Draft – November 2013

State Action Plan on Climate Change

"Bulwark against falling off the map.."




Andaman and Nicobar Islands
2013

Supported by
United Nations Development Programme

FOREWORD

(Optional: to be completed)

ACKNOWLEDGEMENTS

(Optional: to be completed)

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CHAPTER 1

INTRODUCTION

1.1 Background

Climate change threatens the basic tenets of life for people around the world – access to water, food, health, and use of land and the environment. The earth has already warmed by 0.7^{o}C since around 1900, and is projected to further warm over the coming decades simply due to historical accumulated emissions. As per the current trends, average global temperatures could rise by 2–3^{0}C within the next 50 years or so, leading to many severe impacts, often mediated by water.[1] These impacts would broadly result in rising sea level with serious impacts on coastal population including the threat of inundation of low-lying coastal areas and small island territories; ocean acidification; coral bleaching; increased heat stress and its health implications, collapse and crippled functionality of ecosystems (in terms of provisioning goods and services); changes in cropping patterns and declining crop yields; melting of glaciers and the threat of floods during wet season; reduction in off-season water supply; etc.

IPCC Fourth Assessment Report (AR4)[2] confirmed the findings of the Third Assessment Report (TAR) which stated that small islands territories are the most vulnerable to climate variability and long-term climate change impacts.[3] It is projected that the rising sea level will result in millions of people facing floods each year and this will be particularly severe in island territories, with some of them even facing the threat of inundation. The peculiar features of island territories, such as small or very small physical size, remoteness from mainland, limited natural resources (often with unique animal and plant life), innate vulnerability to natural disasters and extreme weather events, economies sensitive to external shocks, populations with high growth rates and densities, poorly developed infrastructure, and limited financial and human resources, constrain the adaptive capacity of islands to climate change.[4]

[1] IPCC, 2001 and Nicholas Stern, 2007, The Economics of Climate Change, Cambridge University
[2] IPCC, 2007. IPCC Fourth Assessment Report AR4 Climate Change 2007
[3] IPCC, 2001
[4] Nurse LA *et al.*, 2001. Small island states. In: McCarthy JJ *et al.*, eds. Climate change 2001. Impacts, adaptation and vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK, Cambridge University Press. pp. 844–875.

1.2 Climate Change: The Indian Context

India is facing the challenge of sustaining its rapid economic growth while dealing with the issue of climate change. India is highly vulnerable to climate change, not only because of high physical exposure to climate-related disasters (65% of India is drought prone, 12% flood prone, and 8% susceptible to cyclones[5]) but also because of the dependency of its economy and majority of population on climate-sensitive sectors such as agriculture, forests, fisheries, tourism, animal husbandry, and fisheries. Climate change is expected to increase relative stress on water resources due to the decline in rainfall, with impact on water availability (per capita water availability is expected to decrease from 1820 m^3/year in 2001 to 1140 m^3/year in 2050[6]) and agriculture/food security (60% of crop area in India is under rain-fed agriculture). Any adverse impact on water availability due to recession in certain pockets would threaten food security, cause die back of natural ecosystems including species that sustain the livelihoods of rural households, and adversely impact the coastal system due to sea level rise and increased frequency of extreme events. The poor, especially the marginalized groups including women and children, will be the most affected by these changes. In addition, achievement of vital national development goals related to other systems such as habitats, health, energy, and infrastructure would also be adversely affected.[7]

[5] National Institute of Disaster Management, 2007.
[6] IPCC, 2007a. *The Physical Science Basis: Contribution of Working Group I to the Fourth Assessment Report of the IPCC.* Cambridge: Cambridge University Press.
[7] MOEF, India's Initial National Communication to UNFCCC, 2004.

1.3 National Imperatives to Address Climate Change

India recognizes that any strategy for addressing climate change has to be based on the pillars of sustainable development, inclusive growth, poverty reduction, and environmental mainstreaming. This is reflected in many of the major programs that aim to address climate change concerns in the country. The current government expenditure in India on adaptation to climate change/variability exceeds 2.6% of the GDP, with agriculture, water resources, health and sanitation, forests, coastal zone infrastructure, and extreme events being specific areas of concern.[8]

India's energy intensity of production has been falling with improvements in energy efficiency, autonomous technological changes, and economical use of energy. Although India's total CO_2 emissions are about 4% of total global CO_2 emissions, India has announced its intentions of ensuring that its per capita emissions are such that they never exceed that of the developed countries. Even with 8%–9% GDP growth every year for the next decade or two, India's per capita emissions are likely to be well

NATIONAL ACTION PLAN ON CLIMATE CHANGE: PRINCIPLES

Released in 2008, the National Action Plan on Climate Change, 2008 (NAPCC), through its eight Missions, provides a multi-pronged and integrated Framework for addressing climate change. The focus of NAPCC is on promoting understanding of climate change, adaptation, mitigation, energy efficiency and natural resource conservation. NAPCC outlines the following principles in this regard:

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

[8] MoEF, 2010. Common Framework for the Preparation of State Action Plan on Climate Change

below developed country averages.[9]

India has released its National Action Plan on Climate Change (NAPCC) in 2008 as part of ambitious domestic actions to address climate change. The NAPCC is designed to achieve sustainable development with co-benefits in terms of climate change adaptation/mitigation. Eight national missions form the core of the NAPCC.[10] Besides, there are several sectoral initiatives related to power generation, transport, disaster management, and capacity building that have good potential to integrate climate change concerns.

1.4 Need for Climate Change Action Plan for Andaman and Nicobar Islands

It is evident that Andaman and Nicobar Islands (ANI), with their unique geo-ecological settings, sit within a 'thick disaster probability envelope'. The 2004 tsunami is a case in point. Climate change risks and uncertainties exacerbate the 'thicknesses' of this envelope and pose additional environmental and developmental challenges for the Island territory.

The impacts may manifest in a variety of ways in the Islands that may range from escalated exposure to external shocks and extreme weather events, sea level rise and associated issues of coastal erosion, increased 'storm surges' and inundation of low-lying areas, salt water intrusion, diminished fresh water supply, coral bleaching and breaching, deterioration in ecosystem functions, reduced opportunities for ecosystem-based livelihoods, excessive dependence on external resource supply, unpredictable crop yields, uncertainty over the functioning of other sensitive sectors such as tourism and fisheries, increased malnutrition and heat stress, etc.

Once climate change impacts start manifesting, the costs for building defence mechanisms against it will be prohibitively high. For instance, upgrading coastal systems and defences against storms and storm surges would require substantial capital investment and ongoing maintenance. As various models predict, at higher levels of warming and increased rates of sea level rise, the risks will become increasingly serious. Infrastructure damage will rise sharply in a warmer world, because of the combined effects of increasing potency of the storms and the increasing vulnerability of infrastructure and growth engines (most of which are located along the coast) to other climate-related events.[11] This situation would be further worsened by the

[9] India's climate modeling studies show that its per capita emissions will be around 2.0–2.5 tonnes of carbon dioxide equivalent by 2020 and around 3.0–3.5 tonnes of carbon dioxide equivalent by 2030, as compared to around 1.0–1.2 tonnes presently.

[10] National Solar Mission, National Mission on Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Water Mission, National Mission for Sustaining Himalayan Eco-System, National Mission for Green India, National Mission for Sustainable Agriculture and National Mission on Strategic Knowledge for Climate Change

[11] Nicholas Stern, 2007. The Economics of Climate Change, Cambridge University Press

insularity and isolation of the Islands from mainland, associated high transportation and communication costs, expensive public administration and infrastructure investments, and limited opportunities to create sustainable and self-reliant economies of scale.

One of the central aspects in developing a pragmatic strategy for addressing climate change in ANI is in translating the national climate change policy imperatives to UT-level activities while keeping in mind the contexts, specificities, needs and aspirations of humans, and natural and geo-physical systems existing in the Island territory. The challenge lies in evolving specific local-level actions with sound linkages to national policy and programme frameworks including budgets. The Climate Change Action Plan for ANI was contextualized keeping these challenges in mind.

1.5 Core Principles of the Andaman and Nicobar Climate Change Action Plan

Mainstreaming climate change into development of ANI

Climate change is an externality that needs to be internalized into the policy and development planning of ANI. The impacts of climate change are likely to occur over a longer time frame and are known to be 'persistent' and 'pervasive' in nature. Further, the risks and uncertainties associated with it are projected to interact negatively with other development challenges and economic social and ecological vulnerabilities. This necessitates the development of a climate-response strategy that essentially hinges around a multi-disciplinary approach with ample vertical and horizontal linkages and feedbacks across sectors, systems, and people. Further, actions aimed at responding to climate change should not be viewed in isolation; instead they should become an integral part of regular development planning, action, and execution. In the context of discussions related to the ethical and 'right to develop' aspirations of developing societies (with inherent low carbon foot prints), while it is important to pursue both mitigation and adaptation measures to combat climate change, considering the overall socio-economic and ecological contexts and vulnerabilities, it would be of high importance to focus on adaptation options including Disaster Risk Reduction in ANI. The edifice of climate change strategy in ANI may thus include these aspects.

Increased focus on adaptation and building adaptive capacity

Adaptation includes strategies, policies, and measures undertaken now, and in future, to reduce potential adverse impacts of climate change. Adaptive capacity in the context of ANI would mean the ability of Andaman administration, sectoral institutions, agencies, local communities, natural systems, and individuals to prepare for and adjust to potential adverse effects (e.g. increased storm surges and coastal erosion) from climate change and take advantage of opportunities that may arise (e.g. some studies suggest that the coconut productivity may increase with marginal

increase in temperature[12]). The challenge is to be dynamic and flexible – constantly review the design, development, and execution of specific adaptation interventions based on the innate and inculcated coping capacity of communities, institutions, and ANI Administration.

In short, in the context of ANI, the adaptation interventions are to be designed and designated to maximize the number of avoidable adverse climate change risks that are to be embedded within the overall ambit of sustainable development. Further, adaptation options also need to be anticipatory (actions taken in advance of serious climate change effects) and responsive (e.g. disaster response) and can include affected individuals' spontaneous responses to climate volatility and change as well as planned responses by the administration or other public or private institutions (effective public warning systems for storm surges).

Emphasis on enhancing the understanding of climate change and its potential impacts on the ANI

Climate change is an evolving multi-disciplinary science. There is large volume of literature generated on this subject at global and regional levels. However, information is conspicuously scanty at the local level. There is some information available and research is being undertaken on climate change and its potential impacts on the ANI. However, these, as well as climate monitoring systems, would need to be strengthened for enhancing the information base. There is particular need for undertaking detailed vulnerability assessments in ANI. This will enable the policy planners, agencies, and communities to take informed decisions related to climate change in ANI.

Climate change response would largely be a subset of overall disaster risk reduction and management

Climate change will increase the frequency and scale of extreme weather events in ANI, including erratic precipitation, storm surges, and tropical cyclones. The Island is already under critical risk of tsunami-genic waves. Though the cause of tsunami need not always be attributed to climate change, it often works in tandem with climate-related risks and increases the overall vulnerability in ANI with implications for the well-being of human and natural systems. ANI will require an improved information base to better manage the changing risks and uncertainty. ANI witnessed the worst incident of tsunami in 2004, causing unforeseen damages to life and property. ANI already has basic capacities and systems (though these need to be strengthened significantly) to deal with disasters. Climate change threats and uncertainties need to be integrated deeply into that.

[12] MoEF, 2010. *Climate Change and India: A 4X4 Assessment A sectoral and regional analysis for 2030s'*, prepared by the Indian Network for Climate Change Assessment (INCCA)

1.6 Preparation of the Andaman and Nicobar Islands Action Plan on Climate Change (ANIAPCC)

A participatory process for drafting the Andaman and Nicobar Islands Action Plan on Climate Change (ANIAPCC) is as important as the final product. Maintaining consistency and linkage to NAPCC and its missions while reflecting the specific needs and contexts of the Island are important priorities in the formulation of the ANIAPCC.

The overall institutional architecture adopted for the preparation of ANIAPCC is given in Figure 1.1. The Lt. Governor of Andaman and Nicobar Administration constituted a multi-disciplinary 'State Level Steering Committee for the Preparation of Action Plan for Climate Change in the Andaman and Nicobar Islands'. The Steering Committee was constituted with the mandate of providing overall supervision and coordination for the entire process of preparation of the ANIAPCC and its implementation. The Committee is chaired by the Chief Secretary and comprises the following members (Table 1.1).

Table 1.1 Composition of the State Steering Committee

Member	Designation
Chief Secretary, A&N Administration	Chairman
Director, Science and Technology	Convenor
Principal Secretary, Environment and Forestry	Member
Principal Secretary, Science and Technology	Member
Development Commissioner, A&N Administration	Member
Chief Engineer-cum-Secretary, APWD	Member
Secretary, Port Blair Municipal Council	Member
Director, CARI	Member
Director, IFGTB Coimbatore	Member
Prof. Ashish Mazumder, Director (School of Water resources and Engineering), Jadavpur University	Member
Prof. Ramachandran, Anna University	Member
Director, Transport	Member
The In-charge, NIOT	Member

The Chief Secretary then constituted an 'Advisory Committee for the preparation of Climate Change Action Plan for Andaman and Nicobar Islands' (Annexure 1). The mandate of this committee is to (a) constitute various core groups for preparing Sectoral Action Plans; (b) arrange for expert inputs and capacity-building programs for core group members to facilitate the preparation of the Sectoral Action Plans; and (c) coordinate and monitor preparation of Sectoral Action Plan among various departments. The Advisory group is chaired by the Principal Secretary, Environment and Forests. The composition of the Advisory Committee is given in Table 1.2.

Table 1.2: Composition of the Advisory Committee

Member	Designation
Principal Secretary, Environment and Forestry	Chairman
Director, Science and Technology	Convenor
Principal Secretary, Science and Technology	Member
Commissioner-cum-Secretary, APWD	Member
Secretary, Planning	Member
Director, CARI	Member
Secretary, Social Welfare	Member
Secretary, Agriculture	Member
Superintendent Engineer, Electricity	Member
Secretary, Transport	Member
The In-charge, NIOT	Member

Department, Science and Technology, ANI was appointed as the Nodal Agency for the preparation of the ANIAPCC. Help from United Nations Development Programme (UNDP) was solicited in compiling relevant information as well as providing overall technical guidance for the preparation of the ANIAPCC. The UNDP team participated in various stakeholder consultations, working group deliberations, and had meetings with senior officials and the Lt. Governor.

Fig.1.1: Overall institutional architecture adopted for the preparation of ANIPACC.

In order to prepare sectoral action plans, core groups were constituted from members of different departments and expert institutions. For each mission under the NAPCC, a nodal agency for the sectoral plan under that mission was identified. As the National Mission on Sustaining the Himalayan ecosystem was not applicable to ANI, it was replaced by the **Mission on Sustaining Island Ecosystems,** which is highly relevant to the fragile and complex island ecosystems of ANI. The eight ANI Missions with the nodal agency and the budget allocated are given in Table 1.3. These working groups convened a number of meetings amongst themselves as well as with stakeholders. The list of such meetings held is provided in Annexure 2.

Table 1.3: Missions in the ANIAPCC and the nodal agency for each mission

Mission	Nodal Department	Outlay (INR in crores)
ANI Solar Mission and Mission on Enhanced Energy Efficiency	Electricity Department	33.88
ANI Mission on Enhanced Energy Efficiency	Electricity Department	0.25
ANI Mission on Sustainable Habitat	Public Works Department	676.53
ANI Sustainable Water Mission	Public Works Department	6.52
ANI's Mission on Green India	Department of Environment and Forests	122.11
ANI Mission on Sustaining Island Ecosystem	Department of Environment and Forests	13.36
ANI Mission on Sustainable Agriculture	Agriculture Department	220.96
ANI Mission on Strategic Knowledge for Climate Change	Department, Science and Technology	0.645/yr

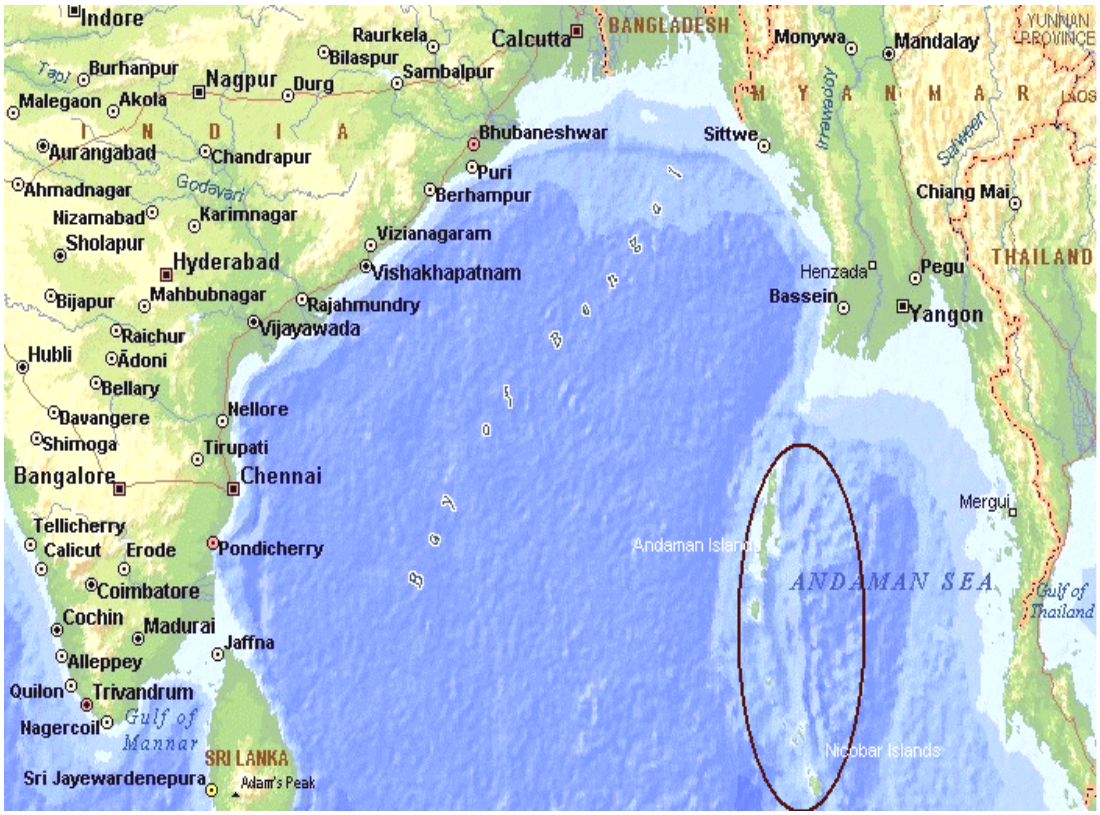
PART A- BASELINE ASSESSMENT

CHAPTER 2

ANDAMAN AND NICOBAR ISLANDS: AN OVERVIEW

2.1 Geographic and Geophysical Profile

Situated about 1,200 km from the Indian mainland, between 6° 45' N to 13° 41' N longitude, and 92° 12' E and 93° 57' E latitude, Andaman and Nicobar Islands (ANI) are an archipelago in the Bay of Bengal, consisting of 306 named islands and 206 rocky outcrops endowed with outstanding natural beauty and ecological diversity. Of these islands, only 38 are inhabited.



Map 1: Location of the Andaman and Nicobar Islands

Geologically the A&N Islands are the submerged southwards extensions of the ArakanYoma mountain range of Myanmar. The Islands have a total land area of 8,249 km^2, of which the northern Andaman group constitutes 6,408 km^2 and the southern Nicobars 1,841 km^2. The two island groups are separated by the 160-km-wide 10° channel, and are geologically and ecologically quite distinct. The Andamans have bio-geographic affinities with Myanmar, while the Nicobars are more closely related to Indonesia.

2.2 Ecological Profile

The A&N Islands are home to highly diverse terrestrial and marine ecosystems, with a variety of habitats ranging from densely forested mountainous areas to sandy beaches and some of the most intact coral reefs in the Indian Ocean. The mangroves fringing these islands are amongst the largest in India, and the Andaman Island forests are included in the WWF Global 200 List of global priority biodiversity hotspots.

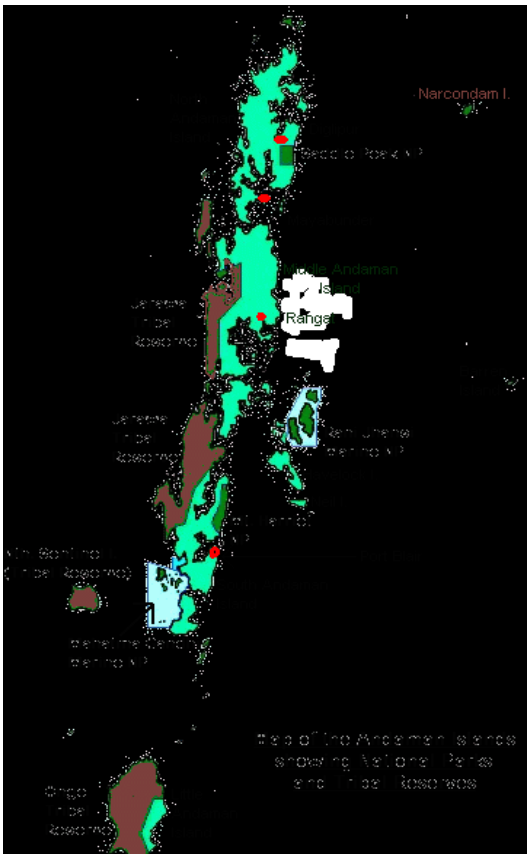
The Andaman Island forests contain a mix of elements from the Indian subcontinent and South-East Asia, and are recognized as a distinct eco-region in the WWF global list (ref: IM0101), with high endemism and distinctiveness. The WWF eco-region profile[13] lists a total of 37 endemic or near-endemic terrestrial fauna species in the Islands. Other sources list 85 flora species as rare, endangered, and threatened.[14]

More than 6,500 species of fauna, which include 2,210

[13] http://www.worldwildlife.org/wildworld/profiles/terrestrial/im/im0101_full.html

[14] An overview of the global significance of the Andaman's terrestrial ecosystem is attached as Annex IV-F.

terrestrial and 4,250 marine species, have been reported from the archipelago. A high proportion of these species are endemic, including over 50% butterflies, almost 40% of birds, and 60% of the 58 mammalian species. There are also 34 endemic reptiles and amphibians in the Islands. The overall faunal endemism is estimated to be 9%. About 14% of angiosperm species are endemic to the islands, comprising around 700 genera within 140 families.[15]



The coral reef of ANI belongs to the Indo-West pacific fauna province as Andaman Islands is located in north-west of the central area of greatest marine biodiversity referred to as the Coral Triangle extending over the Philippines, Indonesia, and New Guinea. On the basis of various studies, at least 400 coral species may eventually be found in ANI (ZSI 2009) as against the 283 species identified so far.

The A&N Islands offer a varied and complex animal life of which the colourful coral reefs constitute the most fragile and interesting faunal element. The coral reef fauna and flora from these islands includes 1,452 species of fishes, 1,422 species of mollusks, 430 species of echinoderms, 112 species of sponges, 334 species of hard and soft corals, 837 species of crustaceans, and 64 species of algae.

2.3 Demographic Profile

According to the provisional census figures of 2011, the total population of ANI is 3,79,944 comprising 2,02,330 males and 1,77,614 females. The decadal population growth is 23,792 in absolute numbers. The decadal growth in population has shown an increase of 6.68% over the population of 2001. While the percentage of increase in the male population is 4.85, the growth in female population is 8.85% (Table 2.1).

[15] A comprehensive biodiversity overview is given in the *Andaman and Nicobar Islands Union Territory – Biodiversity Strategy and Action Plan*, Chapters 3&4.

Table 2.1: Population of ANI

	Total	Male	Female
Population 2011: ANI	3,79,944	2,02,330	1,77,614
South Andaman District	2,37,586	1,26,804	1,10,782
North and Middle Andaman	1,05,539	54,821	50,718
Nicobar District	36,819	20,705	16,114
Decadal growth: 2001–2011	23,792	9,358	14,434
Percentage decadal growth 2001–2011	6.68	4.85	8.85

Source: Provisional figures from 2011 census, Basic Statistics, Directorate of Economics and Statistics

The population density per kilometre has increased to 46 in 2011 from 43 in Census 2001. The sex ratio (number of females per 1000 males) has increased to 878 in 2011 from 846 in Census 2001.

The Gender Disparity Index (GDI) reflects the relative attainments of females compared to males for a common set of variables. ANI's performance has improved drastically from a GDI of 0.645 in 1981 to 0.857 in 1991, which is the highest in the country. It ranks 5th on the Human Development Index (HDI) with a score of 0.574. ANI stands 9th in the country on the Human Poverty Index (HPI). Further, ANI has an infant mortality rate of 21.21, which is much lower than the national average. Birth rate is also amongst the lowest in the country and death rate has shown a continuous decline. Excellent natal care and good institutional support systems have ensured a low maternal mortality rate of 0.5/100 in ANI.[16] These development indicators illustrate the relatively high development status of ANI in terms of human welfare (Table 2.2).[17]

Table 2.2: Sex ratio in A&N Islands (females per 1000 males)

UT/District	Total	Rural	Urban
A&N Islands	878	871	891
South Andaman District	874	854	890
North and Middle Andaman	925	924	951
Nicobar District	778	778	0

Source: Provisional figures from 2011 census, Basic Statistics, Directorate of Economics and Statistics

2.4 Economic Profile

Early economic development of the Islands was built on the extraction of primary resources such as timber and non-timber forest produce. It dates back to more than a century and, by the late 1990s, more than 75,000 m^3 of timber was being logged annually, approximately 70% of which was exported as plywood. Logging was one of the earliest and most important economic activities and continued to be a major source of revenue and employment, livelihood, and government revenue until 2002.

[16] 2001 Census, State Development Report, 2006,

[17] National Human development Report 2001, Planning Commission, GoI

Agriculture consists mainly of rice, coconuts, areca nut, and bananas. Some rubber and oil palm plantations have also been developed. Approximately 50,000 ha are currently under cultivation, of which more than half is planted with coconut and areca nut. A&N Islands encompass 0.60 million km^2 of the Exclusive Economic Zone (EEZ), which constitutes about 30% of the EEZ of India. A large coastline and rich natural resources have contributed to a relatively higher per capita Gross State Domestic Product (GSDP) of Rs. 15,703. The Service sector contributes 47.5% of the GSDP, primary sector contributes 30%, and the manufacturing sector just 20%. There is hardly any manufacturing barring a little wood processing activity in the UT.[18]

2.4.1 Small-scale Industries

The ecological and environmental conditions are not very conducive for setting up large-scale industrial units in ANI. The following table depicts the status of industries at different scales in the Islands (Table 2.3).

Table 2.3: Status of industries in the Islands

Type	2008/09	2009/10	2010/11
Large-/medium-scale industries	Nil	Nil	Nil
Small-scale industries	1,893	1,961	2,039
Industrial centres	15	NR	NR
Industrial estates	8	NR	NR

Source: Directorate of Economics and Statistics. Basic Statistics 2008/09 to 2010/11, (NR – not received)

Government policies have facilitated the growth of small-scale industries and the following table shows the category of industries in terms of raw material used and service provided (Table. 2.4).

Table 2.4: Region-wise small-scale industrial units

Type	2010/11				
	South Andaman	Middle Andaman	North Andaman	Nicobar Islands	Total
1. Wood based	183	24	31	5	243
2. Agro based	96	18	9	17	140
3. Marine based	58	3	4	3	68
4. Food based	100	18	14	18	150
5. Mineral based	86	14	15	–	115
6. Chemical based	52	Nil	1	–	53
7. Engineering based	337	26	17	5	385
8. Leather based	9	1	–	–	10
9. Textile based	106	12	7	6	131
10. Coir based	3	–	–	–	3
11.Cane and bamboo	2	2	1	–	5
12.Printing and publishing	2	1	–	–	3
13. Beauty parlour	2	–	–	–	2
14. Automobile repair and service	1	1	1	–	3
15.Electronic equipment	6	–	–	–	6

[18] 2001 census, Income level and growth in the UT, State Development Report. 2006.

repair					
16. Computer repair etc.	4	–	1	–	5
17. Ships and boat repair	1	–	–	–	3
18. Gold and silver jewellery	3	–	–	–	3
19. Photo studio	–	1	–	–	1
20. Hotel and restaurant	10	–	1	–	11
21. Tourism based	2	–	–	–	2
22. Miscellaneous	486	103	94	16	699
Total	**1549**	**224**	**196**	**70**	**2039**

Source: Basic Statistics 2008/09 to 2010/11, Directorate of Economics and Statistics

2.4.2 Employment generation

There is a major concern regarding the worsening employment scenario in rural areas. Long-term shift in the structure of employment in rural areas shows that self-employment has eroded, share of regular employment has stagnated, and casualization of labour has increased. The following table shows the distribution of population in major activities of the Islands (Table 2.5).

Table 2.5: Work force employed in major activities (from 2001 census)

Major activities	Population	Rural	Urban	Percentage of total population
Total workers	1,36,254	94,052	42,202	38.26
1. Main workers	1,13,607	73,454	40,153	31.90
(i) Cultivators	15,505	15,469	36	4.35
(ii) Agricultural labourers	2,683	2,577	106	0.75
(iii) Household industry workers	4,792	4,447	345	1.35
(iv)Other workers	90,627	50,961	39,666	25.45
2.Marginal workers	22,647	20,598	2,049	6.36
(i) Cultivators	5,956	5,950	6	1.67
(ii) Agricultural labourers	2,486	2,449	37	0.70
(iii)Household industry workers	2,294	2,211	83	0.64
(iv) Other workers	11,911	9,988	1,923	3.35
Non-workers	2,19,898	1,45,902	73,996	61.74

Source: Directorate of Economics and Statistics. Basic Statistics 2008/09 to 2010/11

Another concern is the low and declining productivity of industrial workers. In the organized segment, the public sector continues to play a very dominant role, and accounts for more than 86% of employment in the UT. It is already reaching its limits and hence the Islands need a new approach to increase its employment potential – moving consciously to source jobs from non-organized sectors, particularly from rural-based farm and non-farm sectors. Fisheries, food processing, horticulture and floriculture, medicinal plants, bamboo, and cane have great potential for generating employment. Tourism, handicrafts, and ship repair and servicing have also been identified as sectors with increasing potential for generating employment. At the same time, these sectors are highly vulnerable to the impact of climate change. It is important to adopt appropriate strategies to make these sectors climate resilient as well as diversify livelihood opportunities to rural-based farm and non-farm sectors.

2.5 Social Profile

The Islands have been home to indigenous tribal communities for over 20,000 years. The original inhabitants of the Andaman group of Islands are tribes of Negrito origin such as the Great Andamanese, the Jarawas, the Onges, and the Sentinelese. People of Mongloid origin occupy Nicobar and it hosts two distinct groups of tribal people, the Nicobarese and the Shompens. These indigenous groups exhibit varied livelihoods, preferences for social exclusivity, and cultural differences. The tribal population is affected by fluctuating populations, high incidence of malaria, hepatitis, and other diseases, loss of traditional livelihoods and way of life, influx of outsiders, etc. Table 2.6 depicts the trends in tribal population in ANI.

Table 2.6: Changes in tribal population in ANI

Category	Census Year		
	1981	1991	2001
Shompens	223	250	398
Nicobarese	21,984	26,000	28,653
Andamanese	26	45	43
Onges	97	95	96
Sentinelese	NE	100 estimated	39 estimated
Jarawas	31	280 estimated	240 estimated

Source: , Directorate of Economics and Statistics. Basic Statistics 2008/09 to 2010/11

The characteristics of the prominent tribal communities of ANI are given in Table 2.7.

Table 2.7: Characteristics of the tribal communities of ANI

Name of the tribe	Characteristics
The Shompen	• They were the first inhabitants of the Nicobar Islands. They came from Sumatra more than 10,000 years ago. • They are a nomadic tribe of hunter–gatherers. They build huts on elevated platforms close to streams and practice arboriculture. They raise pandanus, colocasia, lemon, banana, chili, tobacco, betel, and coconuts.

	• Their diet consists of pandanus, pigs, monitor lizard, megapod bird and their eggs, and they also practise ethno-medicine.
The Nicobarese	• Largest tribal group of ANI. They are scattered on different islands of the Nicobar group. They are of Mongloid origin and their language has roots in the Austro-Asiatic family. • Nicobarese in different islands exhibit diversity in traditions. While Car Nicobar is strictly patriarchal, central group of islands such as Nancowry have had women as leaders. • They live in extended families called 'tuhets' and village structure and organization is built around the tuhets. The tribal council holds great power. • Trade in coconut has been the mainstay of the Nicobarese economy. They also participate is subsistence fishing and pig rearing.
The Andamanese	• Originally hunter–gatherers, they have been resettled in Strait Island and have been beneficiaries of government schemes and activities • They are literate and politically aware.
The Jarawa	• Confined to the West Coast of South and Middle Andaman Islands in dense evergreen forests reserved for them. • Jarawas have held on to their territory and traditional lifestyle and have been hostile towards intruders. They do not mingle or marry outside their tribe.
The Sentinelese	• They have been living on the North Sentinel Island for thousands of years without any contact with the outside world and are hostile to outsiders.
The Onges	• The Onges inhabited Little Andaman and are now confined to Dugong Creek and South Bay • They have fallen prey to many diseases and other social maladies.

2.6 Governance Profile

The ANI is a Union Territory of India under the direct jurisdiction of the Central Government. The Territorial Administration is the predominant socio-economic actor in the Islands, being the largest direct and indirect employer and providing extensive public services such as utilities, infrastructure, and transportation links. Central Government Provides financial support for UT administration including for transportation to and from the mainland, intra-island shipping, basic utilities and fuel costs, agricultural inputs, and a variety of other basic necessities.

2.7 Major Sectors

2.7.1 Forests

Recorded forest area of ANI is 7,171 km^2. Many types of forests are found in the Islands, such as tropical wet evergreen, tropical semi-evergreen, moist deciduous, littoral, mangrove, and swamp forests. A large variety of timbers are found in the Andaman group of islands. The most valuable

timber species are *padauk*and *gurjan.* There are 96 wildlife sanctuaries, 9 national parks and 1 biosphere reserve in the Islands.

2.7.2 Agriculture and Animal Husbandry

Approximately 50,000 ha of ANI is under agriculture that includes about 30,000 ha under fruits and plantation crops and about 10,000 ha under field crops. Paddy, the main food crop, is mostly cultivated in Andaman group of Islands, whereas coconut and areca nut are the cash crops of Nicobar group of Islands. Crops such as pulses, oilseeds, and vegetables are grown followed by paddy during Rabi season. Different kinds of fruits such as mango, sapota, orange, banana, papaya, pineapple, and root crops are grown on hilly land owned by farmers. Spices, viz. pepper, clove, nutmeg, and cinnamon are grown under multi-tier cropping systems. Rubber, red oil, palm, and cashew are grown on a limited scale in these Islands. Out of 36 islands, 12 islands have no livestock and another four islands have a population of less than 200 numbers. The North, South, and Middle Andaman have major chunk of livestock in Andaman group of islands and Car Nicobar, Katchal are the centres having more concentration of livestock in the Nicobar group of islands. Cattle, buffalo, and goat are the predominant livestock species in the Andaman group of islands, whereas pig and goat are dominant in Nicobar Islands.

2.7.3 Fisheries

ANI has a coastline of 1,912 km (24% of the Indian coast line) with a continental shelf of 35,000 km^2. The present level of marine fish production is 33,735 tonnes, which is about 12% of the estimated potential. There are 97 fishermen villages in the ANI with a population of 15,320. Around 5,617 full-time fishermen and 718 part-time fishermen are engaged in marine fishing activities. They operate about 2,808 fishing crafts of which 1,524 are non-motorized/traditional crafts, 1,279 motorized crafts, and 10 mechanized boats. The main fishing gear used is drift gillnet, which contributes to over 40% of marine fish landings. Other fishing gears commonly used are shore seine, hook and line, long line, cast nets, etc. There are 57 beach landing centres and 8 fish markets.

2.7.4 Industry

There are 1,833 registered MSMEs and handicraft units as on 31 March 2007. Two units are 100% export-oriented units in the line of fish-/prawn-processing activity. Apart from this, there are shells and wood-based handicraft units. SSI units are engaged in the production of paints and varnishes, mini flour mills, soft drinks and beverages, steel furniture and fixtures, readymade garments, and steel gate grills and structures. MSMEs handicraft units are also engaged in shell crafts, bakery products, rice-milling, furniture-making, etc. The ANI's Integrated Development Corporation promotes tourism, fisheries, industries, and industrial financing.

While there is a general consensus that industrial development in ANI should focus on fishery-, agro-, and horticulture-based fresh and processed products, cane and bamboo and related industries, and handicraft units of small and medium scale, it is also important to increase resilience of these production systems from the impact of climate change. At the same time, commercialization of identified products would imply establishing effective forward and

backward linkages so as to sustain a symbiosis between industry and agriculture, encouragement to the use of modern technology and scientific techniques, investment in irrigation, development of fast means of intra-/inter-island transportation, and strengthening of farmers' training and extension services.

2.7.5 Tourism

The A&N Islands are a tourist's paradise that provides tropical evergreen forests, sandy beaches, mangrove creeks, marine life, corals, etc. as major tourist attractions. There is tremendous scope for enjoying nature in the beach resorts, water sports, and adventure water sports, adventure tourism, etc.

2.7.6 Transport

The Motor Transport Department of Andaman and Nicobar Administration operates from 13 stations in the northern and southern group of Islands. The department has a total of 205 buses in operation mainly in the rural areas of the Islands. During 2007/08, a total of 135.88 lakh people travelled by the state transport buses and the Department has generated revenue of Rs 1075.22 lakh. It is evident that the Department has been making steady progress not only in providing better public transport service but also has been increasing its earnings.

CHAPTER 3

CLIMATE PROFILE

3.1 Observed Trends in Global Climate

Instrumental records of more than one and a half centuries reveal that the earth has warmed by 0.74 [0.56 to 0.92] °C during the last 100 years, with 12 of the last 13 years being the warmest on record. Global average sea level has risen at an average rate of 1.8 mm per year between 1961 and 2003. More intense and longer droughts have been observed over wider areas since the 1970s, particularly in the tropics and sub-tropics. Significantly increased rainfall has been observed in eastern parts of North and South America, northern Europe, and northern and central Asia. Mountain glaciers and snow cover have declined on average in both hemispheres. The maximum area covered by seasonally frozen ground has decreased by about 7% in the Northern Hemisphere since the 1900s. There has been a decrease of up to 15% in the duration of spring. Long-term drying trends during the period 1900–2005 have been observed in precipitation over many large regions over the globe.

3.2 Projected Changes in Global Climate

Knowledge of the climate system, together with model simulations, confirm that past changes in greenhouse gas concentrations will lead to a committed warming and future climate change because of the long response time of the climate system, particularly the oceans. Committed climate change due to atmospheric composition in the year 2000 corresponds to a warming trend of about 0.1°C per decade over the next two decades, i.e. up to 2020s, in the absence of large changes in volcanic or solar forcing. About twice as much warming is expected, i.e. around 0.2°C per decade. Between 2000 and 2020, under the SRES A1B scenario in the ensemble of Atmosphere-Ocean Global Circulation Models (AOGCMs), the rate of thermal expansion is projected to be 1.3 ± 0.7 mm year^{-1}, and is not significantly different under the A2 or B1 scenarios. These projected rates are within the uncertainty of the observed contribution of thermal expansion for 1993 to 2003 of 1.6 ± 0.6 mm year^{-1}. The following table (Table 3.1) shows the projected global average surface warming at the end of the 21st century.

Table 3.1: Projected global average surface warming at the end of the 21st century

Case	Temperature change (°C at 2090–2099 relative to 1980–1999)	
	Best estimate	**Likely range**
Constant year 2000 concentrations	0.6	0.3–0.9
A1T scenario	2.4	1.4–3.8
B2 scenario	2.4	1.4–3.8
A1B scenario	2.8	1.7–4.4
A2 scenario	3.4	2.0–5.4
A1FI scenario	4.0	2.4–6.4

Source: IPCC, AR4, 2007

According to the Intergovernmental Panel on Climate Change (IPCC), WkGp2 Report (2007), there will be acute climate-change-induced water shortage by 2020; rain-fed agriculture could decline by 50%, crop yields will decrease in Central/South Asia by up to 30%. Glaciers and snow cover are expected to decrease, reducing supply of melt water to major regions and cities. About 20%–30% of all plant and animal species would face increased risk of extinction if temperature rises by 1.5–2.5 ^{o}C.

3.3 Observed Trends in Indian Climate

'Climate Change and India: A 4X4 Assessment A sectoral and regional analysis for 2030s', prepared by the Indian Network for Climate Change Assessment (INCCA) provides an assessment of impacts of climate change by the 2030s on four key sectors of the Indian economy (Agriculture, Water, Natural Ecosystems & Biodiversity and Health), in four climate-sensitive regions of India, namely the Himalayan region, the Western Ghats, the Coastal Area, and the North-East.

INCCA (2010) analysed the monthly maximum and minimum temperature data from 121 stations well distributed over the country during the period 1901–2007. Indian annual mean temperature showed a significant warming trend of 0.51^{o}C/100 years, during the period 1901–2007 (Kothawale et al., 2010). Accelerated warming has been observed in the recent period 1971–2007, mainly due to intense warming in the recent decade 1998–2007. This warming is mainly contributed by the winter and post-monsoon seasons, which have increased by 0.80°C and 0.82°C in the last hundred years, respectively. The pre-monsoon and monsoon temperatures also indicate a warming trend.

Mean temperature increased by about 0.2°C per decade (i.e. 10 years) for the period 1971–2007, with a much steeper increase in minimum temperature than maximum temperature (Figure 3Aa). In the most recent decade, maximum temperature was significantly higher compared to the long-term (1901–2007) mean, with a stagnated trend during this period, whereas minimum temperature showed an increasing trend, almost equal to that observed during 1971–2007.

On a seasonal scale, pronounced warming trends in mean temperature were observed in the winter and monsoon seasons, and a significant influence of El Niño Southern Oscillation events on temperature anomalies during certain seasons across India was observed. The all-India maximum temperatures show an increase in temperature by 0.71°C/100 years (Figure 3A). The maximum temperature during 1971–2007 has increased dramatically, which is 0.17 ^{o}C/10 years. However, maximum temperature exhibited a declining trend of –0.03^{o}C/10 years in the recent past (1998–2007). This may be attributed to the increasing cloud cover.

All-India mean annual minimum temperature has significantly increased by 0.27°C/100 years during the period 1901–2007 (Figure 3A). There are some conspicuous changes noted in different sub-periods in the minimum temperature. During the period 1901–1955, the all-India mean annual minimum temperature shows a warming tendency, but after 1955, it decreases

sharply up to 1970 and later gradually increases. In the last three and half decades, the all-India mean annual minimum temperature shows a significant warming trend of 0.20°C/10 years. Unlike maximum temperature, the trend in the minimum temperature during the latest decade is maintained at the rate noted for the last three and half decades. On the seasonal scale, all the seasons show significant warming trends except post-monsoon, where the trend is positive but not significant.

All-India monsoon rainfall series based on 1871–2009 indicates that the mean rainfall is 848 mm with a standard deviation of 83 mm. Inter-annual variability of Indian monsoon rainfall in this period is shown in Figure 3B. The Indian monsoon shows well-defined epochal variability with each epoch of approximately three decades. Though it does not show any significant trend, however, when averaged over this period, a slight negative trend of –0.4 mm/year is seen.

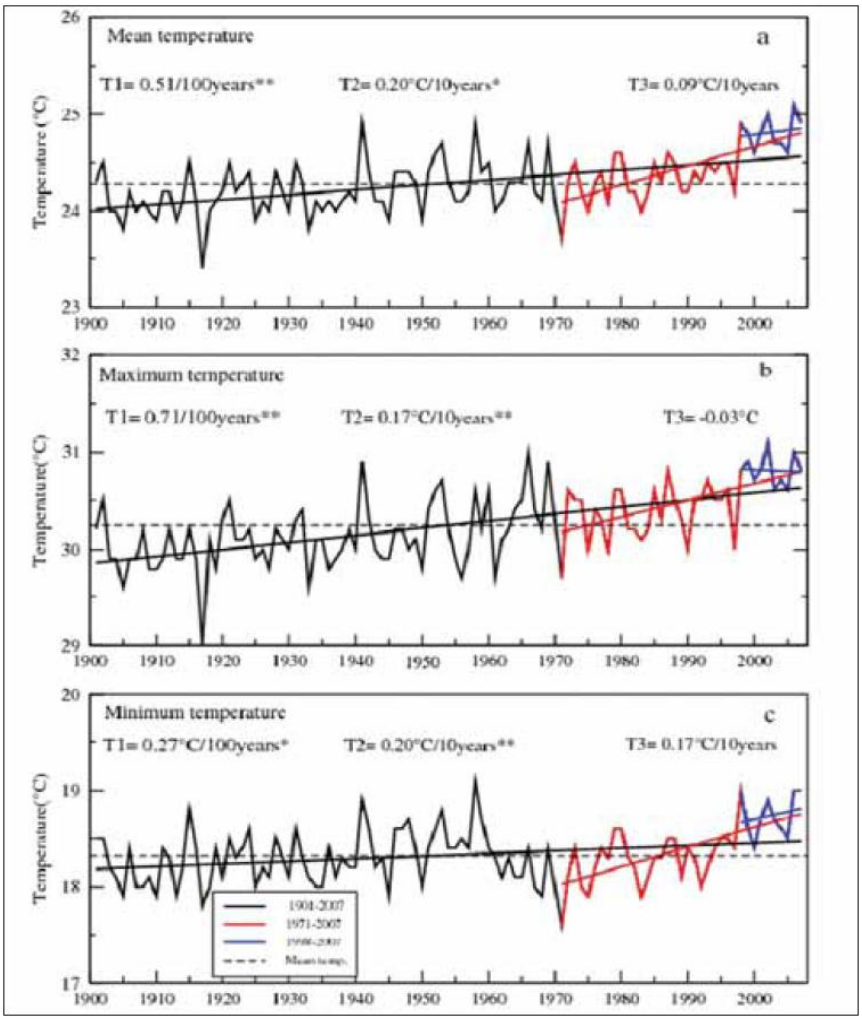


Figure 3A: All-India annual mean, maximum and minimum temperature variations during 1901-2007.

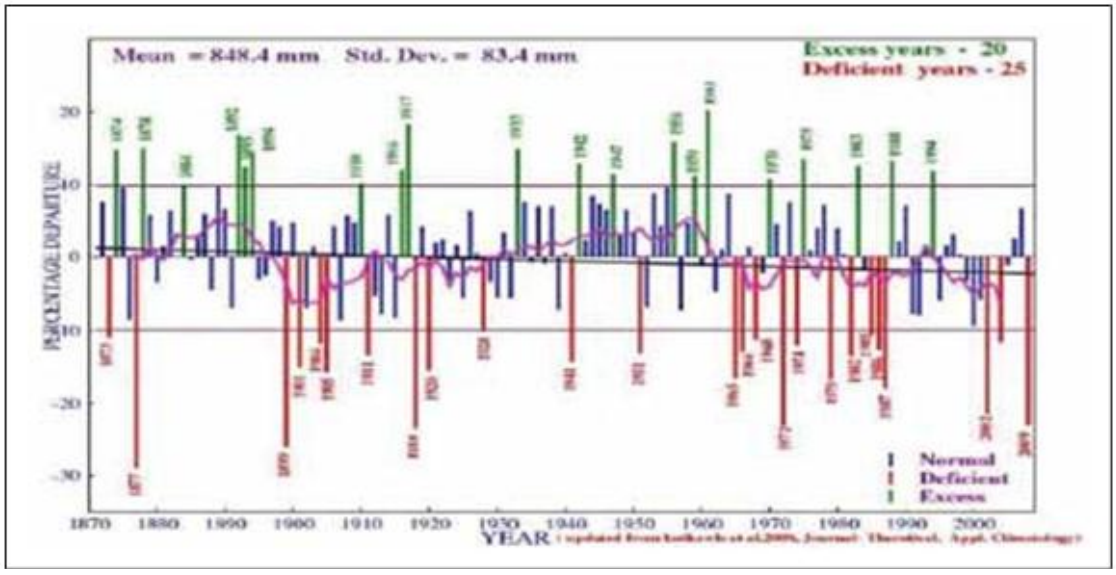


Figure 3B: Inter-annual variability of Indian monsoon rainfall 1871–2009. Bars denote percentage departure from normal (blue) with excess (green) and deficient (red) years. The long-term trend is denoted by the black line. The pink curve denotes decadal variability of Indian monsoon rainfall.

3.4 Climate Profile of the Andaman and Nicobar Islands

3.4.1 Rainfall

The Islands have humid, tropical, and coastal climate. Proximity to the equator and the sea ensures a hot, humid, and uniform climate. The Islands receive rainfall from both the South-west and North-east monsoons. Maximum precipitation is between May and December. The mean annual rainfall is about 3000 mm.

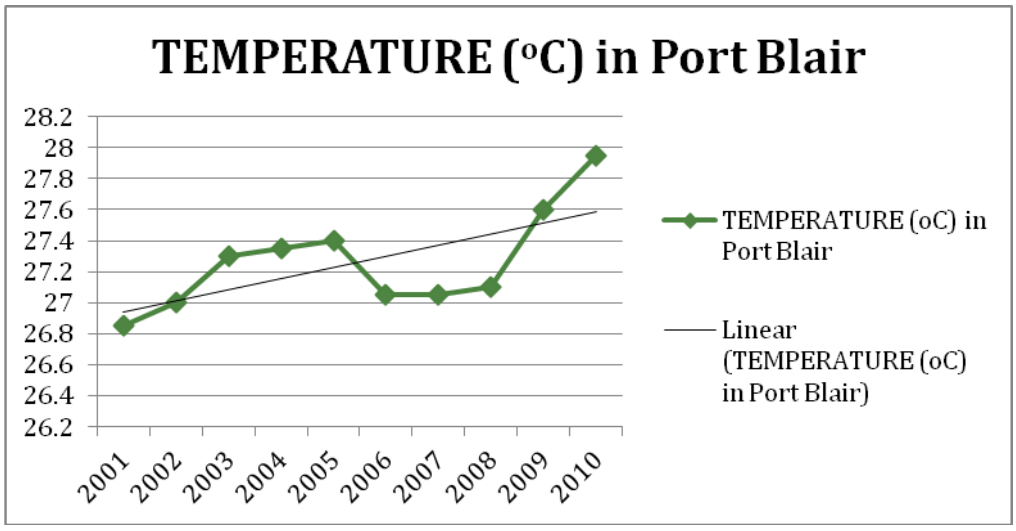
Between 2001 and 2010, the Andaman and Nicobar Islands (ANI) recorded a lowest rainfall of 2287.12 mm during 2002 and a highest of 3254.76 mm during 2008.

3.4.2 Temperature

During the same period, at Port Blair, the lowest mean maximum temperature was recorded as 30.2^{0}C during 2001, 2006, 2007, and 2008 and the highest mean maximum temperature was recorded as 31.3^{0}C during 2010. Similarly, lowest mean minimum temperature was recorded as 23.5^{0}C during 2001 and 2002 and the highest mean minimum temperature was recorded as 24.6^{0}C during 2010. The following table (Table 3.2) details the temperature recorded in Port Blair from 2001 to 2010.

Table 3.2: Temperature (°C) in Port Blair (2001–2010)

Year	Temperature (°C) in ANI (Port Blair only)
2001	26.85
2002	27.00
2003	27.30
2004	27.35
2005	27.40
2006	27.05
2007	27.05
2008	27.10
2009	27.60
2010	27.95



3.4.3 Humidity

On analysing the mean relative humidity percentage recorded at Port Blair from 2001 to 2010, the lowest humidity was recorded at 0830 hours as 76% during 2004 and the highest humidity was recorded at 0830 hours as 80% during 2008 and 2010. Similarly the lowest humidity was recorded at 1730 hours as 79% during 2004, and the highest humidity was recorded at 1730 hours as 83% during 2008 and 2010.

3.4.4 Wind Speed

On analysing the mean wind speed (km/h) recorded at Port Blair from 2001 to 2010, the lowest wind speed was recorded as 5.8 km/h during 2005 and the highest wind speed was recorded as 9.8 km/h during 2008.

3.5 Future Climatic Projection for Coastal Areas Including Andaman and Nicobar Islands

It is expected that there will be an increasing trend in the temperature, precipitation (both in intensity and number of rainy days), and occurrence of extreme temperature in the coastal regions of India (see the picture below).

Projected Climate Change Parameters in 2030s with respect to 1970s

Features	Himalayan region	Western Ghats	Coastal Region	North-Eastern Region
Temperature	↑	↑	↑	↑
Precipitation	↑	↑	↑	↑
Extreme Temperature	↑	↑	↑	↑
Extreme Precipitation – Intensity	↑	↑	↑	↑
Extreme Precipitation – No. of Rainy days	↑	↓	↑	↓

Key

↑ increase ↗ Slight increase → No change ↓ decrease ↕ No particular trend

3.5.1 Annual mean temperature

Most parts of India are showing a warming trend, except in the north-western parts of the country where a cooling trend is observed. All the seasons show significant warming trends except post-monsoon, where the trend is positive but not significant. For India as a whole, the significant decreasing trend in the frequency of cold days and increasing trend (close to 5% significant level) in frequency of hot days have been forecasted. A warming trend is forecast for sea surface temperature data of the north Indian Ocean region. The seasons may be warmer by around 2^0C towards the 2030s.

The characteristics of simulated seasonal and annual rainfall and mean temperature for the eastern coastal region (baseline and A1B scenario) as simulated by PRECIS are given below.

East coast	Rainfall (mm)					Mean temperature (^{0}C)				
Q0	JF	MAM	JJAS	OND	Annual	JF	MAM	JJAS	OND	Annual
Means										
1970s	35	172	798	220	1226	22.8	31.4	28.2	22.7	26.7
2030s	31	190	826	233	1280	25.1	34.7	29.9	24.7	28.7
Standard deviations										
1970s	25.5	76.8	79.7	83.1	140.3	0.9	0.8	0.7	0.7	0.5
2030s	27.3	91	69.0	89	131.2	0.7	1.2	0.8	1.1	0.6

East coast	**Rainfall (mm)**					**Mean temperature (^{0}C)**				
Q1	JF	MAM	JJAS	OND	Annual	JF	MAM	JJAS	OND	Annual
Means										
1970s	18	81	618	143	860	23.6	31.9	29.6	23.2	27.6
2030s	13	90	621	134	858	25.3	33.7	31.1	24.9	29.2
Standard deviations										
1970s	23.1	33.8	109.7	55	138.2	0.7	0.7	0.9	0.9	0.7
2030s	8	45.1	100.0	58	137.6	0.8	0.9	1.2	1.1	0.9

East coast	**Rainfall (mm)**					**Mean temperature (^{0}C)**				
Q14	JF	MAM	JJAS	OND	Annual	JF	MAM	JJAS	OND	Annual
Means										
1970s	52	157	790	210	1208	23.3	32.2	28.7	23.8	27.4
2030s	54	190	816	203	1262	25.4	34.1	30.2	25.8	29.3
Standard Deviations										
1970s	36.1	72.0	87.1	82.2	156.3	0.9	0.8	0.7	0.8	0.5
2030s	37.4	80.3	109	61.7	145.0	1.0	1.0	0.9	0.7	0.7

3.5.2 Sea level rise

According to the IPCC AR4, the losses from the ice sheets of Greenland and Antarctica have very likely contributed to sea level rise between 1993 and 2003. Flow speed has increased for some Greenland and Antarctic outlet glaciers, which drain ice from the interior of the ice sheets. The corresponding increased ice sheet mass loss has often followed thinning, reduction or loss of ice shelves or loss of floating glacier tongues.

As per the 4X4 Assessment, The Indian coastline, including the coastlines of ANI in the Bay of Bengal and Lakshadweep Islands in the Arabian Sea, is 7,517 km of which 81% (6,100 km) is along the Indian mainland surrounded by the Arabian Sea in the west, the Bay of Bengal in the east, and the Indian Ocean in the south. More than 40 million people reside along this coastline. There are 13 coastal states and UTs susceptible to sea-level rise in the country, with about 84 coastal districts affected by tropical cyclones. With climate change, it is projected that the sea level may rise further than what it is today and with the warming of the oceans, the intensity and

frequency of cyclonic activities and storm surges may increase, leading to large-scale inundation of the low-lying areas along the coastlines including ANI.

3.6 Potential Impacts of Climate Change in Coastal Regions in India

Climate parameters	Probable impacts on ecosystems	Emerging impacts on health
• In the west coast, temperature may rise by 1.7–1.8^{0}C in the 2030s w.r.t. the 1970s **• In the east coast, the surface annual air temperature is set to rise by 1.6–2.1^{0}C.** **• Increase in sea surface temperatures** **• Increase in rain fall intensity** **• Rising sea levels** **• Increase in the intensity of cyclones and storm surges, especially in the east coast**	• Decrease in coconut production • Increase in salinity due to incursion of coastal waters due to rise in sea level affecting habitats, agriculture and availability of fresh water for drinking • Changes in distribution and productivity of marine as well as fresh water fisheries • Submergence of habitats and special ecosystems such as mangroves	• Increase in morbidity and mortality due to increase in water-borne diseases associated with cholera epidemics and increase in salinity of water • Loss of livelihoods due to effect on agriculture, tourism, fisheries and hence impacting health and life expectancy • Forced migration, loss of housing and drowning will result due to sea level rise.

PART B

VULNERABILITY OF KEY SECTORS AND AGRO-ECOLOGICAL ZONES TO CLIMATE CHANGE

AND

STRATEGIES TO OVERCOME CHALLENGES TOWARDS THE PATH OF SUSTAINABLE ISLAND DEVELOPMENT

CHAPTER 4

EXPOSURE PROFILE

4.1 Introduction

Andaman and Nicobar Islands (ANI) face high levels of direct and indirect risks and threats mediated by climate change. Climate change will exacerbate existing vulnerabilities of the Islands and Island communities. The exact nature and intensity of these events are difficult to predict, but are expected to be significant. ANI is particularly vulnerable to climate change due to its very 'island' nature, geographical exposure, and susceptibility to the escalated vagaries of nature, limited options for adaptation including natural limits for migration and resettlement, heavily indebted economy on external resources, remoteness from the mainland, high cost of public administration, and greater reliance on climate-sensitive sectors. The isolated and distant positioning of ANI increases its overall vulnerability through high transportation cost, time overruns in accessing external supply, etc. This, along with limited capacity of human and natural systems, increasing population, spatial concentration of productive assets, etc., acts as a critical barrier for developing diversified economies of scale leading to higher levels of vulnerability. Whenever a natural calamity occurs, the lifelines of these islands, viz. communication and transportation get crippled and people have difficulties in moving to other places as is possible in the mainland. During extreme weather events, mobility through sea becomes difficult. The houses and other physical infrastructure are also prone to damage caused by high-speed wind. All these factors expose the islands to multiple and simultaneous risks from climate change.

On a direct level, sea level rise, salinity intrusion, reduced fresh water availability, and changes in sea surface temperature and pH will have significant impacts on the coastal ecosystems, particularly on fisheries and corals. Coral reefs, which are already threatened by multiple stressors such as pollution, destructive removals, and invasive species, would also be affected by coral bleaching induced by rising sea temperature. Coastal and marine resources play an important role in the economy of the region, especially fisheries. Mangroves and coral reefs in particular are breeding grounds for several species of fishes and marine life. Rising waters, frequent and violent storm surges, and more virulent tropical cyclones will lead to inundation of coastal areas and often make them uninhabitable, apart from damaging valuable coastal infrastructure (mostly located along the coast).

Agriculture, fisheries, and allied activities are the prime growth engines in ANI. Tourism and small-scale industries provide supplementary livelihoods. Tourism is one of the most important revenue-generating sectors of the Islands. These sectors are extremely climate sensitive and get affected significantly during extreme weather events thus affecting the livelihoods of the people.

As is common in other similar places, fisherfolk, farmers, and womenfolk bear the brunt of such mishaps because of their deep dependence on climate-sensitive sectors.

Literature and studies regarding the specific impacts of climate change on ANI are limited. However, based on available information, an exposure and vulnerability profile for ANI has been attempted. Accordingly, a range of strategies from scientific studies to policy recommendations and institutional arrangements have been provided to address them.

As stated in the initial chapter, while the causes of some of these natural disasters cannot always be attributed to climate change, it often works in tandem with climate-related risks and increases the overall vulnerability of ANI with implications for the well-being of human and natural systems. Islands predisposed to natural disasters have compromised abilities to cope with additional climatic stressors. In view of this, the following section attempts to detail the exposure of ANI to extreme weather and geological events whereas sector-specific vulnerabilities to climate change are described in Chapter 5.

Cyclone

The design wind speed for the whole UT is 44 m/s (158 km/h), which can be attained during the monsoons. ANI is classified as Moderate Damage Risk Zone – A. The cyclone-affected coastal areas are classified in 50 m/s (Very High Damage Risk Zone – B) and 55 m/s zones (Very High Damage Risk Zone – A). Cyclones are associated with strong winds, torrential rains, and storm surges, which cause abrupt rise in sea level at the time the storm crosses the coast. Storm surge is the most destructive phenomena associated with a cyclone. Low-lying areas along the coast are inundated by seawater, which can result in the loss of human lives. The cyclone of 24 November 1988 was followed by the floods in Diglipur, Mayabunder and other areas on 8 December 1998. About 5,000 people were affected. Increasing occurrence of cyclones, one of the established manifestations of climate change, exacerbates the vulnerability of ANI.

Floods

Islands such as Car Nicobar are flat and sandy with elevated areas at certain places. Such islands where the drainage is predominantly by seepage are vulnerable to flooding in case of heavy downpour.

4.2 Strategies for Addressing High Exposure to Disasters

- There is need for greater emphasis on reducing the negative impacts from natural disasters. This approach of disaster prevention and mitigation needs to be considered as a high-return investment with benefits in the form of long-term cumulative cost savings.
- Disaster management should be mainstreamed into the development strategies/projects of the UT administration and local bodies.
- Programs for disaster management should be action oriented and transparent with realistic targets and clear accountability.

- Measurable indicators should be developed to help the UT administration and other stakeholders to assess their progress in the implementation of disaster management programmes.
- The Island administration needs to be better equipped to undertake techno-economic and environmental appraisal of developmental projects to ensure the suitability of such projects for the UT. Ecological monitoring of various natural assets is yet another necessity. A suitable administrative arrangement for this purpose needs to be created.
- Appropriate measures should be taken to induce a wider appreciation and sensitization regarding the unique natural environment and ecology of the Islands and the risks associated with the unsustainable use of natural resources. In this context, it would be important to collect and institutionalize the widely dispersed traditional knowledge and customs in the Islands to mitigate the risk of natural hazards; spread awareness among people about the various government programmes; and educate people about the importance of conservation and sustainable use of natural capital, and the need to adequately respond to early warning signals, and follow safety and evacuation plans. At the same time, people can help put together and institutionalize the widely dispersed traditional knowledge and customs to mitigate the risk of natural hazards. Government responses based on the community's own priorities, knowledge, and resources are likely to be more acceptable to people and thus more effective in reducing risk factors.
- Lifeline infrastructure in at-risk areas, such as health centres/hospitals, offices, emergency headquarters, schools, must be disaster proof, serving both a protective and symbolic function. People are more likely to respond positively to evacuation plans when protective shelters are familiar structures located in familiar places.
- Priority vulnerable areas/sectors should be identified through baseline assessments.
- Appropriate adaptation measures to the adverse impacts of climate change need to be developed and effectively implemented at all levels, thereby improving the coping capacity of the communities, sectors, and ecosystems.
- Institutional mechanisms for the long-term monitoring of key climate-change-related parameters established.
- Promote integrated management of coastal resources to increase the resilience of coastal ecosystems and communities and compliance with Coastal Regulation Zone regulations.
- Develop detailed profile of geological, ecological, and climate-change-related attributes and detailed vulnerability mapping in the context of climate change.
- Develop contingency plans for disaster risk reduction and management.
- Promote 'natural adaptation solutions' over 'engineering adaptation solutions' as they are cost effective, affordable, and provide multiple solutions.

4.3 Relevant Initiatives, Plans, and Policies

Disaster Management Plan, 2010

In light of the extreme exposure profile of ANI, the UT proposes to evolve a decentralized and collaborative system for planning, organizing, coordinating, and implementing measures necessary to:

- prevent threat of disaster;
- assess the status of existing resources and facilities available with the various departments and agencies involved in disaster management;
- identify requirements for institutional strengthening, technological support, and up-gradation of information systems;
- make the plan an effective response mechanism, with a strong focus on the role of different agencies and departments to respond to disasters;
- evacuation, response, and relief; and
- Rehabilitation and reconstruction.

The ANI administration constituted a Disaster Management Authority, a Disaster Management Executive Committee and district-level disaster management authorities with clearly defined roles and functions. The plan proposes that all government departments and agencies come under a single umbrella of control and direction with their disaster-specific functions.

The plan also outlines an incident response system and lays emphasis on community-based disaster management for a quick response and rehabilitation process.

CHAPTER 5

VULNERABILITY OF KEY SECTORS AND SYSTEMS TO CLIMATE CHANGE AND STRATEGIES TO ADAPT

5.1 Forests and Biodiversity

5.1.1 Overview and Status

The Andaman and Nicobar Islands (ANI) are endowed with rich forest resources. According to the State of Forest Report 2011, the recorded forest area of ANI is 7,171 km^2, which is 86.93% of its total geographical area (45.59% land under very dense forests, 29% is moderately dense, and about 6% is open forest). Reserved Forests constitute 40.85% and Protected Forests account for 59.15% of its total forest area.[19]

ANI is a complex mosaic of different forest types thus supporting varied life forms. There are 12 forest types belonging to four forest groups, namely Tropical Wet Evergreen, Tropical Semi-Evergreen, Tropical Moist Deciduou,s and Littoral and Swamp Forests (Figure 5.1 and Table 5.1). The distribution and extent of each type depends primarily on topography and soil. [20]

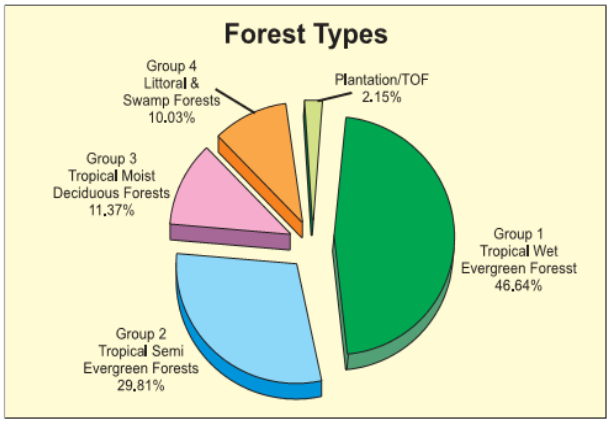


Figure 5.1: Different forest types in ANI

Table 5.1: Different forest types in ANI

Forest type	Description
Giant Evergreen Forests	Occur in deep alluvial soil near the banks of larger streams. Major species found in these forests are *Dipterocarpus spp., Calophyllumsoulattri, Artocarpuschaplasha, Amoorawallichii,* etc.
Tropical	Similar to the giant evergreen forests but not so luxuriant and occur

[19] State of Forest Report, 2011, Forest Survey of India; Web link: http://www.fsi.org.in/sfr_2011.htm Date Accessed: April 2nd 2011

[20] Rural Resources Conservation and Development and Andaman and Nicobar Islands, Dept. of Environment and Forests

Evergreen Forests	mostly on hilltops. Major species found in these forests are *Dipterocarpusgrandiflorus, Xantho-phyllumandamanicum, Artocarpuschaplasha, Myristica Andamanica,* etc.
Southern Hilltop Evergreen Forests	Occur on the exposed upper slopes and hill tops and sometimes on steep slopes lower down. Major species found in these forests are *Dipterocarpuscostatus, Mesuaferrea, Canariummanii, Hopeaandamanica,* etc.
Semi-Evergreen Forests	Luxuriant forests with many giant trees both of evergreen and deciduous nature occur in valleys. Climbers are often heavy. Major species found in these forests are *Dipterocarpus spp., Pterocymbiumtinctorium, Sterculiacampanulata, Terminaliabialata, T.procera, Albizziachinensis, A.lebbek,* etc.
Moist Deciduous Forests	Distributed extensively in the Andamans but not much in the Nicobar group of Islands. Top storey is irregular with tall deciduous trees followed by a second storey, which comprises numerous species including some evergreen trees. Major species found in these forests are *Pterocarpusdalbergioides, Terminaliabialata, T.Manii, T.procera, Pterocymbiumtinctorium, Tetramelesnudiflora, Dilleniapentagyna,* etc.
Secondary Deciduous Forests	Occur in worked-over areas of the primary type. Major species found in these forests are *Euphyllum, Pterocymbiumtincto-rium, Salmaliainsignis, Tetramelesnudiflora, Terminaliamanii, T.procera, Albizzialebbek,* etc.
Littoral Forests	Occur all around the coast wherever a fair width of sandy beach exists. *Manilkaralittoralis* is the most characteristic species of this type in these islands. Other species are *Scavelafrutescens, Hibiscus tiliaceus, Morindcitrifolia, Terminaliacatappa, Pandanustectorius,* etc.
Mangrove/Tidal Swamp Forests	Occupy shores, mouths of creeks and inland channels of islands. These are salt-tolerant species and occupy 966 km^2 area of the islands. Important mangrove species found in ANI are *Rhizophoramucronata, R.can-delaria, Bruguieraconjugata, B.parviflora, Avicenniaofficinalis, Ceriopstagal, Kandeliacandel, Sonneratiacaseolaris, Excoecaria,* etc.
Brackish Water Mixed Forests	Considered as the climax of tidal forests and may be a closed forest of 35 m height. These are found in larger deltas and creeks along the outer periphery and at places where salt water mixes with fresh water. Major species found in these forests are *Heriterialittoralis, Barringtoniaracemosa, B.asiatica, Brownlowialanceolata, Nypafruticans, Phoenix paludosa,* etc.
Sub-mountain	Irregular forest of a limited number of evergreen species. Trees are

Hill Valley Swamp Forests	usually low, crowded, and branchy. Major species found in these forests are dense growth of *Calamus*, while and monocotyledons such as *Alpinia* often form the undergrowth.
Canebrakes	Found throughout the evergreen and semi-evergreen climaxes and locally in moist deciduous forests. Cane brakes are impenetrable thorny thickets sometimes with a few tall trees. Major species found in this areas are *Calamus spp.* and sometimes creeping bamboo *Dixochloaandamanica.*
Wet Bamboo Brakes	Often very dense occurring throughout tropical evergreen tracts of the Andamans. Major species found in these forests are *Dendrocalamasbrandisi, Oxytenthera spp.,* and *Bambusaschizostachyoides.*

Source: Ministry of Environment and Forests. State of Environment Report, 2009.

ANI, nestled between two major biodiversity hotspots, namely the Indian subcontinent and the Malaysian–Indonesian region, is in itself a veritable storehouse for biodiversity. The unique positioning of these islands endows it with a unique distribution of plants with representation of the Indian, Myanmarese, Thai, Malaysian, and Indonesian flora. The flora of the Andaman group of islands shows closer affinity to the Indo-Myanmarese-Thai flora, while the Nicobar group of islands are closer to the flora of Malaysia–Indonesia. These diverse forests are recognized as part of the distinct eco-region in the WWF Global 200 list of priority biodiversity hotspots with high endemism.

Overall, 9% of the fauna is endemic including 40% of the birds and 60% of the mammals. High degree of endemism in ANI is the outcome of the evolution of species in the Island ecosystem, which has limitations for the emigration and immigration of gene flow from nearby landmasses (Table 5.2).

Table 5.2: Types of animal groups in ANI

Animal group	No. of species/ sub spp.	No. of endemics	Percentage of endemism
Terrestrial fauna			
Mammalia (Mammals)	55	32	61.5
Aves (Birds)	246	99	40.2
Reptilia (Reptiles)	76	24	31.6
Amphibia (Amphibians)	18	3	16.7
Mollusca (Mollusc)	110	77	70.0
Arachnida (Spiders)	94	38	40.4
Hemiptera (Cicadas, aphids, etc.)	146	22	15.0

Diptera (Flies)	214	24	11.2
Coleiotera (Beetles)	878	92	10.5
Lepidoptera (Butterflies and moths)	426	52	12.2
Isoptera (Termites)	40	19	47.5
Odonata (Dragonfly & Damsel flies))	36	4	11.1
Annelida (Earthworms, leeches, etc.)	30	9	30.0
TOTAL	**2,366**	**495**	**20.92**

Source: Department of Environment and Forests, Andaman and Nicobar Islands, http://forest.and.nic.in/frst-wildlife1.htm

Protection status: Reserved Forests constitute 40.85% and Protected Forests account for 59.15% of its total forest area. ANI has 9 National Parks and 96 Wildlife Sanctuaries covering an area of 0.15 million ha which constitute 18.18% of the UT's geographical area. The protected area network constitutes 20.91% of the recorded forest area. The Great Nicobar Biosphere Reserve, having an area of 88,500 ha is located in this territory (Table 5.3).[21]

Table 5.3: Protection status of the forests

Protected areas	Nos.	Area (km^2)
Wildlife Sanctuaries	96	466.218
National Parks	9	1153.938
Biosphere Reserves (including two National Parks)	1	885.00

Source: State of Forest Report, 2011

The nodal agency for planning and implementation of policies and programmes for conservation, protection and management of forests and wildlife is the Department of Environment and Forestry (DoEF).

5.1.2 Threats, Issues, and Challenges

There has been a significant loss of forest cover (178 km^2) in ANI because of the 2004 tsunami.[22] Existing challenges and threats to the forestry sector include the following:

- Encroachment on forests and protected areas by smugglers, poaching,, and illicit cuttings.
- Lack of good sea-worthy vessels, inadequate transport system.

[21] Forest Survey of India. State of Forest Report, 2011, <http://www.fsi.org.in/sfr_2011.htm>. Date accessed: 2 April 2011

[22] Ministry of Environment and Forests. State of the Environment Report, India, 2009.<http://moef.nic.in/soer/2009/SoE%20Report_2009.pdf>. Date accessed: 2 April 2011

- Poor communication network and inadequate manpower to adequately protect the vast tracts of forest land.
- Pressure from habitat destruction and degradation due to agricultural encroachment and unsustainable agricultural practices.
- Fragmentation of land holdings owing to increase in family sizes and low agricultural productivity and thus greater demand for agricultural land.
- Requirement of Non-timber Forest Produce (NTFP) such as ballies and posts. They adversely affect the natural regeneration of forests. Timber extraction aimed at increasing the economic value of the forests has changed the forest structure and composition and deciduousness has increased in many areas.
- Proliferation of exotic species and crowding out of endemic species by exotic species.

5.1.3 Vulnerability to Climate Change

- As per the climate projection for the year 2085, 77% and 68% of the forested grids in India are likely to experience shift in forest types under A2 and B2 scenario, respectively. It is expected that 39% of forest grids in India are likely to undergo vegetation type change under the A2 scenario and 34% under the B2 scenario by the end of this century.
- There will be a gradual shift in ecosystem types towards drier seral levels: evergreen forests are shrinking and giving way to moist deciduous forests and the proportion of open forests is increasing in ANI.
- Global warming is expected to have a profound effect on the flowering time of plants thus altering a number of ecological processes such as pollination, etc.
- Tropical rainforests are one of the most fragile ecosystems on earth. The change in temperature regime will have very serious impacts on their ecosystems' functionality and networking abilities.
- Some of the highly specialist species will be significantly affected and might even face the threat of extinction.
- Erratic and more intense rainfall during a short period of time will lead to increased soil erosion and reduced water availability during drought.
- There is also a probability of enhanced colonization by alien species and increase in ocean acidification, which may reduce marine ecosystem productivity.

5.1.4 Strategies to Address Challenges and Vulnerability to Climate Change: Effective Forest Management for the Present and the Future

Forest management in ANI requires a unique strategy, which is sensitive to its high degree of endemism, extensive forest cover, uniqueness of insular flora and fauna, difficulty in accessibility, and fragile environment. High priority areas include the following:

- Protection of forests and wildlife. Provision of infrastructure for environmental protection. Improvement in communication network.

- Building a database for scientific management of forests and protected areas, biodiversity characterization, and inventorization of medicinal plants.
- Promoting alternative livelihood options for forest-dependent communities such as NTFP collection and community based eco-tourism.
- Efficient utilization of timber and enhancing its useful life by adopting appropriate technological solutions.
- Increasing the existing area under forests and trees and improving the quality and density of the degraded forests.
- Improvement in the variety of cattle and protection and management initiatives towards regulated grazing.
- Promoting agro-forestry among local communities.
- Improved biodiversity conservation practices and revamping the working plan process.
- Strengthening Protected Area management including climate proofing.
- Research and capacity building.
- Enhancing effectiveness in forest management.
- Conversion of monoculture plantations into secondary forests.

Strategies under the Biodiversity Strategy Action Plan

- Protected Area Management (*In situ* conservation and *Ex situ* conservation): Demarcation and reorganization of protected areas and plans to consolidate protected areas to make them ecologically sound. Establishment of botanical gardens, gene banks, seed banks, biological parks etc. can help conserve rare and endangered species outside their natural habitat.

- Enumeration of Biodiversity: Habitat survey, species enumeration and studies on genetic diversity within species will help in better documentation and understanding of the flora and fauna of ANI.

- Elimination of Threats due to Introduced Species: There are over 600 introduced species and they should be eliminated immediately if they are a threat to the local flora and fauna. The spotted dear and feral elephants are damaging the regeneration of forests.

- Social Forestry and Joint Forest Management: Social forestry should be promoted on non-forest land for meeting the requirement of NTFP. Resolution for JFM (2005) has been passed in ANI and it recognizes the dual role of villagers in forest protection as well as the importance of forests in meeting the domestic needs of villagers. A JFM Committee has been constituted in select villages.

5.1.5 Relevant Initiatives, Plans, and Policies

Strategies to address challenges to forests and biodiversity have been addressed under various plans, programmes and policies both at the national and UT levels. A number of plans and studies have preceded the ANIAPCC and have laid the foundation for the Mission on Sustainable Forests for ANI. A brief review of some of the pertinent studies and plans are provided below.

Information Management

A sound and elaborate database is a prerequisite for mindful planning and execution of projects. Incorporating data on forest cover, flora and fauna, administrative units, timber and NTFP availability, offences detected, and socio-economic parameters on a Geographic Information System (GIS) platform allows for visual representation of a large number of parameters and quick decision making. The Forest Department has formulated an IT plan and its salient features include knowledge creation, management and monitoring. The Forest Management Information System (FMIS) is an integrated system that allows monitoring forest management activities across administrative units. The Environment Information System (ENVIS) centre located in DoEF is used for collection of information on various environmental parameters. E-Governance involves computerization of various permits. Forest Education and Forest and Wildlife Research activities are also promoted under the plan.[23]

5.1.6 Proposed Plans and their Linkages to the National Action Plan on Climate Change

The guiding document for the formulation of the Climate Change Action Plan was the National Mission for Green India drafted by the MoEF. The principle objectives of the Green India Mission include:

- Enhancing carbon sinks in sustainably managed forests and other ecosystems.
- Adaptation of vulnerable species/ecosystems to the changing climate.
- Adaptation of forest-dependent communities.

There is a strong focus on improving the density of forests and adopting a democratic decentralization governance process and engaging new stakeholders such as NGOs, research organizations, and the private sector.

The ANI Mission on Green India embodies the goals and processes of the National Mission in the context of its unique biodiversity and rich forest cover.

[23] State Development Report of Andaman and Nicobar Islands, 2006, National Institute of Public Finance and Policy

ANI Mission for Green Islands

The mission adopts a four-pronged approach:

- Conservation of forests to reduce carbon emission and protect ecosystem services.
- Afforestation to enhance carbon sequestration.
- Capacity building for state and the vulnerable communities to adapt to climate change impacts.
- Research impact of climate change on natural ecosystems and biodiversity in order to continuously evolve management strategies.

The mission comprises five components, each consisting of action points addressing present and future challenges to forests and biodiversity.

Component 1: Protection of Existing Forests

Standardization of beat area to enhance forest protection

Presently the average beat size of the territorial forest divisions is 17 km^2. Considering the impenetrable nature of tropical evergreen forests, lack of mobility and other issues, the beat area under front line staff is much higher and it needs to be standardized to enable effective protection. It is proposed that a study be conducted on the standardization of forest area and to redraw forest boundaries.

Strengthening the protection machinery

In contrast to mainland scenario, forest protection in ANI is a complicated affair. The presence of vast stretches of ocean, creeks, impenetrable forests and proximity to foreign countries compounds forest protection problems. Foresters are often the first people to detect the presence of foreign poachers and risk their lives in apprehending them. Hence, it is imperative to enhance the protection machinery in terms of manpower, mobility, communication facility and firepower so as to enable the department to protect the existing forests and biodiversity. In addition to that, the staff and officers need exposure to modern forest protection techniques to upgrade their skills on protection (Table 5.4).

Table 5.4: List of proposed activity to be undertaken

Sl. no	Proposed activity	Nature of activity (new/ongoing)
1.a.	Conducting study on the standardization of beat area to enhance forest protection.	New initiative
1.b.	Standardization of beat area to enhance effective forest protection.	New initiative
1.c.	Strengthening of protection machinery in terms of manpower for protection of forest.	Ongoing
1.d.	Strengthening of protection machinery in terms of mobility at sea to enhance forest protection.	Ongoing
1.e.	Strengthening of protection machinery in terms of mobility, fire power, and communication in the Islands to enhance forest protection.	Ongoing
1.f.	Capacity building of protection staff/officers on the latest techniques in forest protection.	Ongoing

Component 2: Increasing the Density of Forests

The Green India Mission has a mandate to increase the national forest cover to 6 million ha to enhance the carbon sink of the country. ANI is bestowed with 87% forest cover, which is much above the national average. Since forests are sinks and potential sources for carbon emission, protecting the existing forests and increasing their density is pivotal to achieve the mandates of the Green India Mission. Natural calamities such as tsunamis, cyclones, and anthropogenic influences such as encroachments, faulty conversion of forests to other land is responsible for the degradation of some very dense forests in ANI.

ANI has about 352 km^2 of open forest area. After subtracting the area under villages, approximately 300 km^2 is available for enrichment activities. These include studies on feasibility of restocking forest areas and other initiatives such as the following (Table 5.5):

- Conducting a study to assess the quantum of open forest area available for restocking and evolving appropriate methodology to enhance its ecological services.
- Since the FSI 2009 report is based on macro-level sampling and ground truthing, it is essential to conduct an intensive study on the actual area available for restocking and techniques to be adopted to restock them. It is proposed that this work be awarded to a technical organization.
- Restocking of open forests to enhance its ecological services. In the first phase, 100 ha of open forests will be restocked according to the methodology evolved.

Table 5.5: List of proposed activities to be undertaken

Sl. no	Proposed activity	Nature of activity
2a	Conducting a study to assess the quantum of open forest area available for restocking and evolving an appropriate methodology to enhance its ecological services.	New initiative
2b	Enrichment and restoring the natural profile of open forest areas in ANI by appropriate silviculture interventions.	New initiative
2c	Restocking of encroachment-evicted area/area to be evicted from forest encroachments.	Ongoing programme

Component 3: Phasing out of Monoculture Plantations and Conversion to Secondary Forests

Plantations are established to serve social needs and to supply material to industries. In ANI, a few areas of natural forests have been replaced with plantations of *Padauk, Gurjan,* teak, or a combination of these and other commercial species to promote ply industry and increase commercial tree production. However, recent scientific studies have proved that the plantations harbour little biodiversity and serve few ecological services such as carbon sequestration in contrast to natural forests and are thus not effective measures. Considering the unique flora and fauna of ANI and the necessity to protect them, the Hon'ble Supreme Court of India has directed the ANI Administration in its order dated 7/5/2002 to phase out all exotic plantations. Thus, the main objectives of this component are to

- Phase out monoculture plantations of exotic species established in ANI in the past and to convert them into secondary forests so as to enhance the ecological services offered by them.
- Enrich mixed plantation of native species through appropriate silvicultural intervention.

Target Area: The ANI administration has created 12431 ha of monoculture plantations/mixed plantations of commercial species. In addition to that the Andaman and Nicobar Islands Forest and Plantation Development Corporation (ANIFPDC), a Government of India (GOI) undertaking has established 2207 ha of red oil palm/rubber plantations (Table 5.6).

Table 5.6: Area under plantations in different divisions

Division	Area under plantation (ha)
Diglipur	106
Middle Andaman	3730
Mayabunder	1952
Baratang	3435

South Andaman	3208
ANIFPDC (Little Andaman)	1593 (Red oil palm) 614 (Rubber)
Total	12431

Source: State Development Report, ANI. Planning Commission, 2008

This component is an ongoing initiative and is being implemented under the working plans of the various territorial divisions. The activity would be continued under state funding (Table 5.7).

Table 5.7: List of proposed activities to be undertaken

Sl. no.	Proposed activity	Nature of activity (new/ongoing)
3.	Phasing out of exotic plantations and enrichment of existing plantations to convert them into secondary forests.	Ongoing programme

Component 4: Improved Utilization of Timber on Government Saw Mills

The Chatham and Betapur saw mills are the sole source of timber from ANI Forests. Both saw mills are equipped with outdated machinery. It is proposed that they be modernized and their capacity be improved to efficiently utilize the timber and to enhance its useful life. This effort will help lock up the carbon present in the timber and would delay emission of CO_2 and reduce demand for more timber.

The timber needs of ANI are met at present by limited extraction of timber by the DoEF, in accordance with the recommendations of its Working Plans, and its conversion in the government saw mills, which is supplemented to an extent by the import of timber by various private agencies. The timber that is extracted from the forests of the Islands is broadly categorized into ornamental timber, plywood, hardwood (structural timber), and softwood (matchwood and pencil wood).

- **Improving the conversion ratio of the log timber to sawn timber**: The conversion rate of timber in the government saw mills is in the range of 50%–60%. This can be improved by improving the quality of sawmilling machinery. At present, the Chatham saw mill and the Betapur saw mill employ sawing machines that are 30–40 years old, on an average. These machines are primarily meant for handling large diameter logs. Since the timber extraction in the future is going to be only from the forests once harvested and regenerated, and no new primary forests are going to be opened up for extraction, the average diameter of the logs will go down. Therefore, there is scope for replacing the old machinery with new ones, which are more efficient in the conversion of logs.

- **Use of short-length timber:** The short length timber that is produced by end cutting to produce standard lengths of sawn timber can be effectively put to use with modern

technology. The finger-jointing machine can be used to join the short lengths to make long lengths. These long lengths can also be joined laterally to form large boards. Techniques are available for the purpose, and there are organizations like the Institute of Wood Science and Technology, which can impart training in the use of this machinery. This way, the mills can recover about 150–200 m^3 of short length timber/year, which is otherwise used as a fuel in the boilers.

- **Increase in treatment and seasoning facilities**: The proportion of treated timber is just one-third of the total sawn timber that is disposed by Chatham saw mill. Timber degrades quickly in these islands due to high humidity and the favourable conditions for the growth of wood deteriorating fungi. The proportion of treated timber can be increased steadily, and at some point, all the timber that is used in the islands should invariably be treated for enhanced life. This can reduce the demand for timber in the long run, and can lead to reduced extraction of timber from the forests.

- **Use of sawdust**: The sawdust produced in saw mills is used only to a limited extent and the major quantity is dumped into the sea, causing pollution and also release of Greenhouse gas (GHG) when the dust deteriorates. There is possibility of producing briquettes employing a briquetting machine, and then using the briquettes as fuel, either in the boilers and canteen or the mill itself. Sawdust compacted into briquette takes on the burning properties of coal. Owing to higher density, the briquettes have a higher calorific value than the same quantity of fuel wood. The extra briquettes that exceed the requirement in the saw mills can also be used as fuel for domestic and industrial use. The use of briquettes will be able to replace the use of fossil fuels like LPG to some extent in commercial establishments and help in mitigation of climate change. The quantity of sawdust and the sawn fuel that is produced is 20–30% and 8–10% of volume of the wood converted respectively (Table 5.8).

Table 5.8: List of proposed activities being undertaken

Sl. no.	Proposed activity	Nature of activity (new/ongoing)
5.a	Conducting a study for modernization of Betapur and Chatham aaw mills.	New initiative
5.b	Modernization of Chatham and Betapur saw mills.	New initiative
5.c.	Conducting a study on effective utilization of wood waste that originates from the saw mills.	New initiative
5.d.	Efficient utilization of wood waste originate from Saw Mill	New initiative
5.e.	Conducting a study for the efficient use of non-hardwood species.	New initiative

5.f.	Efficient utilization of non-hardwood species.	New initiative

Component 5: Development and Enhancing Efficiency of Small Wood and NTFP-based Industry

The primary objective is to diversify income sources for forest-dependent communities by establishing institutions and capacity-building programs for the small wood and NTFP-based units so as to enhance their adaptive capacity.

Bamboos have been a major source for construction material in the islands till recently. The main species used are *Gigantochloaandamanica* and to some extent *Bambusaschizostachyoides. Gigantochloaandamanica*, which is very common, is used in the construction of mats used for walling purposes. However due to lack of any preservation strategy, the products lasts only 2–3 years and have to be replaced. At the same time, domestic consumption is increasing steadily due to increase in the population (Table 5.9).

Table 5.9: Increase in consumption of cane over the years

Year	Quantity of bamboo collected (no.)
2004/05	5,42,363
2005/06	4,93,950
2006/07	6,66,625
2007/08	7,01,600
2008/09	5,53,870

Source: State Development Report, ANI. Planning Commission, 2008

Constant decline in the bamboo resources over the years has been reported in all the working plans due to unsystematic exploitation. However, the management of native bamboos is prescribed only in the recent working plans under the minor forest produce working circle.

ANI has tremendous potential for the development of cane resources. Eighteen species of cane have been reported in ANI, of which five are used industrially for the manufacture of furniture and handicrafts. There are 121 small-scale industries using cane and 17 using bamboos. Export of raw cane from ANI was banned during 1995, in order to provide sufficient quantity to the local industries and also to promote value addition. Scientific harvesting of cane and promotion of its natural regeneration are essential to make the utilization of cane sustainable (Table 5.10).

Table 5.10: Quantity of cane supplied over the years

Year	Quantity of cane supplied to small-scale industries (rmt)
2004/05	3,60,181
2005/06	2,76,322
2006/07	7,05,495
2007/08	3,84,970
2008/09	6,50,958

Action Items:

- Mechanization and training of artisans can improve the quality of the end products.
- There are a number of non-conventional NTFPs such as medicinal plants, Dhup, mosses, etc., which have not been systematically studied as yet to explore their marketing potential. These studies should be promoted.
- Existing small timber and NTFP-based industries lack sophistication and need upgraded skills and machinery. To facilitate improvement in the quality of products and to ensure sustained supply of raw materials, the small-scale furniture and bamboo/cane and other NTFP-based industries should be located in an industrial estate.
- Arrangements should be made for regulated supply of raw materials and for marketing of the produce, either through the forest department or the forest corporation on the lines of Textile Park or IT Park established on the mainland.
- Mechanization of many of the operations related to furniture making is possible in an industrial estate, and the quality of the produce will improve and fetch a better price. The marketing of the produce can be arranged through the forest corporation.
- Industries which can produce bamboo ply, bamboo boards, or bamboo agarbathi sticks or bamboo toothpicks, furniture, wooden toys, etc. should be located within the estate, and these products have a ready market in the mainland. This will also help eliminate illegal extraction of timber, bamboo, and cane.

Sl. no.	Proposed activity	Nature of activity (new/ongoing)
6.a.	Conducting a study for survey assessment and exploring marketing potential of conventional and non-conventional NTFPs.	New initiative
6.b.	Conducting a study on the setting up of NTFP marketing federation.	New initiative
6.c.	Development of NTFP-based plantations to augment supply of NTFP raw material for local artisans.	Ongoing
6.d.	Conducting a study on the establishment of industrial estates for NTFP-based small-scale industrial units in South Andaman, North and Middle Andaman and Nicobar Districts.	New initiative
6.e.	Establishment of industrial estates for NTFP-based small-scale industrial units.	New initiative
6.f.	Training of artisans in modern techniques of small-wood and NTFP-based product.	New initiative

5.2 Coastal Ecosystem and Marine Resources

Ecological systems are very closely interlinked in ANI. Destruction of forest cover could lead to increased erosion, which can choke coral reefs, affecting fish population in the specific area. This would not only have an adverse effect on the biodiversity and ecological balance but on the fisheries sector as well. Similarly, sand mining from the beach or destruction of mangroves will increase erosion by the sea waves leading to increased vulnerability of the landmass. These critical inter-linkages within and between different ecological systems and with the economy and society are pivotal to understand.

5.2.1 Overview and status

Mangroves occupy 644 km^2 in the Andaman Islands and 27 km^2 in the Nicobar Islands. Of the 36 species of mangroves found in ANI, 7 species are found exclusively in ANI. Owing to their remoteness and non-settlement by human beings in many islands, virgin mangrove forests are also available. Mangrove forests are different in ANI since there are no perennial rivers in the islands and thus no delta-like structures. Mangroves are situated either as fringe on flat littoral zone or along creeks as a narrow belt between tropical rain forests and the sea.[24] Mangrove forests are one of the most productive and biodiverse wetlands on earth. Mangrove ecosystems are widely recognized as providers of a wide variety of goods and services to people, including storm abatement, sediment trapping, land accretion, nutrient up take, and transformation and provision of a variety of plant and animal products. Owing to their unique physiology and ecology, mangroves provide optimal breeding, feeding, and nursery grounds for many ecologically and economically important fish and shellfish species as well as feeding habitats for resident and migrant water birds.[25] ANI mangroves have 253 species of fish, 410 species of polychaetes, and 53 species of meiofauna associated with them.[26] Damage to the mangroves would adversely impact not only the unique biodiversity but the fisheries and tourism industries as well. Furthermore, mangroves protect fresh water resources against salt-water intrusion; they protect the land from eroding waves and winds, and stabilize the coastal land. The mangroves can be considered as a natural barrier protecting the lives and property of coastal communities from storms and cyclones. Further, the resistance that mangroves offer to water flow is particularly important during extreme weather events such as cyclones, typhoons, and hurricanes.[27] In a fragile ecosystem with rich biodiversity in a disaster-prone region such as ANI, the importance of mangroves in ANI cannot be undermined.

[24] State Development Report, of Andaman and Nicobar Islands, 2006, National Institute of Public Finance and Policy

[25] Badola R and Hussain, S., A., 2003, *Valuation of the Bhitarkanika Mangrove Ecosystem for Ecological Security and Sustainable Resource Use*, EERC working paper committee, Wildlife Institute of India.

[26] Jayaraj R.S C and Andrews H V. Andaman and Nicobar Islands Union Territory Biodiversity Strategy and Action Plan

[27] Khalil S. 1999. *Economic Value of the Environment: South Asia*, IUCN.

Coral Reefs and Marine Biodiversity: ANI is fringed with one of the most spectacular and extensive reefs in the world. Andaman reefs consist of about 83% of coral diversity found anywhere in the world and is at par with the 'Coral Triangle' of Indonesia. ANI has the last pristine reefs in the Indian Ocean region and is one of the most important coral reef sites in the world. Coral reefs are intimately connected to other marine communities such as mangrove forests, sea grass beds, and the open seas as water currents transport larvae, plants, animals, nutrients, and organic materials. They play a significant role in the development of other ecosystems such as mangroves and wetlands and protect coastlines from wave and storm damage and erosion. Life-saving medicines, such as anticoagulants, and anticancer agents, such as prostaglandins, come from coral reefs.[28]

Many of the beaches are important nesting areas for four species of marine turtles, namely, leatherback sea turtle (the largest marine reptile), Hawksbill, Olive Ridley, and Green turtle. The Dugong is seen frequently in these islands. In addition, seashells of different sizes, sardines, tuna, barracuda, mullets, mackerels, and flying fish are in abundance (Table 5.11).[29]

Table 5.11: Marine biodiversity and endemism

Animal group	No. of species/ sub spp.	No. of endemics	Percentage of endemism
Marine fauna			
Mammalia (mammals)	7	–	–
Reptilia (reptiles)	12	–	–
Pisces (fishes)	1,200	2	0.2
Echinodermata (star fishes, etc.)	350	4	0.4
Mollusca (squids, octopus, etc.)	1,000	18	1.9
Crustacea (crabs, lobsters etc.)	600	6	1.0
Polychaeta (marine worms)	184	4	2.2
Anthozoa (sea anemones and corals)	326	2	0.6
Porifera (sea sponges)	72	–	–
Meiofauna (small invertebrate sea creatures)	490	102	21.0
TOTAL	4,241	138	0.11

Source: Andaman and Nicobar Islands, Department of Environment and Forestry <http://forest.and.nic.in/frst-wildlife1.htm>

[28] Coral Reefs, Ecological Society of America
Web link: http://www.esa.org/education/edupdfs/coralreefs.pdf
Date accessed: 10 April 2012

[29] State Development Report, of Andaman and Nicobar Islands, 2006, National Institute of Public Finance and Policy

Protection Status: The Government of India has identified the coral reefs of ANI for intensive conservation since 1986 and a management plan has been in operation. Since then, a few systematic studies with respect to monitoring of health of coral reefs were undertaken until 1998. Efforts of the Global Coral Reef Monitoring Network (GCRMN) in collaboration with the Federal Ministry of Environment and Forest through the Indian Coral Reef Monitoring Network (ICRMN) have triggered the capacity building in coral reef assessment and coral taxonomy.

The Department of Environment and Forest is the management agency responsible for coral reefs in ANI. The UNDP-Global Environment Facility (UNDP-GEF) project on management of coral reefs in ANI generated a wealth of information on various aspects of coral reef biodiversity. Stakeholder participation leads to effective management of these coral reefs through sustainable utilization.[30]

At present, the Mahatma Gandhi Marine National Park (MGMNP), Wandoor on the western coast and Rani Jhansi Marine National Park (RJMNP) on the eastern cost of South Andaman cover exclusive protected coral reef areas.

5.2.2 Threats, Issues, and Challenges

- Destabilizing the shorelines and increasing the coastal erosion is a problem faced by ANI. Erosion takes place on account of natural causes such as wave action as well as due to destruction of coral reefs. The projected rise in sea level may further aggravate the scenario. Though ANI has a relatively well-developed natural shore protection mechanism from devastating sea surges in the form of coral reefs, sea level rise coupled with the destruction of coral reefs (due to developmental pressures and coral bleaching) can lead to serious coral erosion problems and receding shorelines in the future.

- The 2004 tsunami caused widespread damage of coral reefs and mangroves, making these ecological systems more vulnerable to climatic stressors.

- Construction of improper bunds has resulted in parts of the bunds being washed off and thereby causing sedimentation and choking of the corals.
- Over fishing of large predatory fish and key components of the ecosystem such as snapper and lobsters may cause disruption of reef food webs. Over-harvesting of selected marine species (e.g. reef fish such as grouper), ornamental shells, sharks, and sea cucumbers.

[30] Kulkarni, S., Saxena, A., Muley, E., V., & Alfred, J., R., B. *The Conservation Status of Coral Reefs of Andaman and Nicobar Islands.* Reef Watch Marine Conservation, Department of Environment and Forest, ANI, Ministry of Environment and Forest, Zoological Survey of India
<http://envfor.nic.in/icrmn/events/sr_an.html>
Date accessed: 10 April 2012

- Monitoring of remote coastal and reef areas is insufficient; destructive fishing methods and equipment.

- Damage by irresponsible tourism (e.g. illegal collection of corals and camping on turtle-nesting beaches)

5.2.3 Vulnerabilities to Climate Change

- The projections of global warming indicate a warming trend for all small island states ranging from an annual mean change of 1.98°C in the Pacific Ocean to a change of 2.10°C in the Indian Ocean by the 2050s. Sea surface temperatures are projected to increase by 1°C.

- Rise in sea surface temperature is likely to increase the bleaching and death of corals and reduction in ecosystem productivity. Coral reefs are threatened by rises in sea surface temperatures, which lead to coral bleaching. In the past 20 years, a sea surface temperature rise of approximately 1°C above the normal maximum summer temperature has led to bleaching events. Some studies have predicted that in the next 30–50 years bleaching events could occur every year in most tropical oceans. Another threat to coral reefs is that of rising CO_2 concentrations in the oceans related to rising atmospheric CO_2. Based on projected CO_2 levels, it has been suggested that the calcification rate of corals could decrease by about 14%–30% by 2050.[31]

- Coupled with sea-level rise and loss of corals, the main tourist attractions of ANI, viz. corals and beaches are likely to deplete and the tourism industry, which is emerging as a major revenue source for the Islands, is likely to be affected. The associated livelihood options are also at stake due to climate change impacts

- There is also the probability of enhanced colonization by alien species and increase in ocean acidification, which may reduce marine ecosystem productivity. The deleterious effects have already been perceived. About 60%–70% of the corals of ANI have been found to be affected due to rise in sea surface temperature of the Andaman sea in April–May 2010.

- Mangrove accretion on land may or may not be able to keep pace with the rising sea level depending on the composition of the forest, tidal range and sediment supply. On islands such as ANI, mangroves are already restricted in area by coastal topography and tidal amplitude. Mangroves in these areas may come under stress or may not persist in moderate to high rates of sea-level rise. As about 260 km of the coast of ANI is lined with mangroves and has restricted scope of adjustment in response to sea level rise, the impact of climate change on

[31] Vulnerability and Adaptation to Climate Change by Small Island Developing States, UNFCCC

the extent and species composition of mangroves may be devastative when sea level rise exceeds about 10 cm/100 years.

- Mangroves in tropical regions are extremely sensitive to global warming because strong temperature dependence of physiological rates places many tropical species near their optimum temperature. Increased species diversity at the community level will add to the competitive ability of mangrove communities as a whole. Outside the present latitudinal limits for mangroves, comparable saline coastal environments are generally occupied by salt marsh vegetation. It is likely, given the more herbaceous nature of the vegetation in these communities, that mangroves will compete with such species in the medium to long term and that a gradual replacement of salt marsh vegetation by scrubby mangroves, first of *Avicennia* and later of *Rhizophora*, may be expected to occur. Species diversity is likely to suffer in ANI. The mangroves of ANI are a matter of concern even for low rates of sea level rise.[32]

5.2.4 Strategies

- Undertake periodic monitoring of the extent and health of the coral reef system by setting up a multi-disciplinary Coral Monitoring Team comprising experts and staff from various departments such as Environment and Forests, Fisheries, Agriculture, scientific institutions, etc.

- Stricter enforcement of laws for the protection of coral reefs and coastal zones of ecological significance.

- Discourage the use of corals for construction works and provide alternatives.

- Restoration of degraded lagoons and corals including through coral transplanting in heavily degraded areas.

- Establish a foolproof coastal green wall, preferably using indigenous species and species found to be effective against coastal erosion.

- Prevent disposal of waste into the coral reef system and carry out periodic cleaning/waste removal operations with active participation of local communities. Prevent discharge of pollutants from barges and ships into the lagoon and seas.

- Mangrove restoration programmes.

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[32] Singh, H.S., *Potential Impacts of Climate Change on mangroves of India*, FAO
<http://www.fao.org/DOCREP/ARTICLE/WFC/XII/0894-B2.HTM>
Date accessed: 3 April 2012

These strategies need to be implemented in coordination with other ongoing acts, studies, and activities.

5.2.5 Relevant Initiatives, Plans, and Policies

Coastal Regulation Zone Notification

The Coastal Regulation Zone (CRZ) Notification 1991 has three primary objectives:

- Location of Operations: The coasts are important nesting and feeding grounds for terrestrial and aquatic species. They also sustain the livelihood of coastal communities. Rules for siting of activities seek to ensure that the rights of fishing and other coastal communities are not compromised to meet economic development requirements such as those of the tourism industry.
- Restricting and Permitting Activities: The CRZ Notification has a list of restricted and permitted activities.
- Balancing Development and Protection: Since different areas have different ecological sensitivities, they are provided different levels of protection. CRZ I areas are provided more protection than CRZ II areas.

Most of ANI comes under CRZ IV. This classification in unique to ANI and Lakshadweep Islands and it takes into account the unique and fragile environment of these islands. CRZ I includes reserved forests, mangroves, wildlife sanctuaries and ecologically sensitive land. The entire rural area is under CRZIV. The coastal stretches of Port Blair, Bamboo Flat, Hut Bay, Mayabunder, Campbell Bay and other areas are proposed to be included under CRZ II.

Implementing Agency: The ANI Coastal Zone Management Authority (CZMA) was constituted in 1998 and the latest notification with extension of term of CZMA members in ANI is dated 31 March 2005. There is no fully approved Coastal Zone Management Plan since the initiation of CRZ in 1991, although a conditionally approved draft plan exists.

Coastal Security Scheme

The DoEF submitted a proposal for augmentation of manpower and infrastructure to enhance coastal infrastructure in 2009. The responsibility of coastal protection lies with the Police Marine force but the thick growth of mangroves and littoral forests along the coastal belt make the DoEF an important agency for coastal protection. Forest personnel with adequate logistics information on neighbouring areas etc. are an important resource. Owing to the proximity of the Island to Southeast Asian countries, the region receives a large number of foreign poachers and a large number of uninhabited islands are easily accessible to poachers. The proposal seeks to

augment both manpower and infrastructure such as very high frequency (VHF) facilities, vehicles, boats, and binoculars. [33]

MS Swaminathan Research Foundation Action Plan

An action plan was developed for post-tsunami 'New Andaman'. The report analysed the damage to mangroves due to the 2004 tsunami and recommended an action plan for their rehabilitation. It is evident from the report that there was extensive damage to mangroves in Katchal, Camorta, Nancowry, and Trinket islands due to saltwater ingression and seepage of saltwater into the roots, deposition of sand on pneumatophores and clearing of littoral forests adjoining mangroves. The recommendations from the report include[34] the following:

- Tidal inundation by digging trapezoidal canals in areas where land is elevated to 0.6–0.8 m and water has withdrawn.
- Planting freshwater-loving mangrove species after leeching of salts by monsoon rains.
- In submerged areas, species like *Rhizophora, Ceriops,* and *Bruguiera* could be planted.
- Bio-shields programme.

The MS Swaminathan Research Foundation (MSSRF) Action Plan also proposes a bio-shields programme for coastal protection in non-mangrove areas that are inundated by tidal water or submerged by seawater.

The report states that the bio-shields programme should be implemented immediately, using food for work and other schemes to mobilize the labour required for the project. Three species of priority such as areca nut, casurina, pandanus, sea mahuaetc should be raised. In the three-dimensional cropping system, the tree species should be chosen on the basis of cultural, ecological, and culinary factors. In the bio-shields programme with non-mangrove species, coconut, areca palm, pineapple, cashew nut, cinchona, etc. could be tried. All livelihood activities should be designed with the involvement of the local people.[35]

5.2.6 Proposed Plans and their Linkages to the National Action Plan on Climate Change

The National Action Plan on Climate Change does not have a mission on coastal or island ecosystems. In lieu of the Mission on Himalayan Ecosystem, the ANIAPCC has incorporated the

[33] Proposal for Augmentation of Infrastructure and Manpower for coastal security in respect of DoEF. 2009. Department of Environment and Forests, Andaman and Nicobar Administration. No.F.10 (G-I)/55/Vol.III/343

[34] State Development Report, of Andaman and Nicobar Islands, 2006, National Institute of Public Finance and Policy

[35]Selvam, V., Ravishankar, T., Karunagaran, V., M., Ramasubramanian, R., Eganathan, P., &Parida, A., K. Toolkit for Establishing Coastal Bioshield. M.S Swaminathan Research Foundation

<http://www.mssrf.org/csr/csrpub/17Toolkit%20for%20establishing%20coastal%20biosheid.pdf>
Date accessed: 10 April 2012

Mission on Island Ecosystem. Island ecosystems are unique and fragile and are characterized by a large number of endemic species. This island ecosystem is the lifeline that supports the growing population and economy of ANI and thus the mission on maintaining its integrity and sustaining its services is of great importance to the ANICCAP.

ANI Mission on Sustaining Island Ecosystems

Component 1: Management of Coastal Ecosystem

Component 1 aims at protecting the mangrove ecosystem and littoral forests, which are essential to protect the island ecosystem against sea and wind erosion.

Inter-tidal mudflats, saline, and less productive coastal lands provide opportunities to raise coastal forests as multiple-use ecosystems (sink for carbon barrier against cyclone, storm, and salty winds, coastal land stability; sustainable agriculture behind shelter belt and basic needs of coastal community). Strict protection of existing mangroves against encroachment and cutting, and its expansion by regenerating potential inter-tidal areas through plantation of suitable species, including vulnerable and threatened species are necessary management options. Adaptation capability of the species, which may not adapt quickly to climate change, can be improved through management intervention, especially by facilitating their regeneration in new areas. Scientific studies and consistent monitoring of ecological changes and sea level rise should be done to provide continuous inputs for necessary management intervention. The response of tidal vegetation to climate change will vary from area to area and hence area-specific plans based on inputs of continuous monitoring of changes should be prepared for implementation.

Mangrove restoration

In case of uplifted areas, it is proposed to adopt a combination of ecological restoration systems (ERS) of mangrove reforestation, mangrove planting and fish-bone type canal system to restore the hydrology of the uplifted area. This would involve thorough studies on autecology of mangroves that previously existed or are emerging in the uplifted area, restoration of normal hydrology, modification of hydrology through construction of canals, and facilitating restoration of the mangrove community. In South Andaman, the land mass is sub-ducted and a combination

of mangrove engineering and Rely method of mangrove reforestation is proposed. It is proposed that these works be executed with the involvement of coastal communities. A host of incentives such as live fish culture in mangrove canals by placing wire mesh nets at canal openings, mud crab fattening, and other agro-forestry-based techniques would be explored to develop sustainable job opportunities for the local communities.

Establishing coastal bio-shields

It is proposed that coastal belt plantations consisting of littoral species be taken up in sandy patches and coastal areas to protect against surging sea levels, cyclones, and wind erosion. As per the dataset of the Natural Resource Information System (NRIS) Node of the DoEF, 36.2 km^2 of potentially suitable area for coastal plantations are available in ANI. These areas will be surveyed to assess suitability for plantations and coastal bio-shields consisting of *Pongamiapinnata, Morindacitrifolia, Erythrinavariegata, Calophylluminophyllum, Thespesiapopulnea, Hibiscus tiliaceus, Pandanustectorius Ipomoea pescaprae,* and *Crinum asiaticum* elements may be established with the involvement of local villagers in Joint Forest Management (JFM) mode.

Sl. no.	Proposed activity	Nature of activity (new/ongoing)
1a	Conducting a study to assess the feasibility of re-stocking of degraded mangrove forest areas by ecological restoration method/mangrove engineering method.	New initiative
1b	Afforestation of mangroves in the tsunami-affected areas. Mud flats through mangrove engineering/ecological restoration method based on the outcome of study in 1a.	New initiative
1c	Conducting a study on the establishment of littoral forest on uplifted areas on coastal bio-shield model.	New initiative
1d	Afforestation of littoral forest in uplifted area on coastal bio-shield concept.	New initiative

Component 2: Research and Monitoring on Impacts of Climate Change on Island Ecosystems and Forests

Research and monitoring the impacts of climate change is an important component of the climate change action plan as it generates data for evolving adaptation and mitigation measures.

Monitoring ocean and weather-related data of the Andaman and Nicobar Islands

In order to monitor the effect of climate change on the island ecosystem, monitoring the physical, chemical, atmospheric, and biotic variables of the ocean is essential. It is proposed to place five coral-reef-based data buoy systems in the Interview Island, Avis Island, Out Ram, Nancowrie, and Great Nicobar islands to monitor seawater parameters such as dissolved oxygen,

turbidity, salinity, pH , conductivity, current speed, current direction, sea surface temperature, and atmospheric data like wind speed/direction, humidity, air temperature, air pressure, etc.

Monitoring spatial impact of climate change and other natural disasters

The sea level change (oscillation) normally occurs because of tectonic factors due to climatic change. Continuous monitoring of these two factors is essential. This can be achieved by delineation of major faults and joints using remote sensing and monitoring these regions annually. It is proposed that satellite imageries of all inhabited islands and islands that are critical for endangered flora and fauna be procured to enhance the monitoring mechanism.

Management of the terrestrial eco-system with special emphasis on endemic biota

The rise in the sea level and sea surface temperature has a detrimental effect on the coral reef ecosystem. The evidence of bleaching of corals in ANI justifies the need to protect the coral reefs and promote artificial coral reefs outside protected areas to develop as an additional carbon sequestration source. The artificial reef systems could also develop into tourist spots and could provide livelihood benefits to the coastal communities. It is proposed that artificial coral reefs be developed using concrete blocks in Rutland, Snake Island, Diglipur, and Little Andaman on an experimental basis to observe the coral regeneration and rate of coral recruitment in the wake of climate change.

Monitoring the effect of climate change on terrestrial fauna and flora

A study of the likely change in the phonological parameters of keystone species of endemic flora and endemic fauna and the behaviour of turtle nesting is proposed under this category. The study will be carried out through reputed government institutions having expertise in these fronts in selected locations.

Monitoring of beaches

Since the beaches are important habitats for endangered marine animals and shore birds, continuous monitoring on morphological changes of the beaches and management interventions to promote artificial hatching of Turtle eggs/providing nesting sites for littoral forest birds through artificial means may be essential in the long run.

Sl. no.	Proposed activity	Nature of activity (new/ongoing)
7.a	Establishing coastal data buoy systems at five locations (Avis Island, Interview Island, Rani Jhansi Marine National Park, Nancowry, and Great Nicobar).	New initiative
7.b	Monitoring spatial impact of climate change and other natural disasters.	New initiative
7.c	Establishment of artificial coral reefs.	New initiative

7.d	Study on phonological changes and recruitment pattern of keystone flora to measure climate change impact.	New initiative
7.e	Monitoring critical faunal habitats (turtles/littoral birds) to assess the impact of climate change	New initiative

5.3 Agriculture and Animal Husbandry

5.3.1 Overview and Status

The history of agriculture on the Island is less than a century old. In the early period of the twentieth century, only about 9,000 ha were under agriculture. This gradually increased over the years. Approximately 50,000 ha land is now under agriculture that include about 30,000 ha land under fruits and plantation crops, about 10,000 ha land under field crops (about 8000 ha paddy land after the 2004 tsunami) and about 461 ha land as fallow land. The major crops grown are paddy, coconut, areca nut, vegetables, and fruits. Besides this, red oil palm, rubber, spices, and cashew plantations also occupy sizeable land area. The most important cash crop is coconut, but the productivity is very low compared to national productivity. [36]

The Department of Agriculture is the nodal agency responsible for planning and implementing agricultural activities.

Animal Husbandry: The primary livestock is pig, followed by poultry and goat. A large proportion of the livestock is in the Andaman district except the pig, which is more abundant in Nicobar. Nicobarese consider pigs as a family asset and coconut plantations as a village asset. These islands have the inherent advantage of being free from most diseases but lack quarantine facilities. Further, availability of local feed is uncertain, seasonal and location dependant. Table 5.12 shows the livestock census of 2007.

Table 5.12: Livestock in ANI

Sl. no.	Livestock and poultry	Total number
1	Cattle	49,364
2	Buffalo	10,091
3	Goat	66,721
4	Pig	47,730
5	Horse and Pony	Nil
6	Donkey	03

[36] State Development Report of Andaman and Nicobar Islands, 2006, National Institute of Public Finance and Policy

7	Sheep	–
8	Rabbit	61
9	Total Livestock	173970
10	Total Poultry	978565

Source: Livestock Census 2007, Basic Statistics Directorate of Economics and Statistics

Animal Husbandry and Veterinary Services, ANI is the implementing department for livestock- and poultry-related projects.

5.3.2 Threats, Issues, and Challenges

Poor irrigation: One of the major limiting factors in the development and diversification of agriculture in the Islands is the lack of irrigation facilities, which is further compounded by the lack of groundwater availability, expect for the Calicut belt in South Andaman. This lack of water is the major reason for poor productivity of coconut and areca nut. There is huge potential for spice cultivation as an intercrop of these plantation crops, but due to lack of water during the dry season, farmers do not take up these crops. Further, it also restricts the cultivation of vegetables and flowers during the dry season when there is huge demand due to tourist inflow. At present, only 70% of the vegetable and 16% of flower requirement is met from local sources.

During the rainy season, from May to November, the vegetables and flowers cannot be cultivated because of high rainfall and during the dry season, they cannot be cultivated in the absence of water, making vegetable and flower production a difficult enterprise. Thus to enhance the productivity of plantation crops and spices as well as to enable the farmers to grow vegetables and flowers, it is necessary that the water resources are developed by applying appropriate low-cost technology. It has been found that the productivity of areca nut and coconut increases by more than 100% if water is provided during the dry season. Similar yield increase of about 100% has been obtained for spices, cashew and other crops.

Low productivity of rice: The current annual production of rice in the ANI is 16,790 tonnes with an average productivity of only 2.2 t/ha necessitating an import of about 54,310 tonnes of rice from the mainland to feed a projected population of 4.4 lakhs in 2011. The challenge is to close the yield gaps and meet the food demand of the Islands. Since the scope for expanding area under cultivation is limited, high-yielding tall rice varieties of rice should be promoted.

Poor post-harvest facilities: Post-harvest loss is more than 20%–25% due to climatic conditions and the geographic position of ANI. In the case of banana, they are as high as 40%. Urgent attention needs to be paid to measures to help increase the shelf life of the produce.

Poor farm mechanization: Utilization of available resources and farm mechanization is poor. Threshing is done manually. There is a lack of repair shops to repair agricultural implements.

Intensive agriculture has resulted in soil fatigue, yield stagnation, declining soil organic matter, and low fertilizer use efficiency

5.3.3 Vulnerability to Climate Change

- Increase in the frequency of extreme weather events, particularly tropical cyclones, droughts, floods, and heat waves, will have adverse effects on the crops.

- Unpredictability of local weather conditions and climate would decrease, making the day-to-day and medium-term planning of farm operations more difficult.

- Rising temperatures in the tropics would diminish the yields of some crops due to the shortening of crop duration and forced maturity (IPCC, 2011). More detailed analysis of rice yields by the International Rice Research Institute forecast 20% reduction in yields over the region/°C of temperature rise.

- Loss of agro-biodiversity from some of the most fragile cropping systems, such as agro-forestry systems.

- Increasing temperature would increase fertilizer requirement for the same production targets, and result in higher GHG emissions and cost of crop production.

- Incidence of diseases and pests, especially alien ones, could increase.

- Present (agro) ecological zones could shift horizontally in some cases, and vertically in some other cases, which is crucial for some plants, especially trees, and animal species, which cannot follow in time, and farming systems cannot adjust themselves in time. There will be damaging effects of increasing UV-B on crops. Reductions in yield up to 10% have been observed experimentally with very high UV-B values, and would be particularly effective in plants where the CO_2 fertilization effect is strongest. On the other hand, UV-B increase could increase the amount of a plant's internal compounds that act against pests.

- Climate change is projected to cause sea level rise, with significant consequences to the coastal agro-ecology and the livelihoods of farmers and fishermen. Sea-level rise, increased occurrence of tropical storms and cyclones will lead to inundation and damage to coastal agriculture.

Climate change is likely to have disadvantages on poultry, such as high mortality of outdoor flock, increased heat stress, and low egg production[37,38].

5.3.4 Strategies: Converting Challenges into Opportunities

Organic Farming

Organic agriculture includes all agricultural systems that practice and promote sound production of food environmentally, socially, and economically. Most of the cultivated areas in ANI are under traditional agriculture, i.e. natural farming. The average consumption of inorganic fertilizer in ANI is only 17 kg/ha, compared to 96.40 kg/ha at an all India level. In the case of vegetable cultivation, the major part is consumed at Neil, Havelock, and Diglipur Islands.

In the Nicobar Islands, traditional natural farming systems have been practised for centuries. The basic component of organic farming, i.e. not using the chemical input is followed unknowingly in some of the islands, which has attracted these islands to the organic movement. Nicobar District, except Campbell Bay, is by default practicing natural farming. The island should take advantage of this opportunity by arranging certification for better market avenues for these products in the domestic and international markets which will raise the living standards of the small and marginal farmers.

ANI is blessed with fertile soil, which does not require a lot of fertilization and has relatively fewer problems with pest outbreaks. It is also endowed with tropical forests, rich biodiversity, and a unique coral reef system, which should be protected from agricultural run-off. Thus, the promotion of organic farming is a prudent measure that minimizes damage and exploits opportunities that the Island offers. Organic produce will fetch higher prices in the national and international markets. Biomass generated by plantation crops can be converted into organic manure. Fruits and vegetables so produced will have better value, taste, and shelf life.

Low-Input, Low-Volume, High-Value Agriculture

- ANI has significant potential for high-value agriculture. Out of the 50,000 ha available for cultivation, 38,000 ha are under horticultural crops, which include coconut, fruits, vegetables, spices, and cashew nuts. For the development of high-value horticulture, the following measures are suggested: high-tech nursery and greenhouse, cultivation of micro-

[37] The Poultry Site, 2009, *Climate Change and Poultry production*
<http://www.thepoultrysite.com/articles/1498/climate-change-and-poultry-production>
Date accessed: 10 April 2012

[38] Scottish Agricultural College, *Potential Impacts of Climate Change on Poultry*
<http://www.sac.ac.uk/climatechange/farmingforabetterclimate/about/impact/poultry/>
Date accessed: 10 April 2012

propagated plants, high-density plantations, *in situ* moisture conservation through mulching, and biological control.

- Multi-tier cropping increases the value of produce per unit area. Plantation of black pepper, cinnamon, and clove are suggested using this method.
- Organic medicinal plant estates should be established.
- Post-harvest management is a prerequisite to increase the shelf life of produce by creating storage, treatment, handling and packaging, and transport facilities.
- Establishing of agricultural sector producers' and traders' associations (under the auspices of the Andaman and Nicobar Islands Chamber of Commerce), to facilitate intra-industry and industry-administration cooperation in instituting norms and guidelines for sustainable production.
- Conducting a series of entrepreneur training programmes to catalyse the development of locally owned small- and medium-sized high-value agricultural enterprises and cooperatives. This program will place specific emphasis on the development of agricultural enterprises by women's self-help groups (SHGs) and individual female entrepreneurs.
- Providing microfinance and small-business finance programmes to provide start-up and expansion capital for local enterprises and cooperatives in the high-value agriculture sector.
- Promotion of soil and water conservation through watershed approach.
- Promotion of watershed management approach for rainwater management and supplementing irrigation for raising post-monsoon crops.
- Increasing the efficiency of irrigation using mulch and *in situ* conservation of residual soil moisture through tillage and mulching.
- Strengthening of agricultural insurance schemes.
- Establishing climate-monitoring centres.

5.3.5 Relevant Initiatives, Plans, and Policies

Rural Knowledge Centre[39]

Under the post-tsunami Action plan for 'New Andamans' submitted by the MSSRF, great emphasis was laid on the establishment of rural knowledge centres (RKCs) with the vision to harness the power of ICT in the knowledge, skill, economic, and social empowerment of rural families in the principle of '*reaching the unreached and voicing the voiceless*'. The RKCs are established with the following objectives:

- Enabling rural families to access the latest information, Internet connectivity, and communication technologies. Availability of agricultural resources from the administration.

[39] Department of Agriculture, A&N Administration
<http://agri.and.nic.in/RKC.html>. Date accessed: 12 April 2012

- Training the rural youth in the organization and maintenance of a system that generates locally relevant information.
- Maintenance, updating, and dissemination of information on entitlements to rural families using an appropriate blend of modern and existing channels of communication.
- Relief measures taken by the government during disasters.
- Conducting impact assessment based on organization of surveys, participatory rural appraisal, and other appropriate methods of data gathering.
- Building of a model in information dissemination and exchange in rural areas that uses advanced information and communication technologies.
- Value addition to raw information, use of various local languages by the people of different islands.
- Conducting research on formation of multi-sectoral partnerships (private–public/government NGOs) with rural communities to form a sustainable model of ICTs for rural areas.

Car Nicobar Coconut Mission[40]

The central role of coconut in the lives of Nicobari people and its traditional importance in their social and economic development cannot be undermined. The coconut mission seeks to bring about a shift in the coconut production and commercial use by synergizing the isolated efforts of the Department of Agriculture, NHM, CDB, CARI, RKVY, NABARD, EHL, and other industries under different schemes. The plan of action includes increasing public expenditure on coconut-based activities starting from planting to its commercial exploitation, reducing the regional imbalance in the average production of coconut, pooling resources, integration of organizational structures, optimization of manpower, promoting entrepreneurship among tribal youth, induction of consultative machinery at state and district level, and aiming at establishing a proper organizational link between farmer and customer at all levels.

High-value Agriculture Schemes in ANI[41]

The agro-climatic conditions of the island are favourable for the production of fruits, spices, and flowers. All high-value agriculture schemes have been formulated based on the guidelines of the National Horticulture Mission, National Horticulture Board, and Coconut Development Board. Some of these schemes include the following:

- Mission organic
- Establishment of new gardens for fruits, flowers, and spices
- Pollination support through bee keeping
- Integrated post-harvest management.

[40]Department of Agriculture, A&N Administration
<http://agri.and.nic.in/coconut_mission.html>. Date accessed: 12 April 2012
[41]Action Plan 2011-2012, High Value Agriculture in Andaman and Nicobar Islands, Directorate of Agriculture

The Animal Husbandry and Veterinary Services Department have five ongoing programmes under their annual plan of action.[42] These include the following:

- Cattle Development Programme
- Animal Health Programme
- Poultry, Piggery, and Goat Development Programme
- Strengthening of the AH&VS Department
- Fodder Development Programme.

5.3.6 Proposed Plan and Linkages to the National Action Plan on Climate Change

The National Mission for Sustainable Agriculture seeks to transform agriculture into an ecologically sustainable, climate-resilient production system while at the same time exploiting its fullest potential and thereby ensuring food security, equitable access to food resources, enhancing livelihood opportunities, and contributing to economic stability at the national level.[43] Focus areas include the following:

- Strategic planning at agro-climatic zone level
- Customized interventions to enhance productivity
- Easy access to information and institutional support, new credit and insurance mechanisms to be devised to facilitate adoption of desired practices
- Linking laboratory to land: creating model villages and farm units
- Dry land Farming
- Thermal-resistant crop varieties
- Convergence and integration of traditional knowledge and practice systems, information technology, geospatial technologies, and biotechnology.

The ANI's Mission on Sustainable Agriculture lists several components that not only address the National Mission but also go beyond the focus areas listed in order to propel ANIs on the path of high-value, low-volume agriculture. The Mission on Sustainable Agriculture seamless blends the national imperatives to local agricultural constraints and conditions to evolve a number of strategies for the development and climate proofing of the agricultural sector in the ANIs.

[42]Draft Annual Plan proposal 2012-2013, Abstract for Sub-sector Animal Husbandry

[43]National Mission on Sustainable Agriculture, Department of Agriculture and Cooperation, Ministry of Agriculture <http://agricoop.nic.in/Climatechange/ccr/National%20Mission%20For%20Sustainable%20Agriculture-DRAFT-Sept-2010.pdf>.
Date accessed: 15 April 2012

ANI Mission on Sustainable Agriculture

Climate change is likely to compound the challenges that the agricultural sector already faces and a holistic action plan to address the needs of the agricultural sector should include measures that address their exposure, sensitivity, and adaptive capacity thereby reducing their overall vulnerability to climate change.

- Address current challenges and reduce future exposure to physical stressors, e.g. measures such as micro irrigation.

- Lower the sensitivity of farmers to climatic stressors by disseminating information on local weather conditions (likelihood of rainfall, etc.) to overcome uncertainty. Also, insurance mechanisms that safeguard farmers against loss owing to weather conditions would go a long way in reducing their sensitivity to unpredictable and unsuitable weather conditions.

- Increase farmers' adaptive capacity to respond to climate change by diversifying the crops they grow and participating in high-value agriculture programs that increase their income and diversify their sources of income.

Component 1: Development of database and vulnerability map

Sl.no.	Proposed activity	Nature of activity (new/ongoing)
1a	Development of database and vulnerability maps	New

Component 2: Access to information

Sl.no.	Proposed activity	Nature of activity (new/ongoing)
2a	Establishment of rural knowledge centres	Ongoing (10

		completed)
2b	Sub-depots of the department will be linked by a wide area network, and connectivity up to village level through RKC/CSC would be ensured	New

Component 3: Surveillance and monitoring

Sl.no.	Proposed activity	Nature of activity (new/ongoing)
3a	Strengthening of pest and disease surveillance establishment of bio-control lab	New

Component 4: Contingency plan

Sl.no.	Proposed activity	Nature of activity (new/ongoing)
4a	Model codes on 'droughts, floods, and good weather' to be prepared bringing out short- and long-term measures	New

Component 5: Micro-level weather forecasting and crop insurance

Sl.no.	Proposed activity	Nature of activity (new/ongoing)
5a	Setting up automatic weather stations	New
5b	Weather-based crop insurance	New

Component 6: Focus on sustainable agriculture development

Sl.no.	Proposed activity	Nature of activity (new/ongoing)
6a	Promotion of organic farming	Ongoing
6b	Protected cultivation, polyhouses	Ongoing and new

6c	Livestock production and breeding	Ongoing
6d	Livestock health	Ongoing

Component 7: Management of seawater intrusion

Sl.no.	Proposed activity	Nature of activity (new/ongoing)
7a	Construction of dykes, sluice gates, and drainage and field bunds	Ongoing and new
7b	Develop wind breakers/shelter belts and bio-shields along coastal lines	New

Component 8: Reduction in greenhouse gas emission

Sl.no.	Proposed activity	Nature of activity (new/ongoing)
8a	Promotion of system rice intensification	New

Component 9: Socio-economic security of farmers

Sl.no.	Proposed activity	Nature of activity (new/ongoing)
9a	Revolving fund for self-help groups	New

Component 10: Capacity building

Sl.no.	Proposed activity	Nature of activity (new/ongoing)
10a	Conducting awareness training for disaster preparedness, workshop, demonstrations, farmers' school on best practices adaptation, diversification of livelihood options such as mushroom, apiculture, coastal aquaculture, awareness on different insurance	New

	programs, protected cultivation, and post-harvest value addition	

Component 11: Soil and water conservation

Sl.no.	Proposed activity	Nature of activity (new/ongoing)
11a	Watershed development programme	New
11b	Micro-irrigation	New
11c	Promotion of crop varieties requiring less water	New

Component 12: Research needed

Sl.no.	Proposed activity	Nature of activity (new/ongoing)
12a	To develop crop varieties requiring less water	New
12 b	Development of crop varieties resistant to salinity, long dry spells, pests and diseases, and appropriate cropping patterns	New
12c	Preservation and management of germ-plasm, traditional varieties of seeds	New
12d	Convergence and integration of traditional knowledge and practice systems, information, technologies, and biotechnology	New
12e	Orientation of agriculture research systems	New
12f	Application of bio-technology and skilled animal breeding for development of better adapted breeds	New
12g	Restricting the exotic inheritance of cattle in the cross breeding program to preserve disease resistance capacity of indigenous cattle	New
12h	Salt- and disease-resistant fresh water fish and prawn	New

5.4 Fisheries

5.4.1 Overview and Status

With one-fourth of India's coastline and 80% of the Exclusive Economic Zone (EEZ), ANIs have tremendous potential in the fisheries sector. The present level of marine fish production is 33,735 t, which is about 12% of the estimated potential.[44] Most of the produce is consumed locally and exports are insignificant (Table 5.13).

Table 5.13: Details of fisheries activities in ANIs

Item	2008/09	2009/10	2010/11
1. No. of fishermen engaged in fishing	6340	7204	7204
2. No. of fishing country craft	1451	1620	1465
3. No. of nets used			
(a) Gill net	2192	2243	2249
(b) Shore seine net	20	23	23
(c) Anchor net	04	04	04
(d) Cast net	925	958	1033
(e) Hook and line	3170	3238	3244
(f) Long line	240	261	264
(g) Disco net	56	56	56
4. Mechanized fishing vessels (No.)			
(a) Country craft	1451	1620	1465
(b) Mechanized boats			
(i) Motorized traditional fishing boat	1257	1431	1293
(ii) Mechanized boat	12	63	55

[44]Basic Statistics 2008-09 to 2010-11, Directorate of Economics and Statistics, Andaman and Nicobar Administration

5. Average fuel consumption per vessel per day (in litre)			
(i) Motorized boat	18.33	18.33	18.33
(ii) Mechanized boat	100	100	100
6. Fishermen families settled till end of March (No.)	322	322	322
7. Fisheries requisites distributed during the year (in lakhs)	21	32.86	33.70

Source: Basic Statistics 2008/09 to 2010/11, Directorate of Economics and Statistics

The EEZ has an annual harvestable potential of 1.48 lakh t with the break up given in Table 5.13. The demersal resources constitute perches, silver bellies, pomfrets, shrimps, lobsters, etc.; pelagic resources include anchovies, sardines, mackerels, neretic tuna, barracuda, etc.; and ocean resources are skipjack tuna, yellow fin tuna, etc. (Table 5.14).

Table 5.14: Fish resources

Category of fish	Potential (in tonnes)
Demersal	32,000
Pelagic	56,000
Oceanic	60,000
Total	**148,000**

Category of tuna	Potential (in tonnes)
Yellow fin tuna	24,000
Skipjack tuna	22,000
Bigeye tuna	500
Neritic tuna	18,000
Total	**64,500**

5.4.2 Threats, Issues, and Challenges

- Remoteness of the Island and disconnect from the mainland.
- Coastal areas on the western sides of the Islands are largely inaccessible, restricting development to the eastern sides of the coasts.
- Lack of indigenous expertise, technology, and trained personnel.
- Lack of local capacity for capital investment on high-cost activities.
- Lack of infrastructure for large-scale fishing and coastal/offshore aquaculture.
- Lack of reliable database on the magnitude and dynamics of exploitable and cultivable aquatic resources.
- Inadequate infrastructure for fish processing and marketing.
- Poaching by foreign fishing vessels.
- Possible over-exploitation of specific resources through target fishing.

5.4.3 Vulnerability to Climate Change

- Reduced or more variable yields and supply timing.
- Marine species are also strongly affected by temperature. Thermal tolerance of marine organisms is non-linear, with optimum conditions at midrange and poorer growth at temperatures, which are too high or too low. Temperature-specific growth rates and fecundity declined at higher latitudes.
- Effect of increased temperature, precipitation, and other effects on post-harvest processes.
- Vulnerability of infrastructure and communities to extreme events.
- Trade and market shocks, etc.

5.4.4 Strategies: Climate-proof, Sustainable Fisheries Development

- Preparation of comprehensive island-wide coastal and reef fisheries management plan to ensure that future fisheries operations are environmentally sustainable. The plan may include identified core protection zones/marine protected areas, seasonal and/or permanent no-take zones, specific species catch limits and non-harvest seasons, regulations on permissible equipment and fishing methods, or other fisheries management approaches as appropriate to ensure sustainability.
- A fisheries sector development and upgrading plan to assist local fishing communities in upgrading their equipment, technical skills, and resources to meet sustainability requirements while maintaining or increasing incomes and job creation in the sector. The development plan will focus on identifying and introducing ecologically sensitive fishing equipment and techniques that minimize by-catch and damage to coral reef structures, while maximizing the market value of the catch through efficient storage and handling. A supply chain review and upstream development plan to increase value added from fisheries operations through improved handling, value-added processing, and improved marketing links with key overseas markets.
- Upgradation of traditional fishing crafts and gear and introduction of new motorized crafts.
- Pilot demonstration fishing trials and development of harvest strategies for oceanic tunas.
- Use of fish aggregating devices (FADs) for increasing fishing efficiency.
- Building of infrastructure facilities.
- Training and capacity development and marine resources management and governance.
- Upgrading existing crafts with FRP coating and improved gillnets and lines and introducing three new classes of vessels (gill-netters and long-liners) for exploitation of coastal tunas.
- Introducing large tuna long-liners for the exploitation of oceanic tunas and production of sashimi grade tuna for export to South and Far East Asia.
- Introduction of air/sea connectivity to Bangkok and Singapore markets with cold storage cargo-handling facility for export items such as Sashimi tuna.
- Development of fishery estates with all required facilities (roads, diesel outlets, potable water, ice plants, cold storage, and processing plants) at three major fish landing centres (Diglipur, Port Blair, and Campbell Bay).

- Canning plants to make use of coastal tunas/ skip-jacks.
- Hygienic waste-disposal system.
- In addition to building the infrastructure for the development of fisheries in the Islands on an ongoing basis, the fisheries department of the UT administration provided a wide array of subsidies ranging up to 50% to marine fishermen or tribes and their cooperatives under various schemes for the purchase of deep freezer, fish transport vehicle (insulated or refrigerated) and tricycle, boats, out board engines, etc. An assistance of Rs 5,000 for renovation of ponds or tanks is also provided once in five years. This needs to be strengthened.
- Provision of pre- and post-harvest infrastructure such as boats, vessels, and navigational aids.
- Diversification in the coastal aquaculture.
- Collection, handling, storage, processing, and packaging facilities.
- Access to finance; training of fishermen.
- Strengthening of fishermen co-operatives.
- Transportation facilities.
- Aggressive marketing.

5.4.5 Relevant Initiatives, Plans, and Policies

The foundation for plans and initiatives was laid in 1991 when the Ministry of Agriculture constituted an expert committee to evolve a plan for deep sea fishing, processing, and export of fish in ANI. Their recommendation included the following:

- Training of local people in fish handling and processing.
- Establishment of cold storages, ice plants, chilled storages, processing plants, and ice crushers.
- Exploitation of tuna and tune-like fish and establishment of tuna canning plant.
- Introduction of deep-sea vessels with equal participation from private and public sectors.

Andaman and Nicobar Marine Fishing Policy

Comprehensive Marine Fishing Policy of the government of India, Ministry of Agriculture, Dept. of Animal Husbandry, Dairying and Fisheries for UT of Andaman and Nicobar Islands includes the following points:

- Further development of coastal fisheries would be achieved through introduction of improved types of fiberglass crafts and improved gears.
- Offshore fisheries would be developed through introduction of large deep-sea fishing vessels.
- Infrastructure needs for harvest and post-harvest operations would be developed in identified Islands.
- Joint venture initiatives would be allowed for package proposals consisting of harvest and post-harvest operations to be based in the Islands to improve the employment potential.

- A major fishing harbour with processing complex would be set up at Campbell bay to attract investment.

MS Swaminathan Research Foundation 'New Andaman' Plan for Fisheries Sector

The report recognized that the fisheries sector (both marine and inland) offers great scope for employment and generation and provides nutritional security and thus suggested giving great importance to the fisheries sector as in Iceland. Some of the salient points in the report were as follows:

- Lack of processing facilities, limited local market, and poor forward linkage were sighted as the main reasons for poor fisheries production.
- Consortium of different institutions to be formed to promote fishery entrepreneurship.
- Enhancing fisheries infrastructure and extension in the Island.

Annual Plan for 2012/13

Activities for the year 2012/13 to be undertaken by the Department of Fisheries come under five main areas as listed below.

Creation of infrastructure

This includes construction and maintenance of ice plants and cold storage facilities, maintenance of fish-landing centres, construction of net mending sheds, and extension of fish landing jetty.

Development of capture and culture fisheries and resource management

This includes financial instruments such as subsidies for motorized boats, supply for fishing input, fish transport vehicles, and other measures such as construction of fish farms and culture of finfish and shellfish.

Human resource development, extension in fisheries, and welfare of fishermen families

Some of the objectives of this scheme are as follows:

- Capacity building for the technical personnel of the department.
- Imparting technical knowledge to fisheries/tribes of the Islands.
- Strengthening facilities to organize training and extension programs in the Islands.
- Providing relief to fishermen in the event of loss of fishing equipment during natural calamities as well as for household renovations.

Modernization and upgradation of fisheries museum-cum aquarium strengthening and reorganizing of the fisheries department

Tuna Mission 2009

1. To evolve a strategy to minimize the gap between the present tuna harvest and its potential yield.

2. To upgrade the fishing capacity of traditional fishing crafts for tuna fishing.

3. To converge existing programs of various departments/agencies to achieve this vision.
4. To enable fishermen to get remunerative prices for their harvest through improved marketing.
5. To reduce post-harvest loss by strengthening the infrastructure for landing processing marketing and export.

Short-term strategy (3 years):

- Conversion of existing engine-fitted boats for tuna fishing.
- Introduction of 50 deep-sea fishing vessels through private enterprise by providing government subsidy under RKVY.
- Introduction of small/medium fishing vessels with government subsidies under UT Plan.
- Installation of fish-aggregating devices.
- Providing training on fishing, handling, grading, processing and packaging etc.
- Extension of Junglighat Landing centre by 75 m.
- Establishment of chilled tuna packaging facility at Junglighat fish landing facility.
- Handling facilities at Port Blair airport.

Long-term strategy (5 years and above):

- Introduction of suitable fishing vessels with government subsidies and interest-free loans for local entrepreneurs.
- Establishment of tuna processing and allied facilities by local entrepreneurs.
- Construction of 18 fish-landing centres in various places.
- Value addition and market promotion.

5.4.6 Proposed Plan and Linkages to the National Action Plan on Climate Change

The Mission on Sustainable Agriculture includes components for sustainable fisheries and animal husbandry. These include the following:

Component 6: Focus on sustainable agriculture, fisheries, and animal husbandry development

Sl.no.	Proposed activity	Nature of activity (new/ongoing)
6e	Introduction of intermediary vessel on subsidy	Ongoing

6f	Introduction of deep-sea vessel on subsidy	Ongoing
6g	Development of model fisherman village	Ongoing

Component 7: Management of sea water intrusion and change in coastal morphology

Sl. no.	Proposed activity	Nature of activity (new/ongoing)
7c	Installation of fish aggregation devices	Ongoing and new
7d	Installation of artificial reefs	New
7e	Promotion of coastal aquaculture	Ongoing and new

5.5 Water Resources

5.5.1 Overview and Status

In ANI, 95% of the annual rainfall (3,080 mm) is received during May–December and the remaining four months from January to April. Despite the high annual rainfall, there is scarcity of water during summer for drinking, household chores, livestock, and irrigation. During the dry period, agriculture suffers badly due to moisture stress. In the Islands, the total water availability is 25.3 BCM, which means per capita water resource is more than 70,000 m^3, almost 20 times than the national average. However, this figure is misleading as only a very small part of this is available for use. One of the clear manifestations of climate change is increasing water stress.

The water resource potential of ANIs and its districts, projected population, and per capita water availability in the years 2011, 2021, and 2051 for different districts and ANIs are given in Table 5.15. This indicates very high per capita water availability of 22,380 m^3/year in these islands even in the year of 2051 compared to the national availability (projected to be 1400 m^3/year in 2025). However, these figures are illusory as the amount of water available for harvesting is far below due to topography and high intensity of rainfall.

Table 5.15: Water resource potential of ANIs and its districts

UT / Districts (Area)	Water resource potential (BCM)	Projected population			Projected per capita water availability (m^3/yr)		
		2011	2021	2051	2011	2021	2051
A&N Islands (8249 km^2)	26.2	4,51,957	5,73,533	1,172,050	57,970	45,740	22,380
Andaman (3106 km^2)	9.9	2,64,550	3,35,713	6,86,050	37,422	29,420	14,400
Nicobar (1841 km^2)	5.9	53,270	67,745	1,38,450	1,10,756	86,420	42,285
N&M Andaman (3302 km^2)	10.5	1,34,023	1,70,075	3,47,550	78,345	61,740	30,210

(BCM - billion cubic meter)

Source: Water Policy for ANIs

It is important to estimate future water demands for different islands taking into account its projected population and food requirements. The amount of water involved in agriculture is significant and most of it is provided directly by rainfall particularly to produce rice crop during monsoon season.

Currently, about 150 lakh litres of drinking water is supplied every day in ANI. Owing to the growth of population, demand for drinking water is expected to grow to 370 lakh litres by the year 2025 (Table 5.16).

Table 5.16: Projected water demand in selected islands

Island Name	Water availability (BCM)	Projected population			Projected water demand* (BCM)		
		2011	2021	2051	2011	2021	2051
Long	0.055	2790	3541	7236	0.003	0.004	0.008
Neil	0.058	3639	4619	9439	0.004	0.005	0.010
South Andaman	4.178	230893	293004	598768	0.242	0.307	0.629
Car Nicobar	0.393	25750	32677	66777	0.027	0.034	0.070
Chowra	0.025	1758	2230	4557	0.002	0.002	0.005

* Includes demand of drinking water and food requirements

Source:. Srivastava, R.C. and Ambast, S.K. (2009). Water Policy for Andaman & Nicobar Islands: A Scientific Perspective. CARI, Port Blair, p 18

A&NIslands receives good rains. In the absence of any conscious policy for rainwater harvesting, the UT has not been able to turn this huge advantage to the benefit of its people. Holistic approach on water harvesting is, therefore, a must. In order to meet the long-term demand for drinking water, the feasibility studies initiated with respect to the tapping of water from the Rutland Island, and conversion of part of the sea at Flat Bay into a freshwater lake should be finalized early for seeking approval of the Ministry of Environment and Forests. The low thermal desalinisation water treatment technology successfully implemented in Lakshadweep should be replicated in ANI.

Capacity to treat raw water also needs to be augmented. The existing distribution system designed by Central Public Health Engineering and Environment Organisation is considered to be adequate to cope with the projected water supply up to the year 2011. Additional clear water reservoirs would need to be constructed to cope with the supply load for subsequent years.

As per the census of 2001, out of 502 villages only about 340 are fully covered by the public provision of water. Proper water treatment plants are available only in a few places such as Diglipur, Rangat, Mayabunder, Bakultala, Bambooflat, and Kamotra. This implies that treatment plants need to be constructed to supply clean drinking water to other villages. Water should be duly treated by using locally available technology.

5.5.2 Threats, Issues, and Challenges

Though the islands receive about 3,000 mm of rainfall per annum, water scarcity prevails in the dry months. The increasing population has imposed strain on the water supply system. Groundwater is available in the beach sands, valley fills, and weathered residuum as a freshwater lens over saline water and the estimated availability is about 20 million m^3 for drinking purposes, which is just 4% of the total requirement. Excess removal of this groundwater can lead to salinization of the soil.

In the islands, rainwater storage reservoirs, natural springs, and dug wells are the sources of water, which is treated at major treatment plants at source before supply. Rainwater harvesting (RWH) structures in suitable settings can augment water supply.

Large-scale introduction of RWH structures and making it compulsory under the municipal bye-laws for residential and non-residential buildings would help in efficient water management. The water management in these islands requires a holistic approach with integration of all resources through assessment by comprehensive surveys, water demand assessment, evaluation, and projection of demand by development sectors, development of technologies for effective and efficient use of water, implementation of water conservation methods, utilization of modern technology for water distribution, sewage collection and treatment, and cost recovery from polluters.

5.5.3 Vulnerability to Climate Change

The island territories normally experience water stress at current levels of rainfall input and extraction of groundwater. Water pollution is one of the major problems facing islands states; poor water quality affects human health and the incidence of water-borne diseases is more. Owing to factors such as limited size, geology, and topography, water resources in small islands are extremely vulnerable to changes and variations in climate, especially in rainfall, and with the rapid growth of tourism, there is a need for both augmentation of the existing water resources and more efficient management of those resources that already exist.

A&N Islands depend on three main natural sources of water: surface water (rivers, small lakes), rainwater, and groundwater. Groundwater is the primary source for drinking water. Rainwater is the primary source for agriculture.

This dependency on rainfall increases the vulnerability to future changes and distribution of rainfall. Low rainfall can lead to a reduction in the amount of water that can be physically harvested, a reduction in river flow, and a slower rate of recharge of the freshwater lens, which can result in prolonged droughts. Since majority of the A&N Islands are dependent upon surface water catchments for their water supply, it is likely that the demand cannot be met during periods of low rainfall. On the other hand, during the rainy season, lack of suitable land areas for dams and high runoff result in significant loss of surface and stream water to the sea.

5.5.4 Strategies

The strategy for water security in ANI shall include the following[45]:

[45]Srivastava, R.C. and Ambast, S.K. (2009). Water Policy for Andaman & Nicobar Islands: A Scientific Perspective. CARI, Port Blair, p 18.

- Developing Island-wise hydrological database on area, land use, soil, topography, drainage network, geology, groundwater hydrology, water quality, etc.
- Water resource development projects should as far as possible be planned and developed as multipurpose projects. The involvement and participation of *panchayats* and stakeholders should be encouraged right from the project planning stage.
- Special attention should be given to the needs of scheduled tribes and other weaker sections of the society at planning stage.
- Integrated and coordinated development of surface water and ground water resources should be envisaged right from the project planning stage and should form an integral part of the project implementation.
- Minimum flow in the perennial streams should be ensured while planning a surface water resource development project for environment and ecological considerations.
- There should be a periodical reassessment of the ground water potential on a scientific basis, taking into consideration the quality of the available water and techno-economic feasibility of its extraction.
- Over exploitation of ground water should be avoided especially near the coast to prevent ingress of seawater into sweet water aquifers.
- Roof water harvesting in government and commercial premises should be made mandatory for non-drinking purposes.
- Efficient irrigation techniques such as drip irrigation for plantation/spices/fruit crops (coconut, arecanut, black pepper, clove, banana, watermelon etc.) and sprinkler for vegetables should be promoted.
- Water conservation measures such as mulching, residue soil moisture management, minimizing evaporation losses, and promotion of low-water-requiring crops should be considered.
- Necessary legislation should be made for preservation of existing water bodies by preventing encroachment and deterioration in water quality.
- Feasibility of using renewable energy sources for pumping water specifically for irrigation should be explored. Solar-energy-based pumping systems have a chance as the water requirement period and sunshine periods coincide.
- Management of the water resources for diverse uses should incorporate a participatory approach.

5.5.5 Relevant Initiatives, Plans, and Policies

For meeting the growing demand for drinking water, the supply needs to be substantially augmented. This would require expeditious completion of the ongoing schemes, and identification of new commercially viable schemes. Such ongoing schemes include revival of Dilthaman tank, Nayagoan–Chakragaon Diggi project, Chouldhan scheme, and artificial ground water recharge schemes recommended by the Central Ground Water Board. In addition, two new schemes – raising the height of *Dhanikari*Dam and *Indira Nullah* Project may be undertaken to meet medium-term requirements of the urban areas.

The Andaman and Nicobar Public Works Department has a number of projects in the pipeline to help augment water supply. A summary of the long- and short-term initiatives are provided below in Table 5.17.

Table 5.17: Short-, medium-term projects

Sl.no.	Project	Capacity generated	Approx. cost (Rs. in crores)	Command area
1	Desalination Plant at Port Blair	14 MLD	90.00	Port Blair (Urban)
2	Procurement of barges	5 MLD	40.00	Port Blair
3	Sweet water lake at Sippighat	9.08 MLD	5.00	Port Blair and Garacharma
4	Raising the height of Dhanikhari dam by 5 m.	15.62 MLD	20.00	Port Blair (Urban)
5	Teylerabad weir	0.2 MLD	2.00	Teylerabad – Dhanikhari supply should be diverted to Port Blair Urban
6	Indira Nallah – Development of 14 m high earthen dam	2.0 MLD	20.00	Garacharma – Existing Dhanikhari supply should be diverted to Port Blair Urban.
7	Karupaswamy Nallah, Bimblitan	1 MLD	10.00	Garacharma- Dhanikhari supply should be diverted to Port Blair Urban.
	Total	49.6 MLD	187.00	

Table 5.17: Long-term projects

Sl. no.	Project	Capacity generated	Approx. cost (INR in crores)
1	Flat Bay project	67 MLD	350.00
2	Transportation of water from Rutland island to Port Blair town by laying pipeline under sea.	6.67 MLD	34.30
	Total	73.67 MLD	384.30

5.5.6 Proposed Plans and Linkages to the National Action Plan on Climate Change

The National Water Mission seeks to ensure integrated water resource management to conserve water, minimize wastage, and ensure more equitable distribution both across and within states. Also, there is emphasis on enhanced storage both above and below ground, rainwater harvesting, coupled with equitable and efficient management structures.

The Mission will seek to develop new regulatory structures, combined with appropriate entitlements and pricing. It will seek to optimize the efficiency of existing irrigation systems, including rehabilitation of systems that have been run down and also expand irrigation, where feasible, with a special effort to increase storage capacity.

Both efficient usage of water and rainwater harvesting and storing are eminent features of the ANI Mission on Sustainable Water. In addition, ANI's specific need to augment current water supply has also been duly addressed.

ANI Mission on Sustainable Water


Component 1: Augmentation of water supply

Sl.No.	Proposed activity	Nature of activity
1	Flat bay project	New

Component 2: Efficient use of water and enhancing water storage capacity of water bodies

Sl.No.	Proposed activity	Nature of activity
2a	Awareness Creation Program in Education Institutions and for General Public on consideration of water.	New and ongoing
2b	Installation of a water metering system in all individual household connections for Port Blair and surrounding areas.	New
2c	De-silting and raising of embankment of existing water bodies like Diltaman, Nayagaon, Chakkargaon, and Jawahar Sarovar	Ongoing

Component 3: Rainwater harvesting

Sl.No.	Proposed activity	Nature of activity
3a	Awareness creation on rainwater harvesting in private and public buildings	New and ongoing
3b	Maintenance of existing rainwater harvesting structures in governmentt office buildings	Ongoing
3c	Installation of new water harvesting structures wherever required	New
3d	Establishment of community water harvesting structures wherever feasible	New

5.6 Energy

5.6.1 Overview and Status

Due to the geographical and topographical peculiarities of these Islands, including separation by sea over great distances, there is no single power grid for all the electrified Islands and instead a power house caters independently to the power requirements of an area/Island.

The Electricity Department operates and maintains power generation, transmission and distribution (T&D) systems, and networks in these Islands for providing electric power supply to the general public and also implements various schemes under Plan and Non-Plan Programmes for augmentation of the diesel-generating capacity and establishment of new Power Houses and T&D systems. This department also functions as a Nodal Agency for implementing the Renewable Energy Programme of the Ministry of New and Renewable Energy Sources.

The present total installed capacity is around 83.83 MW with a peak demand of 44.7 MW. The power generation is largely through diesel fuel, which accounts for 95% of the total generation, the remaining 5% being through hydel generation. In a diesel generation scenario the major cost of power generation is the fuel cost, which works out to around 80% of the total cost. There are 43 diesel power houses at different locations in these Islands having DG capacity ranging from 6 kW to 5000 kW (including 20 MW IPP) and one Hydro Power Station having 5.25 MW capacity at Kalpong. The details of the power scenario in the major Islands are tabulated below (Table 5.18):

Table 5.18: Power supply–generation capacity in major Islands:

Sl. No.	Name of Island	Installed Capacity (MW)	Consumer (Nos.)	Annual Generation (MU)	Peak Demand (MW)
1.	North Andaman	7.618	8713	10.53	2.70
2.	Middle Andaman	10.548	14151	22.30	5.05
(a)	Long Island	0.892	305	0.50	0.12
(b)	Baratang	0.512	1190	0.33	0.20
3.	South Andaman	43.77	57869	179.60	30.11
(a)	Neil Island	0.634	665	1.05	0.27
(b)	Havelock	1.33	1281	3.64	0.79
4.	Little Andaman	6.65	5546	8.28	1.81
5.	Car Nicobar	5.92	4186	6.91	1.83
6.	Nancowry Group of Islands	3.275	2964	4.41	1.08
7.	Great Nicobar	2.706	2198	4.35	0.75
Total		**83.833**	**99068**	**241.90**	**44.71**

Consumers:

The category-wise unit consumption and the number of consumers in ANI are tabulated as below (Table 5.19):

Table 5.19: Unit consumption as per category

Sl.No.	Category	Nos.	Consumer (%)	Consumption (%)
(a)	Domestic	81741	82.50	48.24
(b)	Non-Domestic	15078	15.22	27
(c)	Industrial	457	0.46	4.61
(d)	Other & Bulk Supply	1287	1.31	15.25
	Street Lights	505	0.51	4.90
	Grand Total :	**99068**	**100.00**	**100**

5.6.2 Threats, Issues, and Challenges

Power is likely to become a serious constraint. Per capita consumption of electricity in the UT has increased substantially and according to the projections made by the Central Electricity Authority; the peak demands for the years 2015/16, 2021/22, and 2026/27 would be as high as 111 MW, 226 MW, and 323 MW, respectively. This growing consumption requires careful planning for adopting alternative low-cost ways of generating electricity. Unless resources are discovered on the island, thermal power stations using coal or diesel oil are likely to be extremely expensive. Also, the pollution arising out of the fuel could spoil the natural resources of the island. Possibilities for hydropower are limited due to the non-perennial nature of the rivers. In this context, it might be necessary to vigorously explore alternative sources of energy.

Other challenges include distribution to remote Islands further compounded by the Supreme Court ruling of not permitting distribution lines in tribal reserves. The dispersed nature of the habitats of varying sizes and population densities in ANI calls for a prudent energy policy, one that does not depend on a single conventional source of energy but rather a feasible mix of energy sources contingent on local opportunities and needs.

5.6.3 Strategies

Generating Energy through Renewable Energy Sources

- Moving to renewable energy sources will reduce carbon emissions and requires a shift in the policy framework. The following policy initiatives will be implemented.

- Switch over from conventional to non-conventional technologies, which will reduce carbon emission.
- Encourage wind energy.
- Encourage Biomass-based power projects.
- Encourage establishment of mini and macro hydel projects.
- Promoting merchant power plants in existing industrial units with variable power purchase agreement options.
- Develop state-level energy efficiency standards for various sections adopting energy conservation building codes.
- Carrying out a study for the establishment of a Nuclear Power Plant (Barg mounted).

Institutional Development of the Energy Department

Both capacity building and restructuring of the Energy Department will be required for implementing policies and conducting studies to meet the existing challenges. This will include the following:

i) functional reorganization and capacity building of the Energy Department including Energy conservation cell, creation of a separate cell for small and medium hydel plants to have coherent road maps to achieve the efficient functioning and implementation of energy efficiency, energy conservation, and promotion of renewable energy.

ii) Conducting a study for determining the state's emission intensity.

iii) Develop an operational plan for the fund that will get revenue from the sale of power.

iv) Feasibility study for the establishment of wind generators on a large scale.

Reducing Transmission and Distribution (T&D) losses

The reduction of T&D losses will continue to be a focus for reducing carbon emissions. An operational Plan for targeted reduction of losses and outdated systems will be developed. This will include the augmentation of T&D infrastructure and investment Plan, enhancing present practice for improved load management and a feasibility study of evacuation corridors.

Promoting Demand-Side Management (DSM) and Energy Efficiency

The Demand-Side Management (DSM) and energy efficiency will reduce the demand for energy and therefore reduce carbon emission. Under this initiative, a comprehensive policy and plan to save energy use in order to reduce the demand supply of gas and contribute towards climate change abasement will be done. This will include the following activities:

- Implementation of utility level DSM measures.

- Awareness generation for energy conservation is already in action and it will be strengthened more.

- Promotion and implementation of National bureau of energy efficiencies.

- Capacity building of Energy Auditors for proper energy monitoring, strengthening of existing energy conservation cell under the Energy Department supported with manpower and infrastructure.

Harnessing the Biomass Potential

The Department is studying the biomass potential for promoting on-grid and off-grid biomass power projects which will reduce the consumption of diesel and hence lower carbon emission. Under this, the following will be done to harness the biomass potential to maximum:

- Conducting a detailed feasibility study for sloping biomass-based projects in ANI.

- Developing a biomass supply chain involving agro, agroindustrial, and other biomass resources including dedicated energy plantation.

- Promoting biomass-based gasifier projects.

- Creating a conducive a scenario for investment.

Under this scheme, the Department has proposed to set up a 2-MW, biomass-based small power project at South Andaman, 1.5 MW at Car Nicobar, and 2 MW at Little Andaman, to utilize the biomass residue available in the Islands. M/s Darashaw & Co. Mumbai, was appointed as the consultant for the establishment of the project. The Request for Quotation (RFQ), Request for Proposal (RFP), Power Purchase Agreement (PPA), and Project Information Memorandum (PIM) have already been submitted to the administration for scrutiny. The total estimated project cost as per the Detailed Project Report (DPR) prepared by Anna University, Chennai for the 2-MW, biomass-based project at Little Andaman is Rs 895 lakh.

Maximizing Solar Power

To establish India as a global leader in Solar energy, the Ministry of Power, Government of India has launched a project called the Jawaharlal Nehru National Solar Mission (JNNSM) under the brand 'Solar India'. The objective of the Solar Mission is to create policy conditions for its diffusion across the country as quickly as possible. The mission has set a target of 20,000 MW.

In order to increase the non-conventional share in power generation, the Department has taken up various projects with the help of the National Thermal Power Corporation (NTPC), which are under progress and will start very shortly. The objective of the Solar Mission is also to mitigate climate change.

Wind Energy

In order to enhance the wind energy potential in ANI, under the guidance of the Ministry of New and Renewable Energy (MNRE), and with the help of the Centre for Wind and Energy Technology (C-WET), Chennai, the Department has installed 7 nos. of wind monitoring masts, i.e. 5 nos. of 50 m and 2 nos. of 30 m, to study the wind potential for installation of wind generators. Further action has been initiated to install 80 m wind monitoring masts. Wind monitoring masts have been installed at 15 locations in all the three districts. If the study reveals good wind potential, the installation of wind generators will be initiated after one and a half years.

Under the enhancement of the wind energy programme, the study of wind potential at Mount Harriet, South Andaman was carried out with the help of C-WET, Chennai and was found feasible for the installation of a 10 kWp solar hybrid system. The action for the installation of the 10 kWp wind–solar hybrid system is in progress at Mount Harriet.

The total estimated project cost is Rs 50 lakh. The project will address issues such as climate change, global warming, carbon emission, etc. It envisages an improvement in power supply at the rest house complex.

5.6.4 Relevant Initiatives, Policies, and Plans

The ANI Administration has come out with a policy in 2012 to promote renewable energy in the Islands, called the 'Policy for Promoting Generation of Electricity through New & Renewable Sources of Energy in ANI'. This policy will remain in force till 2017.

This policy is framed in the light of the State Development Report, 2006 for ANI in order to tap the potential for Renewable Energy in ANI. The Electricity Department, ANI has formulated these policy guidelines to provide greater thrust to promote and develop renewable energy technologies and applications.

5.6.4.1 ANI Climate Change Mitigation Program

Prioritized list of actions (short- and long-term)(Table 5.20)

Table 5.20: Capacity Addition Programme in ANI to mitigate climate change

Sl.no.	Location	District	Capacity (MW)	Type of fuel	Status
1.	Port Blair	South Andaman	2.00	Bio-mass	Technical clearance received from MNRE. Bidding under process.
2.	Little	South	2.00	Bio-mass	DPR prepared and will

	Andaman	Andaman			be implemented in second stage.
3.	Car Nicobar	Nicobar	1.50	Bio-mass	
4.	Port Blair	South Andaman	5.00	Solar	Technical clearance received from MNRE. Project awarded to NTPC.
5.	Rangat	North and Middle Andaman	1.00	Solar	Technical clearance being processed.
6.	Other places	ANI	1.00	Solar	Appointment of consultant in process.
7.	Other places	ANI	1.00	Small Hydro (7 projects)	Technical sanction received for two projects (700 kW).
Total			**13.50**		

5.6.4.2 Solar Mission in ANI

In order to enhance Solar Energy in ANI, the installation of a 5 MW Solar Power Plant at South Andaman, Garacharama hill and one 1 MW Solar Power Plant at Middle Andaman, Rangat is in progress. The project is to be implemented through NTPC for which the Memorandum of Understanding (MoU) has been signed. The plant will generate around 6,938 MWh unit for the first year. The total project cost will be Rs. 8,123 lakh.

5.6.4.3 Solar Thermal

The New and Renewable Sources of Energy (NRSE) Division of the Electricity Department is the Nodal Agency for the implementation of New and Renewable Energy projects in ANI as per the guideline of MNRE. The Department has made mandatory the use of Solar Water Heaters for commercial, industrial, and all residential buildings/buildings having a total plinth area of more than 100 m^2. Apart from this, the Department is also providing NRSE Devices such as solar cookers, solar lanterns, and biogas plants to general people and below poverty line (BPL) people under subsidy. In order to reduce the burden on the selling cost of NRSE Devices, a proposal has

been sent to the Administration for providing 75% subsidy to the general public, and 90% to Scheduled Tribes (ST)/BPL/un-electrified villages in addition to the MNRE subsidy.

5.6.4.4 Energy Efficiency

Under the centrally sponsored scheme of the Bureau of Energy Efficiency (BEE), New Delhi, the Department has taken up the project of conversion of General Service Lamps (GSL) to Compact Fluorescent Lamps (CFL) with the following objectives:

- To reduce GHG emissions.
- To reduce Carbon emission at the rate of 1.2 kg/kWh–5200 tonnes/year,
- Save energy to the tune of 4.33 MW yearly.

5.6.5 Proposed Plans and Linkages to National Action Plan on Climate Change

JNN Solar Mission: Towards Building Solar India

The Government of India launched the JNN Solar Mission to promote the renewable energy sector, particularly for the grid-interactive-scale (MW) solar power plants. India is a tropical country, where sunshine is available for longer hours per day and in great intensity. Solar energy, therefore, has great potential as a future energy source. It also has the advantage of permitting a decentralized distribution of energy, thereby empowering people at the grassroots level. Renewable energy has significant potential to mitigate global climate change, address regional and local environmental concerns, reduce poverty and increase energy security.[46] The ANI Solar Mission embodies the ethos of the national Mission and provides a portfolio of renewable energy projects with novel institutional arrangements to enable their feasibility and sustainability.

The National Mission on Enhanced Energy Efficiency

The Energy Conservation Act of 2001 provides a legal mandate for the implementation of the energy efficiency measures through the institutional mechanism of the BEE in the Central Government and designated agencies in each state. A number of schemes and programmes have been initiated. In order to enhance the energy efficiency at ANI, these schemes and others have been proposed under the ANI Mission on Enhanced Energy Efficiency, which will be taken up as per the initiatives taken up by the BEE and the Ministry of Power.

46 <http://india.gov.in/allimpfrms/alldocs/15657.pdf>

Summary of the Components of the ANI Solar Mission

Component 1: Installation of Solar Power Plants and SPV Power Plants

Sl. No.	Proposed activity	Nature of activity (ongoing/new)
1a	Installation of 1 no. 5 MW Solar Power Plant at South Andaman, Garacharama hill and 1 No. 1 MW Solar Power Plant at Middle Andaman, Rangat is also in progress.	New
1b	Establishment of 100–500KW SPV Plants with Annual Maintenance Contract (AMC) at 6 locations: Havelock, Terasa, Katchal, Kamorta, and Great Nicobar	New

Component 2: Distribution of Solar Thermal Devices

Sl. No.	Proposed activity	Nature of activity (ongoing/new)
2a	Devices distributed to the public at concessional rates:	Ongoing
	•Solar cooker	
	•Solar lanterns	
	•Biogas plants	
	•Different types of improved chulhas	
	•Improved kerosene stove lanterns and lamps	
	Approval for providing subsidy has been received from the Administration vide 4-4(13)/2009-Power	New
	75% to the general public	
	90% to ST/BPL/un-electrified villages	

Component 3: Promotion of Wind Energy

Sl. No.	Proposed activity	Nature of activity (ongoing/new)
3a	Action initiated for the installation of 80 m wind monitoring masts at 15 locations in all three districts.	New
3b	Action for the installation of a 10 kWp wind solar hybrid system is in progress at Mount Harriet.	Ongoing

Component 4: Promotion of Biomass Energy

Sl. No.	Proposed activity	Nature of activity (ongoing/new)
4a	Proposed biomass-based power plants	New
	•2 MW – South Andaman	
	•2 MW – Car Nicobar	
	•1.5 MW – Little Andaman	
4b	Proposal to set up biomass-based small power projects at various islands	New

Component 5: Promotion of Hydro-projects

Sl. No.	Proposed activity	Nature of activity (ongoing/new)
5a	•Kalpong downstream – 2 × 250 kW	New
5b	•Korang Nallah – 2 × 100 kW	New
5c	•Rangat Nallah – 3 × 60 kW	New
5d	•Panchavati Nallah – 3 × 40 kW	New
5e	•Krishna Nallah – 1 × 20 kW	New
5f	•Vasundhara Nallah – 1 × 10 kW	New
5g	•Kamsarath Nallah – 1 × 10 kW	New

Component 6: Research on the Potential of New Technologies

Sl. No.	Proposed activity	Nature of activity (ongoing/new)
6a	Study on the potential of Ocean Thermal Energy Conversion (OTEC) and Marine Current Turbine (MCT)	New
6b	Potential for bio-diesel	New

Summary of the ANI Mission on Enhanced Energy Efficiency

Sl. No.	Proposed activity	Nature of activity (New/ongoing)
1	Proposed mandatory adoption of an Energy Conservation Building Code (ECBC) in all government buildings and in all new building projects	Ongoing
2	Proposed mandatory use of ISI-marked motor pump sets, power capacitors, foot/reflex valves in the agriculture sector	Ongoing
3	Promotion of CFL/LED in all buildings, street lightings, etc.	Ongoing
4	Energy auditing of buildings	New and ongoing
5	Adoption of mandatory use of star-rated electrical appliances	Ongoing
6	Establishment of energy management cell at the Electricity Department	Ongoing
7	Deputing officials/staff for imparting training	Ongoing

5.7 Tourism

5.7.1 Overview and Status

The tourism vision in ANI is to develop ANI as an upmarket island destination for eco-tourists through environmentally sustainable development of infrastructure without disturbing the natural ecosystem, with the objective of generating revenue, creating more employment opportunities, and synergize socio-economic development of the Island.

The tourist traffic to the islands is on the increase, 95% of the tourists are domestic and largely from the Leave Travel Concession (LTC) segment. The major tourist attractions outside Port Blair are all located in forest areas. Tourism in such ecologically sensitive areas has to conform to certain environmental norms, such as use of recycled paper, avoidance of plastics and other non-biodegradable materials, use of alternative sources of energy, efficient systems of garbage disposal, conservation of water, use of alternative eco-friendly fuels, use of local materials for construction, employment of the local community, and respect for local culture. The carrying capacity of the islands will be a constraint for promoting tourism on a large scale, and this has to be resolved by containing immigration and augmenting availability of freshwater by rainwater harvesting. The Administration aims to promote quality tourism that is sensitive to the ecology of the islands that provides physical, economic, and social security for the Islanders and quality services to the visitors. The tourism sector has high potential for not only creating employment opportunities but also earning valuable foreign exchange (Table 5.21).

Table 5.21: Tourist traffic of ANI over the years

Year	Domestic tourists	Foreign tourists	Total tourists
2000	81,432	4,634	86,066
2001	85,866	5,249	91,115
2002	90,629	4,707	95,336
2003	93,899	4,281	98,180
2004	1,05,004	4,578	1,09,582
2005	30,225	2,164	32,389
2006	1,18,580	9,045	1,27,625
2007	1,36,015	10,975	1,46,990
2008	1,24,439	12,512	1,36,951
2009	1,42,045	13,692	1,55,737

2010	1,80,781	14,615	1,95,396

Source: Tourism Statistics, Directorate of Tourism ANI

5.7.2 Threats, Issues, and Challenges

Other challenges to the development of tourism include long travel time and high travel costs. Port Blair can be reached by air only from Kolkata and Chennai. The only airport in ANI is at Port Blair with unidirectional access. Passenger ships are available between Port Blair and Chennai and Kolkata and the voyage takes about 50–60 h. The cost of transportation to the islands constitutes more than 50% of the expenditure by the tourists, and methods have to be devised for reducing this, so that the discretionary expenditure within the islands for consumption and purchase can increase. [47]

5.7.3 Vulnerability to Climate Change

- Climate defines the length and quality of tourism seasons and plays a major role in destination choice and tourist spending. In many destinations, tourism is closely linked with the natural environment. Climate affects a wide range of the environmental resources that are critical attractions for tourism and also has an important influence on environmental conditions that can deter tourists, including infectious diseases, wildfires, insect or water-borne pests (e.g., jellyfish, algae blooms), and extreme events such as tropical cyclones.[48]

- Coastal and Island destinations are highly vulnerable to direct and indirect impacts of climate change such as storms and extreme climatic events, coastal erosion, physical damage to infrastructure, sea level rise, flooding, water shortages, and water contamination since most of the infrastructure is located within short distance of the shoreline. This high vulnerability often couples with a low adaptive capacity, especially in coastal destinations of developing countries.

- The strong seasonality of beach tourism has to be taken into consideration, as it can be exacerbated by climate change. In many beach destinations, the high tourist season coincides with low-water regimes in dry seasons, aggravating water management, and environmental issues.

- The impacts of climate change and global warming will vary greatly in the different coastal regions, and might bring opportunities as well. For example, in traditional summer beach destinations, seasons might lengthen, and winter season might be more appealing to tourists, providing opportunities to reduce seasonality and expand the tourism product.

[47]State Development Report, of Andaman and Nicobar Islands, 2006, National Institute of Public Finance and Policy

[48]Davos Declaration, 2007. Climate Change and Tourism, responding to global challenges. Second International Conference on Climate Change and Tourism

Northern coastal areas might benefit from warmer summers, attracting more tourists and lengthening the summer season.

- Nature-based tourism relies on a high diversity of tourism resources. These resources are highly variable in space, and will be affected by climate change in various ways. It is rather difficult to assess the magnitude of climate change impacts in nature-based destinations, given this diversity of resources, compared, for example, to ski resorts (relying principally on snow conditions), or coastal resorts (relying mainly on beach and bathing water conditions). Although ecosystems can be highly vulnerable to climate change impacts, there probably are good adaptation options in eco-tourism, given the wide range of activities that can be developed and conducted in natural areas. Therefore, there are good possibilities to design effective adaptation strategies for eco-tourism and nature-based destinations.

5.7.4 Strategies for Sustainable Island Tourism

- Coastal protection to prevent erosion.
- Enhanced design, citing standards and planning guidelines for tourism establishments.
- Integrate climate change factors into regulatory frameworks for tourism development, such as Environmental Impact Assessment for tourism infrastructure and establishments.
- Implementation of tourism development plans within the framework of the Integrated Coastal Zone Management (ICZM) processes and spatial planning such as zoning.
- Reduce tourism pressures on coral reefs.
- Water conservation techniques, such as rainwater storage, the use of water-saving devices, or wastewater recycling.
- Diversification of the tourism product to less climate-dependent and seasonal activities, such as eco-tourism and promoting product diversification: opening up new 'micro destinations' and attractions within and adjacent to an already popular national park or heritage site; diversification is especially important where key elements of the nature-based product are threatened.
- Education/awareness raising among tourism businesses and their staff, as well as tourists.
- Awareness and preparedness to face extreme climatic events and disasters at the national and local levels through improved coordination between disaster management offices, tourism administrations, businesses, and host communities.
- Improved provision of climatic information to the tourism sector through cooperation with national meteorological services.
- Insurance cover (or alternative schemes) for the recovery of infrastructural and other damage.
- Drainage and watershed management to reduce flood and erosion risks.
- Support protected area management, and other means of the conservation of coastal ecosystems in order to enhance their resilience.
- Improve adaptive capacity of authorities and managers of protected areas through capacity

building initiatives, especially in biodiversity hotspots of least developed countries (LDCs) and developing countries.

- Establish scientific monitoring survey programs to assess ecosystem changes and take necessary protection measures (monitoring activities could especially focus on species and habitats most vulnerable to climate change impacts and most important for tourism activities).
- Carry out re-design or redefinition of protected areas, for example revision of zoning of certain areas, extending protected area to a larger surface, and creation of migratory corridors to allow threatened species to find new geographic ranges more easily.
- Promote the application of integrated tourism through carrying capacity assessment techniques (considering physical, economic, environmental, socio-cultural, and managerial aspects) in protected areas as a tool for tourism planning.
- Improve visitors and congestion management to prevent overuse of sites and physical impacts of visitation.
- Promote mitigation options amongst environmentally conscious eco-tourists, e.g., through offsetting their trips to nature-based tourism destinations.
- Ensure active participation of local communities living within or near protected areas, in policy-making and management processes.

5.7.5 Relevant Initiatives, Plans, and Policies

Tourism Policy of ANI

Objectives of tourism promotion:

- To address the growing unemployment problem by placing thrust on the promotion of tourism.
- Higher revenue generation.
- Promoting the concept of eco-tourism.
- To encourage the private sector in tourism.
- To harmonize ecology and tourism for the benefit of the people of the Islands.

The following issues are the key focus of the ANI Tourism Policy:

- Promotion of high-value low-volume eco-friendly and environmentally sustainable tourism.
- Undertaking tourism activities that are not harmful to the ecosystem.
- To implement the UNDP/World Trade Organisation (WTO) master plan for sustainable development of tourism in ANI.
- Encouraging private sector investments in the development of tourism infrastructure.
- Gradual privatization of the management of existing tourism infrastructure.
- Development of new tourism activities/products.
- Marketing ANI as a tourist destination nationally and internationally.

Annual Action Plan 2011/12

The Directorate of Tourism has identified three thrust areas for the development of the tourism sector. These areas include[49] the following:

1. Strengthening of the Directorate of Tourism.
2. Creation and maintenance of tourism accommodation, infrastructure, and destination and ACA
3. Tourism promotional activities.

[49]Annual Plan proposal 2011-2012, Tourism Sector

5.8 Urban Planning and Transport

5.8.1 Overview and Status

The transport sector contributes about 7% of the total GHG emission in the country[50]. With greater economic growth and rapid urbanization, there is constant increase in the number of transport vehicles, which leads to greater use of fossil fuel and more GHG emissions. If the current rate of urbanization and motorization continues, GHG emissions could grow to about 8 times the current level by 2030.

ANI in general and Port Blair in particular call for formulation of a transport policy urgently. The current vehicle population is 43,176 vehicles, which is likely to grow. Particularly, the two wheelers, auto rickshaws, and car segments are going to face an upward trend. In view of the inherited road network, which cannot be widened beyond certain limits and the vehicular pollution because of the usage of fossil fuel, the congestion and pollution will be highly pronounced, spoiling the natural form of the island. Non-availability of extensive flat land for development is also a major constraint to dissipate congestion. Under such circumstances, promotion of public transport is the best option in the long run. In the meanwhile, to contain vehicular pollution, usage of CNG, LPG, and other non-polluting fuels may have to be insisted upon along with a slow reduction in the number of private vehicles. It is possible to introduce a road-based or rail-based mass transport system in a place like Port Blair to reduce the environmental impact. The current level of modal shift in favour of private vehicles should be gradually reduced and the share of public transport increased.[51]

In addition, ANI also needs to look into the sensitization of the water transportation sector. The shipping sector is the lifeline for the people of these Islands and it has made discernible progress in providing mobility to men and material between the mainland and the Island on the one side and inter-Island on the other. The Directorate of Shipping Services (DSS) is responsible for manning, maintaining, and operating the vessels owned by the Administration. The Department is presently providing shipping services to 29 of the 36 inhabited Islands.

Shipping is the main mode of transportation for passenger and cargo between the mainland and the Islands and the only mode between the Islands. The Department has been able to achieve regular service in almost all the sectors.

The DSS presently operates 71 vessels in four sectors. These are listed below.

1. **Mainland–Island Sector:** To provide service between Port Blair and Kolkata/Chennai/Vizag.

[50] Natcom, 2007.

[51] Master Plan for Port Blair Planning Area-2030. May 2011. Town and Country planning Unit, Andaman Public Works Department

2. **Inter-Island Sector:** To provide services between Port Blair and the distant group of Islands.

3. **Fore Shore Sector:** To provide services between Port Blair and nearby Islands.

4. **Harbour Ferry Sector:** To provide services within the sheltered water and narrow creeks by ferry vessels.

These four sectors must also be strengthened so as to complement passenger movement across the islands.

Care must also be taken on human settlements, which largely occupy coastal locations. An unprecedented expansion of towns and urban cities can lead to health and sanitation problems, which can be further aggravated by changes in climate. The infrastructural base that supports the vital socio-economic sectors of island economies is highly susceptible to climate change activities. Safeguards need to be set up and climate mitigating activities need to be initiated along the coastal areas of major settlements.

5.8.2 Threats, Issues, and Challenges

- Increased private vehicles on the roads are resulting in urban roads congestion and traffic management problems. The transport policy for ANI is still in the preparatory stage.
- Increased amount of GHG emissions in urban areas is resulting in damage to the fragile ecosystem of the island.
- Streamlining waterway transport to complement road transportation is the need of the hour.
- With growing urban populations across all the cities and towns, the existing infrastructure and services deficit is only likely to widen, further increasing the risks to these agglomerations unless urgent steps are taken.

5.8.3 Vulnerability to Climate Change

Similar to human settlements, the infrastructural base that supports the vital socio-economic sectors of island economies predominantly occupies coastal locations. Climate change poses a challenge in the transportation sector, especially in the coastal areas emerging from closure of roads due to flooding, and damage to port facilities, etc. The resulting disruption would not be confined to the transportation sector alone, but would impact other key dependent sectors and services including tourism, agriculture, and the delivery. The threat from sea level rise to infrastructure on small islands could be amplified considerably by the passage of tropical cyclones.

5.8.4 Strategies

- Piloting low carbon, green roadways, and waterways.
    - Selected road stretches and water sectors will be identified, even pilot parties who provide adequate bank guarantees to carry out such projects can be encouraged.
    - Feasibility studies to be conducted for the use of cleaner technologies, detailed designs, and approaches planned and implemented.
- Encouraging fuel-use efficiency and tightening enforcement
    - Adoption of better practices to be first introduced, tested, and monitored here in the public transportation sector.
    - Curbing of fuel adulteration and monitoring of vehicular emissions.
    - Building the capacity of the enforcement wing for emission level check-up.
- Vulnerability analysis of areas liable to be inundated.
- Better urban planning (e.g. taking into consideration the drainage pattern while constructing marine drive).
- Pollution control and solid waste management.
- modal shift to public transport.
    - Energy Efficiency in the residential and commercial sector.

5.8.5 Relevant Initiatives, Plans, and Policies

In order to increase and encourage the usage of public transportation, the Department of Transport has proposed refurbishing 14 Outstations Units with its headquarters at Port Blair and Mini Workshop at 8 Outstation Units. There is a proposal to construct Mini Workshops at Havelock and Neil Island in the Tenth Five-Year Plan (FYP). With the construction of the above two workshops, the Outstation Units will be self-sufficient to carry out day-to-day repairs and maintenance of buses in respect of their units. Also, a Central Workshop with all modern facilities is under construction at Port Blair, at an estimated cost of Rs. 2.89 crores which will further enhance the working capacity with new technologies and machineries to maintain a functional fleet of buses. In addition to the workshops, the Department is in the process of procuring 5 Mobile Workshops for which chassis have already been delivered.

5.8.6 Proposed Plans and Linkages to the National Action Plan on Climate Change

The transport sector is an important component of the **National Mission on Sustainable Habitat**. An increase in the demand for transportation services for both passengers and freight is inevitable, given economic growth and increase of population. Road-based transportation is

the main source of GHG emissions in the transportation sector. Further, with the growth of tourism in ANI, transport within and to other Islands will become increasingly important. Various studies have estimated that policy and technological measures can lead to significant energy and thereby emission savings in the transport sector.[52] Both pollution control and a shift to public transport are important focus areas in the transport sector that have been duly addressed in the ANI Mission for Sustainable Habitat, Transport.

ANI Mission on Sustainable Habitat

Component 1: Pollution Control

Sl. No	Proposed activity	Nature of activity (New/ongoing)
1	Setting up of emission testing stations in Port Blair, Rangat, and Diglipur	New

Component 2: Modal Shift to Public Transport

S. No	Proposed activity	Nature of activity (New/ongoing)
2a	Procurement of new buses for augmentation	New
2b	Replacement of existing buses	Ongoing
2c	Strengthening of existing buses	Ongoing
2d	Additional buses for educational institutions during peak hours	New

[52]National Action Plan on Climate Change. Planning Commission

5.9 Health

5.9.1 Overview and Status

ANI has well-developed health infrastructure in the form of 115 Sub-Centres, 21 Primary Health Centres (PHCs), 4 Community Health Centres (CHCs), 8 Homeo Dispensaries, 4 district hospitals (including 1 referral), 5 Urban Health Centres and one Ayurvedic dispensary.

ANI has shown improvement in most health indicators such as Infant Mortality Rate (IMR), Birth and Death Rate and Maternal Mortality Rate (MMR). The incidence of nutritional deficiency diseases, diarrhoea, and communicable disease, which were the main causes of mortality and morbidity in the past, has considerably been brought down (Table 5.22).

Table 5.22: Improvement in vital rates

Vital rates	2008	2009	2010
Crude birth rate	13.26	12.39	11.83
Crude death rate	3.98	4.00	4.09
Infant mortality rate (IMR)	16.63	19.36	20.40
Neo-natal mortality rate (NMR)	11.85	14.44	13.14
Early neo-natal mortality rate	9.22	11.72	9.51
Late neo-natal mortality rate	2.63	2.72	3.63
Post Neo-natal Mortality rate	4.77	4.92	7.26
Pre-natal mortality rate	28.48	26.60	24.35
Still mirth rate	18.90	15.06	14.98
General fertility rate	49.52	45.61	43.07
Sex ratio at rirth	961	973	934
Maternal mortality rate (per lakh)	131.71	118.91	51.86

Source: Vital Statistics, Directorate of Health Services

Major diseases prevalent in ANI are as follows:

- Acute respiratory infection
- Pyrexia, viral fever
- Gastro-Intestinal disorders

- Nutritional deficiencies including anaemia and vitamin deficiency
- Malaria.

Malaria has been endemic in ANI for nearly a century and *Anopheles epiroticus* (previously: *An. sundaicus*) is the incriminated vector. During 1992–2004, the Annual Parasitic Incidence (API) ranged from 1.42 to 4.5 per thousand. So far, Andaman district has been of low endemicity when compared to the Nicobar district.

An. epiroticus (*An. sundaicus*), a brackish-water breeder, is now restricted to ANI in India (Table 5.23).

Table 5.23: Availability of healthcare services in ANI

Medical facilities	2008/09	2009/10	2010/11
Hospitals	4	4	4
Community health centres	4	4	4
Primary health centres	19	19	21
Urban health centres	5	5	5
Sub-centres	114	114	115
Homeo dispensary	8	8	8
Ayurvedic dispensary	1	1	1
Beds available	1045	1045	1055

Source: Basic Statistics, Directorate of Economics and Statistics

5.9.2 Vulnerability to Climate Change

- Potential effects on health due to sea level rise include the following:
  - Death and injury due to flooding.
  - Reduced availability of freshwater due to saltwater intrusion.
  - Contamination of water supply through pollutants from submerged waste dumps.
  - Change in the distribution of disease-spreading insects.
  - Health effect on the nutrition due to a loss in agriculture land and changes in fish catch.
- Health impacts associated with population displacement.

- Climate change would result in increased incidence of vector-borne diseases such as malaria, dengue, and water-borne diseases such as diarrhoea.[53]
- Nearly 40 million people are affected by water-borne diseases in India every year and that places a large burden on both the health sector and the economic sector.[54]
- Increasing global temperatures affect levels and seasonal patterns of both man-made and natural air-borne particles, such as plant pollen, which can trigger asthma.[55]
- Many diarrhoeal diseases vary seasonally, suggesting sensitivity to climate. In India, like in other tropics, diarrhoeal diseases typically peak during the rainy season. Both floods and droughts increase the risk of diarrheal diseases. Major causes of diarrhoea linked to heavy rainfall and contaminated water supplies are cholera, cryptosporidium, *Escherichia coli* infection, giardia, shigella, typhoid, and viruses such as hepatitis A.

5.9.3 Strategies

- Potential adaptation strategies in India could focus on controlling infectious diseases by removing vector breeding sites, reducing vector–human contact via improved housing, and coordinating monitoring of mosquitoes, pathogens, and disease burden. Another potential focus area for adaptation could be improving sanitation and drinking water by supporting inexpensive and effective water treatment and increasing rainwater harvesting, safe storage, and grey-water reuse.
- Develop disease profile of communities.
- Scaling up of disaster management preparedness to check epidemic outbreaks.
- Early case detection and quick control with focus on areas where coverage is low or has not reached.
- Measures for source reduction for all vector-borne and water-borne diseases is required, e.g. filling of the breeding places, proper covering of stored water, channelization of breeding sources, etc.
- Public awareness on health and climate change.
- Capacity building of health personnel and institutions to integrate climate change concerns in planning and actions.

5.9.4 Relevant Initiatives, Plans, and Policies

Under the National Rural Health Mission (NRHM), the following priority areas have been identified, which could be relevant in the present scenario.

[53]India Country Report, 2007, Workshop on Climate Change and Health in South East and East Asian Countries, Kuala Lumpur, Malaysia

[54]Bush, K.F., et al 2011. Impacts of Climate Change on Public Health in India: Future Research Directions. Environmental Health Perspectives, Vol.119: 765-770

[55]Majra, J.P.&Gur, A. Climate Change and health: Why should India be concerned? Web link: www.**indiaclimate**portal.org/.../279-**Climate**-**change-and-Health**-why-... File Format: PDF/Adobe Acrobat - Quick View Date Accessed: 13th May 2012

Augmenting Health Facilities:

- Equipping the existing services with instruments and laboratories so that they can provide better services (BP machine USG machine, CT scan, X-Ray, and OT for surgery).
- Recruiting the staff needed in the sub-centres and PHCs. Appointment of Auxiliary Nurses and Midwives (ANMs), doctors and specialists: gynaecologists, child specialists, pathologists, and laboratory technicians.
- Awareness drives about using existing facilities to be carried out.
- Setting up more sub-centres equipped with staff and facilities.
- Referral support needs to be strengthened.
- CHCs to be set up with advanced medical facilities as per the Indian Public Health Standards (IPHS).
- Improvising Referral Transport.
- Community monitoring of the facilities being provided at each facility.

Nutrition Security:

- Household survey of malnourished children.
- Vitamin supplementation doses for children of 2–6 years of age.
- Regular IFA supply at all schools for girls.
- Regular IFA small supply at all AWCs.

Malaria Control:

- Awareness drives.
- Blood samples collection from all vulnerable areas of the village.
- Presumptive treatment for all suspected fever cases.
- Regular spray of DDT in short intervals and introducing new kinds of insecticides.
- Medical treatment for all positive cases.
- Supply of impregnated mosquito nets and quarterly spray activities.
- Lymphatic Filariasis, Dengue, and Japanese Encephalitis.

Diarrhoea Prevention:

- Regular awareness campaign at a larger level to encourage safe drinking practices.
- Encouraging chlorination of wells, ponds, and other water resources.
- Regular water testing facility in the sub-centres.
- Survey to find out and prevent any epidemic.

Safe Drinking Water:

- Promoting use of safe drinking water.
- Regular quality check-ups of the water storage system.
- Awareness drives and campaigns about methods and quality checks at home.

Sanitation:

- Discouraging the practices of open-field defecations.
- Installing of dustbins at every institution and public places.
- Implementing a waste management system at the village level.
- Mobilizing the community for using sanitary household toilets.

Other Initiatives:

- Conducting health camps annually/half-yearly for dental, cataract, and other eye infections, kidney stones, and Urinary Tract Infection (UTI) problems.

5.9.5 Proposed Plans

- Strengthen regulatory and institutional capacity for vector control.
- Streamline the planning of healthcare services and strengthen medical emergency response.
- Promote healthy islands and healthy buildings.
- Strengthen the capacity for healthcare delivery.
- Undertake research on climate-change-related diseases.
- Increase nutrition promotion campaigns.

PART C- CLIMATE CHANGE ACTION PLAN

The ANIAPCC is structured around the eight state missions keeping in mind the fragile and complex island ecosystems of ANI. This includes the **Mission on Sustaining Island Ecosystems.** The eight ANI Missions with the nodal agency and the budget allocated are given in Table 5.24.

Table 5.24: Missions in the ANIAPCC and the nodal agency for each mission

Mission	Strategies and activities	Outlay (in crores)
ANI Solar Mission		33.88
ANI Mission on Enhanced Energy Efficiency	• Proposed mandatory adoption of Energy Conservation Building Code (ECBC) in all government buildings and in all new building projects. • Proposed mandatory use of ISI-marked motor pump sets, power capacitors, foot/reflex valves in the agriculture sector. • Promotion of CFL/LED in all buildings, street lightings, etc. • Energy auditing of buildings. • Adoption of mandatory use of star-rated electrical appliances. • Establishment of energy management cell at the Electricity Department. • Deputing officials/staff for imparting training.	0.25
ANI Mission on Sustainable Habitat	• Development of database, vulnerability maps. • Model codes on 'Droughts, Floods and Good Weather'. • Micro-level weather forecasting and crop insurance in collaboration with PRIs. • Sustainable agriculture development (organic farming, poly houses, livestock production and breeding, augmented fisheries, etc). • Management of seawater intrusion and change in coastal morphology. • Promotion of System Rice Intensification (SRI)	676.53

	cultivation in paddy. • Soil and water conservation. • Watershed programme.	
ANI Sustainable Water Mission	• Augmentation of water supply. • Efficient use of water and enhancing water storage capacity of water bodies. • Groundwater recharge and rain-water harvesting. • Establishment of community water-harvesting structures. • De-silting and raising of embankment of existing water bodies, maintenance of check dams, etc. • Block-wise mapping of groundwater availability. • Awareness conservation of water.	6.52
ANI Mission on Green India	• Protection of existing forests. • Increasing the density of the forests. • Conversion of monoculture plantations into secondary forests. • Improved utilization of timber in Government Saw Mills. • Enhancing efficiency of small wood and NTFP-based industries	122.11
ANI Mission on Sustaining Island Ecosystem	• Management of coastal ecosystem o Afforestation of mangroves in tsunami-affected areas. o Establishment of coastal bio-shield plantations of multi-purpose trees on uplifted areas. • Monitoring and Research on Impacts of Climate Change on Island Ecosystems and Forests. o Establishing a coastal data buoy system. o Monitoring spatial impacts of climate change and other natural disasters.	13.36

	○ Establishment of artificial coral reefs. ○ Study on phenological changes and recruitment pattern of key-stone flora to climate change impact. ○ Monitoring critical faunal habitats (turtles/littoral birds) to assess the impact of climate Change	
ANI Mission on Sustainable Agriculture	• Development of database, vulnerability maps. • Model codes on 'Droughts, Floods and Good Weather' • Micro-level weather forecasting and crop insurance in collaboration with PRIs • Sustainable agriculture development (organic farming, poly houses, livestock production and breeding, augmented fisheries, etc). • Management of seawater intrusion and change in coastal morphology. • Promotion of System Rice Intensification (SRI) cultivation in paddy. • Soil and water conservation. • Watershed programme. • Research on climate-resilient agriculture.	220.96
ANI Mission on Strategic Knowledge for Climate Change	• Climate modelling and access to data. • Enhanced research and climate modeling. • Promoting data access: Formulation of policies for sustained development within a responsive climate change framework. • Strengthening networks. • Building inter-departmental co-operation on climate change.	0.645/yr

	• Networking of knowledge institutions. • Human Resource development • Capacity building and awareness including school children. • Establishment of Climate Change Division in the Department of Science and Technology (DST)	

Activities identified for preparation of Sectoral action plan for Climate Change (SAPCC) for Andaman and Nicobar Islands

Sustainable Habitat Mission

S. No.	Mission/ Component	Proposed Activity	Nature of Activity (On going/ new Initiative)	No./Quantity of proposed activity	Budget Estimate In crores	Time frame (Year wise physical and financial target) PHASE			Type of proposed activity	Feedback loop	Remarks
						I (2010-15)	II (2015-20)	III (2020-30)			
A.1	Better Urban Planning and Modal shift to public transport	Construction of Regional Market at Prothrapur	New	1	25	---	25	---	Mitigation		It is decentralisation of commercial activity
A.2		Strengthening of Ponghibalu boat jetty	New	1	20	20	---	---	Mitigation		Decentralization activity
					45	20	295				

The Estimated amount of Fund requirement will be met from the Plan funds, Projects under PPP and Centrally Sponsored Schemes like JNNURM etc. It is assumed that 10% of the funds for each of the Project will be met from the Climatic Action Plan. Therefore the Estimated amount for execution the projects under CCAP would be 4.5 crores

Sl. No.	Mission/ Component	Proposed Activity	Nature of Activity	No./Quantity of proposed activity	Budget Estimate	Time frame (Year wise physical and financial target) PHASE			Type of proposed activity	Feedback loop	Remarks
						I (2008-12)	II (2012-16)	III (2016-20)			
B1	Better Urban Planning and Modal Shift to public transport	Widening of Road Stretch from Chatham to Bathubasthi	New	1	102.00	---	102.00	---	Adaptation		Traffic Improvement by widening of Arterial Road
B2		Marine Drive Phase-1	New	1	401.00	401.00	---	---	Mitigation		Traffic Improvement
B3		Environmental Friendly Shuttle Service	New	1	5.00	5.00	---	---	Mitigation		
B4		Shifting of Bus Terminus	New	1	20.00	20.00	---	---	Adaptation		Decongestions activity
B5		Missing Links	New	1	78.00	78.00	---	---	Adaptation		Traffic Improvement
					606 crores	504 crores					

The Estimated amount of Fund requirement will be met from the Plan funds, Projects under PPP and Centrally Sponsored Schemes like JNNURM etc.

It is assumed that 5% of the funds for each of the Project will be met from the Climatic Action Plan. Therefore the Estimated amount for execution the projects under CCAP would be 25.0 crores

Transport Sector

Sl. No	Mission/ Component	Proposed Activity	Nature of Activity	No. quantity of Proposed activity	Budget Estimate	Time Frame (Year wise Physical and Financial Target)	Type of Proposed activity	Feedback loop	Remarks
VIII 1.	a. Pollution Control b. Modal shift to public mass transport.	Setting up of Emission Testing Stations in Port Blair, Rangat & Diglipur	New Initiative	03 Nos	Rs 10.00 Lakhs for each activity i.e Total Rs 30.00 Lakhs	3 Years i.e Per Year Rs 10.00 Lakhs	Adaptation	Yes for imposing stringent Emission norms for all Motor Vehicles in the U.T	
		Procurement of new buses for augmentation	New Initiative	10	Rs. 18.00 lakhs X 10 i.e Rs. 1.80 Crores	5 years	Adaptation	For improving Public Transport in terms of Quantity as well as Quality	
		Replacement against condemnation of existing buses.	Ongoing	15	Rs 18 Lakhs for each bus i.e Rs 2.70 Crores	5 years Yearly 30 Bus X Rs 18 Lakhs = Rs 5.40 Crores	Adaptation	For improving Public Transport in terms of Quantity as well as Quality	
		For Strengthening of existing Buses		50	Rs 5.00 lakhs for each bus i.e Rs 2.50 Crores	5 years Yearly 10 Bus X Rs 5 Lakhs = Rs 50.00 Lakhs	Adaptation	For improving Public Transport in terms of Quantity as well as Quality	
		To operate additional buses for Educational Institution during peak hours	New Initiative	25 Buses 5 Each Buses for 10 Schools	Rs 18.00 Lakhs for each i.e. Total = Rs 4.50 Crores	5 Years Yearly 20 Bus X Rs 9 Lakhs = 1.80 Crores	Mitigation	Yes, to reduce the usage of personal vehicles for lessoning traffic congestions by making mandatory to provide Buses for students by Educational Institutions.	

					Rs. 11.80 Cr				

Urban Development Sector

Sl. No.	Component	Proposed Activity	Nature of Activity	No./Quantity of proposed activity	Budget Estimate In lakhs	Time frame (Year wise physical and financial target)	Type of proposed activity	Feedback loop	Remarks
	Increasing Energy Efficiency in the Residential & Commercial Sector	Mandating certification of (GRIHA Rating) new and existing Govt. Buildings for improving the Energy Efficiency	New	1	10	10	Mitigation through Policy Initiating		Govt should play the lead role in Energy Conservation. Implemented by APWD & Public Agencies
2.	-do-	Incorporation of Energy Efficiency norms (based on ECBC and NBC) in the Building Bye-laws	New	1	10	10	Mitigation through Policy Initiating		Action will be initiated by PBMC

3.	-do-	Mandating certification of (GRIHA Rating) new and existing Private Buildings for improving the Energy Efficiency by providing certain incentives like concession in the property tax etc.	New	1	100	100	Mitigation through Policy Initiating		Major housing stock is from Private side. It is essential to bring them into the fold of energy conservation. Action will be initiated by PBMC
4.	-do-	Education on green Building and Consumer awareness program on economic and environmental benefit from energy efficient green buildings	New	1	25	25	Mitigation through Policy Initiating		Education on energy conservation. Action will be initiated by PBMC
5.	-do-	Construction of green demonstration Buildings	New	1	100	100	Mitigation		Demo Buildings to attract Public Action will be initiated by APWD
6.		Website dedicated for Building codes for	New	1	10	10	Mitigation through Policy		Dissemination of information

	-do-	green buildings					Initiating		on energy conservation Action will be initiated by PBMC
7.	-do-	Mandating Solar Water Heating Equipment in the institutional buildings	New	1	20	20	Mitigation through Policy Initiating		Exploring Alternative Energy options Action will be initiated by PBMC
8.	-do-	Proposal for encouraging Wind Energy by providing certain FAR concessions	new	1	100	100	Mitigation through Policy Initiating		Exploring Alternative Energy options Action will be initiated by PBMC
9.	-do-	Mandating Tree plantations in all new buildings	New	1	100	100	Mitigation through Policy Initiating		Greening the city Action will be initiated by PBMC
10	-do-	Study on Alternate Building Material	New	1	25	25			

					500 Lakhs	500			

Sl. No	Component	Proposed Activity	Nature of Activity	No./ quantity of proposed	Budget estimate In	Time frame	Type of proposed activity	Feed back loop	Remarks
1.a.	Solid Waste Management	Supply of bin for segregation of bio-degradable and non-bio	On going	50,000	70	2011-2012 - Procurement and supply of bins	Adaptation	The segregated solid waste will be sent to	To be executed by PBMC.
1.b.	-do-	Awareness creation about segregation of solid waste at	New Initiative	Lump Sum	2.0	2011-2015 - Awareness creation through	Mitigation	-	To be executed by PBMC.
2.a.	-do-	Segregation of Solid Waste originates from villages by using modern technology.	New Initiative	Lump sum	50.0	2011-2017 – Procurement of machineries and installation at selected land fill site for	Mitigation	-	To be executed by Zilla Parishad / Panchayats.

Sl. No	Component	Proposed Activity	Nature of Activity	No./ quantity of proposed	Budget estimate In	Time frame	Type of proposed activity	Feed back loop	Remarks
2.b.	-do-	Capacity building of staff on use of modern machinery for	New Initiative	Lump sum	1.0	2011-2012 – Training of staff in use of segregating machinery.	Mitigation	-	To be executed by PBMC.
3.a.	-do-	Improving efficient transportation of MSW in PBMC.	New Initiative	Lump sum	100	2011-2017 – Procurement of compactor, dumper placer, cess pool emptier and weighing bridge to facilitate for	Mitigation	-	To be executed by PBMC.

Sl. No	Component	Proposed Activity	Nature of Activity	No./ quantity of proposed	Budget estimate In	Time frame	Type of proposed activity	Feed back loop	Remarks
3.b.	-do-	Study on setting up of communal recycling centers for bio-degradable wastes at selected villages in South Andaman, Nicobar and	New Initiative	3	30.0	2011-2012 - Award and completion of study	Mitigation	Outcome of the study will be incorporated in relevant programme.	To be executed by DC's of South Andaman, Car Nicobar and North and Middle Andaman District.
3.c.	-do-	Setting up of communal recycling centre for bio-degradable wastes in South Andaman, Nicobar and North and Middle	New Initiative	3	75.0	2012-2017 – setting up of modal communal recycling centres for bio-degradable wastes @ 25.0 lakhs	Mitigation	The budget and programme will be modified subject to outcome of study at 3.b.	To be executed by DC's of South Andaman, Car Nicobar and North and Middle Andaman District.

Sl. No	Component	Proposed Activity	Nature of Activity	No./ quantity of proposed	Budget estimate In	Time frame	Type of proposed activity	Feed back loop	Remarks
3.d.	-do-	Setting up of shredding unit for using low density plastic wastes in road making programme	News Initiative	3	10.0	2012-2013 – Procurement on installation of shredders at land fill sites for shredding of low density plastics.	Mitigation	-	To be executed by APWD in collaboration with Dy. Commissioners of South Andaman, Car Nicobar and North and Middle Andaman District and PBMC.
4.a.	-do-	Conducting study for Improvisation and reclamation of land fill site of PBMC at	New Initiative	Lump sum	10.0	2011- 2012 – Award and completion of study	Mitigation	Outcome of the study will be incorporated in relevant programme	To be executed by PBMC.

Sl. No	Component	Proposed Activity	Nature of Activity	No./ quantity of proposed	Budget estimate In	Time frame	Type of proposed activity	Feed back loop	Remarks
4.b.	-do-	Improvisation and reclamation of land fill site of PBMC at Brookshabad	New Initiative	Lump sum	25.0	2012-2017 – Improvisation and reclamation of land fill site at Brookshabad	Mitigation	The budget and programme will be modified subject to outcome of	To be executed by PBMC.
					373 lakhs Or 3.73				

Abstract of Fund Requirement for sustainable habitat

S.No		Requirement for first 5 yrs in Cr
1	Extension of the Energy Conservation Building Code	5.00
2	Better Urban Planning and Modal Shift to Public Transport 4.5+25+11.80	41.3
3	Recycling of material and Urban Waste Management	3.73
	Total	50.03

Sustainable Water Mission

Sl. No.	Component	Nature of Activity	No. / Quantity of Proposed Activity	Budget Estimate	Time frame	Type of proposed activity	Feedback loop	Remarks
1	Augmentation of Water Supply	Flat Bay Project	67.00 MLD	100 lakhs	2004 - 2015	Mitigation	A long term measure for catering to the need of water of Port Blair town for next 50 years. DPR is under preparation. Token fund provision is kept in the plan	
2	Efficient use of water and enhancing water storage capacity of water bodies.	Awareness Creation Programme in Education Institutions and for General Public on consideration of water	1	2.00 lakhs	2012-15	Mitigation	There is a need to create awareness among the General Public for optimum use of water and its conservation.	

3	Efficient use of water and enhancing water storage capacity of water bodies.	Installation of water metering system in all individual household connections for Port Blair and surrounding areas	25000	(25000 x 2000) = 50.00 lakhs	2012-15	Adaptation	In the options of water metering system people tend to use the water lavishly. It is essential to install water metering system for measuring the water usage and levying water charges accordingly.	
4	Efficient use of water and enhancing water storage capacity of water bodies.	De-silting and raising of embankment of existing water bodies like Diltaman, Nayagaon, Chakkargaon and Jawahar Sarovar	4	70.00 lakhs	2012-15	Mitigation	De-silting and raising of embankment is done for capacity augmentation.	
5	Rain Water Harvesting	Awareness creation on Rain Water Harvesting in Private & Public buildings.	1	10.00 lakhs		Adaptation	It is proposed to organize public campaign on rain water harvesting to create awareness of its importance.	

6	Rain Water Harvesting	Maintenance of existing Rain Water Harvesting structure in govt. office buildings.	200	20.00 lakhs	2012-15	Adaptation	Existing water harvesting structures though available in many govt. buildings are not put to use optimally. This can be optimally put to use by carrying out simple maintenance.	
7	Rain Water Harvesting	Installation of new water harvesting structures wherever required.	100	200.00 lakhs	2012-15	Adaptation	Few new govt. building where rain water harvesting structures are not installed to be provided with rain water harvesting structures.	
8	Rain Water Harvesting	Establishment of Community water harvesting structures wherever feasible.	20	200.00 lakhs	2012-15	Adaptation	The existing plot size in Port Blair Municipal and surrounding areas varies from 5200 sqm. and construction of sizable rain water harvesting structure within the plot is not feasible. Therefore wherever possible community rain water harvesting structures can be set up.	
			total	652.00 lakhs or 6.52 Crores				

Mission on Sustainable Agriculture

Component1: Development of Database & Vulnerability Map

Sl. No	Proposed Activity	Nature of Activity	Phy.	Fin.	Time Frame /Source of Funding
1.a.	DEVELOPMENT OF DATABASE &VULNERABILITY MAP	New	Whole of A&N Islands	-	2 Years Dept of E&F, CARI

Component2: Access to Information - Use Of ICT

Sl. No	Proposed Activity	Nature of Activity	Phy.	Fin.	Time Frame /Source of Funding
2.a.	Establishment of Rural Knowledge Centres (Completed)	Ongoing	10 Nos. completed	-	Agriculture Dept.
2.b.	Sub-depots of the dept. will be linked by wide area network, & connectivity upto village level through RKC/CSC	New	49	5.0	2 years GOI and A&N Admn

	TOTAL			**5.0**	

Component3: Surveillance & Monitoring

Sl. No	**Proposed Activity**	**Nature of Activity**	**Phy.**	**Fin.**	**Time Frame /Source of Funding**
3.a.	Strengthening of Pest & Disease surveillance Establishment of bio-control lab	New	-	0.50	5 years Agri. Dept , UT Plan/CSS

Component4: Contingency Plan

Sl. No	**Proposed Activity**	**Nature of Activity**	**Phy.**	**Fin.**	**Time Frame /Source of Funding**
4.a.	Model codes on "Droughts, Floods and Good Weather" to be prepared bringing out short term and long term mitigation measures	New	Whole of A&N Islands	-	2 years

Component5: Micro-Level Weather Forecasting & Crop Insurance

Sl. No	Proposed Activity	Nature of Activity	Phy.	Fin.	Time Frame /Source of Funding
5.a.	Setting up of Automatic weather Stations	New	30 Nos.	1.5	2 years (30 Nos. - 0.75 Cr. 30 Nos. - 0.75 Cr.) RKVY
5.b.	Weather based Crop Insurance	New	-	-	State Plan /GoI
	TOTAL			**1.5**	

Component6: Focus on Sustainable Agriculture Development

Sl. No	Proposed Activity	Nature of Activity (ongoing/ new initiative)	Phy.	Fin.	Time Frame /Source of Funding
6.a.	Promotion of Org. Farming	Ongoing	10000 farmers (whole of A&N Islands)	37.0	3 years Agri., AH&VS Dept,

					RKVY/NHM
6.b.	Protected cultivation - Polyhouses	Ongoing & New	98 (32050 sqmt) + 20ha	1.32 + **15.0**	5 years @ 4 ha/yr. Agri. Dept, NHM
6.c.	Livestock production & breeding	Ongoing	Camps – 100 nos AI – 8000 nos Castration – 3200 nos. Calf Born – 3500 nos Grazing land - 6 panchayats) Fodder plots - 100 nos	0.45	5 years @ 4 ha/yr. UT Plan
6.d.	Livestock Health	Ongoing	Livestock treatment – 02 lakhs Poultry treatment – 10 lakhs Birds vaccination – 10 lakhs	1.23	2years UT Plan

			Animal vaccination – 0.7 lakhs Vet. Camp – 100 nos.		
			Assistance to State Control for Animal diseases (ASCAD)	0.10	
			Foot & mouth Diseases	0.02	
			National Project on Rinderpest Eradication (NPRE)	0.05	
Sl. No	**Proposed Activity**	**Nature of Activity (ongoing/ new initiative)**	Phy.	Fin.	**Time Frame /Source of Funding**
6.e.	Introduction of intermediary fishing vessels on subsidy	Ongoing	50 vessels	12.5	2 Years UT Plan/RKVY
6.f.	Introduction of deep sea fishing vessels on subsidy	Ongoing	100 vessels	7.5	2 Years UT Plan/RKVY

6.g.	Development of model fisherman village	Ongoing	200 families	1.5	2 Years CSS
	TOTAL			76.67	

Component 7.Management of Sea Water Intrusion & Change in Coastal Morphology

Sl. No	**Proposed Activity**	**Nature of Activity (ongoing/ new initiative)**	**Phy.**	**Fin.**	**Time Frame /Source of Funding**
7.a..	Construction of dykes, sluice gates, drainage & field bunds	Ongoing & New	10,458 (rmts) + 10000 (rmts)	26.68 + **50.00**	5 years @ 2000 rmts/yr UT Plan (Additional fund required)
7.b.	To develop Shelter belts/wind breakers/bio-shields in coastal lines.	New	-	-	Agri. & Forest Dept.

7.c.	Installation of Fish Aggregating Devices (FADs)	Ongoing & New	10 + 15	1.11 + **2.25**	3 years UT Plan
7.d.	Installation of Artificial Reefs	New	100	1.0	2 years UT Plan
7.e.	Promoting coastal aquaculture	Ongoing & New	2 + 11 clusters	0.40 + **0.90**	2 years UT Plan/RKVY
	TOTAL			**82.34**	

Component8: Reduction in Green House Gas Emission

Sl. No	Proposed Activity	Nature of Activity (ongoing/ new initiative)	Phy.	Fin.	Time Frame /Source of Funding
8.a.	Promotion of System Rice Intensification (SRI) cultivation in paddy	New	500 ha	0.25	5 years @ 100 ha/yr. Agri. Dept., RKVY/MMA

Component9: Socio-Economic Security of Farmers

Sl. No	Proposed Activity	Nature of Activity (ongoing/ new initiative)	Phy.	Fin.	Time Frame /Source of Funding
9.a.	Revolving fund for SHGs	New	10000 farmers	0.5	5 years Farmers, Govt. Financial Institutions

Component10: Capacity Building

Sl. No	Proposed Activity	Nature of Activity (ongoing/ new initiative)	Phy.	Fin.	Time Frame /Source of Funding
10.a.	Conducting awareness/training for disaster preparedness, workshop, demonstrations, farmers' school on best practices adaptation, Diversification of livelihood options like mushroom, apiculture, coastal aquaculture, Awareness on different insurance programmes, Protected Cultivation & Post harvest and value addition	Ongoing & New	Agri. – All farmers	1.0	3 years Agri., AH&VS, Fisheries Dept. UT Plan/ATMA/ NHM
			Fisheries -100	0.2	
	TOTAL			**1.2**	

Component11: Research Need

Sl. No	Proposed Activity	Nature of Activity (ongoing/ new initiative)	Phy.	Fin.	Time Frame /Source of Funding
10.a.	Watershed development programme	New	2500 ha	3.0	5 years @ 500 ha /yr UT Plan/GoI
10.b.	Micro-irrigation	New	5000 ha	50.0	5 years @. 1000 ha/yr RKVY
10.c.	Promotion of crop varieties requiring less water.	New	--	--	
	TOTAL			**53.0**	

Component12: Soil & Water Conservation

Sl. No	Proposed Activity	Nature of Activity (ongoing/ new initiative)	Phy.	Fin.	Time Frame /Source of Funding
11.a.	To evolve crop varieties requiring less water	NEW	-	-	**CARI**
11.b.	Development of crop varieties resistant to salinity, long dry spell and pest & diseases and appropriate cropping pattern				
11.c.	Preservation & management of germ-plasm, traditional varieties in seeds				
11.d.	Convergence and integration of traditional knowledge and practice systems, information technologies and biotechnology				
11.e	Orientation of agriculture research systems				
11.f.	Application of bio-technology and skilled animal				

	breeding for development of better adapted breed				
11.g.	Restricting the exotic inheritance of cattle in the cross breeding programme, to preserve disease resistance capacity of indigenous cattle				
11.h.	Salt & disease resistant fresh water fish & prawn				

Component13: Research Need

Sl. No	**Proposed Activity**	**Nature of Activity (ongoing/ new initiative)**	**Phy.**	**Fin.**	**Time Frame /Source of Funding**
12.a.	To evolve crop varieties requiring less water	NEW	-	-	**CARI**
12.b.	Development of crop varieties resistant to salinity, long dry spell and pest & diseases and appropriate cropping pattern				
12.c.	Preservation & management of germ-plasm, traditional varieties in seeds				

12.d.	Convergence and integration of traditional knowledge and practice systems, information technologies and biotechnology				
12.e	Orientation of agriculture research systems				
12.f.	Application of bio-technology and skilled animal breeding for development of better adapted breed				
12.g.	Restricting the exotic inheritance of cattle in the cross breeding programme, to preserve disease resistance capacity of indigenous cattle				
12.h.	Salt & disease resistant fresh water fish & prawn				

Abstract of components of Sustainable agriculture

Sl. No.	Name of the Component	No. of Action Proposed	Cost (in Crore)	Nature of proposed activities
1	DEVELOPMENT OF DATABASE &VULNERABILITY MAP	1	-	Adaptation

2	ACCESS TO INFORMATION - USE OF ICT	2	5.0	Adaptation
3	SURVEILLANCE & MONITORING	1	0.5	Adaptation
4	CONTINGENCY PLAN	1	-	Mitigation
5	MICRO-LEVEL WEATHER FORECASTING & CROP INSURANCE	2	1.5	Adaptation & Mitigation
6	FOCUS ON SUSTAINABLE AGRICULTURE DEVELOPMENT	7	76.67	Adaptation & Mitigation
7	MANAGEMENT OF SEA WATER INTRUSION & CHANGE IN COASTAL MORPHOLOGY	5	82.34	Adaptation & Mitigation
8	REDUCTION IN GREEN HOUSE GAS EMISSION	1	0.25	Adaptation & Mitigation
9	SOCIO-ECONOMIC SECURITY OF FARMERS	1	0.50	Adaptation & Mitigation
10	CAPACITY BUILDING	1	1.2	Adaptation & Mitigation
11	SOIL & WATER CONSERVATION	3	53.0	Adaptation, Mitigation & Research
12	RESEARCH NEED	8	-	Research
	TOTAL		**220.96**	

Mission on Green India

Component 1. Protection of Existing forest areas

Sl. No	Proposed Activity	Nature of Activity (ongoing / new initiative)	No./ quantity of proposed activity	Budget estimate	Time frame (Year wise physical and financial target)	Feedback loop (whether the outcome of the proposed activity is linked with other activities, if so details	Remarks
1.a.	Conducting study on standardization of beat area to enhance forest protection.	New Initiative	Lump Sum	25 lakhs	2011-2012 - Awarding and completion of study	The outcome of the study will be incorporated in the relevant programmed for taken provision has been	To be executed on consultancy.
1.b.	Standardization of beat area to enhance affective forest protection.	New Initiative	Lump Sum	30 lakhs	2012-2014 - Implementation of study findings originating from 8.a @	The budget and the programmed will be modified subject to outcome of 1a.	To be executed by DoEF.
1.c.	Strengthening of protection machinery in terms of manpower for protection of forest.	Ongoing	Lump sum	5.0 Crore	2011-2017 – Finalizing modalities for engaging 104 Nos. of Forest Protection staff (Executives) and 1110	The budget and the programmed will be modified subject to outcome of 1a.	To be executed by DoEF.

Sl. No	Proposed Activity	Nature of Activity (ongoing / new initiative)	No./ quantity of proposed activity	Budget estimate	Time frame (Year wise physical and financial target)	Feedback loop (whether the outcome of the proposed activity is linked with other activities, if so details	Remarks
1.d.	Strengthening of protection machinery in terms of mobility in sea to enhance forest protection.	Ongoing	Lump sum	54.0 Crore	2011-2017 – Procurement of 2 Nos. of M.S. Class High Speed medium size boat @ Rs.10.0 Crore per boat for mobility in high sea and maintenance. Procurement of 10 Nos. of Sea worthy interceptor boats for swift operation in high	The budget and the programmed will be modified subject to outcome of 1a.	To be executed by DoEF with assistance from expert institutions.
1.e.	Strengthening of protection machinery in terms of mobility, fire power and communication in Island to enhance forest protection.	Ongoing	Lump sum	1.54 Crore	2011-2017 – Procurement of 10 Nos. of LMV @ Rs.7.0 lakhs per LMV to enhance Forest Protection in Island and maintenance. Procurement of 20 Nos. of Motor Cycles @ Rs.45, 000/- per Motor Cycle to enhance	The budget and the programmed will be modified subject to outcome of 1a.	To be executed by DoEF.

Sl. No	Proposed Activity	Nature of Activity (ongoing / new initiative)	No./ quantity of proposed activity	Budget estimate	Time frame (Year wise physical and financial target)	Feedback loop (whether the outcome of the proposed activity is linked with other activities, if so details	Remarks
1.f.	Capacity building of protection staff / officers on latest techniques in forest protection.	Ongoing	Lump sum	25 lakhs	2011-2017 – Nominating staff / officers for various training to enhance their capability in forest	The budget and the programmed will be modified subject to outcome of 1a.	To be executed by DoEF.
	Total =	6		**61.34**			

Component 2. Increasing density of the Open forests

Sl. No	Proposed Activity	Nature of Activity (ongoing / new initiative)	No./ quantity of proposed activity	Budget estimate	Time frame (Year wise physical and financial target)	Feedback loop (whether the outcome of the proposed activity is linked with other activities, if so details thereof)	Remarks
2.a	Conducting study to assess the quantum of open forest area available for restocking and evolving appropriate methodology to enhance its ecological services.	New initiative	Lump sum	25 lakhs	2011- 12- Awarding and completion of study @ 25 lakhs per study	Feedback will be incorporated in enriching natural profile of 300 Km^2 of Open forest areas in Andaman and Nicobar Islands for which token provision is kept in the	Techno – feasibility study to enrich and restoring natural profile of 300 Km^2 of Open forest areas in Andaman and Nicobar Islands by appropriate silvicultural interventions

2.b	Enrichment and restoring natural profile of Open forest areas in Andaman and Nicobar Islands by appropriate silvicultural interventions	New Initiative	100 ha	60 Lakhs (@ 60,000 Rs / Ha)	2012-17 - enrich 25 ha of open forest per annum in different divisions @ Rs.60, 000/- per Ha. including establishment &	The budget and program will be modified subject to outcome of study at 2a.	To be executed by DoEF with involvement of local communities
2.c	Restocking of encroachment evicted area / area to be evicted from forest encroachments.	Ongoing program	The 2941 ha. Evicted off encroachment and 622 Ha. Still under encroachment are to be	-	As per the working plan prescription	-	Being executed by DoEF departmentally.
	Total =	2		**85 lakhs**			

Component 3. Phasing out of monoculture plantations and conversion into secondary forests

Sl. No	Proposed Activity	Nature of Activity (ongoing / new initiative)	No./ quantity of proposed activity	Budget estimate	Time frame (Year wise physical and financial target)	Feedback loop (whether the outcome of the proposed activity is linked with	Remarks
3.	Phasing out of exotic plantations and enrichment of existing plantations to convert them into secondary forests.	Ongoing program	Out of 12431 ha of plantation most of the plantations are converted under plantation reclamation working circle and presently in various years of maintenance	2.5 Crores	Areas will be worked out as per the working plan prescriptions at an estimated cost of Rs. 50 lakhs per annum	-	Being executed by DoEF departmentally.
	Total =	1		2.5 Crores			

Component 4. Improved utilization of timber in government saw mills

Sl. No	Proposed Activity	Nature of Activity (ongoing / new initiative)	No./ quantity of proposed activity	Budget estimate	Time frame (Year wise physical and financial target)	Feedback loop (whether the outcome of the proposed activity is linked with	Remarks
4.a	Conducting study for modernization of Betapur and Chatham Saw Mills	New Initiative	Lump sum	1.0 Crore	2012-2013 – Awarding and completion of study for Betapur and Chatham Saw	Feedback will be incorporated in modernization plan of Betapur and Chatham Saw Mill	To be executed on consultancy.
4.b	Modernization of Chatham and Batapur Saw Mill	New Initiative	Lump sum	50.00 Crore	2012-2017 – Improvement of Betapur and Chatham Saw Mill by procuring new saw milling machineries, improving saw doctoring facilities	The budget and the program will be modified subject to outcome of study at 6a.	To be executed by DoEF by involving expert institution.
4.c.	Conducting study on effective utilization of wood waste originated from Saw Mill.	New Initiative	Lump sum	30 lakhs	2011-2012 – Awarding and completion of study.	Feedback will be incorporated in the relevant program for which a token provision is kept in	To be executed on consultancy.

4.d.	Efficient utilization of Wood waste originate from Saw Mill	New Initiative	Lump sum	1.00 Crore	2012-2017 – Improvement of capacity of Betapur and Chatham Saw Mill based on the	The budget and the program will be modified subject to outcome of study at 6c.	To be executed by DoEF by involving expert institution.
4.e.	Conducting study for efficient use of non hard wood species.	New Initiative	Lump sum	30 lakhs	2011-2012 – Awarding and completion of study.	Feedback will be incorporated in the relevant programmed for which a token	To be executed on consultancy.
4.f.	Efficient utilization of Non-hardwood species.	New Initiative	Lump sum	1.00 Crore	2012-2017 – Improvement of capacity of Betapur and Chatham Saw Mill to utilize non-hardwood species based on the outcome of study at 6e.	The budget and the programmed will be modified subject to outcome of study at 6e.	To be executed by DoEF by involving expert institution.
	Total =	6		**53.6 Crore**			

Component 5. Development of small wood and NTFP based industries

Sl. No	Proposed Activity	Nature of Activity (ongoing /	No./ quantity of proposed	Budget estimate	Time frame (Year wise physical and	Feedback loop (whether the outcome of the proposed activity is linked with other activities, if so details thereof)	Remarks
5.a.	Conducting study for survey assessment and exploring marketing potential	New Initiative	Lump sum	25 lakhs	2011-2012 – Awarding and completion of study.	Feedback will be incorporated in the relevant program for which a token provision is kept in the Action Plan.	To be executed on consultancy.
5.b.	Conducting study on setting up of NTFP marketing	New Initiative	Lump sum	20 lakhs	2012-2013 – Awarding and completion of	The programmed and budget will be modified subject to outcome of 7.a.	To be executed on consultancy.
5.c.	Development of NTFP based plantation to augment supply of	Ongoing	100 ha.	-	As per the working plan prescription	The programmed and budget will be fine tuned subject to outcome of 7.a.	To be executed by DoEF.
5.d.	Conducting study on establishment of Industrial estate for NTFP based small scale Industrial	New Initiative	Lump sum	40 Lakhs	2011-2012 – Awarding and completion of study.	Feedback will be incorporated in the relevant program for which a token provision is kept in the Action Plan.	To be executed on consultancy.

5.e.	Establishment of Industrial estate for NTFP based small scale Industrial units.	New Initiative	3 Nos.	3 Crore.	2012-2013 – Establishment of Industrial Estate at South Andaman District with required machineries @ 1.0 Crore.	The budget and programmed will be modified subject to outcome of study at 7.d convergence of cross sectoral plans and schemes of the Administration	To be executed in collaboration with DIC & KVI, A&N Administration.
5.f.	Training of Artisans in modern techniques of small wood and NTFP based product.	New Initiative	100 persons	30 Lakhs	2011-2012 – 40 persons from South Andaman District will be trained @ 10.0 Lakhs. 2012-2013 – 30	The budget and programmed will be modified subject to convergence of cross sectoral plans and schemes of the Administration	To be executed in collaboration with DIC & KVI, A&N Administration.
	Total =	6		**4.15**			

Abstract of components for Green India Mission

Sl. No.	Name of the Mission	No. of Action Proposed	Cost (in Crore)	Nature of proposed activities.
1.	Protection of existing Forests	6	61.31	Mitigation
2.	Increasing the density of the Forests.	3	0.85	Mitigation
3.	Conversion of monoculture plantations into secondary forest	1	2.50	Mitigation

4.	Improved utilization of timber in Govt. Saw Mills.	6	53.6	Mitigation
5.	Enhancing efficiency of small wood and NTFP based Industries.	6	1.15	Adaptation
	Total=	**22**	**122.11**	

Mission for Sustaining Island ecosystem

Component 1. Management of coastal ecosystem

Sl. No	Proposed Activity	Nature of Activity (ongoing	No./ quantity of	Budget estimate	Time frame (Year wise physical	Feedback loop (whether the outcome of the proposed activity is linked	Remarks
1. a	Conducting study to assess feasibility of restocking of degraded mangrove forest areas by Ecological Restoration method / Mangrove engineering method.	New initiative	Lump sum	25 lakhs	2011- 12- Awarding and completion of study @ 25 lakhs.	Feedback will be incorporated in Mangrove restoration programs / Littoral Forest restoration program for which token provision is kept in the Action Plan.	Techno-feasibility study to restock 330 KM^2 of Degraded mangroves and 90 km^2 of mud flats in Andaman and Nicobar Islands through appropriate Silvicultural intervention.
1 b	Afforestation of mangroves in the tsunami affected areas. Mud flats. Through Mangrove engineering / ecological restoration method based on outcome of study at	New Initiative	20 ha	4 Crores	2012-17- restore 50 ha of degraded Mangrove Forest per annum in	The budget and program will be modified subject to outcome of study at 5a.	To be executed by DoEF departmentally with assistance of IFGTB
1.c	Conducting study on establishment of Littoral Forest on uplifted areas on coastal bio shield modal.	New initiative	Lump sum	25 lakhs	2011- 12- Awarding and completion of study @	Feedback will be incorporated in Littoral Forest restoration program at 5.d for which token provision is kept in the	Techno-feasibility study to restock 330 KM^2 of Degraded mangroves and 90 km^2 of mud flats in Andaman and Nicobar Islands through

1.d	Afforestation of Littoral Forest in uplifted area on coastal bio shield concept.	New Initiative	200 ha.	3.0 Crore	2013-17- Restore 5 ha of degraded Littoral Forest per annum in different divisions @	The budget and program will be modified subject to outcome of study at 5a.	To be executed by DoEF departmentally with assistance of IFGTB in collaboration with Department of Agriculture
	Total =	4		**7.5 Crore**			

Component 2. Monitoring and Research on Impact of Climate Change on Island Ecosystem & Forests.

Sl. No	Proposed Activity	Nature of Activity (ongoing / new	No./ quantity of proposed	Budget estimate	Time frame (Year wise physical and financial target)	Feedback loop (whether the outcome of the proposed activity is linked with other activities, if so details thereof)	Remarks
2.a	Establishing coastal data buoy system at 5 locations (Avis Island, Interview	New Initiative	5	3.2 Crore	2011-2013 - Fabrication and installation @ 60 Lakhs per buoy 2014 - 2017– Monitoring and feedback @ 20 Lakhs in lump	Feedback will be incorporated in other programs to enhance its effectiveness	To be established in collaboration with NIOT
2.b	Monitoring spatial impact of climate change and other natural disasters	New Initiative	Lump sum	2 Crore	2011-2017 - Procurement and Analysis of remote sensing data for 38 inhabitated islands / critical protected area at one year interval.	Feedback will be incorporated in other programs to enhance its effectiveness	To be executed in collaboration with Forest Survey of India, Dehradun, Space Application

2.c	Establishment of Artificial coral reefs	New Initiative	400 Concrete blocks will be	16 Lakhs	2011-2012 - Fabrication and installation at select locations @ 3 Lakhs per site. 2013-2017 – Monitoring,	Feedback will be incorporated in other programs to enhance its effectiveness	To be executed in collaboration with ZSI, ANET and
2.d	Study on phonological changes and recruitment pattern	New Initiative	Lump sum	25 Lakhs	2011-2012 –Awarding research work @ 25 lakhs per study. 2012-2017 – Monitoring, analysis and feedback.	Feedback will be incorporated in other programs to enhance its effectiveness	To be executed in collaboration with IFGTB, Coimbatore,
2.e	Monitoring Critical faunal habitats (Turtles/ Littoral birds) to assess impact of Climate	New Initiative	Lump sum	25 Lakhs	2011-2012 –Awarding research work @ 25 Lakhs per study. 2012-2017 – Monitoring, analysis and feedback.	Feedback will be incorporated in other programs to enhance its effectiveness	To be executed in collaboration with ZSI, Port Blair, ANET, Port Blair,
	Total =	5		**5.86**			

Abstract of Sustaining Island ecosystem

Sl. No.	Name of the Mission	No. of Action Proposed	Cost (in Crore)	Nature of proposed activities.
1.	Management of Coastal Eco-system	4	7.50	Adaptation & Mitigation
2.	Monitoring and Research on Impact of Climate Change on Island Ecosystem & Forests.	5	5 .86	Research & Adaptation
	Total=	**9**	**13.36**	

Mission on Solar Energy

Sl.No.	Mission/ Component	Proposed Activity	Nature of Activity (ongoing/ new initiative)	No/qtyy of proposed activity	Time frame (year wise physical and financial target)	budget required	Feed back loop	Remarks
1	Solar Mission in A&N Islands	Installation of 1 No. 5 MW Solar power plant at South Andaman, Garacharama hill and 1 No. 1 MW Solar power plant at Middle Andaman, Rangat is in also progress.	New	2 Nos.	2 Yrs	Rs. 1116 lacs recurring expedr)	The project will be implemented through NTPC as per MOU.	The expenditure for the project will be born by the deveiolper selceted throughopen competitive bidding. A&N Admn. will only purchase power to the tune of Rs. 11.16 crore per year through PPA.
	SPV Power Plants	Establishment of (100-500 kw) SPV plant with AMC at 6 locations in A&N Islands (Havelock, Terasa, Katchal, Kamorta & Great Nicobar)	New	6 Nos.	Study will be conducted during current financial year.	Rs. 10.00 lacs	NRSE division	FSR is being carried out.
	Solar Thermal	Devices distributed to the public at concessional rates:	Ongoing				NRSE division	Promote the use of NRSE devices. Popularizing the devices and hence reducing the use of conventional power.
		•Solar Cooker		10 Nos.	1 Year	Rs. 1.00 lacs		
		•Solar Lanterns		300 Nos.	1 Year	Rs. 2.00 lacs		
		•Biogas Plants		5 Nos.	1 Year	Nil		
		•Different types of improved chulas		400 Nos.	1 Year	Rs. 1.00 lacs		
		•Improved kerosene stove lanterns and lamps.		300 Nos.	1 Year	Rs. 2.00 lacs		
	Solar Thermal	Approval for providing subsidy has been recived from Admn. vide 4-4(13)/2009-Power	New		1 Year	Rs. 18.86 lacs	NRSE division	Promote the use of NRSE devices. Popularizing the devices and hence reducing the use of conventional power.
		•75% to general public and						
		•90% to the ST/ BPL/ un-electrified villages.						

	Wind	Action initiated for installation of 80 mtr wind monitoring mast at 15 locations in all three district .	New	15 Nos.	5 Years	Rs. 125.00 lacs	NRSE division	Preparation of EOI for installation of 80 mtr wind monitoring mast is in progress.
	Wind Solar Hybrid System	Action for installation of 10 Kwp wind solar hybrid system is in progress at Mount Harriet.	Ongoing	1 No.	6 Months	Rs. 15.00 lacs	NRSE division	Materials received at Port Blair. Civil works already started.
								Yearly generatiopn= 21600 kwh, HSD saving= 72 KL, GHG reduction= 25.92 tons/ year
	Bio-mass Energy	Proposed Biomass based power plants	New				M/s. Darashaw & Co., Mumbai, appointed as consultant for establishment of project.	The expenditure for the project will be born by the deveiolper seleceted through open competitive bidding. A&N Admn. will only purchase power to the tune of Rs. 9.84 crores per year through PPA.
		•2 MW - S/Andaman.		1 No	2 Years	Nil		
		•2 MW- Car Nicobar.		1 No.	5 Years			
		•1.5 MW- L/ Andaman.		1 No	5 Years			The expenditure for the project will be born by the deveiolper selceted throughopen competitive bidding. A&N Admn. will only purchase power to the tune of Rs. 7.40 crore per year through PPA.
		Proposed to set up biomass based small power projects at various islands.	New		1 Year	Rs. 12.00 lacs		EOI already invited and further FSR is being carried out.
	Hydro Projects	•Kalpong downstream - 2 x 250 KW	New	1 No	5 Years	Rs. 1215.00 lacs	Work is being awarded to NHPC.	
		•Korang Nallah - 2 x 100 KW	New	2 No	5 Years	Rs. 703.00 lacs		

		•Rangat Nallah - 3 x 60 KW	New	3 No	5 Years	Nil	Rangat nallah DPR sent to MNRE for approval.	These projects DPR is being updated and hence only token provisions is kept in plan. Additional budget requiremnet can be assesssed only after updating and approval of DPRs. ***All the seven SHP will genreate 1.98 MU (Approx.) Saving in HSD for one year= 594 KL. Reduction in GHG= 2376 tons/ year (approx)***
		•Panchavati Nallah - 3 x 40 KW	New	4 No	5 Years		DPR being updated at IIT, Roorkee which will be send to MNRE for approval on receipt of DPR	
		•Krishna Nallah - 1 x 20 KW	New	5 No	5 Years			
		•Vasundhara Nallah - 1 x 10 KW	New	6 No	5 Years			
		•Kamsarath Nallah - 1 x 10 KW	New	7 No	5 Years			
1	**2**	**3**	**4**	**5**	**7**		**9**	**10**
	New Technologies	Study, survey and investigation on following technologies are kept in future plan:-	New					To find out the possibility to harness electricity by these technologies.
		Ocean energy (OTEC), Marine current turbine (MCT)				Rs. 10.00 lacs		
		Bio-diesel						
					Total :	33.88 crores		

Mission on Enhanced Energy Efficiency

Sl.No.	Mission/ Component	Proposed Activity	Nature of Activity (ongoing/ new initiative)	No/qtyy of proposed activity	Budget Estimate (in lakhs)	Time frame (year wise physical and financial target)	Budget provision kept in plan	Additional budget required	Feed back loop(whether the outcome of the prposed activity is linked with other activities, if so details thereof	Remarks
	Mission for Enhanced Energy Efficiency	Proposed mandatory adoption of Energy Conservation Building Code (ECBC) in all Government Building and in all new building projects.	Ongoing	_	Rs. 10 lacs	1 Year and will be continue	Nil	Rs. 10.00 lacs		Construction agencies to make necessary ECBC for its mandatory adoption.
		Proposed mandatory use of ISI marked Motor pump sets, Power capacitor, Foot/ Reflex valves in Agriculture Sector.	Ongoing		Nil	1 Year and will be continue	Nil	Rs. 1.00 lacs		Awareness amongst agriculture needs to be created.
		Promotion of CFL/LED in all buildings, street lightings etc	Ongoing			1 Year and will be continue	Nil	Rs. 1.00 lacs		Construction agencies to adopt.
		Energy auditing of buildings.	Ongoing	_	Rs. 5.00 lacs	1 Year and will be continue	Nil	Rs. 5.00 lacs		Request letter sent to BEE for enregy auditing of major buildings
		Adaption of mandatory use of star rated electrical appliances.	Ongoing			1 Year and will be continue	Nil	Rs. 1.00 lacs		Awareness amongst consumers to be created
		Establishment of energy management cell.	Ongoing		Rs. 2.00 lacs	1 Year and will be continue	Rs. 1.00 lacs	Rs. 1.00 lacs		Provision kept in annual plan.

		Deputing officials / staffs for imparting training.	Ongoing		Rs. 10 lacs	1 Year and will be continue	Rs. 3.00 lacs	Rs. 7.00 lacs		Provision kept in annual plan.
		Total						25 lakhs		

Mission of Strategic Knowledge

Sl. No.	Name of	No of Action proposed	Cost (lakhs)	Nature of Proposed Activities)	Remarks
1	Formation of networks of knowledge institutes	New Activity	0.50	Mitigation	CARI & DST
2	Climate Observation, monitoring modeling & Climate Science	Ongoing	10.0	Mitigation/Adaptation	IMD & CARI, Disaster Management, NIOT & District Administration
3	Water	Ongoing	1.00	Mitigation/Adaptation	APWD,CARI and BRAIT
4	AIR	Ongoing	1.00	Mitigation/Adaptation/Research	PCC/DST
5	Ecosystem Modeling	Ongoing	2.00	Adaptation	CARI, Agriculture, DST, PBMC,ZP
6	Agriculture	Ongoing	1.00	Adaptation	Agri. Dept., DST
7	Forest	Ongoing	-	Adaptation	Forest Dept.

8	Health	Ongoing	4.00	Mitigation/Adaptation	Health Dept, DST
9	Identification and transfer of technology for adaptation and mitigation	Ongoing	20.00	Mitigation/Adaptation	CARI, Agri., Forest & ANSTC
10	Research & Development	Ongoing	20.00	Mitigation/Adaptation	DST/ANSTC
11	Awareness	Ongoing	5.00		Administration
	Total		64.50/Year		

ANNEXURES

ANNEXURE 1

MINUTES OF THE MEETING OF THE STATE LEVEL STEERING COMMITTEE CONSTITUTED FOR PREPARATION OF CLIMATE CHANGE ACTION PLAN FOR A & N ISLAND HELD IN THE CONFERENCE HALL OF SECRETARIAT ON 31/03/2011 AT 02.30 PM

The list of officers who attended the meeting is at Annexure -1.

The Chief Secretary, A & N Administration chaired the meeting. The chairman welcomed the participants. Following that the Member Secretary of the Steering Committee informed the members about the progress made on the decisions taken in the last meeting held on 27/10/2010.

Following that, the Member Secretaries of the various Core Groups (CG) made a presentation on activities proposed in the sectoral action plans in their respective missions. Following the presentation, the sectoral plans were discussed and decision taken thereof is given below:

1. **Solar Mission & Mission for enhanced Energy Efficiency**

   a. The Committee felt that the quantity proposed for distribution of solar cooker and other solar based equipments should be enhanced to popularize the use of solar energy in Andaman and Nicobar Islands.
   b. The Committee directed the CG to identify suitable technology to reduce the consumption of electricity in houses and commercial establishments.

2. **Mission on sustainable habitat**

   a. The Committee directed the CG to commission study on promoting alternate building materials for construction activity in Andaman and Nicobar Islands as the use of steel and concrete (non-renewals) in a place where lots of renewal is available plus the transportation of construction materials from mainland means a much higher carbon footprint.
   b. The Committee directed the CG to make provision for efficient use of plastic wastes in road making activity in the sectoral action plan.
   c. The Committee directed the Transport Department to improvise the public transport system to promote and facilitate mass transit.
   d. The Committee emphasis the need for efficient disposal of solid waste in Island Eco System and directed the CG to keep components for the same in the sectoral action plan.
   e. The Committee felt that some of the activities identified by the CG is not directly related to climate change agenda and advised the CG to review the same.

3. **Water mission**

a. The Committee felt that the sectoral action plan should emphasis more on efficient use of water and enhancing water storage capacity of the water bodies. The CG was directed to include the components for the same.
b. The Committee also directed the CG to keep components for rainwater harvesting in private and govt. establishments.

4. **Mission for sustainable Agriculture**

The Committee directed the Core Group to give emphasis for cultivation of high value vegetable and flowers using green house technology and to incorporate component on micro irrigation for watershed development.

5. **Mission for Green India and Sustaining Island Ecosystem**

The sectoral plan on green India and Sustaining Island Ecosystem was approved by the Steering committee as proposed.

6. **Mission for Strategic Knowledge on Climate change**

The sectoral plan on mission on strategic knowledge on climate change was approved as proposed. However the Committee desired that the mission should have linkage with other Missions to disseminate findings to the respective departments.

The Steering Committee in-principle approved the first draft of SAPCC, with above said modification/suggestion and it was decided to forward the draft SAPCC to Ministry of Environment & Forests for information.

The meeting ended with vote of thanks

Dr. S. Senthil Kumar
Director (S& T)

Annexure -1

LIST OF PARTICIPANTS

S.No.	Name
1.	Shri. S.S. Choudhury, Principal Secretary (E&F)
2.	Shri. D.V. Negi, Principal Secretary (S&T)
3.	Dr. S.K. Sharma, Commisisoner-cumSecy APWD
4.	Shri. K.K. Jindal, Secretary Agriculture/Social Welfare
5.	Smti. Achla Singh, Secretary Power
6.	Dr. R.C. Srivastava, Director CARI
7.	Shri. M. Trivedi, Additional PCCF (P&V)
8.	Shri. Ajai Saxena, Secretary Planning
9.	Shri. S. Mathur, Secretary PBMC
10.	Shri. K.C. Aggrawal, Secry- cum- Director Transport
11.	Dr. S. Seithil Kumar, Director (S&T)
12.	Shri. M.A Salam, Director Agriculture
13.	Shri. Yamin Murtaza, S.E Electricity
14.	Shri. Balamurgan, ATCP
15.	Smti. Sreedevi, Asst Director, Agriculture
16.	Shri. V. Jayakumar, Asst. Architect PBMC
17.	Shri. B. Binoy, ME Transport Dept.
18.	Shri. U.K. Paul, EE, NRSE
19.	Shri. J.K. Disouze, AE NRSE
20.	Shri. Rishikesh, Sr. Scientist

6-7/ANSTC/SAPCC/2010/B.O

अंडमान तथा निकोबार प्रशासन

ANDAMAN & NICOBAR ADMINISTRATION

विज्ञान तथा प्रौद्योगिकी विभाग

DEPARTMENT OF SCIENCE AND TECHNOLOGY

Dolly Gunj, Port Blair Ph. No.250370 Tel. Fax 251395

Dated: 04-04-2011

Copy of the minutes of the meeting of Steering Committee held on 31-03-2011 under the chairmanship of the Chief Secretary, A & N Admin is forwarded for information and necessary action.

1. The PCCF(E&F), A & N Admin
2. The PCCF(W&L)/Principal Secretary(S&T), A & N Admn
3. The Development Commissioner, A & N Admin.
4. The Secretary(Power), A & N Admin.
5. The Chief Engg.–cum-Secretary (APWD), A & N Admin.
6. The Secretary(Planning), A & N Administration
7. The Secretary(Transport, A & N Administration
8. The Secretary(Social Welfare), A & N Administration
9. The Secretary(Agriculture), A & N Administration
10. The Add. PCCF(P&D), Dept. of E & F, A & N Admin
11. The Secretary(PBMC), A & n Admin.
12. The Director CARI, Port Blair
13. The Superintending Engineer(Electricity)
14. The Director (Agriculture), A & N Admin.
15. The Director(Transport), A & N Admin.
16. The DCF(Wildlife), Dept. of E & F, A & N Admin
17. The Incharge, NIOT, Port Blair.
18. The Executive Engineer(NRSE)
19. The Associate Town & Country Planner, APWD
20. The Executive Engineer(PHED), APWD

Yours faithfully,

Senior Scientific Officer-II

ANNEXURE 2