

# Integrated Coastal Zone Management for South Andaman Coast Using Remote Sensing and Geographical Information System

Vazeem Iqbal

Department of Disaster Management, Pondicherry University, Port Blair

**Abstract-** The purpose of the study was to develop an integrated coastal zone management plan for South Andaman Island and for this study, three dimensional elevations models; coastal biodiversity and landuse/ landcover pattern changes were analyzed. Spot 1993 and IRS-P6 Jan 2007 Satellite imagery was used for estimating the landuse changes. Three dimensional elevations models, drainage pattern and landuse change map were overlaid for developing an integrated coastal zone management for South Andaman Island which will enable for the sustainable development and management of this island.

**Index Terms-** CRZ, Remote Sensing, GIS, South Andaman Island.

## I. INTRODUCTION

Coastal zones occupy less than 15% of the earth's land surface but are inhabited by roughly 60% of the world's population (Bhibhu Prasad Tripathi) Coastal habitats such as coral reefs, coastal mangroves, sea grass beds maintain a fragile balance in the ecosystem. The importance of the coastal ecosystem is to be understood in its interdependence and inter-relatedness to various other ecosystems. This ecological complexity is further compounded by the fact that people staying along the coast have a unique and cultural connection with the coast.

In addition to farming and fishing, the two major coastal industries, there are also other development interests in the coastal region. Then are activities for which foreshore facilities are essential, for example, ports, harbors, jetties, wharves and quays. All these new development pressures are in addition to demands already being made by existing coastal inhabitants. India's lengthy coast stretches over 6000 km, supporting numerous fishing communities and driving the economies of coastal villages, towns and cities. The Indian coast-line can broadly be divided into four areas i.e. the Gujarat Saurashtra-Kachch Coast, the West Coast, the East Coast, the Andaman Nicobar and Lakshadweep coast.

There are three broad classes of human intervention that threaten India's marine environment which are maritime trade, exploitation of ocean resources and on-land coastal development (Rosencranz and Shyam Diwan, *Environmental Law and Policy in India*, (2nd ed., OUP: New Delhi, 2002) at pg.475) Moreover, population explosion and growing economic development are the two main components of threats to

ecosystem. Other activities such as aquaculture, coastal mining and tourism have also been blamed for the pollution of the coast.

The aim of the paper is to understand the scheme of the Coastal Regulation Zone (CRZ) notification, its efficaciousness and study and if amendments have diluted the original notifications from 1991 to 2011. In addition to this, others goals of this study are demarcating the ecologically sensitive areas, buffer zoning, sustainability development and management of South Andaman island.

## II. SECTION I

### REGULATORY MECHANISM PRIOR TO CRZ

1. Foreshore development was initially regulated by building rules under local town and country planning laws or the land revenue code. (**Regulating the Coast**) Concern for the coastal eco-system began gathering momentum only in 1981 with the first central initiative on 27 November 1981 when Prime Minister Indira Gandhi wrote to the state Chief Minister's expressing distress at a degradation and "misutilisation" of beaches. (A. Rosencranz and Shyam Diwan *Environmental Law and Policy in India*, (2nd ed., OUP: New Delhi, 2002) at pg.475.) In the letter, Mrs. Gandhi suggested that upto 500 m from water level at maximum tide be kept clear of all activity. Following this, working groups were set up in 1982, and in July 1983, the MoEF issued the Environment Guidelines for Development of Beaches.

2. The effect of this was that the states actually took steps to prevent new projects from coming and several large government projects re-located away from the coastal zone in view of the directive. (A. Rosencranz and Shyam Diwan *Environmental Law and Policy in India*, 2nd ed., OUP: New Delhi, 2002) at pg. 477) For a few years Mrs. Gandhi's communication was widely accepted because it came from the PMO. However after her, due to intense lobbying from the tourism industry, there was a relaxation in the restrictive coastal zone ruling.

### COASTAL REGULATORY ZONES

In 1991 the Central Government through the Ministry of Environment and Forests under Section 3(1) and 3(2) of the EPA, 1986 read with rule 5(3) of the EPA rules drafted the Coastal Regulation Zone notification in 1991.

The Coastal Regulation Zone (CRZ) Notification operates on the precautionary principle. Recognizing the rapid

degradation of the coastline due to unplanned industrialization and urban development, it is a step taken by the Government to prevent further de-cay of the coastal eco-system, while allowing it time to revive. So, under the Notification, certain construction activities are completely prohibited within the CRZ areas, and those permitted are to be strictly regulated by the enforcing authorities.

### CONTENT OF CRZ NOTIFICATION

The CRZ Notification addresses the problem of coastal zone management in two ways. (See paras 2 and 3 of the CRZ notification). First by outright prohibition of certain activities and second by regulation of certain activities. The notification depending on varying characteristics, location and intensity of protection required has classified the coastal areas into four zones.

CRZ I area according to the notification is the area between Low Tide Line(LTL) and High Tide Line (HTL) and areas that are ecologically sensitive and important like national parks, marine parks, sanctuaries, reserve forests, etc. In the CRZ I area no new construction activity will be permitted within 500 meters from the High Tide Line except that needed for carrying treated effluents and waste water discharges into the sea. This zone is considered No- development zone.

The CRZ II area consists of areas that have already been developed upto or close to the shoreline. All cities and other built substantially built up areas which have infrastructural facilities such as water supply and have roads etc. fall into this zone. In these areas building activity is prohibited on both the seaward and landward sides of existing structures and all existing structures are to conform to local building regulations.

In the case of Ramnathan v. State of Tamil Nadu (**Appeal No. 1287/1995, Madras High Court**) the Madras High Court held that the CRZ norm cannot be tested with reference to each of the building situated on the seashore and, therefore once it is found that the area is a developed area and there are buildings and roads in the said area which are nearer to the sea, then the impugned construction would fall on the landward side.

CRZ III area consists of areas that are relatively undisturbed and includes rural areas and also areas in legally designated urban areas which are not substantially built up. In these areas 200m from the HTL toward the landward side is declared as NDZ.

CRZ IV category includes Andaman Nicobar, Lakshadweep and other small islands. In these areas dredging and under water blasting in and around coral formation are not permitted.

The CRZ notification provides that in ecologically sensitive areas construction of beach resorts shall not be permitted. However it is permitted between 200m and 500m in the CRZ III area subject to the prior approval of the MOEF and certain conditions laid down in the notification. The rights of traditional inhabitants of the coastal areas i.e. fisher folk etc. are recognized in this notification and they are permitted to construct new or resurrect old dwellings.

In Goa Foundation v. Diksha Holdings Pvt Ltd. and others ((2001) 2 SCC 97) the construction of a hotel was challenged on the ground that it would cause ecological or environmental damage of the coastal area and the pristine beach with sand

dunes. In the facts of the case the plot fell in CRZ-III and was indicated as settlement under the Goa, Daman and Diu Town and Country Planning Act. The court found that the resort was not being constructed on sand dunes. The court held that while maintaining and preserving ecology and environment the development of the state also has to be kept in mind.

### ENFORCEMENT AUTHORITY UNDER THE NOTIFICATION

Enforcing the CRZ Notification involved the identification and demarcation of the CRZ all along the coastline. Under the CRZ Notification 1991, implementing agencies are the Central Government through the Ministry of Environment and Forests (MOEF) and the State or Union Territory Government, through Department of Forest, Environment and Ecology (DFEE).

In the judgment delivered in Council for Indian Council for Environ-Legal Action Case (**1996 (5) SCC 281**) on April 18, 1996, the Supreme Court observed that authorities under whose jurisdiction the implementation of the CRZ Notification has fallen were overworked and had limited control. It directed that Coastal Zone Management Authorities (CZMAs) be set up, in order to supervise the implementation of the CRZ Notification and also provide advice to the MoEF and the GoI on issues of coastal regulation. (**MR. SHYAM DIWAN**) Consequently, by Government order dated November 26, 1998, the National Coastal Zone Management Authority (NCZMA) and the various State Coastal Zone Management Authorities (SCZMAs) came into existence.

### FUNCTION OF CZMAS

The responsibilities entrusted to the CZMAs included ensuring compliance of CRZ, supervising and advising on changes in classification of CRZ, holding inquiries into alleged violations and taking action against violators. The authority also has power to review the cases either suo motu or on the basis of complaint made by an individual or an organization functioning in the field of environment but does not have the powers to grant clearances of any kind to development projects.

### THE COASTAL ZONE MANAGEMENT PLAN (CZMP)

The CRZ Notification directs the administrations of the coastal states and union territories to prepare Coastal Zone Management Plans (CZMPs). (**The CRZ notification**) Preparing CZMPs means identifying and classifying CRZ areas along the coast in accordance to guide-lines laid down in the Notification, or as specified by the MOEF. This includes demarcation of the lines of HTL, LTL, 200 m from HTL and 500 m from HTL, and then a classification of the said areas as CRZI, CRZII, CRZIII or CRZIV.

CZMPs were to be drawn up to help identify the area within which the Notification and its restrictions apply. The various administrations along the coast were given a period of one year to prepare the CZMPs, according to Para (3) (3) (I) of the Notification. However, even after three years of the publication of the Notification, none of the state or union territory governments had prepared the needed CZMPs which meant that there was no way of knowing whether land by the sea was within the CRZ or not, and so whether the prohibitions and regulation of activities applied there or not. This reflects the lack

of inclination on part of the State governments to enforce the notification.

In the IECLA case the Supreme Court directed all coastal states to file before it affidavits indicating the steps taken by them to implement the CRZ notification in their respective states and also to answer the charges of violation which had been brought to its notice by concerned citizens. The court further directed the states to prepare the CZMPs. Within six months of the decision all the coastal states had prepared their CZMPs. **(The Scheme of CRZ Notification)**

### III. SECTION II

#### AMENDMENTS TO CRZ

The coasts are the preferred destination for infrastructure projects like construction of ports, urban infrastructure, highways, resorts, oil and gas exploration, reclamation for real estate development. With development along the coast and the banks of tidal water bodies being restricted, there was pressure from industrialists, hoteliers and developers to have the provisions relaxed. Environmentalists and fisher folk, on the other hand, wanted the provisions to continue as it protected the coastal environment. The justification of the government for the amendments is that difficulties are being faced by the inhabitants of the areas falling within the CRZ and there is a need for infrastructural facilities in these areas.

The first amendment, dated August 18, 1994, was the result of the intense pressure the hotel and tourism lobby put on the Government of India (GoI) regarding the Notification. Their contention was that the restrictions under CRZ severely limited their scope of work. As a consequence, the B.B. Vohra Committee was set up by the Central Government. **(1996 (5) SCC 281)**

Acting on the recommendation of the Vohra Committee the government relaxed the 1991 notification. The amendment:

- a) Significantly reduced the mandatory CRZ of 100 m for rivers, creeks, etc. to 50 m.
- b) Gave expansive powers to the Central Government, which could now grant per-mission for construction on the landward side within 200 m from HTL according to its discretion.

However this was challenged later in Indian Council for Environ-Legal Action v. Union of India. The Supreme Court held that the amendment reducing the width of the zone from 100 m to 50 m in respect of rivers, creeks and backwaters was contrary to the object of the EPA and may lead to serious ecological damage. Also the amendment did not contain any guidelines as to when the discretion was to be exercised and gave unbridled power. The court struck down the amendment as being violative of Article 21. **(1996 (5) SCC 281.)**

In 1995 the Supreme Court issued an interim injunction in the Shrimp Culture Case, prohibiting the setting up of new shrimp farms or the conversion of agricultural lands for aquaculture purpose in the coastal stretches of Andhra Pradesh, Tamil Nadu and Pondicherry. **(S. Jagannath Union of India, 1995 )** this injunction was extended to all the coastal states in August 1995.

On 31 January 1997 the CRZ Regulations were amended a second time to overcome the practical difficulties faced by the

islanders of Andaman and Nicobar. The second amendment was the result of complaints from the people of; the Andaman and Nicobar Islands that they were facing problems due to restrictions on drawl of ground water and the prohibition of sand mining in force under this Notification. So, from January 31, 1997, it was decreed that groundwater could be drawn (manually, for drinking purposes only, and with permission from the administration) in areas where there existed no other.

A third set of amendments was introduced on 9 July 1997 to reduce 'the difficulties being faced by the local people and also for construction of essential facilities in the coastal zone'. This was, supposedly, in answer to difficulties various coastal people claimed to be facing because of the CRZ restrictions on construction activities. It can be seen that under the guise of providing for the problems faced by locals the government actually took care of a variety of interest groups. The amended notification sanctioned, inter alia, with conditions:

1. The storing of certain petroleum products within existing port limits of existing ports
2. Acquisition of landward so that existing fish processing units could install additional equipment and undertake pollution control measures
3. The construction of ports, harbors, jetties, wharves, quays, slipways, bridges and sea-links and other facilities (necessary for other permissible activities under the Notification)
4. The expansion and modernization of existing ports, harbors, etc.
5. The manual drawal of groundwater where no other source of water can be found from 50 to 200 m. From HTL in case of seas, bays and estuaries, and within 200 m from HTL or the CRZ, whichever is lesser, in case of rivers, creeks and backwaters
6. The construction of dispensaries, schools, public rain shelters, community toilets, bridges, roads, jetties and facilities required to provide for water supply and, drainage and sewerage, within CRZI, for traditional inhabitants of the Sunderbans Biosphere Reserve area (West Bengal).
7. The reclamation of land for facilities essential for operational requirements of ports and harbors within existing port limits, but not for commercial proposes like shopping and housing complexes, hotels and entertainment activities
8. In addition to repairs of existing structures, construction for activities permissible under the Notification was also allowed in CRZ III areas.

Addressing the prohibition of sand mining in the Andaman and Nicobar Islands, the fourth amendment provided that sand mining could be allowed in non-degraded areas, upto September 30, 1998.

The Fifth Amendment followed the deadline after which sand mining in the Andaman and Nicobar Islands was to come to a complete halt. The date was extended by a year, to September 30, 1999, and consequently annual plans for the years 1999-2000 and 2000-2001 were requested to regulate quantity of sand mined.

Demarcation of HTL is a fundamental step to implementing the CRZ Notification. This was however not done even years after the Notification first stipulated that it be done. In the sixth amendment, dated December 29, 1998, the responsibility to

demarcate the HTL is granted to authority or authorities so authorized by the Central Government.

In ten years there have been many amendments, directly relating to the provisions of prohibiting and permissible activities under the CRZ Notification 1991. Only in two cases has the MOEF invited public opinion and objections. **(Environment (Protection) Rules)** The rest have been promulgated under Environment (Protection) Rules, 1986, rule 5(4), which states “Not with-standing anything contained within sub-rule 3, whenever it appears to the Central Government that it is in public interest to do so, it may dispense with the requirement of notice under Clause (a) of sub-rule 3.” In such a case there is no proof falling on the Central Government when it resorts to Rule (5), thus leaving large scope for abuse.

The latest amendment brought on May 21, 2002 seeks to open up CRZ-III areas for industrialization and development. It allows “non polluting industries” to be set up in the 200-meter zone from the high tide line (HTL) of the coast in CRZ-III areas if they fall under special economic zones (SEZs).

It is argued that the CRZ rules should allow for amendments in individual States to cater to the local needs of each State. However this made lead to a further dilution of the law as the state may be more willing to accommodate the builder and industrial lobby in the name of development. It is apparent that the government has been trying to dilute the original Notification in favour of various lobbies. The coalition politics at the centre has ensured that the regional parties can get greater concessions for their states.

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## V. STUDY AREA

South Andaman Island is the southernmost island located at Bay of Bengal latitude of 11° 47'N 92° 39'E Archipelago Island and the total area is 1,347.7 km<sup>2</sup>(520.35 sq mi) Highest elevation 456.6 m (1,498 ft) Highest point Koib the Great Andaman and is home to the majority of the population of the

Andaman Islands. Port Blair, the capital of the islands, is located on the southern part of this island. Some areas of the island are restricted areas for non-Indians; however, transit permits can be obtained from the Home Ministry. Like the rest of the archipelago, it was struck by the 2004 Indian Ocean earthquake, leading to many deaths on the island. South Andaman is the third largest island in the island group. It is located immediately south of Middle Andaman Island, from which it is separated only by a

narrow channel, a few hundred meters wide. The island is 93 km long and 31 km in width. Its area is 1348 km<sup>2</sup>. It had a population of 181,949 as of the 2001 census. South Andaman is less mountainous than the more northerly of the Andaman Islands. *Koiob* reaches a height of 456.6 m

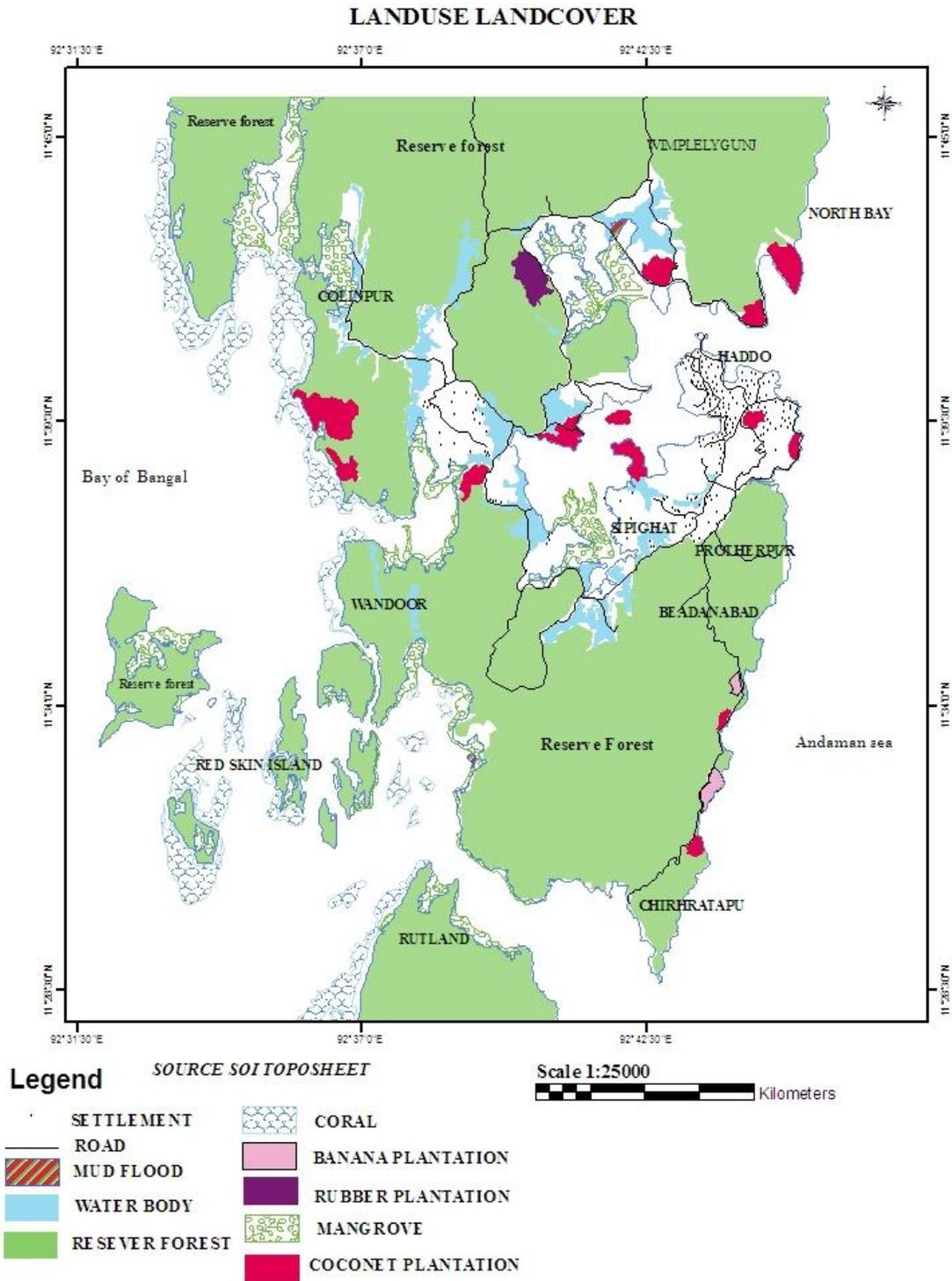


Figure1: Landuse landcove of South Andaman Island 1993

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### LANDUSE LAND COVER 2010 OF SOUTH ANDAMAN

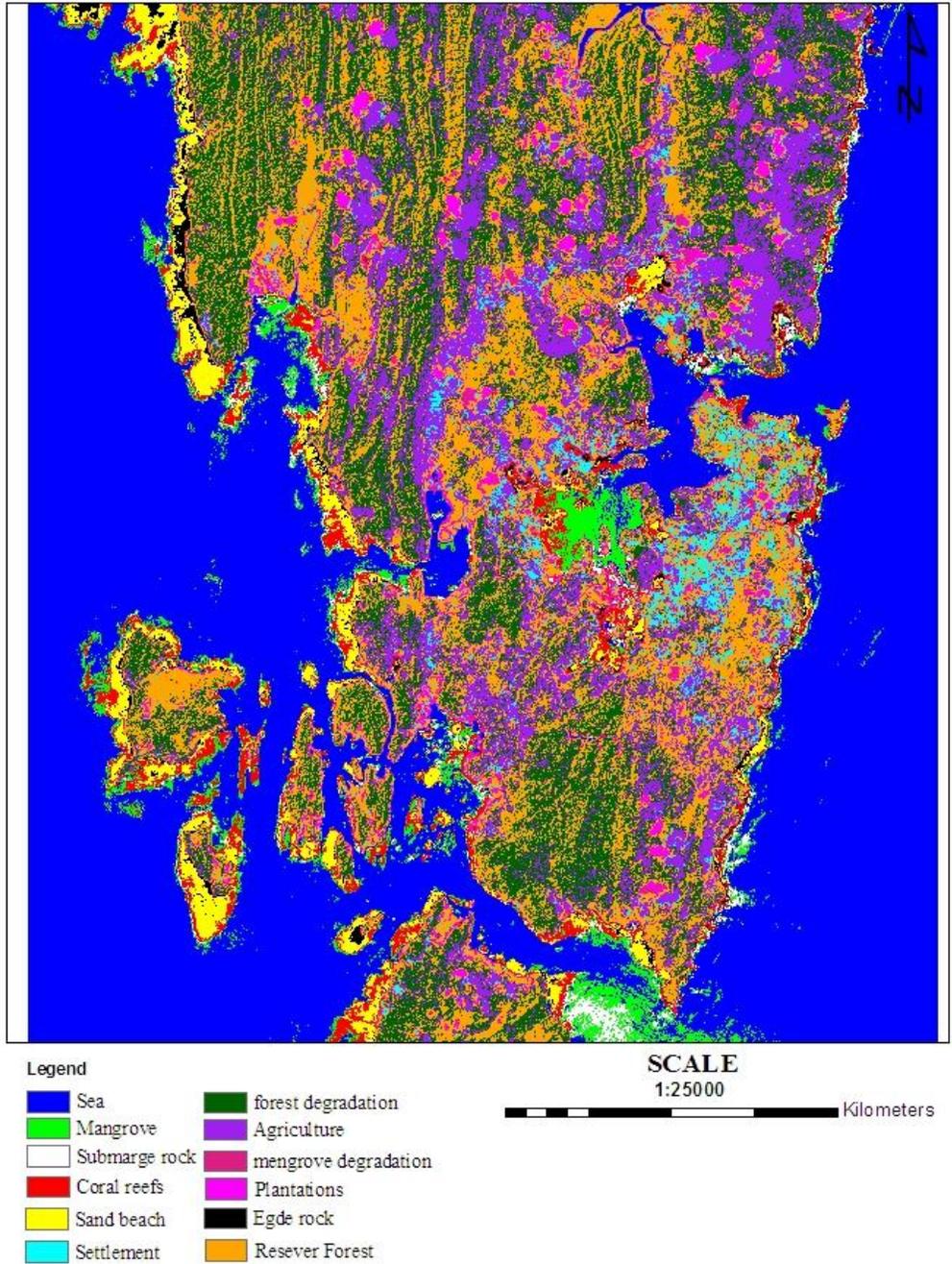
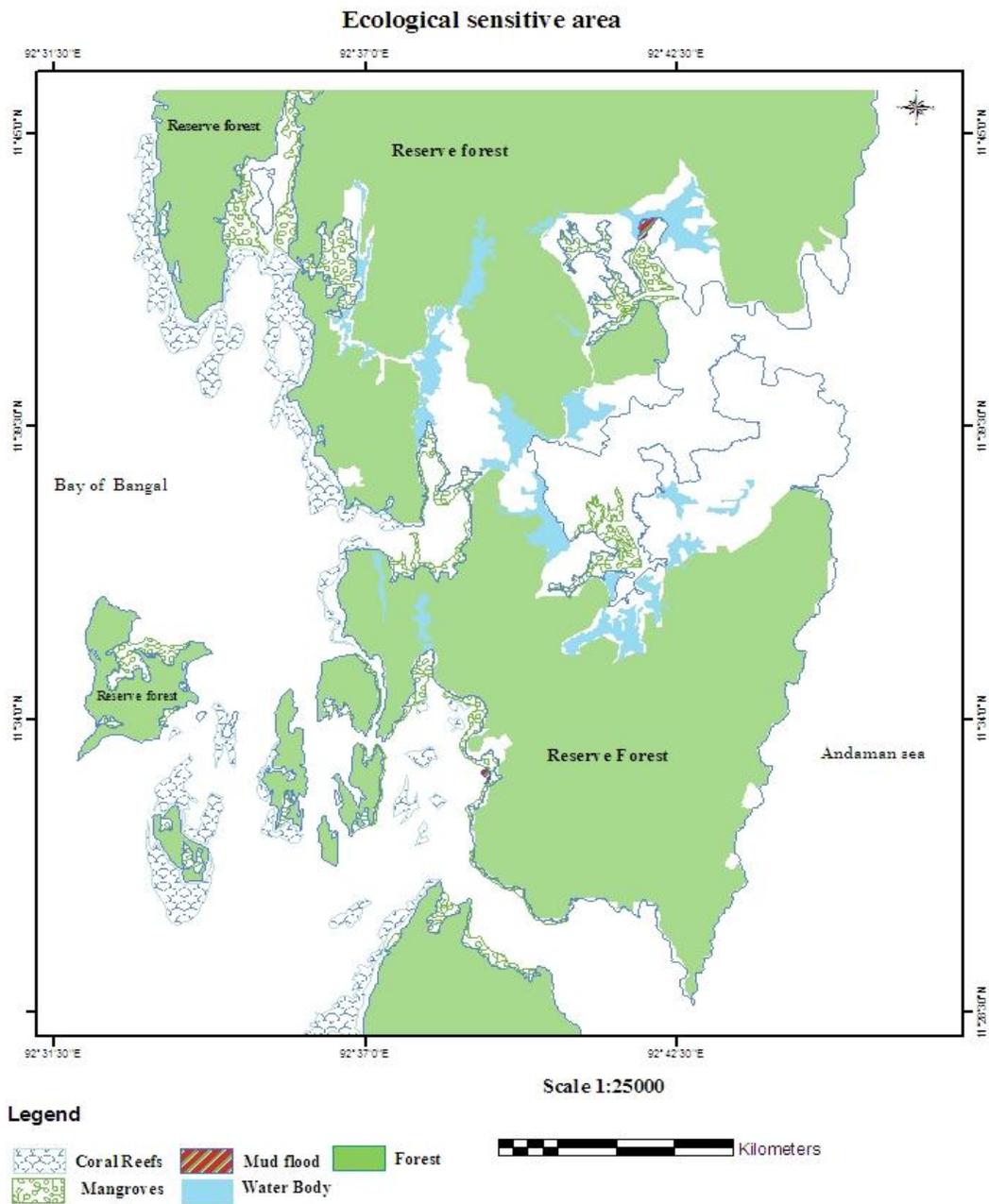
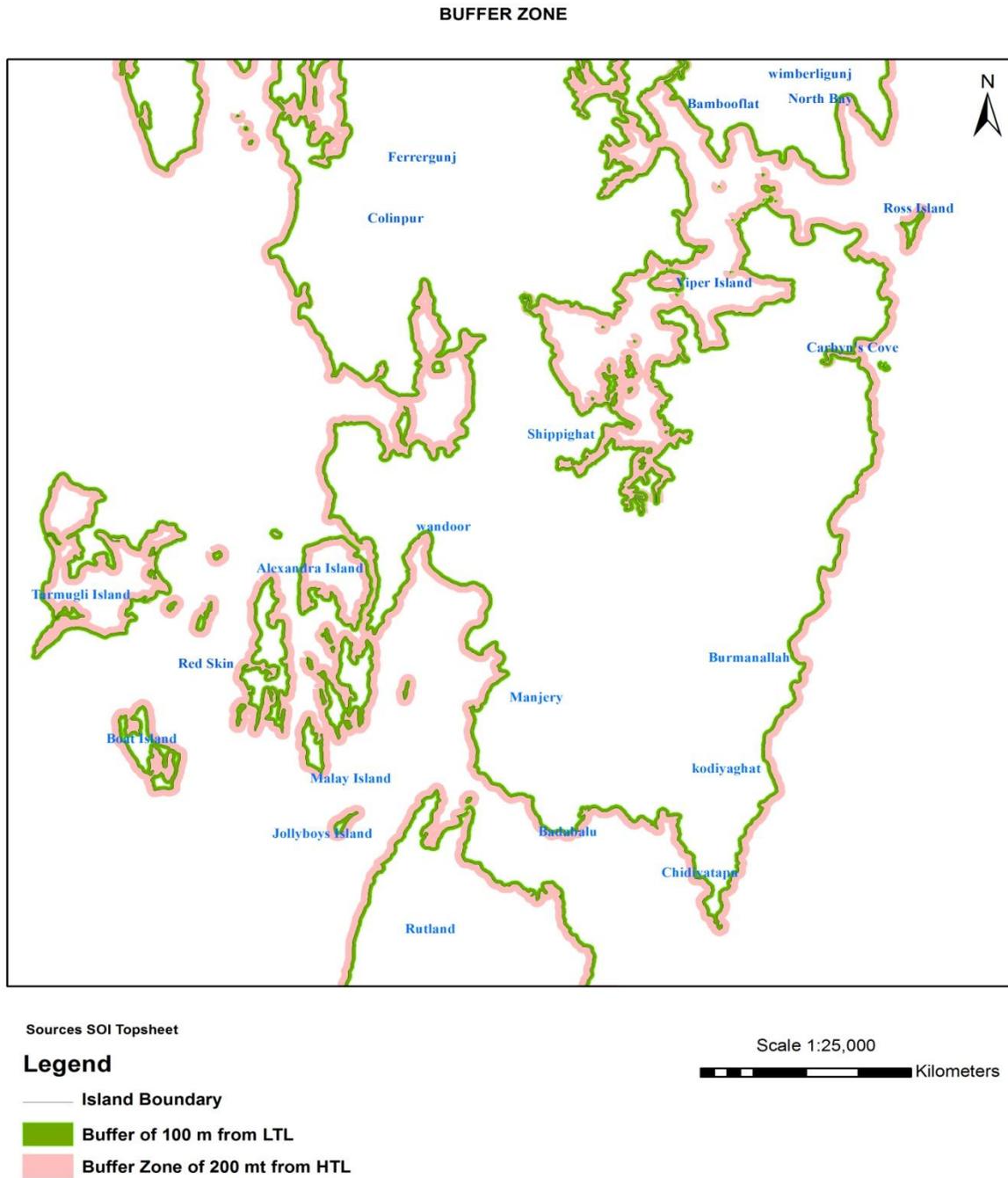


Figure2:

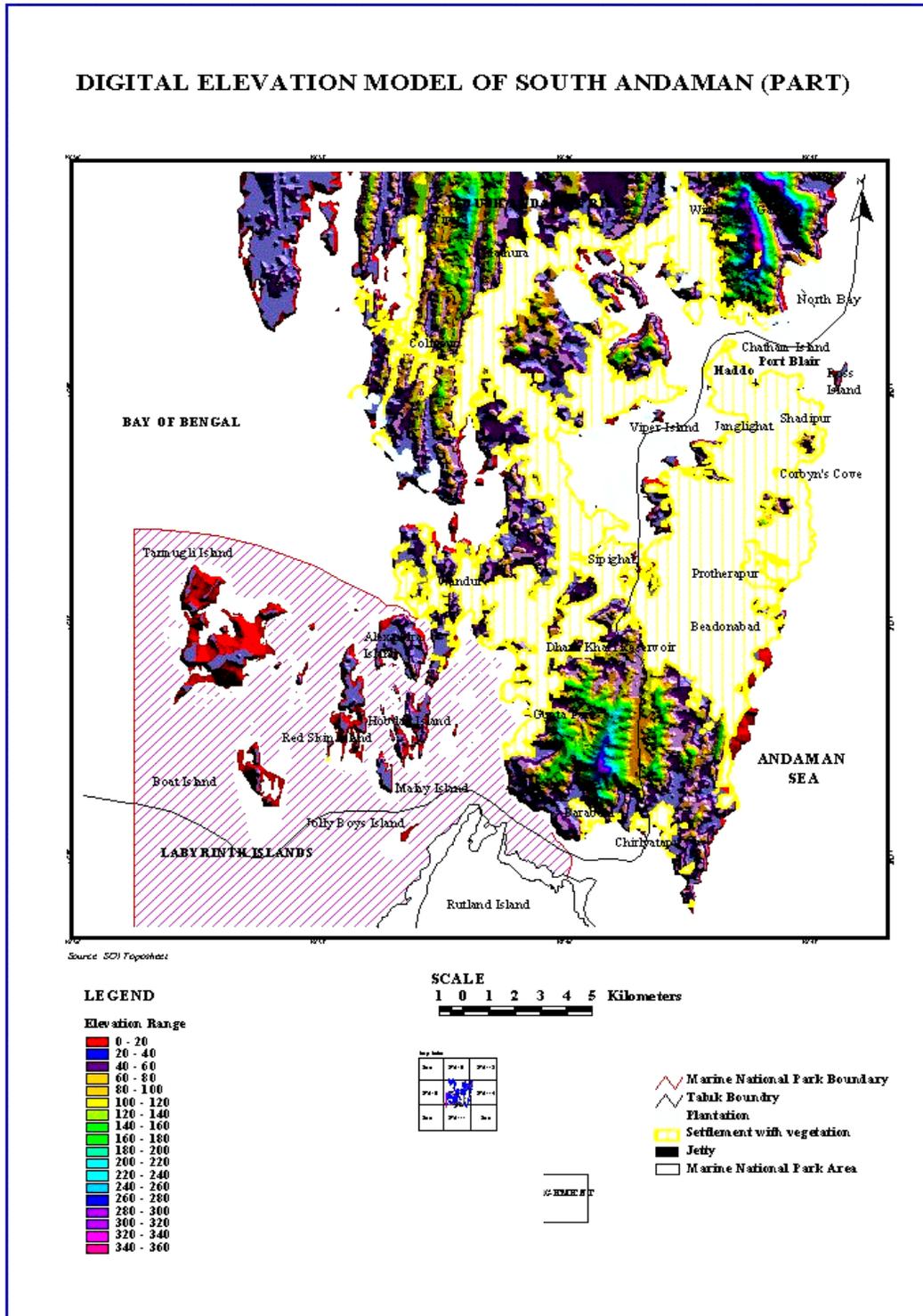
**Landuse landcove of South Andaman Island 2010**



**Figure3: Ecological Sensitive Area of South Andaman Island**



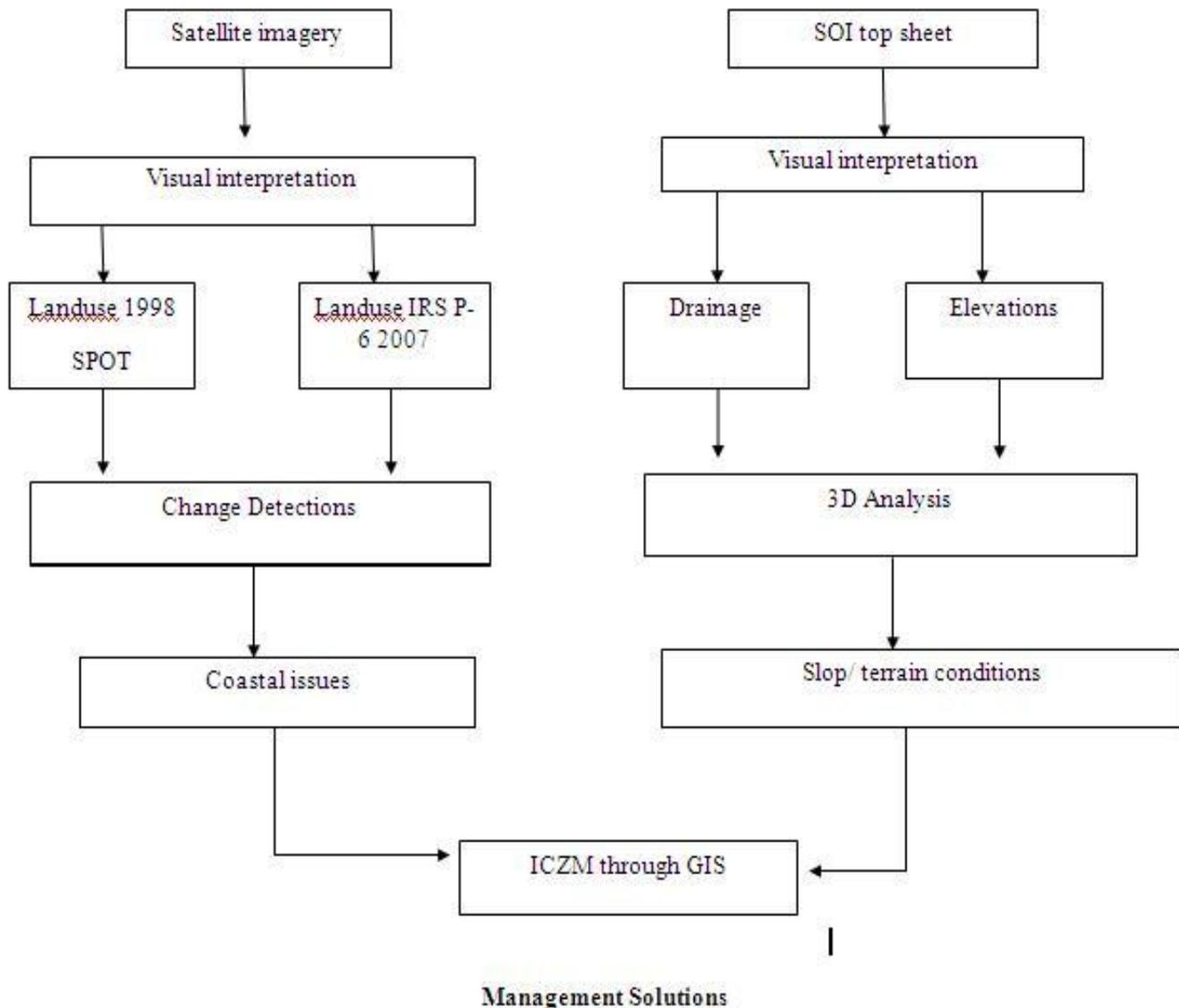
**Figure5: BUFFER ZONE AREA OF SOUTH ANDAMAN ACCOUNTING TO 2011 CRZ**



**FIGURE6: Digital Evaluation Model of South Andaman Island**

## VI. METHODOLOGY

Methodology adopted for the study is given below.



## VII. RESULT AND DISCUSSIONS

### Landuse Change:

For sustainable utilizations of land ecosystem it is essential to know the nature characteristic extent and locations of soil resources its quality, productivity, suitability and limitations for various landuse. (Chaurous et al 1996). In order to improve the economic conditions of the area without further deteriorating the bio-environment every bit of the available land has to be used in a most rational way this require the present and past and

landuse/land cover data change are costly ,low in accuracy and not present a picture of a large area.

Remote sensing because of its capability of synoptic viewing and respective coverage provide full information on landuse and land cover due to natural and human activity are be observed using current and archived remote sensing data (Loung 1993)

### 3-Dimensional Model:

Slope of the island observed through digital Elevations model is as follow the central part 0°to 20° south eastern 10°-40° southern 0°-20° northern western 10°-20°and northern western

10°-20° and north eastern part 25°-80° it is observed that mostly peak where other part of the island are found moderate slope.

#### Drainage:

Stream process in any terrain are controlled not only by climatic conditions, but lithology and geology structure also have great control as influence the nature of flow, erosion and sediment transportations the degree of dependence varies with the physical and chemical properties of rock the permeability the structure characteristic and the degree faulting / fracture also effected the extent to which the materials can be detached by fluvial process (Derbyshire et al., 1981) the role of rock type and geology structure in the development of stream network can be better for understood by study the nature and type of drainage pattern observed in South Andaman Island area were dendritic in nature. The pattern exhibits those mountains in origin. The stream generally followed a steep slope in northern portions of the island the stream generally follow a slope in northern portions but they follow a gentle slope in southern portions as the island. Depending upon the elevations of terrain drainage pattern and river flow directions, particular site were specified for erecting dam. However subsurface study is also necessary to find the exact locations erecting a dam. South Andaman has enough potential for fresh water supply the following locations are supply for pumping to meet out the demand of south Andaman.

#### Coastal Issues:

Degradations in mangrove are observed in northern portions of the island. Development of settlement area and more sedimentation in coastal environment are the major issues for the degradations of mangrove loss in reserved forest as attributed to the development of settlement area the loss in forest is observed at northern portions of the island, gentle slope and sparse forest cover, favour the development of settlement in this portions sand area was found to have decreased in almost all the part of the island this may be due to sand mining or due to natural process.

#### Management issues:

Tourism is a main sector of the world economy accounting for nearly 11 percent of global (Topfler 1999) nature based tourism now comprise 20 percent of the world travel market and ecotourism 7 percent (TIES 1999) according to report presented at a WTO seminar Spain early this year 20 million European consider the environment as their main motive for travel (WTO 1999) there is general agreement that supported conservations actively contributed to local community development and lead to greater understanding and appreciations of the nature and culture environment however conservations is the primary objective of ecotourism.

Ecotourism is the concept that grew from the need to meet the objective of nature conservations while recognizing the right to local people to utilize their locally impositions of the western model of protected area management in area where local people relied on nature for their injustice of the western model of protected area management sight to implement a more considerate form of conservations.

Tourism was introduced as a tool for natural conservations to compensate for reduced consumption of forest produced

income for community is greater through the community involvement in tourism enterprise. The process called ecotourism (Lincoln International 1998). In South Andaman Ecotourism site selections was observed based on the criteria where sandy beach was available slope of the terrain was less than 20° and the ground water of good quality was available slope of the quality was available on the criteria site of ecotourism were suggested for the selected for Indian portions of the island.

The location of site for constructions plays the primary role in the effectiveness of any artificial recharge structure (Jothiprakach et al. 1997). Extensive studies have been carried out by several workers in delineating ground water potential / prospective zone Geographical Information System (GIS) has been found to be effective tool. In recent year, extensive use of Indian topographical map collateral information and field check has made it easier to establish the base line information for ground water prospective zone. (Singh et al 1993; Chi and Lee, 1994, Hardass et al; 1994 Tiwari and Rai; 1996 Das et al; 1997, Pradeep, 1998, Subba Rao and Prathap Reddy 1999, Thomas et al: 1999, Harinarayan et al 2000, Muraudher et al, 2000, Obi Reddy et al, 2000).

In South Andaman Island the constructions of artificial recharge structure are suggested based on the criteria where slope was less than 30°; high drainage density and buried pediment zone where present based structure were suggested at the selected portions of the island.

Utilitarian approach is suggested for sustainable management of the coastal resources in South Andaman.

- ✿ No development activity should be promoted in wet land area.
- ✿ No development activity should be promoted within 10 meter buffer of 1<sup>st</sup> 2<sup>nd</sup> and 3<sup>rd</sup> order streams and within 20 meter buffer for river.
- ✿ Erosion activity of the stream should be checked in the highest elevations by erecting an anti-erosion structure.
- ✿ The ICZM plan must strictly follow for the better of South Andaman Island.
- ✿ No permanent concrete structure should be developed in this Island.

## VIII. CONCLUSION

In recent years, the country's coastal stretches have become a pressure point for indiscriminate and unsustainable development pressures. There is considerable debate regarding the CRZ with the hoteliers etc. lobbying that it is anti-development and the environmentalists stressing that relaxation in the CRZ Notification would only encourage pollution and asking for its strict enforcement.

The CRZ Notification was promulgated with the intention bringing a balance between infrastructure development and preservation of the eco-system along the coastline. However from the very beginning the enforcement agencies have extremely apathetic w.r.t. the CRZ Notification. One of the major criticisms leveled against the CRZ Notification is that it ignores deliberately issues of public participation and, local contexts and issues. This neglect, along with the SCZMA inaction, has led to a clash of functions between the duties of the local bodies like

panchayats and municipal corporations and the designated coastal authorities.

In a paper authored by the Former Secretary, MOEF, Government of Karnataka, Capt S. Raja Rao has attempted to address the problems of implementation of the CRZ. He states categorically that most problems have arisen because the coastal state authorities have not taken the implementation of the Notification seriously. According to him hastily prepared CZMPs and inadequate, non-participate consultations, even among the government officials themselves are to be blamed for the problems being faced. It can be seen that the failure of the CRZ is because of the reluctance of the government to enforce it. The letter written by Ms. Indira Gandhi which did not have any authority apart from being the diktat of the Prime Minister resulted in the development activity being severely restricted. In the present context the government has been conceding the demand of the powerful lobbies by diluting the notification through amendments.

In *Goa Foundation v. Konkan Railway Corporation* the central government decided to lay a broad gauge between Bombay to Mangalore via Goa. The court held that the CRZ notification prescribes that there would be restriction on the setting up and expansion of industries operation or processes in the said areas and land reclamation bunding could not be considered as industry. So the CRZ notification did apply to this case. The Court observed that no development is possible without some adverse on ecology and environment but public utility projects cannot be abandoned and it is necessary to adjust the interests of the people as well as the necessity to maintain the environment. It can be seen from the several decisions on CRZ that of late the attitude of the judiciary has not been very supportive of strict enforcement. One tends to come to the conclusion after looking at the case law that rather effectively preventing pollution of the coastal areas, the CRZ notification has become more of a law regulating land use with litigation on questions of fact as to the category to the CRZ and other such questions of evidence.

Landuse change detections, 3dimensional modeling and drainage patter were studies it found that there is decrease in sand, forest cover and mangrove the decrease is the attribute to the development of settlement through 3d elevations model and drainage pattern, site for dam constructions and borehole locations where identified by integrating landuse, 3d elevation and drainage map ICZM plan map was prepared and site for ecotourism and artificial recharge was suggested according to the ICZM plan map management solutions were also if this plan implementing this would be immense for South Andaman Island.

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#### AUTHORS

**First Author** – Vazeem Iqbal, **QUALIFICATIONS:** BA Geography M.Sc. Coastal Disaster Management Pondicherry University Port Blair. Currently pursuing my Ph.d on Coastal Zone Management at Pondicherry University Port Blair., **ASSOCIATED INSTITUTE:** Pondicherry University

**ADDRESS:** Vazeem iqbal , Dept of Disaster Management,  
Pondicherry University Brookshabad Campus, Port Blair

(Andaman and Nicobar Island) India, Pin: 744103, **Email:**  
**iqbalafly@gmail.com**