Andaman & Nicobar Islands at a Glance

Sl. No.	Items	Statistics
1.	**GENERAL INFORMATION**	
	i) Geographical Area (Sq. km.)	8249
	ii) Administrative Divisions (as on 2001)	
	• No. of Districts	3
	• No. of Zilla-Parishads	2
	• No. of Sub-Divisions	6
	• No. of Blocks/ Tehsils	9
	• No. of Municipalities	1
	• No. of Gram Panchayats	67
	• No. of Census Villages	547
	• No. of Islands	556
	• No. of inhabited islands	38
	iii) Population (as on 2001 Census) (with density of population)	356152 (43 per sq. km.)
	iv) Normal Annual Rainfall (mm)	3180
2.	**GEOMORPHOLOGY**	
	Major Physiographic Units	i) Low to moderately high & steep hills ii) Intermountain narrow valleys iii) Gently sloping coastal tracts including swamps Overall altitude varies from 732 metres upto the sea level.

	Major Drainages	i) Dhanikhari, Mithakhari, Burmanala, Premanala, Prothrapurnala in South Andaman ii) Rangat, Badamnala, Kalsinala in Middle Andaman iii) Kaplong, Karmatang in North Andaman iv) Galathea, Jubilee, Dak Aniang, Dak Tayal and the Amrit Kaur in Great Nicobar Island.
3.	**LAND USE (as on 2004-05)**	
	a) Forest Area (Sq. Km.)	7171
	b) Cultivable Area (Sq. Km.)	175.23
	c) Net Area Sown (Sq. Km.)	166.53
4.	**MAJOR SOIL TYPES**	Entisols, Inceptisols and Alfisols
5.	**AREA UNDER PRINCIPAL CROPS**	Paddy (Pre- Tsunami) 105.6137 Sq. Km. Paddy (Post-Tsunami) 76.3547 Sq. Km.
6.	**IRRIGATION BY DIFFERENT SOURCES**	
	Tube wells/ Bore wells	NIL
	Tanks/ Ponds(as on 2006)	591
7.	**NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.03.07)** No. of Dug wells No. of Tube wells	 63 2
8.	**PREDOMINANT GEOLOGICAL FORMATIONS**	70% of the area is underlain by Marine sedimentary group of rocks, about 15% by volcanic rocks, and remaining areas by igneous rocks and coralline formations.
9.	**HYDROGEOLOGY**	
	➢ Major Water bearing formation	The coralline limestone, and fractured volcanics & igneous rocks.
	➢ Pre-monsoon depth to water level during 2007	2 to 5 mbgl

	➢ Post-monsoon depth to water level during 2007	Within 2 mbgl
	➢ Long term water level trend in 10 years (1998-2007) in m/yr	The water level trend has been analysed for all measurements and found that there is a rising trend to the tune of .021 to 1.196 m/yr.
10.	**GROUND WATER EXPLORATION BY CGWB (As on 31.03.07)**	
	No. of wells drilled	50
	Depth Range	15 -160.40m
	Discharge	Limited to 13 lps
	Storativity (S)	Up to 9.65 X10 $^{-4}$
	Transmissivity (T)	112.3 – 139.6 m^2/day
11.	**GROUND WATER QUALITY**	
	Presence of Chemical constituents more than permissible limit	Iron in few tube wells, and Salinity in few dug wells near coastal tracts (post- tsunami)
	Type of water	Ca-Mg-HCO_3 type, Na-HCO_3 type
12.	**DYNAMIC GROUND WATER RESOURCES (2004)**	
	Net Ground Water Availability	320.798 MCM
	Existing Ground Water Draft for drinking purposes.	11.978 MCM
	Stage of Ground Water Development	3.73%
13	**AWARENESS & TRAINING ACTIVITY**	
	Mass Awareness Programmes organized (Numbers)	1
	Water Management Training Programme organized (Numbers)	Nil
14	**EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING**	
	Projects completed under technical guidance by CGWB and funded by MoWR (Nos. and Amount spent)	3 , and Rs.12.92 lakh
15	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	Water scarcity, as major area is covered by unproductive aquifer,

GROUND WATER INFORMATION BOOKLET

ANDAMAN AND NICOBAR GROUP OF ISLANDS

1. INTRODUCTION

1.1 Location and Area with Administrative details:

The Andaman and Nicobar Group of Islands are situated as a dissected chain in arcuate fashion oriented in N – S in the Bay of Bengal off the Eastern Coast of India and extended between 6^0 and 14^0 North Latitudes, and 92^0 and 94º East Longitudes covering a geographical area of 82 sq. km. There are 3 Districts, 2 Zilla-Parishads, 6 Sub-Divisions, 1 Municipality and 9 Blocks/ Tehsils. These islands are forming two major groups, popularly known as Andaman Group or the Northern Group of Islands and Nicobar Group or the Southern Group of Islands. The capital town of all the groups which form the Union Territory is Port Blair.

It was aimed to prepare a comprehensive brochure for Andaman & Nicobar island, but due to paucity of relevant information of Nicobar Islands, it was focused mainly to Andaman Islands.

1.2 Land Use : An area of 7171 sq. km. is covered under forest, out of which 3025 sq. km is reserved forest and 4146 sq. km is protected forest, and a small area is covered by valleys. The total cultivable area is 175.23 sq. km., whereas the net area sown is 166.53 sq. km.

1.3 Drainage : The major perennial streams are Dhanikhari, Mithakhari, Badamnala, Burmanala, Premanala, Prothrapurnala in South Andaman district. Dhanikhari being the largest flows from south to north for about 15 km from Chidiyatapu to Flat Bay. A reservoir constructed over this stream during British period is primarily meeting the water requirement of Port Blair city after proper treatment.

Apart from this, the Rangat is a major stream in Middle Andaman and the Kaplong is in North Andaman districts.

The Great Nicobar is the only island in Nicobar district with five perennial rivers namely ,the Galathea, the Jubilee, the Dak Aniang, the Dak Tayal and the Amrit Kaur which originate from Mt. Thullier. The Galathea is the longest and widest river which flows southward to meet the sea at Galathea Bay.

1.4 Agriculture : The major crop in the area is paddy, fed by monsoon rain and the area as reported is 105.61 sq. km. (pre-tsunami) and 76.85 sq. km. (post-tsunami).The total water logged area is 43.69 sq. km. An area of 80.68 sq. km. is saline affected but not water logged. High yielding varieties have gradually replaced the traditional ones with modern farm management practices. Crops like coconut, areca nut, banana and spices are grown in the high lands and grow well with rain-fed water and do not require irrigation in general. In low lying plain lands and valley-fills, the crops like rice, Rabi-pulses, sweet-potato, tapioca, papaya, sugar-cane and seasonal vegetables are grown. Cash-crops like rubber, red-oil, palm, cashew-nuts are also grown in commercial basis in different parts of different islands.

Status of Survey carried out by CGWB : Major part of the Andaman & Nicobar islands was covered under systematic hydrogeological surveys during 1981,1983,2000, 2005 (post Tsunami) followed by reappraisal surveys.

- Geophysical Surveys were carried out during 1984, 1985 2001 and during 2005 in different parts of the islands.
- Ground water exploration programme was taken up in the year 1985 to 1994 in South Andaman, Middle Andaman, North Andaman, Great Nicobar, and in Katchal islands.
- To understand the behavior of ground water regime with time and space in Andaman, 63 hydrograph networks stations in the South , Middle, and North Andaman islands
- being monitored twice in a year during pre-monsoon and post-monsoon periods.
- Studies on artificial recharge and conservation of rain water in the islands were taken up during IXth plan in three different places in the South Andaman.
- After the devastating tsunami on 26.12.2004 CGWB took up an intergraded water resources development programme in the area.

2. RAINFALL AND CLIMATE

2.1 Rainfall : The islands receive copious rainfall to the tune of about 3000 mm. per year. The Normal rainfall at Port Blair, is 3180 mm. The average annual rainfall as recorded during the year 2007, is 2779.5 mm in Andaman Islands and 2437 mm in Nicobar Islands.

2.2 Climate : The area enjoys tropical humid climate due to its geographical location. Relative humidity ranges from 79 % to 89%, average wind speed is 7 to 10 km/hr, maximum temperature varies between 27º to 33 ^{0} C and minimum temperature fluctuates between 21º to 25 ^{0} C. Evaporation rate is very high, ie. 1500 -1800 mm/year.

3. GEOMORPHOLOGY, PHYSIOGRAPHY AND SOIL TYPES

3.1 Geomorphology :

Geomorphologically the islands can be divided into three distinct units

A) Low to moderately high and steep hills

B) Intermontane narrow valley.

C) Limited gently sloping coastal tracts including swamps.

The hill ranges are generally covered by dense forest.

3.2 Physiography : A prominent N – S trending hill range of the magmatic rocks extend along the east coast from 732 m high Saddle Peak of North Andaman to 435 m high Mt. Ford (Kalapahar) of Rutland island across the eastern part of Middle and South Andaman. The Mt. Thullier (642 m) ,Mt Kayab (460 m) , Mt. Harriet (365 m) , Adazig (204 m), Panchavati (377 m) etc. are the conspicuous hills in the island. The topography of the area in general is rugged. The Great Nicobar island has an overall rugged topography with parallel ridges of folded sedimentary rocks.

3.3 Surface Water Bodies Including Springs : As the area in the active orogenic belt involving frequent uplifts, there is no well developed surface water system. Moreover the topography is very rugged with major trend of the mountain chain along the length of the island; there is no scope of well developed drainage system or canals.

Rivers/ Streams: The islands are devoid of big river system and obviously without vast catchments. However, a few perennial streams such as Mithakari, Protheropore Nala, Burma Nala, Pema Nala, Karmatang, Betapur, Korang, Rangat, Dhanikari etc. drain in the area. The Great Nicobar is the only island of the Nicobar group with five perennial rivers.

Lakes: There are no natural lakes worth mentioning, however, at places some water tanks are present and used for irrigation purposes.

Springs: Several springs are encountered in the area due to its rugged topography with steep sloping valleys and abrupt mountain chain. It has been revealed from the studies that the average discharge of the springs in the lean period was in the order of 10 -50 lpm.

Canal: There are no major irrigation projects tapping surface water resources and canals are not feasible in the area. The only major dam in the area is the Dhanikhari dam, which is the source of drinking water to the Port blair. The dam is 132 m long and 32 m heigh.

3.4 Soil Types : The Soil of the Andaman & Nicobar islands have been classified into three orders, ie. Entisols, Inceptisols, and Alfisols. The main agricultural soils are found in the valleys and are of alluvial and colluvial origin. The coastal areas prone to tidal floods may have acid sulphate soils on the whole soil of these islands are nutritionally poor and their organic matter content is on the decline.

4. GROUND WATER SCENARIO

4.1 Geology : Late Cretaceous Igneous rocks, the Ophiolite Suite, Marine Sedimentary rocks of Palaeocene to Oligocene age and Recent to Sub-Recent Beach sand, Mangrove clay, Alluvium and Coral rags are the major geological formation in the area. The Ophiolite suite of rocks comprises a wide variety of acidic to ultrabasic plutonic rocks and their equivalent basic volcanic rocks occur in sporadic patches in both Andaman and Nicobar Group of Islands.

Other rock types are white clay beds and raised coralline limestone of late Pliocene to Pliestocene age. The rocks of this group are generally rendered good aquifers due to krastification. The ophiolite and marine sedimentaries have undergone different phases of folding, faulting. The area is considered to be orogenically active even to date.

4.2 Hydrogeology : Hydrogeologically, there are three major formations, a) The porous formation consist of beach sand with coral rags and shells, the thin cover of alluvium in the valleys and foot hills adjacent to valleys and the moderately thick pebbly valley fill deposits (colluvium) in the narrow intermontane valleys constitute the water table aquifer. The thickness of the beach sand and alluvial deposits ranges from 3 to 6 meter and sometimes to 9 m. In Great Nicobar the thickness is thinner, only 2to 2.5meter. The colluvial deposits in narrow intermontane valleys e.g., Beadnabad valley have much higher potentiality. One bore well of

152 mm diameter was drilled by CGWB down to 16.50mbgl tapping the total thickness of the saturated colluvial deposits and yielded 72 m^3/hr.and pumping for 500 minutes did not show any deterioration in chemical quality. The drawdown was recorded as 5.67m and Transmissivity was calculated as 127m^2 /day. The well could cater to the domestic need of 10000 rural population. b) the fissured formation consist of the upper Cretaceous Ophiolite Suite of rocks including the basic volcanics, the ultrabasic and intermediate to acid plutonic rocks. Based on the compactness and fracturing of these rocks as revealed by exploratory drilling carried out in parts of the island the rocks are again classified as consolidated group and semi consolidated group. The fractured upper Cretaceous igneous rocks and the Lower Tertiary conglomerate, grits, graded sandstone (grey wacke) and their weathered upper mantle form the aquifers, the weathered mantle is seldom 3 to 4 meter thick but adjacent to the valleys it is about 6 meter. The saturated thickness of the weathered mantle and the immediately underlying shallow fracture zones form the water table aquifer. Deeper fracture zones within 60 mbgl form semi confined to confined aquifer.

It is apparent from the study that the weathered sandstone are poor aquifers whereas the weathered volcanics rocks act as moderate to good aquifers at suitable locales. Results of 18 exploratory bore wells in South Andaman show that the deeper fractures imparting secondary porosity and permeability are restricted within 60 mbgl in sedimentary rocks. and within 52.7 m in the volcanics and the intermediate plutonic rocks. The most productive fracture zones are in the volcanic rocks as noticed at Calicut in the depth range of 14 -20 m, and 45-52 m where an intrusion of ultrabasic rock (Serpentinites) was noticed. The yield of the bore well was recorded as 44.67 m^3/ hr, drawdown after 500 minutes of pumping was 8.23 m, Transmissivity was calculated and found 139.6 m^2/ day.

The fractured volcanic rocks else where are not productive eg. Brichganj, Hamfreyganj as the yield of the tube wells were in the order of 1.18 m^3/ hr and 0.52 m^3/hr respectively. It appears that the fractured volcanic rocks are most productive where they are intruded by the ultrabasics. The area covered by the fractured sedimentary rocks, 13 exploratory bore holes were drilled and 2 boreholes were found successful i.e., at Potheropore and Dilthaman Tank. At both the places Mithakari Sandstones and Shales were encountered, the productive fracture zones at Prothrapore between 25 to 60 meter, but yielded 17m^3/hr water which is brackish. The borehole at Dilthaman Tank yielded very less but EC value was less and water was potable. The

boreholes drilled at other places in the sedimentary rocks through dark grey shale of Mithakari Group were found dry.

The area covered with semi consolidated Lower Tertiary sedimentary rocks in the Great Nicobar Island were also explored and found the thin bedded fine grained sand stone – clay stone alternation can not be properly termed as aquifers. The maximum discharge obtained by tapping 31 m thick fine grained, soft argillaceous sand stone between 20 -92 mbgl, was 187 litre/ hr and quality of water was found good. Slightly better discharge was found in the same Island water was brackish (EC 4503us/cm at 25 ^{0} C)

In sedimentary rock in valleys and adjacent to Bays, depth of dug wells are restricted to 3.5 to 4 mbgl, depth to water level in the dug wells in valleys 2.5 to 2.75 m, and in the igneous rock in same physiographic unit depth to water level generally less than 3 mbgl, with a seasonal fluctuation around 1.5 to 2.5 m. Sp. capacity of lower Tertiary Sandstone, was found very low in the range of 1.12 to .261 lpm/m, in the weathered volcanic rock sp. Capacity values was in the order of .79 and 9.55 lpm/m.

In order to study the behaviour of ground water regime with time and space in Andaman group of islands 63 ground monitoring stations were established, and periodic water level measurements are being taken 2 times in the year, for premonsoon period during May and for the postmonsoon period during December

Depth to water level in majority of the monitoring stations ranges between 2- 5 meter (66%) and within 2 meter (25%) in rest of the stations during May. The minimum water level 0.9 mbgl was recorded during May at Maya Bunder in North Andaman, and maximum 10.55 mbgl at Calicut ,in South Andaman.

The water level trend has been analysed for all measurements which shows that there is a rising trend of water level in majority of the wells during 1998 to 2007 to the tune of .021 to 1.19 m/yr. However during the same period the pre monsoon trend shows falling trend in most of the wells.

4.3 Ground Water Resources : As per the GEC 1997 norm the watershed or administrative unit could not be applied here since the islands are generally separated. There are 36 Islands which are dwelled by people, hence the water resources of these Islands are taken into consideration. During computation the intermontane valleys and relatively flat topographical

areas were considered as recharge areas. The hilly areas having slope more than 20% are deducted from the geographical area available in the inhabited islands. The water level data of all 36 islands are not available; the Rainfall Infiltration Method was adopted for resource estimation. Base flow of ground water through springs was also noticed, and the discharge was computed and added to ground water draft. The estimated resources are as follows:

Area considered for Resource Estimation	: 7860.51 Sq. Km.
Ground water Assessment year & Unit	: 2001 & 36 inhabited Islands
Gross Ground water Recharge	: 326.273 MCM
Tentative Base Flow	: 5.475 MCM
Net Ground water Recharge	: 320.798 MCM
Current Annual Gross Ground water Draft for drinking purpose	: 11.978 MCM
Annual allocation of groundwater for domestic and industrial water supply upto next 25 yrs	: 7.907 MCM
Available ground water for future use	: 302.772 MCM
Stage of Ground water development	: 3.73 %
Categorisation for future ground water development	: Safe

4.4 Ground Water Quality :

The quality of ground water throughout the island is neutral to alkaline as envisaged from the analytical results of water samples collected from the existing monitoring stations and reference wells (all dug wells). It is generally of the calcium bicarbonate type, and the bicarbonate content varies from 91 to 427 ppm greatly predominates over the chloride content varying between 14-202 ppm. Computation of the chloride-bicarbonate ratio of groundwater from the islands show that the ratio varies between 0.1 to 0.2 which indicates that there has been no large scale saline water intrusion any where in the islands. In general the ground water is fresh with low mineralization having electrical Conductance ranging from 292 to 1120 us/ cm. at 25^0C, baring a few cases eg. 1340 uS/cm at 25^0C at Mirina Park,(South Andaman) and at Sitanagar,(North Andaman), > 2000 us/ cm at Saitankhari (South Andaman) . Iron concentration in groundwater are mostly within the permissible limit, except Namunanagar (1.36 ppm),Light house,(2.15 ppm), at Annicut (2.59 ppm).

Calcium, Magnessium, and Sodium concentration are well within the permissible limit.

The chemical analysis results of water samples collected from spring show that the quality of water is good and fit for domestic and agricultural use.

Water samples from the 15 exploratory wells were analysed maximum of 60 meter deep, majority of which fall in South Andaman area, indicates that the water is dominated by alkalies and strong acids – classified as non carbonate alkalies or primary salinity which is probably due to sea water contamination. Generally groundwater from the deeper aquifer both in South Andaman and Campbell Bay areas are slightly alkaline with p^H ranging from 7.1 to 7.8, except at Protherapore at Power House, quality of water other than with respect to iron content is good with Sp. Conductance and chlorides is good to permissible range. The water quality at Calicut (52 m) and Beadonabad (16 m), are excellent with Sp. conductance and Chlorides in the ranges of 452 -600 us/cm and 12-37 ppm respectively.

The water quality from the deeper fractured ophiolite suites as well as in the colluvial deposits are high in iron, concentration varies from 0.6 to 7.65 ppm. This creates problem for drinking use.

5. GROUND WATER MANAGEMENT STRATEGY

5.1 Water Conservation & Artificial Recharge :

In modern days water conservation and artificial recharge through rainwater harvesting is essential. The average annual rainfall in the island is about 2600 mm (as during 2007) and which is sufficient to design suitable rainwater harvesting structure. Development of groundwater is in low key yet the artificial recharge and conservation structure seem to provide a very good mechanism for augmentation of groundwater resources in the Islands. Even endowed with high rainfall, quick evaporation losses and proximity to sea facilitate high evapotranspiration and huge base flow from the aquifers to the sea. To meet the crisis of ground water artificial recharge structures like percolation tank, cement plug/ nala bund and subsurface dykes as groundwater conservation appears to be highly useful in the islands. Presently in many islands perennial springs ooze through the fractures and topographic lows which cater to a great extent to the village population. Keeping in view the importance of the springs the development of these springs are needed with proper recharge structures at appropriate locations.

Depending upon high rainfall in rainy months and scarcity of drinking water in the lean periods (Dec/Jan to April), harvesting of rain water is very old practice of the islanders. The tribes in the

islands till date collect rain water in green coconuts. Recently the island administrations have started designing the roofs of govt. buildings for harvesting of rain water from the roof top. This practice may be popularized in the entire districts of Andaman and Nicobar so that an appreciable quantity of rain water may be conserved through properly designed roofs and the water may be used for day to day use after rainy season.

Central Ground Water Board has funded during IX th Five Year plan for three rain water harvesting schemes in South Andaman under Central Sector Schemes. For the purpose Rs.12.92 lakh was spent.

6. GROUND WATER RELATED ISSUES AND PROBLEMS

The important problem in the area is non-availability of continuous supply of fresh water in water scarce areas. The groundwater being tapped through deep tube wells at some places is rich in iron concentration which is beyond permissible limit of 1 mg/litre. Fresh water bearing shallow aquifers near to the coastal belt are contaminated with saline water as observed as post-tsunami effect.

The water samples were collected from the open wells at a periodic interval and analysed from the laboratory of All India Institute of Hygiene and Public Health. The analytical results show that all the constituents are within the permissible limit.

7. AWARENESS & TRAINING ACTIVITY

Mass Awareness Programme (MAP) & Water Management Training Programme (WMTP) by CGWB

7.1 Mass Awareness Programme : One at Port Blair on 24.03.2000, among 100 participants.

7.2 Water Management Training Programme : Not yet taken up.

7.3 Participation in Exhibition, Mela/ Fair : Nil

8. AREA NOTIFIED BY CGWA/ S(UT)GWA

No such area is notified in the Islands.

9. RECOMMENDATIONS

Though much work remains to be done to identify the various aspects and complexities of the groundwater regime of these oceanic islands, yet at this stage it is imperative to tackle the situation systematically and in a scientific manner. To bring about this the following recommendations are suggested:

i) Exploratory drilling for fresh groundwater need to be carried out in the accessible areas, especially in the valley areas.

ii) A comprehensive and representative network of hydrograph stations tapping different aquifers may ensure better feed back of water level conditions, aquifer potentials and chemical conditions for the effective management of ground water development programme.

iii) Water sampling of ground water for chemical analysis needs to be carried out along and across the coast line in order to locate the extent, degree and nature of saline water intrusion both during high and low tides. Such sampling is also needed in the vicinity of the innumerable creeks that are found all over the islands.

iv) For domestic use dug wells of maximum 15 meter deep and 4 to 4.5 m, diameter, can partially meet the demand. These wells should be located in the topographic depression and must not be lined right down to the bottom of the well. The distance of the dug wells should be minimum 180 m away from the back water creeks, coastlines or areas which are frequently inundated. This would ensure that dug wells do not get contaminated with saline water.

v) Springs and surface flows (which are perennial) could be developed suitably and used after chlorination as a preventive against bacterial contamination.

vi) Withdrawal from dug wells near the coastlines or creeks should be so regulated that the drawdown never goes down below the mean sea level thereby avoiding the possibilities of saline water intrusion. For this, an accurate measurement of the altitude of the well above the mean sea level is necessary in order to estimate the maximum drawdown which could be allowed without any adverse effect.

vii) Water obtained from dug wells and springs should invariably be chlorinated before consumption. Total hardness and dissolved iron if found excess of the permissible limit of 600 ppm and 1 ppm respectively ,should be removed before use in boilers and also for any domestic use.

viii) To maintain the sustainability of the fresh water bearing aquifer zones, large scale rain water harvesting may act as effective measure to manage and control the ground water resources for future. More number of rain water harvesting structures, such as, sub-surface dykes, check-dams, nala-bunds, pond -renovations and restorations, roof top rain water harvesting structures may be constructed to store the huge rain water during monsoon and may be used for irrigation, agriculture, non-drinking purposes, and after chemical & bacteriological treatment, for drinking purposes in the lean periods.