master Plan and Policy, Tourism Department will shortly move for formation of Goa Tourism Board. On its formation, as part of its planning and monitoring activities: <ul style="list-style-type: none"> <li>· GTB will devise standards / best practices for development of new tourist infrastructure in the state.</li> <li>· It is also proposed to introduce “Green Cess” (calculated as a percentage of total tourism proceeds), which will be collected from all tourism establishments. This Green Cess will be utilized for developing / augmenting vulnerable infrastructure in eco-friendly manner.</li> <li>· In addition, it is planned to introduce “eco-labels” for various tourism establishments in the state, both existing and new, to promote eco-friendly construction, and operating practices. It is proposed that any establishment possessing such eco-label will be exempted, either partly or full as the case may be, from payment of Green Cess, as stated above.</li> </ul>
	<b>Responsible Agency</b>	Multi Department
	<b>Barriers and Gaps in implementation</b>	Barrier: Few precedence's and established practices
	<b>Intervention Type</b>	Activity
	<b>Budget</b>	To be decided
<b>Source of Finance</b>		
<b>INDC Link (Connect to INDC items)</b>	To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation.	

S.No. 6	<b>Intervention</b>	Enhance / modify and restructure the insurance for off-coast or water related tourism activities and infrastructure like boats and ships which are vulnerable to climate change
	<b>Status</b>	To be modified
	<b>Responsible Agency</b>	Multi-department
	<b>Barriers and Gaps in implementation</b>	Barrier: Few precedences and established practices
	<b>Intervention Type</b>	Scheme
	<b>Budget</b>	Under consideration. Modalities to be decided.
	<b>Source of Finance</b>	
	<b>INDC Link (Connect to INDC items)</b>	To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation.
S.No. 7	<b>Intervention</b>	Incentivize use of eco-friendly, recycle / reuse in the tourism sector by facility providers
	<b>Status</b>	In order to promote adaption of processes, services and products that follow environmental regulations and requirements, Tourism Department is planning to introduce "eco-labels" for various tourism establishments in the state, both existing and new. The eco-labels (proposed as Gold / Silver / Bronze ratings) will be given to tourism establishments (after an audit) by checking their performance on various practices like waste management, energy and water efficiency, adoption of sustainability practices, education and awareness, and economic linkages. The eco-label will be renewed on yearly basis. In addition, Tourism Department proposes to exempt (either in part or full) such tourism establishments from Green Cess (proposed), which will be utilized for developing / augmenting vulnerable infrastructure in eco-friendly manner, that possesses "eco-labels".
	<b>Responsible Agency</b>	
	<b>Barriers and Gaps in implementation</b>	Barrier: willingness and local business models
	<b>Intervention Type</b>	Awareness raising and capacity building
	<b>Budget</b>	To be decided
	<b>Source of Finance</b>	
	<b>INDC Link (Connect to INDC items)</b>	To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation.

S.No. 8	<b>Intervention</b>	Single use plastic to be banned with credible alternatives in tourism activity
	<b>Status</b>	During the meeting held on 24.06.2020 under the chairmanship of Secretary Finance, it was decided that this topic will be out of scope of Tourism Department.
	<b>Responsible Agency</b>	Multi-department
	<b>Barriers and Gaps in implementation</b>	Barrier: Credible alternatives, monitoring mechanism, incentives and tourist awareness
	<b>Intervention Type</b>	Others
	<b>Budget</b>	
	<b>Source of Finance</b>	Funds from State Government if needed
	<b>INDC Link (Connect to INDC items)</b>	To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation.
S.No. 9	<b>Intervention</b>	Provide extensive infrastructure and encourage use of non-motorized transport by tourist - Develop a climate friendly tourist mobility plan
	<b>Status</b>	During the meeting held on 24.06.2020 under the chairmanship of Secretary Finance, it was decided that this topic will be out of scope of Tourism Department.
	<b>Responsible Agency</b>	Multi-department
	<b>Barriers and Gaps in implementation</b>	Barrier: Inadequate holistic infrastructure and marketing to promote the same
	<b>Intervention Type</b>	Scheme
	<b>Budget</b>	
	<b>Source of Finance</b>	Funds from State Government or Central Financial Assistance (if available)
	<b>INDC Link (Connect to INDC items)</b>	To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation.

S.No. 10	<b>Intervention</b>	Green skill and capacity development amongst the tourist service providers
	<b>Status</b>	In order to promote adaption of processes, services and products that follow environmental regulations and requirements, Tourism Department is planning to introduce "eco-labels" for various tourism establishments in the state, both existing and new. The eco-labels (proposed as Gold / Silver / Bronze ratings) will be given to tourism establishments (after an audit) by checking their performance on various practices like waste management, energy and water efficiency, adoption of sustainability practices, education and awareness, and economic linkages. The eco-label will be renewed on yearly basis. In addition, Tourism Department proposes to exempt (either in part of full) such tourism establishments from Green Cess (proposed), which will be utilized for developing / augmenting vulnerable infrastructure in eco-friendly manner, that possesses "eco-labels".
	<b>Responsible Agency</b>	
	<b>Barriers and Gaps in implementation</b>	Barrier: willingness and local business models
	<b>Intervention Type</b>	Awareness raising and capacity building
	<b>Budget</b>	To be decided
	<b>Source of Finance</b>	
	<b>INDC Link (Connect to INDC items)</b>	To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation.
S.No. 11	<b>Intervention</b>	Environmental Clearance for large tourism projects / hotels in Goa could include climate mitigation and adaptation plan and climate disaster prepared plan
	<b>Status</b>	During the meeting held on 24.06.2020 under the chairmanship of Secretary Finance, it was decided that this topic will be out of scope of Tourism Department.
	<b>Responsible Agency</b>	SPCB / any other local clearance body
	<b>Barriers and Gaps in implementation</b>	Gap: No existing standard or precedence
	<b>Intervention Type</b>	Policy
	<b>Budget</b>	
	<b>Source of Finance</b>	Funds from State Government or Central Financial Assistance (if available)
	<b>INDC Link (Connect to INDC items)</b>	To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation.

S.No. 12	<b>Intervention</b>	Re-consider the coastal development plan or zone for new construction based on the climate predictions on sea level rise, flooding, and erosion.
	<b>Status</b>	In line with the Tourism Master Plan, Tourism Department intends to diversify the tourists, which are currently concentrated near coastal areas, to underexplored areas/hinterlands of Goa. DOT proposes to develop hinterland tourism through the augmentation/development of tourist attractions, eco-friendly tourism activities/activity hubs, and the creation of wayside amenities, etc. In addition, Tourism Department proposes to develop eco-friendly standards for developing tourism infrastructure in the state.
	<b>Responsible Agency</b>	Tourism Department
	<b>Barriers and Gaps in implementation</b>	Hinterland tourism will be introduced, on finalization of Module-6 of the Tourism Master Plan and Policy.
	<b>Intervention Type</b>	Activity
	<b>Budget</b>	To be estimated in Module-6 of Tourism Master Plan and Policy.
	<b>Source of Finance</b>	
	<b>INDC Link (Connect to INDC items)</b>	To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation.
S.No. 13	<b>Intervention</b>	Reducing hotspot vulnerability
	<b>Status</b>	As part of Module-6 of the Tourism Master Plan and Policy, various tourism hotspots (places that experience high levels of tourist arrivals) will be identified in the state along with their monitoring plan to mitigate climate change risk. The plan will also determine the necessary infrastructure for effective management of the tourism hotspots.
	<b>Responsible Agency</b>	Multiple Departments
	<b>Barriers and Gaps in implementation</b>	Identification and monitoring of hotspots require ongoing data collection and tracking mechanisms.
	<b>Intervention Type</b>	Surveys for the collection of information, suitable infrastructure development, and awareness among tourists
	<b>Budget</b>	To be identified
	<b>Source of Finance</b>	Funds from State Government or Central Financial Assistance (if available)
	<b>INDC Link (Connect to INDC items)</b>	To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation.

**Note: Approximate financial implications of the tourism sector expected to be met from the climate change plan for ten years are approximately ₹ 5 crores. The department will prepare a detailed plan for expenditure within 6 months. The detailed mechanism for green cess will also be prepared.**

### 7.3. Mining

Mining in Goa is primarily focused on sand and iron ore. Goa's iron ore mining belt is mainly concentrated in four Talukas: Bicholim of North Goa district and Salcete, Sanguem and Quepem of South Goa district. The mining belt of Goa is divided into three regions based on the iron ore concentration, namely, Northern, Central, and Southern Zone. Usgao river is the dividing line between the northern and central zones and Sanguem river between the Central and southern zones. The maximum area under mining is in Sanguem Taluka, followed by Bicholim, Sattari, and Quepem. These Talukas also have considerable areas under the forest cover and are part of the Western Ghats, rich in biodiversity. Sand mining is another important mining activity in the state. It is primarily fuelled by the construction sector and carried out along the coastal areas.

Along with tourism, mining is an important part of the state's economy and industrial growth. As per the Economic Survey 2017-18, 38 mining leases were in operation in 2017. However, mining has led to several regional social and environmental problems. These problems can be attributed to 'illegal' and 'unscientific' mining activities. Iron ore mining is water-intensive, leading to the drying up of wells nearby, pollution of water bodies and groundwater, biodiversity loss, etc. In some cases, the dust has been attributed to low cashew production.

#### Impact of Climate Change:

1. Climate change will further exasperate the water scarcity in the mining area for the local population and also for agricultural purposes
2. Mines will as well be impacted by water scarcity
3. Sea level rise and extreme events can cause flooding of mining sites

#### Adaptation Strategies

Sand mining, which is associated with economic activities and indirectly with many people, does increase the sensitivity of the coastal system to coastal hazards.<sup>20</sup>

<sup>20</sup> Multi-hazards Coastal Vulnerability Assessment of Goa, India, using Geospatial Techniques, NIO, 2014

Table 25: Mining related adaptation strategies

Sr. No.	Intervention	Status	Responsible agency	Barriers and Gap in implementation	Intervention Type	Budget	Source of Finance	Time frame	INDC Link (Connect to INDC items)
1	A comprehensive study of Hydro Geology of underground water to be carried out	Proposed	Water Resources Department		Activity	0.5	Multilateral agency	1 year	
2	Independent mining audits to ensure compliance with EIA/clearances and other parameters	To be modified	Climate Secretariat or other institutes		Activity	0.5	Own budget and Central Government Contribution	6 months	To adopt a climate friendly and a cleaner path than the one followed hitherto by others at corresponding level of economic development.
3	Explore and provide treated water for mines or alternate sources	Proposed	PWD		Policy	2	Others	1 year	
4	Resource efficiency and circular economy concept needs to be incorporated into the construction sector to reduce pressure on sand as a resource.	Under progress	PWD		Policy	2	Existing Department Budget	1 year	

Approximate financial implications of mining sector expected to met from climate change plan for ten years are approximately ₹ 5 crores.

## 7.4. Agriculture and allied sectors

Agriculture is an important sector; and out of the total state area of 361113 ha about 131587 ha is under cultivation. The cultivable agricultural and plantation area had reduced from 3,26,671 ha during 1989- 1990 to 3, 23,976 ha in 2009 -2010. The area is sown more than once fluctuates between 3 to 6 %. Conversely, there has been a decrease in the area of cultivable wasteland from 21 to 16 %. This indicates an awareness to use the irrigation potential for double-crop and greening the State. A large area in Sanguem, Sattari, Canacona, Dharbandoda, and Quepem Talukas is under woodland forests and cultivable wastelands. On average, landholding in Goa is small, and the average landholding is around 0.84 ha. Like most other coastal States, the people of Goa practice integrated systems of farming, forestry, horticulture, livestock, and off-farm activities.

Goa has only one agro-climatic zone, i.e., West Coast Plains & Ghat Region, and the state primarily depends on rain-fed agriculture. Paddy, sugarcane, areca nut, and coconut are the major crops grown under irrigation. Besides, pulses are taken in rotation. Goa has a very distinct pattern of land use. The sloppy hills are cultivated with cashew interspersed with Kokum; the lower slopes are cultivated with Coconut. Areas with perennial irrigation have multi-storied cropping, including Coconut, Arecanut, Black Pepper, Nutmeg, Jackfruit, Pineapple, Breadfruit, etc. The valley along the nullah & river is cultivated with paddy in rabi season. The sandy soil in coastal areas is planted with paddy in the rabi season and legumes and vegetables in summer. Khazan lands that are reclaimed by constructing bunds along the tidal rivers and controlling tidal water through an intricate arrangement of sluice gates cover about 18000 ha. These areas are cultivated with paddy only during the rainy season with salt-tolerant varieties and left fallow due to high salinity in dry months.

The State of Goa has around 60.44 % of its geographic area under Government forest (2,237.49 sq. km.) One National Park and six Wildlife Sanctuaries constitute the protected area network of the State, covering 5.33 % of its geographical area. There is a substantial area under private forest and a large tract of plantation under cashew, mango, coconut, etc. Many areas in Goa are famous for their Agro Heritage. These include Mayde (Moirá) for Banana, Aldona & Kholá for Chili, Taleigaon for Bhendi, and Kutthali for Brinjal.

The state's soils are largely acidic, having laterite in plains/midlands and hilly areas while sandy to sandy loam in coastal areas. Brackish water salt pans also exist in the low-lying areas of the coastal regions. About 30 % of the area of Goa has shallow soils, 5 % has moderately deep soils, 46 % has deep soil, and about 7 % has shallow to very shallow soils.

In the upper reaches of the topography, the soils are coarse and gradually become dense towards the valley regions. The percolation is better up to pediplain areas from hills and gradually decreases in the valley regions. Heavy textured soils are encountered in the lower areas, i.e. the soil along the river banks and major streams. In some cases, subsoils are affected by acidity. The surface layer of the soil up to a depth of 25 cm. is normally used by the crop plant. About 38 % has silty clay and gravelly silty clay surfaces soil texture, 26 % has gravelly clay sand clay texture, and 20 % sandy loam and loamy sand, 6 percent gravelly sandy clay loam and gravelly clay loam and 5 % loam and sandy clay loam surface soil texture. The National Bureau of Soil Survey and Land Use Planning [NBSS & LUP], Nagpur has published the "Soil Series of Goa" in 2002. In all 32-soil series have been identified in the State and provided in Annexure III.

Topographically, 13.4 % of the area has less than 3 % slopes, and 5.5 % of the area records between 5-25% slopes. Most of the area, under rain-fed agriculture, possesses 3-5 % slope grade.

The agricultural sector plays a vital role in the distribution of regional income. Hence, land utilization, cropping pattern, the extent of inputs, and other related factors become very important for proper planning at the micro level so that the share in the State income of particularly the small and marginal farmers improves.

The government intends to increase the area under organic farming and has set a target of bringing 350 ha in 2019. It has developed schemes and mechanisms for the same.

The Animal Husbandry sector is also essential for the economy. The State supports around 2.0 lakh livestock population, of which about 72 thousand are cattle, 38 thousand are buffaloes, 59 thousand are sheep, and 11 thousand are goats as per the 2010-11 Economic Survey.

Statistics based on 20<sup>th</sup> Livestock census 2019

<b>Total Livestock Population</b>	<b>1,32,388</b>
Buffalo	27,207
Cattle	60,247
Sheep	08
Goat	9,446
Pig	35,480
Total fowl population	2,03,51
Milk production	1.70 LLPD
Milk required	4 Lakhs LLPD
Deficit	2.30 LLPD
Per day Egg Production	1,09,596
Per day Meat Production	19,758 kgs

There is a huge demand in the State for milk, eggs, meat, and their products. Milk required is about 4 lakh Litres Per Day (LLPD). In comparison to this, State is producing 1.40 LLPD milk, thus having a deficit of 2.80 LLPD. In FY16-17, average milk collection was 66,000 liters/day in 2016-17 with 1395 animals and has gone up to 72,000 liters/day till December 2017 with the purchase of 1559 animals by the beneficiaries under Kamdhenu (Sudharit) Scheme. A 10 TPD biogas plant working on the cow dung unit has also been set up. This deficit predicts the huge demand for milk production and marketing in the State. The grazing area for cattle is often encroached on by mining, industrial, and housing activities. This has primarily hampered the availability of green fodder and thereby decreased production.

**Fisheries:** Goa has 104 km of coast length, 250 km. of inland waterways, and about 100 ha covered under inland water tanks, providing huge fishing opportunities. The coast is full of creeks and estuaries formed by these rivers, providing a good shelter for fishing crafts. Annual fish landing is about 95000 MT. The export of marine fish products earns a good amount of foreign exchange. As a result, there has been a proliferation of a few invasive species of shrub-like Lantana and fishes like African Catfish and Tilapia. These have been established in many pockets, including wild habitats, and threaten native flora and fauna.

**Administrative setup:** Besides Zonal Agriculture Office at each Taluka level, Farmer Training Centre at Ella, Old Goa, State Department supported Krishi Vigyan Kendra at Margao and three-State agriculture farms. There is also ICAR set up in Goa through ICAR Research Complex for Goa at Ella and KVK. Regarding Animal Husbandry, there is the presence of a veterinary dispensary at the Panchayat level.

### Challenges:

Agriculture and allied sectors face several unique challenges in Goa:

1. A decline in interest in agriculture: One of the major problems is drifting interest from agricultural activities towards jobs in other sectors like tourism and mining. In 1960-61, 64 % of the workforce engaged in agriculture and allied activities, which declined to 16.6 % in 2001. While decadal censuses indicate a continuous decline in the workforce in the agriculture sector, agriculture production in the State shows an increasing trend. However, its contribution to GSDP has declined sharply.
2. Erosion of soil and deterioration of soil quality has been observed in large agricultural areas and varies from light to heavy erosion. These areas are mostly fallow or grazing lands or under bushy vegetation.
3. Labour wages have more than doubled over the decades, and very few people are available to undertake highly skilled jobs like Coconut/ Arecanut harvesting.
4. Loss of Agro heritage sites: These areas are rapidly developed to accommodate increasing housing demand and affecting land availability for agriculture.
5. EROSION OF LOCAL GERMPLASM and introduction of GMO seeds
6. Khazan Land was earlier maintained through regular contribution and surveillance and Tenant Association and is currently under the Soil and Water Conservation Department. The traditional system of maintaining bunds using local clay is substituted by cement and boulder. These bunds are often intentionally breached to promote prawn culture, which, though it provides a high return, eventually leads to increased salinity. There is also increasing danger to the bund due to heavy traffic of high-capacity barges which generate waves and lead to erosion of the bunds. If these bunds are not maintained regularly, there is a danger of losing these precious agricultural ecosystems.
7. Unavailability of water during the non-rainy season for irrigation of crops and other agricultural activities
8. The proliferation of invasive species: Invasive species of shrub-like Lantana and fishes like African Catfish and Tilapia is increasing. These have been established in many pockets, including wild habitats, and threaten native flora and fauna.
9. Quality of water: Turbid or poor-quality water can impact the aquatic food chain

### Schemes, Policies, and Initiatives

Agriculture and allied sector are a priority for the government of Goa. To overcome the challenges and other issues being faced government has taken several steps in the last decade and assisted in strengthening the sector.

One of the government's main initiatives has been the development of Vision 2025 for agriculture and allied sectors. This plan envisages doubling farmer's income by 2022 and a substantial increase in the GDP from the agriculture and allied sector.

Some of the other schemes, policies and initiatives are:

- To reverse this order of deterioration of natural resources and support livelihood activities for the inhabitants' watershed management has been taken up as the functional and planning tool for the conservation of natural resources and sustainable development by the Government of India through its Common Guidelines for Watershed Development Projects 2008. The State of Goa, through its State Level Nodal Agency for the same, will be formulating State-Level Perspective Plan (SLPP) for Integrated Watershed Management Project (IWMP) in Goa for 15 years period (i.e. 2010-25).
- **Greening the Young Mind:** To sustain agriculture in the long term, youth need to be brought into farming. To expose school students to vegetable cultivation, a comprehensive program of training followed by actual cultivation of vegetables was taken up in 90 schools through the Agriculture Technology Management Agency (ATMA) in both districts
- **Development of e-Krishi Card:** Bringing technology to agriculture and making it simple to access all agricultural schemes.
- **Shetkari Aadhar Nidhi:** The scheme is implemented for grant of compensation to farmers who suffer a loss of crop/produce due to natural causes like unseasonal rains, floods, droughts, landslides, siltation, natural fire/lightning, an epidemic of pests and diseases, damage due to wild animals, etc.
- **Mechanization in Agriculture:** The scheme aims to promote agricultural mechanization to overcome the shortage and high cost of manual labour.
- **Assistance in agricultural inputs like subsidy on setting up of irrigation facility, organic inputs, etc.**
- **"Rashtriya Krishi Vikas Yojana" (RKVY),** a Government of India flagship program, is being implemented in the state.
- Extension of financial help for growing most horticultural crops like cashew, mango, chikoo, pineapple, banana, coconut, and spices.
- **Control of soil erosion:** Soil erosion can be improved by taking up afforestation, plantation crops, etc. Agronomical measures like the introduction of vegetative hedges and taming of gullies have to be taken immediately in some of the areas.
- **Kamdhenu Scheme (Sudharit):** The scheme proposes to increase milk production in the state. Under this, it is ensured that the cattle market was brought into the State as "Cattle Melas" wherein farmers could purchase the animals of their choice within the State itself, thus saving time and money.
- **Crop Production and Input Management Scheme:** Assistance for high-yielding certified seeds, assistance for fencing crops, demonstration on cereals (Hybrid Rice), hybrid paddy, mini-kits, contingency plan development in sugarcane, plant protection mechanization in agriculture are some of the measures under this head.

- **Development of Agricultural Extension:** Agriculture and home science demonstration camps/courses are being undertaken. Conducting three days of institutional courses, exhibitions, and shows, best farmer support for higher education in agriculture, conducting krishi melas publicity and publication of technical literature, and encouragement of Kisan Call Centre
- **Development of Manure Scheme:** Soil sample collection and analysis assistance for soil health improvement
- **Organic farming:** Organic manure unit assistance for the construction of biogas units and export-oriented certification of organic farming
- **Soil and Water Conservations Scheme:** The scheme has the following objectives: Repairing and maintaining notified ponds, protecting khazan agricultural lands and providing assistance for embankment protection, and revitalizing the waterbodies.
- **Support price and productivity linked incentive scheme:** Support price for paddy, support price to sugarcane, support price to areca nut productivity linked incentives for oil palm crops
- **Western Ghat Development Programme:** The scheme aims to restore the ecosystem and uplift the living of the people of Western Ghat.
- Green fodder scheme to ensure fodder to the cattle.
- Legislation such as the Marine Fisheries Regulation Act and the monsoon ban must be strictly observed and enforced.
- Increasing the **gobar gas plants** – Introducing the same in gaushalas and stray cattle ponds
- Optimizing the use of waste from indigenous and non-indigenous cattle for therapeutic and non-therapeutic uses.
- Minimizing a closed paddock system and shifting to an open one to reduce methane emissions.
- The Self Help Groups' involved in vermicompost production should be registered by the Directorate of Agriculture so that their produce can be sourced under Paramparagat Krishi Vikas Yojana (PKVY) and organic farming.
- 500 organic farming clusters involving more than 10000 farmers have been formed under PKVY.

### Impact of Climate Change on Agriculture in Goa

While the measures as mentioned above assist agriculture, climate change continues to pose new threats and disrupt the plan:

- A threat to production levels and quality due to the rise in ambient temperature and changing season patterns:  
Several stakeholders have made evidence and observations suggesting a shift in the time frame and duration of ripening of popular local fruits and vegetables. A change in produce quality, specifically its taste and smell, have been associated with it. Farmer preparedness for harvesting, labour availability are other factors that would require adjustment to the change.
- Reduction in availability of water for irrigation :  
As predicted, an increase in high-intensity rainfall scenarios and a decrease in slow and long spells of rainfall will impact soil runoff and water availability.
- Degrading soil health :  
IPCC's special report suggests that soil erosion from agricultural fields is estimated to be currently 10 to 20 times (no-tillage) to more than 100 times (conventional tillage) higher than the soil formation rate (medium confidence). Climate change exacerbates land degradation, particularly in low-lying coastal areas, river deltas<sup>21</sup>. Thus, maintaining soil health and increasing focus on this would be essential for Goa's agriculture policy.
- Erratic flood & drought conditions cause the loss of livestock due to flooding.
- The emergence of new pests and pathogens.

<sup>21</sup> [https://www.ipcc.ch/site/assets/uploads/2019/08/4.-SPM\\_Approved\\_Microsite\\_FINAL.pdf](https://www.ipcc.ch/site/assets/uploads/2019/08/4.-SPM_Approved_Microsite_FINAL.pdf)

- Heavier precipitation events and floods accompanied by sea level rise are detrimental to the khazan land, which is crucial for rice cultivation in the state.
- Erratic rains and long dry periods impact the quality and quantity of produce.
- Stress to livestock due to heat

### Synergy with National Mission and SDG

Sustaining agricultural productivity depends on the quality and availability of natural resources like soil and water. Agricultural growth can be sustained by promoting the conservation and sustainable use of these scarce natural resources through appropriate location-specific measures. National Mission on Sustainable Agriculture (NMSA) derives its mandate from the Sustainable Agriculture Mission, one of the eight Missions outlined under the National Action Plan on Climate Change (NAPCC). NMSA caters to key dimensions of 'Water use efficiency', 'Nutrient management', and 'Livelihood diversification' through adopting sustainable development pathways by progressively shifting to environmentally friendly technologies, adopting energy-efficient equipment, conservation of natural resources, integrated farming, etc. Besides, NMSA aims to promote location-specific improved agronomic practices through **soil health management, enhanced water use efficiency, judicious use of chemicals, crop diversification, progressive adoption of crop-livestock farming systems, and integrated approaches like crop-sericulture, agro-forestry, fish farming, etc.**

Several SDG's are partially linked to agriculture. However, SDG 2 i.e. End hunger, achieve food security and improved nutrition, and promote **sustainable agriculture**, is most relevant to this SAPCC. The SDG 2 targets that the SAPCC interventions are linked to are:

- Target 2.3 - By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists, and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment
- Target 2.4 - By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, help maintain ecosystems, strengthen capacity for adaptation to climate change, extreme weather, drought, flooding, and other disasters, and progressively improve land and soil quality.
- Target 2.5 - By 2020, maintain the genetic diversity of seeds, cultivated plants, and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional, and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed.
- Target 2.a - Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research, and extension services, technology development, and plant and livestock gene banks to enhance agricultural productive capacity in developing countries, in particular, least developed countries
- Target 2.c - Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, to help limit extreme food price volatility

## SDG 14: Life Below Water

- By 2025, prevent and significantly reduce marine pollution of all kinds, particularly from land-based activities, including marine debris and nutrient pollution.
- By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience and taking action for their restoration to achieve healthy and productive oceans.
- Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels.
- By 2020, effectively regulate harvesting and end overfishing, illegal, unreported, unregulated fishing, and destructive fishing practices and implement science-based management plans to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics.
- By 2020, conserve at least 10 % of coastal and marine areas, consistent with national and international law and based on the best available scientific information.
- By 2020, prohibit certain forms of fisheries subsidies that contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported, and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation.
- By 2030, increase the economic benefits to small island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture, and tourism.

## Adaptation Strategies for Agriculture and Allied Sector

### 1. Maximizing the agricultural land:

- Human-animal conflict: The availability of drinking water and green fodder/wild fruits to the animals in the forest is to be ensured by the Forest Department. Management of Accasia & Eucalyptus in a phased manner and planting local fruit-bearing plants.
- Areas that are fallow and not currently used should be brought under agriculture by encouraging landholders. Planting flowering trees along roadside would facilitate promoting Apiculture (Soap nut, Taman, etc). IFS&IPM:- Effective use of IFS & IPM will reduce chemical fertilizers and pesticides, resulting in cleaner food availability and reduced pollution.
- Identification of areas under non-cultivation in the State and encouraging landholders to cultivate them by providing some incentives.

### 2. Climate Research in Agriculture

- Development of regional knowledge bases on climate change impacts and adaptation strategies for a farming systems approach, taking into account information such as crop yield responses to climate, crop quality response, water availability for rain-fed and irrigated crops, and livelihood strategies
- Identify and develop indicators for climate risks, including the sector's thresholds and acceptable coping ranges and specific crops, which are critical to improving climate risk management.
- Increase overall investments in agricultural research and development.
- Technological innovation and research in agriculture will be promoted.

The ICAR Goa would be the primary research organization that will work in conjunction with and State agriculture department.

### 3. Increasing farmer income:

The State has already taken various measures to promote agriculture in the State of Goa. Organic farming and market connection are important factors. In addition, it support's existing farmers associations for the same.

### 4. Encourage education in agriculture and educate farmers

- Improve access by farmers, herders, fishers, and foresters to timely weather forecasts and response options, enhancing decision-making and responses to a changing climate.
- Provide training and education programs and agricultural advisory services to help implement agricultural practices and technologies more resilient to climate change.
- Advisory to farmers through the use of modern technology like social media, TV etc to issue an advisory to farmers and the general public on the effects of climate change and ways to mitigate them.

### 5. Fisheries management

- Adopt changes in management philosophy, such as integrating fisheries and aquaculture management into coastal zone management, to increase the coping ability of small communities to sea-level rise.
- Breed fish species that are tolerant to high water temperatures and improve the management of fish stocks, which can be effective measures to reduce climate change impacts on fisheries.

### 6. Livestock management:

Breed livestock that is tolerant to adverse climatic conditions and improves the management of stocking rates and pasture rotation to enhance the climate resilience of livestock production. Modify and construct livestock shelters to reduce climatic stress, especially heat stress on livestock, and explore the natural material choice.

### 7. Managing the cropping pattern:

- Implement farm management practices, such as crop diversification, changing planting dates, and adjusting the application of nutrients, fertilizers, insecticides, and pesticides, to effectively adapt to alterations in the growing season and irrigation opportunities.
- Develop adequate systems for weather data collection, analysis, and prediction.

### 8. Khazan Lands:

- Protecting khazan lands, 'Puran sheti' a unique among other farming practices in Goa, from inundation and other climatic impacts, requires the involvement of local farmers association and a structured mechanism for monitoring the same.
- Investment in coastal flood control structures could combine hard infrastructures like gates, dykes and natural infrastructure like mangroves.

### 9. Gene Bank preservation:

Goa has several unique varieties of rice and other crops. Documentation of the traditional practices and protection of rice variety and other crops through gene banks is essential

### 10. Farm Insurance:

Identify and encourage farm insurance measures covering climate vulnerabilities like crop loss due to temperature variability or climate-induced pest invasion.

Table 26: Adaptation Strategies for Agriculture and Allied Sector

Sr. No.	Intervention	Status	Responsible agency	Barriers & Gaps in implementation	Intervention Type	Time frame	Budget	Source of Finance	NDC Link (Connect to INDC Items)
1	Emergency evacuation plan for livestock during flooding	Proposed & nodal officers appointed	Disaster management cell and AHVS	Data & information on livestock in Goa	Others	6 months	1 crore	State Govt.	To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change
2	Heat stress relieving system in cow sheds	Proposed	Department of Animal Husbandry and Veterinary Services	Data, information and need for focussed program	Others	2 years	1 crore	State Govt.	
3	Demarcated area for such livestock relief	Proposed	Department of Animal Husbandry and Veterinary Services	Land availability and inclusion in planning	Others	2 years	1 crore	State Govt.	
4	Farm insurance and livestock insurance for climate stressors like temperature need to be explored and established	Proposed	Department of Animal Husbandry and Veterinary Services, Agriculture Department	Terms and conditions to define the stressors and availability of private sector insurance products	Scheme	1 year	1 crore	Insurance	
5	Gene Preservation Bank	Proposed	Agriculture Department	Cost intensive	Activity	2 years	1 crore	Own budget and multilateral agency	

6	Investment in coastal flood control structures which could be combination of hard infrastructure like gates, dykes and natural infrastructure like mangroves	Proposed	Interdepartmental including WRD	Need for convergence and consultative planning	Activity	2 years	5 crores	Own budget and Multilateral agency
7	Develop adequate systems for weather data collection, analysis and prediction.	To be modified	With ICAR, WRD and other agencies like IMD	Lack of convergence	Activity	2 years	1 Crore	State Govt, Central funds and NAFCC
8	Formation of strategy breed livestock that are tolerant to adverse climatic conditions	To be modified	Animal Husbandry	Capacity building	Scheme or program and capturing baseline data from People's Biodiversity Registers from GSBB	1 year	0.5 Crores	Own budget from State Govt. and Central Government funds
9	Integrating fisheries and aquaculture management into coastal zone management, to increase the coping ability of small communities to sea-level rise.	To be modified	Fisheries Department	Convergence and capacity building	Activity	1 years	2 Crores	Own budget and Central Government sources

10	Encourage breeding fish species that are tolerant to high water temperatures and improve the management of fish stocks	Proposed	Fisheries department along with beneficiaries of schemes and other agencies	Lack of trained manpower, resources and infrastructure	Activity	2 years	5 crores	Existing Department budget and Central Govt. schemes
11	Enhance access of all stakeholders of agriculture and allied sector to weather information in a format that is usable for their activity	Proposed	Climate Secretariat	Need for online platform and communication system across the State	Activity	2 years	2 Crores	Own budget, Central Government sources and other possible funds from developed nations
12	Provide training and education programs as well as agricultural advisory services to help implement agricultural practices and technologies that are more resilient to climate change.	To be modified	Agriculture Department	Capacity building and manpower	Activity	2 years	1 Crore	Existing Department Budget & other sources
13	Provide enablers for credible and certified organic farming	Under progress	Agriculture Department	Engagement with appropriate agencies and convergence	Activity	1 Year	1 Crore	Existing Department budget

14	Enhancing market connect for farmers	Under progress	Agriculture Department	Exploring more avenues, collaboration with projects in Goa	Activity	2 years	1 Crore	Existing Department budget
15	Climate Research in Agriculture	Proposed	ICAR and Agriculture Department	Convergence	Activity	1 year	0.5 Crore	Own budget and Central Government contribution
16	Maximizing the agricultural land by utilizing fallow land	Proposed	Agriculture Department	Convergence with DSLR and TCP	Activity	2 years	0.5 Crore	Existing Department budget

**Note - Approximate financial implications of the agricultural sector expected to be met from the climate change plan for ten years are approximately ₹ 50 crores. In addition, with allied sectors like fisheries, AVHS, etc above total is 24.5 Crores for ten years in allied sectors like AHVS, Climate secretariat etc.**

## 7.5. Forest

Goa presents an astonishing diversity of endemic species, habitats, and ecosystems. The impact of intensified economic activities on biodiversity in this region is visibly noticeable.

On the other hand, Goa, the smallest state, with just 3702 sq. km. geographical area, has a good forest cover with 1,225.12 sq. km of recorded Government Forest, which is over 33% of the total geographical area of the State. Of this, 62 % is designated as 7 Protected Areas, 6 biodiversity-rich and ecologically sensitive Western Ghats, and one in the Mangrove forest at Chorao island. The Wildlife Sanctuaries and National Parks cover an area of 75,496 ha, constituting 20.39 % of the geographical area of the State, the highest in the country. As per the “India State of Forest Report 2017” published biennially by Forest Survey of India, Dehradun, the Forest Cover of Goa is 60.21 %, and the total forest and tree cover of Goa is about 68.94 %, which includes forests on private lands, plantations such as cashew, and other tree crops. Its entire hills have been declared as protected areas.

Forest cover	2229 sq.km.
Total recorded forest area	1225 sq.km.
Tree cover	323 sq.km.
Total forest and tree cover	2552 sq.km.
<b>National Park</b>	
1. Bhagwan Mahaveer National Park	107 sq.km.
<b>Wildlife Sanctuaries</b>	
1. Mhadei Wildlife Sanctuary, North Goa	208.48 sq.km.
2. Bhagwan Mahaveer Wild Life Sanctuary, North Goa.	133 sq.km.
3. Netravali Wildlife Sanctuary, South Goa.	211.05 sq.km.
4. Cotigao Wildlife Sanctuary, South Goa.	85.65 sq.km.
5. Bondla Wildlife Sanctuary and Zoo, NorthGoa	8.00 sq.km.
6. Dr. Salim Ali Bird Sanctuary, North Goa	1.78 sq.km.

**There is no further potential to increase the forest cover of the state; however, there is a possibility to increase the green cover and the quality of the forest by increasing the carbon content.**

Because of this, about 44 sq. km. forest areas in private lands have been protected as private forests and remaining areas are being surveyed with natural tree cover. These areas support and nurture various ecosystems of life forms – both floral and faunal, particularly in Western Ghat areas of the State located in Sanguem, Canacona, Sattari, and Dharbandora talukas.

Marine and coastal ecosystems, including mangroves, seagrass beds, coral reefs, and associated biota. This system is threatened due to pollution and over-exploitation. Climate change will only exasperate the impact.

### Schemes, Initiatives, and Policies

Forest Department is entrusted with the overall conservation, protection, management, and development of forests and wildlife. Through various State and Central funded projects, Goa's Forest Department has been protecting and enriching its existing forest areas in a highly scientific manner.

Documentation of biodiversity has been and is being carried out under various activities like PBR, documentation of flora and fauna of each sacred grove, and labeling of important plant species.

Several social forestry activities are being taken up. In coastal areas, the plantation of Casuarinas and the protection & maintenance of social forestry plantation is planned.

**The state's first biodiversity heritage site** The Department, in collaboration with the IUCN, conducted a workshop to develop a community response network for marine conservation in Goa to train forest staff, lifeguard/ coast guard to monitor report and document the marine mammals stranding incidences and carcasses in a timely, efficient manner.

**Community Response Network:** The Department in collaboration with the IUCN conducted a workshop to develop Community Response Network for Marine Conservation in Goa to train Forest staff, lifeguard/ coast guard to monitor report and document the marine mammals stranding incidences and carcasses in a timely, efficient manner.

To mitigate human-animal conflict, this Department maintains a 24 x 7 rescue squad centre at Campal, Margao, and Cotigao to rescue wild animals under stress.

Satpal Arboretum consists of 82 plots of different species of trees, shrubs, vines, etc. grown for study and research.

**Goa Forest Development Corporation is also carrying out** rejuvenation of cashew plantations/ estates and conducts the auction for the sale of rights for collections of cashews, nuts, and apples, maintenance and development of rubber plantations, extraction of the latex, processing it to rubber sheets and selling the same.

**Eco-tourism facilities:** Forest Department has established eco-tourism complexes at Bondla, Mollem, and Cotigao for visitors and to improve the livelihood of local people. 3,33,657 tourists have visited the National Park and Wildlife Sanctuaries this year. **Rs. 37.23 lakhs** of revenue have been generated through the sale of forest produce, and **Rs. 260.29 lakhs** of revenue have been generated through eco-tourism and allied activities. Plantation and other conservation-related activities have also generated direct employment for the local youths.

## Impact of climate change

**Forest Fire:** Climate change has resulted and will further result in a change in temperature and humidity in Goa. Temperature rise is predicted to be up to 3 to 4 degrees. Ecological systems are vulnerable to these changes. Forest fire is a phenomenon that can get intensified due to climate change. However, enough documented proof is unavailable on whether Goa's forest fire incidents have increased due to climate change or human activities. The trend depicts Goa's forests' vulnerability to fires, which can get exasperated due to climate change by 2040 (Table 27).

Table 27: Forest fire incidents in Goa from 2014-15 to 2018-19

Year	No. of incidents of forest fires	Area involved in ha.
2014-15	2	11.07
2015-16	24	44
2016-17	92	153.42
2017-18	47	130.80
2018-19	38	113.29

- **Invasion of alien species** and enhanced spread and colonization can impact the native species.
- Changes in the flowering time and fruit ripening time due to temperature changes. This can lead to alternation incomplete cycle of the plant.
- The shift in forest ecosystem.
- Changing rainfall patterns could lead to water availability constraints in certain patches.
- Soil erosion can have drastic impacts.
- **Change in Forest Types and Structure:** Climate change will cause shifts/ changes in the flowering and fruit ripening time due to temperature changes. This can lead to alternation incomplete cycle of the plant. The functions of forest ecosystems might be adversely affected due to climate change.
- **Extreme weather events, including changes in rainfall patterns,** could lead to flooding and scarcity of water and affect overall water availability in various parts of the state. Soil erosion in heavy rains and landslides can have an adverse impact on agriculture.

### Synergy with National Mission and SDG

The Green India Mission aims to protect, restore and enhance India depleting forest resources through increasing forest/tree cover, improving/enhancing eco-system services like carbon sequestration and storage (in forests and other ecosystems), hydrological services, and biodiversity, along with provisioning services like fuel, fodder, and timber and non-timber forest produces (NTFPs); and increase forest-based livelihood income of about 3 million households.

It is an endeavour of the state to increase the green cover wherever possible to achieve the objectives of implementing the Green India Mission. SDG 15, i.e., Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

- By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, particularly forests, wetlands, mountains, and drylands, in line with obligations under international agreements.
- By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.
- By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought, and floods, and strive to achieve a land degradation-neutral world.
- By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, to enhance their capacity to provide benefits essential for sustainable development.
- Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species.
- As internationally agreed, promote fair and equitable sharing of the benefits of using genetic resources and promote appropriate access to such resources.
- Take urgent action to end poaching and trafficking of protected species of flora and fauna and address both the demand and supply of illegal wildlife products.
- By 2020, introduce measures to prevent the introduction, significantly reduce the impact of invasive alien species on land and water ecosystems, and control or eradicate the priority species.
- By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies, and accounts.
- Mobilise and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems.
- Mobilise significant resources from all sources and at all levels to finance sustainable forest management and provide adequate incentives to developing countries to advance such management, including conservation and reforestation.
- Enhance global support for efforts to combat poaching and trafficking of protected species, including by increasing the capacity of local communities to pursue sustainable livelihood opportunities.

### Strategies for climate impact management

Strategies to protect and enhance forest availability generally have cross-cutting impacts, i.e. providing mitigation and adaptation. The strategies for Goa are:

- a. Enhance the forest quality
- b. Restore and increase the coastal defence mechanism
- c. Prepare a strategy to prevent and control forest fires
- d. Afforestation and plantation outside the forest
- e. Support private forest owners in the sustainable management of their forests and derive economic benefit
- f. Water and soil conservation
- g. Capacity building of field staff
- h. Promote eco-tourism

### Action plan to address forest related climate change:

#### Action point 1: Enhancing the quality of existing forests

1. Conversion of the open forest into dense forests: Around 357 sq km of recorded forest area falls under open forest which will be converted into dense through Assisted Natural Regeneration (ANR).
2. Out of 1225 sq km recorded forest area, 1173 sq.km. forest cover. Out of 52 ha remaining, a suitable area will be explored for afforestation.
3. Conservation and increase the mangrove cover wherever possible.
4. Scientific removal of invasive species and conversion into natural forest.
5. Prevention and control of forest fires.

#### Action point 2: Afforestation and plantations outside forests

1. Linear plantations along the National and State Highways, Rural roads, canal & river embankments, and railway lines.
2. Greening urban spaces through appropriate afforestation programs like Nagar Van (City Forest), woodlands, coastal greenbelts, offices and residential complexes, Biodiversity Parks, etc.
3. High-density plantations using local forestry species in degraded lands, including abandoned mining areas.
4. Encouraging people to undertake mass plantation programme through Van Mahotsav and other focused campaigns.
5. Increasing nursery stock for doubling the free distribution of saplings.
6. The department is reaching out to other Government departments and institutions offering support in the afforestation/greening of their lands, office, and residential complexes.
7. Training of local youths as nature guides and community foresters for promoting forest-based livelihoods and improving stakeholders base for conservation.
8. Restoration/greening of ongoing infrastructure projects on their completion.

#### Action point 3: Support private forest owners in sustainable management of their forest and deriving economic benefits

1. A significant area under private forest in the State requires sustainable management. The department will support private forest owners to conserve and improve their forests through scientific interventions (Working Schemes) for sustainable harvesting of forest products etc., and economic viable programmes such as ecotourism.
2. Exploring modern wood-based industries for creating demand for wood from tree growers, including private forest owners.

#### Action point 4: Promote agroforestry and business models

1. Promotion of agroforestry in farmlands and agricultural fallow lands. A suitable policy will be made in consultation with Agriculture Department and land owners to develop a suitable agroforestry model on these lands.

#### Action point 5: Conservation of mangroves and coastal belts

1. Strengthen marine and coastal ecosystems, including mangroves, seagrass beds, coral reefs, and associated biota. This system is threatened due to pollution and over-exploitation. Climate change will only exasperate the impact.
2. Interlinkages of coastal people's livelihoods with conservation through sustainable ecotourism and aqua-culture etc.

#### Action point 6: Addressing other critical issues

1. Improving effectiveness and efficiency of various processes in the implementation of the forestry programme.
2. Building department capacity at field levels for efficient and timely utilization of large afforestation funds through State Plan, CAMPA, and financial support from CSS etc.
3. Hiring of part time staff and human resource for increased afforestation targets.
4. Sensitization of Finance and Account Departments for timely release of funds and accounting process.
5. Keeping the procedures simple with in-built flexibility and a decentralized approach.
6. Economic viability of afforestation and tree plantation by farmers and land owners, efficient utilization of wood through modern hi-tech wood-based industries for creating demands and fair priced marketing interventions. Incentivise and not penalize the tree grower and forest owners.
7. Policy support for extensive use of wood in the country which will help more tree plantation in the private land including farmers.

Table 28: Adaptation Strategies for Forest

Sr. No	Intervention	Status	Responsible Agency	Barriers & Gap in Implementation	Intervention type	Budget (in Lakh Rupees) (Approx.)	Source of Finance	Timeframe	NCD Link (Connect to NDC Items)
1.	Improvement of quality of forests and their resilience to change climate	Goa has about 30% of area under open forests and its density is required to be improved.	Goa Forest Department	Fund allotment and availability of forest land	Afforestation/ Enrichment plantation/ Aided natural regeneration of open forests and medium dense forest. action: An area of 50 ha/year will be taken up for ANR/ plantation for conversion of open forest into dense forest	1000.00	State Plan, CAMPA* and CSS** funds	10 years	To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation. To create an additional carbon sink of 2.5 to 3 billion
2.	Restore and strengthen coastal defence mechanism by natural means viz restoration and improvement of mangrove vegetation and coastal belt plantation.	Coastal belts are vulnerable due to anthropogenic and factors of climate change		Insufficient fund allotment and land availability for mangrove plantation	1. Restoration of damaged and degraded mangrove areas is being done under this intervention. 2. Shelter belt/ Coastal belt plantation 3. Nurseries for mangroves and suitable plants 4. Provide suitable incentives/ livelihood support to people in conservation and management of mangroves in the plantation, protection activities, ecotourism in backwaters/ creeks and aquaculture, pisciculture etc.	500.00	State Plan and Mangrove Management Action Plan	10 years	To create an additional carbon sink of 2.5 to 3 billion

3.	Prepare strategy to prevent and control forest fires	Forest Fire is common in summer season from March to June primarily due to anthropogenic factors.		Timely Fund allotment	Multipronged strategy involving both prevention and timely effective control of forest fires: 1. Preparation of State Action Plan on forest fire 2. Creation of effective and efficient task force of forest staff and fire watchers by regular training and capacity building, supported by adequate communication, fire-fighting equipment. 3. Design and implement appropriate awareness campaigns for pre fire season sensitization of local communities 4. Periodic creation of new firelines clearing of fire lines, removal of dry bamboo, other inflammable materials from forest floors, controlled burning. 5. Strengthening communication network, infrastructure & control room	1000.00	State Plan, CAMPA and CSS for Fire Prevention and Management	10 years	tonnes of CO2 equivalent through additional forest and tree cover by 2030. To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable
4.	Afforestation and plantation outside the forest for increase in ToF			Timely availability of funds	Free distribution of quality seedlings and tree plantation by involving different institutions Roadside plantation	1500.00	State Plan, CAMPA and CSS	10 years	

5.	Support private forest owner in sustainable management of their forests and derive economic benefit	People fear of losing the right to use their land in view of identification of their tree bearing lands as private forests, which creates negative attitude towards planting trees	Regulating provisions under the Forest Conservation Act, 1980	Create supportive policy and legal framework by providing suitable incentives to tree growers under agroforestry programmes and develop market linkages.	25.00	State Plan	5 years
6	Soil and moisture conservation	Efforts are being made by Forest Department for soil and moisture conservation if forests and protected areas, however these need to be expanded substantially.	Lack of sufficient funds	Adequate soil and water conservation measures to recharge the natural aquifers and retain water for dry period to improve the habitat for wildlife and control man animal conflict. Soil and water conservation measures like pond, check dams, bunds, gabion check dams, waterholes etc. in the watershed	2000.00	State Plan & CSS	10 years
7	Strengthening of infrastructure & capacity building of field staff	Insufficient infrastructure in forest areas in terms of mobility, communication, and accommodation of staff.	Inadequate fund allotment	1. Construction and repair of new and existing quarters, forest road / track points, protection camps enhanced mobility communication. 2. Organizing training, seminars, workshops for frontline staff on forest and wildlife conservation etc. 3. Create effective linkages /network with adjoining States of Maharashtra and Karnataka.	5000.00	State Plan, CAMPA and CSS schemes	10 years

8	Promote Eco-tourism in select forest areas by employing local population	Local people in forest fringe villages have not been adequately involved in protection/conservation due to lack of incentives.	Lack of clear policy framework, Fund constraints, no availability of sufficient local entrepreneurs	Increasing effective people's participation in conservation through multipronged strategy: 1. Preparation of Eco-tourism policy with Forest Department to play facilitative role. 2. Creation of essential infrastructure like Nature Education Centres, Nature Camps, etc. 3. Improving forest roads / trek routes, watch towers & protection camps & enhanced mobility 4. Encouraging local communities to take up ecotourism activities in neighbouring protected areas	1500.00	State Plan, and other CSS schemes	5 years
	ii. Skill development of local population to assist as nature guide and related livelihood activities		Lack of sufficient funds	1. Organizing trainings, seminars, workshops for local people on forest and wildlife conservation 2. Help local communities in obtaining suitable benefits through sustainable use of minor forest produce biodiversity and ecotourism etc. 3. Promotion of ecotourism, organization of nature awareness camps, bird walk, bird festival, publication of brochure, pamphlets, poster, books and films etc. on nature conservation for generating employment to local people	1200.00	State Plan, and Central Government contribution and CSS.	05 years

9	Prepare strategy to control ingress of invasive species and prepare plan for future protection of forest from invasive species	Conversion of areas under invasive and exotic species is urgently required	Goa Forest Department	Lack of funds	Eradication of Eupatorium, replacement of Acacia auriculiformis, <i>Eucalyptus</i> spp etc by suitable local species	5000.00	State Plan, CAMPA and other CSS schemes	10 years
10	Research on the impact of changing climate pattern on the forest and prepare plan for forest rejuvenation	There is insufficient knowledge and research on impact of climate change on forest types and wildlife	Forest Research & Training Institute, Goa Forest Department	Lack of funds	1. Setting up of 08 field research stations for research on climate change and forestry issues. 2. Setting up of State Forest Research Institute Goa for conducting collaborative research, training etc. on various aspects of forest, biodiversity and climate change related issues.	2000.00	State Plan, and Multilateral agency	5 years
11	Urban Green Enhancement / improvement of quality of life in cities-	Need to increase green cover in and around urban areas & educating people about the value of forest, biodiversity to general public	Goa Forest Department	Lack of funds	Creation of City Forest (Nagar Van) in various urban centres, Gram Upvan in villages, school nursery, biodiversity park, avenue plantation etc. public engagement on greening Creation of Nagar Van, Gram Van by engaging local public	5000.00	State Plan & CAMPA	5 years

12	Protection and improvement of wildlife habitat	Need to enhance measures for conservation of wildlife including marine wildlife	Goa Forest Department	Lack of funds	Measures required to improve wildlife habitat by creation of grasslands, planting suitable fruit bearing trees and creation of waterbodies and adequate protection	5000.00	State Plan, CAMPA and CSS schemes	10 years
13	Promotion of Agro-forestry, increase in Tree Outside Forests (TOF) Appropriate Scheme - Policy implementation Government facilitation	Emphasis is to help local people earn by planting fast growing agro forestry species	Goa Forest Department	Lack of funds	Multipronged strategy: i. Exemption of tree species grown by farmers and other landowners on private land ii. Helping farmers and landowners in obtaining good quality planting materials for agroforestry, building their partnership with wood based industries and supporting through various CSS and state plan schemes iii. Facilitation in marketing of timber	1000.00	State Plan, CAMPA and CSS schemes	5 years
<b>Total</b>						<b>31725.00</b>	<b>31725</b>	

Note:  
\* CSS- Centrally Sponsored Schemes.  
\*\* CAMPA- Compensatory Afforestation Fund Planning and Management Authority.  
\*\*\*Budget is based on current schedule of rates

**Although the amount indicated above is Rs. 31725 Crores, the forest sector's approximate financial allocation and expenditure expected to be met from climate change plan for ten years are at least ₹ 100 crores from the State and at least 200 crores from other funds.**

### 7.6. Human Health

Human health is of paramount importance in the overall wellbeing and productivity of a state. Goa has 13 government hospitals with 3000 beds and 29 community/primary health centres and 30 dispensaries. It has about 2756 beds in private hospital<sup>22</sup>.

Developing countries face substantial vulnerabilities to climate change's current and projected health risks. The health-related risks depend not only on climatic factors but also the population's exposure to those risks.

The health statistics in the state indicate a rise in several vector-borne diseases in the last 5 years.

Table 29: Vector Borne Diseases in Goa from 2014 to 2019

Year	Malaria Indigenous cases		Malaria Imported cases		J.E	Dengue	Chikungunya	Filariasis
	PF	Total						
2014	42	824	4624		Nil	168	49	Nil
2015	75	651	3802		1	293	32	Nil
2016	130	742	4060		1	150	49	Nil
2017	75	653	3427		Nil	235	48	Nil
2018	50	377	3485		3	335	77	Nil
2019 till Oct.	46	231	1731		1	467	245	Nil

Table 30: Cases of other diseases

Year	Acute Diarrheal Disease	Acute Respiratory Infection/ Influenza Like Illness	Pneumonia
2009	14862	54779	690
2010	11923	54052	763
2011	NA	NA	NA
2012	NA	NA	NA
2013	NA	NA	NA

<sup>22</sup> Goa at a glance 2017-18

2014	NA	NA	NA
2015	13068	75752	890
2016	17072	74458	1156
2017	16932	73465	812
2018	27482	120878	2745
2019 (till 27 Nov 19)	24814	121035	2176

Kyasanur Forest Disease (KFD) is a tick-borne disease confined to Karnataka State for more than 50 years. In 2015, an outbreak of fever along with vomiting & diarrhoea was reported from Pali Village of Sattari Taluka. On investigation of this outbreak, it was confirmed to be KFD. This was the first incidence of KFD in Goa. Since then, KFD has been reported every year from December to May. It cannot be confirmed whether the disease outbreak in Goa is due to climate change; however, it is predicted that such new diseases or an increase in cases of certain diseases may increase due to climate change.



Over and above the existing medical infrastructure, Goa launched Deen Dayal Swasthya Yojana in 2016. It is a universal insurance scheme providing insurance cover to the entire population. Also, under the Goa Mediclaim scheme, financial assistance is offered to every permanent resident of the State availing super specialty treatment that is not available in the Government Hospitals in the State of Goa. The Goa State Illness Assistance Society scheme provides financial assistance to **INR 1.50 lakhs** per patient below the poverty line for availing super specialty treatment not available in the State Government Hospitals<sup>23</sup>.

<sup>23</sup> Goa economic survey 2017-18

### Impact of climate change

The health of human populations is sensitive to shifts in weather patterns and other aspects of climate change. Increased variability in the weather pattern will further impact the ability of the human body to adjust. Based on the climate change projections, it is expected that:

1. The temperature in Goa may rise by 4-5 °C, and beyond a decade state may experience heatwave conditions, which are currently not experienced in the state. This can cause health effects like dehydration, heatstroke, etc. which are known to occur in other states during heatwave conditions.
2. Mortality and morbidity rates due to mudslides, flooding, and cyclonic events are also likely to rise.
3. Changing weather patterns is likely to increase the window for the occurrence of vector-borne disease.
4. It is predicted that climate change can disrupt the health services-related infrastructure and its capacity to serve due to severe events and a rise in the number of illnesses.
5. New diseases can be introduced in the state.

### Alignment with National Mission and SDG

National action plan on health and climate change was launched in 2019 under the national health mission to address health issues related to climate change. Goa is already aligning itself to participate in the programme. In addition, Integrated Disease Surveillance Programme has been identified under Environment Health Cell for NPCCHH.

It is also aligned with SDG3 i.e., ensuring healthy lives and promoting well-being for all ages. Under this, the strategies are specifically focused towards target 3.3, i.e. By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases, and other communicable diseases.

Table 31 - Adaptation strategies for health

Sr. No.	Intervention	Status	Responsible agency	Barriers and Gap in implementation	Intervention Type	Funds ₹	Source of Finance	Timeframe	Monitoring Mechanism & Timeframe
1	Prepare an action plan to reduce the climate change related health impacts	Identification of such health impacts and preparation of plan is proposed	PHE Inhouse expertise	No barriers	Others	1 lakh	Own State budget	6 months	Internal monitoring within Dept.

2	Develop an IT enabled system to inform the public on possible and actual disease outbreak	Proposed	PHE	Support of external experts such as IT Dept. and media is required	Activity	25 lakh	Existing State Budget or Central Funds Sourcing / Provisioning Required	2 years	Internal monitoring within Dept. Six monthly reporting to climate change cell / secretariat
3	Study and map new and emerging diseases in the state in relation to climate change	Proposed	PHE	Support of external experts from GMC is required	Activity	10 lakh	State Budget	Continuous system but also research based intervention in 2 years for baseline map is proposed	Internal monitoring within Dept. Six monthly reporting to climate change cell / secretariat
4	Prepare a heat wave action plan	Proposed	PHE & Secretariat	Support of external experts from climate change domain is required	Others	5 lakh	State Budget	6 months	Internal monitoring within Dept. Six monthly reporting to climate change cell / secretariat
5	Develop a system to predict disease outbreak	Proposed	PHE	Support of external experts from GMC is required	Activity	2 lakh	State budget	6 months	Internal monitoring within Dept. & reporting to climate change cell / secretariat

6	Assess the adequacy and resilience of health infrastructure to climate change	Proposed	PHE	Support of external experts from GMC & PWD / GSIDC is required and also verification agency	Activity	10 lakh	State & Central NQAS (National Quality Assessment) budget	1 year	Internal monitoring within Dept. & reporting to climate change cell/secretariat
7	Strengthen the health infrastructure based on the assessment	Proposed	PHE	Support of external experts from GMC & PWD / GSIDC is required	Activity	6.47 crores	State & Central budget	10 years	Internal Monitoring within Dept. & reporting to climate change cell / secretariat.
8	Enhancing the knowledge skills of health workers with respect to climate change	Proposed and ongoing to have consultant for conducting training and capacity building even to local bodies	PHE	Within the department	Activity	1 crore	State Govt. budget	6 months	Internal monitoring within Dept. & reporting to climate change cell / secretariat.
9	Managing and dealing with pandemics – IEC and other aspects of management	Proposed and ongoing. Such funds are received during pandemics also	PHE with other departments	Cross sectoral headed by PHC	Activity	2 crores	State Govt. budget	During any pandemic	Internal monitoring and reporting to statutory bodies within Dept. & reporting to climate change cell / secretariat

10	Greater focus on climate resilient health infrastructure	Planned	Dept with other concerned departments	Cross sectoral headed by Dir. Health	Activity	To be provisioned after first SLSC for NAFCC and proposal to be included within 25 crores of NAFCC projects	State Govt and NAFCC	Process to be initiated within six months	Internal Monitoring within Dept. & reporting to climate change cell / secretariat.
11	The Nodal Officer in State Health Department should be consulted to address water borne diseases and other health parameters	Planned	Dept. with Climate Change Secretariat	Cross sectoral headed by Dir. Health and Nodal officer climate change	Policy decision	To be ensured during first SLSC within two months	State Govt	To be ensured within two months	Internal monitoring within Dept. & reporting to climate change cell / secretariat.

**Note: Approximate financial implications of the health sector expected to be met from the climate change plan for ten years are approximately ₹ 10 crores.**

## 7.7. Habitat

By 2050 more than two-third of the world population is predicted to live in cities. As per the 2011 census, about 62 % of Goa's population lives in urban areas comprising 14 municipalities and 56 census towns. The annual tourist population of Goa is 3 to 4 times the state population, consistently putting pressure on the state's human habitat and natural resources. The percentage of the urban population has been increasing in the state. Goa has an average population density of 394 persons per sq. km., which is higher than the national average of 382 persons/sq. km<sup>24</sup>.

For effective planning of limited land resources and increasing pressure on the resource - "Regional plan for Goa 2021" was developed by the town and country planning board. The RPG 2021 report, states that by 2021, the population projection for Goa is estimated at 18.07 lakh, with nearly 13.11 lakh living in urban areas spread over 72 census towns and 14 cities. Of this population, it is estimated that 12.36 lakh will be staying in four coastal Talukas of Bardez, Tiswadi, Mormugao, and Salcete, with the urban areas in these talukas accounting for 80.51 % of the population. These are the most urban talukas of Goa, and economic activities, including tourism-related development, are concentrated in these talukas.

To be able to effectively meet the requirements of a growing population and economic activity in these talukas it is essential to not only prepare an effective land use plan but also to provide and maintain:

1. Water and sanitation services
2. Transportation services
3. Solid waste management
4. Energy demand
5. Health services and health management

Sanitation Services: Presently, the Sewerage coverage is about 16 % in the state of Goa with respect to 28 % national average. The major cities i.e. Panaji, Vasco, and Margao (with population more than 50000) are already connected to the sewerage network. Sewerage systems in Navelim, Colva, Ponda, Mapusa, Calangute, Baga, and Porvorim are in progress.

The total installed capacity is 78.48 MLD at present, against which 25 MLD is received at STP. In addition, 73.50 MLD cumulative capacity STPs are in progress for completion by FY21. As of FY 2019-20, urban & rural areas combined in the state generate 388 MLD of wastewater, of which 7 % is treated through the sewerage treatment plant.

Septage treatment is more prevalent in Goa. On-call service is available for septage management. Collected septage is treated in nearby STPs. The future outlook of the state is to achieve total sanitation and zero wastewater discharge into the environment.

Most of the sewerage treatment plants are based on SBR technology and maintain the effluent standards as per Goa State Pollution Control Boards guidelines. Details of sewerage and septage management projects are provided in annexure V.

<sup>24</sup> Socio economic survey 2017-18

### Sewerage at a Glance

State Sewerage coverage	- 16%
Sewerage generation	- 388 MLD
Total installed capacity in MLD (Designed)	- 78.48 MLD (8 major STP's)
Treatment done in MLD (present)	- 24.73 MLD
Total capacity in MLD in progress	- 73.50 MLD (8 major STP's)
DPR's prepared	- <b>Rs. 3078.59 Cr</b>
Additional coverage of balance areas	- <b>Rs. 1660.00 Cr</b>
Time frame required for sewerage scheme	- 5-10 Years (As per availability of Funds)

**Storm Water Drains:** All the Village Panchayats are part of the Disaster Management Plan for the State of Goa. They make their Disaster Management Plan and submit the same to the Taluka Mamlatdar. As a precautionary measure and to avoid likely constraints to be faced due to climate change, all the Village Panchayats regularly undertake works of cleaning drains, repairs, and maintenance of these drains.

Creation of Technical Cell and Green Cell: **establishing an independent Technical Cell for the Directorate of Panchayats is in process, which will help expedite civil works of Village Panchayats and will also help monitor construction with sustainable development such as the use of solar panels, rainwater harvesting etc.** For setting up solar panels for every Panchayat Ghar, the Directorate of Panchayats require funds of Six Crores for the 191 Village Panchayats located across the State of Goa.

### Schemes, Initiatives, and Policies

- The City of Panaji has a city sanitation plan
- Regional land use plans up to 2021
- Affordable housing: In RPG 2021, pockets of settlement areas aimed at providing low-cost housing, industrial/migrant workers housing, 20-point program housing, etc. are designated in the surface utilization plans accordingly. These areas shall be developed by either the government agencies mandated to take up such schemes or by the owners of such lands – collectively or individually depending on whether individuals or communities own the land. This aims to address the current gap in the supply vs. demand for affordable housing
- JICA funding for the sewage treatment plant
- As per the outline plan of major cities, solid waste management site has been identified in the cities of Panaji, Vasco-da-Gama, etc.
- Laying of a sewer network for balance and low-laying areas is proposed at an expenditure of approximately, **Rs. 1660Cr.**
- Sewerage Act and Policy for Mandatory House Sewer Connections

### Impact of climate change

While the state has developed a regional land use plan, climate change can make all plans and infrastructure ineffective if they cannot stand the climatic change impact and exposure.

As per the climate change predictions in an earlier chapter, the Taluka's of Bardez, Tiswadi, and Salcete are most vulnerable to flooding and sea-level rise (Appendix). Also, as indicated earlier, the Taluka of Mormugao is vulnerable due to high population density and 90 % of Goa's slum population.

**Extreme Precipitation Events:** Such events are predicted to rise and can render the service infrastructure in these areas unusable during disasters. It can as well affect the infrastructure resulting in financial loss.

**Increased temperature:** Temperature is predicted to rise significantly, and the duration of high and low-temperature days is expected to change. Increasing urbanization and building infrastructure are adding to the need for cooling systems; like loss of khazan lands due to climate change and the ingress of water up to 40km along the rivers have been predicted.

### 7.7.1 Synergy with National Mission and SDG

The national mission on sustainable habitat is a mission under the NAPCC, which seeks to promote sustainability of habitats through improvements in energy efficiency in buildings, urban planning, improved management of solid and liquid waste, including recycling and power generation, and a modal shift towards public transport and conservation. It also seeks to improve the ability of habitats to adapt to climate change by improving the resilience of infrastructure, community-based disaster management, and measures for improving advanced warning systems for extreme weather events.

The mission requires action based on the following:

- (a) development of sustainable habitat standards that lead to robust development strategies while simultaneously addressing climate change
- (b) preparation of city development plans that comprehensively address adaptation and mitigation concerns
- (d) capacity building for undertaking activities relevant to the Mission

Sustainable development goal no. 11 (SDG11) calls for sustainable cities and communities. It has the below-mentioned targets, and these targets are partially or fully met by the adaptation strategies as applicable:

- By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.
- By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.
- By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.
- Strengthen efforts to protect and safeguard the world's cultural and natural heritage.
- By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to the global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.
- By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.
- By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.
- Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning.
- By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels.
- Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials.

### Strategies for adaptation

Since the Talukas of Bardez, Tiswadi, Mormugao, and Salcete contains most of the state population and economic activity and are at the highest risk due to climate change, adaptation will be prioritized for these talukas. Hence, these talukas are prioritized for

1. Climate-based infrastructure vulnerability assessment of critical services
2. Development of a plan for the resilience of vulnerable structures associated with critical services
3. Redesigning the regional land use planning maps of the most vulnerable areas after considering climatic factors
4. Identifying measures like creating flood control gates etc. for controlling flooding events due to various aspects like the upward flow of water into the rivers
5. Development of a climate-based disaster management plan
6. Implementation of a solid waste management plan
7. Enhancing internal waterways for transportation
8. Strategy to relocate/compensate and identify new means or alternate skills for the owners of khazan lands as the probability of submergence due to climate change increases
9. Identify and explore natural mechanisms like increased mangroves, sea walls etc to guard against sea-level rise.

Sr. No.	Intervention	Status	Responsible agency	Barriers and Gaps in implementation	Intervention Type	Source of Finance	NCD Link (Connect to NDC items)
1	Study on Climatic resilience of Mormugao and development of action plan	Proposed	Climate Change Cell/department/secretariat / TCP	Lack of convergence, policy and capacity building	Others	NAFCC	To better adapt to climate change by enhancing investments in programmes in sectors vulnerable
2	Implementation of climate resilience action plan for Marmugao	Proposed		Lack of convergence, policy and capacity building	Activity	Own budget and multilateral agency	
3	Climatic resilience plan for Salcete, Tiswadi, and Bardez should be developed	Proposed	Climate Change Cell/department/secretariat	Lack of convergence, policy and capacity building	Others	NAFCC	
4	Implementation of climate resilience plan for Salcete, Tiswadi and Bardez	Proposed	Climate Secretariat / TCP / Disaster Management – Collector North and South	Lack of convergence, policy and capacity building	Activity	Own budget and multilateral agency	

5	Gender vulnerability action plan	Proposed	Climate Secretariat and all Depts.	Lack of convergence, policy and capacity building	Awareness raising and capacity building	State, Central and other	
6	Alternate skill development plan for vulnerable population	Proposed	Dept. of Skill Development, GIPARD & All Depts.	Lack of convergence, policy and capacity building	Awareness raising and capacity building	State, Central and other	
7	Alternate skill development and facilitation as per the plan	Proposed	Dept. of Skill Development, GIPARD & All Depts.	Lack of convergence, policy and capacity building	Activity	State, Central and other	
8	Development of last Mile Connectivity and Early Dissemination Solution for the State under NCRMP-II.	Under progress	Disaster Management Authority North & South by proper coordination and convergence	Lack of convergence, policy and capacity building	Activity	State, Central and other	
9	Multipurpose Cyclone Shelter (MPCS) & MPCS with fire stations are proposed to be taken in Canacona, Mormugao, Bardez, Pernem and Tiswadi Talukas.	Under progress	Disaster Management Authority North & South by proper coordination and convergence	Lack of convergence, policy and capacity building	Activity	State, Central and other	

Table 33: Adaptation Strategies for Habitats

Sr. No.	Intervention	Status	Responsible agency	Barriers and Gaps in implementation	Intervention Type	Source of Finance	Time frame	NCD Link (Connect to NDC items)
1	Climate resilient city sanitation plans are developed or existing plans are strengthened to be climate resilient	To be modified	TCP	Lack of Policy, capacity building and convergence	Policy	Existing Department Budget	1 Year	To adopt a climate friendly and a cleaner path than the one followed hitherto by others at corresponding level of economic development.  To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable
2	Service level benchmarks should be met in all major towns and cities	Under progress	TCP & Other departments	Lack of Policy, Capacity building and convergence	Others	Existing Department Budget	1 Year	

3	To carry out the preparedness assessment of low-lying areas in the four talukas to flooding and other climatic stresses which can cause flooding	Proposed	TCP, DSLR and Planning	Lack of policy, capacity building and convergence	Activity	State Govt.	2 Years	
4	Implement measures to make these areas ready for climatic stresses	Proposed	TCP & Disaster Management Authority	Lack of policy, capacity building and convergence	Policy or planning prerequisite, advisory and planning	State and other	1 year	
5	Khazan lands protection from climate change	Proposed	TCP & Disaster Management Authority	Lack of policy, capacity building and convergence	Policy or planning prerequisite, advisory and planning	State and other	1 year	
6	Sea protection walls or natural pathways to guard against sea level rise must be identified and deployed	Proposed	TCP, WRD & Disaster Management Authority	Cost could be prohibitive and effectiveness needs to be assessed	Activity	Multilateral agency	6 to 9 years	

7	Making provision at sea and river confluence to back water or tidal water into the rivers	Proposed	WRD, TCP (while granting approvals), Soil Conservation Division Agri. Dept.	Cost could be prohibitive and options could be limited	Activity	State and others	2-3 years	
8	Identifying vulnerable khazan land owners, providing alternate skills and livelihood options for future	Proposed	TCP and Agriculture Department	Convergence and execution	Scheme	Existing department budget	1-2 years	
9.	<u>Online Management of Sewerage Infrastructure with implementation of GIS based mapping.</u>	Underway	SIDCL, CCP, Smart City Agency, PWD, TCP and GSPCB Convergence	GIS based mapping for Panaji, Vasco and Margao sewerage system has been completed. As other areas get covered this will be applied to them as well.	System development & activity	Existing department budget	2 years	

10	<u>Introduction of village carrying capacity concept in any developments/d evelopment projects in each village</u>	Proposed	Panchayat Raj Department	Lack of capacity building, policy and guidelines	Policy	State and other sources	2 Years	
11	<u>Material recovery facility at village level</u>	Proposed	Panchayat Raj Department	Only villages with land can implement it	Infrastructure	State & other	1 year	
12	<u>Developing climate resilient and low cost housing incorporating green building concepts</u>	Proposed	RDA, TCP and local bodies - Directorate of Panchayats (Convergence)	Lack of focus and time bound program	Sustainable infrastructure	State and others	1 year for planning and implementation on within 2 years	

**Note: Approximate financial implications of the habitat sector expected to be met from the climate change plan for ten years are approximately ₹ 10 crores. Being interdepartmental, the department will prepare a detailed plan for expenditure along with gap analysis within 6 months under the leadership of TCP.**

[https://tcp.goa.gov.in/wp-content/uploads/2016/gazette/RPG21\\_Bardez\\_Tiswadi\\_Mormugao\\_Salcete\\_Notification.pdf](https://tcp.goa.gov.in/wp-content/uploads/2016/gazette/RPG21_Bardez_Tiswadi_Mormugao_Salcete_Notification.pdf)

Table 34 - Adaptation Measures for Solid Waste Management Sector

Sr No	Intervention	Status	Responsible agency	Barriers & Gaps in Implementation	Intervention Type	Budget (INR crore)	Source of Finance	Time frame	Monitoring Mechanism and Frequency
1	Enhancement of Integrated Solid Waste Management Facility – Saligao (250 TPD +20%)	Part enhancement of Integrated Solid Waste Management Facility (SWMF) from 100 tons per day (TPD) to 150 tons TPD is completed and currently is in process of enhancing from existing 150-TPD to 250-TPD (+20%) Works commenced on 29th August 2020 RCC wall work of digester 1 completed and RCC wall work of digester 2 is in progress Wet waste shed, ETP, dewatering shed, solar drying shed - plinth work completed. First floor level work in progress	Goa Waste Management Corporation	Procurement of machineries from European Nations may be hampered due to prevailing COVID 19 situations.	Activity	103.87	Loan from Bank of Maharashtra/NABARD	December 2021	1) State Level Committee constituted in compliance with NGT order OA 606/18 on quarterly basis. 2) Status updated vide Hon'ble High Court of Bombay at Goa in matter SMWP 2/2007

2	Integrated Solid Waste Management Facility – Cacora (100 TPD +25%)	Foundation works of MSRC shed, digester tank, STP, gas engine building and solar shed foundation works are in progress.	Goa Waste Management Corporation	Procurement of machineries from European Nations may be hampered due to prevailing COVID 19 situations.	Activity	173.98	Loan from National Bank for Agriculture and Rural Development (NABARD)	December 2021	1) State Level Committee constituted in compliance with NGT order OA 606/18 on quarterly basis. 2) Status updated vide Hon'ble High Court of Bombay at Goa in matter SMWP 2/2007
3	Integrated Solid Waste Management Facility- Bainguinim (250 TPD +20%)	Request for Qualification (RFQ) was floated and bid was opened on 15/02/2021	Goa Waste Management Corporation	Litigations/complaints/objections from Public surrounding area Land acquisition for additional road assess	Activity	237.00	State Government to be budgeted in Fy 2021-22	Proposed timeline for completion is October 2022	1) State Level Committee constituted in compliance with NGT order OA 606/18 on quarterly basis. 2) Status updated vide Hon'ble High Court of Bombay at Goa in matter SMWP 2/2007

4	Integrated Solid Waste Management Facility- (250 TPD +20%) & Waste to Energy Project at Verna	Work Order issued to L1 bidder M/s Sadekar Enviro Engineers Pvt Ltd on 16/11/2020 Preliminary site visit by EIA Consultant was carried out on 15/12/2020. Letter made to Goa SEAC for revised TOR for change in scope of work, considering additional study for setup of 250 TPD Waste to Energy at the same site. Awaiting reply from Goa SEAC.	Goa Waste Management Corporation	Litigations/ complaints/ objection from Public from Verna area.	Activity	300.00	State Government	3 years	1)State Level Committee constituted in compliance with NGT order OA 606/18 on quarterly basis. 2)Status updated vide Hon'ble High Court of Bombay at Goa in matter SMWP 2/2007
5	Construction & Demolition Waste Management Facility - Bicholim (500 TPD)	GWMC has identified revenue, land under survey no 146/2,3,4,6 and 148/2,6,7 at Curchirem Village in Bicholim taluka, North Goa admeasuring an area of ~44,478sqm inclusive of abandoned mining pit for setting up a C & D treatment facility for which SINTEF, Scientific Research Organisation in Norway is a consultant for GWMC. Awaiting demarcation order from Dy. Collector Awaiting final order for removal of lessees enrolled in the revenue land to be handed over to GWMC free from all encumbrances. Consultant has submitted Draft DPR for approval.	Goa Waste Management Corporation	Land issue Litigations/ Complaints/ Objection from Public from surrounding area.	Activity	51.00	Concessionaire through PPP model	3 years	1)State Level Committee constituted in compliance with NGT order OA 606/18 on quarterly basis. 2)Status updated vide Hon'ble High Court of Bombay at Goa in matter SMWP 2/2007

6	Common Bio-Medical Waste Treatment facility (CBMWTF) 200 kg per hr incinerators at Kundaim	Columns have been erected. Masonry work for walls have been completed. Excavation work for phase two is in process. Autoclave, boiler, segregation belt and plastic recycling unit machinery has reached the site. Commissioning of machinery is in process and Autoclave machine will be commissioned tentatively by March.	Goa Waste Management Corporation	Litigations/ Complaints/ Objection from Public / Village Panchayat BOMA from surrounding area.	Activity	12.00	Concessionaire through PPP model	December 2021	1)State Level Committee constituted in compliance with NGT order OA 606/18 on quarterly basis.
7	Common Hazardous Waste Treatment Storage and Disposal Facility (CHWTSDF) at Pissurlem 25,000 TPA Secured Landfill (SLF) & 1.5 ton/hr incinerators	The erection of Pre-Engineered Building (PEB) structure of storage shed-2 has been commenced. The construction of wheel washing bay, weigh bridge and Shed 1 has been completed. Laying of liners of the 1 <sup>st</sup> SFL has commenced. (50% completed)	Goa Waste Management Corporation	Litigations/ Complaints/ Objection from Public from surrounding area.	Activity	110.00	Concessionaire through PPP model	Phase 1 - March 2021 Phase 2- December 2021	1)State Level Committee constituted in compliance with NGT order OA 606/18 on quarterly basis.

8	Design-Build and Operate an E-Waste Management (Collection, Storage and Dismantling) for the State of Goa (15 TPD) at Pissurlem	Tender for selection of service provider for Design-Build and Operate an E-Waste Management (Collection, Storage and Dismantling) for the State of Goa was floated on 06/07/2020. Technical bid was opened on 30 <sup>th</sup> November 2020. Technical presentation before the TEC of technical proposal held on 27 <sup>th</sup> January-2021. File moved for approval for opening financial bid.	Goa Waste Management Corporation	No Barriers	Activity	4.80	Concessionaire through PPP model	March 2022	1)State Level Committee constituted in compliance with NGT order OA 606/18 on quarterly basis.
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The total financial outgo for waste management activity through waste management corporation is ₹ 992.65 Cr for the next ten years which is relevant to climate change. This is from State funds, PPP mechanism, and other funds.

Table – 35 Adaptation and Mitigation Strategy of Dept. of Environment & Climate Change

Sr. No	Intervention	Type and Status	Responsible agency	Barriers and Gaps in implementation	Amount allocated for ten years in ₹	Source of Finance	NCD Link (Connect to NDC items)
1	Climate secretariat at GSBB for reporting, review and monitoring of climate activities and SAPCC	Proposed activity	Environment Climate Change Cell/department /secretariat	Lack of such cell and manpower	5 Crores	State Govt., MoEFCC and NAFCC	To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable
2	Implementation of SAPCC	Proposed activity	Environment Climate Change Cell/department /secretariat and all sectoral departments and agencies	Lack of such policy document	1 Crores	State Govt., MoEFCC and NAFCC	
3	NAFCC project through various departments	Proposed	Climate Change Cell/department /secretariat	Delay in DPR preparation due to pandemic	10 crores (out of total 25 crores, almost 15 crores are earmarked for Agri. Dept. and accounted there)	NAFCC	

4	Implementation of ICZMP through world bank and State funding	Proposed activity In principle approved and awaiting sanction	GCZMA and associated bodies including GSBB, Fisheries Dept. Envi. Dept. etc.	DPR preparation, other delays in PMU	200 crores	World Bank, Central and State Govt. and multilateral agency
5	Biodiversity conservation through livelihood - project intervention	Ongoing project	GSBB with support from Dept. of Environment and others like CSR etc.	Slow down due to pandemic	10 crores for ten years	Govt. of Goa and multilateral agencies
6	Coastal protection through several interventions by GCZMA including green skilling, bund restoration etc.	Started and proposed from 2022	GCZMA with GSBB	Slow down due to pandemic	2 crores for ten years	Govt. of Goa and multilateral agencies
7	Participative coastal interventions	Proposed capacity building and other activities	SICOM & GCZMA	Slow down due to pandemic	1 crores	Govt. of Goa and multilateral agencies
8	Environment protection and conservation related projects, activities and several interventions	Ongoing activities - soft & hard interventions	Dept. of Environment through GSPCB, GSBB, GSWA, SEAC and SEIAA	Capacity building and trained manpower	50 crores for ten years	Govt, of Goa

9	Various studies such as sand mining impact, river biodiversity index etc.	Under progress by CSIR - NIO through GSBB	Dept. of Environment through GSPCB, GSBB, GSWA, SEAC and SEIAA	Capacity building and trained manpower	9 crores	Govt, of Goa
10	Identification, notification and management of wetlands for conservation through GSWA	Under progress by CSIR - NIO through GSBB	Dept. of Environment through GSPCB, GSBB, GSWA, SEAC and SEIAA	Capacity building and trained manpower	2 crores for ten years	Govt, of Goa

The climate change-related funds by Dept. of environment through the State and other funds for ten decades will be about ₹ 290 Crores for ten years, including State other sources.

In 10 years, from 2006 to 2015, infrastructure and other asset losses in the Asia and Pacific region resulting from floods, earthquakes, and tropical cyclones averaged \$73 billion yearly (56% of the global total) and \$199 million per day. ADB's disaster risk models indicate an average annual loss over the long-term equivalent to more than 2 % of gross domestic product (GDP) for 11 Developing member countries (DMCs) and over 1% of GDP for 21 DMCs. 431 major natural disasters occurred in India in 30 years period from 1980 to 2010, resulting in a huge loss of human lives, property, and resources. Natural disasters between 1998-2017 have resulted in an absolute financial loss of US\$79.5 billion<sup>25</sup>. Similarly, a single extreme weather event in Goa, on 2<sup>nd</sup> of October 2009, in Canacona Taluka, resulted in a loss of over INR 100 crore<sup>26</sup>. Many of these events and the nature of these natural events are attributed to climate change. It is predicted that the severity and frequency of these climatic events will increase due to climate change, and inaction will lead to huge economic losses in the future.

ADB has predicted that inaction in some of the Southeast Asian countries could result in a loss equivalent to more than 6% of GDP while adaptation at the cost of just 0.2 % of GDP for investment in such things as seawalls and drought- and heat-resistant crops, could avoid damages amounting to 1.9 % of GDP, on an annual basis. (Climate Change Operational Framework 2017–2030, Asian Development Bank). Thus, factoring climate action into the future of Goa and climate-proofing Goa and its investments can also contribute to the State's economic progress.

The total budget required for implementing the SAPCC in Goa has been identified to be INR 465 crore which is 0.22% of the state GDP. The same may get revised or updated over the years based on any additions or modifications to the SAPCC. One of the steps for mainstreaming climate change is to factor the above-identified amount into the state budget annually.

As per UNFCCC, Climate Finance refers to local, national, or transnational financing drawn from public, private and alternative financing sources that seek to support mitigation and adaptation actions that will address climate change.

In light of the above, climate finance needed for the state should be sourced from a set of best suitable options. The state budget is expected to be the key contributor to the climate change budget for the state. Besides, SAPCC will also leverage national programs, policy, schemes, convergence with national programs and funds, multilateral and bilateral agency funding, market-based mechanisms/instruments, and other climate finance options.

<sup>25</sup> Climate Change Operational Framework 2017–2030, Asian Development Bank

<sup>26</sup> India's second communication to UNFCCC

<sup>27</sup> Report of the Canacona Flash Floods Study Committee constituted by the Government of Goa

Climate Finance options proposed in this SAPCC are keeping in view India's NDC items:

To mobilize domestic and new and additional fund sources from developed countries including EU collaborating nations to implement the above mitigation and adaptation actions in view of the resource required and the resource gap.

To build capacities, create domestic framework and international architecture for quick diffusion of cutting-edge climate technology in India and for joint collaborative R&D for such future technologies.

Following is an indicative structure to be adopted by Goa for financing the measures under SAPCC

- Allocation of a dedicated budget for climate-related policy development, awareness (including schemes or programs to reward climate-friendly actions), and capacity building.
- Identified projects that are adaptation based and need additional financial resources that are beyond the state's capacity to absorb and are below **INR 25 crore** in value or require co-finance, which is within INR 25 crore and pilot in nature, can apply for NAFCC funding.
- Projects which are large, replicable, and essential for climate mitigation or adaptation but beyond the state's ability to finance in totality and do not have to converge with any other scheme or certain components do not have any source of funding can attempt multi-lateral development agencies or other climate funds like GCF funding.
- For other activities which are essential and regular with a possibility of a return can be undertaken through concepts like the revolving fund, green bonds, etc.

### 8.1. State internal finance

The total budget required for implementing the SAPCC in Goa has been projected to be **INR Rs.2341.06.00** Crores for ten years, which works out to be **Rs.234.106** Per Annum and amounts to approximately 1.1 % of the Annual Budget which is **Rs.21056.35** (estimated for 2020) and 0.050 % of Gross State Domestic Production (GSDP) of Goa State which is **Rs 92260.53** (as per CMs budget speech). The total expenditure of the state is estimated at **Rs.39640.53** crore. On the expenditure side, social services account for **Rs.4732.61crore** i.e. 40.33 % of the estimated total expenditure, followed by economic services at **Rs.3475.38crore** or (29.61 %) and general services at **Rs.3528.05crore** (30.06 %). It has a revenue surplus of **INR 455 crore**. Grant-in-aid & contribution from Central Government is **Rs 1249.68 crore**.

Figure 32: Indicative Budget Estimations for Implementation of Climate Change Related Programs in The State of Goa

Sr. No.	Sector	Budgetary Plan for Next Ten Years (In Crores ₹)
1	Transport	90.00
2	Power (Energy Demand – 307.66 Cr) & Supply Side <b>Rs.120.7 Cr</b> including Renewable energy	428.36
3	Water – WRD	80.55
4	Agriculture (50 Cr) and Allied (Fisheries, AVHS etc.) sector	74.50
5	Environment & Coastal Management - Bund restoration, erosion control and other initiatives for climate resiliency, biodiversity & wetlands	290.00
6	Forest Sector	300.00
7	Fisheries sector through State and Central funds	25.00
8	Solid Waste Management	992.65
9	Sewage Management from State	15.00

10	Human Health	10.00
11	Disaster Management	10.00
12	Habitat	10.00
13	Tourism	5.00
14	Mining	5.00
15	Land use land cover - TCP	5.00
	Rupees ₹ Two Thousand Three Hundred, Forty-One Crores & Six lakh Only for Ten Years	2341.06 Crores
	The total budget required for implementing the SAPCC in Goa has been projected to be INR <b>Rs 2341.06 Crores</b> for ten years, which works out to be <b>Rs. 234.106 Crores</b> Per Annum and amounts to approximately 1.1% of the Annual Budget, which is 21056.35 (estimated for 2020- 21) and 0.2538 % of Gross State Domestic Production (GSDP) of Goa State which is 92260.53 (as per CMs budget speech 2021).	

Above estimates are humble, and the climate-related activities and interventions could be much more than estimated above. However, the same will be captured during the annual review.

**State departments are carrying out activities that directly or indirectly contribute towards SAPCC** i.e. climate mitigation and/ or adaptation. For example, switching to LED lights in Panaji and utilizing power generated at Saligao solid waste treatment plant. However, without any mechanism to account for expenses under climate change, the expenditure on climate change is currently unaccounted.

**Hence, there is a need to establish a mechanism to identify states' current expenses on items that contribute towards climate change and the source of current finance.**

To further enhance the funding of the state on climate change, there is a need to identify its own resources, market, and insurance option which can further contribute to the climate change budget of the state.

Own Resource	Market and Insurance
<ul style="list-style-type: none"> <li>• Own resources at district, town or taluk level</li> <li>• Convergency of state schemes</li> <li>• Incorporation of essential climate elements in the existing programs, schemes, projects, state policies etc will result in utilization of existing committed finance towards climate mitigation and /or adaptation</li> <li>• Setting up of annual dedicated budget for climate change</li> </ul>	<ul style="list-style-type: none"> <li>• Climate Risk insurance specifically for farm sector</li> <li>• Public Private Partnership</li> <li>• Issuance of Green Bonds (for example : Ahmedabad Municipal Corporation)</li> <li>• Catastrophe Bonds</li> <li>• Incentives for Green Initiatives and activities by citizens, tourist and business</li> <li>• Establishing Revolving fund</li> <li>• Channelizing Corporate Social Responsibility funds</li> </ul>

In addition, existing corporate sector in Goa spends on CSR activities. This CSR expenditure by corporate sector can be further aligned to meet the State Governments requirements.

Sector as per CSR fund distribution	Interventions/actions to be incorporated
<b>Education</b>	<ul style="list-style-type: none"> <li>• School level education programmes on climate resilient measures like maintaining agricultural spaces, promoting green buildings, importance of regulating plastic and inorganic material, etc.</li> <li>• FGDs, outreach programmes in schools, madrasas to develop awareness</li> </ul>
<b>Healthcare</b>	<ul style="list-style-type: none"> <li>• Mobilization and streamlining of rag pickers on health and hygiene issues</li> </ul>
<b>Skills Development</b>	<ul style="list-style-type: none"> <li>• Skill development of urban poor to work with non-biodegradable waste recycling methods-Inorganic waste to planter bags and handicrafts</li> <li>• Waste collection and segregation from areas with low accessibility</li> </ul>
<b>Environment</b>	<ul style="list-style-type: none"> <li>• Funds towards improving rate of plantation as part of Haritha Haram</li> <li>• Promotion of vertical gardening and farming</li> <li>• Restoration of water bodies and wetlands</li> </ul>
<b>WASH</b>	<ul style="list-style-type: none"> <li>• Installation and maintenance of dry toilets in public schools and informal settlements</li> <li>• Awareness building and outreach on good sanitation practices</li> <li>• Provision of safe drinking water in informal settlements in the vicinity of the corporate entity</li> </ul>
<b>Livelihood</b>	<ul style="list-style-type: none"> <li>• Organizing workshops, training modules or exposure visits on greener and cleaner technologies for concerned government staff</li> </ul>
<b>Women Empowerment</b>	<ul style="list-style-type: none"> <li>• Funding women SHGs to scale their operations particularly in sanitation, construction of semi-pucca houses, etc.</li> </ul>
<b>Others</b>	<ul style="list-style-type: none"> <li>• Designing effective communication plan for disaster response</li> <li>• Periodic cleaning of drains in areas prone to water logging</li> </ul>

## 8.2. Revolving funds (Rf) or Circular funds for climate change

Revolving Funds or Circular Funds for climate change are pool capital funds using federal, provincial, or municipal funds, which can then be loaned out to finance infrastructure or other climate change projects at low-interest rates. Money is repaid into the fund, which can be loaned out again. These funds are flexible in design and can use many options in terms of the collection of funds. Usually, these funds are well suited for mitigation activities like renewable energy projects but can also be utilized to tackle climate adaptation activities like water security. The differences and similarities in the design of Rfs speak volumes on the strength of the concept as a whole. The differences allow elbow room to tailor-build the mechanism according to the country/state/municipality, while the similarities lend ideas to economies on maximizing its utility.

A revolving fund is proposed for the State of Goa to support the application of initiative between all levels of government. A consensus needs to be reached for the efforts to fructify. The private sector can also be included in this model, and a market-based system can be developed. All activities under this must also satisfy social requirements and environmental safeguards.

The next step is to develop a complete guideline for enacting the fund in the State of Goa for utilization or complementing activities which do not find a regular budget in the State. The operational mechanism for this fund can be through a special purpose vehicle under the state secretariat on climate change.

## 8.3. Green tax on tourism

Tourism is the major industrial sector in Goa. Nearly 14 lakh tourists visit Goa every year. Eco-tax or Green tax to combat climate change is proposed to assist in mitigation and adaptation activities of the areas the tourist most frequently visits. Such taxation models are under implementation in countries like Spain. The system can be developed based on the tourist's standard of accommodation.

As a next step, the institutional structure would need to be established to develop a functional model for taxation and its appropriate utilization. The tourism department will work out the appropriate mechanism, time frames and other modalities.

# Implementation of SAPCC and Institutional Mechanism for Implementation

## 9.1. Institutional Framework for Implementation of SAPCC

An appropriate institutional framework with clearly identified roles and responsibilities is essential for the effective implementation of SAPCC. **In addition to SLSC for NAFCC, there will be a State Nodal Agency on Climate Change Cell which will be formed under the Dept. of Environment to be housed at GSBB and will serve as the Climate Change Secretariat for the State of Goa. Most importantly State Governing Council is proposed under the Chairpersonship of Hon. Chief Minister of Goa and Co-Chaired by Hon. Environment Minister and Chief Secretary.** A designated nodal officer of SLSC will head the secretariat and comprise resources with a background in climate change and an understanding of Goa's local context. It will be supported by experts in climate change from within and outside the state. Other staff, as needed for the effective functioning of the Secretariat, shall be identified.

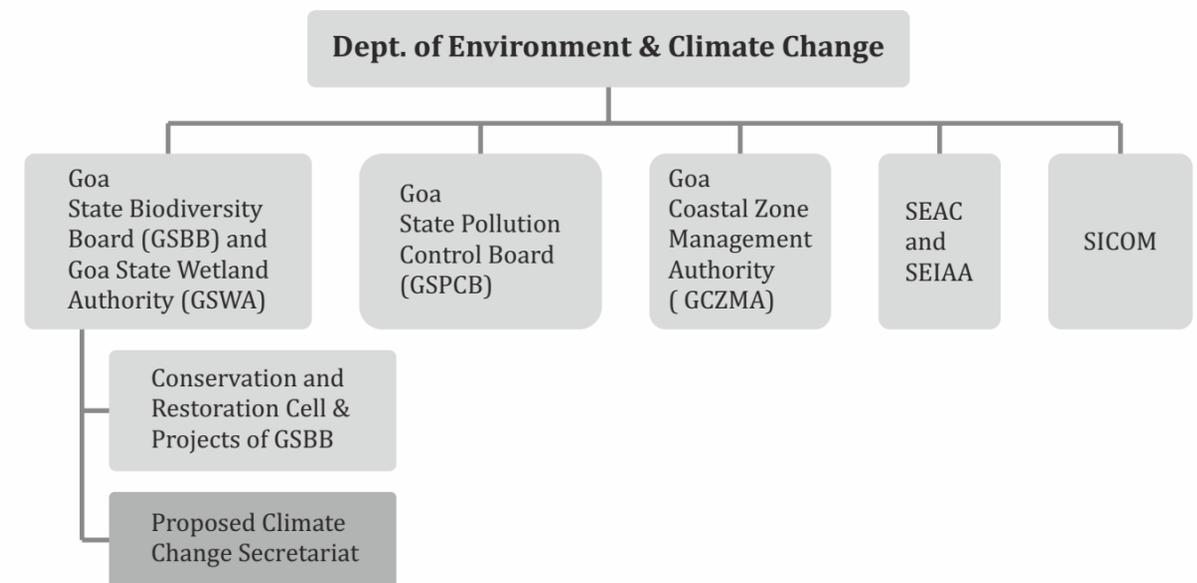


Figure 33: Position of Climate Change Secretariat in the Department of Environment & Climate Change at Goa

**The Secretariat will hold the responsibility of:**

1. Knowledge management - developing, managing, and updating information on climate change from state, national, and global perspectives, disseminating such information to the concerned departments, institute, and other stakeholders on time.
2. Awareness-raising and capacity building – It will be responsible for conducting awareness programs for the public and otherwise and carrying out capacity-building activities for departments and all concerned for the delivery of SAPCC. It will facilitate green skill development on climate change.

Assisting in climate finance – The Secretariat will coordinate any project/ activity or intervention planned under SAPCC or proposed otherwise to be implemented partially or entirely through climate finance options other than the state or department's internal funds. For example, the procedure for obtaining NAFCC Funds for state projects. Two NAFCC projects are already under development in two districts wherein maximum convergence of climate change-related interventions could be exemplified. The project concept note in this regard has been approved. Implementation of SAPCC and projects under it could involve multiple stakeholders in proposed projects, but as decided and approved by the State Level Steering Committee for Climate Change, Secretariat will be the nodal agency for the same has been proposed as given below.

3. Monitoring of SAPCC- Department can consult the Secretariat on matters related to the implementation of SAPCC. At the same time, Secretariat will also monitor the implementation of SAPCC and utilize appropriate tools to record, produce and update the SLSC. The Secretariat should periodically furnish all the data/information and reporting by concerned departments, agencies and stakeholders.

The nodal agency shall be allocated a budget or financial assistance from the state for its activities. Each concerned department will appoint a nodal officer on climate change to interact and deal with the climate change secretariat.

The nodal agency will be guided by the State Level Steering Committee headed by the State's Minister for Environment & Climate Change, Chief Secretary & Environment Secretary & other members. The SLSC will not only guide but also provide approvals as necessary. State departments will also form a part of the SLSC.

The State Governing Council, headed by Honorable Chief Minister, will be the overall guiding body and Chief Secretary, Hon. Minister for Environment for strategic climate change issues in the state. It will constitute the Honorable Chief Minister, Hon. Minister for Environment & Climate Change, Chief Secretary, key experts, and nodal officer of the Secretariat, and others may be included as necessary.

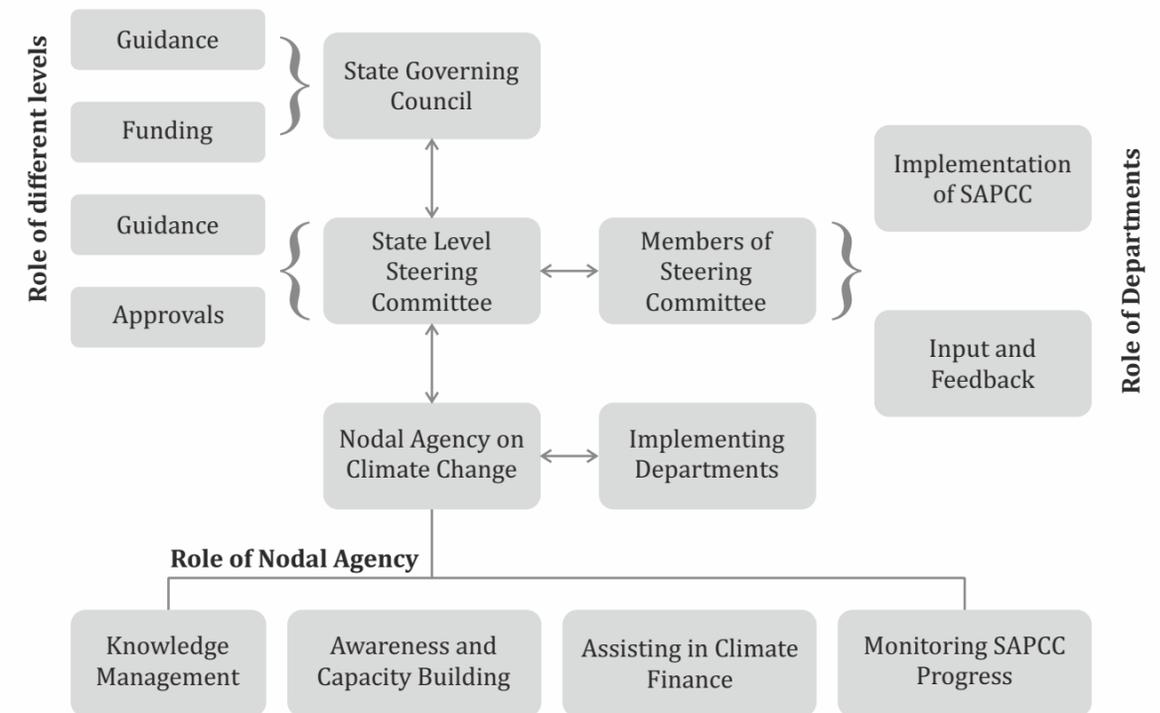


Figure 34: Institutional Mechanism for Implementation of SAPCC

## 9.2. Knowledge Management

Climate change is a dynamic subject. The knowledge about climate change and its region-specific topics is currently scattered, limited, and unorganized, making it difficult for departments to effectively utilize and integrate climate change in policy development and routine actions. Thus, there is a need to systematically organize, synthesize, regularly update and provide information about climate change in the context of Goa to all the stakeholders. Simultaneously, various institutes in the state are involved in climate change-related data gathering and analysis.

In this context, it is proposed that the Secretariat on climate change undertakes the responsibility of collaborating with various agencies and institutes, collating knowledge/data products available with them, and further developing meaningful outcomes for the state.

Thus, under the National Mission for Strategic Knowledge on Climate Change, it is proposed that a climate change hub is created at the Secretariat. The following activities are proposed to be undertaken by the hub collaboratively:

- Knowledge management and capacity building options proposed in this SAPCC are keeping in view India's NDC items:
- To build capacities, create domestic framework and international architecture for quick diffusion of cutting-edge climate technology in India and for joint collaborative R&D for such future technologies
- To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation.

1. Creation of a knowledge management portal.
2. Formulation of integrated databases assists policymakers in making informed decisions while formulating policies.
3. A collaborative project will continuously provide climate change trends and model projects for Goa. For this purpose, the Secretariat may collaborate with state and national-level institutes like BITS Pilani Goa and NIO Goa, IITM Pune, and any other institutes or organizations found related.
4. Develop sectoral climate impact assessments.
5. Develop and periodically update sectoral climatic vulnerability and hydrometeorological hazard risk for all sectors. In some time, the vulnerability of sectors may change, and hence, re-prioritization might be needed. Such a project will help in developing the required knowledge.
6. Develop a system to update and record the government's progress on climate change through policies and programs.
7. Develop and provide guidelines to be included in the pre-implementation stage (i.e. feasibility, DPR) for all infrastructure to climate-proof and minimize climate impact.
8. Develop knowledge material and conduct capacity building for all concerned departments and institutes.
9. Develop various tools and models for the dissemination of climate knowledge among all stakeholders.
10. Conduct skill development programs to provide the state with resources trained to handle activities and infrastructure like STP, and vermicomposting units.

### 9.3. Capacity Building, Awareness Raising, and People's Participation

Climate change impacts all, and people must understand and appreciate the real impacts of climate change that they can expect to experience. It is also essential for people to understand their role in minimizing climate change and how to prepare and respond to climate change through adaptation measures. Hence, people's participation is one of the critical pillars of the effective implementation of SAPCC.

Capacity building and awareness programs are essential for appropriate action at all levels. During stakeholder consultation at Goa, community involvement was emphasized with specific reference to youth and school children.

Based on the above following activities are proposed:

#### 1. Including climate change as a mandatory part of school education

Standardized modules will be created to generate awareness among school children on climate change with specific reference to the local context. Training on climate change to selected teachers from all schools. Schools will be provided with the audio-video course module that trained teachers can use to educate children further.

#### 2. Involving the youth in climate action

Middle and higher secondary school children will be provided with opportunities to participate in community action on climate change through the school. Youth from college will be educated on climate change in the local context, future career opportunities related to climate action, skills needed and skill development courses. A program will be developed and implemented to identify youth mascots to spread awareness of climate change in the state through various mediums.

#### 3. A community-level task force (CLTF)

The community-level task force will be developed at an appropriate level through a structured program. It will create awareness, and act as disaster averting and the first line of action during climate disasters. CLTF will also help gather and document local/indigenous knowledge related to climate change

indicators, and measures available to address climate change. The same will be appropriately vetted and included in the knowledge management system.

#### 4. Capacity building at the departmental level

Every government employee needs to understand the local context of climate change and their expectation in implementing climate change initiatives and enhancing their ability to contribute to the same. The Secretariat will develop a structured program with appropriate tools and implementation mechanisms.

#### 5. Women leaders in climate flight

Globally, women and children have been identified to be among the most vulnerable to climate change. Hence, ensuring that women and women-specific issues arising from climate change are addressed appropriately is essential. It is proposed that women SHGs and other women leaders be identified to ensure that women are well informed on the local context of climate change, their issues are either addressed, or a solution is identified. It is suggested that an appropriate program

Inclusive community initiatives of GSBB and Goa State Wetland Authority

Goa State Biodiversity Board (GSBB) – Nodal Agency for Goa State Wetland Authority – (GSWA)} – Goa State Biodiversity Board is an autonomous body of Govt. of Goa, under the umbrella of Dept. of Environment is line Dept.

It carries out various community-based activities which involve local communities in multiple ways. GSBB has always strived to ensure a maximum participatory approach at a grassroots level, and so far, awareness programs on the need for biodiversity conservation and mainstreaming biodiversity have been conducted at all levels throughout the state of Goa.

Going forward as well as taking initiatives to involve local communities are planned. Such initiatives foster stronger relationships with the local community and are intended to bring about change at the grassroots level. Several of these initiatives also lead to climate-based awareness and development of climate-friendly adaptation measures. Some of these have been mentioned below:

Wetland Mitra belonging to the local community is planned to be appointed for the Notified Wetlands in the state of Goa. It is proposed that Community and BMC-driven Restoration and reclamation of water bodies for future water security will be undertaken by part voluntary labour from the locals.

Another initiative is community-driven conservation and management of wetlands through livelihood projects to be undertaken, with efficient and wise use of the wetlands ecosystem resources.

Biodiversity (Flora, Fauna, and Microbial level) assessment of available resources of the wetland ecosystem will be undertaken through a project involving research-based organizations, institutes, and colleges. It is expected to assist in finding solutions to the water crisis and abatement.

Similarly, awareness programs for the conservation and management of Inland freshwater reservoirs will be undertaken.

Implementing SAPCC would require the state government to channel a significant amount of investment. Hence, measuring the effectiveness, efficacy, and efficiency of SAPCC during the implementation phase is essential. A robust monitoring and evaluation system will ensure that the progress of implementation is appropriately measured and captured, provide accountability for implementation, and draw lessons for the future from the measures being implemented. As measures to contain and adapt to climate change are multi-dimensional and may have constantly changing climatic parameters, a robust M & E system will provide a way forward to strengthen the SAPCC periodically.

Developing monitoring and evaluation indicators for climate change adaptation activities is challenging as it is often independent of other factors like human development and other changes in the environment<sup>28</sup>.

In view of the above, the M&E framework consists of the following:

1. Qualitative and quantitative indicators of adaptation
2. Indicators are attempted to be as ambiguous as possible
3. Monitoring, reporting and communication process for departments and the policymakers

### 10.1.1. M&E framework

SAPCC implementation is proposed to be reviewed, and review the progress report to be submitted by the state nodal agency to the SLSC annually before state budget preparation each year to

- a. Ascertain the financial resources spent on CC under projects/interventions, by various departments and concerned organizations
- b. Provide progress on ground-level implementation based on indicators
- c. Provide a plan for next year, with any changes or deviations from the SAPCC
- d. Provide a plan for expenditure on CC and additional financial resources needed from the state budget

As SAPCC implementation involves multiple stakeholders from different sectors and administrative groups, requiring interdepartmental coordination, in some cases, it is proposed that a **working group** is formed to facilitate transparency, coordination, communication, and learning. The working group must focus strongly on the MRE process.

The climate change secretariat and nodal climate change representatives from each department can be part of the working group. The Climate Change Secretariat will chair the working group. The working group will meet at least every quarter to discuss the progress on the interventions presented in the SAPCC, challenges faced during implementation, and the way forward. The working group's quarterly report will be presented to the SLSC members. Apart from a working group, other modes of wider stakeholder engagement will also be explored to enhance the M&E process. Data on certain M&E parameters will be provided by the concerned departments to the secretariat periodically, maybe once a quarter.

<sup>28</sup> UNFCCC synthesis report on monitoring and evaluating adaptation: <http://unfccc.int/resource/docs/2010/sbsta/eng/05.pdf>

Systematic reporting by the nodal agency and the State Steering Committee on Climate Change meeting to review the progress shall be undertaken at least twice a year.

**As a next step, it is proposed that a state-level climate change performance index is developed for the inter-departmental progress and performance mapping on climate change.**

### 10.1.2. Review and updating of SAPCC

The SAPCC has been developed for a time frame of 10 years starting from 2021. However, climate change being a dynamic subject, with shifting baselines, the results generated by reports of M&E may suggest to the decision-makers a necessity to revise significant aspects of the SAPCC mid-way. To facilitate the assessment of such need, it is proposed that the SAPCC be reviewed in 3 years from the start date of approval. For this to happen, findings need to be documented and analyzed systematically and communicated to a range of decision-makers, at the right time and in an appropriate way.

If the annual M&E reports do not suggest any need for revision in the first 3 years, they must be assessed again midway during implementation. However, if there is the availability of critical data or information ( eg. High-resolution data from satellites etc.), which could lead to significant change in the SAPCC at policy level, then SLSC for NAFCC may take an appropriate decision to update SAPCC.

### 10.1.3. M&E indicators

Indicators play a critical role in M&E systems. To develop effective indicators, it is essential to have a pragmatic approach. They must also be an effective representation of progress on climate change mitigation and adaptation. The indicators proposed in this SAPCC for M&E have been consulted with the departments and agreed upon by them. Quantitative indicators are more favourable towards policy and decision-making; hence, the indicators in this SAPCC are skewed towards the same.

Table 36: Indicative Sectoral Indicators for M&E

Transportation Sector	Monitoring Frequency
Percent reduction in road closures due to landslides or flooding	
Percent reduction in flooding where drainage capacity has been increased	
Improved decision making and sector planning based on climate change considerations	
Transport sector planning documents include adaptation strategies	
Length of road constructed to withstand climate change impacts	
Area of mangrove planted to protect coastal roads	
Percentage increase in population carried through public transport	
Percentage increase in number of bus stops	
Percentage increase in length of path provided for non-motorized transport	
Percentage increase in the distance traversed in km by the public transportation system	

Transportation Sector	Monitoring Frequency
Agriculture Sector	
Agriculture sector planning documents include adaptation strategies	
Number of hectares where climate-resilient cropping practices are introduced	
Number of hectares/communities where rainfall capture and adaptive irrigation management are introduced	
Area of mangrove planted to protect coastal agricultural land	
Number of agricultural officers, extension workers, and farmer cooperatives in target districts trained in climate change impacts on agricultural production and potential community-based adaptation options	
Agricultural land use planning in flood- and drought-prone areas analysed and alternative land use plans developed based on climate risk scenarios	
Improved decision making and sector planning based on climate change considerations	
Percentage of khazan lands protected	
Percentage of population depending on khazan lands provided with alternate livelihood options	
Percentage of non-efficient agricultural pumps replaced with energy efficient and solar pumps	
Energy Sector	
Percentage reduction in transmission and distribution loss	
MWh of solar power plants installed	
MWh of power through other alternate sources of power	
Percentage reduction in increase in power consumption	

## Annexures

### Annexure I: Acknowledgement to Individuals for SAPCC

Names of individuals who have contributed vide their inputs / response to questionnaires by GSBB

Ms. Kamakshi S Pai, Principal Consultant NABCONS / Chief General Manager NABARD	Dr. Bale
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Dr. Nitin Sawant	Shri. Prathamesh Naik
Dr. Charlette Fernandes	Mrs. Apoorva Apte
Dr. Baban Ingole	Dr. Gulab Borkar
Dr. Vinod Dhargalkar	Shri. Maurish Deniz
Dr. G. N. Nayak	Adv. Amol Tilve
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Dr. Shirish Gaonkar	Shri. Nilesh Prabhudessai
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Adv. Chandan Shirodkar	Smt. Deepika D'Silva
Shri. Alvito	Shri. Siddesh Sidhaye
Shri. J. Santano Rodrigues	Shri. Dinesh Desai
Dr. Agostinho Mesquita	Shri. Arturo De Souza
Dr. Nitin S. Naik	Shri. Manguesh Goankar
Dr. Elsa Da Costa	Shri. Mohan Kumar
Dr. Pratima Kesarkar	Shri. Pramod Narvekar
Dr. Saba	Shri. Sushant Naik
Dr. Arvind Haldankar	Shri. Owen Braganza- Assagao
Shri. Devanand Kavlekar	Shri. Nandakumar Bhagat

Dr. Lata Gaude	Shri. Mario Fernandes
Dr. Sushant Naik	Ms. Hyacinth Aguiyar
Dr. Antonio Mascarenhas	Shri. Nanda Kumar Bhagat
Adv. Kakodkar	Shri. Ganpat Siddhaye

## Annexure II: Proposed Treatment Facilities in Waste Management

Sr. No.	Proposed Project	Project Description	Estimated Cost	Source of Funding	Current Status	Proposed Timeline
1	Enhancement of Integrated Solid Waste Management Facility – Saligao (250 TPD +20%)	Recycle & Sorting Line, Segregation, Bio-methanation and In Vessel Composting of Capacity of 250 TPD  Proposed power generation after expansion is 24000 units per day	103.87 Cr	Proposed loan from Bank of Maharashtra	<ul style="list-style-type: none"> <li>Environmental Clearance granted from Goa State Environment Impact Assessment Agency.</li> <li>Consent to Establish obtained from the Goa State Pollution Control Board.</li> <li>GWMC will sign a contract agreement with Concessionaire after Council of Minister's approval is accorded.</li> </ul>	The project was scheduled to commence in March 2020 however due to administrative and financial approvals, and COVID 19 pandemic and consequent lockdowns, approval is expected to be completed by end of June 2020 where contract agreement will be signed with concessionaire and the project construction is expected to commence effectively post monsoons i.e. Sept 2020 and to be completed in 12 months, for trial operations which requires another 3 months' time. Therefore, the timeline for the effective operation of expanded Saligao plant to 250TPD is Dec 2021

Sr. No.	Proposed Project	Project Description	Estimated Cost	Source of Funding	Current Status	Proposed Timeline
2	<b>Integrated Solid Waste Management Facility – Cacora (100 TPD +25%)</b>	Recycle & Sorting Line, Segregation, Bio-methanation and In Vessel Composting of Capacity of 100 TPD  Proposed power generation shall be 10000 units per day	173.98 Cr	Loan from National Bank for Agriculture and Rural Development	<ul style="list-style-type: none"> <li>Environmental Clearance granted by Goa State Environment Impact Assessment Agency.</li> <li>Consent to Establish obtained by Goa State Pollution Control Board.</li> <li>Letter of Award has been issued and the Concession Agreement has been executed.</li> <li>Due to COVID 19, Pandemic and consequent lockdown pre-construction work at the site was suspended since the mobilization of men and material to the site was hampered due to the lockdown. However, the site development works such as levelling and providing stormwater drains, ground demarcation /marking for excavation etc. was done.</li> </ul>	The project was scheduled to commence in the month of March 2020 however due to COVID 19 pandemic, consequent lockdowns and monsoons, the work shall commence post monsoons in September 2020 and to be completed in 18 months i.e. <b>March 2022</b> which includes 3 months of trial operation

Sr. No.	Proposed Project	Project Description	Estimated Cost	Source of Funding	Current Status	Proposed Timeline
3	<b>Integrated Solid Waste Management Facility- Bainguinim (250 TPD +20%)</b>	Recycle & Sorting Line, Segregation, Bio-methanation and In-Vessel Composting of Capacity of 250 TPD  Proposed power generation shall be 24000 units per day	~250 Cr	State Government	<ul style="list-style-type: none"> <li>Environmental Clearance (EC) has been granted by the Goa State Environment Impact Assessment Agency.</li> <li>Tender documents based on RFQ and RFP is under final preparation and thereafter tender will be floated.</li> </ul>	The tender for Solid Waste Management Facility at Bainguinim was proposed to be floated by December 2020 after incorporating estimates of GSR 2019 and tweaking the tender document accordingly and work towards same shall commence April 2021 and expected to be completed in 18 months i.e. <b>October 2022</b> which includes 3 months of trial operation

Sr. No.	Proposed Project	Project Description	Estimated Cost	Source of Funding	Current Status	Proposed Timeline
4	<b>Solid Waste Management Facility -Verna (250 TPD + 20%)</b>	Recycle & Sorting Line, Segregation, Biomethanation and In Vessel Composting of Capacity of 250 TPD Proposed power generation shall be 24000 units per day	~300 Cr	State Government	Tender for conducting Rapid EIA studies was floated and on approval, letter of Intent (LoI) to the lowest bidder will be issued.	GWMC to complete EIA studies by December 2020. Upon grant of EC, GWMC shall float tender for SWMF 250 TPD.
5	<b>Construction &amp; Demolition Waste Management Facility - Bicholim (500 TPD)</b>	Recycling of C & D Waste through wet and dry process.	~120 Cr	Built Own Operate and Transfer after 20 years	GWMC has taken the possession of revenue, land under survey no 146/2,3,4,6 and 148/2,6,7 at Curchirem Village in Bicholim Taluka, North Goa and measuring an area of ~44,478 sqm on 12/06/2020 for setting up a C & D Waste Management facility.  Furthermore, GWMC consultant SINTEF, Scientific Research Organisation from Norway is assisting GWMC in development & implementation of new technologies in C&D Waste Management.	The consultant shall submit DPR within four weeks from taking possession of the land and GWMC shall float tender for setting up C & D Waste Management Facility by November 2020 and construction work towards the same shall commence by January 2021 and to be completed in 18 months i.e. <b>July 2022</b> including trial operation.

Sr. No.	Proposed Project	Project Description	Estimated Cost	Source of Funding	Current Status	Proposed Timeline
6	<b>Common Bio-Medical Waste Treatment facility (CBMWTF)</b>	200 kgs Per hour incinerators.	~12 Cr	Built Own Operate and Transfer after 20 years	<ul style="list-style-type: none"> <li>Health Care Facilities (HCFs) generate about 02 tonnes of BMW per day and are being disposed-off as per the provision of the Bio-medical Waste Rules, 2018.</li> <li>Goa Medical College (GMC) has commissioned incinerator since December 2019 having 100 Kg per hour capacity, wherein incinerable BMW collected from Government as well as Private HCFs' is treated.</li> <li>In respect of setting-up a CBMWTF, letter of Award has been issued to M/s Biotech Waste on 04<sup>th</sup> February 2020 and GWMC has signed the Concession Agreement with M/s Biotic Waste Solutions Pvt. Ltd. Delhi to set up the Common Biomedical Waste Treatment Facility at Kundaim Industrial Estate.</li> <li>Due to COVID 19 Pandemic and consequent lockdown mobilization of men and material at site to commence work has been hampered/delayed.</li> </ul>	The construction of the project was scheduled to commence in April 2020 however due to COVID 19 pandemic, consequent lockdowns and monsoons, the work shall commence in the month of September 2020 and to be completed in 15 months' time i.e. December 2021 including trial operation

Sr. No.	Proposed Project	Project Description	Estimated Cost	Source of Funding	Current Status	Proposed Timeline
7	<b>Common Hazardous Waste Treatment Storage and Disposal Facility (CHWTSDF)</b>	25,000 TPA Secured Landfill (SLF) & 1.5 tonne/hr incinerators	~90 Cr	Built Own Operate and Transfer after 25 years	<ul style="list-style-type: none"> <li>• Currently, the Hazardous Waste generated in the State are disposed of as per CPCB/GSPCB norms or guidelines for recycling and incineration at Maharashtra and Karnataka</li> <li>• Environmental Clearance has been granted by MoEF&amp;CC</li> <li>• Consent to Establish has been granted by Goa State Pollution Control Board.</li> <li>• As regard to setting-up a Common HW treatment and storage facility at Pissurlem industrial estate, it is informed that M/s Ponda Envirocare – an SPV of M/s SMS Envirocare (contractor) has commenced the erection of PEB-structure of shed-1 on-site.</li> <li>• Temporary laboratory facility on-site has been completed. Once the administration building is completed, the laboratory will be shifted accordingly.</li> <li>• Due to COVID 19 Pandemic and consequent lockdown mobilization of men and material to the site was hampered/delayed, so also laying of liners got delayed.</li> <li>• Laying of liners of the 1<sup>st</sup> Secured Landfill (SLF) will commence post-monsoon.</li> </ul>	The laying of liners of the 1 <sup>st</sup> SLF was supposed to be completed in May 2020 however due to COVID 19 pandemic, consequent lockdowns and oncoming monsoons, the laying of liners requires three months of the dry season, hence the laying of liners for 1 <sup>st</sup> Secured Landfill (SLF) shall commence post monsoons i.e. in the month of November 2020 and to be completed in by February 2021. The operations of the Landfill shall commence by March 2021

Sr. No.	Proposed Project	Project Description	Estimated Cost	Source of Funding	Current Status	Proposed Timeline
8	<b>10 TPD Biodigester &amp; 10 TPD Material Recovery Facility at Chicalim and neighbouring 3 Village Panchayat</b>	Sorting Line, Segregation and Bio-methanation of Capacity of 10 TPD Proposed power generation shall be 750 units per day	~15 Cr	CSR from Airport Authority of India (AAI)	<ul style="list-style-type: none"> <li>• GSPCB has granted Consent to Establish for Chicalim 10 TPD Biodigester.</li> <li>• Tender of 10 TPD Biodigester Plant was floated and opened on 16/06/2020.</li> <li>• Scrutiny of technical documents is in process.</li> </ul>	Jan 2021

### Annexure III: REGIONAL WATER SUPPLY SCHEMES

Name of the Regional Water Supply Scheme (Source)	Rated Capacity in MLD	Production in MLD	Taluka Covered
1	2	3	7
Assonora Water Supply Scheme (Tillari Irrigation Canal/ Kalna River)	92.00	104.00	Bardez & Bicholim (Part)
Chandel Water Supply Scheme (Tillari Irrigation Canal/ Kalna River)	15.00	16.02	Pernem Taluka
Podocem Water Supply Scheme (Valvanti River)	40.00	36.00	Bicholim & Sattari (Part)
Sankhalim Water Supply Scheme (Valvanti River)	12.00	12.00	Bicholim (Part)
Dabose Water Supply Scheme (Madei River)	15.00	13.40	Sattari (Part)
Opa Water Supply Scheme (Khandepar River)	142.00	119.80	Ponda & Tiswadi
Canacona Water Supply Scheme (Ardhopond River)	15.00	8.00	Canacona Taluka
Salaulim Water Supply Scheme (Salaulim Dam)	260.00	260.00	Sanguem (Part) Quepem Mormugao Salcete
Maisal Water Supply Scheme (Maisal Dam)	10.00	10.00	Ponda (Part)
<b>TOTAL</b>	<b>601.00</b>	<b>580.22</b>	

### ADDITIONAL WATER SUPPLY SCHEMES – PRESSURE FILTERS

Name of the Regional Water Supply Scheme (Source)	Rated Capacity in MLD	Production in MLD	Taluka Covered
1	2	3	7
Verna Water Supply Scheme (Salaulim Dam)	10.00	10.00	Mormugao (Part)
Shivde Water Supply Scheme (Ragada River)	1.00	0.82	Sanguem (Part)
Sanvordem Water Supply Scheme (Madei River)	1.00	0.30	Sattari (Part)
Paikul Water Supply Scheme (Valvanti River)	1.00	0.30	Sattari (Part)
Nagargao Water Supply Scheme (Madei River)	0.50	0.20	Sattari (Part)
Keri Water Supply Scheme (Anjuna Dam)	2.00	1.80	Sattari (Part)
Guleli Water Supply Scheme (Anjuna Dam)	1.00	1.00	Sattari (Part)
<b>TOTAL</b>	<b>16.50</b>	<b>14.42</b>	

### ADDITIONAL WATER SUPPLY SCHEMES – SPOT SOURCES

Type of Spot Source	No. of Sources	Rated Capacity in MLD	Production in MLD	Taluka Covered
1	2	3	4	5
Tube Well	15	0.20	0.20	Canacona (Part)
Open Well	18	0.30	0.30	Canacona (Part)
Spring	06	0.80	0.80	Canacona (Part)
Tube Well	06	0.65	0.53	Sanguem (Part)
Open Well	13	0.50	0.48	Sanguem (Part)
Spring	05	0.28	0.13	Sanguem (Part)
Tube Well	23	0.90	0.80	Quepem (Part)
Open Well	03	0.20	0.18	Quepem (Part)
Spring	04	0.30	0.25	Quepem (Part)
Tube Well	14	0.31	0.31	Pernem (Part)
Open Well	17	0.56	0.56	Pernem (Part)
Tube Well	13	0.91	0.91	Sattari (Part)
Open Well	17	0.88	0.88	Sattari (Part)
<b>Total</b>	<b>154</b>	<b>6.79</b>	<b>6.33</b>	

**PROPOSED PROJECTS: (110 MLD)**

Sr. No.	Proposal	Capacity (MLD)	Taluka benefitted	Financial implications (In Crores)	Completion Period
<b>A</b>	<b>NORTH GOA</b>	-			
1	WTP at Porvorim (work is ongoing)	15	Bardez	27.00	2020
2	WTP at Chandol (work is ongoing)	15	Pernem	85.10	2022
3	WTP at Tuem	30	Pernem	88.00	2023
4	WTP at Assonora	30	Bardez	15.00	2022
5	WTP at Anjuna	5	Bardez	5.00	2023
6	WTP at Podocem	5	Bicholim	5.00	2020
	<b>Total</b>	<b>100</b>			
<b>B</b>	<b>SOUTH GOA</b>	-			
1	WTP at Canacona	5	Canacona	43.00	2023
2	WTP at Netravali	5	Sanguem	30.10	2023
	<b>Total</b>	<b>10</b>			
	<b>TOTAL</b>	<b>110</b>	<b>298.20 Crores</b>		
<b>C</b>	<b>Replacement of aged old pipelines, network including main trunks across Goa</b>			<b>2000.00 Crores</b>	<b>2020-2025</b>

**Annexure IV: Soil Classification and Soil Series**

The following table gives information about Soil series, their area, classification and use.

**Table: Details of Soil Series**

Sr. No.	Soil Series	Area *(ha.)	Classification	Present land use	Suggested land use
1	Arukot	17,679	Very fine, Kandic Paleustalfs		Coconut with intercrops
2	Batim	6,857	Fine, Kanhaplic Haplustalfs	Wetland rice	Rice in Kharif and pulses/vegetables in rabi
3	Bandoli	29,242	Clayey, Typic Haplustults	Pasture Land	Coconut with intercrops/ Cashew
4	Chapora	9,950	Fine- loamy, typic Ustropepts	Coconut, Mango etc	Coconut with intercrops/ Cashew
5	Dabolim	6,289	Loamy, Lithic Ustorthents	Grazing land	Forest/Natural vegetation
6	Dande	793	Clayey, Kanhaplic Haplustalfs	Thin Forest Pasture land	Forest; may be interspersed with cashew
7	Darbandora	5,247	Very fine, Ustoxic Humitropepts	Forest interspersed with cashew	No change
8	Devabag	816	Clayey- Skeletal, Typic Ustropepts	Thin forest	Forest: may be interspersed with cashew
9	Gavane	22,583	Clayey- Skeletal, Typic Ustropepts	Coconut with intercrops	Forest interspersed with cashew
10	Gudi	1,061	Fine- Loamy, Ustoxic Dystropepts	Thin forest	Forest interspersed with cashew
11	Harmal	1,334	Typic Ustipsamments	Coconut	Coconut/ Casuarina plantations
12	Karmali	3,034	Clayey, Lithic Dystropepts	Cashew	Forest interspersed with cashew
13	Kalangute	10,495	Fine - Loamy, typic Tropaquets	Wetland rice	Wetland rice
14	Karven	12,287	Clayey- skeletal, Oxic Ustropepts	Thin forest	Forest interspersed with cashew
15	Kolva	558	Fine loamy, Typic Sufaquents	Wetland with natural vegetation	Wetland with natural vegetation
16	Madgaon	22,860	Loamy- skeletal, Fluventic Ustropepts	Forest interspersed with cashew	Forest interspersed with cashew

17	Mandavi	616	Typic Ustipsamments	Barren land	Natural vegetation
18	Metavada	18,409	Clayey- skeletal, Lithic Dystropepts	Forest	Forest interspersed with cashew
19	Nagowa	13,592	Fine, Ustoxic Dystropepts	Coconut	Coconut with intercrops
20	Netravali	44,312	Clayey- Skeletal, Ustoxic Dystropepts	Forest	Forest interspersed with cashew
21	Panaji	385	Typic Psammaquents	Rice/Salt pans	Wetland rice
22	Padi	3,572	Loamy- Skeletal Ustoxic Dystropepts	Forest	Forest interspersed with cashew
23	Pali	4,198	Fine Loamy, Ustic Dystropepts	Rice/Pasture	Coconut, arecanut, rice, sugarcane, vegetables etc.
24	Raya	3,080	Clayey- Skeletal, Lithic Ustrorthents	Grazing land	Forest
25	Saligao	2,570	Clayey- Skeletal, Typic Kanhaplustults	Pasture land	Coconut with intercrops
26	Surla	1,076	Very fine, Typic Ustropepts	Cashew	Forest interspersed with cashew
27	Torse	52,005	Clayey- Skeletal, Lithic Dystropepts	Thin forest/ Grassland	Forest/Natural vegetation
28	Ugeum	5,451	Very fine, Fluventic Ustropepts	Rice	Wetland rice
29	Velge	13,325	Loamy- Skeletal, Lithic Ustrorthents	Forest/Grassland	Forest
30	Verna	8,191	Clayey- skeletal, Lithic Dystropepts	Forest	Forest interspersed with cashew
31	Zaimolo	10,824	Clayey, Typic Paleustults	Coconut	Coconut with intercrops
32	Zuari	17,639	Very fine, Aquic Ustropepts	Rice	Wetland rice

1.\*Excluding area covered by water bodies and rock outcrops

## Annexure V: Sewerage and STP system

### EXISTING SEWERAGE SCHEMES & STP's

Name of the Sewerage Scheme	Installed Capacity in MLD	Treatment done in MLD	Area Covered
1	2	3	4
Sewerage Scheme for Panaji Sewerage Scheme for Taliegao (part)	12.5 + 15 = 27.50	10.00	Panaji City, Mala, St. Inez, Altinho, Miramar, Campal, Part of Taleigao, Caranzalem & surrounding
Sewage Treatment Plant at GMC Bambolim	1.35	0.50	Goa Medical College, Bambolim
Sewerage Scheme for Sanquelim (Part)	0.80	0.30	3 Wards of Sanquelim Municipal area
Sewerage Scheme for Durbhat	1.00	0.30	Durbhat Village
Sewerage Scheme for Vasco	20.00	4.00	Vasco City, Sada, Baina, Mormugao, Mangor Hill, Dabolim Part and surrounding
Sewerage Scheme for Margao	20 + 6.7 = 26.70	8.50	Margao City, Fatorda and surrounding
Sewerage Treatment Plant at Zuarinagar Sancoale	1.00	1.00	Slum area of Zuarinagar Sancoale
NTS Pythorid Plant at Porvorim, Varkhande	0.08+0.05 = 0.13	0.08+0.05 = 0.13	Education Dept & Surrounding, Varkhande
<b>TOTAL</b>	<b>78.48</b>	<b>24.73</b>	

**Note:** All the above STP's are commissioned 2015 onwards and are designed for 30 years i.e. for 2045 onwards except 12.50 MLD STP at Panaji.

### SEWERAGE SCHEMES AND STP's inProgress and Proposed

Name of the Sewerage Scheme	STP Capacity in MLD	Status	Area proposed to be Covered	Time frame
1	2	3	4	
Sewerage Scheme for Mapusa	5.40	Under construction	Mapusa Municipal area (Part)	May 2021
Sewerage Scheme for North Coastal Belt (Calangute – Baga)	5.60	Under Construction	Calangute – Baga and Surrounding	Dec. 2021
Sewerage Scheme for Panaji-Patto	2.00	Under Construction	Panaji Patto area, Mala, Fontainhas and surroundings	May 2021
Sewerage Shceme for Porvorim	15.00	Network done, STP to be taken up for construction	Porvorim plateau area and surroundings	Dec. 2021
Sewerage Scheme for Ponda, Curti, Kavelem & Bandora	8 + 15 + 15 = 38.00	15 MLD STP at Kavelem ins under construction	Ponda Municipal area, Curti (part), Kavelem and Bandora Village	Partial by May 2021
Sewerage Scheme for Colva – South Coastal Belt Phase I	7.50	Under Construction	Colva Village, Gaundalim, Vanelim, Sernabatim (part)	May 2021
<b>TOTAL</b>	<b>73.50</b>			

### ADDITIONAL SEWERAGE SCHEMES – DPR's Prepared

It is proposed to cover all the major towns with sewerage network using appropriate technology, to achieve total sanitation and clean environment in urban and rural areas. Provide sewerage network in all low-lying unsewered areas followed by extension of the network to all unsewered areas. Studies have been done and DPRs have been prepared for sewerage schemes for major cities/coastal areas, listed below along with estimated cost.

Sr. No.	New Proposals	Amount in Cr.	Time Frame
1.	Sewerage Scheme for Curchorem and its surrounding areas	155.88	2021-31
2.	Sewerage Scheme for Siridao Palem village in Tiswadi Taluka	47.84	2021-31
3.	Sewerage Scheme for Saligao, Nerul, Pilerne and Surrounding areas	175.00	2021-31
4.	Sewerage Scheme for Savordem and its surrounding areas	82.51	2021-31
5.	Sewerage Scheme for Candolim and Surrounding areas	254.00	2021-31
6.	Sewerage Scheme for Bicholim and Surrounding areas	185.00	2021-31
7.	Sewerage Scheme South Coastal Belt Phase II	534.36	2021-31
8.	Sewerage Scheme Dabolim and its surrounding areas in Mormugao-Taluka – Phase II	275.00	2021-31
9.	Sewerage Scheme for Marcela Town and Surrounding areas	256.00	2021-31
10.	Sewerage Scheme for Old Goa (Heritage Site) and Surrounding areas	284.00	2021-31
11.	Sewerage Scheme for Valpoi Municipal town and Surrounding areas	110.00	2021-31
12.	Sewerage Scheme for Pernem Municipal area and Surrounding agglomerates	75.00	2021-31
13.	Sewerage scheme for St.Cruz constituency in Tiswadi-Taluka.	379.00	2021-31
14.	Sewerage Scheme Cortalim and its surrounding areas in Mormugao-Taluka – Phase I	265.00	2021-31
	<b>Total</b>	<b>3078.59</b>	Time frame as per Availability of funds

## Annexure VI: References

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**Annexure VII: Minutes of the 16<sup>th</sup> meeting of National Steering Committee on Climate Change (NSCC) held on 24<sup>th</sup> August 2022.**

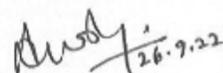
**No. 14/08/2017-CC  
Government of India  
Ministry of Environment, Forest & Climate Change  
Climate Change Division**

**Fifth Floor, Vayu Wing  
Indira Paryavaran Bhawan  
Jor Bagh Road,  
New Delhi-110003**

**26<sup>th</sup> September, 2022**

**Subject: 16<sup>th</sup> Meeting of National Steering Committee on Climate Change (NSCCC)-reg.**

The minutes of the 16<sup>th</sup> meeting of National Steering Committee on Climate Change (NSCCC) held under the chairpersonship of Secretary (EF&CC) on 24<sup>th</sup> August 2022 at 4.30 P.M. through hybrid mode is enclosed for kind information.



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Director (CC)  
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**To**

**All Members of National Steering Committee (List attached)**

Copy to:

1. PPS to Secretary (E&FCC), MoEFCC
2. PPS to AS (RS), MoEFCC
3. PS to JS (NKS), MoEFCC

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\*\*\*\*\*

**Minutes of the 16<sup>th</sup> National Steering Committee on Climate Change held under the Chairpersonship of Secretary (EF&CC) on 24.08.2022**

The sixteenth meeting of the National Steering Committee on Climate Change (NSCCC) was held on 24<sup>th</sup> August 2022 at 4.30 PM through Hybrid Mode under the Chairpersonship of Secretary (EF&CC). The agenda of the Meeting is placed at **Annexure-A**. The list of participants is placed at **Annexure-B**.

2. Secretary EF&CC and Chair of NSCCC, welcomed all the participants, and directed Joint Secretary (CC) to initiate discussion as per agenda.

**Agenda 1 - Action taken report on the 15<sup>th</sup> National Steering Committee Meeting held on 28.10.2020.**

3. In respect of the ATR, in compliance to **Para 3.iv** of the 15<sup>th</sup> NSCCC Meeting held on 28.10.2020, the Joint Secretary informed that Chairman of NSCCC had directed not to release any further funds in the Regional Project, titled "Climate Resilience Building among Farmers through Crop Residue Management", being implemented under the National Adaptation Fund on Climate Change in the States of Punjab, Haryana, UP & Rajasthan State (**Annexure D**). **The Members agreed to the post facto approval of NSCCC for closure of this project.**

4. In compliance to the Para 3.v. of the 15<sup>th</sup> NSCCC, NABARD informed that they have developed and launched a Climate Change Portal for monitoring all climate change projects including National Adaptation Fund on Climate Change (NAFCC), Adaptation Fund (AF) and Green Climate Fund (GCF). A mobile app has also been developed for field level monitoring of the projects.

**Agenda 2 - Approval of revised State Action Plan on Climate Change (SAPCC) documents submitted by the States/UTs: Brief presentation by the States**

5. Joint Secretary, Climate Change, MoEFCC informed that four States Goa, Odisha, Himachal Pradesh and Gujarat had submitted their SAPCC after the review of the Expert Committee on Climate Change on 3<sup>rd</sup> March 2022. Goa had prepared the SAPCC for the first time whereas Odisha, Himachal Pradesh and Gujarat had revised their existing SAPCC based on the SAPCC guidelines issued in the year 2019 from the Ministry. Each of the States made presentation before the Committee alongwith compliance to the recommendations made by the Expert Committee on Climate Change.

6. Responding to the presentation of SAPCC by Goa, the **Chair** asked to highlight the priority and financial allocation accorded within the five pillars -

Transportation, Power, Agriculture, Forest sector and waste management. NABARD informed that a request has been received from Goa for having a NAFCC project. NDMA advised to include organic linkages of disaster management with cyclones. **Ministry of Power** mentioned that the expenditure patterns should be clearly demarcated. **DARE** mentioned that for the agricultural interventions, State needs to be in touch with the ICAR- Central Coastal Agricultural Research Institute. **DST** suggested to have synergy with the support being provided from the climate change cell of DST for the activities mentioned in the SAPCC. In response, the **State** mentioned that all such suggestions and observations are being taken up in the SAPCC. **The Committee approved the Goa SAPCC in principle** but advised to specify the financial allocations identified within the sectors in the SAPCC. Also to avoid duplication the SAPCC should specify the support received from the Central and State Government Departmental initiatives and ensure better convergence for having more impact.

7. Gujarat after making the presentation on revised SAPCC, as a response to the Committee, mentioned that the core elements under mitigation and adaptation included in the SAPCC are renewable energy, water resources, agriculture, disaster management, coastal and desert regions, rural and urban livelihoods, biodiversity, forest sector, infrastructure and industry and health sector. **The Committee approved the revised SAPCC of Gujarat.**

8. Responding to the presentation made by the State of Himachal Pradesh, The Chair advised to check whether the design of Sustainable infrastructure had been included in the SAPCC, especially the roads and highways which are highly vulnerable to landslides and flash floods. The Chair also advised to check whether the sustainability of roads and highways in the context of climate vulnerability had been addressed in the State by any other scheme of the Central/State Government. If not, then it was advised to include the design of sustainability of the roads and highways in the SAPCC. In context of energy sustainability approach, Ministry of Power advised to connect with the Department of Energy in the State to get some important demand side measures, so as to form part of the energy policy. **The Committee accorded in principle approval to the revised SAPCC of Himachal Pradesh.**

9. Odisha State in the presentation mentioned that they identified 12 sectors viz: Agriculture, Coast & Disaster management, Energy, Fisheries & ARD, Forestry, Health, Industries, Mining, Transport, Urban Development, Water Resources, Waste Management. Responding to Ministry of Power, the State mentioned that under the Mining sector major measures prioritized are green belt development and formation of avenue plantation for reducing the heat island impact. After the presentation, Chair of the Committee complimented Odisha for following a comprehensive and cohesive approach where macro to micro activities have been brought out including the budgeting part. NABARD suggested that the competencies

developed by the State Governments through the SAPCC may be taken up for mainstreaming into the planning for other relevant areas and Departments.

**The Committee approved the revised SAPCC of Odisha and suggested the States to follow the suggestions made by the Committee.**

***Agenda 3 - A brief presentation on NAFCC projects by NIE (NABARD) to appraise the overall project progress to the Committee.***

**10.** National Implementing Entity (NIE) of National Adaptation Fund for Climate Change (NAFCC), National Bank for Agriculture and Rural Development (NABARD) made a presentation on overall progress in implementation of NAFCC. Key highlights of the presentation were as follows:

- i. 30 projects, including two regional projects, have been sanctioned under NAFCC. Total sanctioned project cost for these 30 projects is Rs 847.48 cr.
- ii. As on 18.08.2022, a sum of Rs 579.83 crore was released by MoEFCC to NABARD. NABARD in turn released a sum of Rs 511.45 crore to the Executive Entities (EEs) in States/UTs. Eleven states have utilized above 75% of the grant, eight states have utilized between 51%-75% of the grant; seven states have utilized between 26%-50% of the grant and in four states utilization is below 25%.
- iii. There were delays in implementation mainly due to initial operational requirements like opening of separate project specific bank account; requests for changes in components of project; inter-departmental coordination issues and country wide lockdown due to covid pandemic.

***Agenda 4 - Proposal for consideration for extension/component changes of the NAFCC projects since last Steering Committee meeting: Post facto approval of NSCCC to the projects given extension/component change since the last Steering Committee Meeting***

**11.** JS (CC) informed the Committee that the Ministry had received proposal for extension/component changes in the NAFCC projects from the States of Himachal Pradesh, Maharashtra and Gujarat (**Annexure- II**). The proposals presented before the NSCCC for consideration and approval are -

- 11.1. For the ongoing NAFCC project in Himachal Pradesh -
  - i. No-cost extension for 15 months up to 31st March 2023
  - ii. Utilize the balance funds in additional climate change adaptation focused activities in the project area
- 11.2. For the ongoing NAFCC project in Maharashtra -
  - i. No-cost extension up to 31st March 2023.
  - ii. Area expansion of following components

- a. Area expansion of drip/sprinkler component in all the villages of Nadurbar district and all the villages of Devulgain Raja tehsil of Buldhana district
- b. Area expansion of Farm Pond lining and Plastic Mulching component in all the villages of Navapur tehsil of Nadurbar district and all the villages of Devulgain Raja tehsil of Buldhana district

11.3. For the ongoing NAFCC project in Gujarat -

- i. Revision in physical target under Micro Irrigation Scheme from 460 ha to 405 ha without changing the sanctioned budget of the component.

**The above three proposals of Himachal Pradesh, Maharashtra and Gujarat mentioned at 11.1, 11.2, 11.3 were approved by the Committee.**

**12.** JS (CC) apprised the committee that Post facto approval of NSCCC is required for the twenty-one projects given extension/ component change since the last 15th NSCCC Meeting. These proposals had the recommendation of the State's Chief Secretary / State Level Steering Committee of Climate Change as well as that of the National Implementing Entity. To avoid any delays in project execution, these 21 projects were accorded concurrence by Secretary (EFCC) in the capacity as Chairperson of the National Steering Committee, subject to post-facto approval of NSCCC. JS said that the extension/component changes in the 21 projects are presented for post facto approval of the NSCCC. **The Committee accorded post facto approval to the twenty-one (21) projects (Annexure-III).**

**13.** The meeting ended with thanks to the Chair.

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#### Annexure-A

**16th meeting of National Steering Committee on Climate Change (NSCCC) through Hybrid Mode under the Chairpersonship of Secretary (EF&CC)**

**Date: 24<sup>th</sup> August, 2022**

**Time: 4.30 P.M.**

**Venue: Kaveri Hall, 4<sup>th</sup> Floor, Prithvi Wing, Indira Paryavaran Bhawan, New Delhi**

#### Agenda

1. Action taken report on the 15th National Steering Committee Meeting held on 28.10.2020.
2. Approval of revised State Action Plan on Climate Change (SAPCC) documents submitted by the States/UTs: Brief presentation by the States
3. A brief presentation on NAFCC projects by NIE (NABARD) to appraise the overall project progress to the Committee.
4. Proposal for consideration for extension/component changes of the NAFCC projects since last Steering Committee meeting: Post facto approval of NSC to the projects given extension/component change since the last Steering Committee Meeting
5. Any other Items with the approval of the Chair.

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#### Annexure B

**Meeting of the Sixteenth National Steering Committee on Climate Change held on 24.08.2022 (Hybrid Mode) at 4.30 P.M. at Kaveri Hall, 4<sup>th</sup> Floor, Prithvi Wing, Indira Paryavaran Bhawan, New Delhi**

#### List of Participants

1. Ms Leena Nandan, Secretary, MoEFCC - In Chair
2. Shri Neelesh Kumar Sah, Joint Secretary, MoEFCC
3. Shri Amit Raj, Director, MoEFCC
4. Shri Ajay Tewari, Additional Secretary, Ministry of Power, Email as-power@nic.in
5. Shri. Kunal Satyarthi, Joint Secretary/Advisor (Policy & Plan), National Disaster Management Authority (NDMA), Email kunalsatyarthi@gmail.com
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#### Annexure-I

#### Post facto approval of NSCCC for the closure of Regional Project (for Punjab, Haryana, UP & Rajasthan State) regarding - Climate Resilience Building among Farmers through Crop Residue Management.

<b>Project Name</b>	'Climate Resilience Building among Farmers through Crop Residue Management'
<b>Project Duration</b>	3 years ( 23.02.2018- 22.02.2021)
<b>Project Location</b>	Punjab, Haryana, Rajasthan & Uttar Pradesh
<b>Major Project Components</b>	(i) Awareness Creation by NABARD; (ii) Diversification by State Governments; (iii) In- Situ management of crop residue; (iv) Provision of machineries/implement related to residue management and (v) Fodder banks
<b>Sanction Letter Date</b>	23.02.2018
<b>Lead Departments</b>	i. Punjab – Department of Agriculture (DoA) & Punjab Council for Science & Technology ii. Haryana – Department of Agriculture (DoA) iii. Rajasthan – Department of Agriculture (DoA) and Dept. of Animal Husbandry iv. Uttar Pradesh - Department of Agriculture (DoA) and UP State Bio – Energy Development Board
<b>Project Extension (if any)</b>	This is a non-starter project. No proposals were received for the extension.
<b>Total Grant Assistance Sanctioned (INR)</b>	120,66,00,000
<b>Amount Received by NABARD from MoEFCC (INR)</b>	60,33,00,000
<b>Amount released by NABARD to Executing Entity (EE) (INR)</b>	44,05,78,254
<b>Percentage of utilized amount by EE against sanctioned amount</b>	21.3

2. Under (NAFCC), the regional project on 'Climate Resilience Building among Farmers through Crop Residue Management' was approved on 28th December 2017 at a total cost of Rupees 120.66 Cr for a period of 3 years (01.04.2018 to

31.03.2021). The project is being implemented in the States of Punjab, Haryana and partly in Rajasthan and Uttar Pradesh.

3. The project was reviewed in the virtual Meeting organized under the Chairpersonship of Joint Secretary (Climate Change), MoEFCC on 17th July 2020 and 1st March 2021. Despite the suggestions provided in the review meetings, the project progress remains unsatisfactory.

4. The project is due for completion on 31st March 2021; however, it remained as a non-starter in Rajasthan as well Uttar Pradesh and progressed with a slow pace in Punjab and Haryana. **Considering the status of the project, a view has been taken on 22<sup>nd</sup> March 2021 by the Secretary MoEFCC and Chairman, National Steering Committee on Climate Change that no further funds will be released under this project by anyone.** Further Ministry has issued letter dated 26<sup>th</sup> March 2021 to NABARD and requested to send the Project Closure Report.

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## Annexure-II

### THREE EXTENSION/COMPONENT CHANGE PROPOSALS PLACED BEFORE THE NSCCC

#### **I. Proposal for No-Cost extension and additional components of NAFCC project on "Sustainable Livelihoods of Agriculture - Dependent Rural Communities in Drought Prone District of Himachal Pradesh Through Climate Smart Solutions" in Himachal Pradesh.**

The Executive Entity (EE) of Himachal Pradesh has submitted proposal of no-cost extension for 15 months up to 31st March 2023 and utilise balance funds in additional climate change adaptation focused activities for NAFCC project on "Sustainable Livelihoods of Agriculture - Dependent Rural Communities in Drought Prone District of Himachal Pradesh Through Climate Smart Solutions".

2. The project details are given below:

Project Name	Sustainable Livelihoods of Agriculture - Dependent Rural Communities in Drought Prone District of Himachal Pradesh Through Climate Smart Solutions
Project phasing	5 years (January 2016 to December 2020) First extended upto Dec 2021
Project Location	3 blocks (Pachhad, Sangrah and Paotna) of Sirmour district of Himachal Pradesh
Executing Department	Department of Environment, Science and Technology, Government of Himachal Pradesh
Present Proposal	iii. No-cost extension for 15 months up to 31st March 2023 iv. Utilize the balance funds in additional climate change adaptation focused activities in the project area

3. The proposal is approved by the SLSC and recommended by NABARD.

**II. Proposal for No-Cost extension and area expansion of components of NAFCC project on “Efficient Water Management and Agriculture Technology Adoption for Climate Adaptive and Resilient Farming System in 51 villages of Nandurbar and Buldhana Districts of Maharashtra State ”.**

The Executive Entity (EE) of Maharashtra has submitted proposal of no-cost extension up to 31st March 2023 and area expansion of components for NAFCC project on “Efficient Water Management and Agriculture Technology Adoption for Climate Adaptive and Resilient Farming System in 51 villages of Nandurbar and Buldhana Districts of Maharashtra State ”.

2. The project details are given below:

Project Name	Efficient Water Management and Agriculture Technology Adoption for Climate Adaptive and Resilient Farming System in 51 villages of Nandurbar and Buldhana Districts of Maharashtra State
Project phasing	4 Years (Feb 2017– Feb 2021) First extended upto March 2022
Project Location	37 villages of Navapur block in Nandurbar district and 14 villages of Deulgaoon Raja block in Buldhana district.
Executing Department	Vasundhara Watershed Development Agency
Present Proposal	iii. No-cost extension up to 31st March 2023. iv. Area expansion of following components a. Area expansion of drip/sprinkler component in all the villages of Nadurbar district and all the villages of Devulgain Raja tehsil of Buldhana district b. Area expansion of Farm Pond lining and Plastic Mulching component in all the villages of Navapur tehsil of Nadurbar district and all the villages of Devulgain Raja tehsil of Buldhana district

3. The proposal is approved by the SLSC and recommended by NABARD.

**III. Proposal for revision in physical target of NAFCC project on “Climate change adaptation for natural resources dependent communities in Kachchh, Gujarat: strengthening resilience through water and livelihood security and ecosystem restoration ” in Gujarat.**

The Executive Entity (EE) of Gujarat has submitted proposal of revision in physical target under Micro Irrigation Scheme from 460 ha to 405 ha without changing the sanctioned budget of the component for NAFCC project on “Climate change adaptation for natural resources dependent communities in Kachchh, Gujarat: strengthening resilience through water and livelihood security and ecosystem restoration”.

2. The project details are given below:

Project Name	Climate change adaptation for natural resources dependent communities in Kachchh, Gujarat: strengthening resilience through water and livelihood security and ecosystem restoration
Project phasing	4 years (March, 2017 to June, 2021) First extension upto March 2022 Second extension upto Sept 2022
Project Location	3 Talukas of Kachchh district (Khadir bet in Bhachau taluka, Abdasa taluka, Banni grassland in Bhuj taluka)
Executing Department	Gujarat Ecological Education and Research (GEER) Foundation, Gujarat.
Present Proposal	Revision in physical target under Micro Irrigation Scheme from 460 ha to 405 ha without changing the sanctioned budget of the component.

3. The proposal is approved by the SLSC and recommended by NABARD.

**Annexure -III**

**Extension/Component changes agreed to the NAFCC projects since the last NSCCC Meeting (held on 28.10.2020)**

Sl No	State/UT and Project Name	Original tenure of the Project	Extension/component change agreed with date of letter issued to NABARD
1	<b>Madhya Pradesh</b> Increasing Adaptive Capacity to Climate Change through developing climate-Smart Villages in Select Vulnerable Districts of Madhya Pradesh	16/8/2016 to 15/8/2019	Second no cost extension for two years till 16th August 2022 and component changes as per the following details: <ul style="list-style-type: none"> <li>Number of villages for construction of lined farm ponds increased to 100 per district</li> <li>The component on fodder bank dropped.</li> <li>Create end-to-end communication system for sharing the weather advisories with farmers</li> <li>Under energy smart component, solar irrigation pumps to farmers included.</li> </ul> (Date of Letter issued: 10-11-2020)
2	<b>Puducherry</b> Integrated Surface Water Management through rejuvenation of 20 tanks and 32 village ponds for Climate Change Adaptation in Puducherry	30/3/2016 to 29/3/2020	Change in project name as 'Integrated Surface Water Management for Climate Change Adaptation in U.T. of Puducherry' along with revision of DPR and First no cost extension till April 2022. (Date of Letter issued: 24-11-2020)  Second no cost extension of the project up to September 2022. (Date of Letter issued: 24-05-2022)
3	<b>Kerala</b> Promotion of integrated farming system of	31/12/2015 to 30/12/2019	Second no cost extension of the project till 31 October 2021 and utilisation of balance of Rs. 0.56 crore in the contingency fund.

Sl No	State/UT and Project Name	Original tenure of the Project	Extension/component change agreed with date of letter issued to NABARD
	Kaipad in coastal wetlands of North Kerala		(Date of Letter issued: 25-11-2020.)
4	<b>Punjab</b> Towards Climate Resilient Livestock Production System in Punjab.	16/12/2015 to 15/12/2020	First no cost extension of the project till October 2022 and change in components as per the details given below: <ul style="list-style-type: none"> <li>Setup a biogas digester of 100 cubic meter capacity along with 10 KW Genset in place of a biogas plant and bottling unit</li> <li>LED street lights, soft lights and provisioning of LED lights in other Gaushalas of the project district, in place of 2000 LEDs in selected Gaushala sheds.</li> </ul> (Date of Letter issued: 11-01-2021)  Re-appropriation of funds as per the following details: <ul style="list-style-type: none"> <li>Additional amount of Rs. 3.22 lakh for setting up biogas plant – approved for utilise the available budget of Miscellaneous Head</li> <li>A sum of Rs. 3.31 lakh for hiring research fellow - approved for use unutilised amount under activities 17b,2.12,1.13 and Miscellaneous Head</li> </ul> (Date of Letter issued: 28-04-2022)
5	<b>Himachal Pradesh</b> Sustainable Livelihoods of agriculture – dependent Rural communities in drought prone district of Himachal Pradesh	31/12/2015 to 30/12/2020	First no cost extension of the project till 31 December 2021 (Date of Letter issued: 05-02-2021)

Sl No	State/UT and Project Name	Original tenure of the Project	Extension/component change agreed with date of letter issued to NABARD
			through climate smart solutions.
6	<b>Rajasthan</b> MukhyaMantri Jal SwavlambanAbhiyaan (MJSA) for Climate Change Adaptation and Water harvesting in Arthuna, Anandpuri and Sajjangarh Blocks of District Banswara in Rajasthan.	25/9/2017 to 24/9/2018	Third no cost extension of the project till 30 June 2021 (Date of Letter issued: 08-02-2021)
7	<b>Gujarat</b> Climate Change adaptation for Natural Resource Dependent communities in Kachchh, Gujarat.	23/3/2017 to 22/3/2021	First no cost extension of the project till 31 March 2022 (Date of Letter issued: 23-02-2021)  Included additional component promoting 'Virdas' under Pastoral Area for Water security, without any cost escalation (Date of Letter issued: 2-08-2021)  Second no cost extension of the project till 30 September 2022 (Date of Letter issued: 18-04-2022)
8	<b>Karnataka</b> Conservation and Management of Indigenous varieties of livestock (Cattle and Sheep) in the Wake of Climate Change in Karnataka.	16/8/2016 to 15/8/2021	First no cost extension of project for one year till 15 August 2022 and revision of project component by dropping the fodder making units (Date of Letter issued: 06-04-2021)
9	<b>Odisha</b> Conserve Water through the Management of runoff in the River basin to improve ground water recharge to reduce	16/12/2015 to 15/12/2018	Second no cost extension of the project till March 2022 (Date of Letter issued: 03-06-2021)  Third no cost extension of the

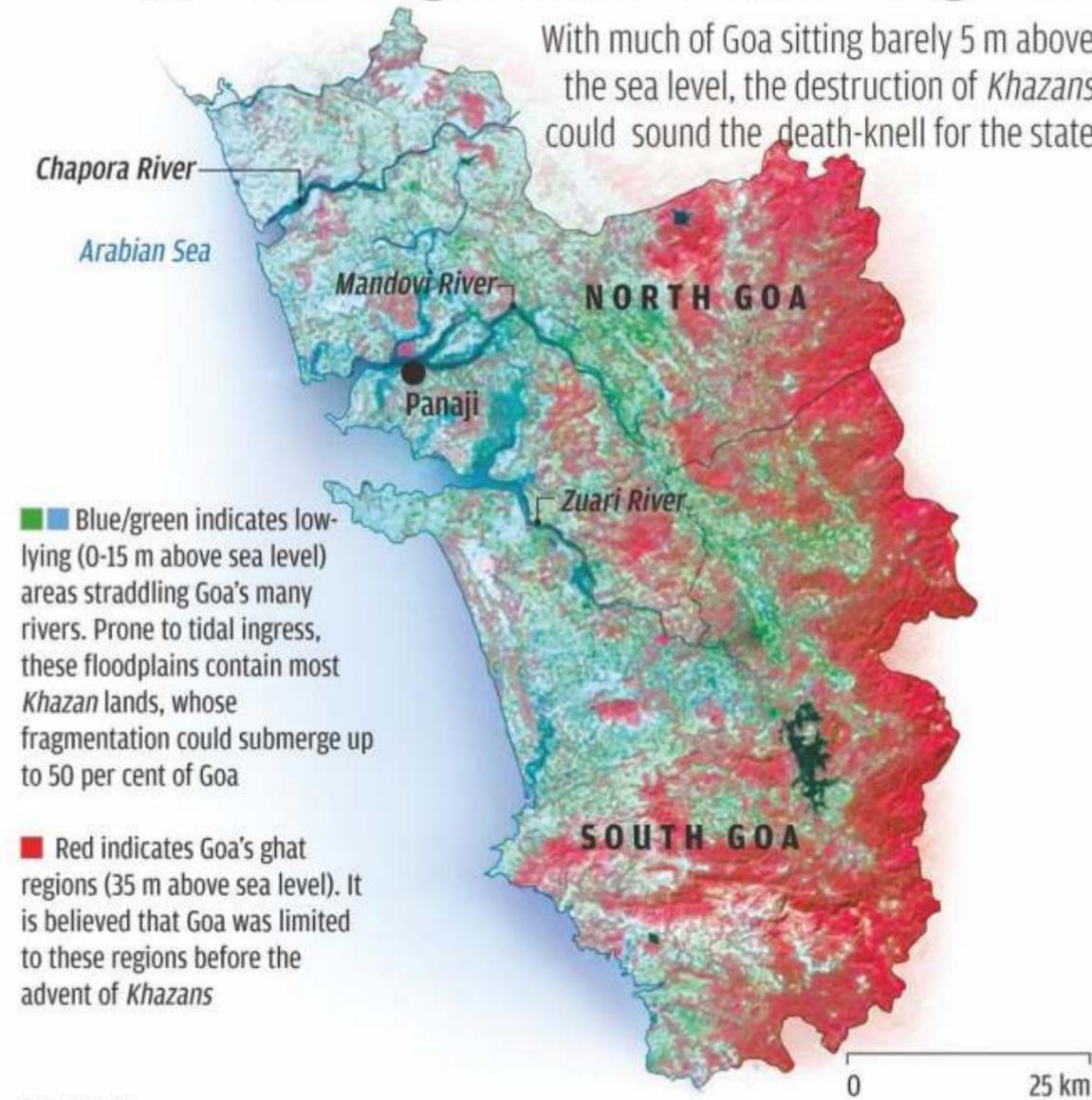
Sl No	State/UT and Project Name	Original tenure of the Project	Extension/component change agreed with date of letter issued to NABARD
			project till March 2023 (Date of Letter issued: 25-03-2022)
10	<b>Mizoram</b> Sustainable Agriculture Development through Expansion, Enhancement and Modelling in the state of Mizoram	26/2/2016 to 25/2/2020	Second no cost extension of the project till March 2021 (Date of Letter issued: 05-06-2021)
11	<b>Bihar</b> Scaling up climate smart agricultural through mainstreaming climate smart villages in Bihar.	27/12/2017 to 26/12/2020	First no cost extension of the project till April 2022 and change in the implementation structure replacing ICAR Research Campus, Patna with Dr, Rajendra Prasad Central Agricultural University, Pusa and Bihar Agricultural University, Bhagalpur. (Date of Letter issued: 11-06-2021)  Second no cost extension of the project till April 2023 (Date of Letter issued: 16-08-2022)
12	<b>Chhattisgarh</b> Climate Adaptation Strategies in Wetlands along Mahanadi River Catchment areas in Chhattisgarh	26/2/2016 to 25/2/2020	Second no cost extension of the project till March 2022 (Date of Letter issued: 07-09-2021)  Third no cost extension of the project till March 2023 (Date of Letter issued: 07-07-2022)
13	<b>Jammu &amp; Kashmir</b> Climate Resilient Sustainable Agriculture in Rain – Fed Farming (Kandi) Areas of Jammu & Kashmir	26/2/2016 to 25/2/2020	First no cost extension of the project for two years till 31st March 2023 (Date of Letter issued: 01-10-2021)

Sl No	State/UT and Project Name	Original tenure of the Project	Extension/component change agreed with date of letter issued to NABARD
14	<b>Assam</b> Management of Ecosystem of Kaziranga National Park by creating Climate Resilient Livelihood for Vulnerable Communities through Organic farming and pond based Pisciculture	30/9/2016 to 29/9/2019	Second no cost extension of the project till March 2023  (Date of Letter issued: 06-10-2021)
15	<b>Nagaland</b> Gene pool Conservation of Indigenous Rice Varieties under Traditional Integrated Rotational Farming System ( <i>Jhum optimisation</i> ) for Promoting Livelihood and Food Security as Climate Change Adaptation Strategy in Nagaland	27/2/2018 to 26/2/2021	Second no cost extension of the project till 30th September 2022  (Date of Letter issued: 11-10-2021)
16	<b>West Bengal</b> Rain Water harvesting and sustainable water supply to the hilly areas in Darjeeling adaptive measures climate change impacts	30/9/2016 to 29/9/2020	Exclusion of the following project component: <ul style="list-style-type: none"> <li>Setting up of community rainwater harvesting facilities for 200 household</li> <li>Sanctioned allocation of project reduced from Rs. 23.12 cr to Rs. 20.07 cr.</li> </ul> (Date of Letter issued: 26-02-2021)  Second no cost extension of the project till end of September 2021  (Date of Letter issued: 14-12-2021)
17	<b>Meghalaya</b> Spring-shed development works for rejuvenation of springs for climate resilient development in the	26/2/2016 to 25/2/2020	Second no cost extension of the project till end of March 2021  (Date of Letter issued: 08-02-2022)

Sl No	State/UT and Project Name	Original tenure of the Project	Extension/component change agreed with date of letter issued to NABARD
	water stressed areas of Meghalaya		
18	<b>Telangana</b> Resilient Agricultural Households through Adaptation to Climate Change in Mahbubnagar district, Telangana.	16/3/2016 to 15/3/2020	Second no cost extension of the project up to 30 September 2023, change of components and inter-component reallocation funds as per the details given below: Reallocation of Rs. 27.60 lakh from capacity building and workshops, for shifting 44 farmers from rainfed to irrigated farming Installation of 5 food processing units/seed processing units instead of Dam mills.  (Date of Letter issued: 27-06-2022)
19	<b>Jharkhand</b> Enhancing Climate Resilience of Forests and its Dependent Communities in Two Landscapes of Jharkhand.	30/3/2018 to 29/3/2022	First no cost extension of the project till 31st March 2023  (Date of Letter issued: 29-06-2022)
20	<b>Arunachal Pradesh</b> Addressing Climate Change Vulnerability of Papum-Poma River for conservation and recharging of its spring	6/3/2019 to 5/3/2022	First no cost extension of the project till 31st March 2023  (Date of Letter issued: 11-04-2022)
21	<b>Uttar Pradesh</b> Ecosystem Services based Adaptation to Climate Change Project in Bundelkhand Region of Uttar Pradesh	27/2/2018 to 26/2/2022	Component changes without any project cost escalation to construct earthen Checkdams (CDs) in Jalaun (41 nos.) and Hamipur (56 nos.) of length ranging from 20 m to 50 m each with an average cost of Rs. 2,280/- per running meter, in place of Concrete Checkdams in Jalaun (3 nos.) and Hamipur (4 nos.) districts as sanctioned in the DPR  (Date of Letter issued: 19-02-2021)

## Approaching a state of submergence

With much of Goa sitting barely 5 m above the sea level, the destruction of *Khazans* could sound the death-knell for the state



Source: ISRO