DEVELOPING MODEL FOR SUSTAINABLE SOLID WASTE MANAGEMENT IN PENHA DE FRANCA VILLAGE WITH EMPHASIS ON ECOSYSTEM PRESERVATION IN AND AROUND PORVORIM - GOA

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FOR THE DEGREE OF

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Under The Board of Moral and Social Sciences Faculty Studies

By

Pradip Vithal Sarmokadam
02111004174
Under The Guidance
Of
Dr. Bhagyashree M. Yargop
Former HOD - PG Department of Earth Sciences
Tilak Maharashtra Vidyapeeth – Pune

Year 2017

CERTIFICATE

This thesis entitled "DEVELOPING MODEL FOR SUSTAINABLE SOLID WASTE MANAGEMENT IN PENHA DE FRANCA VILLAGE WITH EMPHASIS ON ECOSYSTEM PRESERVATION IN AND AROUND PORVORIM - GOA" submitted by Mr. Pradip Vithal Sarmokadam for the award of degree of Doctor of Philosophy Submitted To The Tilak Maharashtra Vidyapeeth Pune In Earth Sciences Subject Under The Board of Moral and Social Sciences Faculty Studies of is a record of bonafide research work done by him and it has not been submitted for the award of any degree, diploma, associateship, fellowship of any University/Institution.

_____

Signature of Guide

Dr. Bhagyashree M. Yargop
(Guide)

Former HOD - PG Department of Earth Sciences

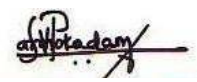
Tilak Maharashtra Vidyapeeth – Pune

Year 2017

Place: Pune Date: 30.12.2017

DECLARATION / UNDERTAKING

I hereby declare that the thesis entitled "DEVELOPING MODEL FOR SUSTAINABLE SOLID WASTE MANAGEMENT IN PENHA DE FRANCA VILLAGE WITH EMPHASIS ON ECOSYSTEM PRESERVATION IN AND AROUND PORVORIM - GOA" submitted by me for the degree of Doctor of Philosophy To The Tilak Maharashtra Vidyapeeth Pune In Earth Sciences Subject Under The Board of Moral and Social Sciences Faculty Studies of is the result of my original and independent research work carried out under the guidance of Dr. Bhagyashree M. Yargop, Former HOD - PG Department of Earth Sciences Tilak Maharashtra Vidyapeeth – Pune and it has not been submitted for the award of any degree, diploma, associateship, fellowship of any University/Institution.



Signature of Student

Shri. Pradip Vithal Sarmokadam

Mahalasa Niwas – Kasartala, Talarn, Pedne, Goa

Year 2017

Place: Pune Date: 30.12.2017

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विषादप्यमृतं ग्राह्यं बालादपि सुभाषितं ।

अमित्रादपि सद्दत्तं अमेध्यादपि काञ्चनम् ॥ संस्कृत सुभाषित.

We should be ready to appreciate good things no matter where they come from. May be nectar from poison, a wise word from a little boy, a good quality of an enemy or a small **bit of gold from** garbage. Sanskrit Subhashit.

At the onset I am grateful and humble at the feet of Shree Sambasadashiv-Gopal Krishna-Mahalasa-Batubhairav-Mahavishnu Pramukh Panchayatan, Shree Ravalnath, Shree Gurudev Dutt, and Almighty God as it is due to blessings that I have successfully been able to complete my research and thesis. I am also indebted to my parents, especially my late father Shri. Vitthal Jairam Sarmokadam, My mother Smt. Anandi Vithal Sarmokadam, my beloved sister – Tai, (Mrs. Maya Manohar Umarye) who prayed for me and shaped my life in my childhood, one of the elder brother Shri. Anil Sarmokadam and all other family members and relatives for imparting me with necessary values with which I stand firmly in this world.

I wish to extend gratitude to all those who directly and indirectly supported me in every way for my completing my Ph.D. It was not possible to spare dedicated time for research work till year 2010 due to my busy industrial life of three shifts which was full of struggle and couldn't fulfill my aspirations of further learning. I am grateful to Late Dr. Madhavrao Dixit sir, (Former Dean of TMV) who was introduced to me by Shri. Ramesh Kulkarni. Dixit sir inspired me to register for Ph.D. at TMV, which otherwise I had given up due to unavailability of my subject and area of choice in other places wherever I tried. The journey started with help of senior-most scholars such as Dr. Karlekar sir.

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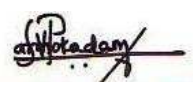
Mopa International Airport in Goa, using matric methodology as one of the tool as a part of my PGDEPCT dissertation, under guidance of Dr. Nandakumar Kamat. However the success story in solid waste management at village level was created only due to my association with Shri. J.K.Rao, IRS, Chairman of Lila trust and other trustees, Shri. Vithal Pawar, Shri. Venktesh Babladi and Gavin D'Souza. **This pilot project was only possible due to inspiration from Shri. Auduthbab Timblo, Chairman of Sociadade de Fomento group of companies** who supported this project financially and due to his continuous guidance during execution of project. I cannot complete my acknowledgement without extending gratitude to ground warrior of VPPDF, Shri.Umesh Fadte, People of VPPDF, All Sarpanches of VPPDF namely Rajesh Naik, Gopal Sawant, Eknath Narvekar, Rajesh Volvoikar, Vishranti Desai, Rajkumar Desai, Hon. MLA Shri Rohan Khaunte and all the staff of VPPDF including Secretaries who served the VPPDF during project duration.

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Thanks to one and all.



Pradip Vithal Sarmokadam

Abbreviations

VPPDF- Village Panchayat Penha de Franca or Village Panchayat Penha de France

GSPCB – Goa State Pollution Control Board, CPCB- Central Pollution Control Board

MoEFCC- Ministry of Environment, Forest & Climate Change

SFI- Sociadade De Fomento Industries

PO- Purchase Order

IEC- Information Education & Communication

NOC- No Objection Certificate

MoU- Memorandum of Understanding

SWM- Solid Waste Management

GSPCB- Goa State Pollution Control Board

OWC- Organic Waste Composter

BMCs - Biodiversity Management Committees

VDCs - Village Developments Committees

PBRs – Peoples Biodiversity Registers

FAO - The Food and Agriculture Organization United Nations

ASSOCHAM - The Associated Chambers of Commerce of India

CRZ – Coastal Regulation Zone, GCZMA – Goa Coastal Zone Management Authority

(**Note** – Wherever other than above given abbreviations are used, either full form is given or they are most common and relevant to the topic of research)

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Chapter I – Introduction

Coastal / Riverine pollution with emphasis on solid waste management in Goa.

1.1 General Introduction

1.2 Large Marine Ecosystems of the World

1.3 Coastline of India and Goa

1.4 Brief survey of available earlier work

1.5 Land Use in Goa

1.6 Coastal Erosion and Mangroves:

1.7 Study Area - Broader Outlook

1.8 Aims and Objectives

1.1 General Introduction: Earth appears blue from space. “The reason it looks blue is the oceans - about 70% of the Earth's surface consists of water. The oceans are a key element for the existence of life on Earth. 97% of all the water on Earth, and 99% of the habitable space on this planet, is in the ocean. The atmosphere we breathe, and which controls the weather and climate, is intimately connected to the oceans - half of the oxygen produced by plants is produced in the ocean, and the oceans are also responsible for absorbing 50% of the carbon dioxide humans have released into the atmosphere by burning fossil fuels for energy. If we are to protect, preserve, and conserve the oceans for our life and health and for the benefit of future generations, we must use the view from space and look as closely as possible at the dynamic forces that stir the colours of the ocean. The coastlines, the irregular boundaries between land and sea. There are about 620,000 kilometres (372,000 miles) of coastline. Over

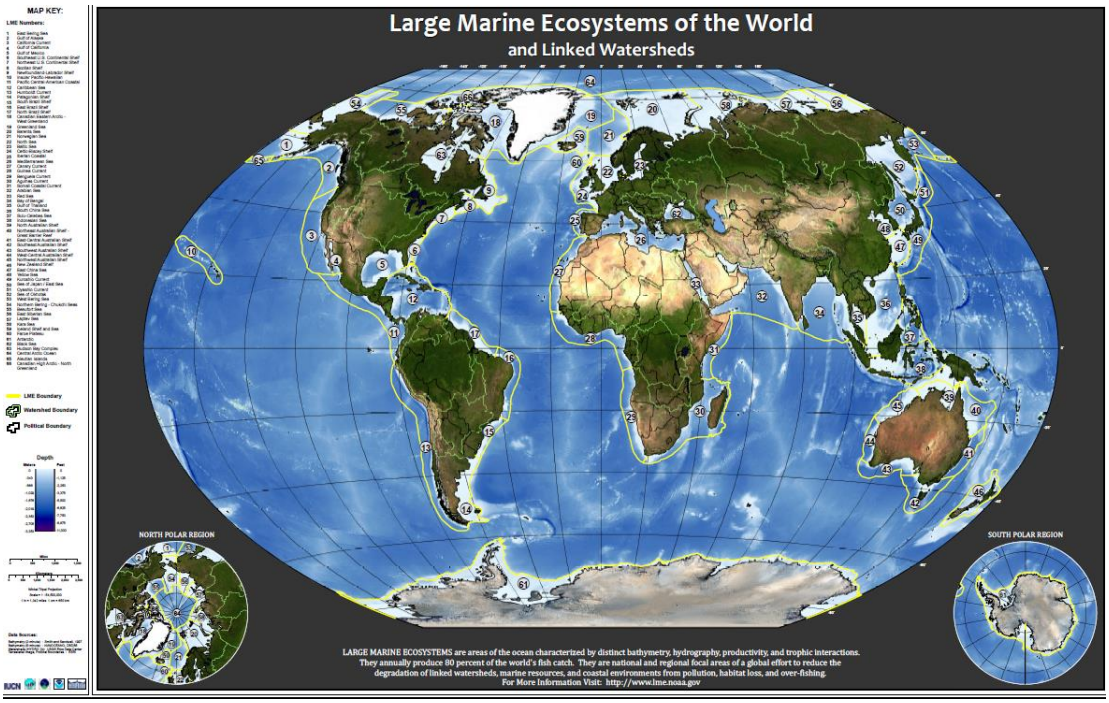
one-third of the total human population, nearly 2.4 billion people, lives within 100 km (60 miles) of an oceanic coast, a fact emphasized by the devastating tsunami in the Indian Ocean in 2004. Since the human population is growing, and because more and more people are living close to the ocean, the human impact on the oceans, particularly the coastal zone, is increasing as well.

Increasing population and their needs for home, shelter, and food lead to depletion of oceanic fisheries, deterioration of water quality, death of coral reefs, and beach erosion. The oceans are also vital to the world's economy through shipping, mineral resources and tourism." (Source: NASA Official, 2017)

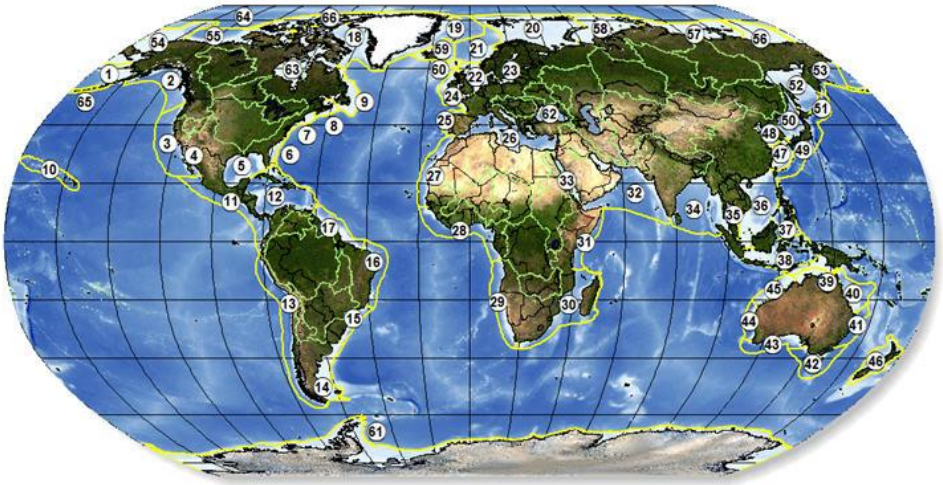
1.2 Large Marine Ecosystems "(LMEs) are relatively large areas of ocean space of approximately 200,000 km² or greater, adjacent to the continents in coastal waters where primary productivity is generally higher than in open ocean areas. These LMEs produce 80% of the world's annual marine fisheries yields ("Sherman et al. 2011" © 2017 Large Marine Ecosystems of the World - Global map of average primary productivity and the boundaries of the 64 Large Marine Ecosystems (LMEs) of the world, available at www.lme.noaa.gov-LMEs - IME 1998-99)

Considering ecosystem and economic services offered by marine and fresh water ecosystems and the dependency of over 80% population for food & livelihood, and rest 100% for water, there is no option but to seriously take care of water bodies around us.

Below placed are the images placed separately in maps section of the thesis.



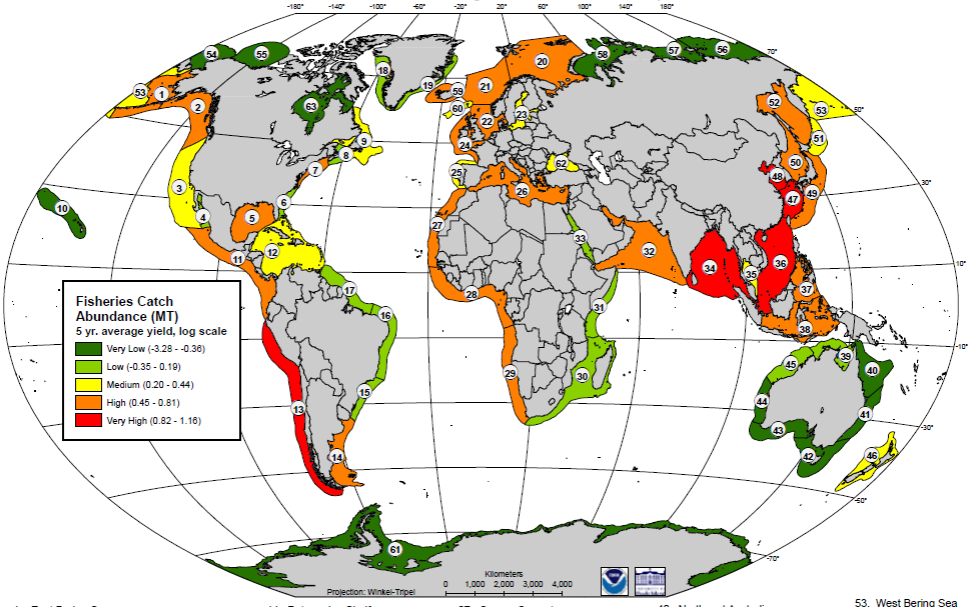
Large Marine Ecosystems of the World and Linked Watersheds



1. East Bering Sea
2. Gulf of Alaska
3. California Current
4. Gulf of California
5. Gulf of Mexico
6. Southeast U.S. Continental Shelf
7. Northeast U.S. Continental Shelf
8. Scotian Shelf
9. Newfoundland-Labrador Shelf
10. Insular Pacific-Hawaiian
11. Pacific Central-American
12. Caribbean Sea
13. Humboldt Current
14. Patagonian Shelf
15. South Brazil Shelf
16. East Brazil Shelf
17. North Brazil Shelf
18. Canadian Eastern Arctic - West Greenland
19. Greenland Sea
20. Barents Sea
21. Norwegian Sea
22. North Sea
23. Baltic Sea
24. Celtic-Biscay Shelf
25. Iberian Coastal
26. Mediterranean
27. Canary Current
28. Guinea Current
29. Benguela Current
30. Agulhas Current
31. Somali Coastal Current
32. Arabian Sea
33. Red Sea
34. Bay of Bengal
35. Gulf of Thailand
36. South China Sea
37. Sulu-Celebes Sea
38. Indonesian Sea
39. North Australian Shelf
40. Northeast Australian Shelf
41. East-Central Australian Shelf
42. Southeast Australian Shelf
43. Southwest Australian Shelf
44. West-Central Australian Shelf
45. Northwest Australian Shelf
46. New Zealand Shelf
47. East China Sea
48. Yellow Sea
49. Kuroshio Current
50. Sea of Japan/East Sea
51. Oyashio Current
52. Sea of Okhotsk
53. West Bering Sea
54. Northern Bering-Chukchi Seas
55. Beaufort Sea
56. East Siberian Sea
57. Laptev Sea
58. Kara Sea
59. Iceland Shelf and Sea
60. Faroe Plateau
61. Antarctic
62. Black Sea
63. Hudson Bay Complex
64. Central Arctic Ocean
65. Aleutian Islands
66. Canadian High Arctic-North Greenland

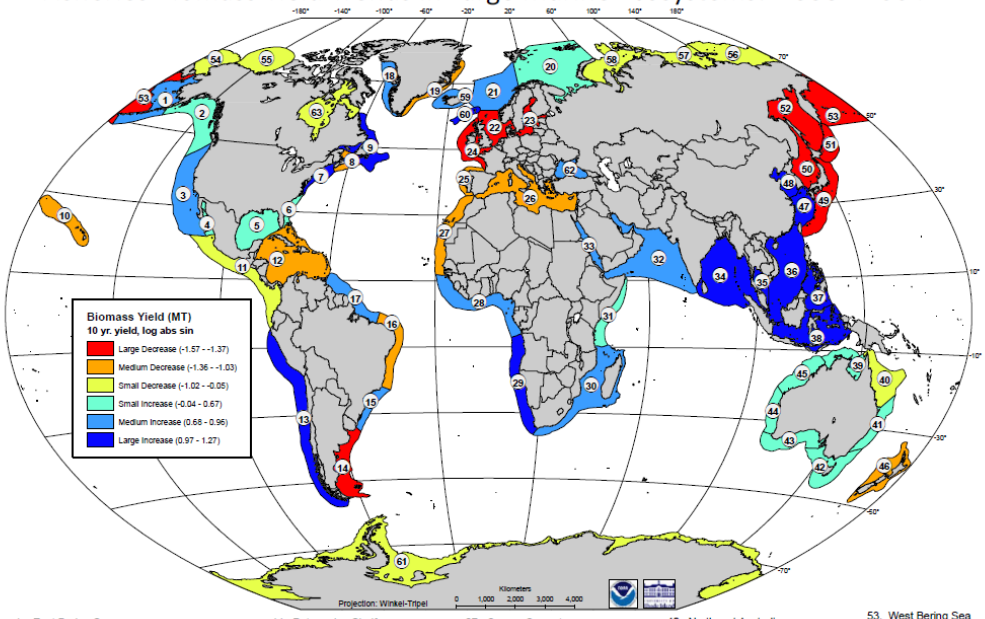
Source: © 2017 Large Marine Ecosystems of the World - LMEs - IME 1998-99

Fisheries Catch Abundance in Large Marine Ecosystems: 2000 - 2004



1. East Bering Sea
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54. Chukchi Sea
55. Beaufort Sea
56. East Siberian Sea
57. Laptev Sea
58. Kara Sea
59. Iceland Shelf
60. Faroe Plateau
61. Antarctic
62. Black Sea
63. Hudson Bay

Fisheries Biomass Yield Trends in Large Marine Ecosystems: 1995 - 2004



1. East Bering Sea
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60. Faroe Plateau
61. Antarctic
62. Black Sea
63. Hudson Bay

Source: © 2017 Large Marine Ecosystems of the World - LMEs - IME 1998-99

After understanding above given four presentations of maps (placed from M1 to M4) about large marine ecosystems and linked watershed of the world, fisheries catch abundance and fisheries biomass yield trends in large marine ecosystems of the world, few conclusions could be drawn such as – The Arabian Sea and Bay of Bengal are the large marine ecosystems existing on the west and east side respectively. The depth of waters the eastern side i.e. Bay of Bengal is shallow than the western side Arabian Sea. Fisheries catch abundance between years 2000 to 2004 is high in Arabian Sea (0.45 to 0.81 MT / Year – Avg.) and is very high in Bay of Bengal (0.82 to 1.16 MT / Year – Avg.). Considering the fisheries biomass yield trends studied over 10 years average show medium increase in Arabian Sea (0.68 to 0.96 MT / Year – Avg.) and large increase in Bay of Bengal (0.97 to 1.27 MT / Year – Avg.).

1.3 <u>Coastline of India and Goa -</u>"India has about 7500 km long coastline. The coastline of India has been undergoing morphological changes throughout the geological past. The present coastal geomorphology of India has evolved largely in the background of the post – glacial transgression over the pre-existing topography of the coast and offshore. Goa as mall state along west coast of India has about 100 km long coast and is characterized by pocket beaches flanked by rocky cliffs, estuaries, bays, and at some places mangroves. Beaches in southern Goa are long and linear in nature with sand dunes. The Mandovi and Zuari estuarine system in Goa is the largest in this part of the coast. Mud flats, swampy marshes and wetlands are found mainly along estuaries and creeks. The beaches of Goa are stable beaches with seasonal morphological changes and annual cyclicity." (Source: G.N.Nayak, 2010)

As per another study, India has a coastline of about 8000 km adjoining the continental regions and the offshore islands and a very wide range of coastal ecosystems such as estuaries,

lagoons, mangroves, backwaters, salt marshes, rocky coasts, sandy stretches and coral reefs {A. David, 2013 (Venkataraman, 2003; Venkataraman and Wafar, 2005)}.

"The coastal zone is characterized by a large variety of forms sandy beaches, rocky shores, river mouths, estuaries, lagoons, inter-tidal flats, wetlands and barrier islands, which have been shaped in the course of geological history. In and around these landforms, a number of specific biological communities have developed, including inter-tidal and marsh communities, mangroves, sea grass and coral reefs. Man has settled in the coastal zone for reasons such as easy accessibility, availability of basic facilities and abundance of food. The coastal zone is a scarce, vulnerable and dynamic territory, where natural, economic, demographic, social and environmental aspects come together. With the increase in population, its pressures on coastal zone in general, coastal resources in particular are rising. This can cause rapid decline in the quality of the coastal zone if no initiation is taken to conserve and manage. (Source: G.N.Nayak, 2010)

Earlier studies about Goa's coastline, particularly around Mandovi River are fairly well documented with respect to their marine ecosystems and biodiversity. There is of course scope for further detailed probe and continued research for deeper understanding about the changes in geomorphology, biodiversity, hydrogeology and various other ecological aspects with respect to developmental impacts from landwards as well as seawards.

Goa is located on the western coast of the Indian peninsula wedged between the Arabian Sea on one side and Western Ghats on the other side {A. David, 2013 (Mascarenhas, 1999; Mahadev et al., 2004, Nagi, 2008)}. Goa encompasses an area of 3,702 km2 (1,430 sq miles) {A. David, 2013(Nagi, 2008)}. It is located between latitudes 15° 48' 00" N and 14° 53' 54"

N and longitudes 74° 20’ 13”E and 73° 40’ 33” E, is 1,022 meters above sea - level and has a coastline of 101 km (63 miles) {A. David, 2013 (Mahadev et al., 2004; Nagi, 2008)}.

Goa experiences tropical weather for most of the year and temperatures vary between 19°C - 32°C {A. David, 2013 (Mahadev et al., 2004; Nagi, 2008)}. The Southwest monsoon hits the state between June and September and July receives the highest rainfall (98 mm), while February is the driest month {A. David, 2013 (Mascarenhas 1999; Mahadev et al., 2004; Nagi, 2008)}.

However, Dept. of water resources has prepared unique layout of rainfall patterns in Goa, as shown below.

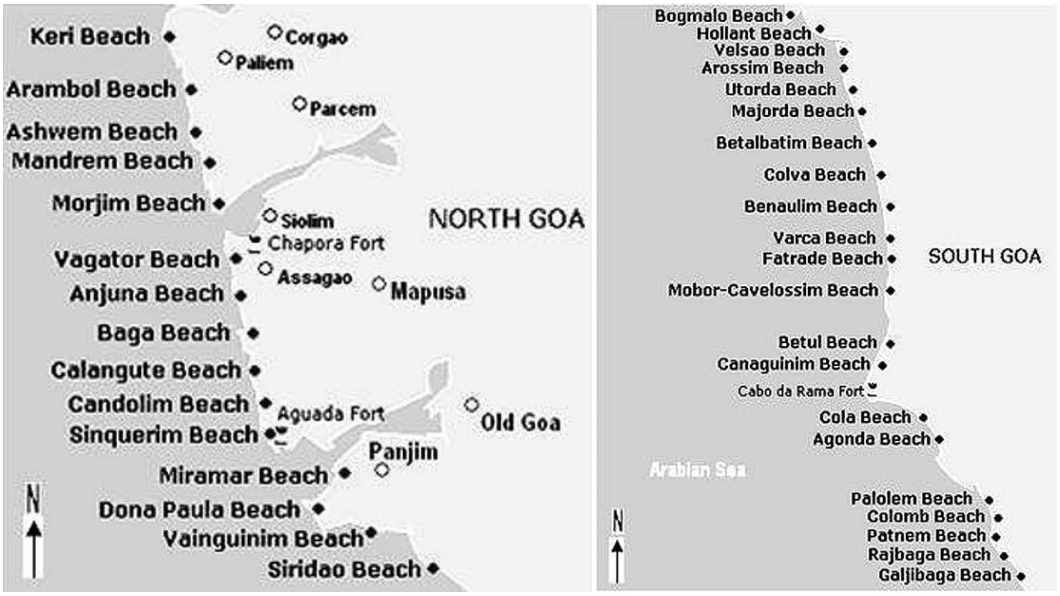


Fig. 1 Extract of map showing north Goa (left site) and South Goa beach stretch (right side)

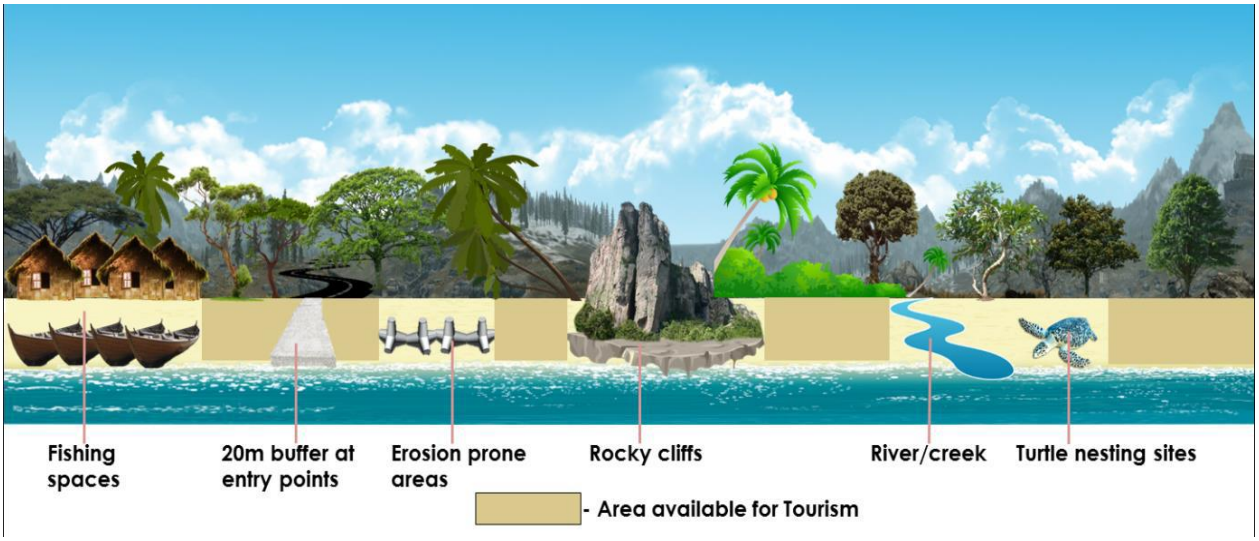
The coastal zone of Goa has been exclusively used for agriculture, farming, shell fishing, traditional fishing and low-key recreation. Native Goans used the shoreline and the hinterland water bodies to fish by using hand-cast and hand pulled nets, gather shells for economic and various other purposes {A. David, 2013 (Mascarenhas, 1999)}. A rapid increase in

urbanization and tourism seems to have affected the biodiversity and distribution of gastropod fauna in this region.

Above contents are extracted from (A. David, 2013)

The study area selected is broadly Porvorim – Bardez – Goa which is a conglomerate of five Village Panchayat (VP) areas namely, VP Penha de France, VP Salvador do Mundo, VP Reis Magos, VP Soccoro, and VP Pilerne Marra. But in order to understand and address the problem under consideration, the research is mainly focussed on VP Penha de France (VPPDF). Further the narrow focus is in the area, then ward no 8 of VPPDF little over one word consisting of 500 households.

The broad area selected is ever-growing urban sprawl which is more near to the capital city of Goa, Panaji and is prime connecting point to most famous North Goa beach areas like Candolim, Calangute, Baga and further extends to other beaches ahead of it. Porvorim also serves as most important destination between Panaji and another significant city of Mapusa in Goa. Below given conceptual drawing shows excellent presentation of coastal features of Goa especially beach areas.



*Conceptual Drawing of **Beach Area Available for Tourism in Goa,** (Source – Beach Carrying Capacity Report 2016, by NCSCM)*

1.4 Brief survey of available earlier work

Extensive survey of existing work relevant to study was carried out. There is more information available on marine and coastal ecosystems than that of waste management problem. However closely relevant statements are included in this study in various chapters and their applicability to the present research is mostly discussed. Below given are some statements, but many are spread across various chapters at appropriate relevance.

Study area lies on the banks of river Mandovi. The area includes coastal zone especially in Britona area, and further till jurisdiction of Salvador-de-Mundo village panchayat.

(Source: ICG, CZM Goa, Dr. Ehrlich Desa, 1998)

"The coastal zone basically looks at all the causes, including all the point and long line sources of land based discharges the affect the sea, their pathways into the coastal waters and processes of their pathways into the marine system. It appears to be a one way process, but could also reverse its direction, for the material that goes from land to sea gets absorbed and resides in what humans have always considered to be an infinite dumping site." (Source: ICG, CZM Goa, Dr. Ehrlich Desa, 1998)

"The subject is presently being discussed in international Science Circles and studied in programme called LOICZ- Land Ocean Interaction in the Coastal Zone. The programme has definition for coastal interaction in the coastal zone, (albeit workable definition used by man and something that nature does not respect too much), "from zero level or the datum level, 200 meters above and from the datum level 200 meters below." This definition, if used for Goa, will probably include all of Goa, up to the Western Ghats and sizable chunk of its continental shelf. There are scientific bases in describing such a large coastal zone for a tiny place such as

Goa is line 26 to 31- this approach is adopted in recognition of the contiguity of the land-ocean system, whose various parts do not function in isolation, but are portions of a larger system. Besides, the coastal zone of Goa that is under consideration, an area of plus 200 meter around sea level is a small part of the earth when environment is considered as global issue." (Source: ICG, CZM Goa, Dr. Ehrlich Desa, 1998)

(Below given statements are selected from Coastal Tourism, Environment and Sustainable local Development - Editors- Ligia Noronha, Nelson Lourence, Jogo Paulo Lobo- Ferreira, Ana Lieopart, Enrico Feoli, Kalidas Sawkar, Adiveppa Chachadi, TERI - 2002)

"The coastal ecosystems referred before conducting this research are sand dunes, coastal vegetation, coastal aquifers, land cover and marine and estuarine waters. There are also the ecosystems that are typically stressed by developmental activity in Indian Costal areas * {Source - Coastal Tourism- ESD, Ligia Noronha et al. TERI 2002 (Rajagopalan 1996, Page2, 27-30)

• Coral reefs (Sensitive ecosystem) not considered in this study as they are uncommon" (Source - Coastal Tourism- ESD, Ligia Noronha et al. TERI 2002).

[This publication is result of collaborative research by three Indian and four European Institutes] "Societal drivers and coastal ecosystems are the two main parameters studied to examine aspects of change and sustainability on the coast. Considering the expanse of the "canvas" of issues, the focus is on what contributes most to the variations observed. As workshops of coastal planners, researches and activists was convened in 1999." (Page 1, line 9, 10, 11 and 12). "Accepted drivers' population growth and migration. Five dominant development drivers of the Indian coast identified were 1. Industry * 2. Tourism * 3. Port

Activity 4. Urbanization 5. Intensive agriculture or aquaculture * [this project collaborative research has focused on the drivers *]" (Page 1, Line 15 to 22). **Tourism being one of the prime economic activity in Goa, the following statement is important "coastal tourism, which is an activity at the interface of humans, land and water.**" (Page 2, line 5&6). "while we have the broader concerns of sustainability in mind, our focus here is on **environmental sustainability, by which we mean a path of tourism development that lasts** in that **it does not stress the health of the coastal ecosystems** of interest, in terms of their ability to provide humans with the goods and services that are required for their continued well-being over time {Source - Coastal Tourism- ESD, Ligia Noronha et al. TERI 2002(Costanza, D'Arge, de Groot, et. 1992; Jacobs 1997; Munasinghe and Shearer 1995)" (line 7 to 14)}. **"**Ecosystem Services" we need such fresh water, breathable air, a stable climate and productive land**.** (R.K. Pachch) The involvement of civil society is important not only because in **democracies today it is playing an increasingly important role in providing link between the government and the communities** but also because its advocacy of issues that directly concern the public has value. **To bring about a change in the right direction, corporate organization in the emerging countries would have to define a totally new set of values** than what was practices by the business organizations in the developed world at similar stages of growth and development. Even the best companies can be surprised by environmental issues. The environment is not a fringe issue- it can cost business real money. **Real benefits can come from seeing things in a new light**. To oversimplify every product known to man come from something mined or grown. **The book you are reading was once a tree.** Behind the green wave lie two interlocking sources of pressure. First the limits of the natural world could constrain business operations, realign markets and

perhaps even threaten the planets well – being. Second **companies face a growing spectrum of stakeholders who are concerned about the environment.** The Science, we stress, is not black and white on all these issues. Some problems, like ozone layer depletion or water shortages are fairly straight forward. The trends are plainly visible on other issues- climate change most notably – uncertainties persists, but the evidence is clear enough and the scientific consensus strong enough to warrant action. Across all societies, we see serious efforts to control emissions and make pollutants pay for the harm they cause." (Source - Green to Gold, Esty & Winston, 2006) The above reference was highly inspiring and objectively relevant to devise strategy to deal with the problem.

Brief review of existing work on marine biodiversity studies on Goan coasts include the studies on bryophytes (Phatak et al. 2007), gastropods (David 2013), fish (Padate 2011; Sluka 2013), Mangroves (Wafar 1987); Sand dunes (Desai and Untawale 2002) and Sea shells (Sonak 2017). Ecosystems such as mangrove ecosystems have been extensively studied for their overall biodiversity, their existing and potential uses and threats (Dhargalkar et al. 2014). Also past studies by Parluekar (1980) had comprehensively documented the benthic diversity of estuaries along the Goan coast. Whereas there are less studies on other sensitive habitats such as coral patches (Manikandan et al. 2016). (No statements are included from above studies but the papers are referred to know the significant research in the field and their mere mention is made)

Some selected studies worth referring, in relation to topic of the present research specific to Mandovi and Zuari estuaries are carried out namely by Satish R. Shetye, M. Dileep Kumar, and D. Shankar (The Mandovi and Zuari Estuaries, NIO – 2007), Tidal Circulation and Salinity Distribution in the Mandovi and Zuari Estuaries: A Case Study by N.T. Manoj* and

A.S. Unnikrishnan (2009)R. Sluka, 2013and many more researchers which will be quoted from time to time as per the relevance.

However, it is important fact revealed after extensive research that, there is no published research work on the problem of waste management in the area studied as a part of this thesis. Hence the work done in this thesis is unique, due to several reasons and aspects. These will be discussed further, but the main feature of this research is interdisciplinary nature, involving environmental, technological, economic, social, local political, statutory and regulatory, Govt. functionaries and related fields and stakeholders.

Below given is an important information regarding existing land-use pattern in a small State of Goa. There is unique systems of landholding, apart from Govt. and individual ownership of lands, there are Communidade Bodies – consisting of members mainly original inhabitants / resident villagers known as Gaonkars are members of these committees in every village and they own huge lands. This system was mainly developed to ensure optimal utilization of lands, prevent them from being fallow, provide opportunity for landless to cultivate and many more holistic reasons by ensuring revenue generation and judicious management of land. However there are many instances of misuse and illegalities, which are being addressed by Govt. from time to time. It is important to learn from below given table that still Goa has considerable forest land which has also shown enhanced mangrove cover. “The Forest types of India were classified in the Year 1936 By Sir H.G. Champion which was later on revised in theyear 1968 by Sir H.G. Champion and S.K. Seth as 'A Revised Survey of Forest Types of India'. The Champion and Seth's (1968) Classification is still in use while many forest types have been changed in their composition and extent due to various anthropogenic and natural factors. Champion and Seth (1968) have used temperature and rainfall data for classifying the Indian

forest into five major groups and 16 type groups (climatic types) and >200 subgroup types. The work of Champion and Seth (1968) although widely accepted in India but the owing to large number of subgroup types at times it is not very feasible for forest manger to manage his forest in according to forest types." (Source - Revisiting forest types of India …, Senthil kumar, Prakash, Rajesh Kannan, A. Prasath and Krishnakumar, 2014)

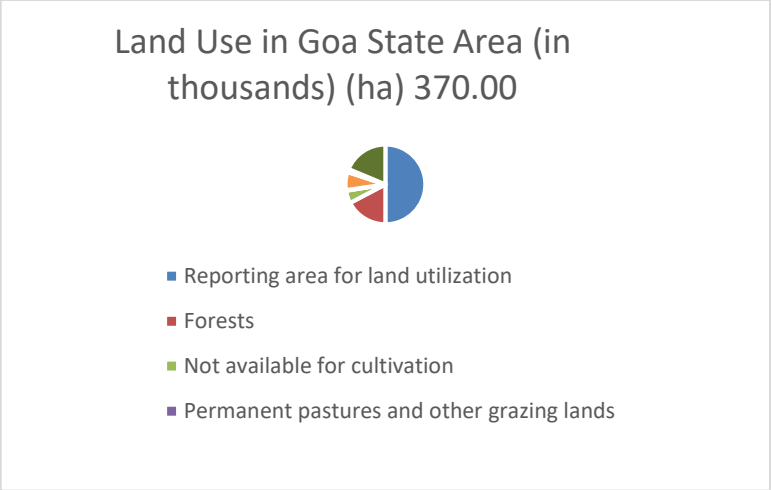
"The forests of Goa are typical of the Western Ghats (Southern Maharashtra and Karnataka). There is diversity in the forests due to the variation in altitude, aspect, soil characters, slope etc. As per Champion and Seth (1968) Classification of Forest types of India, the forests of Goa fall in the following types:-

(i) Estuarine vegetation consisting of mangrove species along narrow muddy banks of rivers
(ii) Strand vegetation along the coastal belts
(iii) Plateau vegetation confined especially to the low altitude
a. Open scrub jungle, b. Moist mixed deciduous forests ,
c. Secondary moist mixed deciduous forests , d. Sub-tropical Hill forests
(iv) Semi-evergreen and evergreen forest.
a. Semi-evergreen forests, b. Lateritic Semi-evergreen forests
c. Evergreen forests" (Source: Forest Dept. Forest Dept. Website 2017 (Champion and Seth (1968)

1.5 Land Use in Goa

Land Use in Goa State		
Land Use	Area (in thousands) (ha)	Percentage
Total geographical area	370.00	NA
Reporting area for land utilization	361.00	100.00
Forests	125.00	34.63
Not available for cultivation	37.00	10.25
Permanent pastures and other grazing lands	1.00	0.28
Land under misc. tree crops and groves	1.00	0.28
Culturable wasteland	53.00	14.68
Fallow lands other than current fallows	0.00	0.00
Current fallows	9.00	2.49
Net area shown	135.00	37.40
Source : https://data.gov.in/catalog/land-use-pattern		

Table 1



Pie Chart of Land - Use in Goa State

In Appendix – 1, given are few pages about the ecological, traditional and socio-ecologically most relevant details including 13 ecosystem regimes in Goa, which are extracted from State Biodiversity Action Plan of Goa, most concise report on Goa, which was prepared by leading scientists of Goa for Goa Foundation (one of the most prominent NGO). This report is very closely relevant to the ecological understanding of the study area. Researcher felt that with due acknowledgement to the report, the contents are included in the thesis to facilitate availability of most relevant contents within the body of this chapter.

State Forest Scenario – (Source of contents in "inverted contents" is Goa Foundation's Goa State Biodiversity Action Plan Report – 2002, http://www.goafoundation.org/completed-projects/biodiversity.html - Dr Nandakumar Kamat presented the summary of the Goa BSAP work at a workshop organized by the CEE on January 15th, 2002, at Dona Paula, Goa, to discuss Rio+10 issues exclusively for the Western region)

"North to South, the length of Goa State is 105 km from North to South and 60 km from east to west. Since in Goa, 84% of existing forests in Goa belong to the Government and 52% of the forest area of Goa falls under Wildlife Sanctuary notifications, protection and regulation is

well ensured. Goa's marine resources like other forest resources are also being shared by immigrants from the neighboring states.

Goa encompasses an area of 3,702 km² (1,430 sq mile). Goa lies between the latitudes 14°53′54″ N and 15°40′00″ N and longitudes 73°40′33″ E and 74°20′13″ E. Most of Goa is a part of the coastal country known as the Konkan, which an escarpment is rising up to the Western Ghats range of mountains, which separate it from the Deccan Plateau. The highest point is the Sonsogor, with an altitude of 1,167 meters (3,827 feet). Goa has a coastline of 101 km (63 miles – Also referred to as 105 Kms in many studies and reports. However, the data from latest studies from NSCSM are also mentioned in this study for understanding aspects more closely. As per State Biodiversity Action Plan by Goa Foundation, the altitude ranges from sea level to more than 600 mts above sea level in the Western Ghats and the geographical area of Goa State is 3702 sq km.)

Goa's main rivers are the Mandovi, the Zuari, the Terekhol, Chapora River and the Sal. The Mormugao harbour on the mouth of the river Zuari is one of the best natural harbours in South Asia. The Zuari and the Mandovi are the lifelines of Goa, with their tributaries draining 69% of its geographic area. These rivers are one of the busiest rivers in India. Goa has more than forty estuarine, eight marine and about ninety riverine islands. The total navigable length of Goa's rivers is 253 km (157 miles). Goa has more than three hundred ancient tanks built during the rule of the Kadamba dynasty and over a hundred medicinal springs.

Most of Goa's soil cover is made up of laterites which are rich in ferric aluminium oxides and reddish in colour. Further inland and along the river banks, the soil is mostly alluvial and loamy. The soil is rich in minerals and humus, thus conducive to plantation. Some of the oldest rocks in the Indian subcontinent are found in Goa between Molem and Anmod on Goa's

border with Karnataka. The rocks are classified as Trondjemeitic Gneiss estimated to be 3,600 million years old, dated by the Rubidium isotope dating method. A specimen of the rock is exhibited in the Goa University.

The state is divided into two districts: North Goa and South Goa. Panaji is the headquarters of the north Goa district and Margao of the south district. Each district is governed by a district collector, an administrator appointed by the Indian government.

The districts are further divided into twelve talukas – Talukas of North Goa are Bardez, Bicholim, Pernem, Ponda, Sattari and Tiswadi, the talukas of South Goa are Canacona, Mormugao, Quepem, Salcete and Sanguem. Headquarters of the respective talukas are Mapusa, Bicholim, Pernem, Ponda, Valpoy, Panjim, Chaudi, Vasco, Quepem, Margao and Sanguem.

Goa's major cities include Vasco, Margao, Mormugao, Panaji and Mapusa. The region connecting the first four cities is considered a de facto conurbation, or a more or less continuous urban area.

(Source: Dept. of Information & Publicity – Govt. of Goa)

State	Erosion Length(km)	Accretion Length (km)	Stable Length (km)	Total Length (km)
Goa	27.03	46.98	81.38	155.39

Length does not include river mouth, creeks etc.

State		Area Under Accretion (Sq km)	Area Under Erosion (Sq km)	Net gain/ loss (Sq km)
Goa		1.53	0.771	0.759

(Source: NHO, (SAC and CWC) using satellite data of 1989-91 and 2004-06 time frames)

1.6 <u>Coastal Erosion and Mangroves</u>: owing to sea level rise: For the 21st century, the benefits of protecting against increased coastal flooding and land loss due to submergence and erosion at the global scale are larger than the social and economic costs of inaction (limited evidence, high agreement). Without adaptation, hundreds of millions of people will be affected by coastal flooding and will be displaced due to land loss by year 2100; the majority of those affected are from East, Southeast, and South Asia (high confidence). {5.3.4.1, 5.4.3.1} At the same time, protecting against flooding and erosion is considered economically rational for most developed coastlines in many countries under all socioeconomic and sea level rise scenarios analysed, including for the 21st century GMSLR of above 1 m (limited evidence, high agreement). {5.5.5} (Source - Working Group II to the Fifth Assessment Report of the IGPCC, 2014). Shoreline changes induced by erosion and accretion are natural processes that take place over a range of time scales. They may occur in response to smaller-scale (short-term) events, such as storms, regular wave action, tides and winds, or in response to large-scale (long-term) events such as glaciation or climate change that may significantly alter sea levels and tectonic activities that cause coastal land subsidence or emergence. Hence, most coastlines are naturally dynamic, and cycles of erosion are often important feature of their ecological character. A combination of these natural forces and human activities often exacerbate coastal erosion in many places and jeopardize opportunities for coasts to fulfil their socioeconomic and ecological roles in the long term at a reasonable societal cost (Prasetya, 2012). Sea level changes can be of two types: (i) changes in the mean sea level and (ii) changes in the extreme sea level. The former is a global phenomenon while the latter is a regional phenomenon. Estimates of mean sea level rise made from past tide gauge data at selected stations along the coast of India indicate a rise of slightly less than 1 mm/year;

however these estimates need to be corrected by including the rates of vertical and movements, whose measurements are not available at present. (Unnikrishnan et al., 2006)

Mangroves: The definition that {Kathiresan and Bingham, 2001 (Duke (1992)} adopts for a mangrove is a ‘tree, shrub, palm or ground fern, generally exceeding one half meter in height, and which normally grows above mean sea level in the intertidal zone of marine coastal environments, or estuarine margins, Mangroves are quite old, possibly arising just after the first angiosperms, around114 million years ago {Kathiresan and Bingham, 2001 (Duke (1992)}’.“Mangroves flora in Goa comprises of 15 species generally dominated by Rhizophora mucronata,Avicennia alba, Sonneratia alba, S. caseolaris, Exoecariaagallocha and Acanthus ilicifolius. Kandeliacandal found in the oligo-haline region has better formation in Goa as compared to other state {Singh, Ansari, Kumar and Sarkar, 2012 (Jagtap & Singh, 2004)}. While reporting the total number of “Mangrove species” associates or riverside vegetation that occur occasionally within the mangrove”. It is by now established after intensive research that mangroves mostly grow in the intertidal zone and each mangrove appears in certain specific tide levels. Some species common at the seaward mouth of an estuary are not present near the fresh, more riverine headwater regions of the estuary. “A wide variety and assortments of fish, molluscs, crabs and prawns inhabit here. The amphibious mud-skipper fish such as Periopthalmus sp. and Boleopthalmus sp.arouse considerable interest. The fauna also found are Whale Shark, Tiger Shark, Hammer Headed Shark, Sawfish, Guitar fish and some common edible fish e.g., Hilsailisha, Setipinnabreviceps , Setipinnataty , Gudusiachapra etc. Among the crustaceans, commonly found are the One Armed Fiddler Crab (Ucaspp) and the two species of trilobite (Tachypleusgigus and Carcinoscorpiusrotundicauda). The latter is also known as the Horse Shoe Crab, which is known as a living fossil and needs

serious protection owing to its medicinal value and uncontrolled collection by quack doctors for commercial purpose. (Singh, Ansari, Kumar and Sarkar, 2012)

Bowman (1917) and Watson (1928) added, that the frequency of tidal flooding, salinity and soil type were the important determinants of mangrove zonation. The average variations in water pH 5-7 and average 15-28 ppt salinity was observed in major rivers but in minor rivers during low tide estuary water reside toward the sea with small oasis like patches and during high tide sea water reaches upstream thus there is no much difference in water except in rainy season and in upstream check dams. During rainy season fresh water influx is more at upstream and it starts gradually decreasing from Feb. to May and the variation in salinity recorded is 0-34% in minor and major rivers and it is also noticed that when there is increase in Dissolved Oxygen there decrease in Carbon-di-oxide and vice versa. The Oxygen content and Carbon-di-oxide content is in range of 3.5 to 5ml/ L1 at NTP and 0.75- 1.5mg at NTP respectively. There was not much variation in water and air temperature recorded of minor rivers but in major rivers like Zuari, Mandovi and Chapora etc it is noted that there is increase in water and air temperature at river mouth compared to upstream region. There was wide variation in content of sand silt and clay composition in every sub –station and it was noticed that silt and clay composition gets increased during monsoon and post monsoon season which is due to surface runoff and settlement of silt and clay respectively.

Mangrove planting programs were initiated by department of forest, Government of Goa. Mangrove replanting programs were initiated and supported with the help of governments and non-governmental organizations. However, the success of such programs depends on the selection of suitable species based on the prevailing edaphic and hydrological conditions at the planting site. True mangrove species are characterised by adaptations to harsh environmental

conditions. However, most species show optimum growth only under a rather narrow range of conditions, and whilst they may be capable of growth under suboptimal conditions for a few variables, multiple sources of stress will lead to high mortality {Jayatissa, Wickramasinghe, Dahdouh-Guebas, and Huxham, 2008 (ALLEN et al., 2003; HWANG and CHEN, 2001; YE et al., 2005)}.

India has a long coastal line of over 7500 km supporting vast habitats such as lagoons, backwaters, estuaries, coral reefs and mangrove swamps. Among them, the mangrove ecosystem commands the highest importance because of its biological productivity and specialized diversity. After coral reefs, mangrove forests have the highest productivity among the coastal wetlands. With regard to biodiversity, mangroves support a unique group of fungi, microbes, plants and higher animal species including several species of migratory water birds. Such unique wetlands are in peril due to increasing salinity in recent times especially after the tsunami of 2004. It is time to control the increasing salinity, failing which the Indian subcontinent stands to lose its unique coastal biodiversity which, in turn, might affect the marine food web of the entire tropical region. (Sandilyan, Thiyagesan, Nagarajan and Jayshree Vencatesan, 2010)

The increasing human habitation in the coastal areas of the world that is estimated to reach 6 billion by 2030 provides the inevitable need for biodiversity conservation. In most of the developing countries, priority of necessity is given to food production and socio-economic development, which are often at the expense of biodiversity conservation. **Mangrove habitats have survived the onslaught of man by using them as sites for dumping of organic wastes.** Their survival is because of three reasons: (1) flow through the habitat disperses wastes from a point source over vast areas, (2) the vegetation itself filters nutrients from the

water, and (3) the mangrove soil, algae, microbes, and physical processes absorb large amounts of pollutants (Wong et al., 1995). Mangroves such as Avicennia spp. in general are tolerant to high organic load. In Indonesia, Avicennia spp. and Acanthus ilicifolius are planted in aquaculture ponds for controlling salinity and pH in rainy season (Lacerda et al., 2002). {Prof. K. Kathiresan, 2012 (Wong et al., 1995), (Adeel & Caroline, 2002), (Lacerda et al., 2002)}.

Mangrove areas are ecologically sensitive and important because they are rich in genetic diversity, act as breeding and spawning grounds of fish, other marine life and nesting sites for sea and shore birds.

With 20% of its total geographical area dedicated for the proliferation of wildlife, the state of Goa has 6 Wildlife Sanctuaries and 1 National Park. These protected areas are provided with complete protection to the fauna & flora to conserve the unique biodiversity of the State. (Source – Forest Dept.)

Topographically, Goa falls into 3 distinct areas: the mountainous region of the Western Ghats, the midland plateau region, and the low-lying river basins with the coastal plains. Every region of Goa is interrelated with every other in a complex manner, and changes occurring in one area are bound to have consequences on the others. Therefore Goa should be considered holistically as conglomerate of sensitive ecosystem when considering any region of the state.

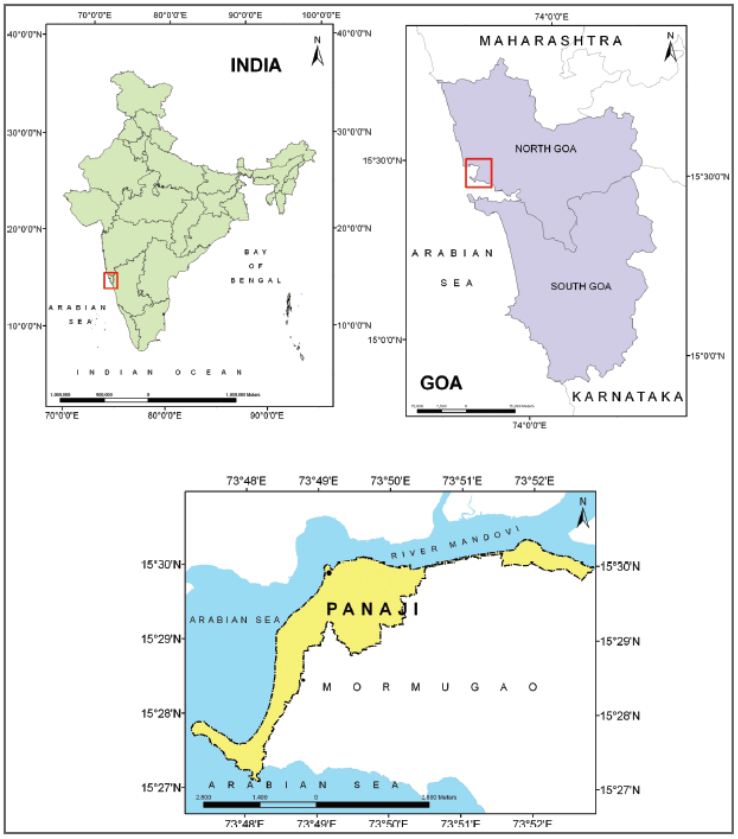
The coastal ecosystem is the most fragile and at the same time, the most threatened of Goa's ecozones. This is the area of close interaction between sea and land, between water, wind and sand dunes, between brackish water and mangrove populations. The continued health of this region is crucial for the survival of the Goan ecosystem as a whole.

Agriculture occurs in the riverine and alluvial plains of the coastal belt. The cultivation of traditional or indigenous varieties of rice is needed and should be propagated, as indigenous varieties have resistance to pests and viral attacks as the basis of their survival for centuries. Khazan lands, unique to Goa, have their major importance in their high adaptability to both agriculture and pisciculture and their ability to serve as emergency storm water receptacles.

Goa has unique styles of agricultural practices such as 'Puran-Sheti' (farming carried out in flowing water), Kumeri (traditional form of creating farming plots on forested hill slopes by tribal and forest dwellers whereby such plots are cultivated for few years and again allowed to fallow and return to the forest – crops taken are vegetables, pulses or millets, etc.) cultivations, seasonal vegetable and other farming practices, paddy cultivation in khazan lands and excellent management of mangrove ecosystem surface saline water management by deploying sluice gates. Traditionally several communities are associated and dependent on this unique system. Above mentioned system is an important component of coastal ecosystem which constitutes second line of defence from sea level rise and climate change.

The open sea coast/beach areas as well as the khazan lands are under threat from the combined effects of climate change, urbanization, industrial and domestic pollution. Pressures on coastal areas are placing severe strains on the harmonious relationship that earlier existed between man and nature. Sand dunes along the open sea coast are the worst affected, the destruction of which is almost exclusively anthropogenic. The degradation of sand dunes poses various consequences for the coastal environment. The khazans, being seaward agricultural lands, become affected by saline water ingress, which is not arrested due to the destruction of sand dunes and mangroves. This may render khazans no longer suitable for paddy cultivation if inundation by saline water occurs. Efforts towards the protection and conservation of these

coastal resources are therefore imperative as adaptive measures against the impacts of climate change.



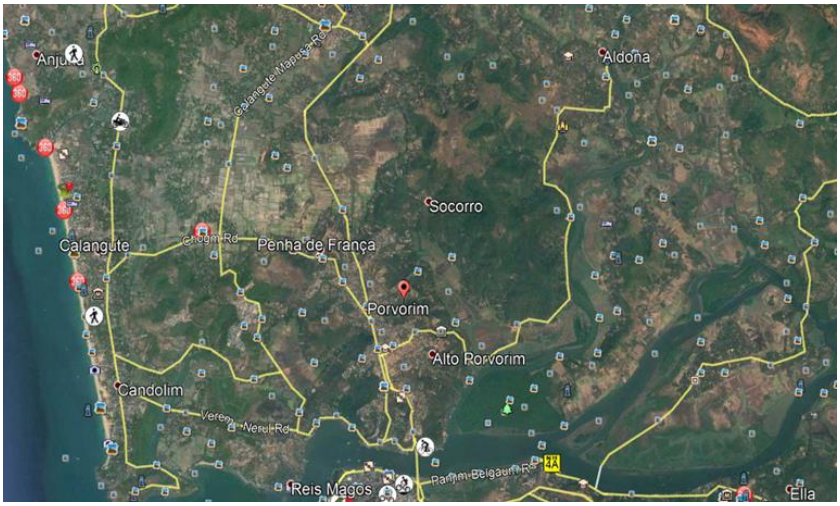
Source of Above Maps: TERI Report on Panaji (PCRCC: WP-Oct, 2014)

1.7 Study Area – Broader Outlook

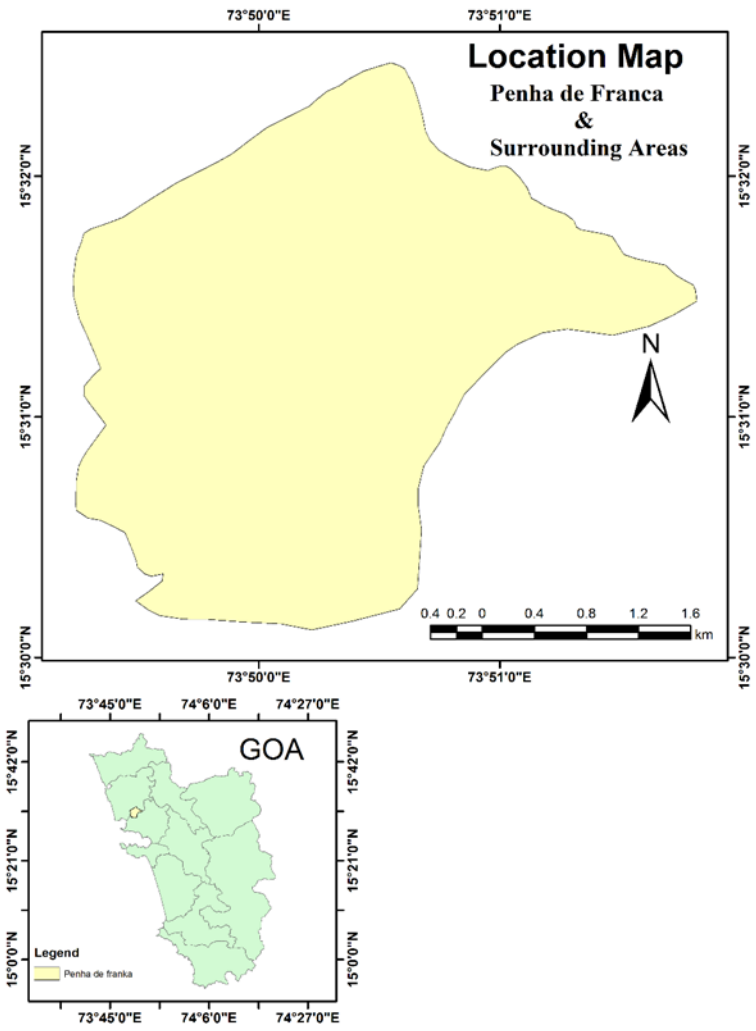
Study area is broadly, Porvorim an urban sprawl of Panaji the capital city of Goa and specifically focused on Village Panchayat Penha de France (sometimes referred as Penha de Franca - VPPDF). The study area lies in North Goa District and Bardez Taluka of Goa State, a tiny State of India.



Above photograph shows View of Goa Legislative Assembly from Riverside Mangroves View from River to Plateau (Pic credit – Shri. Nirmal Kulkarni)



Google Earth Image Showing Study Area in Porvorim



Above map shows location map of study area – Placed at M1

Porvorim plateau, has overlapping areas of five village panchayat of Goa, on the North is VP Soccoro, on the East is VP Salvador do Mundo and VP Penha de France extending till Southwards and on the West is VP Pilerne Marra and VP Reis Magos extending till south. On the southwards lies Mandovi River that further flows eastwards. Also a renowned forest bird sanctuary named as Dr. Salim Ali Bird Sanctuary is located on the south east side of the plateau.

Descript ion of specific study area: It is a plateau on the banks of river Mandovi. The area includes river bank areas starting from Betim and extending towards Britona area and further till jurisdiction of Salvador-de-Mundo village panchayat.



Above Photograph shows mangroves and Human Inhabitations in Study Area (Pic credit – Shri. Nirmal Kulkarni) Stake-Net fishing technique is seen whereby vertical bamboo poles are used to create fence. Nets are set like veils between bamboo poles known as Cuttani – locally known as Phutani. The fish catch is harvested periodically during low tide based on the experience.

Study area is Porvorim, an urban sprawl of Panaji the capital city of Goa. Specific focused is on Village Panchayat Penha de France (sometimes referred as Penha de Franca - VPPDF). The study area lies in North Goa District and Bardez Taluka of Goa State.The study area selected broadly Porvorim – Bardez – Goa consists of areas five Village Panchayat (VP) namely, VP

Penha de France, VP Salvador do Mundo (part area), VP Reis Magos (part area), VP Soccoro (part area), and VP Pilerne Marra (part area). In order to understand and address the problem under consideration, the research is mainly focussed on VP Penha de France (VPPDF). Further the narrow focus is in the area, then ward no 8 of VPPDF little over one word consisting of 500 households.

1.8 Aims and Objectives:

Aims of the study are the statements which will reveal the intent of research and broader outcomes of the study.

1. To understand the existing environmental problems in the study area and address top priority issue of solid waste management by taking pilot scale restoration work.
2. To understand the problem of solid waste management, collect local relevant data, decide the strategy, approach and develop sustainable working pilot scale project in study area.
3. To record and document the lessons learnt from the pilot project so as to provide guidelines to tackle similar problems elsewhere.

Objectives of the study: are the detailed steps to achieve aims of the study. They are the objective statements which will lead to realization of desired outcomes of the study.

1. To understand the background ecological setup of the study area and understand the various environmental problems.
2. To prepare prioritized approach for addressing the problems.
3. The model concept and implementation model to be prepared by incorporating environmental and economic aspects.

4. To understand various intricacies, aspects, data analysis and role of stakeholders with respect to the problem under study - namely solid management problem, using scientific methodology.

5. To understand various impacts on environmental set up of the area by considering existing ecosystems in the area.

6. To provide recommendations based on experiences and lessons learnt after implementation of pilot project at VP Penha de France and arrive at sustainable model.

Chapter II –The Review of Literature

2.1 Literature review

2.2 Introduction to the study area

2.3 Criteria for selection of the study area

2.4 Important Features, Biodiversity and Environmental conditions

2.5 The pattern of area development in study area

2.6 Environmental set up of the study area

2.7 Biodiversity in the study area

2.8 Observations during field work in the study area: Mangrove forests

2.9 Mangroves mortality – an issue

2.10 Malim Fishing Jetty

2.11 Role of coastal /riverine ecosystems

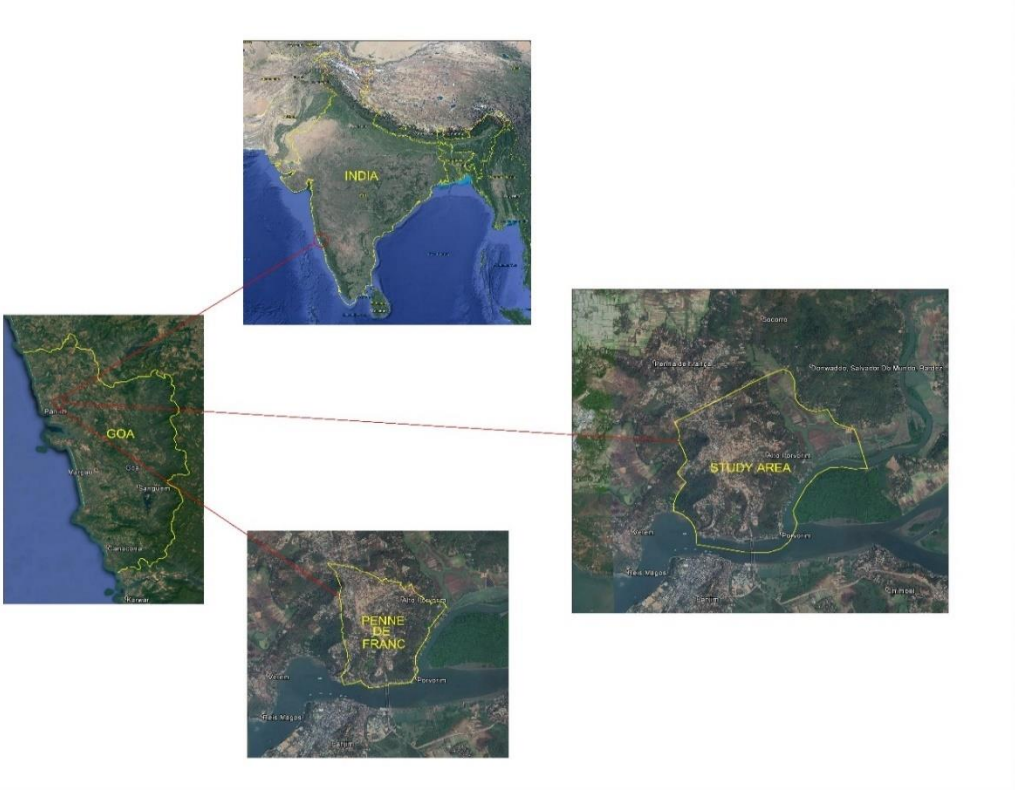
2.1 Literature Review:

Format used for literature survey with sample data filled is given below. This format was mainly used to extract most relevant information from the books.

LITERATURE SURVERY	**PRADIP VITHAL SARMOKADAM**	**PH.D**	**Sheet No : -**
Topic - DEVELOPING MODEL FOR SUSTAINABLE SOLID WASTE MANAGEMENT AT VILLAGE PENHA DE FRANCA - EMPHASIS ON ECOSYSTEM PRESERVATION IN AND AROUND PORVORIM - GOA			**Date : 15th August 2013** **Alphabet : E**
Name of book	Environmental Economics - In theory and practice		
Name of the Author	Nick Hanley- University of Stirling, Jason F. Shogren – University of Wyoming and Ben White – University of New Castle upon tyne		
Publication & other details	Macmillan India led. 1999 (reprinted) by permission Copyright licensing Agency 190, Tottenham Court Road, London WIPGHE		**P / U / Thesis (Grad / Masters / Ph.D / Dissertation _____ / Others _____)**
Summary of contents			
Page No & Line No			
Page 3, line 1	Economy Environment Interaction fig 1.1		
Page 2, line 24	the Environments first role, then, is as a supplier of resources. Its second is as a sink or receptor, for waste products. These wastes may result directly from products, as already mentioned, or from consumption : when am individual puts out their garbage or when they drive to work they are contributing to this form of waste. In some cases wastes are biologically and or chemically processed by the environment.		
Page 2, line 32	whether this results in harmful affect on the estuary depends on a number of factors, including the volume of waste relative to the volume of receiving water, the temperature of water and its rate of replacement.		
Page 3, line 8	Only once the oxygen in the river drops below a critical level so that, for example fish are no longer present, does the effect become 'significant' on some criteria.		

Information collected from other sources was directly included in the chapters with due acknowledgement.

2.2 Introduction to the study area:



Google Earth Image Showing Study Area & VPPDF with Reference to the Country & State

Broader area of study is Porvorim and focus area is VP Penha de France. "Porvorim (Konkani:पर्वरी/Porvorim, pronounced /pɔrʋɔrĩ/) is the legislative capital of the state of Goa, India. It is situated on the right bank (north bank) of the river Mandovi. The administrative capital Panaji (Panjim) is located on the opposite bank. Considered as suburb of Panjim, Porvorim is considered an upmarket residential hub as it lies on the prime Mumbai-Goa highway NH-17.

Porvorim is hardly a couple of kilometres from the state capital, Panaji. A second city, Mapusa, is situated some 7 kilometers from here. Officially a village, it provides facilities no short of that of a town or a small city. Tourist folks usually visit this peaceful paradise to enjoy

some leisure. As of the other parts of Goa, Konkani remains the predominantly spoken language. Many housing localities and complex are also located in Porvorim such as Defence Colony, Saldanha Colony, Nova Cidade, Sapana Gardens, Landscape City etc. Porvorim is well connected by roads. The Mumbai-Goa highway NH-17 runs through Porvorim. Porvorim is still a developing area. Large number of shops are coming up in Porvorim. Porvorim still has a lot of green areas. There is lots of area left for future development. Porvorim now is particularly a residential area with educational institutions around. There are several restaurants in **Porvorim**, such as Biryani Palace, O'Coquiroestaurant, Casino Motels, Don Pedro's Restaurant, Cajueiro restaurant, Tapasvi restaurant, Sanskruthi pure veg restaurant, Chandrakant restaurant, Hotel Patrao bar & restaurant, Mona Lisa bar & restaurant, Picnic Restaurant & Pub. Alua-Sangolda," (Source: Govt. of Goa Website, 2017)



Google Earth Image Showing Mandovi River & Study Area in the North (Enlarged copy placed at M2& M3)

Few Prominent Educational and other Government Institutes in Porvorim	
Sr. No.	**Name of Institution / Body**
1	Goa Legislative Assembly & Secretariat Complex
2	Directorate of Education
3	Goa Board of Secondary and Senior Secondary Education
4	Directorate of Technical Education
5	Campus of Water Resources Dept.
6	Campus of Porvorim Police Station
7	Campus of Goa Housing Board
8	Campus of Dept. of Statistics & Other Govt. Bodies - Deendayal Upadhyay Bhavan
9	Capus of Goa Cricket Association
10	Campus of Institute of Hotel Management, IHM
11	Vidya Prabodhini Parivar's L.D. Samant High School along with Vidya Prabodhini Higher Secondary School
12	ACDIL High School
13	Holy Family High School
14	Teachers Training College
15	Thomas Stefens Konkani Kendra
16	Sanjay School for the disabled
17	Dattaram Chopdekar High School
18	Gnyan Vikas High School
19	Working Womens Hostel
20	Campus of Father Pillar Seminary Near Porvorim Police Station
21	Mall de Goa - Huge mall on highway side
22	Many private pre and primary schools as well as play schools such as Kids kingdom, Chubby Chicks, etc.
23	Many private institutes such as Ann Institute of Hotel Management, etc.
24	Many private halls such as Azad Bhawan, Kshatriy Maratha Samaj Hall, Sant Gadge Maharaj Hall, etc.
25	Many private hospitals such as Chodankar Nusring Home, Goa Scan Centre, RG Urology and laparoscopy hospital, JMJ Hospital, Bhale Hospital, Dr. Kinil's, Dr. Chandrashekhar Naik's Hospitals, Accupuncture Hospital of Dr. Prabhu, etc.

General information about Village panchayat Penha de France is as follows:

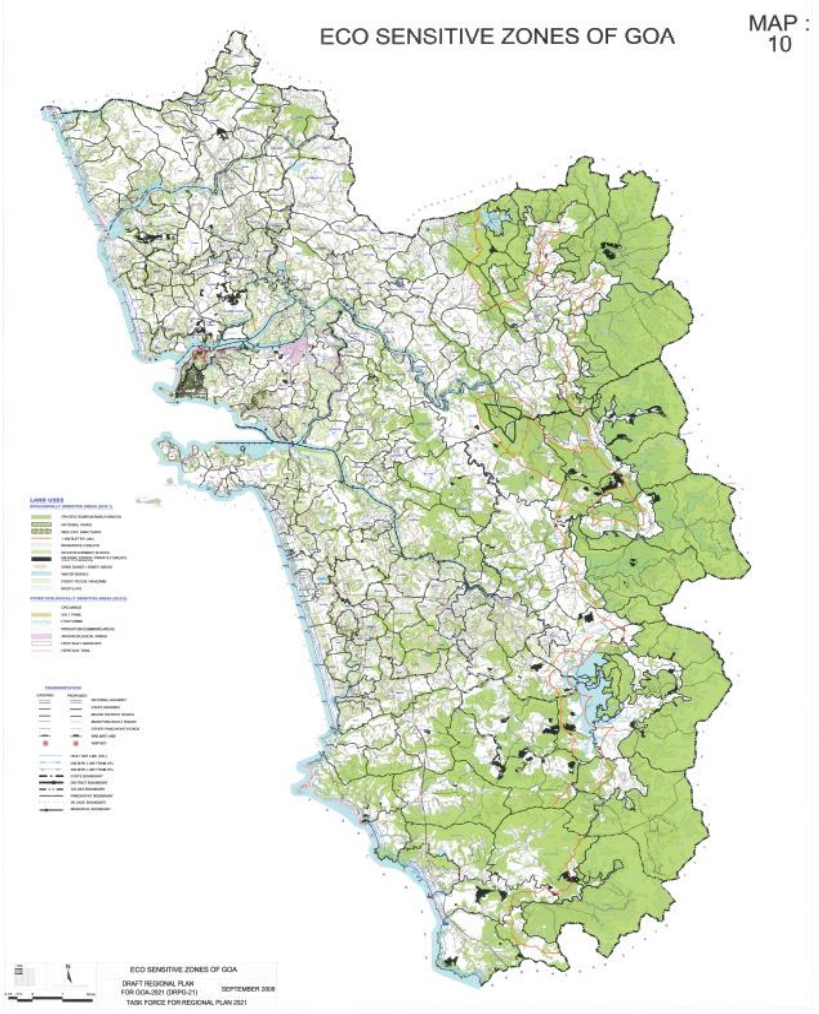
VP PENHA DE FRANCE

1) Total No. of wards- 11
2) Population- 15375(2002 census)
3) No of males-8199
4) No of females- 7176
5) No of houses- 4085
6) No of shops/ establishments- 579
7) No of churches/chapels- 3
8) No of temples- 8
9) No of Gurudwara's- 1
10) No of Anganwadis- 7
11) No of govt. primary schools- 3
12) No of high schools- 1
13) No of private schools- 3
14) No of private higher secondary schools- 1
15) No of colleges- 1
16) No of other institutions- 0
17) No of sluice gates- 1
18) No of fishing jetty- 1
19) No of gardens- 4
20) No of community halls-1
21) No of play grounds- 1
22) No of crematoriums- 1
23) No of petrol pumps-4
24) No of Govt. hospitals-0
25) No of industries- 2
26) No of disabled schools- 1

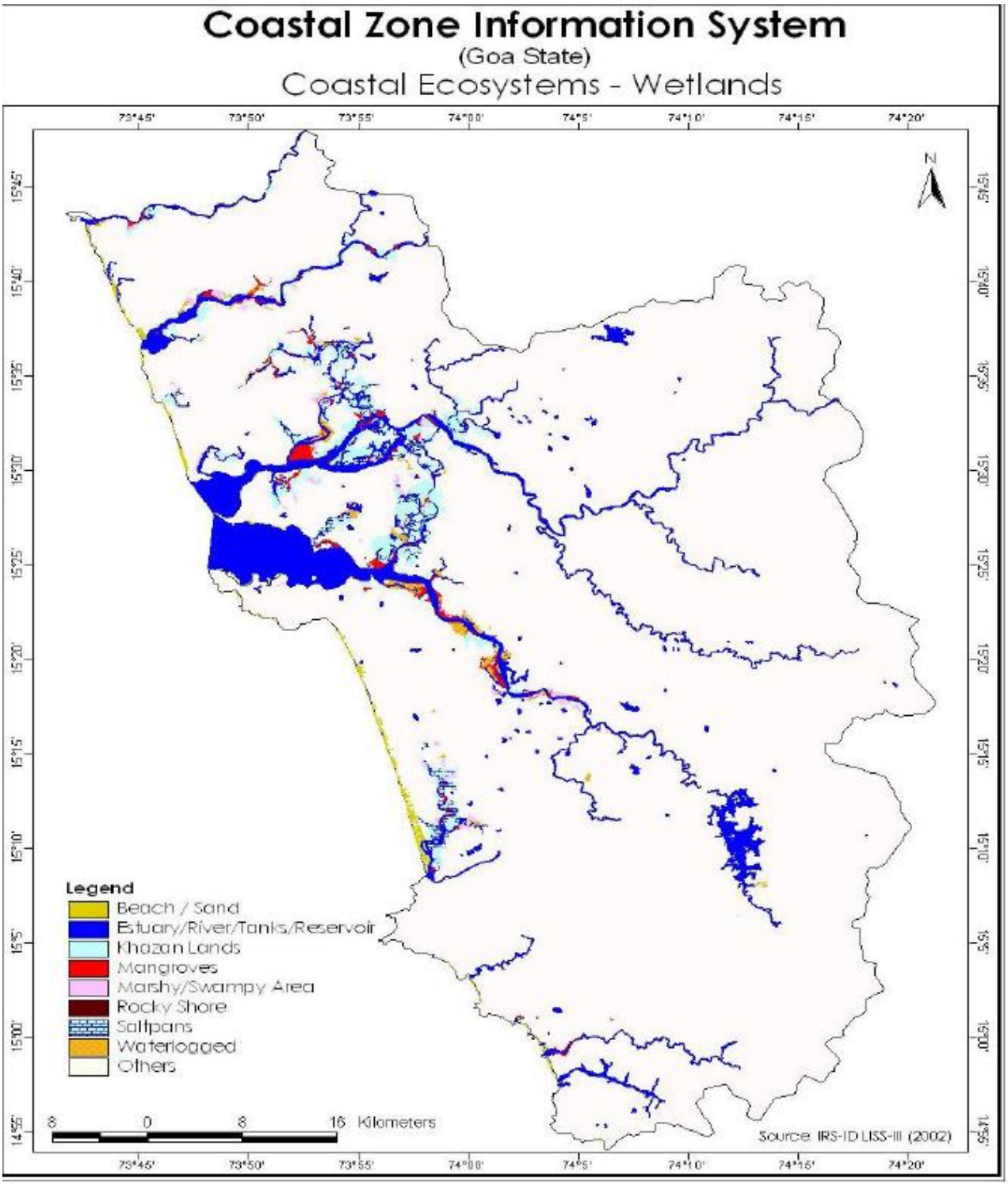
Population / Density
2001- 15377 / 2001- 2837 (people/ sq.m)
2021- 27274 / 2021-5032
As per Regional Plan 2021 projections, (Source: VP Penha de Franca)

Area of study area = Area: 11.04 sq km,

As per the draft regional plan maps prepared for 2021, detailed map of Bardez Taluka of Goa is in optimum scale. It shows detailed land-use patterns of the area projected for 2021. These maps are prepared after public consultations but are subjected to changes as the time goes ahead and depend upon the prevailing socio-political opinion while approving the same. However these are the available maps presently on digitized platform.



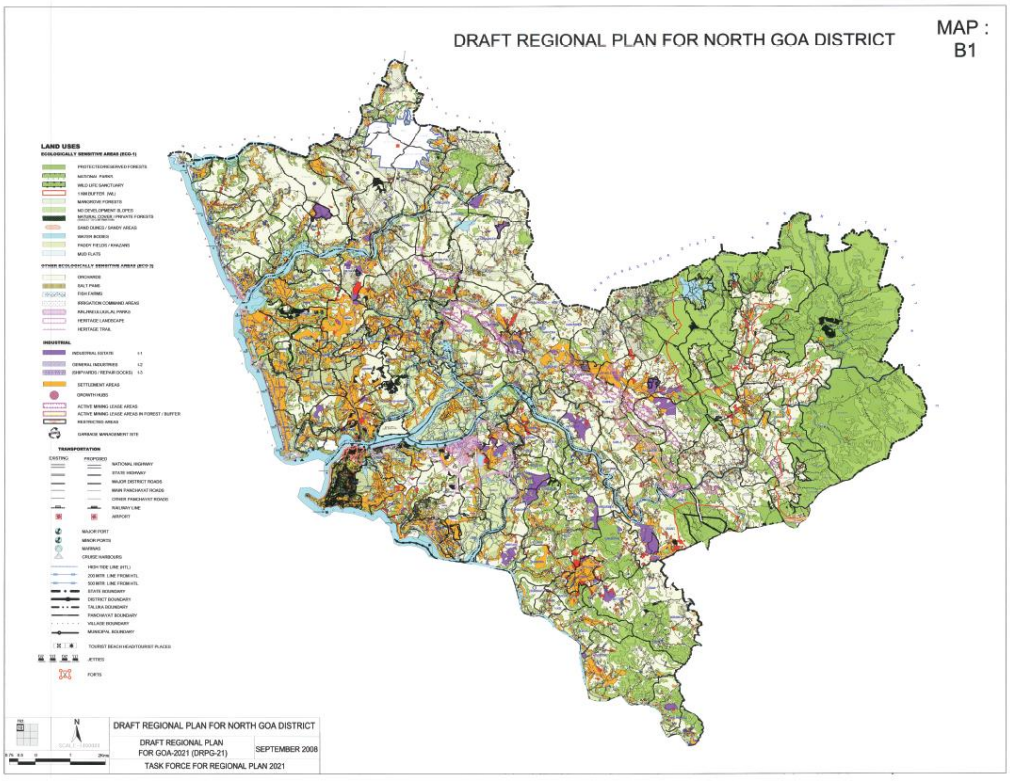
Above shown is the map of Eco-Sensitive Zones of Goa



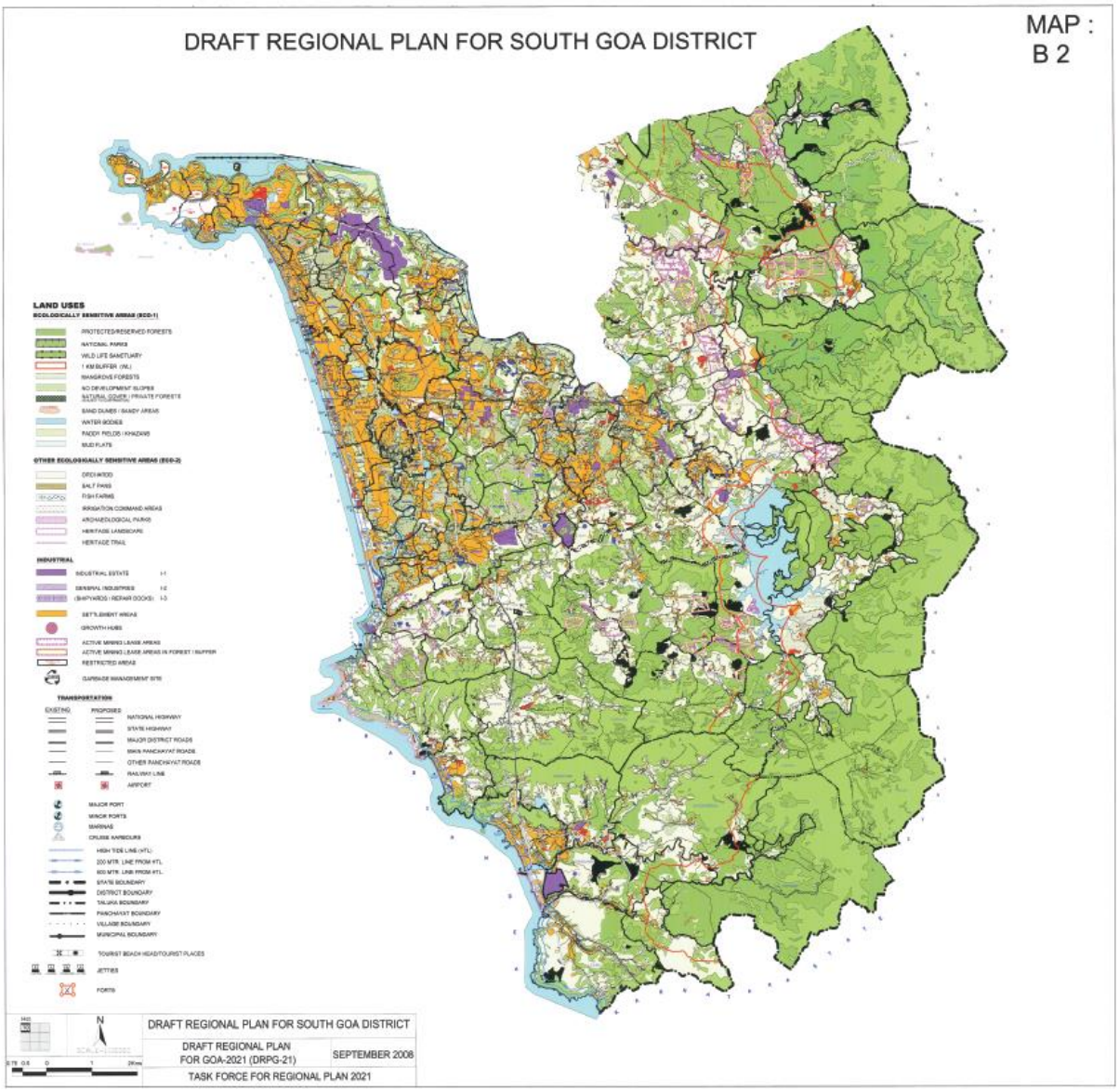
Above shown is the map of Coastal Wetlands of Goa, (Source: Integrated Coastal Zone Management – A Case Study from Goa by D'Souza and G.N.Nayak – 2008)



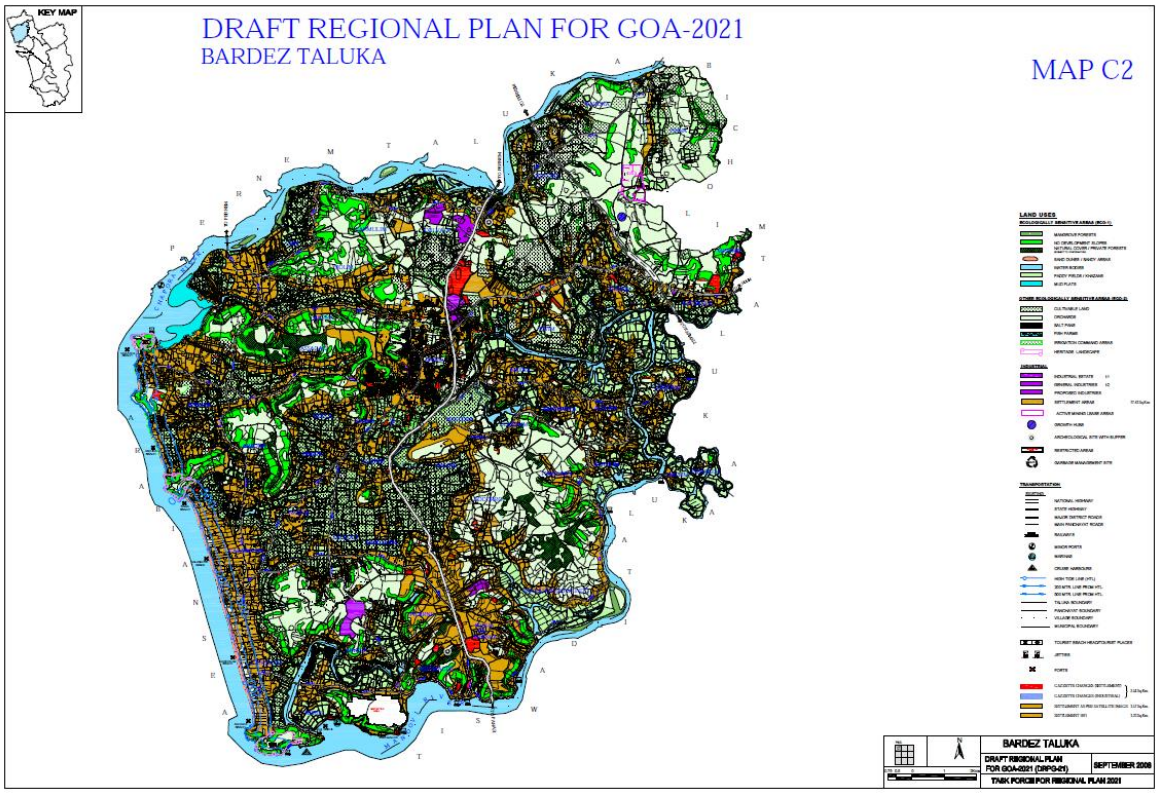
CRZ Areas of Goa are shown in above image



<u>Above shown is the map of North Goa District</u>



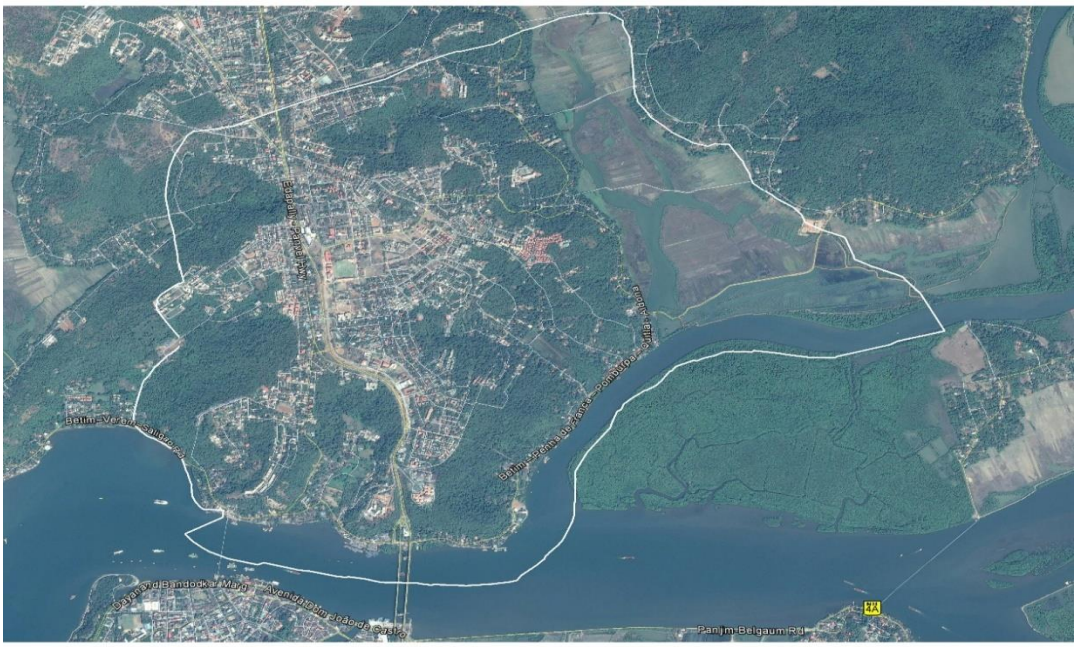
Above shown is the map of South Goa District



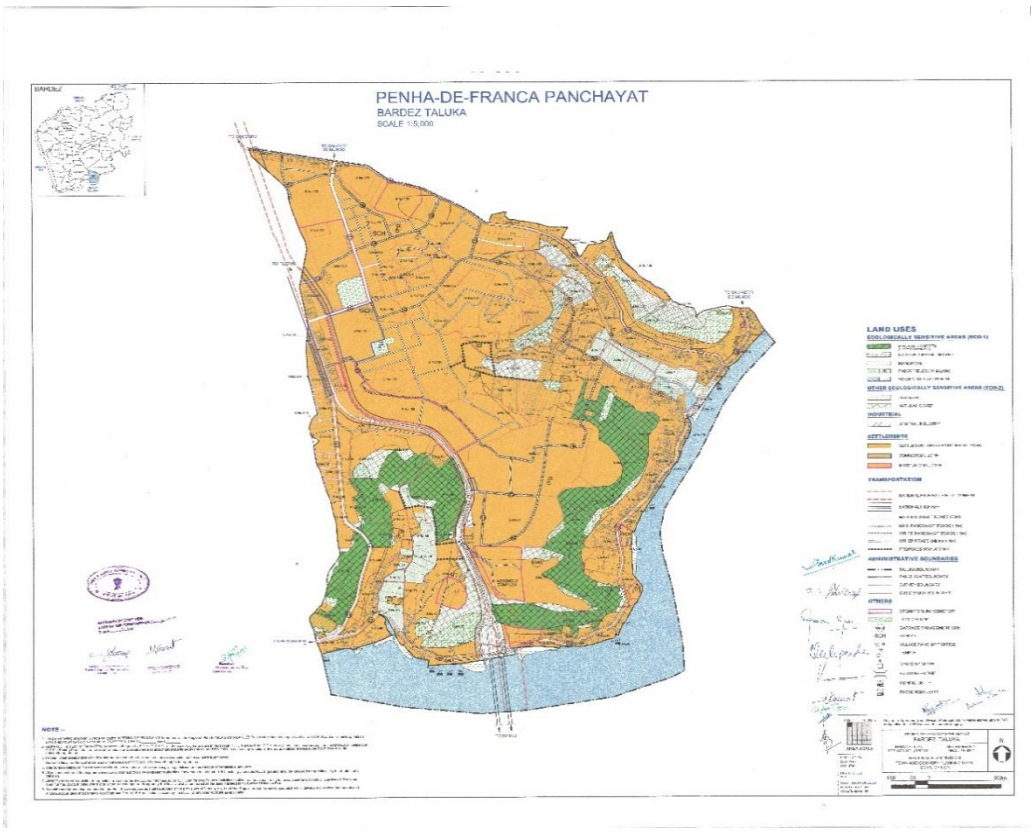
Above shown is the map of Bardez Taluka, Detailed study area map placed at M4

Few maps are placed at M1 to M9 for providing better understanding of the local features of the study area (list provided in index). AutoCAD copies of these maps with various layers are collected and hence these maps were useful ad important from every planning perspective.

Outcome of digital elevation model, elevation points and slope direction reveal that the central plateau portion is highest with few depressions especially opposite to Goa cricket academy is prominent. This is also physically verified during monsoon season to stagnate water and create lake. Elevations are prominent on North-East and Southern sides of study area but maximum directions of slopes are towards South-Westwards.



Above shown is the google image of VP Penha de France placed at M3



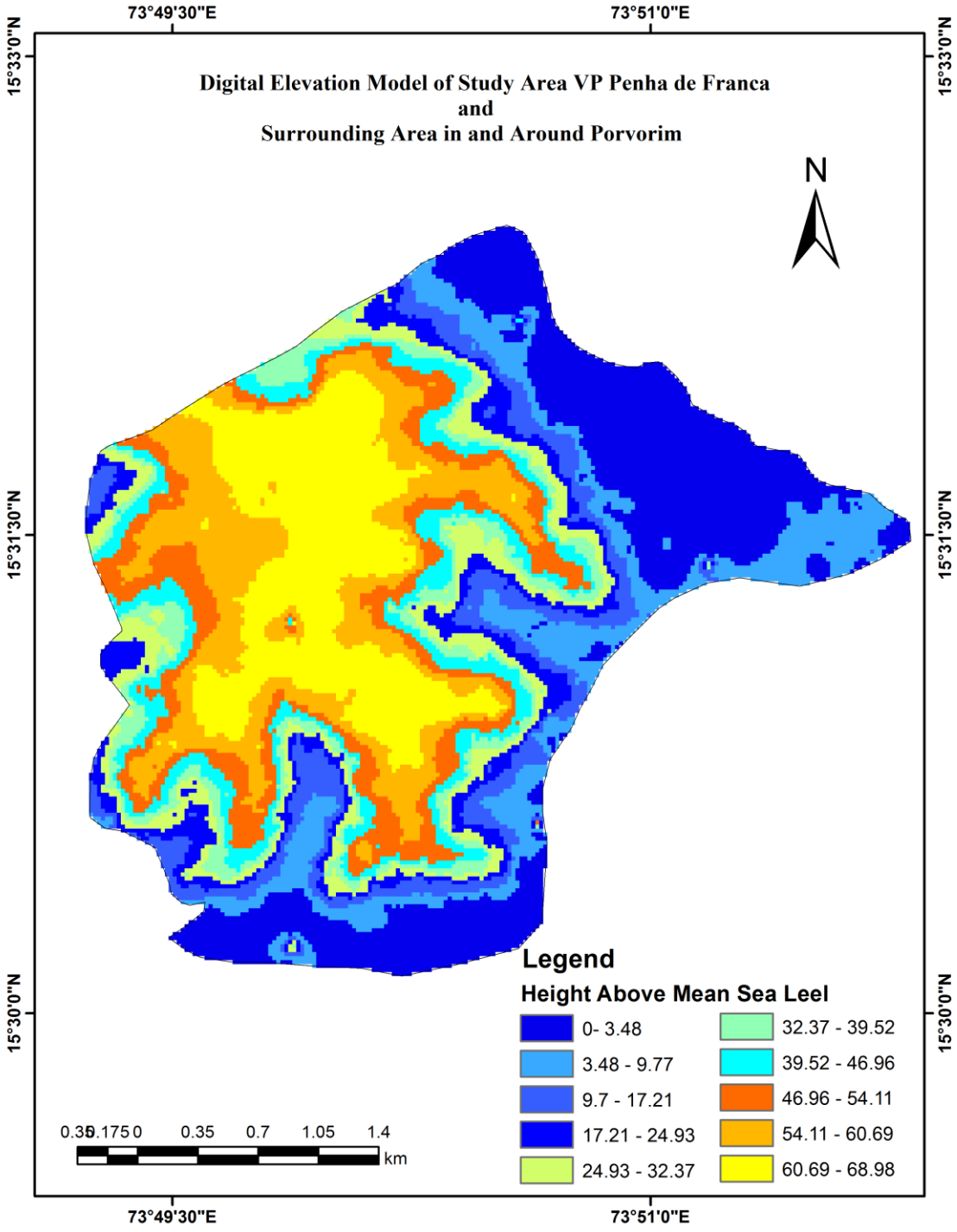
Above shown is the map of VP Penha de France, enlarged copy placed at M5



Above shown is the elevation view of study area

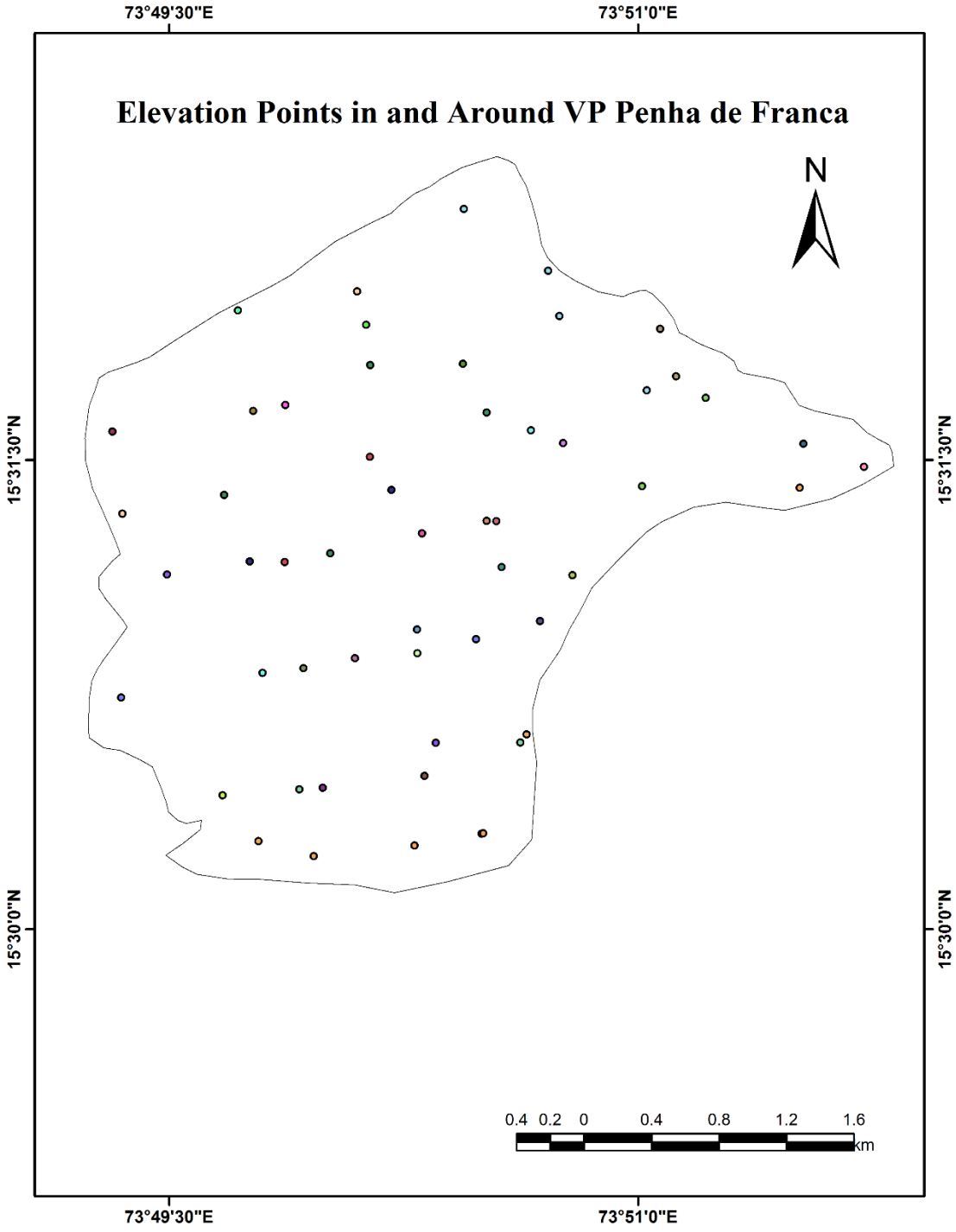


Above shown is the elevation view from study area towards sea. Enlarged copy placed at M6

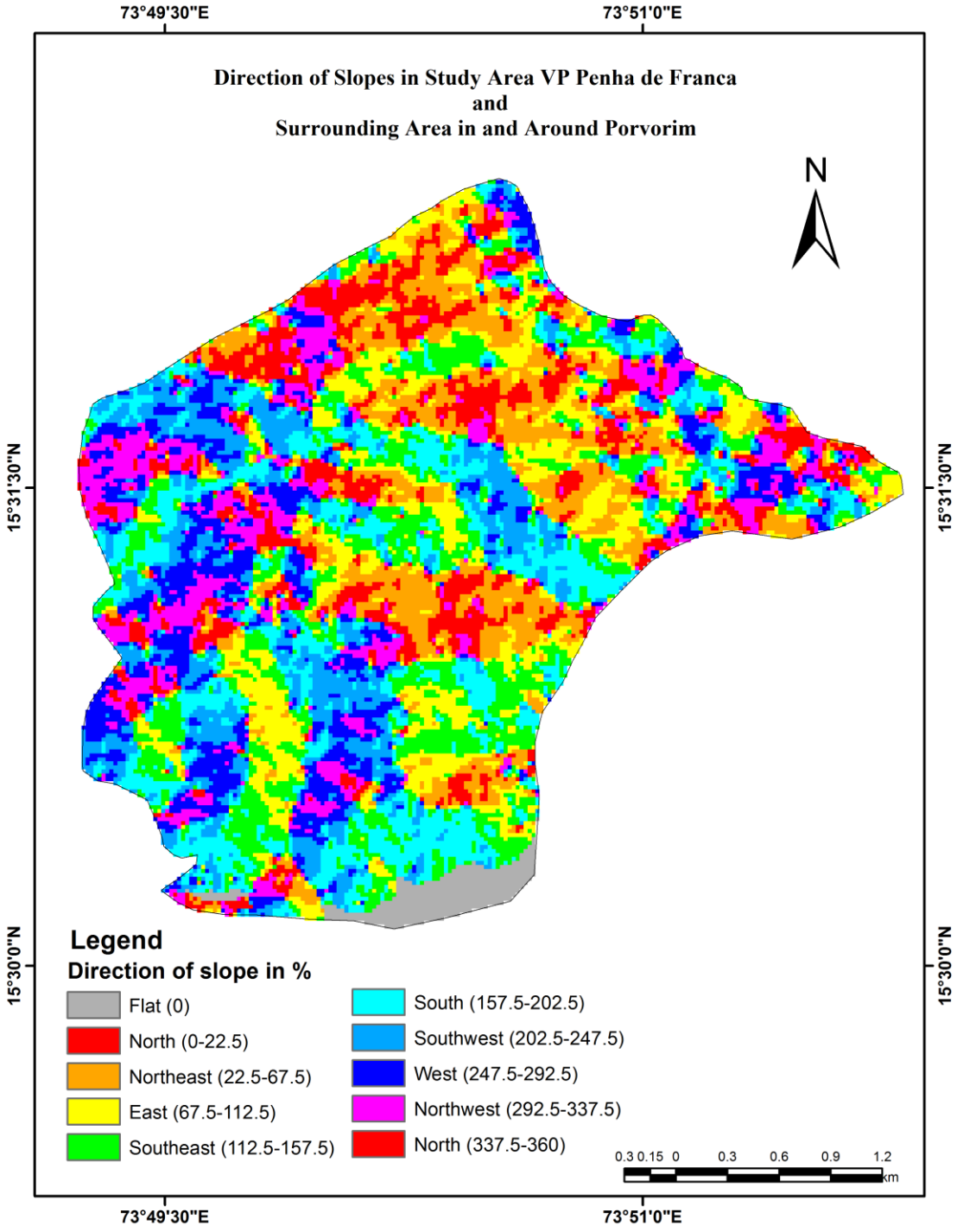


Above shown is the digital elevation model study of area under study.

Enlarged copy placed at M7



Above shown are the elevation points in and around the study of area
Enlarged copy placed at M8 (Points placed in Appendix II)



Above shown is the map showing direction of slopes in % in the study of area
Enlarged copy placed at M9

2.3 Criteria for selection of the study area:

Selection of study area is broadly Porvorim plateau but specific focus is on VP Penha de France. The basic reason is that this area is representative of several parameters such as river bank areas, mudflats, mangroves, creek / rivulet, riverside agricultural lands, wetlands, ravines, valleys, sloping peripheries after plateau, plateaus, urban ecosystems with organized as well unplanned haphazard growth, crowded areas as well as patches of dense forests with rich biodiversity, and various rural, urban as well as semi-urban features. Socio – economic and cultural diversities further add interesting dimensions to this area and thus the interest was developed for selection of this study area.

Criteria for selection of the area are as given below:

1. Study area is representative in several ways and the lessons learnt here have greater applicability to rural, semi urban as well as urban areas.
2. The pace of growth in Porvorim is very rapid and so are the pressures on resources. The intensity of existing environmental problem is visible. Hence it is relatively possible to get early results of executions done, for solving the problems thereby making it possible to develop a model and set an example.
3. Diversity of ecosystems ranging from river front, mangroves to uplands, plateau as well as diversity of species are complemented by diverse environment problems observed in the area. Hence this area is of immense interest.
4. During the first round of meetings with various Village Panchayats in North Goa, Coastal Areas, VP Penha de France had shown keen interest namely Shri. Umesh Fadte and other VP Panchayat members to cooperate on ground. This support further proved to be very reliable hence decision to select area was justified.

5. Educated and literate public with better exposure to latest gadgets and well connected provide sample of various levels ranging from small slums to high end residential complexes providing socioeconomic cross sections for study.
6. Applicability of diverse rules in the area right from Coastal Regulation Zones, (CRZ) to Village Panchayat as well as Town & Country Rules in addition to several other regulations make it further interesting. Presence of National Highway no 17 as well as riverside road provide classic combination of urban as well as village features of the study area.
7. Overall it is important to mention that presence of prestigious Goa Legislative Assembly & Secretariat I addition to several other public and private institution provided unique visibility to study area and also opportunity for researcher to consider and interact with such important stakeholders.
8. In selection of study area, the important criteria was, to ensure if the most common environmental problem of state could be also evident and whether successful solution could be devised on scale that would find a financer especially under its Corporate Social Responsibility (CSR). With this perspective several locations were discussed with many companies for funding so that practical working solution could be provided and the project implemented merely does not generate library research work but could also exhibit working model eventually leading to sustainable working model of solution for the problem.
9. It was also ensured that the local body of study area jurisdiction should be ready to sign Memorandum of Understanding (MOU) with various stakeholders including funding, implementing agency and carry forward the work of proven solution or model to its logical sustenance.

10. VP Penha de France (VPPDF) agreed to sign MOU as well as participate and abide by financial conditions of MOU which was based on mutual agreement of stakeholders.

    Later on several other advantages of having selected the study area were found as the various stakeholders reciprocated and entire state appreciated the efforts of the project.

    Hence the study area was selected for focus as ward no.8 and nearby houses of VP PDF. Accurately 500 households were selected as pilot size, whereas surrounding Panchayats in Porvorim as well as residents from other wards were observing as well as participating in project awareness programs and cleanliness drives.

2.4 Important Features, Biodiversity and Environmental Conditions

Study area is largely, a mountain top plateau on the banks of river Mandovi. The area includes river bank areas starting from Betim and extending towards Britona area and further till jurisdiction of Salvador-de-Mundo village Panchayat. As mentioned earlier, study area is broadly, Porvorim an urban sprawl of Panaji the capital city of Goa and specifically focused on Village Panchayat Penha de France (sometimes referred as Penha de Franca - VPPDF). The study area lies in North Goa District and Bardez Taluka of Goa State, a tiny State of India.

"Penha-de-Franca is a panchayat in North Goa, in Bardez taluka. Geographical area of the Panchayat is 4468725 Ha. Human population under the Village Panchayat is 15342: Total (Male: 7816 Female: 7526). Habitat and Topography is mainly coastal, hilly region with ample forest cover. (Source: Biodiversity of PDF, Goa, Ganguly, P.Sarmokadam, K.Kumar, S.Mutnuri, 2017.)

Local body jurisdiction & study area : The study area selected broadly Porvorim – Bardez – Goa is a conglomerate of five Village Panchayat (VP) areas namely, VP Penha de France, VP Salvador do Mundo, VP Reis Magos, VP Soccoro, and VP Pilerne Marra. But only VPPDF

has its complete jurisdiction in the study area. Whereas others have their parts in the study area of Porvorim. Hence in order to understand and address the problem under consideration, the research is mainly focussed on VP Penha de France (VPPDF). Further the narrow focus is in the area, then ward no 8 of VPPDF little over one word consisting of 500 households.

The study area is largely a laterite plateau with varying slopes, scarce grass, spread cashew shrubs, greenery of various trees, bushes, coconut palms and natural growth, there are few orchards (kulagars which are horticultural plantations in riverine side of the plateau) and the plateau base merge into the alluvial flats below rich in mangroves and mudflats along the river banks. This form a recurrent theme in the landscape similar to that of most of central and coastal Goa.

Approach and scope of study: Since the study mainly focusses on one major environmental problem of solid waste management most prominently felt, the research on ecology of area is limited to broader understanding. Aspects such as chemical, microbiological or microscopic, laboratory analysis of waters, sediments, life forms, measurement or quantification of parameters of is not part of this study.

However most relevant secondary and primary research work is included to considerable extent, to ensure that the focus is maintained on one **problem of solid waste management, finding solution, developing workable model and recording of lessons learnt.**

The expertise required to understand the environmental set up of the area varying from river to plateau was attained by researcher during previous research work. Understanding the geomorphology of the river bank, the nature or type of the river bed, composition of sediment and benthic biodiversity especially aquatic life forms is also attempted to certain extent.

Riverbank area consists of mangroves, khazan land, agricultural land and dense forest patches which are surrounding the periphery areas of plateau. The central areas of plateau and those along national highway are facing rapid urbanization phase whereas the remaining areas are facing pressures of high demand for conversion of existing land use patterns from forests or orchards to settlements.

2.5 The pattern of area development in study area is evident in few places wherever systematic planned development process is followed. Those areas which are not planned and develop haphazardly are deficient in open areas, proper storm drains, sanitation facilities, water availability and lack in other recreational facilities.

Analysis of Landuse in VP Penha de Franca Area		
Sr. No.	**Type of Land - Use**	**Percentage of Total Area**
1	**Mangrove Areas**	**0.44**
2	**Paddy Fields / Khazans**	**1.05**
3	**Rivers / Nallahs / Ponds**	**60.20**
4	**Orchards**	**0.63**
5	**Natural Cover**	**2.28**
6	**Private Forests**	**4.32**
7	**No development slopes**	**3.28**
8	**Settlement Areas / Existing Retained**	**24.04**
9	**Institutional Zones**	**3.02**
10	**Commercial Zones**	**0.70**
11	**Industry**	**0.04**
	Grand Total	**100.00**
Source - Regional Plan 2021 maps, areas calculated using AutoCad		

Table 2

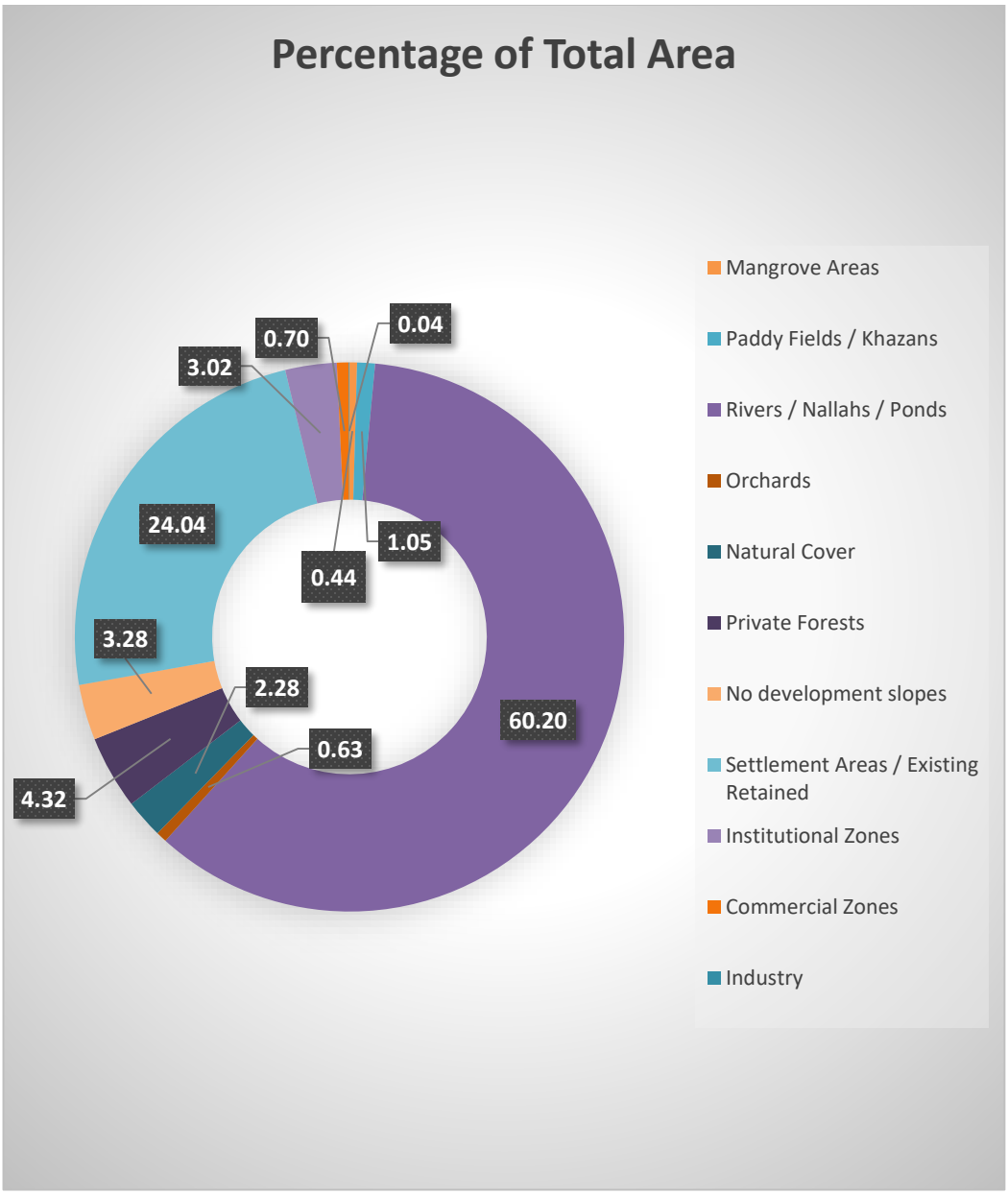
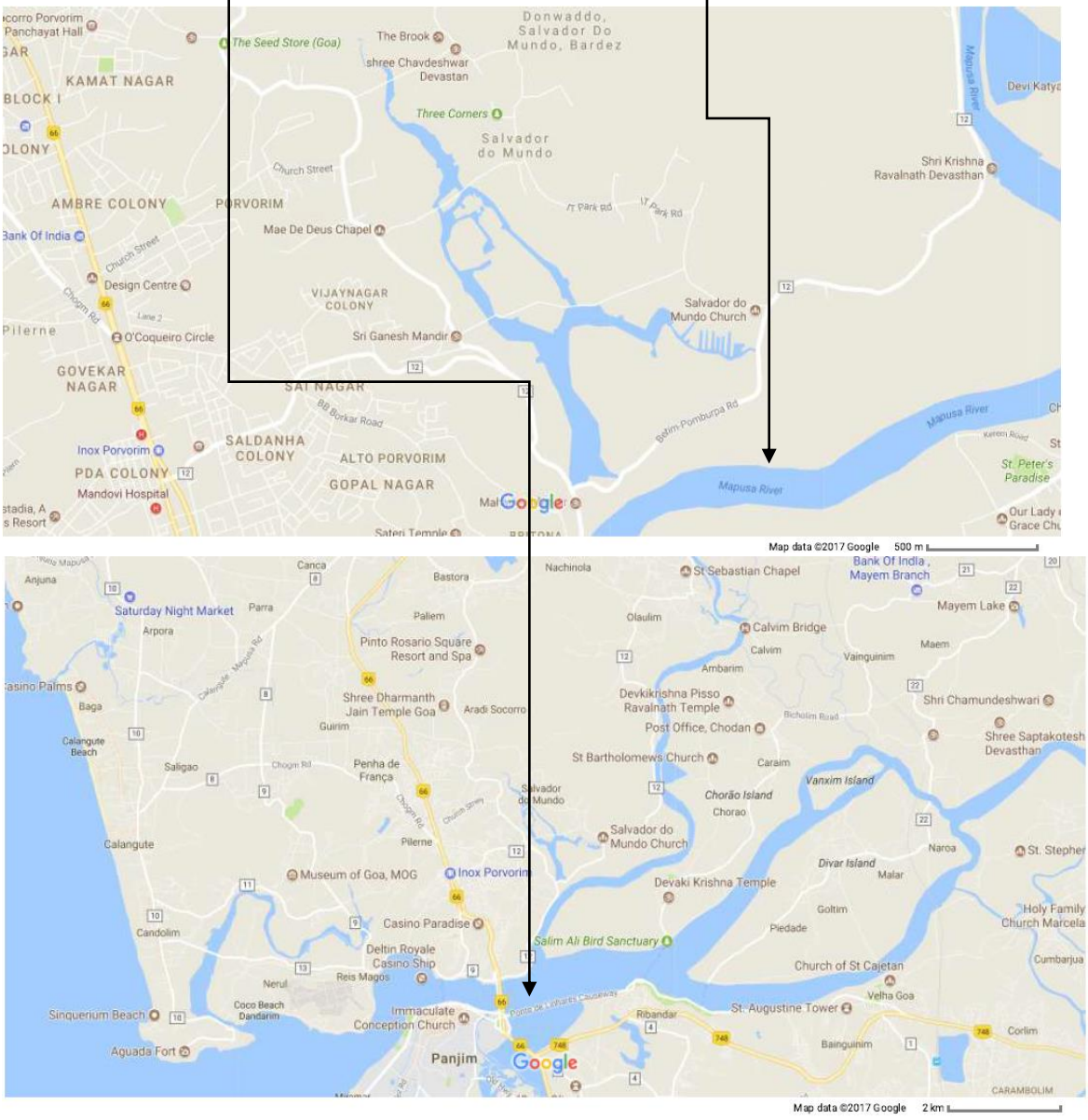


Chart 2

Maximum area of VP PDF jurisdiction shows water front of Mandovi River and Other Waterbodies (Sr. No 3 of table no 2) and together 12 percent is the natural cover, mangroves, orchards, paddy fields, khazans, no development slopes and private forest areas. However together with waterbodies and natural areas constitute about 72% of the area. Next largest are the settlement areas constituting about 24%.

2.6 <u>Environmental set up of the study area (previous work review and relevant observations)</u>: It is felt appropriate and convenient to begin ecological description of the area from water-ward side towards the plateau and then overall description. As shown in a figure below, Mandovi river gives rise to a tributary namely Mapusa River that flows towards North-East further towards Mapusa via Britona, Salvador do Mundo, Pomburpa, Ekoshi, and so on. On the other side of river is the Chorao Island which hosts Dr. Salim Ali Wildlife Bird Sanctuary.



"**River basins** of the Mandovi and Zuari drain 2553 sq km, about 70% of the total geographical area of Goa. Goa's rivers are unique in that they are both tidal and rain fed. Huge volumes of monsoon water fall within the watershed areas and are then drained out through the major rivers to the sea. But all the rivers are subject to tidal influence to a great distance inwards from their mouth. The estuarine islands are densely populated and include-Chorao, Divar, Corjuem, Juve, Cumbarjuve. The riverine islands are colonized by vegetation and are poorly known being small in size and subjected to erosion. All these alluvial valleys are areas of rich cultivation with settlements of agricultural populations. Both rice and coconut, together with the fish harvested from the seas and rivers, are essential to the idea of Goa as it has evolved over the centuries. From the coastline, if you leave aside a narrow 80 m stretch from the sea, the entire lowlands strip, varying in width from 12 to 15 km, is the most developed part of the State, containing about 80% of the population. **This area is densely urbanized.** Chorao Island along the Mandovi estuary has denser mangrove vegetation dominated by *A. officinalis, R. mucronata*and*S. alba*. Zuari estuary has about 900 ha of mangrove area with dominant species as *S. alba, A. officinalis* and *R. mucronata*. *Kandeliacandel*, a mangrove that is on the verge of extinction worldwide, appears in abundance along the Mandovi-Zuari complex. ***Xylocarpus*species, which was reported by Cooke (1908), has completely disappeared from the coast.** *Wood borers*—Biodeterioration of mangrove wood is quite severe along the Indian coast. The destruction is caused by 14 mollusc species and one variety of crustacean. The estuarine islands are densely populated and include-Chorao, Divar, Corjuem, Juve, Cumbarjuve. The riverine islands are colonized by vegetation and are poorly known being small in size and subjected to erosion.

The word ‘khazan’ stands for saline lands. The khazan lands constitute a unique agro-ecosystem that has proven its sustainability through centuries of use. Although they are the result of conversion of natural estuarine ecosystems, they do not seriously alter either its physical or living components. Instead, the *khazans* work with existing natural features. Unlike many modern forms of agriculture, the range of agricultural species and varieties adds to the diversity of the estuaries.

The tidal estuaries of Goa stretch some 30-km inland. Either side of the estuaries lie *khazans*: saline flood plains that lie below sea level at high tide. Over centuries, Goans have reclaimed these lands with an intricate system of dykes (bunds) and sluice gates. These barriers prevent salt water from entering the proven its sustainability through centuries of use. Although they are the result of conversion of natural estuarine ecosystems, they do not seriously alter either its physical or living components. Instead, the *khazans* work with existing natural features. Unlike many modern forms of agriculture, the range of agricultural species and varieties adds to the diversity of the estuaries. Eight of the eleven talukas (sub-districts) in Goa have a total of 17,500 ha under *khazans*. At least 2000 ha (12% of the total) are under dense mangrove vegetation. The mangroves help protect the outside side of the mud and laterite bunds that enclose the *khazan*. The total length of these bunds is about 2000 km.

2.7 <u>Biodiversity in the study area</u> - Mussels, clams, oysters, crabs and prawns are harvested seasonally and appear in village markets. The fish and shellfish sustain a large population of indigenous and migratory birds and the ‘mugger’, or marsh crocodile.” (Source: Goa Foundation’s Goa State Biodiversity Action Plan Report – 2002)

The mud clam *Polymesodaerosa*is found in the mangrove forests of tropical and subtropical regions around the world and in India it is found abundantly along the west coast {Sandhya Clemente and Baban Ingole, 2011(INGOLE et al., 1994, 2002)}.



Tisryo, clam- Chicalim shell fish, *Bivalvia sp./Tisryanchicodi*

The mud clam *Polymesodaerosa* (Solander, 1876) is an ecologically and economically important benthic invertebrate with high abundance in the mangrove forests of Chorao Island, Goa, India. In the seaward region, adults were completely absent at the low tide level. Higher densities of juveniles observed at the low and mid-tide levels were assumed to be due to frequent inundation which allowed the young individuals to feed adequately and attain the critical sizes at which vulnerability to physical and biological constraints is substantially reduced, whereas, at high-tide level, increased desiccation may account for the mortality of settlers. It is speculated that initially the settlers settle according to the hydrodynamic conditions for sedimentation; however, adult survival is affected by their recruitment in a suitable habitat (e.g. substrates near A*vicennia*sp.). Thus, habitat dependent viability during the post-settlement phase could be the best explanation for the non-random, patchy distribution of *P. erosa* observed in the Chorao mangrove swamp.

Juvenile and adult distribution of *P. erosa* differ on Chorao Island and these differences are attributable to post-settlement processes. It appears that *P. erosa* prefers substrates near the *Avicennia*in the high intertidal region. Great differences in *P. erosa* abundance between sediments underlying stands of *Avicennia*sp. and other mangrove species in otherwise similar areas of mangrove forest may then be attributed to differences in tree root structure, the availability of microalgae, and the physical and chemical nature of the sediment surface to make generalizations about the importance of a specific mangrove plant species for the distribution of this clam, large data sets from a variety of mangrove forests in different geographical areas, substantiated with field experiments, will help to understand the role of a particular mangrove species in structuring the *P. erosa* community. (Source: Sandhya Clemente and Baban Ingole, 2011).

Regarding notification of Dr. Salim Ali Bird Sanctuary at Chorao - in exercise of the powers conferred by sub-section (1), clause (v) and clause(xiv) of sub-section (2) and sub-section (3) of Section 3 of the Environment (Protection) Act, 1986 (29 of1986) read with sub-rule (3) of rule 5 of the Environment (Protection) Rules, 1986, the Central Government hereby notifies an area up to the river bank abutting the Dr. Salim Ali Bird Sanctuary on the three sides of the said Sanctuary and to the extent of 100 meters on the eastern side towards Chorao village from the Sanctuary in the State of Goa as the Eco-sensitive Zone.(Copy of notification is placed at Appendix III)

Flora & Fauna from study area: Below given are some of the findings during site visits.

Flora:

1) *Celosia argentea*
2) *Sidaacuta*
3) *Sidacordata*
4) *Chromolaenaodorata*
5) *Mimosa pudica*
6) *Rhizophoramucronata*
7) *Rhizophoraapiculata*
8) *Sonneratiacaseolaris*
9) *Avicennia officinalis*
10) *Avicennia marina*
11) *Excoecariaagallocha*
12) *Acanthus ilicifolius*
13) *Derris heterophylla*
14) *Helicteresisora*
15) *Spondias sp.*
16) *Pennisetumsetaceum*
17) *Eclipta prostrate*
18) *Desmodiumheterocarpon*
19) *Dryopteris sp.*
20) *Passiflorafoetida*
21) *Ipomoea marginata*
22) *Cajanusscarabaeoides*
23) *Aervajavanica*
24) *Lantana camara*
25) *Cayratia trifoliata*
26) *Cassia tora*
27) *Alternanthera sessilis*
28) *Clerodendruminerme*
29) *Eclipta alba*

Birds:

1. Little Cormorant
2. Little Egret
3. Asian Openbill
4. Lesser Sand Plover
5. Common Sandpiper
6. Golden Plover
7. Brahminy Kite
8. Large Egret
9. Small blue kingfisher
10. Red wattled lapwing

Other riverside species found in low lying mangroves and khazan areas:

1. Fiddler crab
2. Mud skipper
3. Mud lobster
4. *Telescopium sp.*
5. Barracuda (Tonki)
6. Oyster sp.



Asian Openbill (seen in the vicinity)



Little egret (seen in the vicinity)



Sidacordata



Ipomoea marginata



Mimosa pudica



Dryopteris sp.



Desmodium heterocarpon



Cajanuss carabaeoides



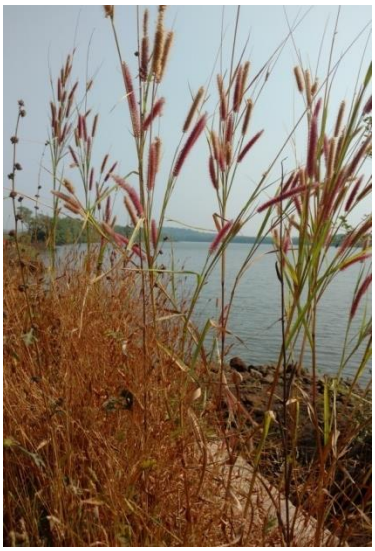
Aervajavanica



Lantana Camara



Cayratia trifoliata



Pennisetum setaceum



Acanthus ilicifolius



Aervalanata



Excoecariaagallocha



Clerodendruminerme



Sidaacuta



Different types of patterns created by mud crabs on the clayey mud



Mud lobster mound





Kindal Tree- Terminalia paniculate, Tirafal Zanthoxy lumrhetsa (limonella): Curry fruits



Large Egret, Ardea Alba in Penha de Franca, mangrove area. Background shows just upcoming tender mangrove plants.

Egret, **Ardea Alba** in Penha de Franca, Mangrove area.



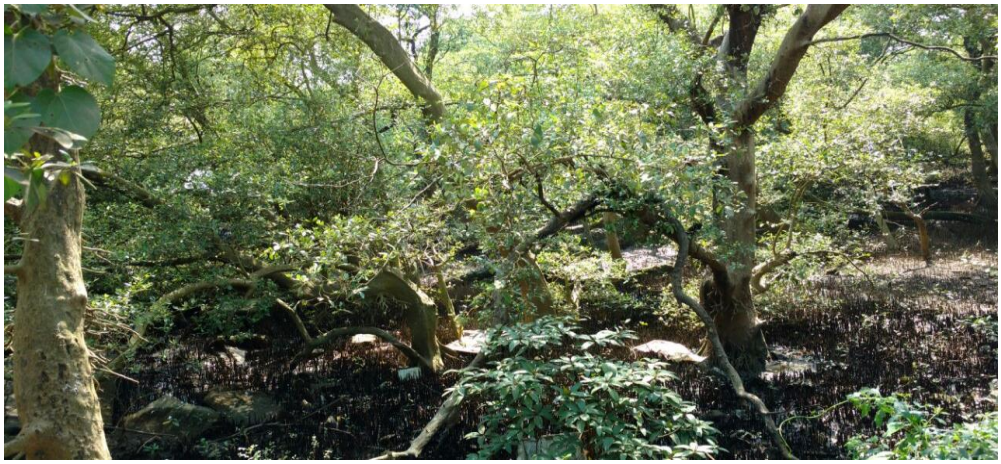
Brahmini kite, ***Haliasturindus***

2.8 Observations during field work in the study area: Mangrove forests are considered as a best form of coastal bio-shield and play a primary role in avoiding or reducing soil erosion. Mangroves form the support of an important food chain based on detritus. It also provides breeding and feeding grounds for fish, prawns, birds, invertebrates and some mammals. As such areas are the terminal recipients of coastal watersheds are highly fragile in nature and since they are the roosting and feeding grounds for several species of endangered vertebrates and invertebrates any proposed developmental activity which could influence the aquatic biodiversity needs to be properly planned before execution.



Above photograph shows picturesque mangrove habitat with canoe parked, (Pic credit – Shri. Nirmal Kulkarni)

It is important to repair and maintain the bunds for preventing salt water intrusion in paddy fields but there is need also to know that such bunds should not be used as roads for any other illegal/ commercial activity/ purpose for plying of vehicles. It is also recommended to have highly standardized technical drawings with provision for local ecosystem specific changes using locally available material, whereby traditional methods may be improvised with scientific inputs.



Above photograph shows mangrove habitat



Above is the photos of mangroves in study area – launch is seen moving across (Pic credit – Shri. Nirmal Kulkarni), Below shown is the mangrove micro-habitat.



Mangroves near the Mandovi Bridge are shown below:





Above Given Are Photos of Mangrove Forest, *Rhizophoramucronata*

Few prominent species of mangroves at certain locations are given below. Near Mandovi Bridge – Sonneratia Alba, Rhizophora Mucronata & Avicennia Alba. On Britona Side – Avicennia officinalis, Avicennia Alba, Acanthus illicifolius & Derisheterophylla.



Avicennia Alba



RhizophoraMucronata

There are low lying Khazan areas which are demarcated from agricultural lands and protected by bunds (laterite, bolder and / or silt / clay based structures like walls which are reinforced with wooden material) from the saline waters of River Mandovi. As per to CRZ notification, (Placed at Appendix IV) the areas that lie within 100 m from High Tide Level (HTL) of River Mandovi and

falls under No Development Zone (NDZ); The khazan areas falls under CRZ I,an ecologically sensitive area dominated by mangrove vegetation.

In the vicinity of the mangroves there are vast fallow paddy field/ khazan land overgrown with mangroves and grasses. Based on *prima facia* information received from the local representatives the paddy fields/ khazan lands are flooded every monsoon leading to difficulty and inconvenience to the local residents in the area.

Mangroves are ecologically as well as economically important. Ecologically mangroves are breeding grounds and nurseries for marine and aquatic life including fish and crustaceans which are important for human food security. Mangroves provide shelter for birds and wildlife. "Mangroves can absorb energy of normal waves to the extent of 70-90%" (Miththapala, 2008), mangroves protect landmasses by absorbing wave shocks, tsunamis, storm surges, floods etc. (from website to ocean health index – Dec, 2017)

2.9 Mangroves mortality – an issue: The study carried out by Lugo *et al* (1980) suggests that mortality of mangroves occurs when mangroves are flooded chronically with poor drainage. Dr. Kathiresan revealed that the causes of 'natural degradation' of mangroves are mainly due to high salinity, low level of available nutrients and poor microbial counts in the soil substrates based on the results of the sampling sites of luxuriantly growing mangroves and the degrading mangroves in Pichavaram mangrove forest, Tamil Nadu, India. (Source: {Barret and R. Rosenberg, K. Kathiresan. 2002, Lugo et al (1980) 1981, 2002})

"Mangroves are disappearing at the rate of 1 to 2% per year" {OHI, 2017 (Duke, 2007)} **"Mangroves have threat** from Mariculture (primary shrimp farming), timber harvest, deforestation for development, water diversion and overexploitation, Rising sea levels and erosion force mangroves to retreat landwards but this is allowed only if such lands have lesser demands" {from website to ocean health index – Dec, 2017 - (OHI, 2017)}

Methods of assessment of distribution & structure of mangrove forests – Although the scope of this research is not focussed on mangroves, being one of the most significant ecosystems of the area, it is appropriate to make a brief review of selected latest work about mangrove forest assessment. "The frequency and duration of tidal flooding is important in determining the zonation, distribution and species composition of mangrove forests. There is a need for more quantitative description of tidal inundation classes that is both ecologically and hydrologically meaningful across a wide range of tidal regimes." (Methods of studying Mangroves - Prof. K. Kathiresan). "The species composition and growth of mangroves is directly affected by the physical composition of mangrove soils. The proportions of clay, silt and sand, together with the grain size, dictate the permeability (or hydraulic conductivity) of the soil to water, which influences soil salinity and water content. Nutrient status is also affected by the physical composition of the soil with clay soils, which are generally higher in nutrients than sandy soils" (English et al., 1997).

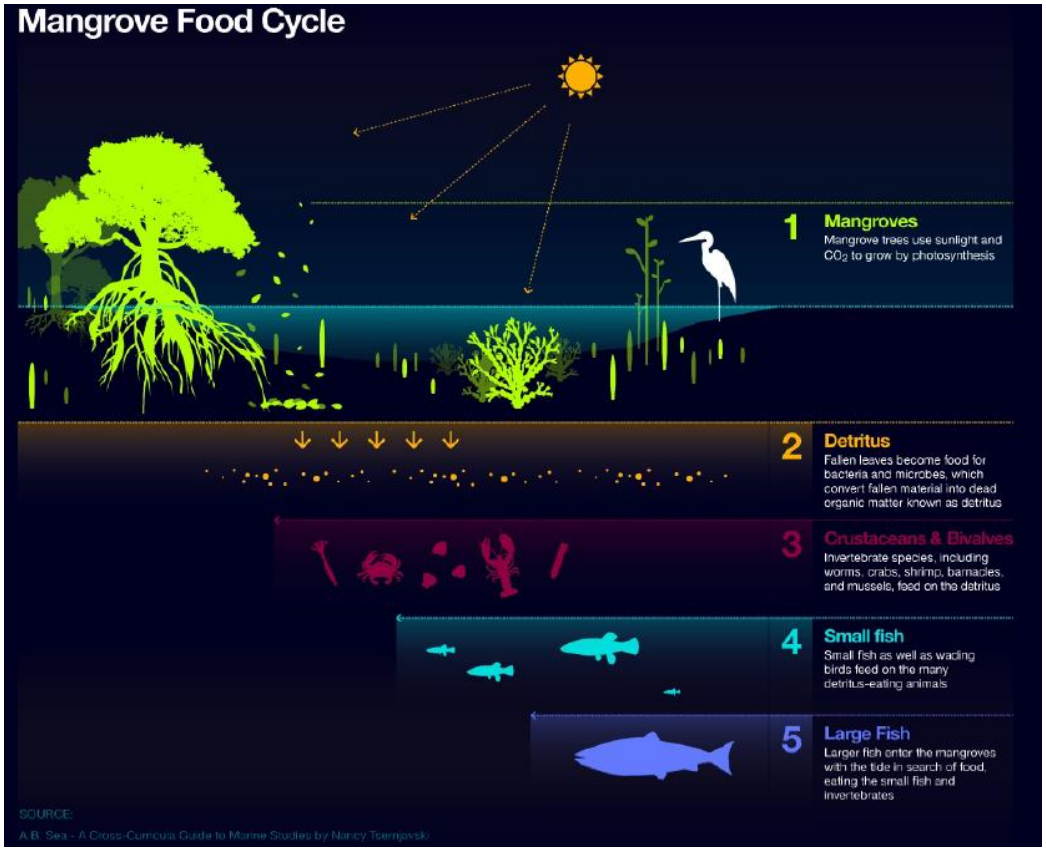
"The architecture of a forest is influenced by the magnitudes and periodicities of such forcing functions as tides, nutrients, hydro period, and stressors like hurricanes, drought, salt accumulation and frost. Because the action of these factors varies widely over geographic regions, mangrove stands exhibit wide regional and local variation in structural characteristics. Also, where species diversity is high, structural variation is even greater "(English et al., 1997)

The salinity of mangrove soils has a significant effect on the growth and zonation of mangrove forests. The majority of mangrove species grow best in low to moderate salinities (25 ppt), although there appear to be marked differences in the ability of species to tolerate very By analyzing the forest vegetation characteristics to calculate the following (Cintron & Novelli, 1984):

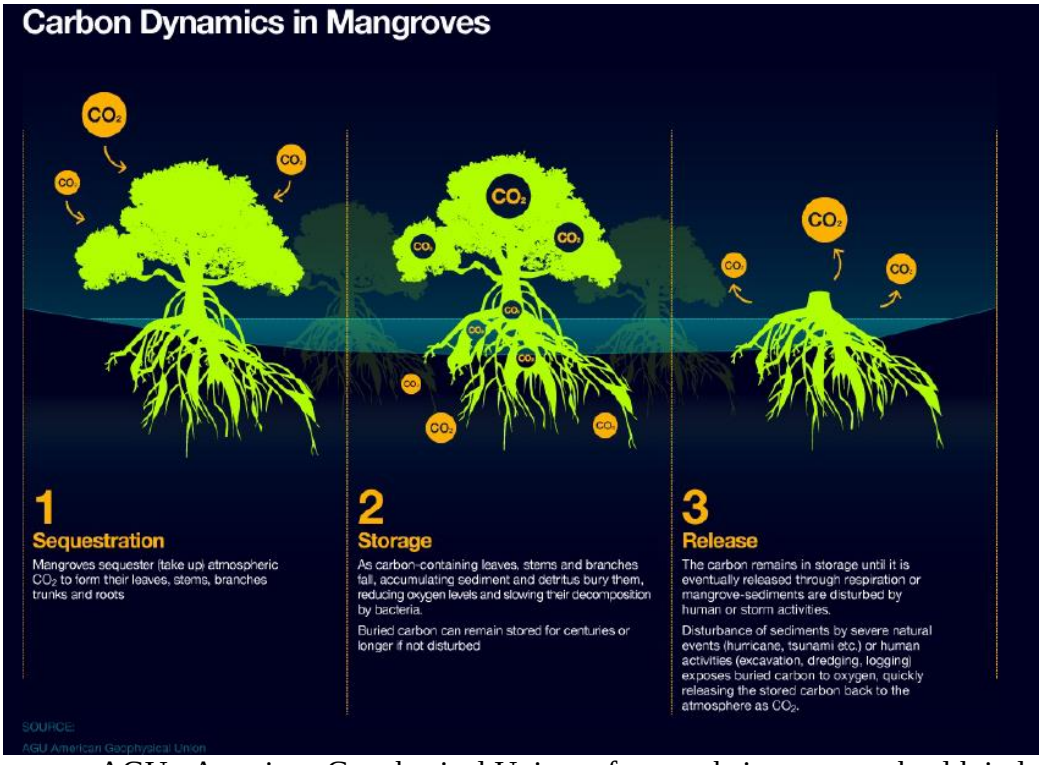
Complex Index: It denotes the diversity and abundance of flora within the forest community. It is calculated combining the number of species, stand density, basal area and height.

Importance value index (IVI): It indicates the structural importance of a species within a stand of mixed species. Itis calculated by summing up the relative percentages of basal area, density and frequency, each weighed equally for each species, relative to the same dimensions for the entire stand.

“For various reasons the mangrove forests have been ruthlessly exploited and cleared. Coral reefs have been indiscriminately mined. The fishery resources have been over exploited. Many other organisms have been exterminated for ornamental and medicinal purposes. There has been widespread degradation of the habitats. Due to industrial development and large scale use of pesticides and insecticides in agriculture, the pollution load has increased in the estuaries, mangroves backwaters and seas. Measures of diversity are frequently seen as indicators of the wellbeing of ecological systems. It is mainly due to the fact that ecologists have devised a huge range of indices and models for measuring diversity. So for the various environments, habitats and situations the species abundance models and diversity indices should be used and the suitability evaluated. Some methods are namely Biodiversity Indices, Species Richness Indices - Simpson’s Index, Margalef Index, Berger-Parker Index, Rarefaction Index, Species Diversity Indices - Shannon-Wiener Index, Brillouin Index, Log series Index, Log Normal Diversity, McIntosh’s Measure of Diversity, Jackknife Index, Q Statistic, Species Evenness Indices, Hill Numbers, Caswell Neutral Model /‘V’ Statistics, Newly Introduced Indices, Taxonomic Diversity Index, Taxonomic Distinctness Index, Phylogenetic Diversity Index, etc. Other methods such as Abundance/Biomass Comparison (ABC) Plots, Dominance Plot, Geometric Class Plots, Species Area Plot, The variety of diversity measures, species abundance models and graphical tools available help ably in assessing the biodiversity of all the habitats. The advancement in computer technology has made biodiversity studies more easy and interesting. However this development should be made good use of in protecting the very rich biodiversity our country is blessed with.(Extracts from - Methodology for Assessing Biodiversity - Prof. S. Ajmal Khan)



(Source – A.B.Sea, A cross curricula guide to marine studies by Nancy Tsernjavski)



(Source – AGU –American Geophysical Union – from website to ocean health index - http://www.oceanhealthindex.org/methodology/components/mangroves-condition)

Economics of mangroves –"The global value of the goods and services (eg. Food production, raw materials, recreational fishing, art, education, science, climate regulation and waste treatment)

provided by Mangroves to humans has been estimated to be as much as 1.6 trillion dollars or 9.990 per hectare in total (Costanza et al, 1997)"

"In 2002, mangrove-dependent commercial fish comprised an annual catch of almost 30 million tons (Nagelkerken, 2008). This constitutes approximately a third of the global annual wild catch as recorded at 89.7 million tons in 2008 (FAO, 2008)



Above photograph in study area shows roots of mangroves destroyed by making concrete wall, (Pic credit – Shri. Nirmal Kulkarni)

The paddy field/ khazan land - is a human-managed ecosystem where tidal influence is regulated ideally through a highly structured system of canal, bunds and sluice gates using resources that is available locally. However in this case due to poor management large scale mangrove infestation has occurred and due to improper sluice gate operations the water logging or water scarcity (for a long duration) in the vicinity of the mangrove might also case the death of mangroves which are known to absorb the erosive energy of the tidal currents.



Above photograph in VP Salvador de Mundo, area shows relative absence of mangroves due to presence of concrete wall, (Pic credit – Shri. Nirmal Kulkarni)

Major stress was given on recording commonly found biodiversity found in the area. The region is very rich in terms of bio-diversity. It should be protected, explored and shared. Below given photograph shows associated plants and trees with mangroves in study area, (Pic credit – Shri. Nirmal Kulkarni)



The ecological significance of the area is also proven due to **presence of mudflats** along the southern side of river bank and the northern bank of Mandovi River. The mudflats are exposed during low tide and attract variety of birds in search of their pray.



Above & below given photographs show prominent patch of well grown mangroves (colour and texture difference amongst varieties is easily visible) between Mandovi bridge area and Penha de Franca (Britona) Church, (Pic credit – Shri. Nirmal Kulkarni)





Above photograph shows taking over of mangroves by human habitations. Concrete walls have disallowed mangroves and plantation of banana and other fruit bearing trees like mango and other associated mangroves visible, (Pic credit – Shri. Nirmal Kulkarni)

2.10 Malim Fishing Jetty -There is also a fishing jetty (at location Malim – hence known as Malim Jetty) amidst the prominent mangroves near Old Mandovi Bridge and the activities as well as fish arriving at Jetty were studied and the below given are few details as were found. The coastline or the line of Mandovi river bank along village Penha De Franca jurisdiction shows interesting ecosystems including mangroves ecosystem, where the river water is saline. As we move ahead along the NE side of river bank, after Chorao islands we reach at the estuarine ecosystem area, which receives sweet water from the inland river network. Besides there are many micro discharges of surface runoff during rainy season and also discharge of liquid and solid wastes from various activities along the Mandovi river bank coastline. Whenever anyone enters Panaji – capital city of Goa, at the onset there is strong repellent odour / stink of rotten fish. Surrounding area of about 300 meters distance around fishing jetty is affected with this stink. That's the fishing jetty at Malim which is main human activity in the study area Village Penha De Franca.

Geographical details – Jetty study area is between Latitudes N $15^{0}30^{'}20$ and N $15^{0}30^{'}22$and Longitudes E $73^{0}\,49^{'}56$ and E $73^{0}50^{'}22$



Above Google image shows Mandovi Bridge on right side and Malim Jetty on left side

Demand for sea food is therefore high and hence the trawler owner can't just allow the biggest and best fish to be sold to the wholesale buyers on jetty. There is tendency of keeping aside best catch for the resorts who buy it at any cost. The Malim jetty, which is one of the four major fishing jetties in the state having two berthing portions of about 80m and 60 mtrs length.

The other main jetties are located at Cutbona, Vasco and Chapora – Malim has around 300 fishing vessels attached to its Mandovi Fishermen Marketing Co-operative Society. In all there are around 18 jetties in the State, of which all are not being used nor maintained. Fisheries department has five jetties at Chapora, Malim, Cuncolim, Curtorim and Talpona. There are 17 jetties which are in bad condition. Initially the jetties were used and therefore maintained. But now we do not use them as those routes are not in use.





Above Google Image & Photo Provide View of Malim Jetty



Above shown is photo of Shri. Josham Bude showing crab received on Malim Jetty



Above photos are taken at Malim Jetty Entrance and inside



Above photo shows view of Malim Jetty from the Mandovi Bridge side

Major ecological features of the Malim Jetty and nearby are as given below:

Mangroves ecosystem, Saline river water interface, as we move ahead along the NE side of river bank, after **Chorao Islands (Dr. Salim Ali Bird Sanctuary)** we reach at the estuarine ecosystem

area, which receives sweet water from the **inland river network**. There are **many micro discharges of surface runoff** during rainy season and **micro inlets at various points exchanging** surface runoff and other fresh water to and fro during tidal actions. Discharge outlets of liquid and solid wastes are evident from various activities and households along the Mandovi river banks.

The immediate hill behind jetty towards Porvorim has very high steep slope (about 47 mtrs height within 300 meters distance but also has thick green cover) but due to the highway along hill sides, erosion cannot be ruled out in spite of RCC wall embankments made on roadsides. There are endemic tall trees, bushes, creepers, etc. on the mountain with thick and green canopy evident of small green patch still amidst crowded haphazard and unplanned urban slums beyond the hill.

Activities at Malim Jetty which is the only fishing jetty in study area and is major revenue contributor to VP Penha de Franca as per the sources of VP PDF.

- This jetty is busy from 4 am in morning (first lot of trawlers arrive) onwards till 9 pm in the night. Second lot of trawlers arrive at about 3 pm. A trawler may take time ranging from 4-10 hrs to 10 – 15 days to return with fish catch. Trawler master needs to carry his crew along with sufficient fuel, ice for fish preservation, fishing nets, tools, safety gadgets, sufficient food for all and routine necessities.
- This sector is functional all-round the year except during the fishing ban period which begins from June 15, in view of the spawning period of aquatic life and mostly continues till July 31.
- Presently, over 300 trawlers are operating from the Malim jetty and the work of extending this jetty by another 50 meters is ongoing.
- Goa presently has about 1,150 registered fishing trawlers with 825 of them in operation. A drop has also been registered in the quantity of inland fish catch in the last few years. (Source – Jetty Sources)

- The only one good impact of reduced fish availability on ecology is that wastage / rejection is reduced but the main economic uncertainty is concern for trawler owners. Besides need of space is more and expansion is awaiting the start of work.

There is **impact of human activity** like fishing jetty on ecosystems along the coast which needs proper planning, implementation and monitoring mechanism. This study will help various stake holders to be more responsible towards ecosystem, authorities to have better improvement & planning for future, neighbouring stakeholders could look for quality of life, sustainability to ecosystems and long term sustenance of activity to those, who are directly involved and dependent on fishing jetty.

Fishing activity and Jetty operations are both contributing to the growth of **primary economy**. In addition to the earning through direct sale of fish and allied dependant service providers, Village Panchayat Penha De Franca (VPPDF) also receives 1% additional grants (this grant was received in the past as direct Octroy by VPPDF before 2004 – About 2 % to Govt.) which is presently received from directorate of panchayat.

The amount is about 40 lakhs per annum (about 10% of annual budget of VPPDF). Three petrol/diesel fuel outlets at Malim (One by River & Navigation Dept (RND) and two diesel pumps of Mandovi Fisheries Cooperative Society are the main payers.

(Source VPPDF records and interviews with past and present VPPDF Panchayat staff and members)

Few photos of marine biodiversity seen at Malim Jetty are given below. It is important to note that the species have been received from far off waters and do not belong to the Study Area



Indian Giant Perch



Jumbo Tiger Prawn



Shark Fish



Silver Pomphret



Solar Prawns



Sole Fish



Whip Fin Fish



Lady Fish



Croaker Fish

Above shown are some of the species and there is exhaustive numbers which will require separate study for assessment of marine species received at various jetties in Goa.

2.11 <u>Role of coastal /riverine ecosystems</u>: The ecosystems in the study area have significant roles in securing various life & livelihood support systems. Few important roles of these ecosystems are given below.

• Protection & shielding the landmasses and populations from natural disasters such as storms, hurricanes, tsunamis etc.

• Providing climate change resiliency to the area by way of stabilization of various physiological processes and by way of biogeochemical cycles e.g. green areas are major carbon sinks.

• Conserving various unique ecosystems, species and genetic pool constituting biodiversity of the area which has immense ecological as well as economic importance.

• Acts as significant interface between aquatic and terrestrial systems whereby dynamic aquifers below ground and surface waters carry nutrients, seeds, etc. to enable exchange of biotic and abiotic components to maintain equilibrium.

• The study area, by virtue of existence of various ecosystems, has bountiful resources and by tradition, most of the riverbank communities have fishing occupation.

• The forest areas and plateau grasslands support terrestrial biodiversity and also maintain balance in food web and trophic levels. The entire life support systems to which humans are central can sustain only if the planned development is sustainably achieved or else various quarantines and equilibriums of nature will cause irreversible damage to the socio-economic environment of the area.

Ecosystem services are innumerable and only understood better when detailed research is carried out.

Chapter III – Research Methodology

3.1 General Introduction, Data Sources and Methodology

3.2 Questionnaire by Shri. Pradip Sarmokadam for research purpose

3.3 Multidisciplinary approach in planning of the pilot project

3.1 General Introduction, Data Sources and Methodology

Data Sources range from internet sources, books, published / unpublished research papers / write-ups from known and reliable sources and from knowledge assimilated from various conferences, seminars, lectures, meetings, interaction with all levels of professionals and others involved in the areas of relevance. Most important statements are those derived from experiences during actual planning, execution, review and presentations to various stakeholders.

Various data sources are quoted at the points wherever statements are used. The detailed list of al URLs and references is given in list of references.

Methodology:

Coursework was successfully completed and certificate was received dated 15th February 2013. After completion of coursework, literature review and compilation of field observations commenced. Some main sources are as given below.

- Information downloaded from various important **websites**. Their records are maintained with URLs (Universal Resource Locators) and date of download.
- Referred the **books** related to the research topic.
- Referred to the **research articles, thesis and journals** to explore existing work already carried out in this field.
- Contacted various **intellectuals** and researchers in this field and libraries like NIO, Goa University etc. Wrote letters to concerned departments like Goa State Pollution Control Board regarding information sharing.
- Field visits were carried out with renowned experts from coastal geomorphology, ecology, waste management and other areas. Their valuable inputs have also inspired and resulted in new ideas. As a researcher and project in charge, it was routine to visit the study area everyday morning around 6am to 8:30am for over 2 years.

During compilation of field observations and literature review, it was realized that there is need to conduct actual survey of the locality specific to this site as per the types / pattern density of housing in order to arrive at actual successful solid waste collection system.

State of the art maps, top sheet analysis, elevation maps, study area measurement, measurement of various land uses were also done by using AutoCAD and overlay techniques and by learning professional software and by involving experts. Use of latest tools & google earth features is evident in the maps attached.

It was also realized that there is need to study existing provisions by government bodies in solid waste management. Therefore, few Departments visited repeatedly like, Directorate of Panchayat to understand Rural Garbage Scheme 2005 and other related acts. There was need felt to interact with more individuals working in this field in social as well as administrative areas dealing with solid waste in Goa. Survey map of complete village is obtained.

In addition to daily visits for project supervision, started the visits to other wards where solid waste management had still not started with door to door waste collection. Understanding the study area more closely was main objective of these visits. Photos were extensively taken for the area and for overall project implementation.

It was decided to develop the SWM (solid waste management) checklist for interested areas, which will help record keeping and continual improvement of managing such issue in future. Hence such checklist was developed. Most important part was carrying out working model acceptable to all the stake holders namely, Village Panchayat Penha de Franca Members, Project Funding Agency and Implementing Agency.

During planning, implementation and post implementation stages of the project, all the family heads of 500 households were contracted by researcher as well as ward member (panchayat member) for purpose of awareness, interaction, involvement, feedback, cleanliness drives, education and also to understand the thought process which will enable us to decide our

strategy and future course of action for continuous improvement. Questionnaires were used during above exercise. Written feedback was taken with signatures and names only from most responsible local stakeholders with comprehensive and representative contents. These representative questionnaires were evaluated to record the responses. However all the decisions were based on consultations held with Village Panchayat Penha de France members, Team at Sociadade de Fomento especially Chairman and researcher along with execution team.

Activities that were taken up are as below.

1. Completed site specific actual survey of the locality specific to this site was conducted based on the types / pattern density of housing in order to arrive at actual successful solid waste collection system.
2. More legislation like Rural Garbage Scheme 2005 and other related acts were studied.
3. Researcher interacted with more individuals working in this field in social as well as administrative areas dealing with solid waste in Goa and elsewhere.
4. Additional information along with survey map of complete village is studied and compiled.
5. Developing working model by identifying & defining locality specific stakeholders.
6. More legislation like Municipal Solid Waste Act 2000, Rural Garbage Scheme 2005 and other related acts were studied.
7. Researcher interacted with more departments in addition to individuals working in this field in social as well as administrative areas dealing with solid waste in Goa and elsewhere.
8. Additional information along with survey map of complete village is studied and compiled.

SWM (solid waste management) checklist is prepared for interested areas, which will help record keeping and continual improvement of managing such issue in future. Hence such checklist is developed and has scope for further modifications.

In addition to local bodies and ULBs, I also visited several industries and developed comprehensive checklist. Industrial solid waste management is itself a separate area of study.

Since the topic of research touches various interdisciplinary areas, it was decided to define the framework of research in order to arrive at manageable work.

During the course of project, whatever lessons learnt or observations noted were recorded.

Due to interdisciplinary nature of work**,** it was decided to confine the scope of this research work in areas as given below.

1. Understanding the problem under study, understanding more about the existing research carried out by others, compiling prominent points from existing knowledge on the subject under consideration and most appropriately close references taken for analyzing problem under study. Understanding extent of the problem.
2. Understanding ecological set up of the area - understanding environmental problems, prioritizing them and justifying selection of solid waste management issue as problem for the study.
3. Systematic presentation of the efforts carried out in developing, implementing and reviewing solid waste management at Village Penha de Franca. Analysis of complete process and deriving inference from the observations and research.
4. Understanding the stakeholders related and within the problem under study, understanding more about the wider perspective of research carried out by others, compiling prominent points from existing knowledge on the subject under consideration and most appropriately trying to specifically define extent of the problem.

5. Further research on understanding ecological set up of the area - understanding environmental problems, prioritizing them and justifying selection of solid waste management issue as problem for the study.
6. Systematic presentation of the efforts carried out in developing, implementing and reviewing solid waste management at Village Penha de Franca. Analysis of observations and deriving inference from the observations and research. Started visiting the other states and areas including municipalities where solid waste management was at different levels of progress. Understanding the problems in the study area in comparison with other areas was main objective of these visits. Photos were extensively taken for the area and for overall project implementation.
7. Starting implementation of working model by involving all the stakeholders.
8. Further understanding practicalities of local legislative framework.
9. Researcher involved more with stakeholders and intensive work including local data collection and daily work of project started with more close involvement of Village Panchayat Penha de Franca.
10. Practical observations, reports, analysis of observations started.
11. Successful implementation of existing working model by involving all the stakeholders.
12. Further improvising model by incorporating the better practices.
13. Researcher involved further with understanding of dynamics of problem by understanding Panjim model of waste management by Corporation of City of Panaji (CCP) and further intensive work including local data collection and daily work of project started with more close involvement of Village Panchayat Penha de Franca.
14. Practical observations, reports, analysis of observations started.
15. In addition to the daily presence on site for project supervision, I started meeting other project managers facing various issues, Village Panchayat member especially Shri.

Umesh Fadte provided great anchorage to the project by his involvement. Understanding the problems in the study area in comparison with other areas was main objective of these visits. Photos were extensively taken for the area and for overall project implementation.

16. Evaluation of issues and positive points in implementation of existing working model by involving all the stakeholders.
17. Further improvising model by incorporating the findings after consulting the stakeholders, mainly village panchayat members.
18. Researcher involved further with understanding of dynamics of problem by interacting with various experts from the field of waste management and further intensive work including local data collection and daily work of project started with more close involvement of Village Panchayat Penha de Franca.
19. Methodology used is literature survey, various publications, newspaper clips, field visits, information from various departments including fisheries department, river navigation dept., captain of ports, VP PDF (Village Panchayat Penha De Franca) questionnaire outcome by former village representatives, Shri. Umesh Fadte, Trawler Owner Josam Bude and his friends from Malim Jetty (detailed study was done on this significant activity).
20. Practical observations, reports, analysis of observations started.
21. Overall ecological set up of the study area, digitized scanned map and general information is compiled. Various ecological features including mangroves are described.
22. Finalized points regarding implementation of waste management working model by involving all the stakeholders, were listed.
23. Further documentation includes improvised model with lessons learnt and future scope.

24. Researcher concluded the understanding of dynamics of problem by interacting with various experts from the field of waste management including international experience on strategy and vision. Site specific recommendations for Village Panchayat Penha de Franca, are proposed.
25. Practical observations, reports, analysis of observations concluded.
26. Literature review, field observations concluded.

Questionnaire – was circulated in hard copies amongst selected people, response from most sampled 7 individuals are recorded in Appendix V (to avoid duplication) and format is as attached below. However response and opinion of public was understood and noted during interaction with all sections of society during every morning site visit in the study area. Contents of Questionnaire are given below.

3.2 Questionnaire by Shri. Pradip Sarmokadam for research purpose

1. Name of information provider -
2. Age -
3. Gender – Male / Female
4. Family Size
5. Past system from Year 2000 till Year 2016 and Present System of garbage management at home -
6. Past system from Year 2000 till Year 2016 and Present System of garbage management in village panchayat -

Specific Information in addition to above for better understanding of the problem

7. What was ancestral or traditional method of garbage disposal in your area?
8. When did you feel that the garbage handling, disposal or as problem became prominent? Which year approximately?
9. What is the cause of problem according to you?

10. What could be the best way to solve the problem, according to you?
11. Is there any effort taken by you, or anyone else in your area, according to you? What was the outcome of the effort?
12. Did you feel that enough efforts are taken by your local governing body?
13. Do you feel that efforts are taken by your local governing body will become successful?
14. How much garbage approximately is generated daily from your house? In Kgs. do you segregate at source? Yes / No, If no, then Why? How many categories do you segregate and which are they? Do you feel that segregation at source is important? Why?
15. What is your prediction for future of garbage problem in your area?
16. Do you feel that public participation is necessary for the success?

Any other important view or expectation regarding garbage issue?

Thanks for the information.

Yours, Truly

Pradip Sarmokadam

You may also write for your valuable inputs to pradipskadam@gmail.com, to support the research and for developing effective strategic inputs to decision makers in the field of environment. Your views shall be duly acknowledged. Please attach separate sheet or send email for providing more information, if any.

Note: Information and concepts developed during the research work by researchers, are results of over 7 years of assimilation of thoughts by various sources of knowledge including individuals, books, internet, project professionals, suggestions received from members of public, workers and supervisors associated with projects and experience gained by self during implementation. Every instance has contributed to the learning process and every place visited

was looked at as reference to the study area. Hence it gave a new outlook to understand deeper aspect of the issue / problem under study.

3.3 Multidisciplinary approach in planning of the pilot project:

In order to understand the various stakeholders involved in the problem, it was decided to document and analyse various activities which were carried out while setting up pilot solid waste management project at Penha de Franca.

Various activities were recorded chronologically and criteria for selection of pilot study were recorded. Basic questions are listed down which will decide the milestones and direction of research to be carries out.

In addition to the daily presence on site for project supervision, researcher started meeting workers, Village Panchayat members and active stakeholders at different levels of progress. Understanding the problems in the study area in comparison with other areas was main objective of these visits. Below given are some important broad considerations made during planning of the project.

- Community support is vital and decisive for success of any SWM project
- It enables segregation at source
- Communities need to be trained and sensible in segregating waste at home
- Reduction in complexities for garbage handling
- Manpower / Technology costs for post collection sorting is reduced
- More value of dry and recyclable waste
- Methods of biodegradable waste treatment become more effective
- Maximum categories of waste sorting , Minimum harm to environment
- Readiness by all interested parties in handling waste segregated at source

Interdisciplinary approach of this study – Justification: The subject / topic is by & large interdisciplinary as it not only involves ecological inputs, technology selection, and

understanding of various scientific methods of treatment but also management of community system takes equally important position. Selection of solution needs to consider site specific factors such as rainfall, topography, humidity, temperature variation etc. which are dependent on geographical aspects.

Geographical Implications of Solid Waste Management – Selection of the solid waste management solutions or methods are dependent on geography of the area where the solution is sought.

Important factors to be considered are altitude, humidity, rainfall, topography of the area and actual location with surrounding ecological set up.

Methodology and technology used for preparing elevation maps and other topographic analysis:

Software Used, Arc GIS 10.3, Google Earth, TCX Converter, Data

Aster Dem Data: data accessed 2nd February 2017

Elevation Points from Google Earth

Chapter IV – Analysis and Interpretation

4.1 Solid waste situation

4.2 Composition of Municipal Solid Waste in India

4.3 "Problem of solid waste mismanagement and effects on environment & health

a) Legal & Statutory framework "

4.3b) Few important legal terms

4.3c) Effects of solid waste mismanagement on health

4.3d) Environmental effects of solid waste mismanagement

4.4 Toxics and xenobiotics

4.5 Extent of outreach of solid waste from space to ocean bottoms

4.6 Historical Overview of Solid Waste Management

4.7 Various solid waste management methods and technology options

4.8 Significant features, topography and photographs of study area

4.9 Significant issues featuring in the study area

4.9.1 Ongoing construction of third Mandovi Bridge

4.9A Pollution and solid waste management problem in the study area

4.9B Extent and nature of the problem

4.9C Photographic report and presentation of solid waste management problem in area.

4.9D Understanding the stakeholders in the society pertaining to the problem

4.9E Public health considerations

4.9F Pilot Project at Penha de Franca village Panchayat Ward no 8

4.9G Economic model and cost working at SWM pilot project:

4.9H Situation after inception of pilot project

4.9-I Salient features of the pilot SWM project at VPPDF

4.9-J Significant project memories and events

4.9-K Data analysis and substance of lessons learnt

4.9-L Compost Dynamics

4.9-M Review of newspaper / media and Analysis of questionnaires

4.9-N Presentation and analysis of working economic model

4.9-O Selected newspaper clips about the SWM pilot project

4.1 Solid waste situation










Above photographs show significant sites and features of solid waste sites (Source –Internet)
Below given are few pics of solid waste problem observed by researcher elsewhere in different situations and the ways in which it is dealt.



Above pics shows storage of packed waste at Shimla in Himachal Pradesh amidst pristine environmental set up. Below given is the photograph showing instructions and well-designed waste disposal bins. For a tourism based area, everything needs to be aesthetically designed.



General Introduction.

"Large Marine Ecosystems (LMEs) are relatively large areas of ocean space of approximately 200,000 km² or greater, adjacent to the continents in coastal waters where primary productivity is generally higher than in open ocean areas." (Source: http://www.lme.noaa.gov/)

"As per IUCN (International Union for Conservation of Nature)Summary of challenges and threats in coastal and marine ecosystems include:

Overexploitation of coastal & marine resources, Loss of biodiversity, Environmental degradation, Pollution, Coastal erosion, Low levels of investment in alternative coastal livelihood programs, Mariculture, Tourism, Governance, Lack of institutional coordination.

Monitoring, control and surveillance (MCS) of fishing operations, Illegal, unregulated and unreported (IUU) catches, those threats are further exacerbated by impacts of climate changes and recent evidence of the regions propensity to extreme events such the tsunami and other natural disasters. And Indicators of Changing Ecosystem State are: Productivity, Fish and Fisheries, Pollution, Socioeconomic & Governance."(Source – IUCN,PPT 2004)

"Despite recent progress, access to improved sanitation remains far lower in India compared to many other countries with similar, or even lower, per capita gross domestic product. Bangladesh, Mauritania, Mongolia, Nigeria, Pakistan, and Viet Nam—all with a lower gross domestic product per capita than India" [1]—are just a few of the countries that achieved higher access to improved sanitation in 2006.[2]

"In rural areas, the scale of the problem is particularly daunting, as 74% of the rural population still defecates in the open." [3]

(Source: ADB, 2009, WDI, 1 - As measured by purchasing power parity (current international $). 2- World Development Indicators. 2006 and 3 - Ibid.)

"As the world hurtles toward its urban future, the amount of municipal solid waste (MSW), one of the most important by-products of an urban lifestyle, is growing even faster than the rate of urbanization. Ten years ago there were 2.9 billion urban residents who generated about 0.64 kg of MSW per person per day (0.68 billiontonnes per year). This report estimates that today these amounts have increasedto about 3 billion residents generating 1.2 kg per person per day (1.3 billion tonnesper year). By 2025 this will likely increase to 4.3 billion urban residents generatingabout 1.42 kg/capita/day of municipal solid waste (2.2 billion tonnes per year). Poorly managed waste has an enormous impact**on health, local and global environment, and economy**; improperly managed waste usually results in down-stream costs higher than what it would have cost to manage the waste properly in the first place. The global nature of MSW

includes its contribution to GHG emissions, e.g. the methane from the organic fraction of the waste stream, and the increasingly global linkages of products,urbanpractices, and the recycling industry.` **Waste composition is influenced by factors such as culture, economic development, climate,and energy sources; composition impacts how often waste is collected and how it is disposed.Low-income countries have the highest proportion of organic waste.Paper, plastics, and other inorganic materials make up the highest proportion of MSW in highincomecountries.**" (Source: World Bank 2012, GRSWM) It is very important to note that in above mentioned world bank report C&D waste (Construction & Demolition Waste) is not included unless specificallyidentified. A separate case-by-case review isrecommended for specific cities.**Basically solid waste could be classified as organic and inorganic or biodegradable and non biodegradable**. Besides this there are other categries such as biomedical waste, slaughter waste, toxic waste, high volume low toxic, low volume high toxic, e-waste, plastic, scrap, metal, glass, combinex complex waste, soiled and mixed waste and many other types based on its chemical, physical or biological composition , degradability or commercial / recyclable value. The classification or evaluation depends upon the interested party looking at the waste.

" Global way of classification of municipal waste is as given below.

Organic Waste - Food scraps, yard (leaves, grass, brush) waste, wood, process residues

Paper - Paper scraps, cardboard, newspapers, magazines, bags, boxes, wrapping paper, telephone books, shredded paper, paper beverage cups.

Strictly speaking paper is organic but unless it is contaminated by food residue, paper is not classified as organic.Plastic Bottles, packaging, containers, bags, lids, cups, Glass Bottles, broken glassware, light bulbs, colored glass, Metal Cans, foil, tins, non-hazardous aerosol cans, appliances (white goods), railings, bicycles, Other Textiles, leather, rubber, multi-laminates, e-waste, appliances, ash, other inert materials.

Methods of treatment evaluated based on income : Landfilling and thermal treatment of waste are the most common methodsof MSW disposal in high-income countries.Although uantitative data is not readily available, most low- and lower middle-income countries dispose of their waste in open dumps.Several middle-income countries have poorly operated landfills; disposal shouldlikely be classified as controlled dumping."

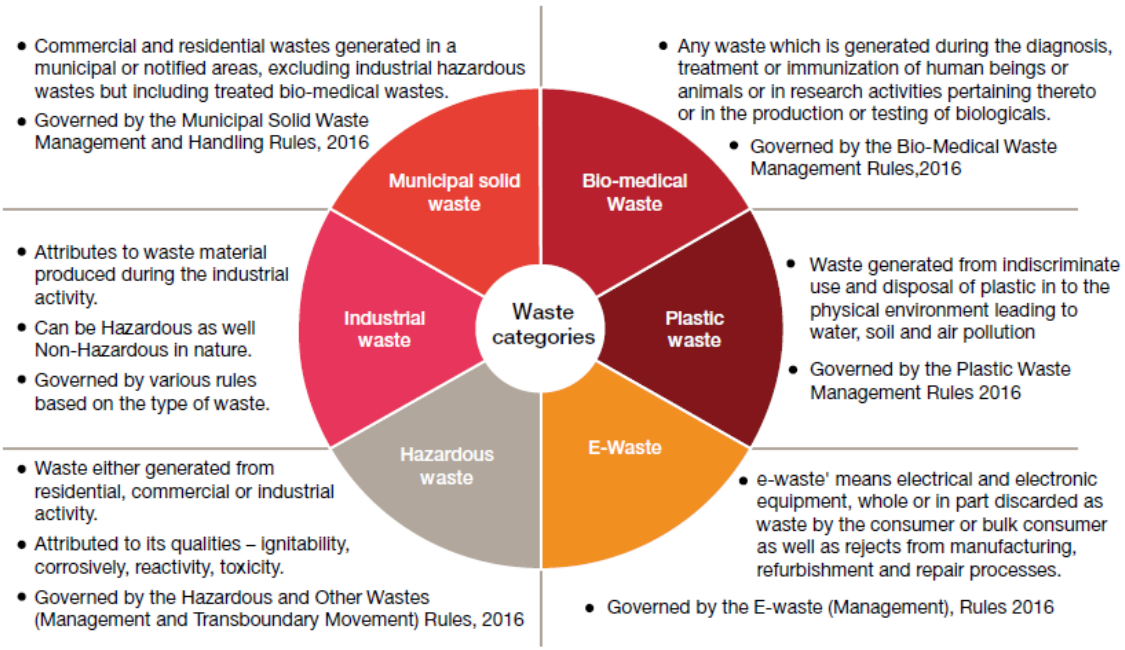
TABLE 14 Landfill Methane Emissions and Total GHG Emissions for Selected Countries

Country	Methane Emissions from Post-Consumer Municipal Waste Disposa* ($MtCO_2e$)	Greenhouse Gas Emissions** (CO_2, CH_4, N_2O) ($MtCO_2e$)	% Methane from Disposal Sites Relative to Total GHG Emissions
Brazil	16	659	2.4%
China	45	3,650	1.2%
India	14	1,210	1.1%
Mexico	31	383	8.1%
South Africa	16	380	4.3%

*EPA 2006a.
**UNFCCC 2005.

(Source: World Bank 2012, GRSWM)

Figure 2: Key waste types



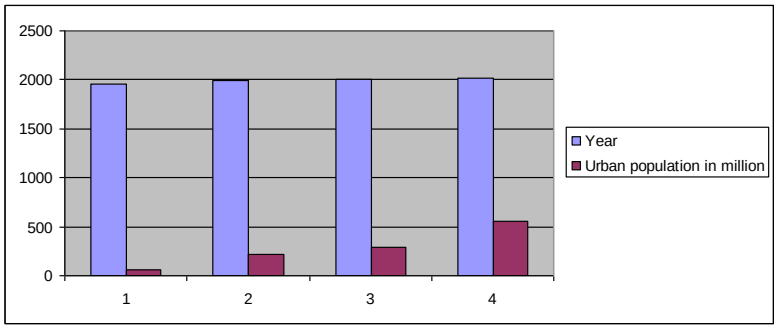
(Source – ASSOCHAM Publication on Waste Management in India – Shifting Gears, by PWC, March 2017)

India produces 42.0 million tons of municipal solid waste annually at present. Per capita generation of waste varies from 200 gm to 600 gm per capita / day. Average generation rate at 0.4 kg per capita per day in 0.1 million plus towns. Collection efficiency ranges from 50% to

90% of the solid waste generated. Urban Local Bodies spend around Rs.500/- to Rs.1500/- per ton on solid waste management of which,*60-70% of the amount is on collection alone, *20% - 30% on transportation, *Hardly any fund is spent on treatment and disposal of waste. Crude dumping of waste is general practice in most of the cities.

Major issues -Storage of waste at source is lacking, Domestic waste is thrown on streets, Trade waste thrown on roads / streets, Construction & demolition debris left unattended, Bio-medical waste is disposed in municipal waste stream, Industrial waste is disposed in open areas, Segregation of recyclable waste at source is not done, Primary collection of waste isnot doneat place of generation. Design & location of municipal waste storage depots is not scientific and is inappropriate resulting in littering of garbage, Street sweeping is not done regularly, Waste transportation done in open vehicles, Waste processing partially practised in 35 urban local bodies only, Final disposal is done through crude dumping, Rag pickers collect recyclables from municipal bins / dumpsites and litter the waste causing insanitary conditions

Urbanization and SWM - India's Population = 1027 Million, (As per 2001 Census), Urban Population =285Million, Urban Areas =5161 (Cities / Towns)



Above Graphical Representation Shows Urban Population (2001 Census)

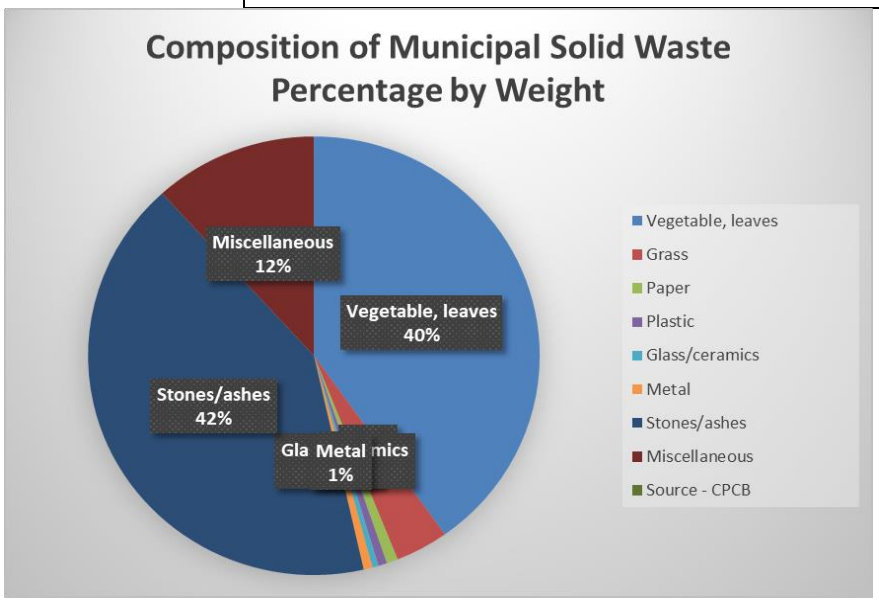
Magnitude of problem in India - Estimated waste generation is 1, 00,000 MT/day / In Goa around 1200-2000 MT per day (approx. as per newspaper statistics), Per capita waste generation ranges between 0.20 to 0.60 kg. / In Goa 1-1.7 Kg per day per head, Per capita waste generation increasing by 1.3% per annum, With urban population increasing between 3 –

3.5% per annum, Yearly increase in waste generation is around 5% annually, (Source of above information – CPCB and MoUD – Govt. of India)

4.2 Composition of Municipal Solid Waste in India as per CPCB

Composition of Municipal Solid Waste	
Description	**Percentage by Weight**
Vegetable, leaves	**40.15**
Grass	**3.8**
Paper	**0.81**
Plastic	**0.62**
Glass/ceramics	**0.44**
Metal	**0.64**
Stones/ashes	**41.81**
Miscellaneous	**11.73**
Source – CPCB	

Table 3



The salient features of Goa State with respect to Solid Waste are as below.Profile and Demography is given below as per 2001 census and subsequent (Source – GSPCB)

Population Present, as per 2001 census	1,347,668
Literacy rate	82 %
Area in Square kilometers	3,702
Present MSW in T /day	193.00 T /day
No of Corporations	01
No of Councils	13

Projections of MSW up to 2033 by GSPCB is as given in below table

Year	Population	Total MSW (MT/day)
2008	1500000	375*
2013	1650000	412
2018	1815000	453
2023	1995000	498
2028	2195000	548
2033	2415000	603

*** Total quantity of MSW is considered including all villages and small towns.**

As per CPHEEO website extracts, it was the outbreak of an epidemic in the city of Surat (Gujarat) in 1994, which actually threw light on the appalling condition and realities regarding solid waste management services. This provided a renewed impetus to the efforts of the Government. A 'High Powered Committee (Bajaj Committee, Member Planning Commission)' was constituted in 1995, which made a number of wide ranging recommendations including waste segregation at source, primary collection, levying of user charges, use of appropriate equipments and vehicles, focus upon sanitary land filling & composting and encouraging public private partnership (PPP) on a pilot basis. The early initiatives of Government of India on urban solid waste management primarily focused on promoting composting of urban municipal solid waste.

Waste Generation Statistics are as given in table below (Source – GSPCB)

City	Population (2008)	Waste / Day MT
North Goa		
Panaji	69790	50
Mapusa	40487	24
Pernem	5289	0.5
Ponda	17713	6
Valpoi	7917	2
Bicholim	14913	5
Sanquelim	11191	3
	167300.00	**90.50**
South Goa		
Margao	78382	50
Mormugao (Vasco)	97154	45
Quepem	12573	1.0
Cacora-Curchorem	21407	3.0
Canacona	11901	1.5
Cuncolim	15860	0.5
Sanguem	6173	1.5
	243450	**102.50**
Total	**410750.00**	**193.00**

Physical composition of MSW as per GSPCB for Panjim City is given in below table

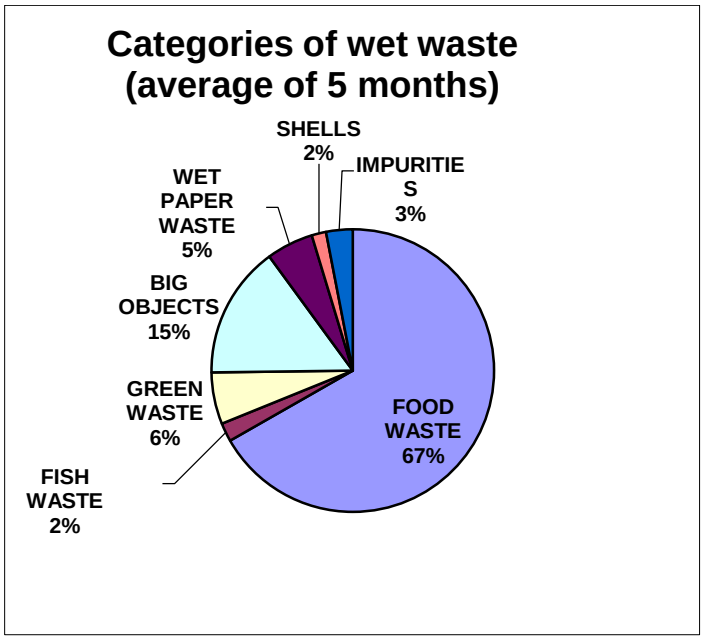
Constituent Type	Percentage of Constituents
Paper/Straw /Baggasse	18
Plastics	5.5
Glass	2.5
Metals	0.8
Rubber and Leather	2.2
Rags /Cotton waste /fabric discards	1.0
Wooden matters, garden wastes/ timber/ leaf letter	18
Coconut husk	3
Food waste	34
Inert	15

Physical composition of MSW as per GSPCB for Panjim City is given in below table

Parameters	Values
Moisture of biodegradable waste	73.5
PH	7.6
Volatile matter 550 C	Variable
Carbon	50 %
Nitrogen	6.51
Phosphorus as P2O5	0.83
Potash as K2O	1.70
C/N Ratio	15-25
HCV (Kcal /kg)	Variable

It is interesting to see the mention of our project at VPPDF by GSPCB in its report for VP PDF.

COMPOSITION OF WASTE IN STUDY AREA AS A RESULT OF OUR STUDY



Above trends in composition of waste at international, national level and study area shows that different communities have different composition depending upon food habits, lifestyle of people, economic status – wasteful cultures, urban and working populations with parcel take away lifestyles, use and throw culture will have different patterns.

Various possible reasons behind the problem - Lack of planning for waste management while planning townships, Lack of proper institutional set up for waste management, planning and designing in urban local bodies, Lack of technically trained manpower, Lack of community involvement, Lack of expertise and exposure to city waste management using modern techniques / best practices, Lack of awareness creation mechanism, Lack of Management Information Systems, Lack of funds with ULBs, Indifferent attitude of ULBs to levy user charges and sustainability.

It is the product of unplanned and ever-growing urbanization, Changing food habits, packed foods, Wastage of food, Excessive storage in refrigerators, **not in my backyard**…attitude, waiting for emergency to occur to initiate action.

Failure of system of solid waste collection, handling, treatment and value addition.

4.3 Problem of solid waste mismanagement and effects on environment & health

4.3 a) Legal &Statutory framework for waste management in India and Goa - three important notifications were issued by Ministry of Environment and Forests, Govt. of India, which are Bio Medical Waste (Management and Handling) rules, July 1998; Municipal Solid Wastes (Management and Handling) rules, September2000;Recycled Plastic Manufacture and usage Rules 1999.

Central Pollution Control Board of India (CPCB) and State Pollution Control Board of Goa State (GSPCB) are the statutory and regulatory bodies mandated with powers to implement the existing legal framework, make rules by involving various stakeholders and agencies. The regulatory framework is made by CPCB for **Municipal Solid Waste** Management & Handling Rules 2016, **Hazardous Waste** (Management, Handling & Transboundary Movement) Rules, 2016, **Bio-Medical Waste** Management Rules 2016, **Plastic Waste** Management Rules, 2016, **E- Waste** (Management) Rules, 2016&**Batteries** (Management and Handling) Rules, 2001 as Amended in 2010.

Municipal Waste Management in India is regulated by very strong legislation and concepts like extended manufacturers responsibility are important dimensions of sustainability added in the ambit of law. Previously it was MSW Management & Handling Rules 2000 and subsequently 2016. These rules stipulate that all urban local bodies are responsible for proper collection, storage, transportation, processing and disposal of the municipal wastes. Only the residual inert material after due processing of waste are to be (treated) disposed off into a sanitary landfill in accordance with these rules. The rules advocate the use of composting, bio-methanation, palletisation with or without energy recovery and other thermal processes for adoption as processing techniques for municipal wastes. However, there is a cautious approach when it comes to advance techniques of incineration, thermal co-processing, waste to fuel etc. and rightly so till these techniques are tried and tested over period of time.

4.3 b) **Few important legal terms** used throughout the thesis are given below with definitions and significant extracts from Municipal Solid Waste Rules 2016 (MSW-2016) and Plastic Waste Management Rules, 2016 (PWM -2016) are also given for the ease of understanding and reference.

Rule 2 of MSW Rules, 2016 mentions applicability of the rules as – "**Application -** These rules shall apply to **every urban local body, outgrowths in urban agglomerations, census towns** as declared by the Registrar General and Census Commissioner of India, notified areas, notified industrial townships, areas under the control of Indian Railways, airports, airbases, Ports and harbours, defence establishments, special economic zones, State and Central government organisations, places of pilgrims, religious and historical importance as may be notified by respective State government from time to time and to every domestic, institutional, commercial and any other non-residential solid waste generator situated in the areas except industrial waste, hazardous waste, hazardous chemicals, bio medical wastes, e-waste, lead acid batteries and radio-active waste, that are covered under separate rules framed under the

Environment (Protection) Act, 1986." **local body**" for the purpose of these rules means and includes the municipal corporation, nagarnigam, municipal council, nagarpalika, nagarPalikaparishad, municipal board, nagar panchayat and town panchayat, census towns, notified areas and notified industrial townships with whatever name they are called in different States and union territories in India; "**solid waste**" **means and includes** solid or semi-solid domestic waste, sanitary waste, commercial waste, institutional waste, catering and market waste and other non-residential wastes, street sweepings, silt removed or collected from the surface drains, horticulture waste, agriculture and dairy waste, treated bio-medical waste excluding industrial waste, bio-medical waste and e-waste, battery waste, radio-active waste generated in the area under the local authorities and other entities mentioned in rule 2;

"**Biodegradable waste** "means **any organic material** that can be degraded by micro-organisms into simpler stable compounds; "**non-biodegradable waste**" means any waste that cannot be degraded by micro-organisms into simpler stable compounds; "**leachate**" means the liquid that seeps through solid waste or other medium and has extracts of dissolved or suspended material from it; "**sorting**" means separating various components and categories of recyclables such as paper, plastic, cardboards, metal, glass, etc., from mixed waste as may be appropriate to facilitate recycling;"**bio-methanation**" means a process which entails enzymatic decomposition of the organic matter by microbial action to produce methane rich biogas; "**buffer zone**" means zone of no development to be maintained around solid waste processing and disposal facility, exceeding 5 TPD of installed capacity. This will be maintained within total and area allotted for the solid waste processing and disposal facility. "**Combustible waste**" means non-biodegradable, non-recyclable, non-reusable, non-hazardous solid waste having minimum calorific value exceeding 1500 kcal/kg and excluding chlorinated materials like plastic, woodpulp, etc;"**door to door collection**" means collection of solid waste from the door step of households, shops, commercial establishments , offices , institutional or any other

non-residential premises and includes collection of such waste from entry gate or a designated location on the ground floor in a housing society , multi storied building or apartments , large residential, commercial or institutional complex or premises; "**handling**" includes all activities relating to sorting, segregation, material recovery, collection, secondary storage, shredding, baling, crushing, loading, unloading, transportation, processing and disposal of solid wastes; "**disposal**" means the final and safe disposal of post processed residual solid waste and inert street sweepings and silt from surface drains on land as specified in Schedule I to prevent contamination of ground water, surface water, ambient air and attraction of animals or birds; "**composting**" means a controlled process involving microbial decomposition of organic matter; "**co-processing**" means use of non-biodegradable and non-recyclable solid waste having calorific value exceeding 1500k/cal as raw material or as a source of energy or both to replace or supplement the natural mineral resources and fossil fuels in industrial processes; "**decentralised processing**" means establishment of dispersed facilities for maximizing the processing of biodegradable waste and recovery of recyclables closest to the source of generation so as to minimize transportation of waste for processing or disposal; "**Dump sites**" means a land utilised by local body for disposal of solid waste without following the principles of sanitary land filling; "**facility**" means any establishment wherein the solid waste management processes namely segregation, recovery, storage, collection, recycling, processing, treatment or safe disposal are carried out;

"**Extended producer responsibility**" (EPR) means responsibility of any producer of packaging products such as **plastic, tin, glass and corrugated boxes, etc.**, for environmentally sound management, **till end-of-life of the packaging products**;**(As per MSW-2016)** "Extended producer's responsibility" means the responsibility of a producer for the environmentally sound management **of the product until the end of its life**;**(As per PWM - 2016)**

"**Producer**" means persons engaged in manufacture or import of carry bags or multi-layered packaging or plastic sheets or like, and includes industries or individuals using plastic sheets or like or covers made of plastic sheets or multi-layered packaging for packaging or wrapping the commodity; "Multi-layered packaging" means any material used or to be used for packaging and having atleast one layer of plastic as the main ingredients in combination with one or more layers of materials such as paper, paper board, polymeric materials, metalised layers or aluminium foil, either in the form of a laminate or co-extruded structure;**(As per PWM -2016)**

"**Institutional waste generator**" means and includes occupier of the institutional buildings such as building occupied by Central Government Departments, State Government Departments, public or private sector companies, hospitals, schools, colleges, universities or other places of education, organisation, academy, hotels, restaurants, malls and shopping complexes; "**plastic**" means material which contains as an essential ingredient a high polymer such as polyethylene terephthalate, high density polyethylene, Vinyl, low density polyethylene, polypropylene, polystyrene resins, multi-materials like acrylonitrile butadiene styrene, polyphenylene oxide, polycarbonate, Polybutylene terephthalate; "**recycling**" means the process of transforming segregated plastic waste into a new product or raw material for producing new products; **(As per PWM -2016)**

It is most important to note that in the regulatory framework maximum concerns are covered, yet the ground situation is taking immense time to show the difference. It is therefore important to note the responsibility of waste producer which are given below as extracted from MSW – 2016.

"**Rule 4** Duties of waste generators. - (1) every waste generator shall,-

(a) Segregate and store the waste generated by them in three separate streams namely bio-degradable, non-biodegradable and domestic hazardous wastes in suitable bins and handover

segregated wastes to authorised waste pickers or waste collectors as per the direction or notification by the local authorities from time to time;

(b) Wrap securely the used sanitary waste like diapers, sanitary pads etc., in the pouches provided by the manufacturers or brand owners of these products or in a suitable wrapping material as instructed by the local authorities and shall place the same in the bin meant for dry waste or non- bio-degradable waste;

(c) Store separately construction and demolition waste, as and when generated, in his own premises and shall dispose off as per the Construction and Demolition Waste Management Rules, 2016; and

(d) Store horticulture waste and garden waste generated from his premises separately in his own premises and dispose of as per the directions of the local body from time to time.

(2) No waste generator shall throw, burn or burry the solid waste generated by him, on streets, open public spaces outside his premises or in the drain or water bodies.

(3) All waste generators shall pay such user fee for solid waste management, as specified in the bye-laws of the local bodies.

(4) No person shall organise an event or gathering of more than one hundred persons at any unlicensed place without intimating the local body, at least three working days in advance and such person or the organiser of such event shall ensure segregation of waste at source and handing over of segregated waste to waste collector or agency as specified by the local body.

(5) Every street vendor shall keep suitable containers for storage of waste generated during the course of his activity such as food waste, disposable plates, cups, cans, wrappers, coconut shells, leftover food, vegetables, fruits, etc., and shall deposit such waste at waste storage depot or container or vehicle as notified by the local body.

(6) All resident welfare and market associations shall, within one year from the date of notification of these rules and in partnership with the local body ensure segregation of waste at

source by the generators as prescribed in these rules, facilitate collection of segregated waste in separate streams, handover recyclable material to either the authorised wastepickers or the authorised recyclers. The bio-degradable waste shall be processed, treated and disposed off through composting or bio-methanation within the premises as far as possible. The residual waste shall be given to the waste collectors or agency as directed by the local body.

(7) All gated communities and institutions with more than 5,000 sqm area shall, within one year from the date of notification of these rules and in partnership with the local body, ensure segregation of waste at source by the generators as prescribed in these rules, facilitate collection of segregated waste in separate streams, handover recyclable material to either the authorised waste pickers or the authorized recyclers. The bio-degradable waste shall be processed, treated and disposed off through composting or bio-methanation within the premises as far as possible. The residual waste shall be given to the waste collectors or agency as directed by the local body.

(8) All hotels and restaurants shall, within one year from the date of notification of these rules and in partnership with the local body ensure segregation of waste at source as prescribed in these rules, facilitate collection of segregated waste in separate streams, handover recyclable material to either the authorised waste pickers or the authorised recyclers.

The bio-degradable waste shall be processed, treated and disposed off through composting or bio-methanation within the premises as far as possible. The residual waste shall be given to the waste collectors or agency as directed by the local body." (Extract from MSW – 2016)

Current status of Solid Waste Management in India

The MSW Rules came into being in year 2000, a reasonable time has since then passed allowing for the percolation of these rules, through the administrative hierarchy for implementation. However, the level of compliance for mandatory processing has been dismal. The level of compliance is put around 9% on the mandatory processing front in India17. None

of the major metros have any projects of significant scale of Solid Waste processing into operation. Capacity built up in the compost processing sector is on rise but the problems on account of seasonal nature of business, applicability to large capacities in view of geographical limitations on marketing front persist. Thus, it is not surprising that dumping of wastes and open burning continues at places like Hyderabad, Pimpri and elsewhere. The dump sites are eyesore, inviting public indignation with open burning and leachate overflowing.

Besides regulatory framework, there are recommendations made by the **Hon. Supreme Court of India Committee** on Solid Waste Management for improvement of the situation in India includes - All Food and biodegradable waste should be composted; recyclable waste should be passed on to the recycling industry; and only rejects should be land filled in a scientific manner; Decentralized composting with public and NGO's/CBO's participation should be encouraged wherever possible; Caution against using unproven technologies should be observed. Local Bodies are advised not to adopt expensive technologies of Power generation, fuel pelletization, incineration etc. until they are proven sound under Indian conditions. Outsourcing of all activities under Solid Waste Management Services recommended by 12th Finance Commission for using grants, ULBs to concentrate on segregation of waste at source, Waste processing like composting, bio-methanation should be done through public-private partnerships/private sector, Final disposal viz. sanitary land filling to be done under public private partnerships / private sector. However suitable alternative for landfill needs to be devised. Bio-medical waste to be managed by Central Bio- Medical Waste Management Facilities.

E-Waste (Management) Rules, 2016came into force from the 1st day of October, 2016. These rules shall apply to every manufacturer, producer, consumer, bulk consumer, collection centres, dealers, e-retailer, refurbisher, dismantler and recycler involved in manufacture, sale, transfer, purchase, collection, storage and processing of e-waste or electrical and electronic equipment

listed in Schedule I, including their components, consumables, parts and spares which make the product operational but shall not apply to -(a) used lead acid batteries as covered under the Batteries (Management and Handling) Rules, 2001 made under the Act;

(b) micro enterprises as defined in the Micro, Small and Medium Enterprises Development Act, 2006 (27 of 2006); and(c) radio-active wastes as covered under the provisions of the Atomic Energy Act,1962 (33 of 1962) and rules made there under.

Plastic Waste Management Rules, 2016 - These rules shall apply to every waste generator, local body, Gram Panchayat, manufacturer, Importers and producer.(2) The rule 4 shall not apply to the export oriented units or units in special economic zones, notified by the Central Government, manufacturing their products against an order for export: Provide this exemption shall not apply to units engaged in packaging of gutkha, tobacco and pan masala and also to any surplus or rejects, left over products and the like.

Bio-Medical Waste Management Rules, 2016 - These rules shall apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio medical waste in any form including hospitals, nursing homes, clinics, dispensaries, veterinary institutions, animal houses, pathological laboratories, blood banks, Ayush hospitals, clinical establishments, research or educational institutions, health camps, medical or surgical camps, vaccination camps, blood donation camps, first aid rooms of schools, forensic laboratories and research labs.

Batteries (Management and Handling) Amendment Rules, 2010 - These rules shall apply to every manufacturer, importer, re-conditioner, assembler, dealer, recycler, auctioneer, consumer and bulk consumer involved in manufacture, processing, sale, purchase and use of batteries or components thereof.

Hazardous Waste (Management, Handling & Transboundary Movement) Rules, 2016 - Hazardous Waste Management Rules are notified to ensure safe handling, generation, processing, treatment, package, storgae, transportation, use reporcessing, collection, conversion, and offering for sale, destruction and disposal of Hasardous Waste. These Rules came into effect in the year 1989 and have been amemded later in the years 2000, 2003 and with final notification of the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008 in supersession of former notification. The Rules lay down corresponding duties of various authorities such as MoEF, CPCB, State/UT Govts., SPCBs/PCCs, DGFT, Port Authority and Custom Authority while State Pollution Control Boards/ Pollution Control Committees have been designated with wider responsibilities touching across almost every aspect of Hazardous wastes generation, handing and their disposal. CPCB has published list of about 35 hazardous waste contaminated dump sites in India, fortunately, Goa doesn't have any one so far.

Below given is important information specific to goa extracted from GSPCB report regarding statutory and legal information.

"Court Directives dated - 8th April 2009 - Further time of 6 months is given to 11 municipal councils namely Bicholim, Quepem, Ponda, Canacona, Cuncolim, Curchorem, Margao, Sanguem, Sanquelim, Pernem and Corporation of Panjim to report full compliance with directions dated 09-07-2008.Maupsa and Valpoi do not have authorized sites for treatment of garbage and disposal of inert / residual wastes as per interim directions dated 09-07-2008, we grant time of six months to acquire the site and to report full compliance. GSPCB has identified 189 establishments as source of biodegradable waste and 144 out of them have been inspected. We direct the pollution control board to complete the process of verification within two months and submit report. The Court Matter is still Subjudice.

Initiatives at Village Panchayat level - In order to tackle the garbage problem in the village Panchayats, the department is implementing the “Goa Rural Garbage Scheme 2005”. 134 village have identified the land site for collection and treatment of the garbage. Further, 75 proposals have been cleared by the Goa Pollution Control Board and the same are being processed for land acquisition purpose.

Urban development Achievements - Solid Waste Management Plan is introduced in the Municipal areas in order to provide clean environment and freedom from menace of garbage. There is a proposal which will cater to the needs of councils and village panchayats.

Tetrapak Initiative: Tetrapak packaging was not collected in Goa previously. Ragpickers (people who collect garbage) now get 4 rupees for every kilo of tetrapak they collect. Scrap dealers, the people who ragpickers sell their waste to get 8 rupees per kilo from Tetrapak. The problem is the cost and environmental impact to transport it to Vapi, 2000 km away where the tetrapak is then recycled. Each 9 ton truckload that goes from Bangalore to Vapi is worth 100,000 rupees. The cost of transportation is 20,000rupees and is currently paid for by Tetrapak. The discarded packaging is then made into fantastic notebooks, beautiful roof tiles and building wall sheets. It’s as strong as concrete and the same price too.

MoU with ACC: A Memorandum of understanding (MOU) between the Department of Environment, Government of Goa and Associated Cement Companies Ltd (ACC), Wadi Cement works, was signed for the disposal of plastic waste generated in the state of Goa.

The MoU envisages establishing collection and segregation mechanism of plastics waste from non-biodegradable solid waste for disposal through co-processing at ACC’s Wadi Cement Works. The MoU will be valid for a term of 3 years from the date of execution of the MoU with an option of renewal with mutual consent and on mutually agreed terms and conditions. ACC will provide the services free of cost to the Department of Environment, Government of

Goa. ACC and Department of Environment will nominate persons who should act as points of contact during the term of MoU. As per MoU ACC and Department of Environment will join hands to work together for safe disposal of plastic waste and other non-recyclable combustible waste such as small pieces of rubber, wood, cotton, paper, thermocol (polystyrene), tyres etc. segregated from the above said non-biodegradable solid waste.

Actions already taken - The Board has issued authorization to all the 14 local bodies under the Municipal Solid Waste (Management & Handling) Rules. Five Municipal bodies have partly adopted effective composting methods for processing of their waste.

Actioned proposed and partly initiated is making arrangements for collection, segregation, transportation and processing of biomedical waste.

The Goa Non-Biodegradable Garbage (Control) Act, 1996 (as amended till 2000)

Notification no: 7-4-1997/LA, An act to prevent throwing or depositing non-biodegradable garbage in public drains, roads and open places.

Rural Garbage Disposal Scheme: Eleven village panchayats in the state have been identified for an action plan under the state government's Rural Garbage Disposal Scheme.

Directions in this regard were issued by the directorate of Panchayats to the Block Development Officers to adopt a panchayat in their respective jurisdictions. The BDOs in ten talukas have responded and identified the panchayats. The government had formulated the Rural Garbage Disposal Scheme for assisting the village panchayats in safe and hygienic disposal of the garbage in the panchayat areas. However, progress made by the village panchayats in this regard was dismal. Hence, the government decided that the BDOs shall adopt a village panchayat under their respective jurisdiction for assisting the selected village panchayat in formulating an action plan so that the Rural Garbage Disposal Scheme could be implemented without any hindrance. Under the above-mentioned scheme the government

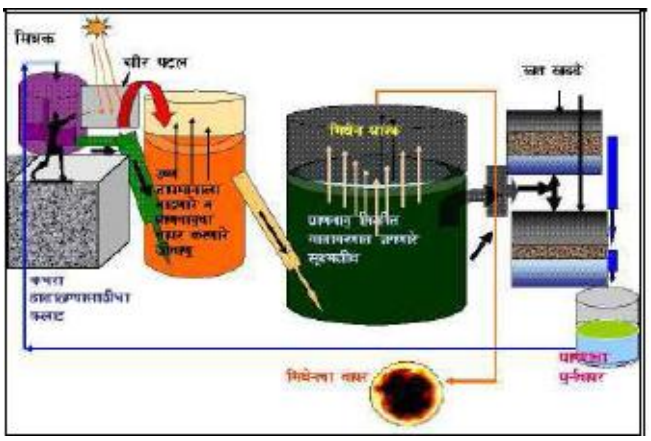
provides financial assistance to village panchayats to identify a site within the village for garbage disposal besides funding the construction of composting pits etc. However, the response had been poor with the panchayats failing to identify a suitable plot in the villages. Ironically, many plots selected by providing Sanitary landfill site. Create proper Facilities at landfill sites the village panchayats had been rejected by the state pollution control board as the villages failed to meet the criteria for setting up a garbage disposal site.

The action plan for the villages involves ward wise data collection of names and number of households, schools, hotels and industries, preparation of route for collection of plastic waste from households by the labourers, preparation of estimates for requirement of labourers, preparation of estimates for setting up of composting pits within the panchayat areas, preparation of estimates for recurring cost/expenditure on maintaining composting pits, holding of regular collection drives and awareness campaigns and monitoring the progress of garbage management in the villages every month.

The report by GSPCB is first comprehensive effort hence serves as most important document do far from State agency. Few important concerns recommendations made in the report are that - Segregation is a common problem for all municipal councils. Segregation is not done as per the MSW rules 2000, at least biodegradable and non-biodegradable waste should be collected separately. Emphasis should be given on segregation of waste. Two bin systems should be adopted by all. Basic guideline of MSW rules 2000 should be followed by waste generators, collection and transport contractors, and treatment agencies. There should be amendment in the municipal act for house to house collection, segregation to be made compulsory of MSW. There should be imposition of penalty if unsegregated waste is received. In most of the cases municipal engineer is looking after waste management. Preferably there should be separate person to look after this critical issue. Additional composting units should be constructed by all municipal councils for treatment of biodegradable waste. *Instead of centralized treatment*

plant, Decentralized approach should be followed. Small projects of 2 – 3 tons capacity per day can solve the problem of most of the municipal councils. Either OWC or biogases of this capacity are easily available. Henceforth separate funds should be provided for treatment of MSW. (This recommendation is proven correct to a large extent in our VPPDF pilot project)

Treatment of MSW is most important thing but unfortunately this is the most neglected area. Various treatment methods are discussed in this report any one of them should be adopted and either bio gas or bio manure should be generated from MSW. 3Rprinciple of waste management **Reduce, Reuse and Recycle** should be adopted. Village Panchyats are far behind regarding MSW rules 2000. (Rural Garbage Scheme2005) Initially awareness program should be conducted for all village Panchayats, then for selected village action plan should be developed which will include collection, segregation and treatment of garbage. Funds are available with some of the Panchayats but they have not approached the Director for availing the funds." (GSPCB Report). Above report also mentions about successful methods and techniques used elsewhere and use of OWC machines and shredder is also appreciated along with "Nisargaruna" technique of BARC (Bhabha Atomic Research Centre). While selecting appropriate technique at VPPDF pilot project, selection of OWC was one of this criteria that it is also endorsed by GSPCB. Below given is image depicting Nisargaruna method of BARC which is based on bio-methanation. It has pre-digester before main bioreactor and researcher visited the BARC site to understand this technique along other bio-methanation methods.



Quantities of waste:

"In India, under the 'business as usual' scenario, the total municipal solid waste management (MSW) generation within the next five decades would multiply five times the present level of about 50 million tons per day." (Article, Toxics link, Gopal Krishna, 2005)

Ecological issues in the study area are basically disposal of solid and liquid waste in the river bank area by the residents which has been going on since time immemorial. However after implementation of coastal regulation framework in India many houses have also made efforts to build septic tanks. There is also initiative taken by government to connect sewage pipes and create treatment system.

Protection of river bank ecosystems is an essential exercise. Over the years there were laterite and boulder bunds prepared with silt and clay at many locations to regulate **saline water ingress into surrounding fields.** The bunds are made behind mangroves with sluice gates which are provided to manage the surface water. Presently it is also seen that concrete walls that have been built for protection of riverbank becomes an issue due to prohibition of natural protection feature offered by mangroves which has no further maintenance, it does not support marine biodiversity especially crevices and rough surfaces are lost for crabs, other organisms such as crustaceans. Mudskipper and other species are also under threat wherever there is concretization done for erosion control.

4.3 c) <u>Effects of solid waste mismanagement on health</u>

After going through maximum available information from global as well as local sources, below enlisted are the major effects on various spheres. Concern is the pollution caused to the earth – be it land, air, and water. With increase in the global population and the rising demand for food and other essentials, there has been a rise in the amount of waste being generated daily by each household. This waste is ultimately thrown into village Panchayat or Municipal waste collection centres from where it is ultimately ends up in treatment facilities, landfills, dumps,

etc. However, either due to soiled waste which cannot be recycled, resource crunch or inefficient infrastructure, not all of this waste gets collected and transported to the final treatment sites. If the management and disposal is improperly done, it can cause serious impacts on health and problems to the surrounding environment.

Unattended waste lying around attracts flies, rats, and other creatures that in turn spread disease. Normally it is the wet waste that decomposes and releases a bad odour. This leads to unhygienic conditions and thereby to a rise in the health problems. The plague outbreak in Surat is a good example of a city suffering due to the callous attitude of the local body in maintaining cleanliness in the city. Plastic waste is another cause for ill health.

Effects on health: Most important aspect is of human health as the general outlook is anthropocentric.

a. Direct effects are seen when one comes in direct contact with waste. It depends on type – qualities of waste, quantity of waste in contact and health vulnerability of the individual coming in contact. Some direct effects are skin and body infections, already wounded person or sick person is more prone to infections. Skin and blood infections resulting from direct contact with waste, and from infected wounds. Eye and respiratory infections resulting from exposure to infected dust, especially during landfill operations. Different diseases that results from the bites of animals feeding on the waste. Intestinal infections that are transmitted by flies feeding on the waste. Waste workers, recyclers, all the transporters, those involved in segregation, sorting, loading, unloading, working at disposal facility etc. are more exposed to such hazards.

b. Effects due to indirect contact with waste – Public at large may be affected due to burning of waste in open – several poly-aromatic hydrocarbons and toxics such as pyro-benzene which are carcinogenic are emitted and respirable particulates are responsible to result in respiratory tract issues / infections, asthmatic problems and in certain cases may cause cancer. Incineration

operators and those exposed to stacks of such operations are at risk of chronic respiratory diseases, including cancers resulting from exposure to dust and hazardous compounds.

c. Effects due to unexpected or accidental problems – Injuries, bone and muscle disorders resulting from the handling of heavy containers, wounds resulting from contact with sharp objects, Poisoning and chemical burns resulting from contact with small amounts of hazardous chemical waste mixed with general waste. Burns and other injuries resulting from occupational accidents at waste disposal sites or from methane gas explosion at landfill sites.

(Source - Adapted from UNEP report, 1996)

Sick building syndrome: it is a new emerging concept which is a outcome of solid waste problem. It means that if any building is constructed on landfill or similar polluted sites, then emissions of gases such as methane, hydrogen sulphide, carbon dioxide etc, result in depletion of oxygen and creates imbalance in air constitution. This creates feeling of discomfort or sickness amongst residents. This is called sick building syndrome. (one of the concept learnt by researcher during occupational health and xenobiotics training)

- Views of Eminent Experts and Stalwarts about Solid Waste Management Strategy: Every part of the world deals with the issue of solid waste management in its own way based on the strategy which convincing to the respective entity. There are several factors which will decide the dealing methodology and success. Some of them are, type of agency for dealing with the issue, techno-financial capability, method, model and expertise involved in dealing with the problem, type of society – materialistic, conservative or mixed type, public participation and sustainability model adopted. Each of the factors need brief explanation and discussion.

Important extracts taken down by researcher during presentation by Prof. Shyam Asolekar in National Environmental Conference at Mumbai, while speaking about ship recycling at intertidal zone at biggest site is Alang near Bhavnagar Gujarat, probably best suited global site. India is world's largest recycling country. This activity mostly takes place in intertidal zone.

During high tide transportation becomes easy. Nothing is wasted. Tin present in benthic sediments deep below is dangerous in quantity. Also at Darukhana Sewri mudflats, near Mumbai, mercury found entry in body parts of Flamingos & sediments (is irreversible phenomenon), As per Prof. Asolekar, most corporates are interested in green washings rather than remedial measures. About 1.5 lacs in India are associated with this sector.

- Type of agency dealing with the problem of waste management – if the problem is dealt at national level as national program integrated with inclusion of various stakeholders then it means that priority focus may give successful results. At municipal level the success is possible if the implementing dedicated cell / team is in place and focus is continuous along with availability of other resources.

4.3 d) <u>Environmental effects of solid waste mismanagement</u> are already known and they are also observed in the study area. Effect on all environmental spheres is due to presence of unwanted and unexpected components. Effects on soil could be referred to as contamination of land due to presence of non-biodegradable solid waste or things derived from solid waste with toxic properties or any other characteristics that will result in adverse effects of soil by virtue of their chemical, physical or biological properties. The dangerous levels of toxic heavy metals such as Arsenic, Chromium, Mercury, Tin or any other components from leachate or unexpected and undesired battery waste, chemical, paints, expired medicines, infected syringes, medical dressings, sharp objects, blades, oils from servicing of vehicles, workshop rejections, non-functional parts, e-waste etc. when enters stream of municipal solid waste, may cause irreversible levels of land contamination in pristine soils at micro or macro level depending upon quantities and qualities of waste. Eg. When activities such as repairing workshops – ship and other workshops, vehicle wash centres, painting / sandblasting activities, storage of accident vehicles, rejected material are taken up in the ecologically vulnerable areas, such as mudflats, intertidal zones, khazan lands, fields, etc. it mostly leads to land contamination of

sediments, soils and other ecosystem components receive the contaminants and further dilute or react to result in different pollutant by permutation and combination process. Complication caused is so intensive, that it is not possible to understand the source or cause. Even small piece of plastic or unwanted item can prevent water percolation, disturb soil texture, nutrient transfer and many other normal processes. Non-biodegradable items may adversely affect the productivity for very long span causing infertility and enhanced areas of barren lands. Due to availability of limited fertile areas and ever increasing food demand, it is high time to take up programs for prevention of soil pollution due to solid waste and bioremediation of affected areas.

Water being more dynamic than the soil, is more prone to pollution due to irresponsible solid waste dumping. Secondary contamination due to further travelling of soil contamination and leachate is very prominent but direct effects of solid waste on water rich ecosystems is great concern. Availability of portable fresh water itself is a great concern. Less than 1 % is available on global level and hence due to solid waste dumping wetland conservation and management rules, 2016 have provisions to prevent disposal of solid waste in wetlands. In certain cases, even ground water is polluted due to leachate from solid waste sites. In Goa, there is superficial and perched ground water as well as deeper aquifers hence are prone to pollution.

Effect and contribution of solid waste on air pollution – Solid waste on burning and by virtue of aerosols during handling, odour and due to particulates arising out of solid waste contributes to air pollution. On burning, furans, polyaromatic hydrocarbons (PAHCs), pyrobenzene, etc. are emitted which are carcinogenic.

4.4 Toxics and xenobiotics - In a study on xenobiotics, whereby Butyltins (Tributylin (TBT), Dibutylin (DBT), Monobutylin (MBT) were measured in water and sediment samples collected from various locations in the Mandovi (ten stations) and Zuari (nine stations) gave the results as presented below.

“The Mandovi and Zuari estuary are located on the west coast of India and are used for navigation of recreational boats and fishing vessels and for the transport of iron and manganese ores from the hinterland to the Marmugoa harbour. Along both the estuaries, there are small jetties and wharfs that are used for berthing of small recreational boats, fishing vessels, and barges. There are also small shipbuilding units located along the banks of these estuaries that are involved in construction, repair and maintenance of small ships and barges. Both the estuaries are fringed with mangroves along the banks. Mangroves support several flora and fauna and serve as nursery grounds as well as nutrient sources to economically and ecologically important organisms such as prawn, fishes and many other invertebrates (Bhosle 2007). Therefore, the Mandovi and Zuari estuaries are sensitive ecosystems that may be subjected to organotin contamination due to shipping activities. Sampling locations in the Mandovi and Zuari estuaries along the west coast of India are shown in Fig. 1. Seawater and sediment samples were collected from ten stations in the Mandovi estuary (Fig. 1). These areas include a creek where treated wastewater is discharged (station 1) in to the Mandovi estuary, a fisheries jetty (station 2), small jetties for the berthing of small commercial vessels and passenger ferries (stations 3 and 4), a shipbuilding unit (station 5) and a few stations in the navigation channel used for the transport of ores (stations 6, 7, 8, 9 and 10) during November, 2007. Mandovi Stations 1. Campal Creek, 2. Fish Jetty, 3.Captain of Ports Jetty, and 4.Ribander Ferry are in proximity of present study area and hence relevant to this study. The levels of TBT observed both in water and sediments appear to reflect the activities performed at all the sites sampled, and some of the areas showed contamination levels high enough to pose a risk to aquatic and benthic organisms. In view of this, it is necessary to form legislations to control the usage of TBT compounds in order to reduce their level in marine waters of India. {Source: {A. Garg, R. Meena, N. Bhosle, 2009(Bhosle, 2006, 2007)}

Organotin compounds, mainly tributyltin (TBT) and, to some degree, triphenyltins (TPhT), have been widely used as antifouling agents in marine paints for more than four decades. These compounds are used as polyvinyl chloride (PVC) heat stabilisers, catalysts, agrichemicals and in glass coatings {A. Garg, R. Meena, N. Bhosle, 2009(Bhosle, 2006, 2007)}

Many studies have revealed that there exists large number of microbial biodiversity in the Mangrove sediments and in overall ecosystem which are tolerant to *xenobiotics* such as Sediment samples from three stations in mangrove swamps along the Mandovi-Zuari estuarine complex showed the presence of phenolic compounds varying from 0.26 to 1.01 mg kg-1. Phenolic acids such as ferulic, p-coumaric, p-hydroxy benzoic and gentisic were identified by Gomes and Mavinkurve *(1982)*(Source:{J.K. Reshma V. Salom Gnana Thanga (H. Gomes and S. Mavinkurve, 1982), 2011})

Mangrove swamps are complex and dynamic ecosystems occurring in thick fringes in the intertidal zones along tropical and subtropical coastlines.

4.5 <u>Extent of outreach of solid waste from space to ocean bottoms</u> – waste or debris or trash has crossed all the administrative and ecosystem boundaries and has reached even most extreme places including ocean bottoms and even space. It has affected life cycles and reached into body parts of migratory birds like albatross as well as feathers of flamingos.

Solid waste in space – “Space debris (also known as space junk, space waste, space trash, space litter or space garbage) is a term for the mass of defunct human-made objects in Earth orbit, such as old satellites and spent rocket stages. It includes the fragments from their disintegration, erosion and collisions. As of December 2016, five satellite collisions have resulted in generating space waste. Rocket boosters, pieces that came loose from spacecraft, and fragments and particles created by space collisions or explosions are other examples of the

types of trash whizzing around Earth at speeds of up to 36,000 km per hour.(Source – Wikipedia, 2017)"

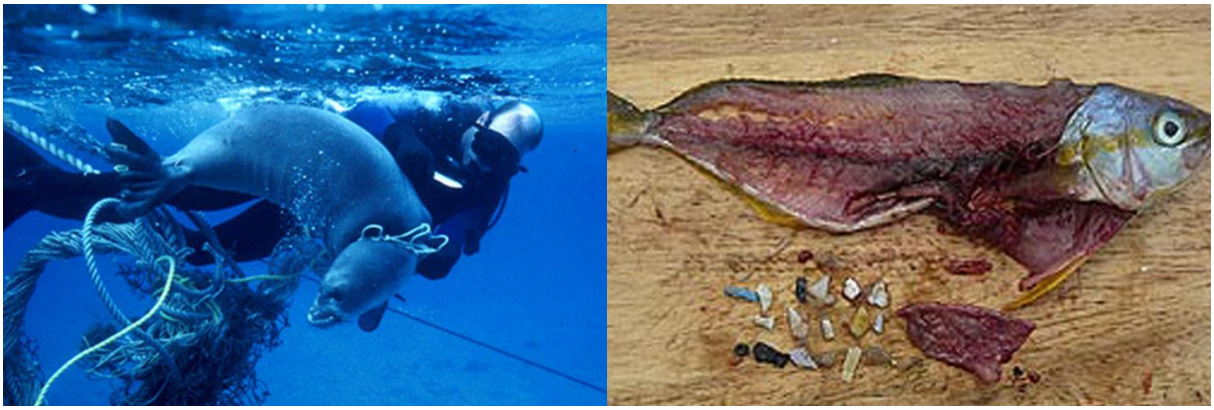
"Some call it space trash, others refer to it as space junk or space debris. All three terms identify the same items - man-made objects remaining in space though they no longer serve any useful purpose. Mankind¹s journey into space began in 1957 when the Soviet Union launched Sputnik, the first artificial satellite. Since that time more than 4,000 satellites have been launched into orbit. With so much traffic travelling into space, is it any wonder that a little trash has been left behind? It is estimated that hundreds of millions of pieces of space trash are now floating through our region of the solar system. Some of them are as large as trucks while others are smaller than a flake of paint. Earth¹s gravitational field pulls a lot of space trash into lower and lower orbits until it finally reaches Earth's atmosphere. Most of the trash burns up when it enters Earth¹s atmosphere. The higher the altitude at which it orbits the longer the space trash will remain in orbit. Space trash moving in orbits lower than 600 km normally falls back to Earth within a few years. Space trash orbiting at altitudes higher than 1,000 km can continue circling Earth for a century or more. The main problem with space trash is the danger it poses to working satellites and manned space craft. Because of the very great speeds at which space trash travels, small pieces between 1 and 10 centimetres in size can penetrate and damage most spacecraft. A ten-centimeter long piece of space trash can cause as much damage as twenty-five sticks of dynamite! (Source –NASA, 2017). Besides the ecological wide reaching consequences, waste also has social angle. It causes infections to several underprivileged and extremely poor populations. Children and future generations are most vulnerable. Cattles, stray dogs and other members of biodiversity are suffering due to ingestion of plastic and other undesirable substances along with eatables, causing irreversible health problems. Below give two images gathered from known internet sources to understand the damage.



Bottom left pic shows, a river in China polluted with trash – can cause serious health problems, right side pic from bottom shows people harvesting plastic from a polluted river in Indonesia.



Above pic (left) shows polluted Yamuna River and right pic shows polluted Sea bed with botles



Above pic (left) shows seal entangled in rope discarded by the passing boats and right pic show plastic pieces found in the guts of an edible fish(http://coastalcare.org/2009/11/plastic-pollution-Coastal Care 2017)



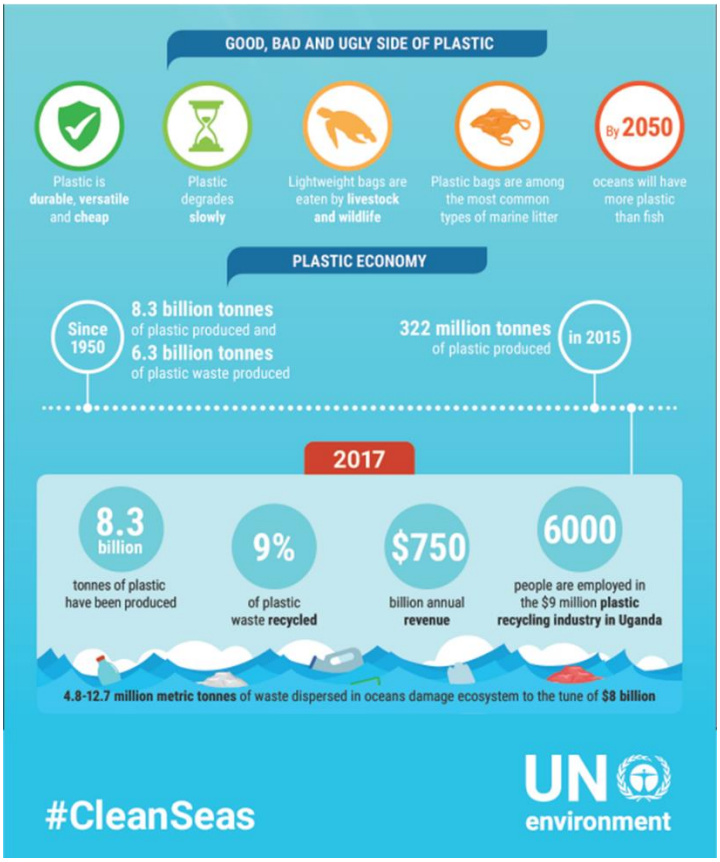
Above pic shows plastic items ingested from sea found in stomach of a dead Albatross – a migratory bird. It is known to reside on pacific Island but gets short time for landing due to which it consumes whatever available.



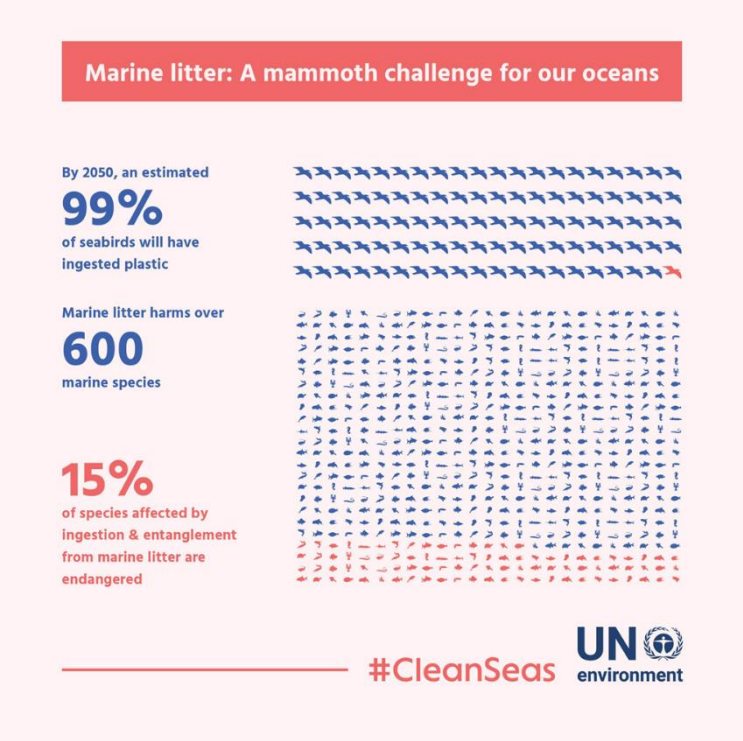
Above given is the UN massage in 2017 for World Environment Day, Apt for Topic

1 PETE	**Polyethylene Terephalate Ethylene** PETE goes into soft drink, juice, water, detergent, and cleaner bottles. Also used for cooking and peanut butter jars.	5 PP	**Polypropylene** PP goes into caps, disks, syrup bottles, yogurt tubs, straws, and film packaging.
2 HDPE	**High Density Polyethylene** High Density Polyethylene HDPE goes into milk and water jugs, bleach bottles, detergent bottles, shampoo bottles, plastic bags and grocery sacks, motor oil bottles, household cleaners, and butter tubs.	6 PS	**Polystyrene** PS goes into meat trays, egg cartons, plates, cutlery, carry-out containers, and clear trays.
3 PVC	**Polyvinyl Cloride** PVC goes into window cleaner, cooking oils, and detergent bottles. Also used for peanut butter jars and water jugs.	7 OTHER	**Other** Includes resins not mentioned above or combinations of plastics.
4 LDPE	**Low Density Polyethylene** LDPE goes into plastic bags and grocery sacks, dry cleaning bags, flexible film packaging, and some bottles.		

Above given are general categories of plastic based on recyclability



Above given information release by UNEP gives a strong massage and data about extent of damage to environment by plastic



Above given information release by UNEP gives a strong massage and data about marine environmental pollution due to marine litter – problem due to waste mismanagement

Heavy metals in solid waste :

" Studies indicated that average concentration of heavy metals in the raw waste that was fed to the various compost plants was in the range of 47 to 185 mg per kg in respect of lead, 36-63 mg/kg for nickel and 1.5 to 6.5 mg/kg for cadmium. The levels of mercury in raw waste were between 0.01 and 0.23 mg/kg. Heavy metals in the finished compost were ranging as follows; Pb; 108-203 mg/kg; ni- 8-80 mg/kg; cd- 3.8-12.4 mg/kg and mg – 0.01-0.31 mg/kg." Source – (CPCB studies)

4.6 Historical Overview of Solid Waste Management Problem Elsewhere and in Goa.During internet research, very interesting article on trash, authored by Roberta Crowell Barbalace was found. It gives interesting history about garbage problem mostly in European countries. The extract from the article "A timeline of Trash" is placed in Appendix VI. "Humans are by their very nature careless with trash,

Consumption and waste of resources is probably related to **supply available** more than any other factor, It reveals about how disposal or management of garbage has evolved over years in western world. Some of the significant milestones like in the year 1898, NY has first rubbish sorting plant for recycling (most important to note). Outbreak of vesicular exenthama in New York in the year 1900, due to raw garbage consumption by pigs resulted in the destruction of 1,000s of pigs, fact that landfills were becoming a popular way of reclaiming swamp land while getting rid of trash in 1920's. Also that in 1976, Resource Conservation and Recovery Act (RCRA) was created emphasizing recycling and hazardous waste (HW) management. This was the result of two major events: the oil embargo and the discovery (or recognition) of Love Canal." (Source - Article, RCB, Envi. Chem, 2003)

In India, the waste management has been addressed at national level though various programs and the present most popular movement taken up by Hon. Prime minister of India as nationwide program is Swachch Bharat. Also great efforts are made in the direction of stopping open defecation. The problem is result of fast growing urbanization, materialistic lifestyle, and use and through culture, advancement in packaging industry, ease of logistics creating small parcels and more wastage, extravagance wasteful culture that exceeds greed over need. In a country like India whereby the wide disparity in incomes has led to marginalized populations which thrive on recycling industry. Hence very important consideration needs to be given to the significant aspect of solid waste as misplaced wealth for someone down the line if tackled at the point of generation and not mere trash or filth.

In Goa and Konkan area – solid waste was not most significant issue till the tourism business and population has resulted in heaps and piles of solid waste referred to as garbage dumps that have stinking leachate flowing out, egrets and birds hovering

above garbage sites and rag pickers are seen plucking things without any protective clothing and in unhygienic ways. The past practice was to dispose refuse or non-re-usable material in abandoned village well and the biodegradable or decomposable wet waste, food waste, green litter etc. were disposed in a pit behind house along with livestock dung to convert into compost. Gobarde (Ash mixed with dry cow/buffalo dung) Each house in village has a Gairi – Pit with dung and green waste – Suggest to have one more garbage pit adjacent to take daily garbage material covered with dung. Green matter is fodder and left over food may be danger for cattle.

Proper mixture of goat droppings, cow dung, buffalo dung and chicken sheet with practice of burning field etc.

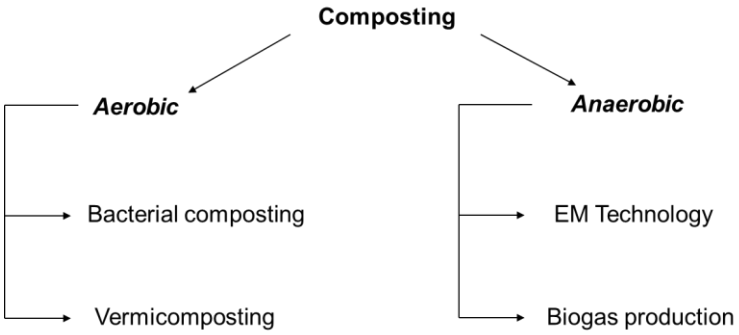
The practice was successful when the quantities were small and manageable. The lifestyle was in harmony with surroundings, hence quality of refused material was relatively eco-friendly. But when waste quality altered, quantities enhanced, the degradability time was altered thereby resulting in more time demand for degradation. The problem of solid waste has evolved with lifestyle. The present scales of huge magnitude of problems is result if long term inaction and lack of prioritization. Further, change in lifestyles and values of easy and irresponsible civic attitude have complicated the issue to present levels.

4.7 <u>Various solid waste management methods and technology options</u> recommended for waste processing as per Govt. guidelines - Towns generating garbage - upto 50 metric tons / day(mt/day) = vermi-composting - between 50 mt& 500 mt / day = vermi-composting + mechanical composting

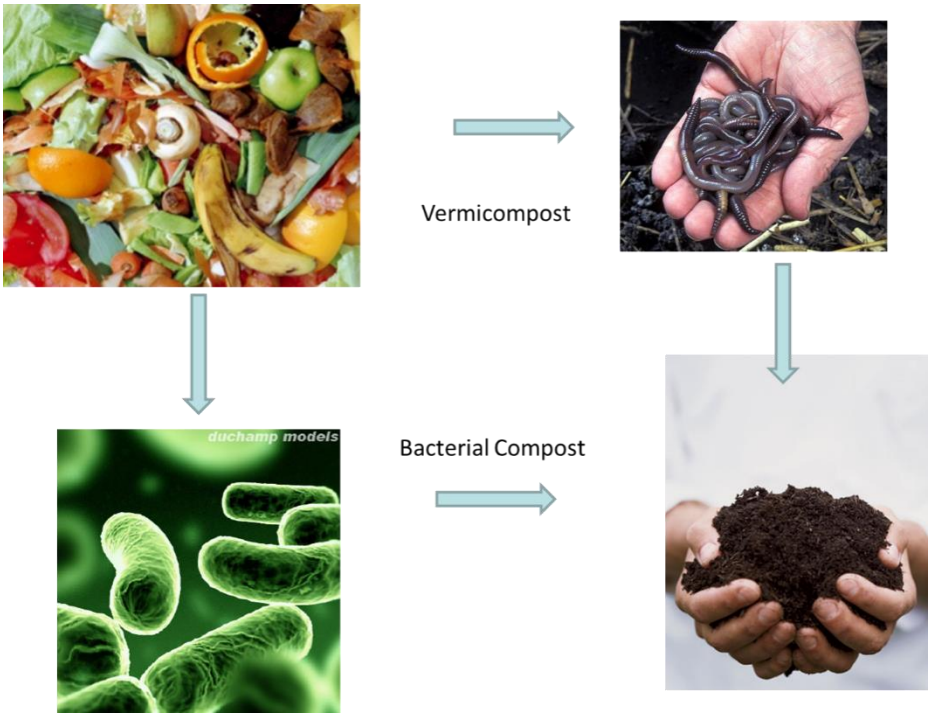
More than 500 mt / day = mechanical composting + refuse derived fuel(rdf)

From rejects keeping in view the type of the city (industrial or non- industrial) or bio-methanation. Below shown are the composting & other methods of waste management

suitable for large, medium scale and even individual home scale methods. Composting means a controlled process involving microbial decomposition of organic matter.



Garden Composting is shown below – generally 1m X 1m X1m pit is made and biodegradable wet waste is buried with intermediate layers or green material, soil and / or old compost. Various combinations are used based on the experience.

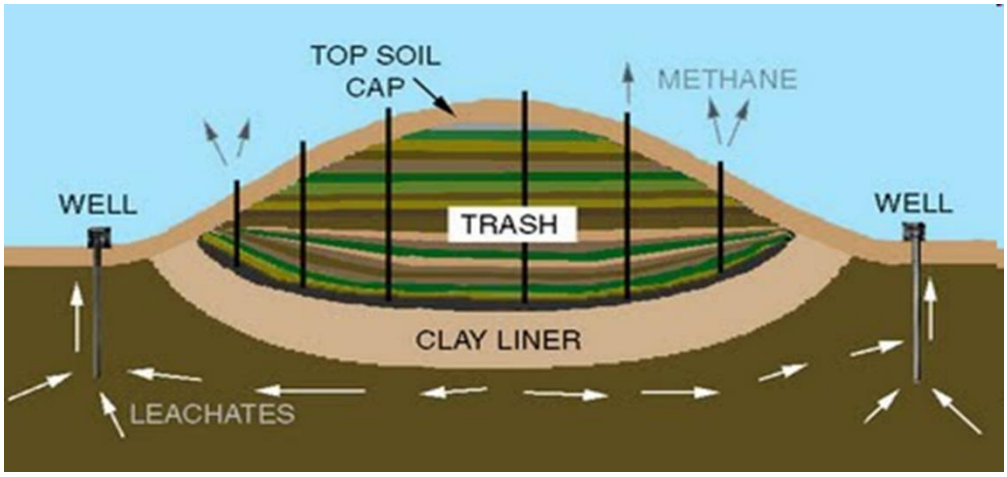








Above pictures show Windrows Method of Composting



Above pictures shows typical landfill site plan

Composting at home using KHAMBA



Day 1



Day 20



Day 45



Above shown is method of composting using Khamba (Means Pillar in Hindi)

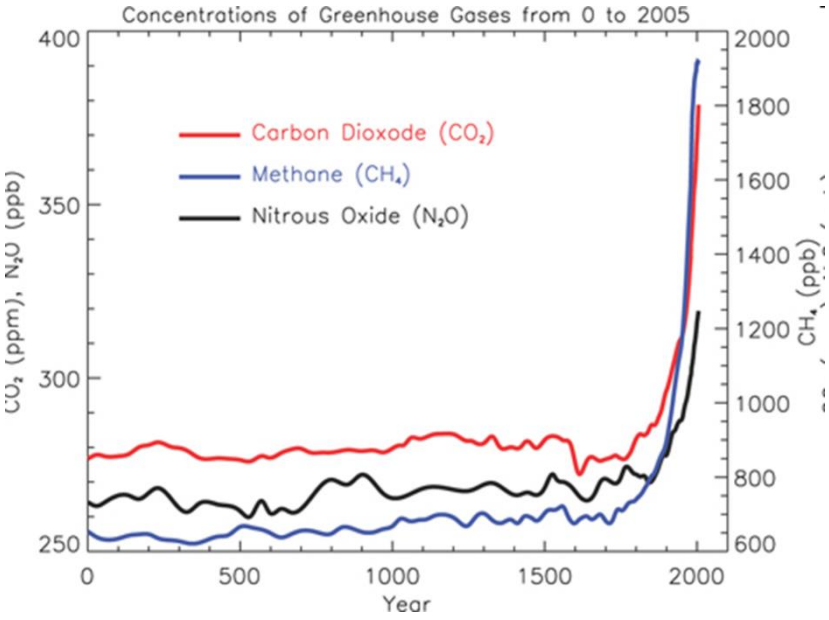
Khamba technique is suitable for small quantities of green waste and very little waste with non-vegetable contents as it should not attract ants or rodents. This technique has many disadvantages for higher quantities and is suitable for very small home scale vegetable based waste. But is aesthetically good and successful is passionately done in dry areas. Humidity may lead to release of leachate and dampness to clay body of khamba.





Home Scale Biogas





"India is one of the pioneer countries in the design and application of household (HH) biogas plants & large- scale implementation of this technology in rural areas. Systematic development and promotion of HH plants in India is over 60 years old. Existing biogas methods could be described as Floating Gas Holder Biogas Plants (Two important models are),

IARI (India Agricultural Research Institute) Model- Design & developed by IARI in 1940's and KVIC (Khadi and Village Industries Commission) Model- Designed & developed by KVIC (Jasbhai Patel) in 1950's.Fixed Dome with Fixed Gas Storage Chamber as the integral part of the digester (Three important models are)Main building material used is brick with cement mortar and mild steel for gas holder, Janata Model- Designed by GGRS (PRI) in 1970's and improved by a team of AFPRO engineers & specialists. Deenbandhu Model- Designed, developed & improved by a team of AFPRO engineers & specialists in 1980's.Main building material used is brick with cement mortar, Grameen Bandhu Model- Designed & developed by the Secretary General (Raymond Myles) INSEDA in 1990's. Main building material used is bamboo with cement mortar.



Above given is photograph of Deenbandhu Model (Source – Shri. Hemant Mahajan - ARTI)

ENVIRONMENTAL IMPACT OF BUILDING HOUSEHOLD (HH) BIOGAS PLANTS IN RURAL INDIA - This 1.00 million tone dung that is presently being used, either: As fuel by burning of 300 kg of dung cake or by dumping 700 kg of dung in heaps or in open pits in rural India for making organic manure. Is responsible for directly releasing GHGs (greenhouse gases) in the form of either carbon dioxide (CO2) or methane (CH4) or both in to the atmosphere. Therefore, by installing 20 million household biogas plants of 2 M3 capacity, 1,000 million kg (1.00 million tons):Fresh bovine dung could be recycled and utilized in an

efficient manner. These 20 million HH plants would also offset GHGs(CO2& CH4) to atmosphere, creating positive environmental impact. Methane (CH4) is 19 times more potent than carbon dioxide (CO2) and aggressive GHG and remains in atmosphere for a far longer period, as compared to CO2.Methane emission and its equivalent (as GHG) value of carbon dioxide is calculated in terms of 1 M3 of bovine dung (20% TS), therefore, this value of CO2 has to be converted in terms of 1 kg of bovine dung for practical purposes & subsequent use.(Source - PPT by Myles, 2004)

Some other options like in-vessel composting, large scale biogas, wind-rows composting, underground pit system as well as STAC (Sulabh Thermophilic Aerobic Composter) were considered but finally after comparison of probable suitability, success, long term durability, effectiveness, performance efficiency, products of treated solid waste, time required for treatment, possibility of using existing 7 no of compost pits and cost consideration, it was decided to select OWC with double shredder. Alternative techniques and projects developed by renowned academies that were discussed/ worked out -Anaerobic biogas production from garbage, Vermicomposting, Open heap composting, Burial, Hand filling, Chemical pyrolysis, Electric Arc (Convert into ash), Incineration, Recycle- plastic compression, etc.





Above shown are photos of basin fixed with crusher (left side pic) and ARTI type biogas system (right side pic) from the residence of researcher, successfully used for single burner gas use for past 6 years

Sulabh Thermophilic Aerobic Composting - A note from P K Jha on STAC

Dr.P.K.Jha, Advisor Technical, Sulabh International Academy of Environmental Sanitation, New Delhi, has developed a new and effective technology of composting of biodegradable wastes. The technology known as Sulabh Thermophilic Aerobic Composting (STAC) requires only 12 days degrading compost any biodegradable wastes. Further, turning of garbage is not required during composting period and finally liquid generated during composting is collected in a separate space provided in the compost plant. This liquid contains a good percentage of plant nutrients that can be utilised for agricultural purposes. Degraded solid that contains high moisture contents is kept in pits where it is used for agricultural purpose. The plant is cylindrical structure made up of G.I. sheet, double wall filled with glasswool, in order to insulate the plant completely. It has three perforated partitions making the three chambers of the plant. Wastes are put into first upper and middle parts. Liquid is collected in lower most part from where it is collected and use for agriculture purpose. Plant is based on aerobic condition. Air is provided through air compressor. Before waste is put into plant it is pulverizes into pieces (1-2”). It works satisfactorily even in winter season when the atmospheric temperature goes down to 5-6°C. Inside plant during composting, temperature rises up to 65-70°c. At high temperature pathogens in wastes are completely eliminated making compost free from health risk. The practical utilities of this technology are (i) organic solid waste can be efficiently converted into manure and soil conditioner, having direct/ indirect economic return (ii) it will control diseases transmitted from waste because at high temperature pathogens are eliminated from the wastes (iii) owing to reduction in volume, carriage cost of waste disposal site as well as areas needed for landfills will be drastically reduced and (iv) spread of weeds

from wastes will also be controlled. The technology got patented through the Patent office, Government of India.

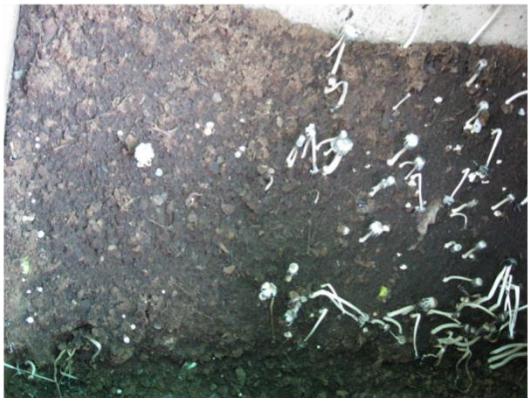
Most of the above shown methods could be used for individual house also for hepurpose of waste management. In case of use for higher quantities, suitable modifications are required.

Aerobic Bacterial Composting at Penha Da Franca (Provorim)



Segregated wet waste

Ready compost
Showing growth of mushrooms

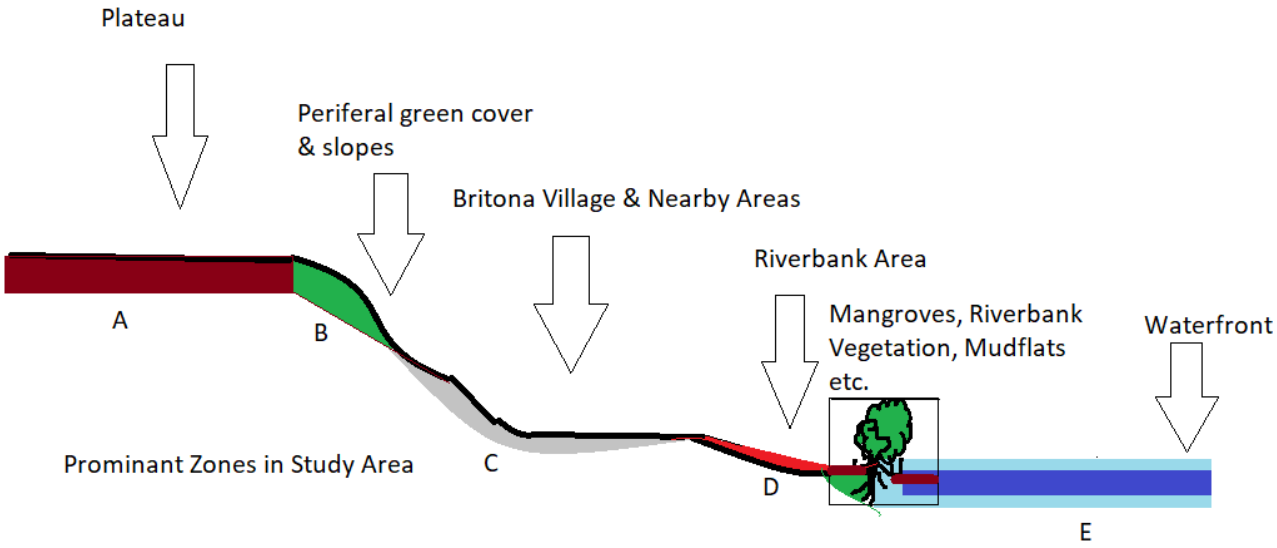


Above shown is the photograph if raw waste and compost in composting pit. Sprouted seeds like watermelon were also seen growing in the compost along with others. The physical characteristics and jar test also showed satisfactory results. (Jar test was done by keeping some ready compost in jar for over 48 hours in moist condition and if there is no odour then it is good). Only good compost having satisfactory quality was supplied to buyers.

4.8 Significant features, topography and photographs of study area

As we look upon the Pehna de Franca Plateau from the Mandovi Bridge, the scene is such that the rich canopy harbouring rich biodiversity is visible. It is also interesting to see that in the evening or early morning times the various Birds including egrets, kites and several seabirds including seagull, several scavenging birds sit in the canopy giving appearance as if they are

flagged on the canopy adjoining the river Mandovi. The migratory birds are plenty and the best time to see maximum Birds is during low tide or the twilight times when the mudflats and intertidal zones are exposed. The birds try to find their prey during this time.



Above given is the broad schematic elevation pattern with top plateau area **Zone A** – Lateritic and enriched with soil cover in many parts on plateau and peripheral parts thereby keeping it very green plateau resembling dense forest with features of tropical forest species.

This area is under maximum pressure of development. Major establishments including Goa Legislative Assembly is located in this area.

Zone B – is very rich forest ecosystem consisting of valleys and various topographic features along the slope. Maximum elevation level is 69 meters found on plateau at 15.515973 Latitude, and 73.838207 Longitude, and lowest on southern side in Mandovi River waters. Due to accretion of runoff silt in this area, there is high productivity and rich species biodiversity especially of small games consisting of wild hare, porcupines, wild boar, civet cats, many species of snakes, other reptiles, birds etc. Large number of wild fruit varieties and trees namely TirafalZanthoxylumrhetsa (limonella): Curry fruits is most prominent along with Alstonia Scholaris – Satvin, Bombax Ceiba – Savar, etc. Coconut plantations are seen predominantly along river banks. Slopes are

Zone C – is most inhabited after plateau. In addition to native fisher folk communities, lot of other commercial activities are flourishing in this zone. These activities existing since generations are well within limits and have no significant adverse impact in the area.

Zone D – Extension of unplanned activities from zone C, have resulted in regulatory violations. This zone is eco-sensitive area and vulnerable to shocks of development, mainly construction and waste dumping. Although this zone is prone to shocks, it has capabilities to regenerate till certain point. However the carrying capacity and reversible potential should not be exceeded. There is scope to conduct such studies and also take up restoration work in future.

Zone E – This is area of Mandovi Riverfront. Marine and estuarine ecosystem having rich species as described in biodiversity part of this thesis. This waterfront is used as parking by boats, launches, jetty area etc. The other side of bank is Chorao Island having Dr. Salim Ali Bird Sanctuary is known to harbour rich diversity of birds and also crocodile – keystone species is seen on both the banks.

Comparison between pristine river bank of Chorao and VPDF - While looking at both the river banks of VPPDF and Chorao Island, which are facing each other, few observations are as below.

1. River bank area of VPPDF is under severe stress due to population demand and that Chorao side of river bank is like controlled reference sample which is protected being wildlife sanctuary. Mangroves, mudflats, associated greenery along riverbank are very prominently evident. Most prominent Church on the river bank with the name Penha de Franca (Britona Church) which is reason for the name of village and entire jurisdiction can be seen from nearby areas and is standing tall since the year 1926 (as per information from local sources and prominent historians of Goa).



Above photograph shows both river banks – Chorao on Left and VPPDF on the right(Pic credit – Shri. Nirmal Kulkarni)

2. Mangroves are important features of this area as they are first line of defence and interface between land and waterfront. However destruction of mangroves along the river bank of VPPDF and further areas such as Salvador de Mundo and further-on are prominently visible. There is encroachment of houses, other establishments, fixed and floating jetties into waters. Most of the households belong to the fishing community but at the same time halls, rest houses, workshops, tourist hotels, ship repairing facilities and parked boats are existing in this area no more giving it a village look but is a place with more demand for floating jetties, pontoons, fixed jetties, mini marina like facilities along with associated structures. The efforts are made to replace natural line of defence with concrete walls as means of erosion control. However general observation is that wherever there is concrete wall along the riverine bank, mangroves have disappeared.

3. The storm-water drains are discharging into waters and also discharge pipelines from various households and establishments are visible. Solid waste dumping is evident and even construction and demolition waste is evident in ecologically vulnerable areas.

4. The small creek whereby Torda Rivulet meets Mandovi River is prominent and very uniquely beautiful offshoot for canoe mangrove trip.



Above shown is the photo showing connecting rivulet meeting Mandovi River(Pic credit – Shri. Nirmal Kulkarni)

"Humans are by their very nature careless with trash, Consumption and waste of resources is probably related to supply available more than any other factor" (Article on internet -RCB, Envi. Chem, 2003)

“The Environments first role, then, is as a supplier of resources. Its second is as a sink or receptor, for waste products. These wastes may result directly from products, as already mentioned, or from consumption: when am individual puts out their garbage or when they drive to work they are contributing to this form of waste. In some cases wastes are biologically and or chemically processed by the environment. Whether this results in harmful effect on the estuary depends on a number of factors, including the volume of waste relative to the volume of receiving water, the temperature of water and its rate of replacement. Only once the oxygen in the river drops below a critical level so that, for example fish are no longer present, does the effect become ‘significant’ on some criteria.”

(Source: Nick Hanley- Jason F. Shogren, 1999)

4.9 Significant issues featuring in the study area

The study area is in most proximity of capital city and hence has very highly suitable for creation of several facilities such jetties, mini marinas, pontoons, workshops, riverside rest houses, tourist homes, commercial support systems for suitable activities etc. The place is in high demand. The ongoing construction of third bridge Mandovi Bridge is one of the most significant activity which is also mentioned in the study.



Above photo shows view of Penha de Franca Plateau near Goa Cricket Academy showing rain water accumulation which looks like lake during peak rainy season and many kids enjoy swimming at this location

Above shown location is suitable for water augmentation and harvesting technique by ground water recharge system. It is also possible to have treatment system for water supply in future as there is lake like structure formed here during monsoon season.



Above photo shows view of Kranti Udyan in VP Penha de Franca



Above placedand below given photographs show the traditionally existing occupations in the study area. Fisher folk population is predominant.(Pic credit – Shri. Nirmal Kulkarni)





Above photographs (Pic credit – Shri. Nirmal Kulkarni) show existing jetty with fishing gadgets and fishing bamboo sticks / poles which are used for stake net fishing by creating a fencelike pattern (locally known as Futani -) with net near mangrove areas to periodically harvest fish catch.



Above photograph shows newly emerging commercial activity for parking boats along floating pontoons, (Pic credit – Shri. Nirmal Kulkarni)



Above photograph shows newly emerging commercial activity for tourist boats along floating pontoons, (Pic credit – Shri. Nirmal Kulkarni)



Above photo shows VPPDF river bank on the right side with tourist boats, fishing launches, and households as well as establishments, (Pic credit – Shri. Nirmal Kulkarni)

4.91 Ongoing construction of third Mandovi Bridge is a significant large scale project which has its concrete facility, gantry crane and other activities in the study area. The impact on mangroves created hurdles for the project and Govt. had to give undertaking assuring replantation of mangroves through Dept. of Forest – Govt. of Goa.



Above and below given are the two photographs showing ongoing construction of third Mandovi Bridge with support facilities like heavy earth moving equipments (below given photo)(Pic credit – Shri. Nirmal Kulkarni)





Above photograph shows concrete making facility and below photograph shows gantry crane (Pic credit – Shri. Nirmal Kulkarni)





Above & below placed photo shows VPPDF river bank with households as well as establishments, mobile tower and bustling anthropogenic activities including smoke coming out from cleaning and burning in open.





Above photo shows VPPDF river bank on the right side with fishing launches(Pic credit – Shri. Nirmal Kulkarni)



Researcher on field trip by boat - (Pic credit – Shri. Nirmal Kulkarni)

4.9A Pollution and solid waste management problem in the study area

It is learnt from the experience and feedback from Goa, that public is not supportive for central solid waste system as they have not seen well managed garbage plant in near vicinity. The problem of solid waste management is directly related to the lifestyle habits and materialistic as well as individualistic attitude of new generation population.

1. Therefore solution for the problem is site specific.

• In some places e. g. Ponda having identified and legally complied place for SWM it is possible to have **Centralized Process Plant and landfill facility.**

• The areas like Penha de Franca with no central place but already having ready small sites completely identified are ideal for **decentralized model**.

• Those areas with central area but also willing to have few decentralized schemes are ideal for **combined model**. E.g. Saligao.

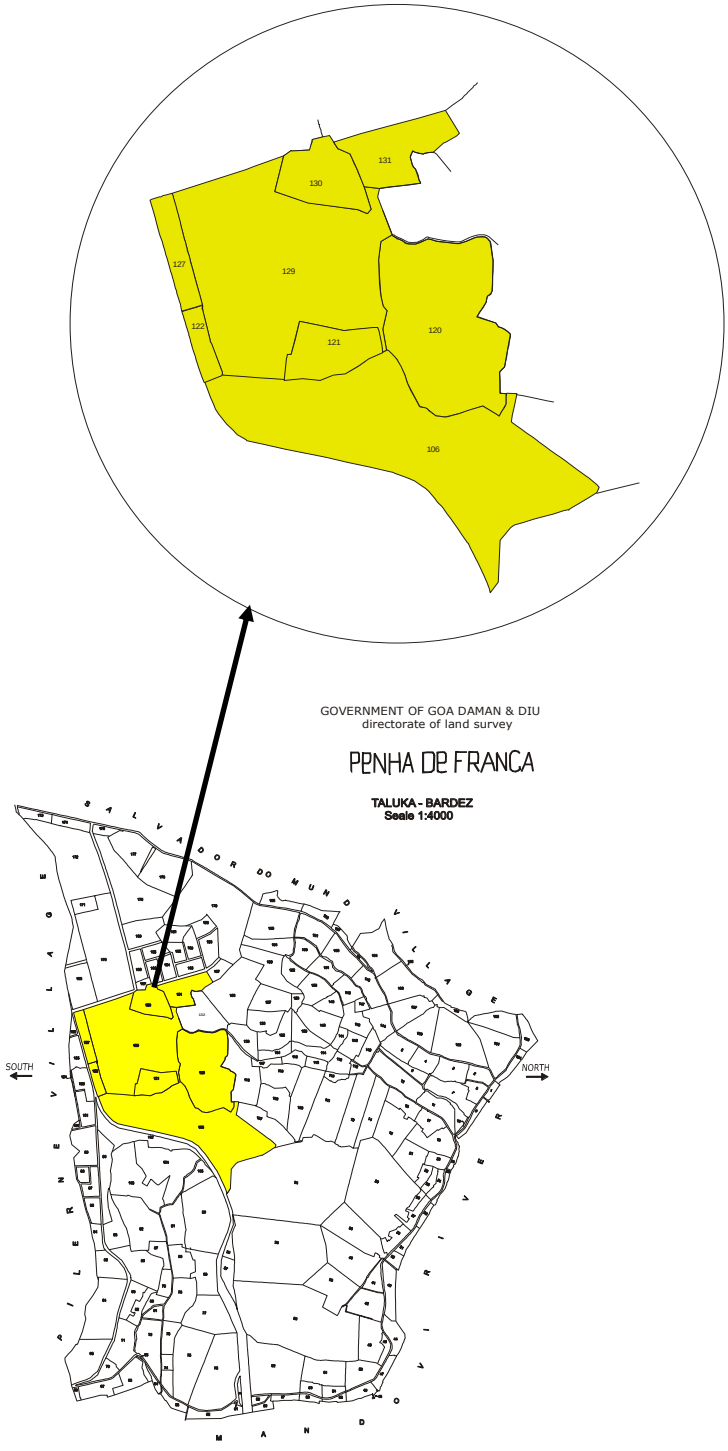


Above photo shows dumping of construction and demolition waste in Mandovi River waters in Britona area. It also shows destruction of mangroves, concrete wall, and discharge pipes along with canoes parked on the step type provision created along the wall. (Pic credit – Shri. Nirmal Kulkarni)



Above photograph shows construction touching waterfront and the foundation is prone to the process of erosion visible and it is necessary to assess the safety aspects (Pic credit – Shri. Nirmal Kulkarni)

Exact working area and data analysis was done in and around ward no 8 of VP PDF before delimitation as shown in the map given below.



Maps placed on left side of this page are not to scale but areas shown are correct and are based on existing authentic VPPDF Maps

No of 500 households were provided with service, awareness, education, participation opportunity and free supply of specially designed 2 binsin each household. Door to door collection was started in this area for the first time.

4.9B Extent and nature of the problem

The problem of solid waste mismanagement has prominent existence not only in study area, but the entire State of Goa, Country as well as at global level. The extent of outreach of

impacts of the problem are wide reaching ranging from land, mountains to oceans. Not only wherever the humans have presence but even in space and other unreached places away from human inhabitations. Hence the dangers posed and extent of problem outreach are equally complex.

While understanding this problem, it may not be always possible to ascertain origin of point of waste generation. Hence polluters pay principle may not be applicable always. Even when such point of origin are known, there is seldom any action or mechanism to impose penalty or disciplinary actions. Often local bodies are made responsible for waste management and disposal.

Solid waste consists of household waste, construction and demolition debris, sanitation residue, and waste from streets. This garbage is generated mainly from residential and commercial complexes. With rising urbanization and change in lifestyle and food habits, the amount of municipal solid waste has been increasing rapidly and its composition changing. In 1947 cities and towns in India generated an estimated 6 million tons of solid waste; in1997 it was about 48 million tonnes. More than 25% of the municipal solid waste is not collected at all; 70% of the Indian cities lack adequate capacity to transport it and there are no sanitary landfills to dispose of the waste. The existing landfills are neither well equipped nor well managed and are not lined properly to protect against contamination of soil and groundwater. The four broad categories **organic waste**: kitchen waste, vegetables, flowers, leaves, fruits. **Toxic** waste: Old medicines, paints, chemicals, bulbs, spray cans, fertilizer and pesticide containers, batteries, shoe polish. **Recyclable**: Paper, glass, metals, plastics. **Soiled**: Hospital waste such as cloth soiled with blood and other body fluids. Over the last few years, the consumer market has grown rapidly leading to products being packed in cans, aluminium foils, plastics, and other such non-biodegradable items that cause in calculable harm to the environment. In India, some municipal areas have banned the use of plastics and they seem to have achieved success.



Above photograph is taken along the riverside area in study area in Britona –Here maximum problems are visible in single location. Absence of mangroves, dumping of waste, presence of haphazardly kept crates and mismanaged backyard is aesthetically eyesore.



Above photograph taken along the riverside area in study area in Britona shows several discharge pipes in the backyard of houses indicating that not only sewage but also floor washings, storm waters and other waters are discharged into river.

4.9C Photographic report and presentation of solid waste management problem in area.



Roadside disposal of garden waste and coconut foliage along with other solid waste




Stray dogs menace and cattle unknowingly ingesting plastic along with food from garbage is very well known and was also observed here, near the bin at Hanuman Temple in the study area plateau.




As shown in above and below given photo - some areas like Oval Park were found to be

most affected due to dumping of waste as shown above.






Burning of waste in open is nuisance and has caused lot of irritation and respiratory issues to locals as was revealed during personal interactions with locals.



View of storm drains filled with solid waste and existing compost pit and garbage dumped around





Even the areas near existing compost pits were completely covered by waste which was further cleaned and all the areas go transformed.



View of existing compost pit and garbage dumped around



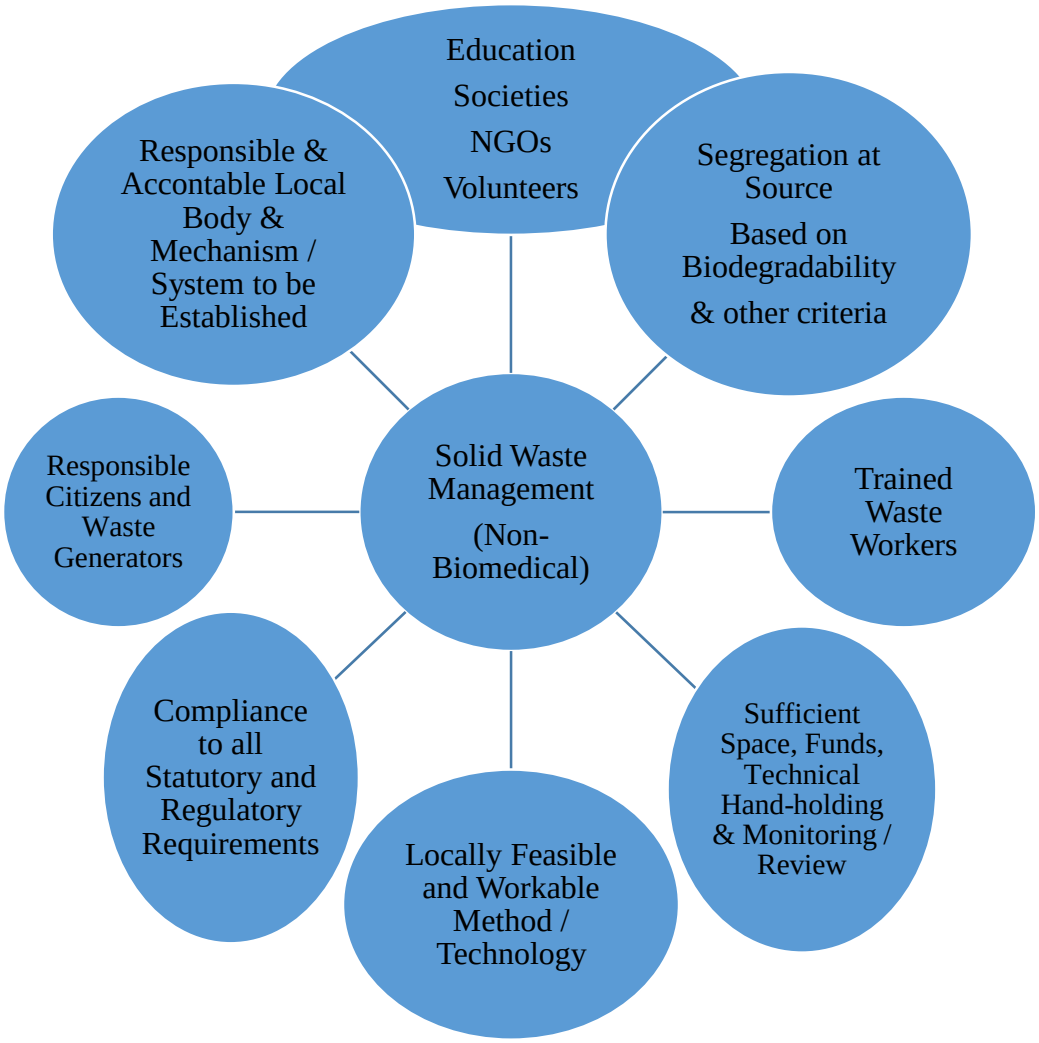
Close view of existing compost pits in the study area which were used in the pilot project. The provision for leachate collection and preventing flies due to mesh cover is evident.

Hence while selecting technology of treatment, only machines were taken and curing system for composting was not purchased to be able to use the existing compost pits which were cleaned and modified suitably.



Above photos show plastic collection centres which were cleaned and used for the project purpose

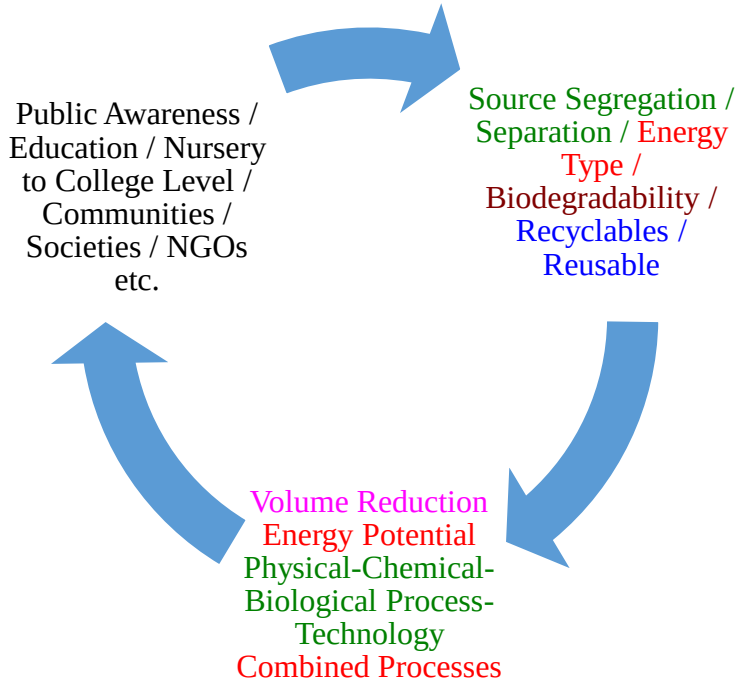
4.9D Understanding the stakeholders in the society pertaining to the problem



The stakeholders have major role to play. The waste generators, local bodies (Village Panchayats, Municipalities, Corporations etc.), regulators, waste workers, funding agencies – Directorate of Panchayat or any other Govt. Depts. Local land owners including Village Communidade, Housing Boards, Govt. Departments having lands in their possession and having housing complexes, other private complexes.

Local NGOs, Housing Societies, Clubs, Senior respected citizens, VP members and representatives, VP Garbage Committee Members, etc. have larger roles to play.

We have also learnt that education of house maids, servants and security guards also helps in a big way to achieve success especially in segregation and further carry / transport the waste in segregated form.



Stakeholders

- ✓ **Major role is segregation at source and is of public.**
- ✓ **Timely availability of service is vital as far as service part is concerned.**
- ✓ **Many times it was difficult to maintain minimum no of manpower due to which service timings were disturbed.**
- ✓ **Public is increasingly adding impurities in spite of being enlightened & educated during various occasions.**
- ✓ **VPPDF has not collected public contributions during current year.**
- ✓ **VPPF has also not taken timely actions to add more houses to existing project.**

- ✓ **However VPPDF has made contributions for the project from its main fund.**
- ✓ **During September 2011, initiatives are planned by VPPDF to expand the project, allocate more funds and strengthen the collection system**

Garbage issue is rocking the public bodies and is everyday news at some or the other part of Goa. The private bodies and those with space availability and sensitivity to the subject have adopted solutions but account for negligible quantity.



View of stray dogs relaxing – they are also stakeholders. When door to door collection started, they thought that green rangers are their competitors and started attacking them. This was a different type of human animal conflict based on solid waste management.

4.9E <u>Public health considerations</u> - viewpoint and feedback from health department sources from the State and study area –As a part of consultation process and understanding of view from important stakeholders, effort was made to interact with the health officials and authorities. The solid waste sites are important source of bad odour, distinct offensive stink hovering scavenger birds, encourages pests, rodents and houseflies. The plastic, rubber waste including tyres, coconut shells, etc. biodegradables mostly cause water stagnation after heavy rains during dry spells create micro water storage & stagnation leading to mosquito breeding. Two major vector borne diseases namely malaria and dengue are caused and spread due to stagnated water breeding sites of mosquitos. Offensive odour may cause allergic rhinitis

(running nose due to allergy), psychological disturbances, headaches, and uneasiness in certain locations of garbage proximity. Houseflies cause communicable diseases being carrier of bacterial and other contaminations from waste matter to eatables, sweets, food items especially activities and houses along roadside and near waste management sites.

The Government efforts are not supported by best management practice hence objections from public for providing / operating SWM facility at central place.

Those desiring to volunteer or adopt solutions do not have guidance about available methods of handling SW. Urgent need to set up a model facility.

Project is taken up by LILA Trust with financial backing by "Sociadade – de Fomento" a corporate house out of its social responsibility, after request and getting convinced by researcher.

Remarkable response during public meetings and pilot site is selected at ward no 8 village panchayat Penha De Franca due to their appreciable efforts awaiting to activate, plan and implement the incomplete SWM system.

Pilot results will guide in carrying **out large scale multiplication of site specific SWM projects in other places. Chronological sequence of actions planned, design aspects and activities planned as well as actually undertaken.**

How the concept got initiated: While working with industries, researcher realized that there is need to take serious note of the existing degraded environmental scenario and that professional / dedicated effort is required to seek solution. Need was realized in order to find localized & specific solutions for environmental problems, Therefore researcher decided that should allot 2 valuable years from my life (active 2 yrs) and try level best to implement at least one solution at village panchayat level sincerely & dedicatedly. Decided to leave JSW south west port and on 25th may 2009 resigned from the position of Environmental in charge from JSW owned south west port Marmugao Goa. The assignment in the post was to implement ISO 9001,

14000 & 18000 which was successfully completed. Joined as Jt. CEO LILA Trust & working partner with Technology in May 2009. Streamlined LILA Trust's Cyber Gurukool Centre, efforts made for getting direct assessment for the students & started hardware & networking course in association with Mushtifund School &other organizations like PNEF Pune. Based on motivation and inspiration from Shri. Auduthbab Timblo Chairman – Sociadade de Fomento, Shri. Sujay Gupta & appropriate permission from Shri. J K Rao IRS Chairman LILA started looking out for pilot site. Shri. V. Y.Pawar (CEO-LILA) supported the initiative and initiated meeting with LIONS CLUB & coordinated efforts. First public meeting was held was at LIONS Medical Centre Porvorim.

4.9F Pilot Project at Penha de Franca village Panchayat Ward no 8

Type - Completely decentralized model

No of households **: 500 households, flats and shops**

Population **:** 2500, Solid Waste generation 0.600Kg /day per head

Expected Solid Waste per day = 0.6 X 2500 = 1500 Kg i. e. **1.5 MTPD**

Process involved

Primary Treatment - for organic/ biodegradable waste - Organic Waste converter : OWC-130 & Double Shredder (for non veg + big objects – dry waste)

Primary Treatment - for non-biodegradable waste

Sorting, Segregation, Bailing and Storage to be taken by recycler

& in future plan for ERT- fuel production or any other feasible option.

GLASS, METAL, BOTTLES, CANS waste - Sorting, Segregation and Storage to be taken by recycler

Secondary treatment

Bacterial Composting using OWC (organic waste converter) and Vermicomposting for green matter.

Resources: Existing compost pits 7 nos having volume of 3 cubic meters and 60-70 household capacity are sufficient. One pit was used for Vermicomposting of green material.

• Existing Plastic collection points with fencing- 3 nos. Proposed 4 more points already approved by VP PDF but was not possible to actually implement.

• Other requirements and infrastructure including centralized shed was done.

• Soon after starting collection and composting, ARTI Biogas and autoclave (appropriate technique) for biomedical waste treatment was planned but subsequently biogas was implemented.

• MOU between LILA Trust and Village Panchayat PDF was signed on 1st October 2009.

• Plan was to start the trial process with effect from 15th Dec 2009 in ward no 8 and cover the entire five wards within a period of one year as a part of MOU.

• However actual implementation may deviate from plan based on the existing conditions from time to time.

Steps involved in IEC: - Information, Education and Communication

Information of the SWM scheme to the public was done by many ways.

Preparation of survey formats and planning the area.

Interview for selection of volunteers.

Orientation to volunteers.

Division of area into blocks: - 1 worker for 125 households.

Collection of information about the households by paid volunteers.

Daily attendance maintained and Identity cards issued.

Daily digitization and processing of forms in Excel format.

Certification and payment of honorarium to volunteers.

Personal Supervision by Project Authorities.

All the above steps were systematically carried out based on the plan.

Pre-requisites and surveys conducted and findings

SOME PHOTOGRAPHS/ MEDIA OF IEC AT VP PDF



Above shown are the photos of trained volunteers to conduct survey of households as per the checklist and forms



Above shown are the photos of trained volunteers receiving certificates after completion of work

Activities carried out for volunteers.

- Outline plan for the two level volunteers, Honorary volunteers (11nos for 11 wards at VP PDF), appointed volunteers (need at least 1 per 10 households).
- Preparation of Site specific training programs for volunteers and workers, designing the presentations and training modules, Identify & register/ employ Project labourers, Self-help groups (Preparation of paper bags), and all interested parties.
- Designing and dissemination of pamphlets, Information brochures, Community banners and boards.

- Below given are some promotional and informative brochures collected from various sources – those from Pune are depicted below.



Designing the contents for brochures is an important artistic assignment. Selection of images to attract and appeal to all the stakeholders and interested parties is an important requirement for spreading awareness, inform all, educate all and communicate with all.



Brochures collected from Swach project by Pune municipality with KKPKP (Kagad kach Patra Kashtakari Panchayat) is placed towards left side. Visit to Pune by researcher with ward member of VPPDF Shri. Umesh Fadte was mainly intended to learn best practices. The learning was helpful in designing communication material and while managing workers. Below given is the brochure presently issued in the public interest by Goa State Pollution Control Board on their website.



Our Scheme of Waste Colour Codes which was planned at Village Panchayat Penha De Franca is given below. However it was only possible to provide black & green colored specially designed bins and a red coloured small paper bag for disposal of sanitary pads, napkins, diapers etc. and Plastic / Gunny bags for disposal of plastic waste that was collected twice in week or whenever it was full. Otherwise, wet and dry waste and other wastes were collected every day from door to door.

Green Coloured Bin	Black Coloured Bin	Red Coloured paper Bag	Brown Coloured Bin	Gunny Bag
Wet Garbage/ Biodegradable Waste	**Dry waste/ Non Plastic Dry Waste**	**Biomedical waste**	**Glass Waste & Metal Waste**	**Plastic Waste**
Constituents: FOOD & KITCHEN ORGANIC WASTE – LEAVES, PEELINGS AND SCRAPS, SPOILED FOOD, GRASS CLIPPINGS	**Constituents: PAPER – NEWSPAPER, OFFICE PAPER, PACKING MATERIALS, CARDBOARD**	**Constituents: SANITARY PADS, EXPIRED MEDICINES, WOUND DRESSING WASTE, PATIENT'S WASTE, CLINICAL WASTE, BABY'S DIAPERS**	**Constituents: GLASS, METAL, BOTTLES, CANS**	**Constituents: PLASTIC – BEVERAGE CONTAINERS, HIGH TECH WASTE, PACKING MATERIALS, Electric Cables, Wires**

Daily procedure / routine followed at the pilot project site was as given below.

• Garbage collection time:-06:45am sharp initially which was further made very flexible up to 8am and sometimes even second round was taken on request or phone call.

• House to house collection (green bin (for wet waste), black bin (for dry waste, paper) with gunny bag (plastic) and red paper bag (bio medical), by designated workers with identification and uniform. Gunny bags containing plastics and bottles were be collected twice a week or based on need felt. Glass & Metal & Other waste were collected based on availability

• Sorting and segregation of waste as per plan and further treatment was done as per plan. All the care for safety of workers with supply of PPEs (personal protective equipments) being provided. Workers and supervisors were trained regularly by researcher being project in charge.

• Organic waste was sent to Organic Waste Converter (OWC), a patented machine by Excel Industries. This machine was selected after lot of study of existing techniques and machines. In Goa, this machine was first time utilized for treatment of solid waste from public source. After the success achieved here, many hotels and even village panchayats and municipalities have visited our site and used this machines at various locations.

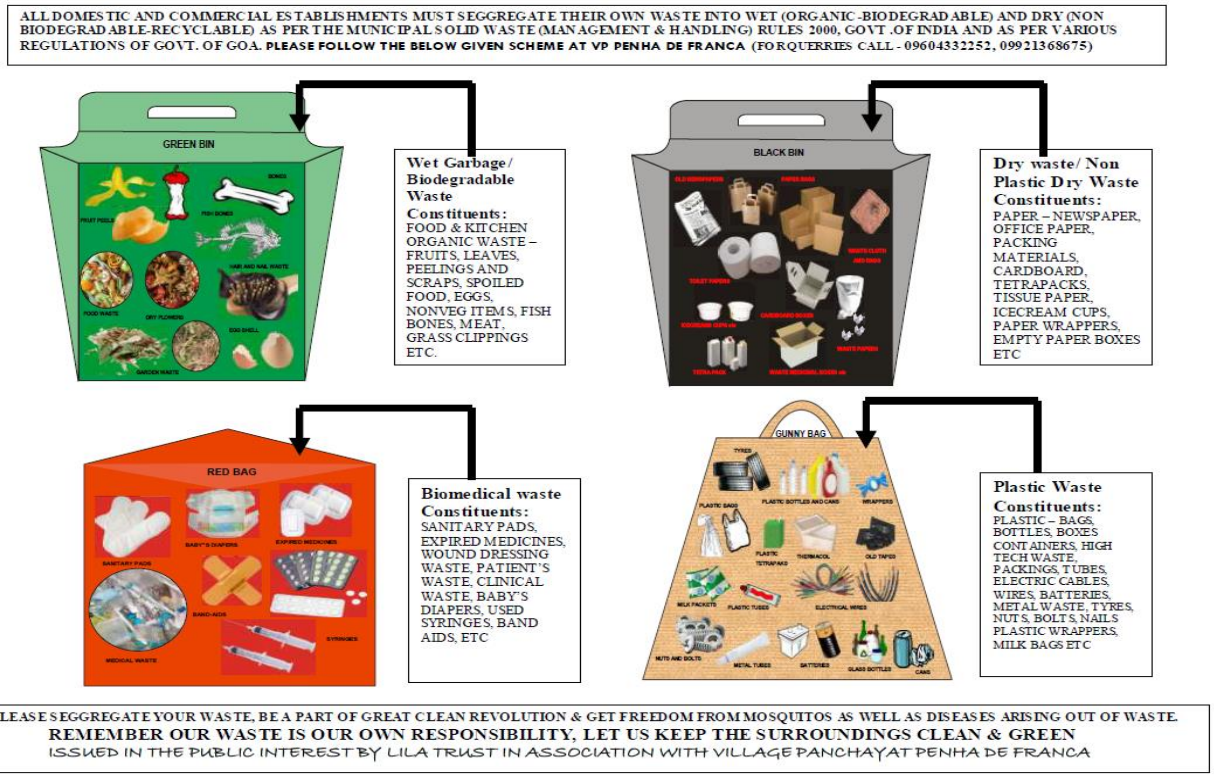
• Plastic, Metal, and glass and other wastes were sent to sorting sites and lastly to one storage location that was made near dumping site with the place provided by VPPDF.

INTREGRATION OF RURAL DEVELOPMENT, ENVIRONMENTAL MANAGEMENT AND SOCIAL UPLIFTMENT

SOCIAL	ENVIROMENT	RURAL DEVT
Education	Solid waste management	Water (pure)
Empowerment	Sewage management	Housing
Employability- Skill development	Water management & rainwater Harvesting	Sanitation(toilets)
Underprivileged EDP facilitation	Enhancing ecological interdependence, living standards and morals. (sustainable living)	
Rural BPOS	Live, let live, let us live	
	Understanding common moral values like interdependence	

Educating all above responsibilities as a part of moral responsibilities. Facts and figures giving resource depletion. Battle is to save our plants, reduce impacts of developmental activities, conservation and replenishment of resources

Sample of pamphlet that was distributed to each household & establishment is given below.



Above information was created and distributed in every household and later it was widely used to educate schools, companies, general public and the funding agency used the matter and these pamphlets for creation of awareness to larger populations in waste management. The aims envisaged at that point of time for the project were, To encourage Solid Waste Treatment at community level and empower small societies, housing complex, panchayats, wards, slums etc. Thereby making them more responsible to reduce, reuse and recycle at source. Availability of land being central and primary requirement to start the project, we intend to start with available space by exhibiting clean ways of managing solid waste.

The project is a first step towards making Goa a place that has complete Garbage Management Systems.

The process lay out planed at SWM project of VPPDF: Below given is the layout of process that was practiced at VPPDF project. But it was not possible to have bailing machine, fuel plant and autoclaving as the financial assistance was not available and also proven technology in case of fuel plant was not found to be convincing to the team. Besides the cost benefit analysis and scale of the project was not sufficient to take up fuel plant. Efforts were made for bailing machine and autoclave procurement but further it was decided to have them in bigger project which was planned at new site.

4.9G <u>Economic model and cost working at SWM pilot project:</u> The most significant part and learning opportunity was in deciding about type and extent of financial support to be extended to VPPDF for pilot solid waste management project. The success of model is not for cost effective implementation or per ton cost of treatment of waste, as the volumes are less than 1.5 tonnes per day and door to door collection services are involved. During the time of project implementation VPPDF was spending monthly charges of about Rs 7 lacs for the truck contractor to centrally collect and dispose solid waste from public places in all 11 wards. The first effort for door to door collection was from our project ward. First time, return was received from sale of compost. Monthly average cost of complete waste management in 500 households was Rs 40322/- in first year, Rs 72790/- in the second year and Rs 80747/- in the third year. First year it was just a beginning in few houses and after 8 months all the 500 houses were covered. Minimum cost after full swing start was Rs 45000/- and Maximum cost was about Rs 1 lac which also included some cost of purchase of appliances. If three years average of Rs 64619/- is considered then average cost of treating average 1 tonnes per day comes to Rs 2153/- per tonne. **However as mentioned earlier, the main achievement and feature of the project is financial handholding between VPPDF and Lila Trust**

(Supported by SFI) and immense learning that was achieved as well as education offered to public at large from a smaller turnkey decentralized project. Raw waste to compost volume reduction was to the tune of 40-50% hence the product available for sale was in high demand and due to smaller scales, we could not meet the demand. Maximum rate per kilogram of compost sold was Rs 10 per Kg and minimum rate was up to Rs 4 per Kg (during this time, some municipalities were selling large compost on scale @Rs 3 to 4 per Kg and another project at Verna Polytechnic was selling at Rs 7 per Kg). Households were charged by VPPDF @Rs1 per day which comes to Rs 30 per month. Commercial establishments were charged higher to the tune of Rs 50 per month or based on waste generation. But the readiness to pay was from very few residents. Most of them expected best service for free. It was learnt that there is necessary to treat larger quantities of waste. Door to door collection by single worker in a day was from maximum 150 households. Optimum is 125 households per person in half day. Another half was used for processing the waste at the treatment facility. However during festival times when absenteeism was high, there was stressful situation and workers even collected from 300 to 400 houses and the project site was managed with just 2 green rangers (waste workers). Best strength was 7 no of green rangers and during such times, even street cleaning in selected places and cleaning of public spots was ensured. Routine activities were segregated door to door collection, transporting the waste in separate bins and bags to the site. Secondary sorting at the site and further processing by shredder and OWC-500 homogeniser and mixer operating at 1400rpm (revolutions per minute). Further sorted fractions were further taken to dry sorting site and stored separately. The most advantage of door to door segregated waste collection was that good condition items such as old toys, mementos, old clothes, disposed utensils and many other items were reused by our green rangers itself. People were given option for the first time to facilitate reuse in a true manner. Recyclables were sold to the highest bidder.

Type – Reducing CSR fund support and increased financial participation by VPPDF. First plan was to reduce financial support after every quarter by 10 % and equal contribution to be taken from VPPDF. However later on it was understood that VPPDF was not equipped with speedy system to approve and implement the finances practically. Hence six month period was suggested and approved by Chairperson of CSR supporter SFI (Sociadade de Fomento).

Actual experience was different than the planned process. Unexpected expenses were incurred and also unexpected incomes from sale of plastics and compost were generated.

Approval for the pilot project was obtained from Goa State Pollution Control Board. Pic shown below.

GOA STATE POLLUTION CONTROL BOARD
गोंय राज्य प्रदुशण नियंत्रण मंडळ

Phone Nos. : 91-832 2438567, 2438528
2438563, 2438550
Fax No. : 832-2438528

GOA

Dempo Towers, 1st Floor,
EDC Plaza, Patto,
Panaji 403 001, Goa.

No.8/28/10-PCB/Vol. V/ 8131 | 02/2010

APPROVAL

The Goa State Pollution Control Board after examining the proposal of the Village Panchayat, Penha de Franca, Bardez, Goa hereby approves the proposal of the Sarpanch, Village Panchayat having their administrative office at Penha de Franca, Bardez - Goa to set up an Organic Waste Converter and composting units at locations stated as under in strict compliance of the Rural Garbage Scheme 2005 as amended in 2007.

1) Kranti Nagar Public Garden, and other locations in Ward No 8

The conditions for establishing of composting units are as follows:

1. The Village Panchayat should organize house to house collection of waste on regular pre-informed timings.
2. The Village Panchayat should establish the Composting Units for treatment of bio-degradable waste in compliance of the provisions of the Rural Garbage Scheme 2005 as amended in 2007..
3. The Village Panchayat should ensure that no foul odour should escape out the Composting Units for treatment of bio-degradable waste
4. The Village Panchayat should ensure that no leachate should escape out of the Composting Units for treatment of bio-degradable waste
5. The Composting Unit should be constructed on cement concrete platform raised above the surrounding ground level by at least 30 cms
6. The validity of this approval is till two years from date of issue of this approval. The renewal of approval is to be sought before the expiry of the validity of this approval.
7. The Goa State Pollution Control Board may, at any time revoke any of the conditions application under the approval and shall communicate the same in writing.
8. This Approval is granted without any prejudice to any other permission(s) required under any laws, by laws and regulations in force

Member Secretary
Goa State Pollution Control Board

To,
The Secretary/Sarpanch,
Village Panchayat Penha de Franca
Bardez Goa

c.c. to :
1) The Director,
Dte. of Panchayats
Junta House, Panaji Goa

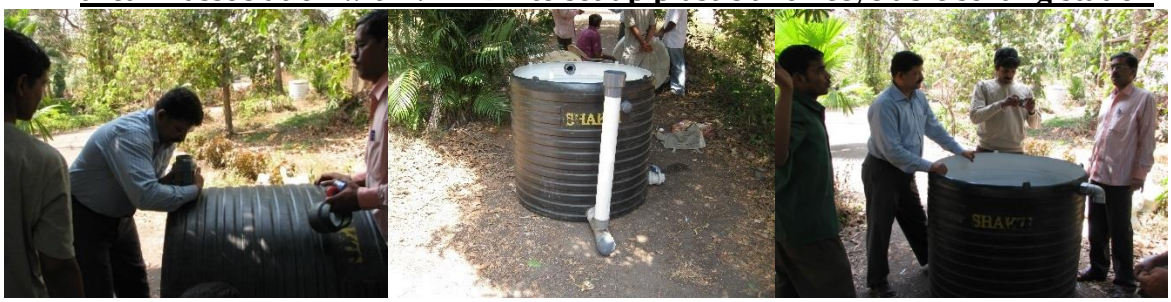
2) The Block Development Officer
Bardez- Goa.

Future plans that were initially envisaged for phase-wise approach to solve the solid waste management issue in the study area are as given below. However actual achievements were confined to 500 houses and support to ward no 7 partially and other areas as per need or by way of cleanliness campaigns. Etc.

- **Phase I**
- Developing community model of solid waste management, implement and succeed,
- Pilot results to be well studied and interpreted, Build the intricate network of social workers, volunteers, field technocrats, designers and ground level workers
- **Phase II**
- Add on more areas and develop the plan on larger scale, Develop professional set up to handle large scale integrated projects
- **Phase III**
- Developing in-house manufacturing team – (the mechanical engg., electrical engg., 2-3 technicians.), design, development.
- 1- Commercial & financial manager, 1- Material stores – officer, 1- Marketing, Sales, Business development
- Bio fertilizer plant with MoEFCC approved laboratory, Purchase of all the compost
- Add – nutrients, stabilizers, Packed Fertilizer, Complete **waste to fertilizer** loop to be developed. Similar scheme could be worked out for non-biodegradable
- **Phase IV**
- Plastic recycling plant, Fuel from plastic and also complete biomedical treatment plant with metal recovery and plastic processing. Manufacturing alternatives to plastic with ecomark.
- **Phase V**
- Integration of sewage treatment, Sanitation facilities, Development of green belt and Resource management (Water Harvesting) with existing projects & Ensure- Basic Amenities to the Society.



Above photo shows researcher (on the right extreme) along with Shri. Umesh Fadte (VP Member VP PDF – a man in cap) during remedition and cleaning work in the valley area in association with VP PDF to set up plastic and recyclable sorting station





Above Pics Show ARTI Model Biogas in Making which was used by workers for coocking. Besides above shown pics, there are several more photographs and numerouds videos actually showing daily collection, segregation and processing of waste & interactions with stakeholders

4.9H Situation after inception of pilot project – Photographic Presentation

After signing of MOU between VP Penha de Franca and Lila Trust, the project was inaugurated whereby Pooja was performed by ward member Shri. Umesh Fadte, who was ground level supporter and pillar for this project. Prior to Puja, the shed was built by VP PDF with support from the project funds. The administrative and financial approvals were taken from funding agency. All the systematic accounting procedures, receipts, vouchers, VP approvals were taken. The correspondence files and documents as well as records are maintained in the office of the Trust.



Above photos are taken during inauguration of SWM shed



Above photos are taken during Pooja by Shri Umesh Fadte (left photo) and Team of VPPDF Sarpanch (right photo) with Ward Members after inauguration of SWM shed



View of Kranti Udyan before project inception



View of Green Shed from Roadside after Inception of Project.
View of same area before pilot project inception is shown below



Above & below photograph shows view of worst site – burning valley like area which was dumping site in study area before project implementation



Above photo shows view of burning valley before restoration

Above photograph shows most worst affected area, valley near to Kranti Udyan Road, this place was used as dumping site, often set to fire by unknown people and caused air pollution affecting locals. Further this place was remediated. Sometimes such waste dumping sites also catch fire due to formation of methane in the contents triggered by hot sunlight and any item catching spark causes massive fires.



Above photograph shows valley area after restoration, reclamation by filling and plantation. As on Dec, 2017. There is no more dumping and burning in this area



Photo of Green Shed Constructed



Above given are photos of bins used for collection and transportation of waste Green – for wet waste – biodegradable wate and Black – for dry waste





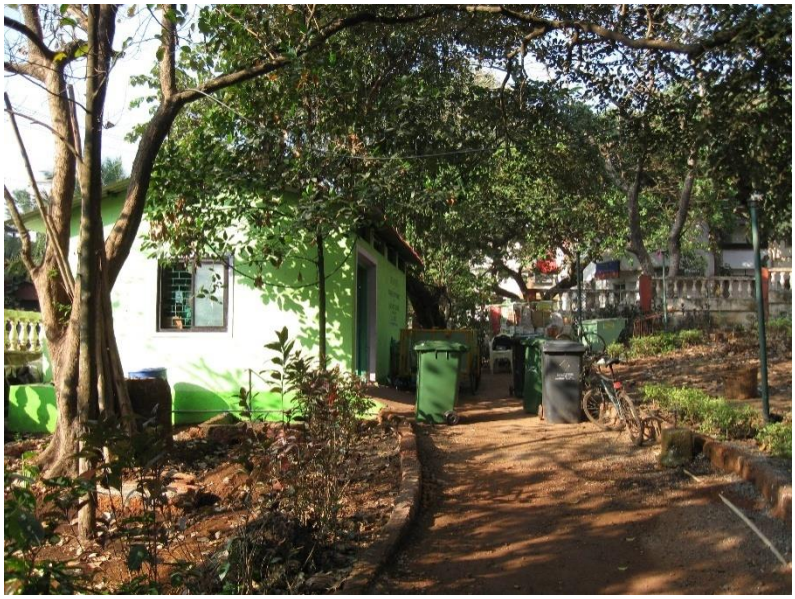
Above given are photos of bins used for home storage the waste – Specially designed by researcher with experts and registered with industry in the name of trust. Green – for wet waste – biodegradable waste and Black – for dry waste.



Above given are photos of trolley specially designed for carrying additional dry waste



Above given is photo of trolley specially designed for carrying additional wet waste



Above place is photo of waste management facility along with collected waste







Photos placed above and on the left side are door to door collection from residents. Ward member is also a resident



Above placed is the photo of green ranger while collecting and transporting waste in trolley mounted bins



Above placed are photos of waste management team, Left photo – Green Rangers Team with researcher (standing on right extreme) **Right photo –** Unloading of processing machines on site : Interesting to see and note that caps as well as uniforms were provided as part of pilot project and workers called as green rangers and not garbage workers to ensure their self-respect.



Above photo of project team with researcher in the centre



Above placed are the photos of sorting of waste on large platforms



Above placed is the photos of experiment of sorting waste using perforated tray which was not as successful as it was thought as it required lot of water for cleaning and efforts hence not an efficient means

Specifications of machines selected at VP PDF SWM Pilot Project

1. Composting Machine (OWC 130) - Capacity 600 -800 kg/day – One number

a) Power Connection: 8 HP (Main motor & Chopper Motor)

b) Brim Capacity: 130 lit.

c) Waste Batch size 50 kg

d) Batch Duration 15 min.

e) MOC All contact parts of SS304

f) Trolley One No. of SS 304

g) Mobility arrangement Suitable mobility arrangement for the equipment for movement

2. Shredder – One number

Shredder is required if garden waste like plant pruning is to be converted into organic manure as also will take care of meat bones.

Double Shredder of M.S. Contact parts, having feed cross section of 130 mm x 300 mm and depth of 100 mm complete with 2 H.P. Drive geared motor and mounted on fabricated frame for easy working.

Note: The cutters are made of C.S duly carburized and hardened. The two shafts holding the cutters operate at differential speeds i.e. 100 R.P.M and 70 R.P.M to facilitate self-cleaning. Body Cover SS 304 and Mobility Arrangement.



Above shown are two photos of OWC – 130 and Double Shredder in Operation at Pilot Project of VPPDF



Above placed are the photos of sorting of processed waste cured in pits and final compost in a container and in hands of researcher

4.9-I <u>Salient features of the pilot SWM project at VPPDF:-</u>

1. First Community Waste Management Project in Goa by a Charitable Trust with Corporate Support.

2. Complete responsibility of collection, segregation, composting, biogas generation, community involvement, public education and end to end solution provided to 500 households on pilot basis thereby allowing us to multiply the outcome of this project to various other places.

3. The present site was considered for pilot study due to its worst affected scenario considering solid waste. There are potential chances of many health hazards apart from existing

problems of garbage stinking, mosquitoes, Leachate spreading on roads and entering storm drains during rainy season, stray dogs menace and unidentified rag pickers collecting recyclables in unhygienic manner, and many other socio-environmental issues.

4. Due to continuous dumping of solid waste in a valley where instances of setting fire to the garbage were on increasing manner leading to air pollution. Besides there was lot of ground and water pollution taking place. Hence this site was selected for pilot project.

5. Enabling self-sufficiency of funds through special model involving private and public funds.



Double Shredder and Organic Waste Converter (OWC – 130) Placed at our Pilot Plant Porvorim - Project Commenced on 01/01/2010 – Lila Trust as Process Owners.

4.9-J Significant project memories and events - Reuse of working toys by green rangers children received during door to door collection. Green rangers were trained for social behaviour, especially greetings received from green rangers, uniformly well-dressed green rangers with valid identity card were introduced to ward members and residents whenever new person was inducted. Green rangers became friendly with residents who even offered them sweets, gifts and at times tips during festivals. Senior citizens had faith in green rangers who sometimes gave them extended services such as cleaning their backyard, shifting and lifting of heavy things and even in maintaining gardens etc. Ward member and researcher were on ground early morning to further interact with locals and understand their issues which helped in further improvement of services. Garden waste was received separately from residents who

even bought our compost for their garden. This was a great symbiotic relationship. Few responsible and proactive residents took EM (effective microbial) solution for odour control at home and walked voluntarily to the treatment facility with freshly generated waste before it starts stinking – especially fish and prawn waste. Few residents were friendly and some were unnecessarily hostile to our green rangers. They refused to hand over waste and rather disposed in open, were abusive and considered that green rangers should serve them as their maids. However conflicts were resolved with the help of ward member. In one incidence there was always waste dumped in one open space which in spite of door to door collection was not getting reduced. Finally we had to investigate and it was found that one resident had event management business who disposed the waste at night. We made him pay for it. Visitors were educated at the facility, for which a supervisor was engaged. The costs were bit high also due to additional services such as maintaining accounts, receipts and vouchers on behalf of Lila Trust as well as VPPDF. Poor participation in cleanliness drives was memorable but those who participated proved that it is only few who make the difference.

Felicitation of Chairman of SFI Shri. Auduthbab Timblo by people of VPPDF in a grand public program in hands of Hon. Former High Court Judge Justice Shetye who is resident of VPPDF area. Public program of laying corner stone for newly planned decentralized waste management plant in land which was handed over by Housing Board of Goa in presence of then Hon. Minister for Environment and Forest, Govt of Goa Mrs. Alina Saldanha in presence of other distinguished dignitaries. Felicitation of green rangers in hands of a prominent industrialist lady Mrs. Menezes who supported the project by regularly purchasing the compost from our project. Her words of appreciation to green rangers (solid waste workers) where she said that she is “grateful to all waste workers and treats them on par with any other prestigious professional" are unforgettable.

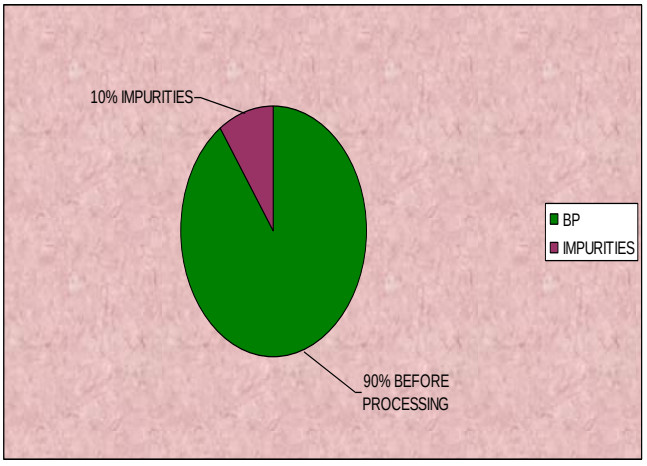
4.9-K Data analysis and substance of lessons learnt - Actual Findings are different from initial assumptions

All the stakeholders have shown continued support for tenure of project till about 4 years. SFI along with O & M agency are continuing support by managing the project & by doing initial capital and operating expenditure out of which operating expenditure is then shared by VP PDF

Average wet waste generation actually found per household is 0.6 kg per household per day. (about 120 grams per person per day – considering 5 member family)

- Average dry waste generation actually found per household is 0.015 kg (15 grams) per household per day (excluding home toxic waste, card board and residual waste). (about 3 grams per person per day – considering 5 member family)
- Residual Waste or the impurities which are generated due to poor segregation at source and mixing of non-biodegradable items into wet waste.

Waste Received at Site and impurities are shown in chart below



Please note: The above estimates are based on average annual data actually gathered after regular door to door collection.

Below Given Table Shows Initial Capital Investment

Sr. No	Capital Investment	Amount in Rupees
1	PLANT AND MACHINERY	919322.00
2	ELECTRICAL EQUIPMENT	41626.00
3	FURNITURE	5500.00
4	SHED	355340.00
5	CYCLE	2000.00
6	BINS AND OTHER EQUIPMENT	432739.00
7	EARTHING	4164.00
8	LANDSCAPING	43100.00
9	PLUMBING	5733.00
	TOTAL	1809524.00 Rupees Eighteen Lakhs, Nine Thousand Five Hundred and Twenty Four

SWM Vital Data

Parameter	Year 2009-10	Year 2010-11
Total Wet Waste Generated Per Household (5 members)	0.60 Kg	0.55 Kg
Total Dry Waste Generated Per Household (5 members)	150 grams	150 grams
Impurities	3%	10%
Loss of weight while composting	Range from 50 % to 75 % (and even more 5% during Extreme Summer and Less as 45% during rainy season)	

4.9-L Compost dynamics

• Out of total compost loss due to moisture and degradation ranges from 50 – 75 % depending upon whether rainy season or summer. Loss due to initial rains and lack of storage space.

• Loss due to initial experiments to establish most suitable stoichiometry for getting good quality compost. After sale of compost, its performance effect and feedback from user on different plants is awaited. Almost 50 % of the daily generated compost id reused for the process as moisture absorbent to prevent leachate.

Lessons learnt from composting - It is observed in study area by trying several combinations of additives such as cow dung, goat shit, poultry shit in different combination of stoichiometry ad experiments were based on empirical observations. Chemical tests could not be carried out for all types due to various limitations. However it is important learning that if due care is taken while doing composting, the quality of compost is like tea powder and sometimes finer after screening for less than 4mm sieve. The findings from our experience are as stated further. There was need to add regular moisture content in form of water to the compost in the pit and the experience is that after rise in compost pit temperature, it needs to be mixed well to ensure good compost after about 30 to 40 days depending on the season. Composting time is maximum in rainy season, relatively better in winter and best in summer but water demand in summer is more. In case of absence of moisture and mixing, fungus was observed to grow in the pits in powdered form to such an extent that working personnel were not ready to go for mixing due to allergy or fear of uneasiness and infection. The biochemical changes observed in the compost are extremely interesting. When goat shit was added to the processed raw compost in various proportions, half, equal and double of the quantity of raw waste, it was observed that there was excessive moisture in the composting pit. Compost quality was analysed from approved laboratory and was found to be very good. Sale of compost was carried out to ensure some revenue generation for the project.

Compost Bags Were Labelled as Shown Below

Bacterial Compost Fertilizer

Produced from valuable green waste at our Solid Waste Pilot plant

V P Penha De Franca ward no 8

Directions for use

Mix one part of compost in ¼th part of sand and 3/4th parts of soil.

OR

For one kg of compost add 250 Gms of sand and 750 Gms of soil

The mixture is ready for plantation.

Caution - Do not eat, Keep out of reach of children.

Pure, organic & rich with micronutrients, tested from approved laboratory

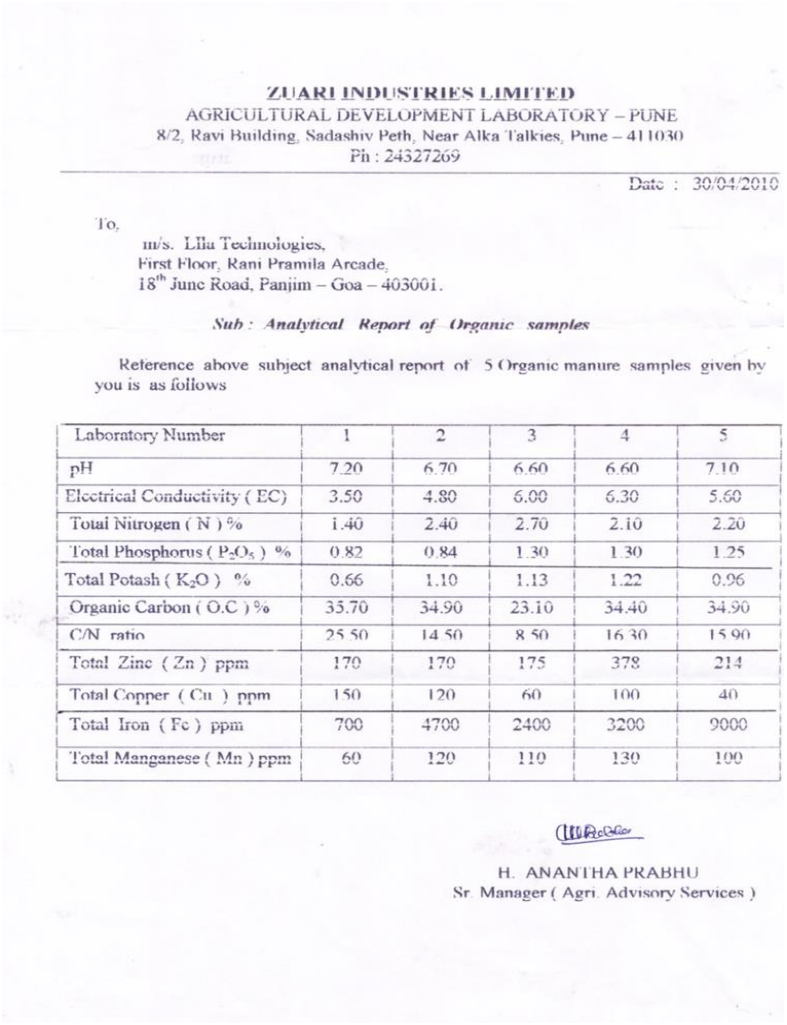
No chemicals

Project Supported by Sociadade de Fomento

Compost Parameters	Actual Findings
pH	6.6
El.Cond	6.0
T.N	2.7
P_2O_5	1.3
K_2O	1.13
O.C	35.7
C/N Ratio	25.5
Total zinc	175 ppm
Cu	60-100 ppm
Total Fe	2400ppm
Total Mn	110 ppm

Table 4

Report of Compost Analysis is placed below



ZUARI INDUSTRIES LIMITED
AGRICULTURAL DEVELOPMENT LABORATORY – PUNE
8/2, Ravi Building, Sadashiv Peth, Near Alka Talkies, Pune – 411030
Ph : 24327269

Date : 30/04/2010

To,
m/s. Lila Technologies,
First Floor, Rani Pramila Arcade,
18th June Road, Panjim – Goa – 403001.

Sub : Analytical Report of Organic samples

Reference above subject analytical report of 5 Organic manure samples given by you is as follows

Laboratory Number	1	2	3	4	5
pH	7.20	6.70	6.60	6.60	7.10
Electrical Conductivity (EC)	3.50	4.80	6.00	6.30	5.60
Total Nitrogen (N) %	1.40	2.40	2.70	2.10	2.20
Total Phosphorus (P_2O_5) %	0.82	0.84	1.30	1.30	1.25
Total Potash (K_2O) %	0.66	1.10	1.13	1.22	0.96
Organic Carbon (O.C) %	35.70	34.90	23.10	34.40	34.90
C/N ratio	25.50	14.50	8.50	16.30	15.90
Total Zinc (Zn) ppm	170	170	175	378	214
Total Copper (Cu) ppm	150	120	60	100	40
Total Iron (Fe) ppm	700	4700	2400	3200	9000
Total Manganese (Mn) ppm	60	120	110	130	100

H. ANANTHA PRABHU
Sr. Manager (Agri. Advisory Services)

Intermediate outcomes during implementation

- It is not possible to make profits from sale of compost and plastic and the recovery in VPPDF was 7- 8 % of the capital cost and one month's O & M cost. The major economic contribution other than SFI comes from VPPDF and Public. The contribution from SFI has enabled existence of this project, continual functioning and future development with existing capital assets. Need of funds in future is as below
- Considering average monthly expenditure of about 95000 /- (annual 1140000) with expansion and O & M fees of Rs 228000/- Expenditure Share between VPPDF and SFI planned is 70:30 per cent (First 6 months) and 80 :20 per cent (Next 6 months).

4.9-M Review of newspaper / media and Analysis of questionnaires – from 2009 to 2017, researcher has kept the track record of the articles as well as news items related to waste management issue. It is observed that waste management issue is featured almost every day in daily newspapers. There was also series of public feedback that was conducted by one of the eminent newspaper. Analysis of the media reports shows that by large, opinion is directed towards inaction, negligence and non-functional existence of local bodies leading to failure of waste management. The reports feature garbage dumps, failure and delay of efforts by several municipalities. Most featured projects were solid waste management projects at Sonsodo – Madgao, Mormugao, Ponda, Mapusa an Saligaon – Bardez (this project located on existing dump site at Saligao – known to have caused pollution to Salmona spring due to leachate contamination flowing downstream of the dumping site whereby this spring is located - in spite of opposition from few, has seen light of the day and is most successful functional mega scale project – almost 100 tonnes per day capacity as on today). Almost every day news from some or the other area is featured. However there is need to spread awareness about provisions of MSW rules and encourage public participation.

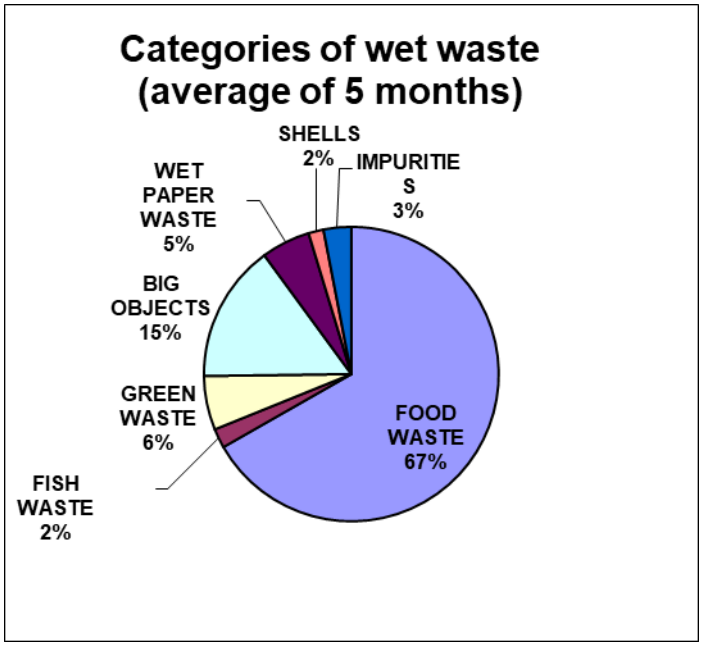
Evaluation of Selected Representative Questionnaire Response			
	Question	**Response**	
2	**Gender**	***Male***	***Female***
		2	5
3	**Age Group**	***Range***	***Average***
		21 to 49	34
4	**Family Size**	***Range***	***Average***
		02 to 08	5
5	**Past system from Year 2000 till Year 2016 and Present System of garbage management at home**	Better at present	

6	**Past system from Year 2000 till Year 2016 and Present System of garbage management in village panchayat**	Better at present	
	Specific Information in addition to above for better understanding of the problem	Appreciable inputs are received and included in the contents of thesis	
7	**What was ancestral or traditional method of garbage disposal in your area?**	Dispose garbage in pits (by less than 5% people) rest in open and **burning of non degradable waste**	
8	**When did you feel that the garbage handling, disposal or as problem became prominent? Which year approximately?**	***Range***	***Average***
		2000 to 2007	
9	**What is the cause of problem according to you?**	Overall failure (both govt and public)	
10	**What could be the best way to solve the problem, according to you?**	Proactive public	
11	**Is there any effort taken by you, or anyone else in your area, according to you? What was the outcome of the effort?**	Commom approach - door to door collection of waste	
12	**Did you feel that enough efforts are taken by your local governing body?**	***Remarks***	***Average***
		Government trying to solve but no outcome	Yes
13	**Do you feel that efforts are taken by your local governing body will become successful?**	***Remarks***	***Average***
		Public corporation and support needed	Yes
14	**How much garbage approximately is generated daily from your house? In Kgs.**	***Range***	***Average***
		0.5 to 2 kg	1 kg
	do you segregate at source? Yes / No, If no, then Why?	Yes	
	How many categories do you segregate and which are they?	Two categories -Dry and Wet	
	Do you feel that segregation at source is important? Why?	Yes	
15	**What is your prediction for future of garbage problem in your area?**	Awareness needed	
16	**Do you feel that public participation is necessary for the success?**	Yes	
	Any other important view or expectation regarding garbage issue?	Inputs given are reflected in the concluding contents	

Analysis of questionnaires is placed at Appendix VII. During awareness and interaction, feedback was recorded verbally from entire public constituting the sample volume but the most representative questionnaires are analysed above.

Major outcome of representative data analysis of constitution of solid waste at VP PDF is shown below.

CATEGORIES	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Average	%
FOOD WASTE	152.13	180.23	208.13	194.28	166.62	**180.28**	**66.74**
FISH WASTE	6.30	7.41	4.48	6.44	4.12	**5.75**	**2.13**
GREEN WASTE	16.56	15.85	11.10	15.93	20.59	**16.01**	**5.93**
BIG OBJECTS	37.29	46.35	56.38	39.25	25.32	**40.92**	**15.15**
WET PAPER WASTE	11.41	15.12	12.14	16.77	17.10	**14.51**	**5.37**
SHELLS	6.86	5.73	1.34	4.12	4.16	**4.44**	**1.64**
IMPURITIES	9.57	8.00	4.12	3.37	16.01	**8.21**	**3.04**
TOTAL WEIGHT(B.P)	240.13	278.68	297.69	280.16	253.93	**270.12**	
BULK DENSITY(B.P)/500ML							
TOTAL WEIGHT (with impurities and shells)	240.13	276.17	290.21	276.11	244.67	**270.12**	**100.00**



IMPORTANT NOTES – Although the project duration was longer, the data selected for analysis and interpretation and presentation is that having reliability, continuity and only from the actual work done by researcher.

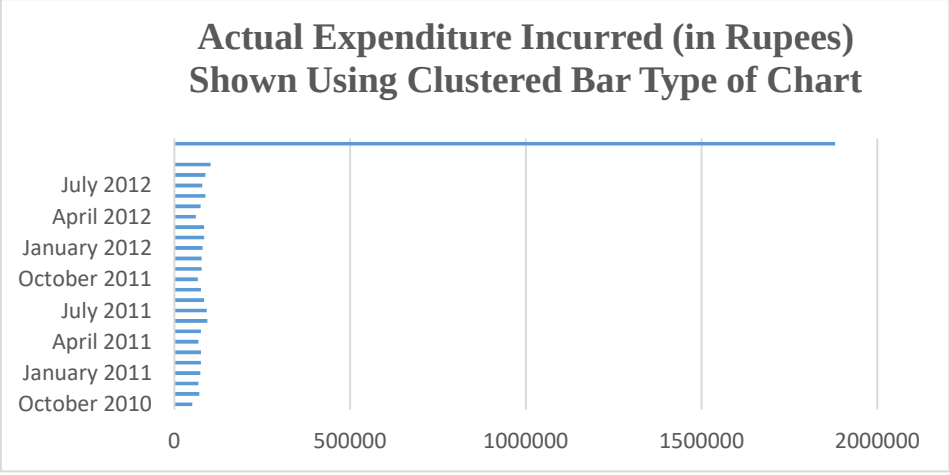
All the expenses were carried out by following all the standard financial controls and accounting procedures. No expenses were done without approval. Periodic review was done to ensure control and optimization of expenditures.

The lessons learnt are based on concrete professional techno-financial work implementation. Hence the learnings which are expressed in the final concluding chapter and in recommendations are based on serious ground work.

4.9-N Presentation and analysis of working economic model are carried out during the period of operation and management of project by Lila Trust with funds from SFI and Collaboration with VPPDF. The table is as given below and most data is presented in charts.

Month	Actual Expenditure Incurred (in Rupees)
	I
October 2010	51003
November 2010	71768
December 2010	68929
January 2011	74009
February 2011	75677
March 2011	76279
April 2011	68957
May 2011	76159
June 2011	94336
July 2011	92566
August 2011	85144
September 2011	75732
October 2011	67240
November 2011	77547
December 2011	77415
January 2012	80867
February 2012	84671
March 2012	84975
April 2012	60944
May 2012	74814
june 2012	88952
July 2012	79286
August 2012	88916
september 2012	103338
Total	**1879524**

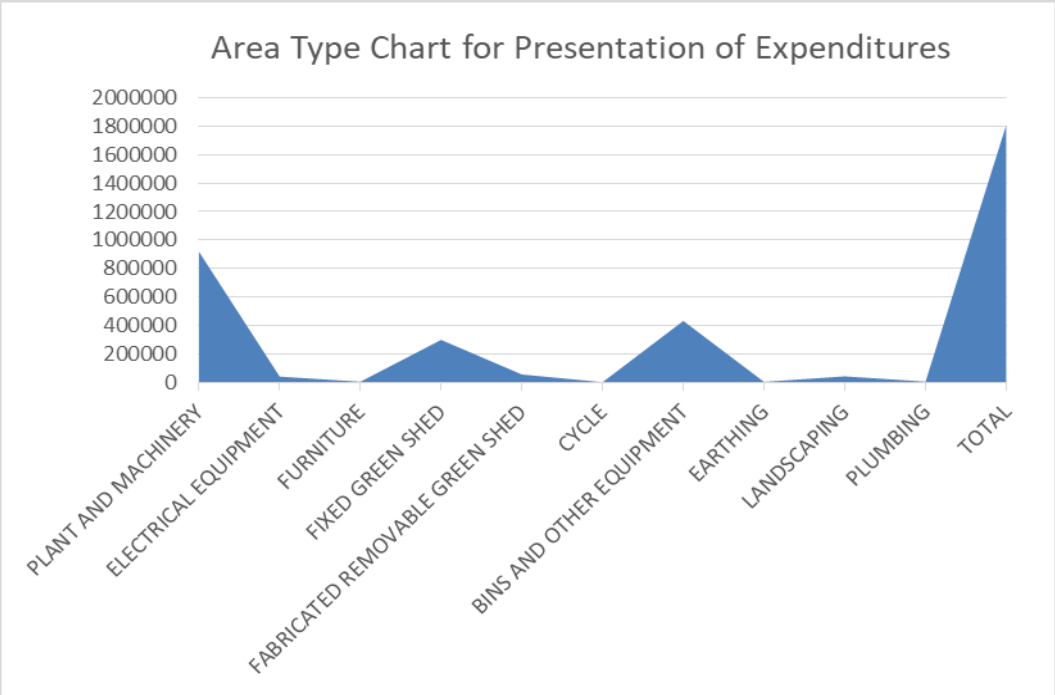
Graphical presentation in form of clustered bar chart is given below



Below given are the major expenditures made during the project.

PLANT AND MACHINERY	919322	919322
ELECTRICAL EQUIPMENT	41626	2000
FURNITURE	5500	5500
FIXED GREEN SHED	299318	
FABRICATED REMOVABLE GREEN SHED	56022	56022
CYCLE	2000	
BINS AND OTHER EQUIPMENT	432739	
EARTHING	4164	
LANDSCAPING	43100	
PLUMBING	5733	
TOTAL	**1809524**	**982844**

Table 5



Entire funds were not utilized and remaining funds were refunded to SFI. Below given are additional headings for which the funds were utilized. Less: Expenditure towards purchase of books "Turn Waste into Resources", Expenditure towards Repair and maintenance of OWC and Double Shredder and replacement of parts, Expenditure towards Organising Inaugural function of new project, Masonry work for Board and Misc. expenses at VPPDF, Expenditure towards Plastic bag disbursement in Ward no 10 and 11 of VPPDF, Expenditure towards Collection and Disposal of Plastics in ward 10 and 11 of VPPDF workers salary 2 workers@6500 for 1months, Supervisor 1@8000/- for 1month, Expenditure towards Medical

Reimbursement for accidently Injured worker Arjun while on the job. Still in progress as on Oct 2013, miscellaneous- Transport, refreshment to managing staff etc. Excess Amount Remaining & Was Refunded to SFI as on 26th Oct 2013.

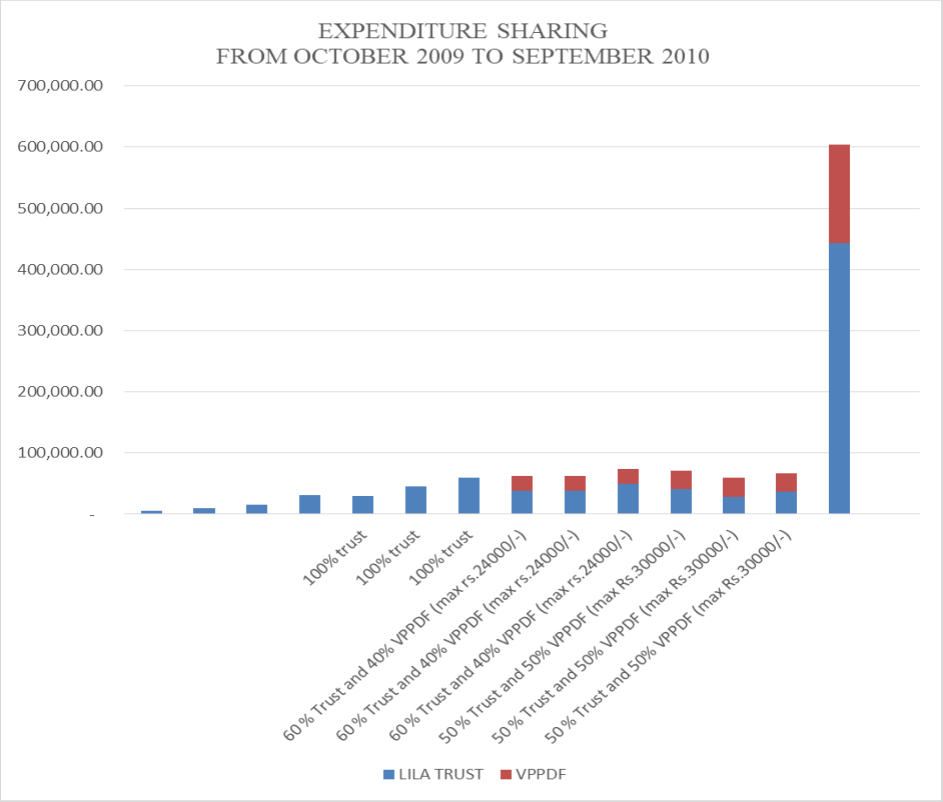
Most important part of expenditure sharing between VPPDF and Lila Trust long with funding agency SFI (Sociadade de Fomento) are given below for the period till the project was implemented by above agencies. After this period, separate agency was appointed by VPPDF for operation and management, however the project team continued to do the work under new combination as the main duration of economic handholding involving the trust was concluded.

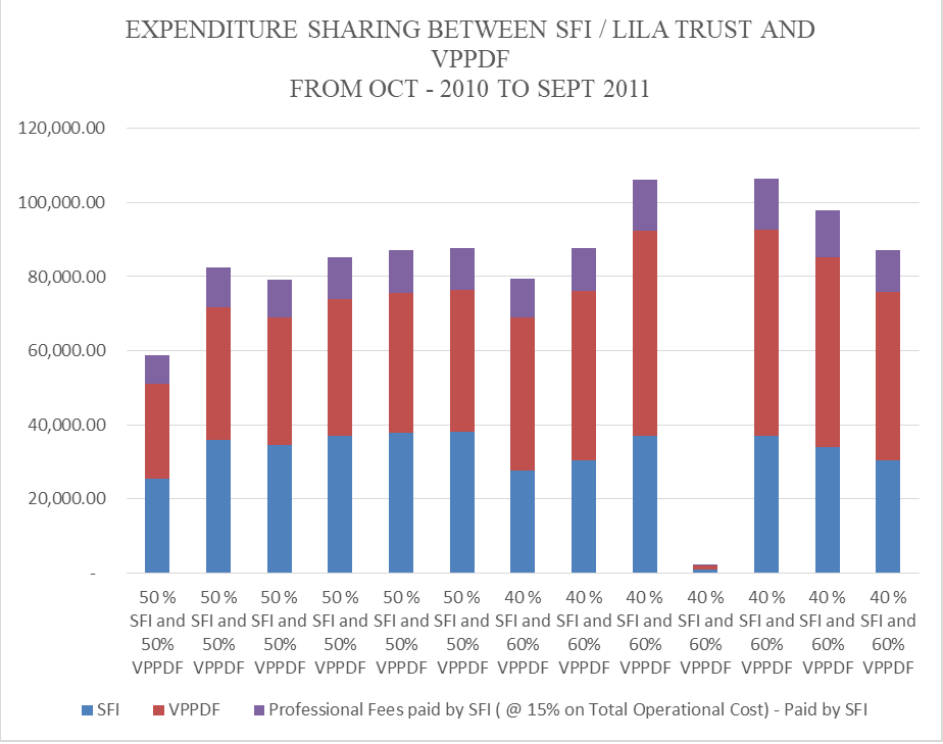
Major headings of costs incurred are given below.

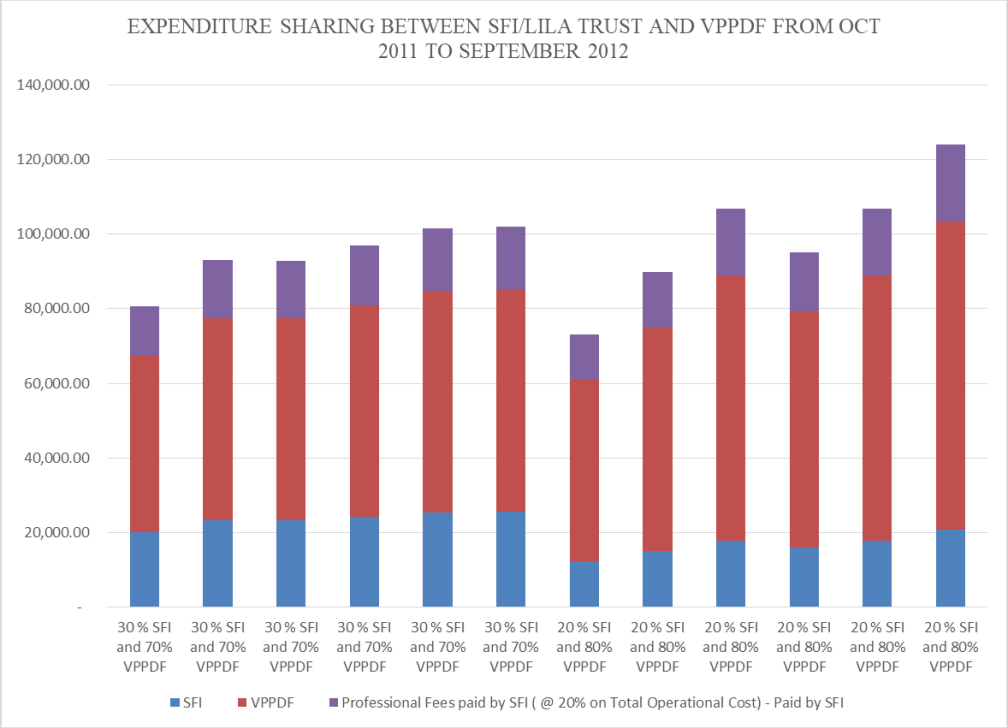
TRANSPORT AND TRAVELLING
SALARY LABOURERS
SUPERVISORS SALARY
QC / LABORATORY TECHNICIAN
MARKETING/SALES/LIASONING/MAINTENANCE ENGINEER
DIRECT METERIAL COST, CONSUMABLES, ADDITIVES,PROCESS MATERIALS
PPE - SAFETY GADGETS
BACK OFFICE, STATIONARY, ACCOUNTING,ETC
GARDEN MAINTENANCE,ELECTRICAL,PUBLIC MEETINGS,PLUMBING,ETC
EXTRA LABOUR FOR WARD CLEANING/ MAINTENANCE
RENT FOR HEAVY EQUIPMENTS
OVERHEADS,CONTINGENCIES & MACHINES RENT
STAFF WELFARE

All the graphical presentations are preferred for the ease of understanding the financial model and details regarding audited accounts of Lila Trust, all the vouchers, bills, purchase / work orders to vendors, financial controls, excel sheets of detailed expenses and receipts, etc. are available for verification in the office of the trust and also soft copies with the researcher. They were presented to all the active stakeholders from time to time.

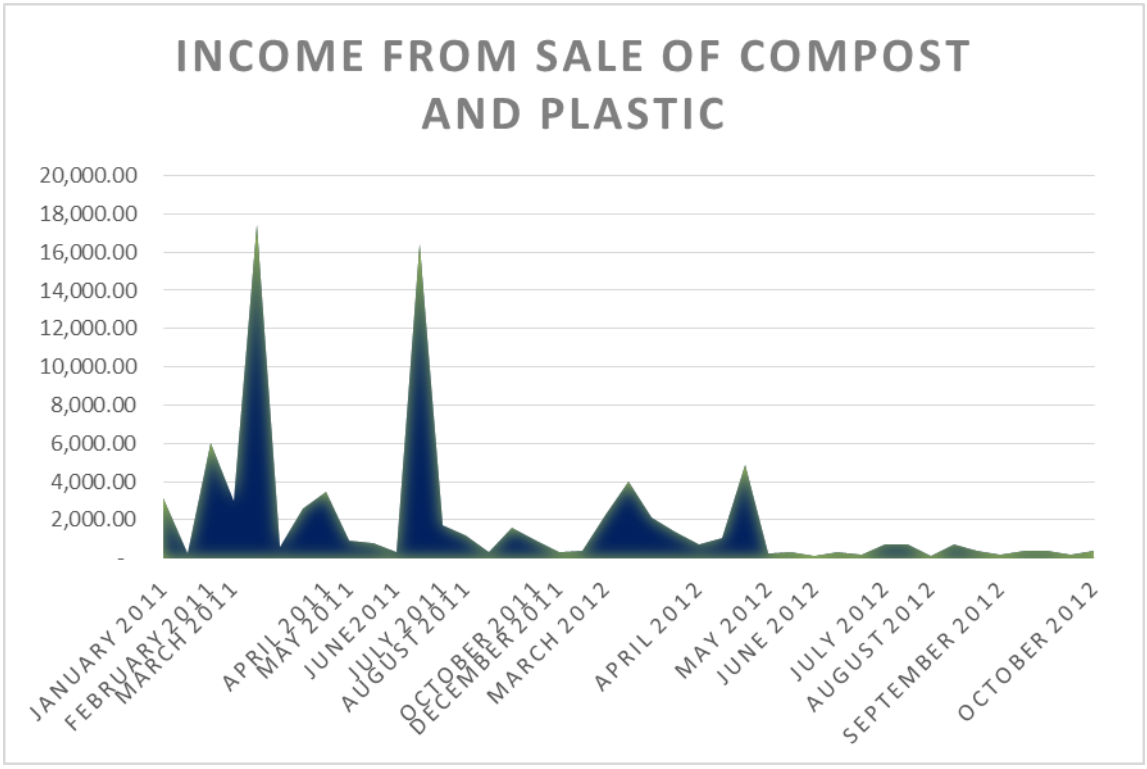
Below given are the clustered column charts used for visual presentation of the expenditure sharing. Gradual increase in percentage of contribution from VPPDF is evident.







Besides above given expenditure sharing, below given is the area chart of sale of compost & recyclables like plastic from project output



4.9-O Selected newspaper clips about the SWM pilot project

DIRT BUSTERS!

The first community waste management project in Goa, funded by Fomento began three months ago, in the hinterlands of Penha De Franca. Onilda Fernandes reports.

Pics Onilda Fernandes

At a time when most of Goa is asleep and only the distinct hooting of the *poder* is audible, the houses in ward no 8 of the Penha de Franca village Panchayat is bustling with diligent activity: Housewife, Elizabeth Thomas of Krantinagar has lined up all her garbage bags, with the waste segregated according to the chart pinned up on her fridge. Hardly has 6 am chimed on her wall clock, and uniformed workers are at the door, exchanging pleasantries and stacking up the different bags of garbage.

This is a routine followed every single day with 500 households, flats and shops, as part of the community waste management project.

Prides Pradip Sarmokadam, Joint CEO of the Lila Trust and an environmental engineer, "All our boys have undergone the routine medical checkups and are healthy! Going to pick up garbage from house to house, they have become more like friends of the villagers today".

And if the overall landscape of the village is anything to go by, the garbage collectors have certainly been doing a terrific job!

What was once an area littered with a carpet of trash, so much so that one had to hop their way across, all the while sheathing their nose, has now been transformed into a clean expanse, devoid of stench. Boards have been propped at regular stretches warning people not to fling any waste, public garbage bins have been done away with and systematized collection has replaced the random dumping customary to the villagers.

But the revolution was indeed not all in a days work.

Rewind 6 months back when garbage clogged every nook and cranny, and the villagers were illiterate about segregating their waste...

Enter Umesh Phadte, ex Sarpanch and present panch of ward no 8. "I wanted to start small and literally give a major makeover to at least one ward. My biggest challenge turned out to be sensitising the people. I knew that if my plan was to succeed, the contribution of the people would be essential."

And so the story goes...Umesh went door to door, educating the people on garbage segregation and around 6-8 months down the line, Pradip and Umesh got talking.

The former was looking for a similar opportunity to work on and what better project to take up than the one with the groundwork already done.

Alike minds boosted this little crusade even further, and it was decided that the project be officially taken up by Lila trust and financially backed by Fomento, a corporate house with a great sense of social responsibility.

Says Umesh and Pradip in unison, "This project wouldn't have been possible without Fomento providing the finances and our panch, Rajendra Naik signing the MOU".

Once that was got out of the way, the hiring of employees turned out to be a Herculean task. "We scouted the slums but no local workers were ready to commit themselves. Now looking at how dignified the job is and how well are boys are treated, hopefully there will be others to join the handwagon,"sighs Pradip.

A fact that deserves special mention is that the project physically began work on December 31,2008 only 3 months post signing the MOU.



Sorting the bio-degradable waste at the composting unit.



Umesh and Pradip with one of the workers at the plant.

Treatment at the plant

A total population of 2500, generate solid waste amounting to 1500 Kgs per day. This garbage is divided into seven categories- big bones, fruits and pieces of vegetables, green leaves, wet paper, meat and eggshells, stale food waste and impurities like blade, plastic or metal that invariable find their way into household dustbins.

Each of the households have been given specific bags to dispose a certain waste.

Once all this waste is accumulated, it is placed onto wheel-mounted trolleys and taken to the Central processing unit, where the bio degradable wet waste is converted and dry waste (non veg and big objects) falls prey to the double shredder.

Non-biodegradable waste on the other hand, is sorted, segregated, bailed and stored to be used by the recycler. Explains Pradip, "The secondary treatment involves bacterial composting using organic waste converter. We have got a good culture of micro organisms and thus, the sale of the compost goes back to the panch and that money is utilised for similar projects...in a way making the village self sufficient". (About 20-30 kilos of compost is generated, a bulk of which is sent for experimenting).

Currently, seven pits have been constructed in and around the village, with the seventh one relegated for vermi composting.

In the near future however, the project hopes to expand to include several other wards and thereafter, other villages. But being in the initial stages, it is still too early to tell.

Nonetheless, the project most definitely has the gung ho support of the villagers. Says Elizabeth Thomas of Krantinagar, "It is amazing how this project has shaped up. And what's even more appealing is that Umesh is with the collectors every single day, watching how they collect the garbage. Such dedication is not apparent otherwise today." She goes on to add how such projects usually begin well but fizz out in some time. In this case however, so far, all is going well.

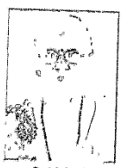
Another resident, Lotlikar explained how initially it was a problem to segregate the waste, as she was not one to follow such a system but following the same procedure day in and day out, she hopes her mistakes have reduced. "Initially I would invariably mix categories," smiles a sheepish Loutlikar. "But Umesh would patiently explain to me how its done and now I'm a lot better."

Taking to the project like fish to water is Alzira Dantes, who has the pamphlet of the segregation of waste pinned onto her refrigerator and follows it like gospel truth. "I am ready to do anything to maintain the cleanliness of this village. I couldn't bear to get out of the house earlier, now taking a walk is so refreshing."

□ पणजी □

गोवा राज्य प्रदूषण नियंत्रण मंडळाने पेन्ह-द-फ्रान्स या पर्वरी मतदारसंघातील पंचायतीला या पंचायत क्षेत्रातील कचऱ्यामुळे होणाऱ्या प्रदूषण समस्यांवर कारणे दाखवा नोटीस दिली व सात दिवसांच्या अवधीत उत्तर देण्यास सांगितले होते.

त्यावर सरपंच सौ. विश्रांती राजकुमार देसाई यांच्याशी संपर्क केला असता त्यांनी सांगितले, कचरा समस्या ही गोव्यातील एक प्रमुख समस्या आहे. ती सोडवावयाची असेल तर फक्त सरपंच, ग्रामपंचायत सदस्य यांनीच विचार करून चालत नाही तर त्यासाठी ग्रामपंचायतीवरील सरपंच नागरिक, स्वयंसेवी संस्था तसेच सरकारने एकत्रित येऊन काम करण्याची गरज आहे. तेव्हाच या समस्येला उत्तर मिळू शकते. आपण केलेली घाण दुसऱ्याने काढावी अशी अपेक्षा करणे चुकीचे आहे. आपण सर्वांनी मिळून आपला गाव स्वच्छ व सुंदर ठेवूया अशी आपली मानसिकता तयार व्हायला पाहिजे, असे त्या म्हणाल्या.



विश्रांती देसाई

कचरामुक्त पंचायतीचा निर्धार

मी सरपंचपदाचा ताबा घेऊन बीस दिवस झाले. पहिल्याच पंचायतीच्या बैठकीत कचरा व्यवस्थापनासंबंधी विचार-विनमय करण्यात आला, पंचायत, नागरिक, स्वयंसेवी संस्था, शाळा व सरकारची मदत घेऊन पेन्ह-द-फ्रान्स पंचायत क्षेत्र प्लास्टिकमुक्त व कचरा मुक्त करण्याचे ठरविलेले आहे, या दरम्यान एडगर डिसोझा यांनी केलेल्या तक्रारीनुसार प्रदूषण मंडळाने सादर केलेल्या अहवालामुळे कचरामुक्त पंचायत करण्याचा निर्धार केला आहे. आम्हांला एक दिशा देण्याचा प्रयत्न एडगर डिसोझा यांनी केला त्यामुळे सरपंच या नात्याने मी त्यांची आभारी आहे, असे सौ. देसाई म्हणाल्या. कचरा प्रकल्प टप्प्याटप्प्याने राबवण्यात येणार आहे. या सर्व उपक्रमासाठी स्थानिक नागरिकांचे पूर्ण सहकार्य असणे आवश्यक आहे. सरकार आणि नागरिक यांच्या माध्यमातून हा प्रकल्प राबविल्यास नक्कीच यशस्वी ठरणार आहे, असे विश्रांती देसाई म्हणाल्या. विविध स्थानिक स्वयंसेवी संस्थाही त्यात सहभागी होऊ शकतात. तरच पर्वरी तसेच गोवा कचरामुक्त होणार आहे.

पर्वरी कचरामुक्त करण्यासाठी सहकार्य द्या

पेन्ह-द-फ्रान्स सरपंच सौ. विश्रांती देसाई यांचे आवाहन

❑ पंचायत मंडळाच्या अधक्ष परिश्रमामुळे १००० चौ. मी. जागा प्रकल्पासाठी हाऊसिंग बोडने देण्याचे मान्य केले आहे.

❑ प्रदीप सरमुकादम - डायरेक्टर तीता डिजीटल ॲण्ड ॲनॉयरमेंटल सोल्युशन प्रायव्हेट लिमिटेड हे कचरा व्यवस्थापनातील एक तज्ज्ञ व्यक्ती आहेत. त्यांची मदत घेऊन पंचायत क्षेत्रासाठी पंचायतीने कचरा प्रकल्पासाठी प्रोजेक्ट रिपोर्ट बनवतेवा आहे. तो आम्ही राबवणार आहोत.

❑ पंचायत क्षेत्रातील प्रत्येक घराचा प्लास्टिक गारबेज साठवण्यासाठी पिशवी देण्यात येईल व महिन्यातून तीन वेळा घरोघरी जाऊन त्या पिशव्या गोळा करण्यात येतील. ऑगस्ट अखेरपर्यंत वॉर्ड सदस्याच्या मदतीने ही योजना राबविली जाईल. त्यामुळे इन्चार्वअंशी प्लास्टिक मोकळ्या जागेत दिसणार नाही.

❑ त्यानंतर सप्टेंबरपासून घरोघरी कचरा उचलला जाईल, पहिल्या टप्प्यात वॉर्ड क्रमांक ७ ते ११ पर्यंत दुसऱ्या टप्प्यात १ ते ६ पर्यंत कचरा उचलला जाईल.

अशी साकारू कचरामुक्त संकल्पना

❑ हाऊसिंग बोर्डने दिलेल्या जागेत कचरा प्रकल्प वर्षअखेरपर्यंत होईल. त्यासाठी साधारणतः ५५ लाखांची गरज आहे. ती आम्ही ग्रामीण कचरा विल्हेवाट योजना व खासदार निधी योजना यांच्या माध्यमाने मिळवण्यासाठी प्रयत्नशील राहू. त्या संदर्भात मुख्यमंत्री मनोहर पर्रीकर यांची भेट घेण्याचे ठरवले आहे.

❑ पंचायतीच्या सर्व वॉर्डामध्ये घरोघरी कचरा उचलण्यासाठी वर्षाला ३२ लाखांची तरतूदही आगामी प्रकल्प अहवालामध्ये केलेली आहे.

❑ आगामी पंचायत क्षेत्रात सरकारी वसाहत, कस्टम वसाहत, पोलीस वसाहत, पोस्ट व टेलिफोन वसाहती आहेत. त्यांच्या अधिकारी वर्गाकडे बोलणी करून त्यांच्या जागेत छोटे छोटे कचरा व्यवस्थापन केंद्र उभारण्यात येतील.

❑ या व्यतिरिक्त काही प्रमुख ठिकाणी ज्या जागी रहिवाशांनी आणून टाकलेला कचरा कुत्री, उंदीर, घुशी या सारख्या प्राण्यांमुळे तो इतरत्र पसरता जातो म्हणून जुने वर्तुळाकार पाइप इटवून झाकण असलेल्या कचऱ्याकुंड्या ठेवण्यात येतील व वेगवेगळ्या रंगांच्या कचऱ्याकुंड्या ठेवण्यात येतील. प्रत्येक काऊंटरवर एका माणसाची नेमणूक केली जाईल व तो प्रत्येक घराला आलेल्या कचऱ्याची विभागणी ठेवलेल्या तीनही कुंड्यात करेल.

❑ हिरव्या कुंडीत- ओला कचरा, काळ्या कुंडीत- सुका कचरा, या व्यतिरिक्त राहिलेला सर्व कचरा निळ्या रंगाच्या कुंडीत टाकण्यात येईल. तसेच घरात निर्माण होणारा काही कचरा,विषजन्य असलेले अशाप्रकारचा कचरा तात कचऱ्याच्या कुंडीत घातला जाईल.

❑ घरोघरी जाऊन जमा केलेला कचरा पुढे मुख्य प्रक्रिया प्रकल्पाकडे खास कचराबाहू गाडीने झाकून नेला जाईल व पुन्हा विभागणी होईल व त्यानंतर कुजणाऱ्या कचऱ्यापासून कंपोस्ट खत केले जाईल व न कुजणारा कचरा प्रक्रिया कारण्यासाठी पाठविला जाईल.

❑ वेगवेगळ्या प्रकारची कचरा विभागणी, प्लास्टिकचा कमी वापर या विषयावर सर्व पंच सदस्यांच्या सहकायनि प्रत्येक वॉर्डात लोकशिक्षण दिले जाईल तसेच या महत्वाच्या प्रकल्पाची चोखपणे कार्यवाही होण्यासाठी तस दिले जाईल.

❑ गोवा प्रदूषण मंडळाने सूचना तसेच उल्लेख केल्याप्रमाणे हाऊसिंग बोर्ड मार्केटमध्ये घालणारे कनत खाने काही दिवस बंद केले जातील. बेती जेटीवरचे कुजलेल्या माशांचे प्रदूषण (नदीत टाकून देणे) या संदर्भात कठोर कारवाई केली जाईल. मेसर्स साई सर्व्हिस व इतर औद्योगिक आस्थापनांना त्यांनी स्वतः च्या कचऱ्याची व्यवस्था लावण्यासाठी नोटीस पाठविण्यात येईल.

प्लास्टिक कचरामुक्त पर्वरीसाठी...

स्वच्छ परिसर व शुद्ध हवेसाठी एकेकाळी प्रसिद्ध असलेल्या पर्वरी पठाराचा विकास होत गेला. पोलीस वसाहत, हाऊसिंग बोर्ड, पुंडलिकनगर, डिफेन्स कॉलनी, पी. एन्ड. टी. अशा अवघ्या काही वसाहती व श्रीमंतांचे बंगले सोडल्यास पर्वरीची लोकसंख्या तशी कमी होती. परंतु गेल्या काही वर्षात पर्वरी पठार आमूलाग्र बदलले. अनेक अपार्टमेंटस्, हॉटेल्स, शैक्षणिक संस्था, कार्यालये व दुकाने उभी राहिली. लोकवस्ती वाढली व पाहता पाहता 'पर्वरी' हा स्वतंत्र मतदारसंघ म्हणून उदयास आला.

इतर अनेक समस्यांबरोबरच लोकसंख्या वाढीमुळे पर्वरीला प्लास्टिक व इतर कचऱ्याची समस्या गंभीरपणे भेडसावू लागली आहे. पर्वरीतील अनेक चौक, नाके व बसस्टॉप्स् छोट्या गाड्यांनी (टपऱ्यांनी) गजबजून गेले आहेत. त्यातील कायदेशीर व बेकायदेशीर किती हा विषय निराळा आहे. अनेक बांधकाम व्यावसायिकांनी उभारलेल्या अपार्टमेंटसमध्ये दुकानांची सोय केली आहे. या सर्वच ठिकाणी प्लास्टिक पिशव्यांचा (कॅरी बॅग्ज) अनिर्बंध वापर होताना दिसतो. प्लास्टिक पिशव्या व इतर कचऱ्याची विल्हेवाट लावण्यास दिवसेंदिवस यंत्रणा अपुरी पडत आहे. त्यामुळे पर्वरी पठार अतिशय गलिच्छ व विद्रूप होण्यास वेळ लागेल असे वाटत नाही.



चर्चा

पर्वरीतील सर्व पंचायती व या मतदारसंघाचे आमदार रोहन खंवटे प्लास्टिक कचरा निर्मूलनाबाबत प्रयत्नशील आहेत. परंतु स्थानिक रहिवाश्यांमध्ये जागरूकतेचा अभाव दिसून येतो. प्रतिष्ठित नागरिकांपासून ते मजूर वर्गापर्यंतचे सर्व लोक इथले रहिवासी आहेत. कोणतीही समस्या उद्भवल्यानंतर सरकारी यंत्रणेच्या नावाने बोटे मोडण्यापेक्षा पर्वरीतील सुजाण नागरिक व युवकांनी पुढाकार घेऊन उपाय योजावेत.

प्लास्टिक वापरावर कडक निर्बंध

सर्व छोटे गाडे व दुकानांमध्ये वापरण्यात येणाऱ्या प्लास्टिक पिशव्यांवर पंचायतींनी निर्बंध घालावेत. विशेषतः कॅरी बॅग्ज म्हणून वापरात असलेल्या पिशव्या नियमानुसार ४० मायक्रोनपेक्षा कमी नसाव्यात. ४० मायक्रोनपेक्षा कमी असलेले प्लास्टिकचे पूर्णपणे नैसर्गिकरित्या विघटन होण्यास साधारणतः एक हजार वर्षांचा कालावधी लागतो. प्लास्टिक पिशवी हलकी असल्यामुळे वाऱ्याबरोबर उडून जाते व झाडांच्या पानाफांद्यांवर अडकून बसते व झाडांच्या प्रकाश संश्लेषणात अडथळा निर्माण करते.

त्यासाठी कमी मायक्रोनच्या प्लास्टिक पिशव्या वापरणाऱ्यांवर दंडात्मक कार्रवाई करावी. पर्वरीतील अनेक विद्यालये, सरकारी कार्यालये व इतर आस्थापनांनी आपल्या संकुलात या पिशव्यांचा वापर टाळावा व तसे निर्देश द्यावेत.

या मतदारसंघातील तिन्ही पंचायतीतर्फे प्लास्टिक कचरा समस्येच्या निवारणाबाबत काही उपाययोजना राबविण्यात येत आहेत त्यासाठी स्थानिकांनी पूर्ण सहकार्य देणे आवश्यक आहे.

काही स्तुत्य उपक्रम

लीला ट्रस्टच्यावतीने लायन्स क्लब, पेन्ह-द-फ्रान्स पंचायत व तिंबलो ग्रुप यांच्या सहकार्याने वॉर्ड क्र. ८ व आसपासच्या घरातील कचरा उचलण्याचे काम गेली तीन वर्षे चालू आहे. कचरा उचलणे, त्याचे वर्गीकरण, ओल्या कचऱ्याचे खतात रूपांतर करून त्याची विक्री, सुका कचरा टाकण्यासाठी व त्यातील रिसाईकल करून तो पुन्हा वापरात आणण्यासाठीची प्रक्रिया कार्यान्वित होणार आहे. या व्यवस्थेसाठी लागणारे मनुष्यबळ, त्यांची निवास व्यवस्था, पगार, गणवेश इ. सर्व जबाबदारी वरील संस्थांनी स्विकारली आहे. पुंडलिकनगर वेल्फेअर असोसिएशनतर्फेही तेथील घरामधून कचरा उचलला जातो.

पर्वरी पठाराची वाढती लोकसंख्या पाहता नजिकच्या काळात ही समस्या उग्र रूप धारण करू शकते. त्यासाठी वरील काही उपक्रम सर्व वसाहतींमधून हाती घेणे आवश्यक आहे. मुळात स्वतः प्लास्टिक पिशव्यांचा कमीत कमी वापर व इतरांना त्यापासून रोखावे. सरकारी पातळीवरील यंत्रणा कार्यान्वित होण्याची नितांत गरज आहेच, परंतु स्थानिकांनी या विषयाकडे गांभीर्याने पाहिल्यास पुढील दुष्परिणाम टळतील व प्लास्टिक कचरामुक्त पर्वरीचे स्वप्न साकार होईल.

–मंगेश काळे, पर्वरी

Besides visits to project by pubic and various presentations to schools, clubs, village Panchayats and other interested parties, there were awareness programs and cleanliness drives taken up in the area. People including Sarpanch, Panch member and many eminent citizens participated and were provided with hand glove, collection sticks and were not hesitant to put their hands in drains and street garbage. The unique experience was that an elderly person came with his grandchild for cleanliness drive. Almost three generations were on ground. Many homemaker ladies expressed their willingness to use effective microbial solution regularly. Experience sharing after inception of segregation at source. Important suggestions as well as feedback was received during the cleanliness drive. Such interactive sessions after an activity were found to be more useful and participative rather than mere interactive sessions which were also organized and it was found that they were relatively less participative.



Photos of Public Cleaning Rally (Late Shri. Dias, Senior Freedom Fighter is also seen)



Above Photos of Public Cleaning Rally, Three Generations on Work

Chapter V – Conclusion, Summary and Recommendations.

5.1 Contribution of the study -

5.2 Summary - Major Impact of pilot SWM project at VPPDF

5.3 Limitations and difficulties

5.4 Findings of the Project - Positive (+) and Negative (-)

5.5 Achievements of project

5.6 Future Scope

5.7 Conclusion, hypothesis and outcome

5.8 Recommendations

The problem of solid waste has several dimensions as discussed in thesis. But one most unique and important consideration is that any type of component may be found in any place where it may not be expected. For example, an imported expired perfume, adulterated food item, grocery or any other consumables or non-consumables, expired battery or cell containing chemicals such as lead, acid or any other heavy metal, disposed medicines containing steroids or chemicals, may be encountered in domestic waste in quantities that may be negligible but might have high toxicity or catalytic effects in combination with other things present in the solid waste.

5.1 Contribution of the study - is in terms of proposing new outlook. It is necessary to consider attributes of product with high, medium and low solid waste creating potential, at the point of manufacturing or handling or packaging or while usage. Based on few of above given criteria and item specific criteria. Hence it is proposed as part of this study to develop Coefficient of Solid Waste Potential (CSWP) for each item. Coefficient of Solid Waste Potential (CSWP)–could prove to be one of the significant requirement for successful and cost efficient management of solid waste problem is segregation at source or at point of creation of waste. This coefficient should also consider factors such as shelf life / time of perishability (hrs), solid waste treatability potential (Low - 0.3, Medium - 0.2 and high - 0.1), Max. CSWP Coefficient =1.Any item having max. CSWP will have maximum resourceful potential value and its waste potential will be least. It means minimum need for treatment for maximum CSWP. This formula will give numeric value which can be further incorporated in the cost benefit analysis of any waste treatment plan or treatability and in calculation of extended manufacturer's responsibility, selection of treatment methodology

Formula proposed is as given as

"Resourceful potential value of solid waste (or any item) at expected time = Quantity of waste (item) in kg (at time of assessment) X Coefficient of Solid Waste Potential"

Above formula proposed is based on the idea out of thought process after learning various lessons from pilot project and also difficulties encountered during calculation of various financial aspects while designing the pilot project. Resourceful potential value of solid waste can be also referred in easy terms as “value of item as resource” and Coefficient of Solid Waste Potential can be referred in simple words as “vulnerability as waste”. This will enable understanding of calculation and evaluation of ecosystem services of a resource with respect to its waste management implications. The formula could be tested on various existing waste management projects and each type of waste constituent to further validate and standardise the Coefficient of Solid Waste Potential and Resourceful Potential Value of Solid Waste. It will also help in the cost benefit analysis of any waste treatment plan or treatability and in calculation of extended manufacturer’s responsibility, selection of treatment methodology etc. However this formula and coefficient is not tested and presently is in just process of concept. Some factors that need to be considered while calculating coefficient of solid waste potential ate time taken for degradation or creating nuisance, environment conditions, time taken for converting into non odour generating intermediate resource or final product completely. Whether the item needs high end treatment method (slaughter waste, biomedical waste, composite or complicated waste such as ACP, PU, Soiled plastic, etc) / technology that will require complicated technology - indigenous or foreign or patented. Various permutations and combinations to be created in tabular form to create item-wise list of coefficients by involving multiple stakeholders and experts. Such potential could be basis on which it is possible to decide tax or fees or cess or fines, treatment charges etc. All above factors and criteria should have value attached to them which could be used to understand the technical as well as economic feasibility of treatment of particular type of waste. Attributes of society whether it will participate and cooperate or will not adhere to systems is also an important consideration. Number of awareness sessions and other interventions required to sensitize, motivate and

educate the communities for participating in successful results. Higher the coefficient, (max =1) easier to treat or less treatment needed and could be directly reused. Similarly, if coefficient is less, that means, it will reduce the value of resource, when multiplied and will have high treatment costs.

Important to consider attributes of product with high, medium and low solid waste creating potential, at the point of manufacturing or handling or packaging or while usage. Based on few of above given criteria and item specific criteria. Hence it is proposed as part of this study to develop solid waste potential coefficient for each item. Attributes of society whether it will participate and cooperate or will not adhere to systems.

Number of awareness sessions and other interventions required to sensitize, motivate and educate the communities for participating in successful results.

Higher the coefficient, (max =1) easier to treat or less treatment needed and could be directly reused. Similarly, if coefficient is less, that means, it will reduce the value of resource, **when multiplied and will have high treatment costs.**

5.2 Summary - Major Impact of pilot SWM project at VPPDF

☺ Awareness created amongst public in ward no 8 that SWM projects could be well handled with proper system.

☺ Due to VPPDF model, other VPs have got inspiration from this project. Namely VP Verna, VP Corlim, CCP has declared that it will install similar machines like VPPDF.

☺ Locals are benefited from door to door collection.

☺ Ward no. 8 area is relatively clean.

☺ Housing Board has allotted space of 1000 sq meters for swm project on lease.

☺ Nearby wards have come forward requesting door to door collection.

☺ VP PDF has created SWM fund for the first time dedicated for the cause.

☺ Governor had convened special meeting where this project was appreciated.

☺ Scope to replicate similar efforts by varying parameters like alternative collection method.

☺ Adding dignity to the job of garbage collector and attracting more unemployed and hardworking youths.

5.3 Limitations and difficulties

☹ No proper stay and sanitation (latrines &bathroom) arrangement for labourers.

☹ Attrition of labourers due to lack of above facilities.

☹ Space constraints to store finished product and also recyclable waste till it is taken by the vendor.

☹ Advance expenditure by SFI / Lila which is then reimbursed by VPPDF.

☹ No system for processing residual plastic and recyclables due to lack of space.

☹ During initial 3-4 moths of inception less income from compost sales as gradually no of houses were increased to 500.

☹ After starting Initial loss of compost to establish the stoichiometry or process formulation.

☹ During first year rains some compost which was kept for drying was carried away by rains however most of it recovered.

☹ Initial few months and even recently proportion of impurities is increasing due to poor segregation at source by many households.

☹ No system for dealing with home toxics hence adds to residual waste.

☹ Piling residual waste needs special process and creates pause in expansion.

☹ No visual impact as area under service is small and gets littered from neighbouring areas

☹ Need to procure more big bins and uniforms costing about Rs.75000/-

5.4 Findings of the Project - Positive (+) and Negative (-)

+ Good beginning and step to inculcate good habit among public.
+ VPs and Public bodies will get more pressure to perform.
+ Better sanitation and cleanliness leading to better living.
+ Lesson for others, Creation of employment to downtrodden.
- Drain on capital investment since underutilized capacity.
- Public contributions not collected and shortfall of funds due to low amount shared by public and VP.
- Space constraints and lack of proper welfare to labourers leading to attrition.
- Never to take up such projects without proper legal ownership of process like MOU or Tender or Work Order.

5.5 Achievements of project:

Many Village Panchayats, environmentalists, social workers, municipal engineers, village panchayat members across the state, MLAs, industrialists, general public, clubs, decision makers, builders and even delegations of NGOs, Lions Club of Udupi (Karnataka) visited the project site and learnt the method of managing solid waste. The project has contributed in big way

The project in-charge (researcher) and the VPPDF representative Shri. Umesh Fadte made several efforts and proposal as well as request letters were made to Goa Housing Board located in the study area to provide land for setting up integrated decentralized waste management facility for all the 11 wards of VP PDF. Several meetings were held with engineers, office

bearers, management and the then minister Shri. Nilkanth Halarnkar who finally allocated 1000 square meters of land to VPPDF for setting up solid waste facility. The local public representatives also joined efforts for allocation of land. The local MLA Shri. Rohan Khaunte, continued the good work aggressively and extended the facility of door to door collection not only to all the wards but also to neighbouring VPs. This is a very great achievement which perhaps could be attributed to good work initiated by the pilot project.

Researcher visited few states and got opportunity to be part of All India Waste (AIW) Association whereby Lila Trust became member of AIW. Places visited included Okhla in Delhi to visit and understand IL & FS SWM Plant. Visited mountains of solid waste and was exposed to unimaginable scales of garbage dumps. Visited Gorai solid waste restoration site in Mumbai. Visited Pune to see "Kach Kachra Kashtakari Panchayat" model of waste management. Had opportunity to visit Sulabh Biogas Plant in Delhi for 1000 seater toilets whereby waste is used as biogas plant feed and biogas is used for cooking. Producing campfire, generated of electricity from biogas is supplied to illuminate lights of Sulabh school campus. Visited model colony solid waste management plant, whereby high mast electricity lamp gets electricity supply from biogas based generator which gets solid waste feed from local residents. Besides the site visits, several national and international conferences were attended to understand the complete issue in detail.

5.6 Future Scope after this research is enormous. It may be possible to use the findings to improve further efforts towards sustainable waste management. There is scope to carry out microhabitat study with their enumeration and toxicology / xenobiotics in ecosystems and their bio-magnification dynamics, including qualitative and quantitative analysis. There is scope to create specific awareness and training tools as well as modules of awareness for various stakeholders, involve all levels including residents including those residing in rented places – often missed in planning, students (most effective means of convincing all the generations in

spite of gap in ways of thinking), housewives (homemakers), retired citizens, prominent Govt. authorities and other residing in the area.

There is scope to test the formula proposed to further validate and standardise the Coefficient of Solid Waste Potential and Resourceful Potential Value of Solid Waste. It may prove an important tool in the cost benefit analysis of any waste treatment plan or treatability and in calculation of extended manufacturer's responsibility, selection of treatment methodology etc.

5.7 Conclusion, hypothesis and outcome

Problem of solid waste has several dimensions are discussed in thesis. But one most unique and important consideration is that any type of component may be found in any place where it may not be expected. For example, an imported expired perfume, adulterated item food, grocery or any other consumables or non-consumables, expired battery or cell containing chemicals such as lead, acid or any other heavy metal, disposed medicines containing steroids or chemicals, may be encountered in domestic waste in quantities that may be negligible but might have high toxicity or catalytic effects in combination with other things present in the solid waste.

One of the major requirement for successful and cost efficient management of solid waste problem is segregation at source or at point of creation of waste.

The hypothesis and outcome -

The broader objective was to identify the environmental set up, geographical features, ecosystems types and pollution of coastal ecosystems in and around study area in Penha de France in Porvorim in Goa. Emphasis on understanding solid waste problem and developing sustainable model in village Penha De Franca in Porvorim as pilot case study to achieve preservation of coastal ecosystems.

Hypothesis –"It is possible to conserve and improve river bank and plateau ecosystems by developing sustainable and economic hand-holding model for managing pollution problem due to solid waste in Village Panchayats in and around Porvorim"

The above hypothesis is tested with the help of reliable primary data and analytical study of literature available as secondary data which has enabled drawing logical inferences on the problem. There is need to involve all the stake holders in true spirit and engaging professional expertise or developing it amongst local bodies through garbage committees and BMCs. If the primary segregation at source is done in maximum categories then the overall solid waste management is successful with less financial burden. More the involvement at household level, better is the segregation, better is the process / product success in any technique / method of treatment. Sustainability of such projects or any solid waste management projects depends on responsible role of each stakeholder right from garbage generator to the project implementing body or process owner and operator and most importantly local bodies. Understanding reasons for failure or less success of existing solid waste projects and systematic analysis of chances of sustainability with respect to several variables is one of the main outcome of learnings from the research. The hypothesis is tested and proven to be successful in the study area.

As initially stated on page 11 of thesis in reference quoted, “to bring about a change in the right direction, corporate organization in the emerging countries would have to define a totally new set of values than what was practices by the business organizations in the developed world at similar stages of growth and development.” (Source - Green to Gold, Esty & Winston, 2006) – This was what exactly tried in the study area and was tested to large extent.

5.8 Recommendations

1. Ecological preservation or conservation ensuring protection and improvement of ecosystems in the area necessarily needs to include recently functionalized BMCs (Biodiversity management Committees), VDCs (Village Developments Committees), Garbage Committees along with dedicated ownership and participation from Village Panchayat in unified approach to deal with the problem of solid waste. All the statutory and voluntary bodies from village Panchayat jurisdiction should share responsibilities and involve everyone by making time bound work plan. There is need to document all the important ecosystems and microhabitats in Peoples Biodiversity Register of the area by BMC. The plateau depressions where lake like feature is created in monsoon, and other areas, could be used for rain water harvesting or contour trenching etc. Conservation plan could be derived after completing PBRS and deciding focus areas for environmental conservation of the entire jurisdiction of village Panchayat.

2. It is utmost important to preserve, conserve and improve the peripheral forests on the plateau. Slopes are also under process and threat of encroachment. Protecting slopes on all sides of plateau is urgent need. Hence it needs strong mechanism of annual monitoring for such high demand areas by special conservation committee consisting of representatives from Panchayat, BMC, Town and Country Planning Dept., Water resources Dept., Agriculture and Forest Depts. Along with Environmental Dept. / GCZMA. This committee should have powers to take Suo moto cognisance of any violations of illegal encroachment and deal with them on fast track manner. Failure to protect slopes and forests will prove to be disastrous for both plateau as well as lower settlement areas. The riverine areas and mangroves will be worst sufferers leading to not only violations of CRZ regulations but consequently lead to eradication of natural defence mechanism. The erosion of slopes due to encroachment / forest destruction

and vulnerability of river bank populations to disasters if mangroves are not protected are the major concerns which will further affect quality of life of future generations.

3. Goa State has unique situation whereby the floating population as on today is about five times more than that of existing population. Hence the problem of solid waste management cannot be just tackled effectively if local residents are following healthy civic practices. It is also necessary to educate tourists and visitors entering the state that it is not possible to get away with the dumping and irresponsible wasteful behaviour but there shall be strict adherence to the culture of minimization of waste, reduce, recycle, reuse, segregate at source, dispose only in designated bins rather than leaving wasteful footprints in nature. Tourism Dept. and all other departments along with public should participate in spreading culture of eco-friendly responsible tourism. Strong local legislation for every type of waste handling and responsible active agency equipped with all the necessary mechanism to ensure clean State. Waste generator or producer should be made responsible to pay or deal.

4. There is no substitute to waste minimization, waste segregation, composting and recycling, but mere lip service to these issues was deemed sufficient. (Indian municipal garbage: How to manage it? By Gopal Krishna, Published in www.toxicslink.org, 19/07/2005)

Above statement was proven while observing functioning of waste management plant on site. Every time whenever unsegregated waste was received, it took at least an hour more to segregate, separate soiled components mixed with wet waste and process the wet or biodegradable waste for further processing to pre-processed compost which needs further curing. Further when state of the art treatment facility came up at Saligao Goa, in spite of the technical capabilities of the plant to process mixed waste, it is opined by the experts that if the same plant receives segregated waste then efficiency will be much higher. It is necessary to understand upward integration of waste to the source and backward

5. Local bodies rural and urban both lack capacity to professionally deliver time bound results especially the pace of work is much slower due to multiple decision making hierarchies involved. Hence repayment, participatory financial support models should have more time flexibility. It also gives time to take up intensive consultative processes and participation will be better.

6. Thus excessive solid waste that is generated should be controlled by taking certain preventive measures especially if cannot be treated then its characterization, tagging and segregated storage is essential for further disposal.

7. Planning process should consider not only normal situation and routine waste generated but also should include plan for contingencies and disaster and likewise situations, when waste received at treatment site will exceed all the calculations. In such times strategy of having additional landfill and bio-methanation capacity, multiple technological availability and provision of buffer storage is advisable.

8. Population expected by 2050 in Indian, is 7 billion. Hence preparedness for dealing any situation is important consideration. Effect of each disaster on quantities of waste received and impacts, eg. Displacement of waste in unexpected ecosystems especially in water bodies, contamination of ground water, etc. are to be considered during planning.

9. Recommended to involve support from other local bodies like in study area, support was taken from Porvorim Gymkhana, Green Ray Foundation and other individuals like Mrs. Menezes and others who will support directly/indirectly VPPDF SWM fund to strengthen the project.

10. Need to devise mechanism to control the flow of impurities to the process. Incentive / disincentive scheme for residents and wherever required strict enforcement to stop littering / dumping in open spaces.

11. Adopting combination of various successful models for collection and processing, cost effective process operation and management support, designing model and implementing project is required by involving multiple stakeholders.

12. Model selection, Technology selection, overcoming social/political problems and systematically planned road map are the main components to make the project successful system and will be most cost effective solution.

13. It is high time that we have to eradicate the attitudinal barriers and take responsibility of our waste. If not ready to pay for the cost and come out with the solutions and suggestions. Panchayats, municipalities, residential societies and also individuals with little space compared to that needed for park, ground, recreation centre etc. Identify and demarcate place for integrated sewage, solid management and non-biodegradable recyclable outlet.

14. An independent agency should work in collaboration with existing depts. Concerned with solid waste management, sewage management and resource management. It is definitely possible to achieve excellent results by combination of localized and centralized methods to treat entire solid waste. Solid waste management corporation of Goa is a very important step in this regard.

15. Wide campaigns for awareness at all levels in community, schools, colleges etc. NGO's, volunteers to be involved for better results.

16. Encourage and welcome efforts by corporates which have taken this issue at high priority on their list. More corporates, NGO's, Volunteers should show their willingness to involve without expecting any position or huge emoluments.

17. Only a mass movement with immediate and decisive action by the government authorities at the earliest. Empowerment for imposing penalty system and making the polluter pay can only result in a good beginning.

18. Complete failure of concerned authorities or lack of committed deadline based program has resulted in the present scenario which will soon worsen the case.

19. Corruption is a root cause of failure of good efforts. This was also experienced while dealing with various stakeholders – most residents expected best service without willingness to pay. They felt it is the responsibility of village Panchayat. Few members from VPPDF felt that this was yet another contractor – so they expected pay backs on bills, without realizing or bothering that it is pilot project that needs cost control and sincere efforts. Project workers were always demanding more incentives and asking about when their services will become permanent, so that they can also relax. Overall it is obvious that constant efforts are required to bring each stakeholder back to business by motivation, constant counselling / training and wherever necessary by punitive and strict actions.

20. Solution for environmental issues cannot be found by any-one interested party but calls for another green movement. Appropriate and low cost technology produce biogas from solid waste and sewage is already available but unfortunately not popularized at any level. There could be combination of various methods used specific to each site and local conditions. There cannot be single yard stick for all the measurements.

21. Along the riverside prominent to note that the geomorphology is fast changing due to fast concretization of river bank. Unregulated structures are flourishing by flouting coastal zone management regulations. There is need to regulate the area, intervene by taking suo moto cognisance by authorities. The erosion and accretion aspects need to be clearly understood, quantified by measurements, mangrove interventions are necessary and eco-friendly means of river bank protection need to be practiced. Even while taking up concrete work. Accretion of silt is prominent on both sides of the river bank. Interdisciplinary task force consisting of experts from geomorphology, ecology, engineering, biodiversity, marine science, botany and

local stakeholders may be set up to deal with such problems, devise guidelines, standard technical drawings with specifications and prove the successful after ground implementation.

22. In case of Construction & Demolition Waste (C & D Waste) and soiled plastic / non-recyclable category, a separate case-by-case review and guidelines is recommended for specific cities. There is need to have systematic ways to deal with this waste as it is mostly used to reclaim marshy, wetlands, fields, fallow lands and other lands by dumping C & D wastes to create massive foundation.

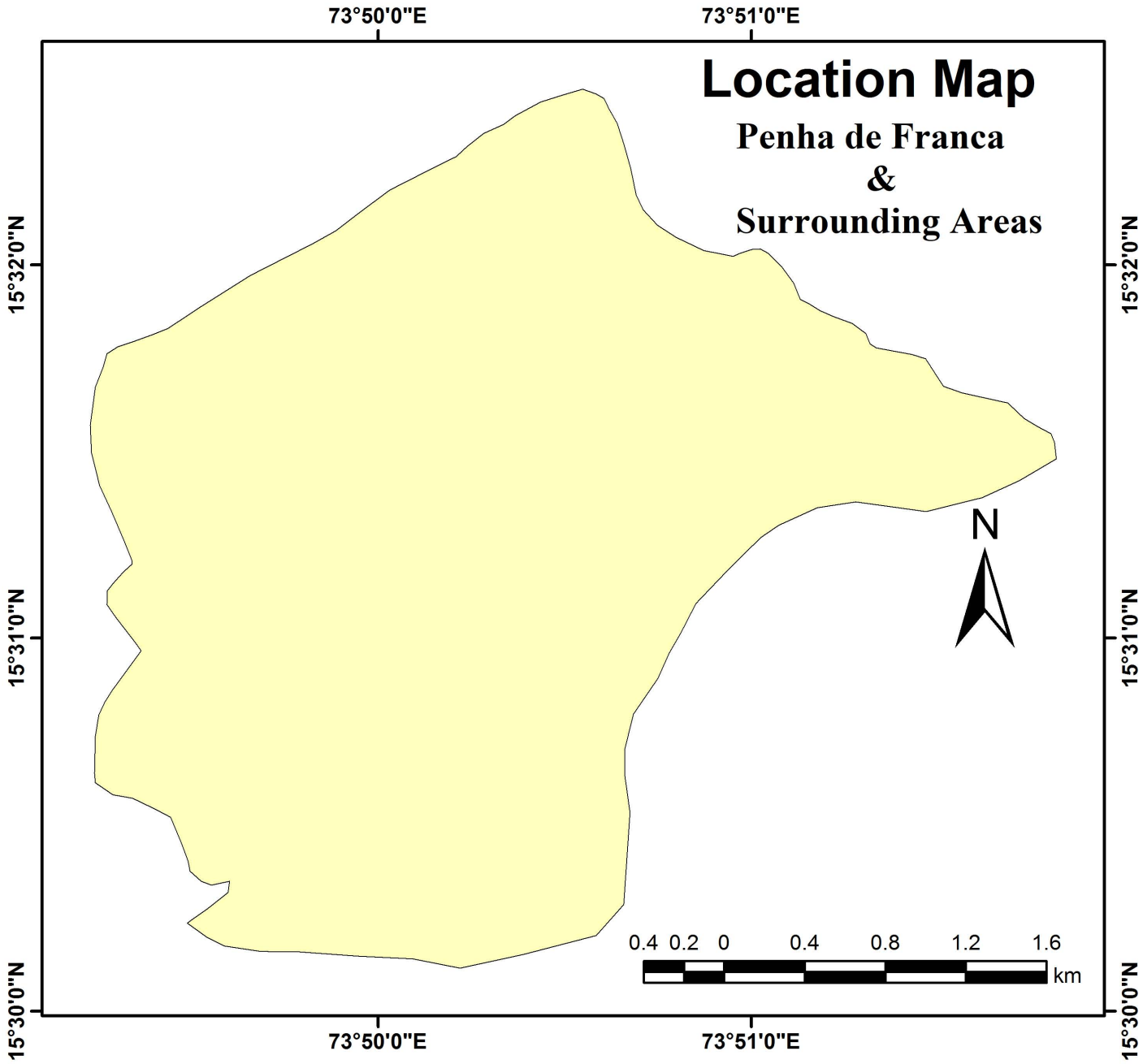
23. Lack of public participation and compliance – The lessons learnt and experience gained from the implementation of the pilot project, clearly reveals that it is not possible to achieve any success in any project if the awareness, adherence to waste reduction and segregation at source and continuous public participation in owning their waste management responsibility is achieved. There is need to popularize the provisions of the MSW Rules at all levels especially to educate everyone regarding responsibilities and duties of public as waste generators. The waste generator should be made to realize the extended responsibility to pay their contribution for waste management and ensure that it is well transported in segregated form, treated and the resultant product after processing should be visible to public. Rather such projects should have periodic stakeholders' consultations, monitoring & review meetings and most importantly audits pertaining to the quality, environmental performance, occupational health of working personnel and social accountability.

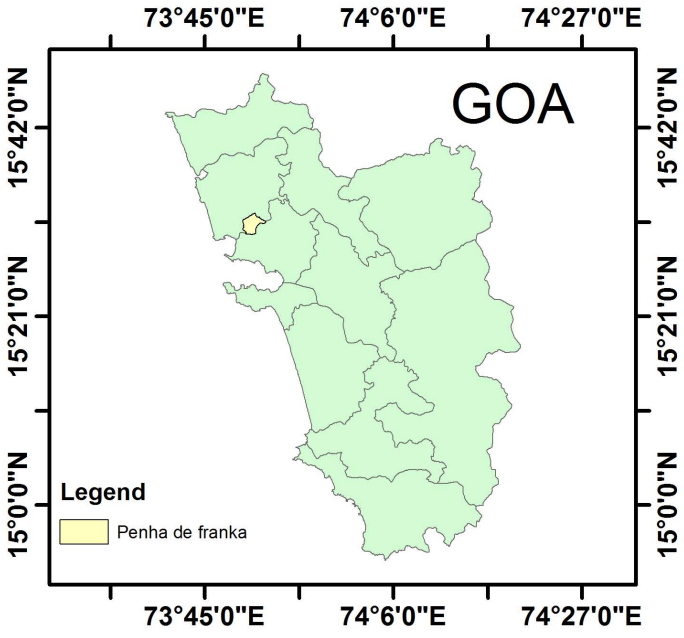
24. In spite of existing successfully functional solid waste management plant catering to over twenty four (24) coastal village Panchayats, in which VPPDF is also a beneficiary, an in spite of available space for the solid waste management, appointed contractor and elected bodies in place, yet articles are found to appear in most recent local newspapers about occurrence of dumping sites in the area. The important learning that can be derived is that complete solution to management of solid waste problem in study area is neither possible with one time effort nor

can assure one time solution but needs continuous commitment and effective adherence to established procedures at all times. Since the waste is generated on daily basis, t can be managed best at the time and place of generation. May it be kitchen, dining table, cooking platform or wherever food is consumed – even in car, platforms, airports, offices or any other public or pristine place. The problem starts when waste producers mind is not alert or irresponsible and insensitive to the consequences.

25. State of Goa is in process of effective plastic ban. So far 17 states have plastic ban, Goa could show effective implementation of wise use of plastics in unavoidable areas only and by encouraging the alternative biodegradable substitutes in phase wised manner that would make the difference on ground.

LIST OF SIGNIFICANT MAPS


Location Map
Penha de Franca
&
Surrounding Areas
73°50'0"E
73°51'0"E
15°32'0"N
15°31'0"N
15°30'0"N
N
0.4 0.2 0 0.4 0.8 1.2 1.6
km


73°45'0"E
74°6'0"E
74°27'0"E
15°42'0"N
15°21'0"N
15°0'0"N
GOA
Legend
Penha de franka

Untitled Map
Write a description for your map.

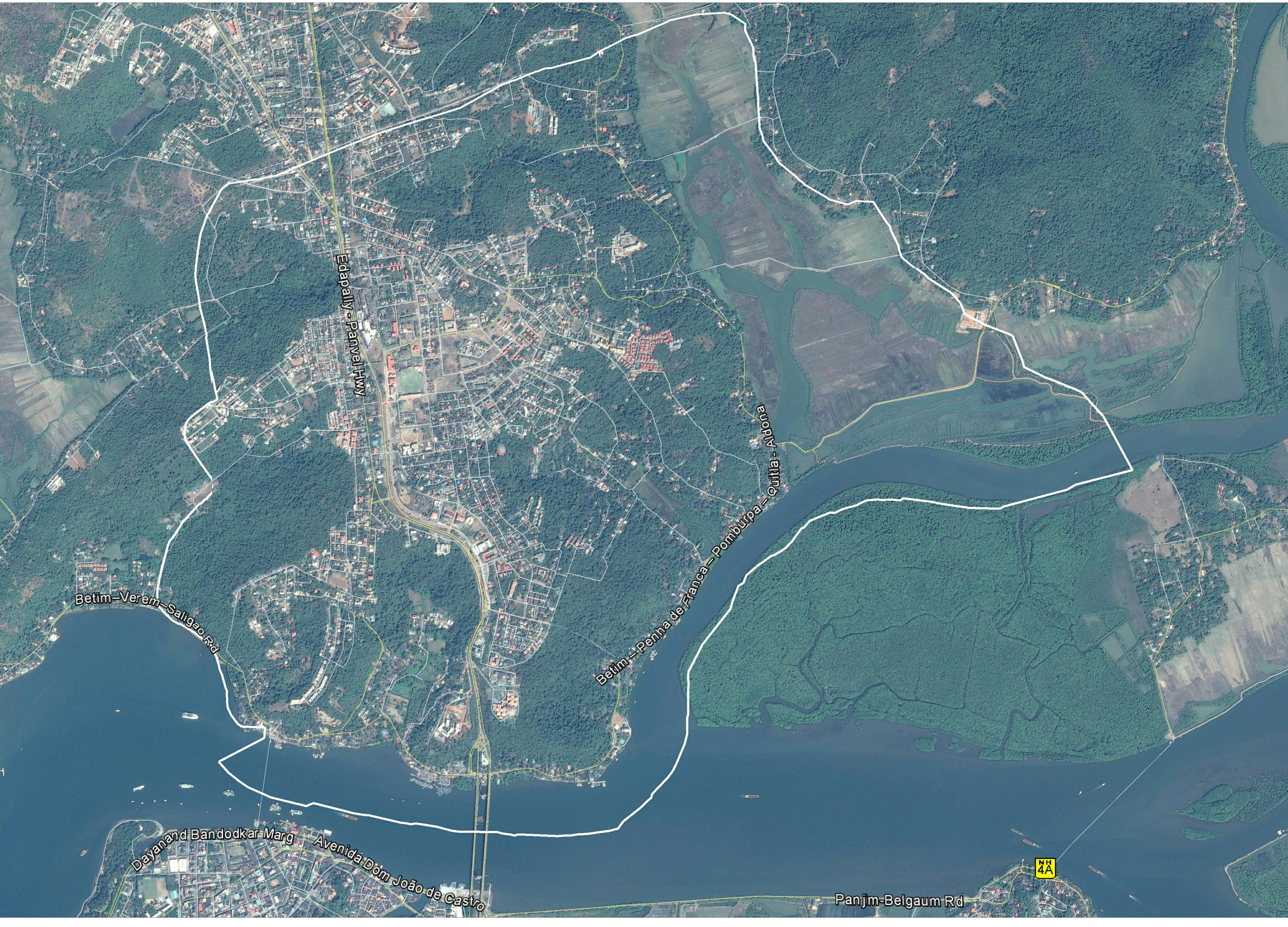
Legend
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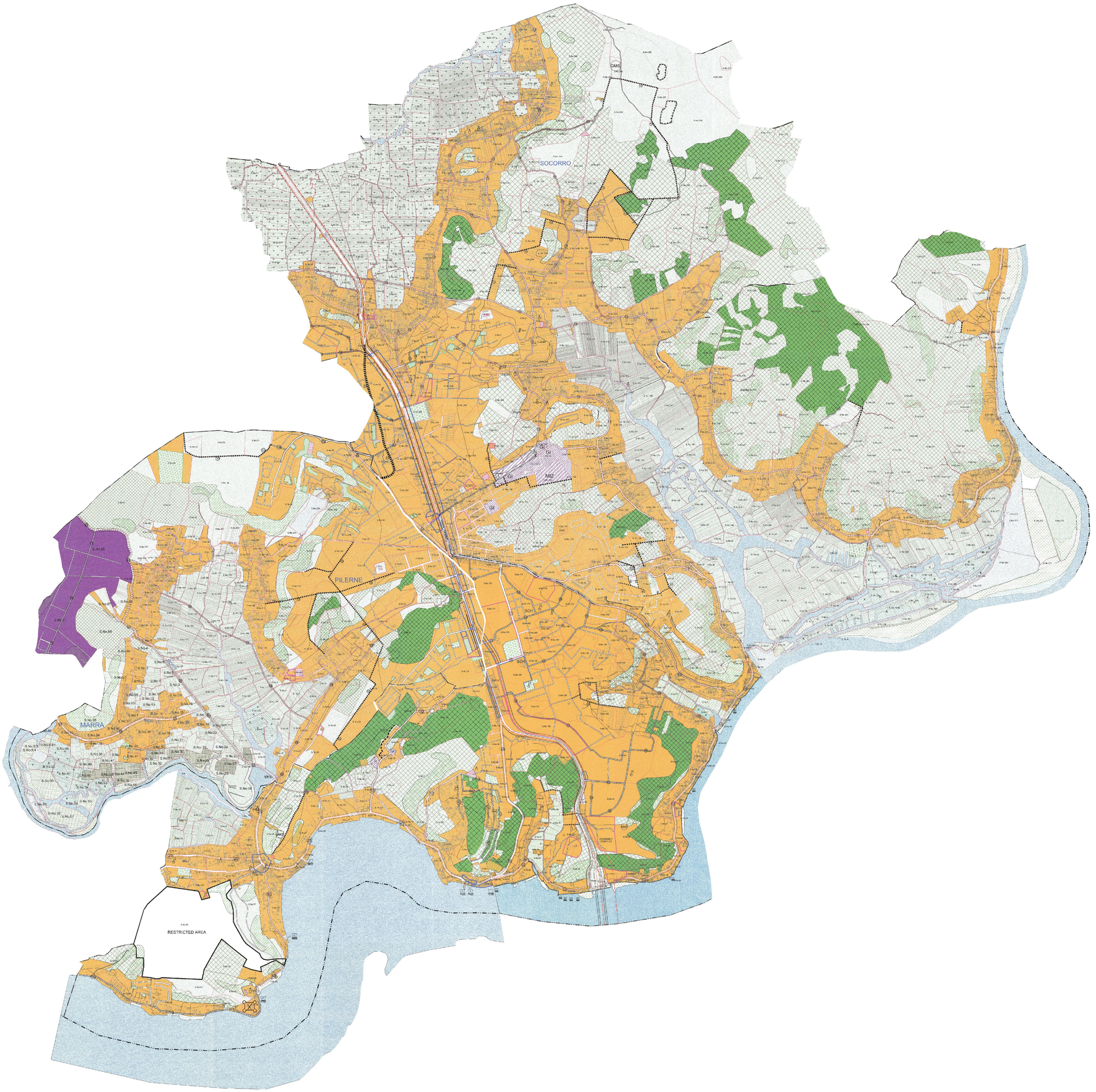
Socorro
Saligao
Penha de França
Donwaddo, Salvador Do Mundo, Bardez
Chorao
Alto Porvorim
Nerul
Verem
Porvorim
Reis Magos
Panjim
Chimbel
Baingui

Google Earth
Image © 2017 TerraMetrics
© 2017 Google
Image © 2017 DigitalGlobe

N

1 km


Edapally - Panvel Hwy
Betim–Verem–Saligao Rd
Betim–Penha de França–Pomburpa–Quitla
Dayanand Bandodkar Marg
Avenida Dom João de Castro
Panjm-Belgaum Rd
NH 4A



LAND USES

ECOLOGICALLY SENSITIVE AREAS (ECO-1)

- PRIVATE FORESTS (SUBJECT TO CONFIRMATION)
- NO DEVELOPMENT SLOPES
- MANGROVE
- PADDY FIELDS / KHAZANS
- RIVER & NALLAS / PONDS

OTHER ECOLOGICALLY SENSITIVE AREAS (ECO-2)

- ORCHARD
- NATURAL COVER

INDUSTRIAL

- GENERAL INDUSTRY

SETTLEMENTS

- SETTLEMENT AREAS EXISTING RETAINED
- COMMERCIAL ZONE
- INSTITUTIONAL ZONE

TRANSPORTATION

- NATIONAL HIGHWAY PWD ALIGNMENT
- NATIONAL HIGHWAY
- MAJOR DISTRICT ROADS (25m)
- MAIN PANCHAYAT ROADS (15m)
- OTHER PANCHAYAT ROADS (10m)
- OTHER ROADS (Minimum 6m)
- PROPOSED ROADS (10m)

ADMINISTRATIVE BOUNDARIES

- TALUKA BOUNDARY
- PANCHAYAT BOUNDARY
- SURVEY BOUNDARY
- SUB DIVISION BOUNDARY

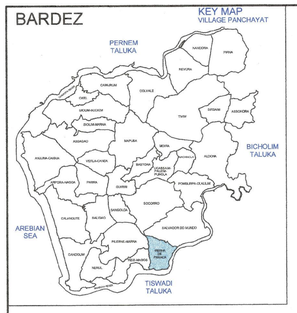
OTHERS

- CREMATORIUM / CEMETERY
- PLAY GROUND
- GMS — GARBAGE MANAGEMENT SITE
- SCH — SCHOOL
- V. P. — VILLAGE PANCHAYT OFFICE
- TEMPLE
- CHURCH / CHAPEL
- EXISTING BRIDGE
- F — FISHING JETTY
- P — PASSENGER JETTY

PENHA-DE-FRANCA PANCHAYAT

BARDEZ TALUKA

SCALE 1:5,000



TO SOCORRO

TO SALVADO DO MUNDO

TO PILERNE

TO SALVADOR DO MUNDO

TO REIS-MAGOS

TO PANAJI

ASSEMBLY COMPLEX

SCH

GMS

V. P.

LAND USES

ECOLOGICALLY SENSITIVE AREAS (ECO-1)

AREA = 538622 SQM — PRIVATE FORESTS (SUBJECT TO CONFIRMATION)

AREA = 408321 SQM — NO DEVELOPMENT SLOPES

AREA = 55021 SQM — MANGROVE

AREA = 130794 SQM — PADDY FIELDS / KHAZANS

AREA = 7502912 SQM — RIVER & NALLAS / PONDS

OTHER ECOLOGICALLY SENSITIVE AREAS (ECO-2)

AREA = 79015 SQM — ORCHARD

AREA = 283592 SQM — NATURAL COVER

INDUSTRIAL

AREA = 5001 SQM — GENERAL INDUSTRY

SETTLEMENTS

AREA = 2995761 SQM — SETTLEMENT AREAS EXISTING RETAINED

AREA = 86905 SQM — COMMERCIAL ZONE

AREA = 376876 SQM — INSTITUTIONAL ZONE

TRANSPORTATION

- NATIONAL HIGHWAY PWD ALIGNMENT
- NATIONAL HIGHWAY
- MAJOR DISTRICT ROADS (25m)
- MAIN PANCHAYAT ROADS (15m)
- OTHER PANCHAYAT ROADS (10m)
- OTHER ROADS (Minimum 6m)
- PROPOSED ROADS (10m)

ADMINISTRATIVE BOUNDARIES

- TALUKA BOUNDARY
- PANCHAYAT BOUNDARY
- SURVEY BOUNDARY
- SUB DIVISION BOUNDARY

OTHERS

- CREMATORIUM / CEMETERY
- PLAY GROUND
- GMS — GARBAGE MANAGEMENT SITE
- SCH — SCHOOL
- V. P. — VILLAGE PANCHAYT OFFICE
- TEMPLE
- CHURCH / CHAPEL
- EXISTING BRIDGE
- F — FISHING JETTY
- P — PASSENGER JETTY

TOWN & COUNTRY PLANNING DEP. PANAJI GOVT. OF GOA, PANAJI

APPROVED BY GOVT. VIDE
NOTE No. 29/8/TCP/2011/RP-21/ No.2-1(6)/2014/5
Dated:.....

CHIEF TOWN PLANNER
Town & Country Planning Dept.
Panaji - Goa.

Secretary
Government of Goa,
Secretariat.

NOTE :-

1. This plan showing proposed Surface Utilization of PENHA-DE-FRANCA V.P forms part of the Regional Plan for GOA 2021 of BARDEZ Taluka which has been approved by the T.C.P. Board in its meeting held on 2011 & approved by Govt. vide note no. 29/8/TCP2011/RP-21/_____ dated _____
2. All the O.D.P's & Zoning Plans (ZP's) prepared in the past by P.D.A's/T.C.P.D , as the case may be and are in force (both in P.D.A areas & non P.D.A areas) have been incorporated in to the RPG-2021. Respective O.D.P's /Zoning Plans shall be referred for details and development control of developable areas only as per RPG-2021. In case of any variations, the matter shall be referred to the T.C.P. Board for its opinion/interpretation.
3. Private Forest areas indicated in this plan are subject to the final confirmation & demarcation by the competent Authorities.
4. Surface Utilization Plans shall be read with the report of RPG-2021 (Release I/Final) for interpretation.
5. This Surface Utilization Plan shows broad land uses which are to be read along with guidelines for interpretation of permissible land uses .
6. All past commitments/developments like sub-division approvals by competent Authorities, conversion sanad under LRC, building approvals/NOC's granted, shall be honoured for specific uses, if not reflected in this plan.
7. All NOCs for Land Acquisition for specific purposes under the L.A. Act 1894 issued by TCP Dept for specific uses /activities shall be treated as confirming to the said use for which NOC was issued. The same shall not hold good, in case where acquisition proceedings are dropped by the Govt. and shall be treated as per uses indicated in the Surface Utilization Plan.
8. Not withstanding anything contained in this Plan, the developments shall be subject to the provisions of Tenancy Act, Land Use Regulation Act, Forest Conservation Act, Highways Act, Ancient Monuments and Archaeological Sites and Remains Act (State and Central) EIA notifications issued by the MOEF or any other Act/Rule as applicable.

400m² 10,000m²

AREA SCALE

Original or Approved Sub - Division Plots upto 350 m² will be allowed upto 80 FAR irrespective of the VP Status of Settlement Category.

PENHA-DE-FRANCA PANCHAYAT
BARDEZ TALUKA

REGIONAL PLAN FOR GOA-2021 (RPG-21) | SEPTEMBER 2011 FINAL / 21092011

REGIONAL PLAN DIVISION
TOWN AND COUNTRY PLANNING DEPT.
GOVT. OF GOA

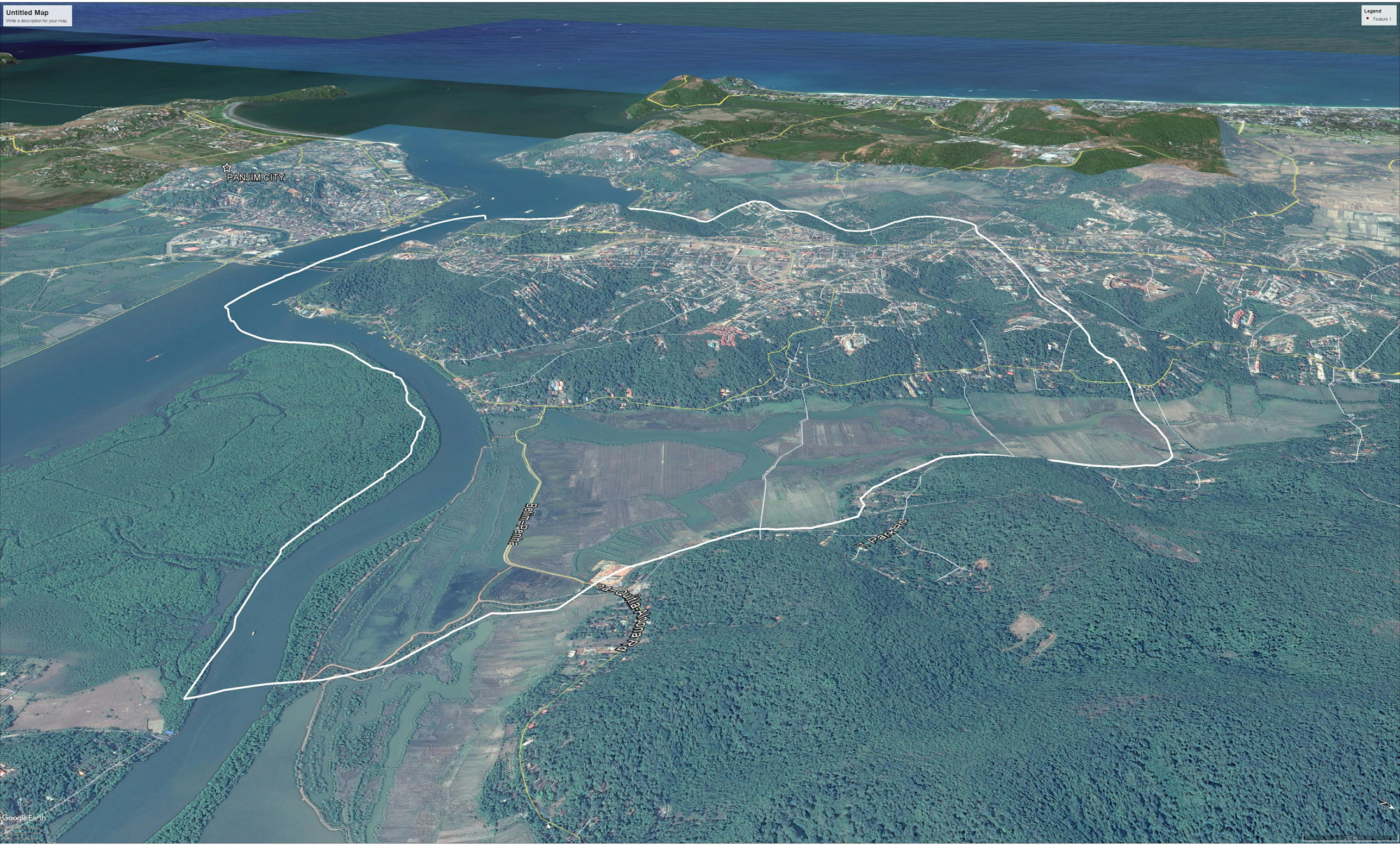
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2021 - 27274

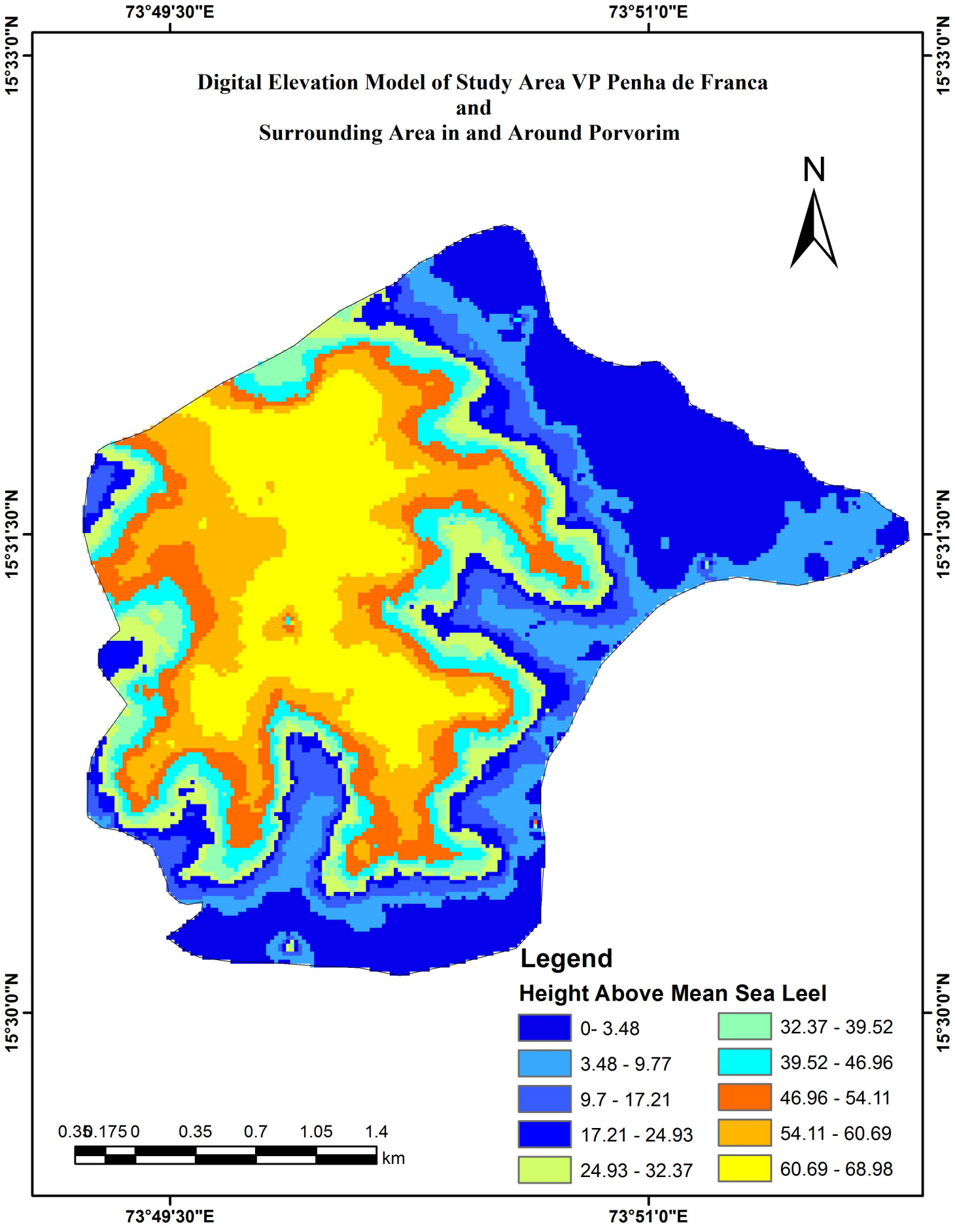
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VP-1

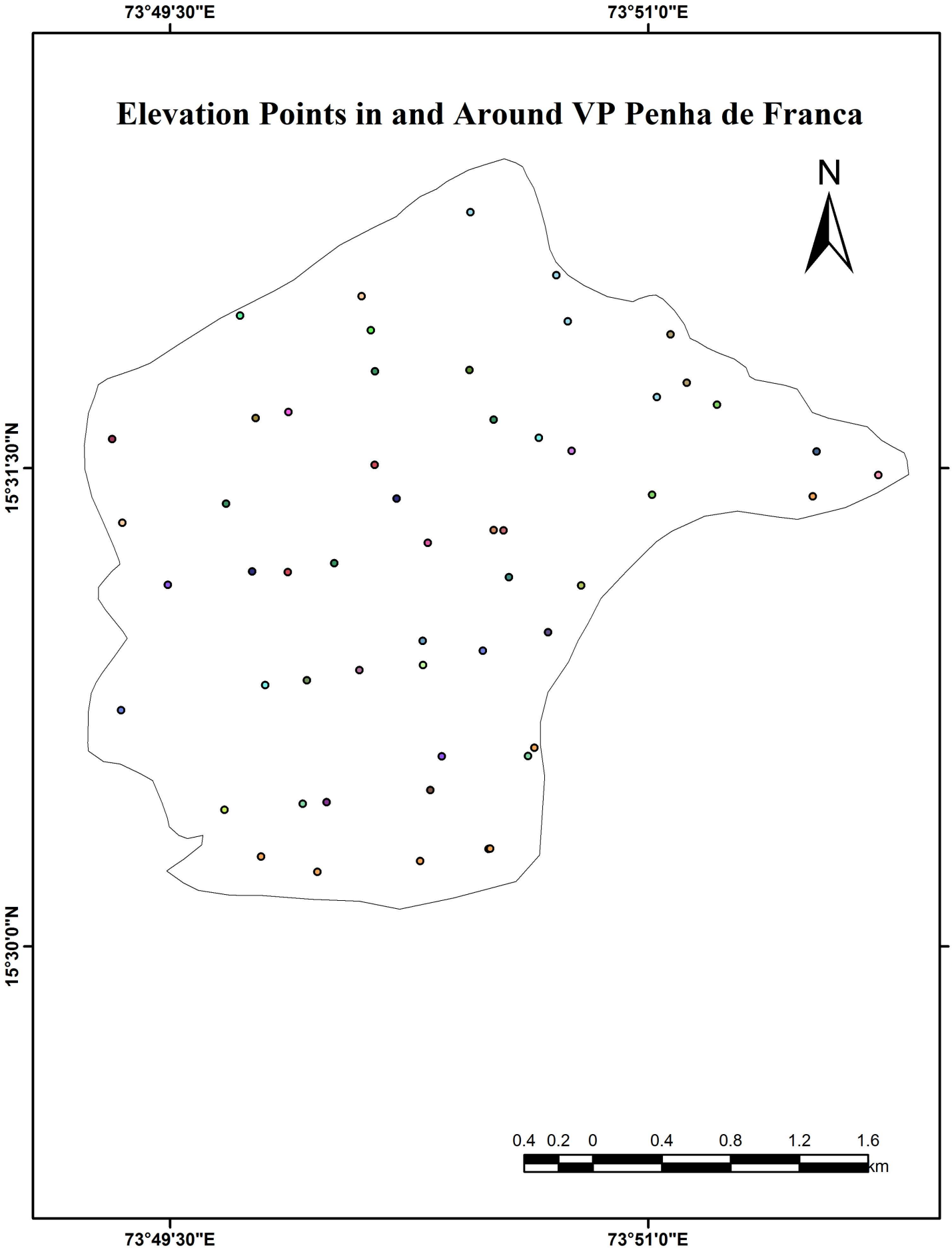
MAX- FAR PROPOSED
BELOW 4000 m² 80
4000 m²& ABOVE 60

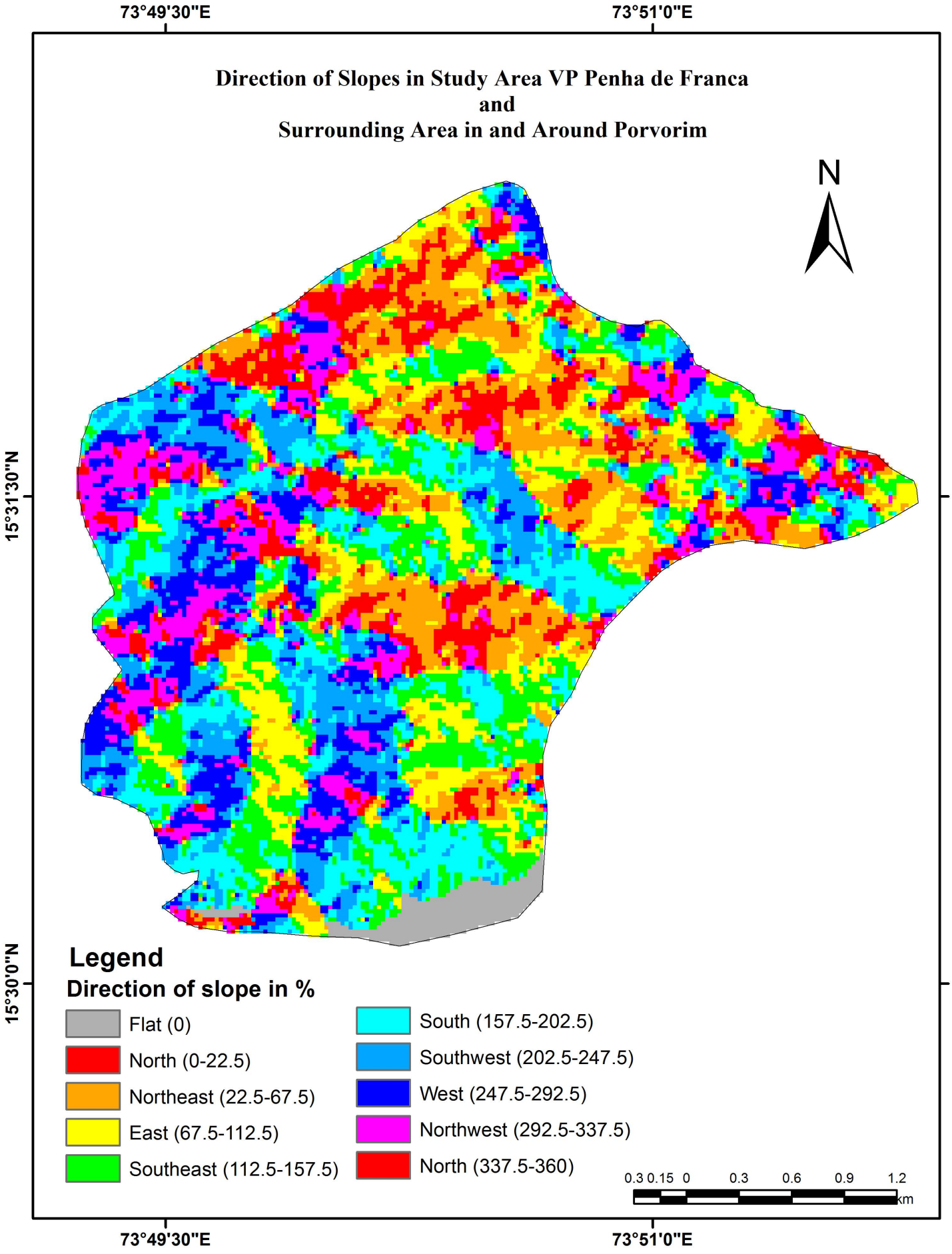
N

150 50 0 300m


Untitled Map
Write a description for your map.
Legend
Feature 1
PANJIM CITY
Belim-Penha
Par-Kpra-Quitla-Ponda-Rd
T-Park-Rd
Google Earth
200 m


Digital Elevation Model of Study Area VP Penha de Franca
and
Surrounding Area in and Around Porvorim
N
73°49'30"E
73°51'0"E
15°33'0"N
15°31'30"N
15°30'0"N
Legend
Height Above Mean Sea Leel
0- 3.48
3.48 - 9.77
9.7 - 17.21
17.21 - 24.93
24.93 - 32.37
32.37 - 39.52
39.52 - 46.96
46.96 - 54.11
54.11 - 60.69
60.69 - 68.98
0.35 0.175 0 0.35 0.7 1.05 1.4
km


73°49'30"E
73°51'0"E
Elevation Points in and Around VP Penha de Franca
N
15°31'30"N
15°30'0"N
0.4 0.2 0 0.4 0.8 1.2 1.6
km


73°49'30"E
73°51'0"E
Direction of Slopes in Study Area VP Penha de Franca
and
Surrounding Area in and Around Porvorim
N
15°31'30"N
15°30'0"N
Legend
Direction of slope in %
Flat (0)
North (0-22.5)
Northeast (22.5-67.5)
East (67.5-112.5)
Southeast (112.5-157.5)
South (157.5-202.5)
Southwest (202.5-247.5)
West (247.5-292.5)
Northwest (292.5-337.5)
North (337.5-360)
0.3 0.15 0 0.3 0.6 0.9 1.2
km

APPENDIX – 1

Extracts from Goa State Biodiversity Action Plan Report – 2002

Source : Goa State Biodiversity Action Plan Report – 2002, http://www.goafoundation.org/completed-projects/biodiversity.html - Dr Nandakumar Kamat presented the summary of the Goa BSAP work at a workshop organised by the CEE on January 15th, 2002, at Donapaula, Goa, to discuss Rio+10 issues exclusively for the Western region)

The State plays host to 55 sacred groves, preserved and maintained because of their association with various deities." (Presently Goa State Biodiversity board is already in process of publishing more data and information about sacred groves of Goa).

"In the coastal areas, satellite pictures indicate that while the vegetative cover has increased, the number of species used largely by resorts, etc. show a steady decrease.

Geology - Specifically, the State is predominantly covered by the rocks of the Goa Group belonging to the Dharwar sub-group of the Archean to proterozic age, except for a narrow strip along the northeastern corner occupied by the Deccan traps. The Goa group consists of green schistic faces of metamorphic rocks which have been folded and intruded by granite gneiss, feldspar gneiss, hornblende granite and porphyritic granite followed by basic intrusives. The rocks of the Goa group are broadly comparable and correlated with the rocks included in the Chitradurga group of Dharwar Super Group of Karnataka. During sub-recent to recent times, the rocks have been subjected to laterisation resulting in a cover of laterite of varying thickness. The soils of the state belong to 4 orders, 6 sub orders, 10 great groups, 14 subgroups, 21 families and 32 series. Inceptisols are dominant followed by entisols, ultisols and alfisols.

Watersheds - The country has been divided into several watersheds which are reflected in the Watershed Atlas of India (see map). Goa falls in the 5th Water source region of

the ‘B’ Cauvery basin of the first catchment (Sharavati to Savitri) and ‘B’ sub-catchment (Kalinadi to Vaghotan). This area has been classified into 6 watersheds and given the classification Nos. 5B1B1, 5B1B2, 5B1B3, 5B1B4, 5B1B5 and 5B1B6. These 6 watersheds then further subdivide into 67 sub-watersheds which are themselves further subdivided into 139 mini watersheds (approx. area of 10-30 sq.km.) and 374 micro watersheds (approx. area of 5-10 sq.km.) (Source: Goa State Remote Sensing Centre, Department of Science, Technology and Environment).

River Systems

The region is drained by nine independent rivers flowing generally from East (Western Ghats) to West (the Arabian Sea). An exception is the Sal River in south Goa which follows a north-east to south west course due to the west coast fault.

Terekhol, Mandovi, Zuari, Colvale, Sal, Talpona, Saleri, Canacona and Galgibag are the main nine rivers of Goa. Due to the extent of their drainage areas and the human attraction they hold, these main nine rivers and their 42 tributaries are particularly significant. Between themselves, the Mandovi and Zuari drain 2553 sq km, about 70% of the total geographical area of Goa.

These rivers are a major source of potable water. The surface water system is intimately linked up with their development since they provide irrigation facilities for agriculture, produce biotic and mineral resources, help in the barge-based transport of ore from the mining areas to the port and ferry men and goods to different parts of the state.

Goa’s rivers are unique in that they are both tidal and rainfed. Huge volumes of monsoon water fall within the watershed areas and are then drained out through the major rivers to the sea. But all the rivers are subject to tidal influence to a great distance inwards from their mouth. In some case, the ebb and flow of the tides reach 40km inland. The salinity factor in the river varies sharply between the monsoon and non-monsoon periods, and so

does the quality of water in wells all along the banks, which tends to get increasingly saline as the summer months advance. The rivers pour their water into the Arabian Sea in several areas, completing the hydrological cycle.

The two major riverine plains are those of the Mandovi and the Zuari rivers which between themselves comprise the major alluvial deposits. The Chapora in the North and the Kushavati and Sal river valleys are the locations of the other major riverine plains in Goa.

However, such alluvial plains and valleys can be found in between the plateau regions as well. All these alluvial valleys are areas of rich cultivation with settlements of agricultural populations.

The entire area comprises a distinct ecological zone of the State. It comprises the main paddy-growing areas including the khazans, but excludes the cashew growing areas which are generally found in the higher tracts. Besides paddy, the other principal crop is coconut. Both rice and coconut, together with the fish harvested from the seas and rivers, are essential to the idea of Goa as it has evolved over the centuries. Only the proper and adequate availability of all three elements can continue to bring mental and spiritual peace to the local population.

Besides these rivers, there are numerous wetlands, a few of them man-made, but the rest largely natural. Many of these wetlands are the habitats of a large variety of birds. Some of them are used for purposes of irrigation. The most important of these are the wetlands of Chandor, Raitolem-Curtorim, Panchwadi Carambolim, Chimbel, Mayem, Kakora and Calapur.

From the coastline, if you leave aside a narrow 80 m stretch from the sea, the entire lowlands strip, varying in width from 12 to 15 km, is the most developed part of the State, containing about 80% of the population. This area is densely urbanized.

While the Western Ghat area is now a completely protected zone, this is not the case with the coastal region, which, till 1991, continued to remain the frenzied focus of every new development from five star resorts to aquaculture farms. The Coastal Regulation Zone notification now protects the area from the High Tide Line upto 500 metres.

Within these three ecozones lie a myriad of natural and agro ecosystems, each exhibiting its own unique biodiversity.

State of Natural Ecosystems and Plant/Animal Species: As mentioned earlier, Goa can be divided into three broad ecozones. Within these, there is a wide diversity of ecosystems from the Arabian Sea to the ranges of the Western Ghats. A minimum of 14 distinct ecosystems can be identified, as follows:-

I. Aquatic ecosystems - The natural aquatic ecosystems constitute an important fraction of Goa's habitats and include, the coastal stretch with the associated sandy beaches, rocky beaches and sand dunes, subtidal waters stretching up to the shelf break, rivers and their estuaries, mangroves fringing the estuaries, islands and saline lakes including salt pans. Each one of these is described in brief below.

1. Coastal habitats: The beaches, predominantly sandy, occupy about 4000 ha of area along the north-south coastline. Goa has some of the most beautiful beaches in the world like Morjim, Calangute, Colva and Palolem. The typical sandy beach fauna like crustaceans (a common example is the ghost crab one sees everywhere) and the bivalve molluscs are common in all the beaches. Some of them are unique habitats for some groups as well. For example, the Siridao beach with a sizeable population of the razor clam. The rocky beaches are homes to a variety of other forms of life, especially the marine algae and sedentary organisms like the sponges and coelentrates. The rocky pools within these beaches provide microhabitats for many organisms like snails and sea-anemones. An important component of the sandy beaches in Goa are the sand dunes in

the supralittoral region. These are colonized by a variety of sand binding vegetation, notably *Spinifex littoreus* and *Ipomea pescaprae*.

2. In terms of economic use of biodiversity, the **continental shelf** that extends over 10,000 sq km, is the most important. The entire marine fishery harvest of Goa comes from this region. While about 200 fishes are known from shelf waters of Goa, only few support major fisheries. These include sardines, mackerels, tunas, seerfishes and pomfrets. Important shellfishes of the shelf region are prawns, crabs and mussels. Fish production from the marine waters of Goa is of the order of 70-80,000 tonnes per year, though precise figures are unavailable.

The shelf region has also some patchy coral growth. This occurs around some offshore islands. While the recorded number of coral species (*Porietes lutea*, *Favites* sp. *Turbinaria* sp.and *Astangia* sp.) and their areal cover are quite low, not really enabling them to be designated as ecosystems per se, the coral patches still have a resident fish population typical of rocky bottom.

3. **Lotic freshwater ecosystems:** Since the tidal portion of all the rivers of Goa is estuarine the lotic freshwater part is much in interior and generally the tributaries of Mandovi and Zuari in the foothills of the Western Ghats represent this ecosystem. Between these two rivers, they drain 70% of the geographical spread of Goa. There are smaller freshwater streams which have diversity of algae and freshwater fungi. Still lesser known are the springs and fountains.

4. **The estuarine ecosystem**: This covers nine estuaries of Goa. The sediment transported by the estuaries supports life in varying zones of salinity. The mangroves on the banks of these estuaries in meso and oligohaline zones are important vegetational features. The estuaries are known for fish and shellfish diversity and as refugia of several bird species.

5. Mangrove ecosystem — the mangroves occupy about 2000 ha and occur along both the banks of the seven tidal estuaries and the Cumbarjua canal. Besides being nurseries for a large number of commercially important finfish and shrimps, they are also sites of sustenance for shellfish harvests, especially oysters.

Associate flora and fauna are important components of the mangrove ecosystem as they enhance the productivity and recycling in the system.

The mangrove flora consists of 15 species of 10 genera belonging to 7 families. The dominant mangroves are *Rhizophora mucronata*, *Sonneratia alba* and *Avicennia officinalis*. Major mangroves in Goa are recorded from Mandovi-Cumbajua-Zuari complex with *R. mucronata*, *Kandelia candel* and *S. alba* as dominant species. Chorao Island along the Mandovi estuary has denser mangrove vegetation dominated by *A. officinalis*, *R. mucronata* and *S. alba*. Zuari estuary has about 900 ha of mangrove area with dominant species as *S. alba*, *A. officinalis* and *R. mucronata*.

Mangroves are rare in the upstream region, however *S. caseolaris* and *K. candel* continue to be present. Cumbarjua canal has mudflats on either side with quite dense mangrove vegetation of 200 ha. The southern part of Cumbarjua canal has the dominant species like *Avicennia*, *Rhizophora*, *Sonneratia*, etc.

Kandelia candel, a mangrove that is on the verge of extinction worldwide, appears in abundance along the Mandovi-Zuari complex. *S. caseolaris,* which has limited distribution along the Indian coast, is still found growing in the upstream region of Zuari estuary. The species like *Ceriops tagal* and *Lumnitzera racemosa* occurring along the north central West Coast do not occur in Goa. *Xylocarpus* species, which was reported by Cooke (1908), has completely disappeared from the coast. *Bruguiera gymnorhiza* is rarely seen and can be considered as an endangered species from the Goa coast.

Sea grasses are often associated with mangroves. *Halophila beccarii* and *H. ovata* and *Halodule uninervis* occur in the mangrove-influenced regions. *Galophila ovalis* occurs in sheltered parts (salinity > 30%) of the estuaries

Microbial flora (yeast, bacteria and fungi) play a significant role in the degradation of mangroves' litter. Mangrove environments harbour 50 bacterial strains, mostly grampositive. *Micrococus*, *Brevibacterium* and *Kurthia* have been reported as predominant.

Mangrove environments, though fairly high in primary production, have very few phytoplankton species. These include *Pleurosigma*, *Navicula* and *Nitzchia*, followed by *Bacillaria*, *Coscinioidiscus* and s. *Halophila beccarii* and *H. ovata* and *Halodule uninervis* occur in the mangrove-influenced regions. *Galophila ovalis* occurs in sheltered parts (salinity > 30%) of the estuaries

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Higher marine fungi play significant role in the formation of mangroves detritus. Seventy-six species of higher fungi have been reported from the mangroves of the West Coast.

Benthic macrofauna—Meiofaunal density in the mangrove environments have been reported to range from 3538-111,000/m^2. It is higher during the pre- and post-monsoon periods. Nematodes, especially *Chromadoidae* and *Desmodoride*, account for 80% of the

density, followed by copepods with 7%. Almost 60% of the meiofauna occur in the top 2 cm layer of sediment.

Wood borers—Biodeterioration of mangrove wood is quite severe along the Indian coast. The destruction is caused by 14 mollusc species and one variety of crustacean.

Fishes, shellfishes and crustaceans—105 species of fish, 20 species of shellfish and 229 species of crustaceans have been reported in mangroves of the west coast. Commercially important species include *Meretrix sp*., *Crassostrea sp*., *Peneaus sp*., *Scylla serrata* and *Mugil cephalis*. The commonly cultivated species are *Penaeus monodon, P. indicus*, *Metapenaeus monocerous*, *Mugil cephalus*, *M. persica, Chanos chanos*, *Etroplus suratensis*, and *Lates calarifer*.

Wildlife—Crocodylus palustris, *Varanus sp*., different species of monkeys, otter, fishing cats and snakes are sometimes found in the mangroves. More common are birds like flamingos, herons, storks, sea eagles, kites, kingfishers, sandpipers, tits, bulbuls and whistlers.

6. Riverbank freshwater ecosystem:- Reduces soil erosion and harbours many plant species. **The Island ecosystems**: These are not fairly well studied systems in Goa. There are three categories: 1. Marine 2. Estuarine and 3. Riverine. The island of Anjedive, Grande, Pequeno, Saint George's are well known marine island ecosystems. The estuarine islands are densely populated and include-Chorao, Divar, Corjuem, Juve, Cumbarjuve. The riverine islands are colonized by vegetation and are poorly known being small in size and subjected to erosion. These occur in the rivers of Mahadeyi, Colvale, Tiracol, Talpona and number about 100. Most of these are uninhibited but have dense vegetation.

7. Islands of Goa: There are 36 islands in Goa out of which Tiswadi group of islands are well known. Among the important islands, three are in Terekhol river; eleven

are between Mandovi and Zuari rivers; six are in Arabian Sea area; five are in Zuari river and four in Baga river. Name and location of some islands of Goa is given in Table 5 (Desai, 1976).

8. Offshore Islands of Goa: The important islands off the coast of Goa are Pikene, Grande, Kambariam, St. Jacinto, St. George and Kanko. These islands are detached portions of coastal headlands now isolated from the retrograding coast due to wave action or due to rise of sea-level. According to Feio (1956), the present Marmagao headland was also an island now connected with the mainland by a tombolo. Aerial photographs indicate that the tombolos are under formation connecting the St. Jacinto and Kurmagad islands to the main land (Wagle, 1983).

9. **Lentic ecosystems**: - There are two types-natural and man-made. The natural lakes are found in the Western Ghats area. The manmade lakes, reservoirs, tanks and ponds are scattered in the coastal and the central portion of Goa and include large dams like Selaulim and Anjunem. A well-known lentic freshwater ecosystem is the Carambolim lake in Tiswadi taluka. There are many big tanks in Chandor, Borim, Lotulim, Curtorim villages.

10. **Khazan lands-saline agroecosystems of Goa:** The word 'khazan' stands for saline lands. The khazan lands constitute a unique agro-ecosysytem that has proven its sustainability through centuries of use. Although they are the result of conversion of natural estuarine ecosystems, they do not seriously alter either its physical or living components. Instead, the *khazans* work with existing natural features. Unlike many modern forms of agriculture, the range of agricultural species and varieties adds to the diversity of the estuaries.

11. The tidal estuaries of Goa stretch some 30-km inland. Either side of the estuaries lie *khazans*: saline flood plains that lie below sea level at high tide. Over centuries, Goans

have reclaimed these lands with an intricate system of dykes (bunds) and sluice gates. These barriers prevent salt water from entering the proven its sustainability through centuries of use. Although they are the result of conversion of natural estuarine ecosystems, they do not seriously alter either its physical or living components. Instead, the *khazans* work with existing natural features. Unlike many modern forms of agriculture, the range of agricultural species and varieties adds to the diversity of the estuaries.

Eight of the eleven talukas (sub-districts) in Goa have a total of 17,500 ha under *khazans*. At least 2000 ha (12% of the total) are under dense mangrove vegetation. The mangroves help protect the outside side of the mud and laterite bunds that enclose the *khazan*. The total length of these bunds is about 2000 km.

As a result of careful management of the *khazans*, the estuarine biodiversity has been largely retained and enriched despite population pressure in these areas. The *khazans* have a wide range of indigenous and introduced plant species, many tolerant to salinity. Mussels, clams, oysters, crabs and prawns are harvested seasonally and appear in village markets. The fish and shellfish sustain a large population of indigenous and migratory birds and the 'mugger', or marsh crocodile.

The following economic activities are dependent directly or indirectly on the biodiversity associated with *khazan* lands.

- Agriculture- paddy, ragi, legumes, rainfed and irrigated;
- Horticulture:- Coconut, mango, Cashew
- Horticulture:- Vegetables, tubers, fruits and flowers
- Crude pisciculture
- Organised semi-intensive pisci-culture
- Sluice-gate auction based marginal fisheries

- Backwater fisheries
- Food-processing industry:- toddy, vinegar, dried fish, prawns etc.
- Fuel wood exploitation esp. from fringed mangroves

The Ecosystem services (goods included) rendered by the *khazans*:-

- Genetic resources:- *Khazans* have unique salt-tolerant flora and fauna e.g. Salt-resistant varieties of grasses, shrubs, medicinal plants.
- Biological control:- *Khazans* influence predator-prey balance e.g. insect pests and birds, amphibians and mosquito larvae etc.
- Food production:- *Khazans* provide exploitable edible gross primary production (crops, honey, fish)
- Raw materials:- *Khazans* provide fuel, fodder.
- Refugia:- *Khazans* are habitats of migratory birds.

12. The salt-pan ecosystem:- This is a man-made hypersaline ecosystem from which crude salt is extracted during summer.

Salt-pans in Goa are inundated by tidal waters and monsoon runoff. They undergo three seasonal phases: submerged (June to November), shallow (December to February), and dry (March to June).

13. Myristica Swamps : In Valpoi, Sattari Taluka there is an unique fresh water marshy ecosystem. Here the dominant species of *Myristica malabarica* grows with inverted 'U' shaped roots**.**

II. Terrestrial Ecosystems - Apart from these aquatic ecosystems, there are also the following terrestrial ecosystems:

Grasslands on rocky plateaus Predominantly deep-rooted lithophyte which avoid competition with shallow-rooted plants. It also contains threatened plant species. Eg.,

Alstonia scholaris , Bombax ceiba, Holarrhena antidysenterica. Grasses important for livestock forage, e.g., *Digitaria longiflora, Heteropogon contortus, Iseilema laxum*.

13. Forest ecosystems in Goa:-

Forest types found in Goa

The vegetation of Goa is typical of the Western Ghats (Southern Maharashtra and Karnataka). The narrow coastal plains lead eastwards to hills ascending about 1200 m. With altitudinal zonation the vegetation shows a spectrum of variability from west to east, the gradient being correlated with ascending contours from sea coast to the crest line of the ghats.

The vegetation of Goa can broadly be classified into:

i. Estuarine vegetation consisting of mangrove species; along the narrow muddy banks of rivers.

ii. Strand vegetation along the few coastal belts.

iii. Plateau vegetation confined especially to the low altitude of the ghats.

iv. Semi-evergreen and evergreen forests limited to patches along high altitude of the ghats.

I) ESTUARINE VEGETATION OF MANGROVES ALONG SWAMPY RIVER BANKS: arenarius and Fimristlis schoenoides and grass Spinifex littoreus.

III) PLATEAU VEGETATION ALONG UNDULATING TERRAIN AND HILLS:

A major portion of Goa belongs to this category extending from 50-200 mt. and further divided into two types viz. (a) Open scrub jungle (b) Moist deciduous forests.

a) OPEN SCRUB JUNGLE: This type of vegetation occur from Panaji to Cortalim, Cortalim to Margao and from Bicholim to Sanquelim. *Anacardium occidentale* is cultivated on an extensive scale. Several eroded waste lands sustain patchy vegetation composed of dry deciduous elements such as *Carissa congesta, Hollarrhena*

antidystentrica, Lantana camara, Calycopteris floribunda, Woodfordia fruiticosa, Grewia tilifolia, Vitex negundo and species of *Calogropis, Zizyphus, Cassia, Ixora, Acacia, Albizia, Terminalia* and *Crotalaria*.

b) MOIST MIXED DECIDUOUS FORESTS: This is the main forest type of Goa, covering more than half of the catchment. This type of forests occur around Tudal, Ordofond, Butpal, Molem, Codal, Ambiche Gol near Valpoi, Anmode ghat and Canacona. Predominant species are Terminalia crenulata, T. bellerica, T. paniculata, Lagerstroemia lanecolata, Adina cordifolia, Albizia lebbeck, A. procera, Mitragyna parvifolia Holoptelia integrifolia, Trewia nudiflora, Dillena pentagyna, Semicarpus anacardium, Mallotus philippensis and Stereospermum colais.

c) SECONDARY MOIST MIXED DECIDUOUS FORESTS: This type has formed due to moist conditions resulting in secondary origin of past shifting cultivation. Trees found in this type are knotty and of coppice origin. The main species found are Terminalia crenulata, T. chebula, Adina cordifolia, Alstonia scholaris, Lannea coromandelica, Bombax ceiba, Careya arborea and Dillenia pentagyna. Common associates are Xeromphis spinosa, Ziziphus xylopyrus, Z. caracutta, Calycopoteris floribunda, Helicteres isora and Moullava speicata.

In Goa this vegetation is distributed in a 3 sq.km. area. Botanically, this zone is characterised by peculiar root formations (stilt roots of *Rhizophora, pneumatophores* in *Avicennia,* knee root in *Bruguiera*, etc). These occur mostly in sheltered bays and are found in areas which are covered by salt or brackish water at high tidal streams and borders of lagoons and estuaries more or less protected against heavy wave action and

winds. The main mangrove localities in Goa are Maxem in Canacona, Durbat, Panaji and Akshi, Cortalim.

II) STRAND AND CREEK VEGETATION ALONG COASTAL BELT:

Most of the coastal regions of Goa is rocky with projecting ridges as well as rocky boulders and consequently the strand vegetation is limited to a few patches of narrow strip bordering the Arabian Sea. The vegetation along the south bank of river Mandovi near Panaji belong to this category.

Tree species are: Pongamia pinnata, Thespesia pupulnea, Calophyllum inophyllum, Cerbera manghas and Pandanus tectorius. The other associates such as shrubs are Derris trifoliata and Caesalpinia crista intermixed with herbs Sesuvium portulacastrum, Phylla nudiflora, Arthrocnemum, Melanthera biflora, sedges like Cyperus d) SUB-TROPICAL HILL FORESTS: These forests have formed due to past "Kumeri" cultivation. Spzygium cuminii and Cinnamomum verum are of common occurrence. Caryota urens is the most common palm over such type. In the second story Carvia callosa (Strobilanthes callousus), Elaegnus conferta and Capparis spp. are found. Pseudoxytenanthera is of frequent occurrence.

IV) SEMI EVERGREEN AND EVERGREEN VEGETATION ALONG UPPER GHATS:

a) SEMI-EVERGREEN FORESTS: This type intermingles between the tropical evergreen and the moist deciduous forest mostly above 500m, bordering the contiguous forests of Ratnagiri district, or the North Kanara District in the South. This forest occurs at Amboche gol, Molem, Butpal and Nadquem. Species composition is of Artocarpus hirsutus, A. gomezianus, Calophyllum spp. Sterculia guttata, Kydia calycina, Lagerstroemia microcarpa, Pterospermum diversifolium, Garcinia indica, Diospyros montana and Macranga peltata.

b) LATERITIC SEMI-EVERGREEN FORESTS: The soils are typically lateritic, shallow, dry and open. Xylia xylocarpa is the prominent tree species of this type with other associates like Pterocarpus marsupium, Grewia tillifolia, Terminalia paniculata, Schleichera oleosa, Careya arborea, Bridelia retusa and Strychnos nux-vomica. The ground flora is typically represented by Calycop-teris floribunda and Holarrhena pubescens.

a) c) EVERGREEN FORESTS: In deep gorges and depressions, along the nallahs and streams, with congenial soil and moisture conditions the evergreen species occur. The evergreen species occur with a composition of *Calophyllum inophyllum, Garcinia indica, Canarium strictum, Lophopetalium wightianum, Myristica spp., Knema altenuata, Chroisophyllum acuminata, Palaquium ellipticum, Artocarpus gomezianus, Mangifera indica, Persea macrantha, Mimusops elengi, Hopea, Wightianum, Olea diocia, Hydnocarpus laurifolia, Syzygium cumini, Holigarna arnotiana, Litsea coriacea, Carallia brachiata, Mallotus philippensis, Ficus spp.*

14. The cave ecosystem:- There are natural and man-made caves in Goa which have troglobic communities which are not well known. A rare amblypygid (*Phrinycus phipsoni*) has been recently reported from one such cave in Goa. The Chiropteran segment of the cave fauna is also underexplored.

Political history of Goa - It is well-known that the Portuguese captured Goa in 1510 and continued to rule the State till 1961. Thereafter Parliament amended the Constitution (in early 1962) and Goa, together with Daman and Diu (the other Portuguese enclaves), became a centrally administered Union Territory of India. A Lieutenant Governor was sworn in and an informal 'Consultative Council' of 29 members was constituted on September 24, 1962. It advised the Union Government till the first popular elections were held in 1964. Thereafter, Goa, Daman and Diu had a common legislative assembly of 30 members headed by a Chief Minister.

In 1987 in official language status being conferred on Konkani and co-language, non-official status for Marathi. on May 30, 1987 when Goa became the 25th full-fledged State of the Indian Union. Since the elections in 1989, the State has had a 40-member assembly with full legislative powers.

Traditional Methods of Governance: Comunidades

One unique feature of Goa is its still existing system of the Comunidades which does not exist in any other part of the country. Many political dynasties have ruled Goa since the Mauryan period, but it was the continuity of the self-governed village institutions called the 'village gaunkaris' which survived the political, religious, social and ecological turmoils. The term 'Gaunkari' has been derived from 'Ganv' (village). The 'essence' of a 'Ganv' was in 'gaunvpon' (=sense of belonging to the village). The Portuguese replaced these terms with 'comunidades' meaning 'village communities'.

The comunidades were actually the custodians of Goa's natural resources and biodiversity for more than 3000 years. The institution of the comunidade, which had much to commend it, is nowadays in a state of irreversible decline and hence offers only passing historical interest, though it may also give some indications as to how natural resources could be sustainably managed at the level of the community.

There are at present 226 comunidades in Goa spread over its eleven talukas. While they own only 14% of the cultivable land in this territory, they are significant as far as paddy cultivation is concerned. According to available statistics in three talukas of Ilhas, Salcette and Bardez having the largest paddy area, the comunidades hold over 55% of land (Ilhas - 55%, Salcette - 51% and Bardez - 56%). In Marmagao taluka, where the total paddy area available is 1019 ha, the comunidades have 62% land.

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Ecology –

Broadly speaking, there are three main physical divisions or ecozones: the mountainous region of the Sahyadris in the east, the middle level plateaus in the centre and the low-lying river basins, and the coastal plains. Of these, naturally, the least known is the Western Ghat region, which runs from north to south but in the hinterland. The most visible or well-known part is the coastal belt which runs as a strip from north to south. Sandwiched in between is the midland region, apparently nondescript, but nevertheless with its own significant ecological and cultural characteristics and the focus of much of the State's industrial development.

The second ecozone (the central strip) consists, by and large, of plateaus at varying levels, not exceeding about 100 metres and not less than 30 metres in height. While apparently nondescript, this 'midland' portion nevertheless has significant ecological and cultural characteristics, often in sharp contrast to coastal Goa. The plateaus are a characteristic feature of Goa; the tops are fairly level but in many areas deeply notched by gullies. The

plateau rims are noticeably sharp. A scarp slope usually marks the quick transition to the alluvial plain below.

Wherever the plateaus meet the coastline they end in headlands: in the north of Goa, the Aguada, the Cabo and Mormugao heights are good examples of this.

Not unnaturally, the historic forts of Goa's defence were all strategically situated on such headlands. Today they lie largely in ruins. The vegetation topping the plateaus and their laterite cover is comprised mainly of various species of scrub and rough grass due to the very poor shallow soil. There is more intense vegetation, both natural and cultivated, along the scarp faces and in the hollows of the gullies. This includes good strands of typical monsoon forest. The gullies have numerous springs which feed the rivers down below.

As the Gazetteer of Goa describes it: 'The laterite plateau with clumps of grass and thinly spread cashew shrubs, often with a church or a cross perched, skirted by greenery of coconut palms and natural growth, deeply entrenched notches of low grounds with betel and coconut gardens, the kulagars and the plateau base sharply merging into the alluvial flats below, form a recurrent theme in the landscape of most of central and coastal Goa.'

The more prominent of the group are the plateau lands of Pernem, Mopa, Morgim, Assonora (North), Ponda and Cundaim, and Betul, Sanvordem and Quepem (South). Associated towns include Assonora, Bicholim, Ponda and Quepem. The plateaus like Verna, Kundaim, Marcaim, Pilerne-Saligao were converted into industrial estates, whereas dense settlements have come up at Porvorim, Bambolim-Donapaula plateaus. The plateaus display a large biodiversity of plants, especailly grasses, shrubs, herbs, insects, amphibians, reptiles and birds and are known for many species of wildflowers.

This part of Goa contrasts with coastal Goa in more ways than one. While the coastlands carry a Westernised landscape, this is a region of Hindu iconographies, expressed in numerous shrines and temples, the most important of which are the shrines of Mangueshi and Shantadurga.

The third distinct ecological component of the Goa bioregion—after the Western Ghat area and the lateritic plateaus—comprises the alluvial lowlands and coasts. The former comprise the stretches of rivers which have over the centuries received the eroded material from the higher levels of the Sahyadris.

The two major riverine plains are those of the Mandovi and the Zuari rivers which between themselves comprise the major alluvial deposits. The Chapora in the North and the Kushavati and Sal river valleys are the locations of the other major riverine plains in Goa. However, such alluvial plains and valleys can be found in between the plateau regions as well. All these alluvial valleys are areas of rich cultivation with settlements of agricultural populations.

The entire area comprises a distinct ecological zone of the State. It comprises the main paddy-growing areas including the khazans, but excludes the cashew growing areas which are generally found in the higher tracts. Besides paddy, the other principal crop is coconut. Both rice and coconut, together with the fish harvested from the seas and rivers, are essential to the idea of Goa as it has evolved over the centuries. Only the proper and adequate availability of all three elements can continue to bring mental and spiritual peace to the local population.

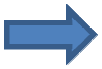
Besides these rivers, there are numerous wetlands, a few of them man-made, but the rest largely natural. Many of these wetlands are the habitats of a large variety of birds. Some

of them are used for purposes of irrigation. The most important of these are the wetlands of Chandor, Raitolem-Curtorim, Panchwadi Carambolim, Chimbel, Mayem, Kakora and Calafur.

From the coastline, if you leave aside a narrow 80 m stretch from the sea, the entire lowlands strip, varying in width from 12 to 15 km, is the most developed part of the State, containing about 80% of the population. This area is densely urbanized.

While the Western Ghat area is now a completely protected zone, this is not the case with the coastal region, which, till 1991, continued to remain the frenzied focus of every new development from five star resorts to aquaculture farms. The Coastal Regulation Zone notification now protects the area from the High Tide Line upto 500 metres.

Within these three ecozones lie a myriad of natural and agro ecosystems, each exhibiting its own unique biodiversity. (Extracts from State Biodiversity Action Plan – Goa Foundation)

Appendix II - Elevation Points in study Area around VPPDF						
LAT	**LONG**	**ALT - Meters**		**LAT**	**LONG**	**ALT - Meters**
15.532204	73.835493	66	**Contd. on next columns** 	15.52761	73.829467	64
15.535083	73.845189	0		15.532971	73.828661	44
15.530129	73.840648	28		15.534578	73.828724	56
15.527934	73.831178	65		15.537337	73.833376	55
15.526519	73.821965	21		15.533991	73.835003	55
15.522147	73.822498	55		15.530064	73.835711	60
15.523147	73.82792	60		15.523411	73.836847	62
15.525169	73.835698	63		15.515973	73.838207	69
15.526582	73.844287	49		15.509929	73.839201	30
15.530217	73.856216	0		15.50075	73.840876	1
15.525873	73.858808	6		15.502218	73.845486	1
15.523613	73.850201	2		15.510378	73.84404	1
15.521752	73.841923	7		15.519298	73.842712	19
15.52109	73.838466	18		15.521743	73.84243	13
15.520025	73.833574	60		15.527538	73.841909	60
15.519604	73.829286	62		15.538389	73.840702	0
15.518891	73.824874	30		15.540957	73.840075	1
15.518343	73.821051	27		15.541551	73.844143	3
15.512338	73.822425	52		15.532678	73.845791	0
15.513658	73.82997	49		15.525904	73.845998	14
15.514433	73.834902	58		15.518868	73.846499	4
15.514704	73.838217	59		15.512021	73.846863	6
15.515456	73.841352	52		15.516162	73.852243	6
15.516411	73.844755	20		15.528718	73.850448	0
15.517493	73.849263	9		15.538043	73.848451	38
15.510744	73.850237	6		15.533561	73.85312	3
15.509948	73.843706	5		15.528308	73.853599	2
15.508166	73.838609	53		15.519656	73.854701	9
15.507528	73.833184	34		15.516311	73.85931	5
15.507131	73.827833	38		15.516478	73.859268	5
15.507148	73.823649	3		15.516724	73.859181	5
15.504018	73.82412	1		15.517025	73.859139	5
15.504682	73.82976	1		15.5172	73.859136	5
15.504451	73.838066	1		15.517448	73.859011	5
15.505091	73.841643	1		15.517826	73.858625	6
15.505104	73.841728	1		15.518315	73.858529	6
15.506099	73.847016	1		15.518651	73.858603	6
15.5029	73.84511	1		15.518958	73.858762	6
15.50091	73.836125	1		15.523527	73.858609	1
15.500759	73.831843	2		15.530837	73.857951	0
15.503886	73.832691	1		15.531903	73.860337	0
15.507451	73.831925	5		15.524645	73.862036	3
15.513911	73.832143	22		15.519452	73.862378	4
15.519568	73.831156	63				

Appendix III

रजिस्ट्री सं० डी० एल०-33004/99 REGD. NO. D. L.-33004/99

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अधिसूचना

नई दिल्ली, 24 फरवरी, 2015

का.आ. 607(अ).—भारत सरकार के तत्कालीन पर्यावरण और वन मंत्रालय ने एक प्रारूप अधिसूचना संख्यांक का.आ. 634(अ) तारीख 3 मार्च, 2014 भारत के राजपत्र, असाधारण में प्रकाशित किया था, जिसमें डॉ. सलीम अली पक्षी अभयारण्य के चारों ओर पारिस्थितिकीय संवेदी जोन को प्रस्तावित किया गया, जिस के द्वारा उन सभी व्यक्तियों से, जिनके उससे प्रभावित होने की संभावना थी, उस तारीख से, जिसको भारत के राजपत्र में प्रकाशित रूप में उक्त अधिसूचना की प्रतियां जनता को उपलब्ध करा दी गई थीं, साठ दिन की समाप्ति के पूर्व आपेक्ष और सूझाव मांगे गए थे ;

और, उक्त अधिसूचना को अंतर्विष्ट करने वाले राजपत्र की प्रतियां 3 मार्च, 2014 को जनता को उपलब्ध कराई गई थीं ;

और प्रारूप अधिसूचना के जवाब में सभी व्यक्तियों तथा पणधारियों से प्राप्त सभी आक्षेपों और सुझावों पर केन्द्रीय सरकार द्वारा सम्यक रूप से विचार कर लिया गया है ;

और, अब केन्द्र सरकार समझती है डॉ. सलीम अली पक्षी अभयारण्य (जिसे इसमें इसके पश्चात् अभयारण्य कहा गया है), गोवा राज्य के उत्तरी जिले में 15^0 31' 36.03'' उत्तर और 15^0 30' 35.35'' उत्तर अक्षांश तथा 73^0 52' 14.31'' पूर्व और 73^0 50' 44.12''पूर्व देशांतर के बीच स्थित है और 1.78 वर्ग किलोमीटर के क्षेत्र में फैला हुआ है, जो मापुसा नदी और मांडोवी नदी के संप्रवाह पर समृद्ध मैंग्रोव का निर्माण करती है;

और, अभयारण्य, विविध उभयचरों, उद्विलावों, घड़ियालों, विविध प्रकार की मछली, जलचर पक्षियों, सहारा पक्षियों और वृक्षवासी पक्षियों और सर्पणशाली, भोज्य चमगादड़ (चमगीदड़ जोड-बंध), प्रवासी पक्षियों, खगेश सारस पक्षियों का अनन्य आश्रय है और उत्साही पक्षी जैसे ओस्प्रे संरक्षित क्षेत्र में वार्षिक रूप से प्रवास करते हैं;

और, इस अभयारण्य के मैंग्रोव वन उपजाऊ भूमि को बांधते है और बह जाने से संरक्षित करते हैं; और, उक्त वन्य जीव प्रजातियों के लिए आश्रय स्थल और प्रजनन के लिए अति सुन्दर स्थल प्रदान करते हैं;

अतः, यह आवश्यक है कि डॉ. सलीम अली पक्षी अभयारण्य के चारों ओर के संरक्षित क्षेत्र को पारस्थितिकी और पर्यावरण के दृष्टिकोण से एक पारिस्थितिक संवेदी क्षेत्र के रूप में संरक्षित और संधारित किया जाए; जिसकी विस्तार एवं सीमाएं, इस अधिसूचना के पैरा 1 में निर्दिश्ट हैं और उद्योगों अथवा उद्योगों के वर्गों के संचालनों तथा प्रक्रियाओ को कथित पारिस्थितिक संवेदी क्षेत्र मे प्रतिशेध किया जाए;

और, अब, केन्द्रीय सरकार, पर्यावरण (संरक्षण) नियम, 1986 के नियम 5 के उपनियम (3) के साथ पठित पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) की धारा 3 की उप-धारा (1), उप-धारा (2) के खंड (v) और खंड (xiv) और उप-धारा (3) द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए, गोवा राज्य में डॉ. सलीम अली पक्षी अभयारण्य की परिधि के तीन ओर से लगने वाली नदी के किनारे तक और पूर्व में अभयारण्य से चोराव ग्राम की ओर 100 मीटर के क्षेत्र को पारिस्थितिक संवेदी जोन के रूप में अधिसूचित करती है, जिसका विवरण निम्नानुसार है, अर्थात् :--

1. पारिस्थितिक संवेदी जोन का विस्तार और उसकी सीमाएं--(1) पारिस्थितिक संवेदी जोन का विस्तार गोवा राज्य में डॉ. सलीम अली पक्षी अभयारण्य की परिधि के तीन ओर से लगने वाली नदी के किनारे तक और पूर्व में अभयारण्य से चोराव ग्राम की ओर सौ मीटर तक होगा ।

(2) पारिस्थितिक संवेदी जोन तीन ओर से अर्थात् उत्तर, पश्चिम और दक्षिण की ओर से, मापूसा नदी और मन्दोवी नदी से सीमाबद्ध है तथा पूर्व की ओर से तिसवाड़ी तालुक का चोराओ ग्राम स्थित है ।

(3) पारिस्थितिक संवेदी जोन की सीमा का मानचित्र इस अधिसूचना के साथ **उपाबंध 1** के रूप में दिया गया है तथा पारिस्थितिक संवेदी जोन की सीमा पर प्रमुख स्थलों के अक्षांश और देशांतर की सूची इस अधिसूचना के साथ **उपाबंध 2** पर यथारूप में दी गई है ।

(4) पारिस्थितिक संवेदी जोन की सीमा के भीतर आने वाले ग्रामों की सूची **उपाबंध 3** पर दी गई है ।

(5) उपाबंध 3 में दिए गए ग्रामों की सूची को राज्य सरकार द्वारा जोनल मास्टर प्लान तैयार करते समय और देखे जाने के लिए तथा पुष्टि के लिए दी गई है ।

2. पारिस्थितिक संवेदी जोन के लिए जोनल मास्टर प्लान--(1) पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय, भारत सरकार के विचार और अनुमोदन के लिए पारिस्थितिक संवेदी जोन के प्रभावी प्रबंधन के प्रयोजन हेतु राज्य सरकार, राजपत्र में इस अधिसूचना के अंतिम प्रकाशन की तारीख से दो वर्ष की अवधि के भीतर स्थानीय व्यक्तियों के परामर्श से जोनल मास्टर प्लान तैयार करेगी । जोनल मास्टर प्लान, राज्य सरकार के सभी संबंधित विभागों, जैसे पर्यावरण, वन और वन्य जीव, कृषि, राजस्व, शहरी और आवास विकास, पर्यटन, ग्रामीण विकास, सिंचाई और बाढ़ नियंत्रण, खनन और लोक निर्माण विभाग, की सहभागिता से, उक्त योजना में पारिस्थितिक और पर्यावरणीय प्रतिफलों को एकीकृत करते हुए तैयार किया जाएगा ।

(2) जोनल मास्टर प्लान में अवकृष्ट क्षेत्रों के जीर्णोद्धार, विद्यमान जल निकायों के संरक्षण, आवाह क्षेत्रों के प्रबंधन, जलसंभरों के प्रबंधन, भूतल जल के प्रबंधन, मिट्टी और नमी संरक्षण, स्थानीय समुदायों की आवश्यकताओं तथा पारिस्थितिकी व पर्यावरण से संबंधित ऐसे अन्य पहलूओं, जिन पर ध्यान देना आवश्यक है, के लिए उपबंध होंगे ।

(3) जोनल मास्टर प्लान सभी विद्यमान और प्रस्तावित शहरी बंदोबस्त, ग्रामीण बंदोबस्त, वनों के किस्म, कृषि क्षेत्र, उद्यान-कृषि क्षेत्र, मानव द्वारा निर्मित विरासत और स्थलों, नैंसर्गिक विरासत स्थलों, चालू खनन पट्टे, झीलों और अन्य जलाशयों का अभ्यंकन करेगा ।

(4) पारिस्थितिक संवेदी जोन के लिए इस प्रकार तैयार जोनल मास्टर प्लान को गोवा राज्य के क्षेत्रीय प्लान में समेकित किया जाएगा ।

(5) जोनल मास्टर प्लान इस अधिसूचना के उपबंधों के अधीन पैरा 4 के स्तंभ (2) में निर्दिष्ट कृत्यों के पालन के लिए राज्य स्तर की पारिस्थितिक संवेदी जोन मानीटरी समिति के लिए एक संदर्भ दस्तावेज होगा ।

(6) इस प्रकार तैयार किया गया जोनल मास्टर प्लान क्षेत्रीय विकास प्लान के सहविस्तारी होगा ।

(7) जोनल मास्टर प्लान इस अधिसूचना के उपबंधों के अधीन अपने कृत्यों की मानीटरी को पूरा करने के लिए राज्य स्तरी पारिस्थितिकी संवेदी मानीटरी समिति (जिसे इसमें इसके प चात् रा.स्त.पा.सं.मा.स. कहा गया है), पैरा 5 में यथा संदर्भित के लिए निर्दे ा दस्तावेज होगा ।

3. राज्य सरकार द्वारा किए जाने वाले उपाय- राज्य सरकारें इस अधिसूचना के उपबंधों को प्रभाव देने के लिए निम्नलिखित उपायों को करेंगी, अर्थात् :-

(1) पारिस्थितिक संवेदी जोन में, वनों, उद्यान-कृषि क्षेत्रों, कृषि क्षेत्रों, उद्यानों और खुले स्थानों, जो आमोद-प्रमोद के प्रयोजन के लिए निश्चित किए गए हैं, का वाणिज्यिक उपयोग या उद्योग संबंधित विकास क्रियाकलापों के लिए भू-उपयोग में संपरिवर्तन अनुज्ञेय नहीं होगा :

परंतु कृषि योग्य भूमि का पारिस्थितिक संवेदी जोन के भीतर संपरिवर्तन, राज्य स्तरीय पारिस्थितिक संवेदी जोन मानीटरी समिति की सिफारिश पर, और राज्य सरकार के पूर्व अनुमोदन से, स्थानीय निवासियों की आवासीय जरूरतों को पूरा करने के लिए, पैरा 4 की सारणी के स्तंभ (2) में यथा विनिर्दिष्ट संबंधित क्रमशः मद सं0 24, सं0 26, सं0 28 और सं0 31 को पूरा करने के लिए ही अनुज्ञात होगा, अर्थात्: -

(i) लघु स्तरीय उद्योग जो प्रदूषण कारित नहीं करते हैं,

(ii) वर्षा जल संचयन, और

(iii) कुटीर उद्योग जिसके अंतर्गत ग्रामीण उद्योग भी हैं,

(iv) पारिस्थितिक रूप से अनुकूल पर्यटन क्रियाकलापों के लिए पारिस्थितिक रूप से अनुकूल कोटेज जो अस्थायी रूप से पर्यटकों के अधिभोग के लिए हों जैसे टेंट, लकड़ी के घर, आदि :

परंतु यह और कि जनजातीय भूमि का उपयोग राज्य सरकार के पूर्व अनुमोदन और भारत के संविधान के अनुच्छेद 244 अथवा तत्समय प्रवृत्त विधि के उपबंधों, जिसके अंतर्गत अनुसूचित जनजाति और अन्य परंपरागत वन निवासी (वन अधिकारों की मान्यता) अधिनियम, 2006 (2007 का 2) भी है, के अनुपालन के बिना संपरिवर्तन अनुज्ञात नहीं होगा ।

परंतु यह भी कि पारिस्थितिक संवेदी जोन के भीतर भू अभिलेखों में प्रकट होने वाली किसी त्रुटि को राज्य सरकार द्वारा राज्य स्तरीय पारिस्थितिक संवेदी मानीटरी समिति के विचार प्राप्त करने के पश्चात् संशोधित किया जाएगा, जो प्रत्येक मामले में केवल एक बार ही होगा और उक्त त्रुटि का संशोधन केन्द्रीय सरकार के पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय को सूचित किया जाएगा :

परंतु यह और कि किसी मामले में उपरोक्त त्रुटि का सुधार करने में भू-प्रयोग में परिवर्तन सम्मिलित नहीं होगा सिवाय उस दशा के जैसा कि इस उप पैरा में उपबंधित किया गया है ।

(2) सभी जलस्रोतों के आवाह क्षेत्र की पहचान की जाएगी और उनमें से जो अपनी प्राकृतिक संरचना में सूख रहे हैं, उनके संधारण तथा नवीकरण की योजना जोनल मास्टर प्लान में सम्मलित की जाएगी और उन क्षेत्रों में या उनके निकटवर्ती क्षेत्रों में विकास क्रियाकलापों को प्रतिषिद्ध करने के लिए राज्य सरकार द्वारा नियमनिष्ठ मार्गदर्शक सिद्धांत बनाए जाएंगे ।

(3) पारिस्थितिकी संवेदी जोन के भीतर पर्यटन से संबंधित क्रियाकलाप जो जोनल मास्टर प्लान का हिस्सा होंगे निम्नानुसार है, अर्थात्-

(क) पारिस्थितिक संवेदी जोन के भीतर सभी नए पर्यटन क्रियाकलापों या विद्यमान पर्यटन क्रियाकलापों का प्रसार पारिस्थितिक पर्यटन, पारिस्थितिक-शिक्षा और पारिस्थितिक विकास तथा पारिस्थितिक संवेदी जोन की वहन क्षमता पर आधारित अध्ययन पर जोर देते हुए भारत सरकार पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय और राष्ट्रीय व्याघ्र संरक्षण प्राधिकरण के माध्यम से केन्द्रीय सरकार द्वारा जारी मार्गदर्शक सिद्धांतों के अनुसार होगा ;

(ख) पारिस्थितिक संवेदी जोन के भीतर नया संनिर्माण अनुज्ञात नहीं होगा सिवाय पर्यटकों के अस्थायी अधिभोग के लिए पारिस्थितिक के अनुकूल आवास जैसे टेंट, लकड़ी के घर, छप्पर की छत और पारिस्थतिक के अनुकूल पर्यटन क्रियाकलापों के लिए :

(ग) जोनल मास्टर प्लान के अनुमोदन होने तक, पर्यटन के लिए विकास और विद्यमान पर्यटन क्रियाकलापों का विस्तार को संबंधित विनियामक प्राधिकारियों द्वारा अनुज्ञात किया जाएगा जो राज्य स्तरीय पारिस्थितिक संवेदी जोन मानीटरी समिति की सिफारिश और स्थल की वास्तविक रूप से विनिर्दिष्ट संवीक्षा पर आधारित होगा ।

(4) पारिस्थितिक संवेदी जोन में मूल्यवान नैसर्गिक विरासत की पहचान की जाएगी और जोनल मास्टर प्लान में सम्मिलित किया जाएगा; सभी जीन पूल के लिए आरक्षित क्षेत्र, चट्टान विरचनाएं, जल प्रपातों, झरनों, घाटी मार्गों, उपवनों, गुफाएं, स्थलों,

भ्रमण, अश्वारोहण, खड़ी चट्टानों आदि को परिरक्षित किया जाएगा ; उनके संरक्षण और संधारण के लिए इस अधिसूचना के प्रकाशन की तारीख से छह मास के भीतर उपयुक्त प्लान बनाएगी और ऐसे प्लान बनाया जाएगा और ऐसे प्लान जोनल मास्टर प्लान के भाग होंगे ।

(5) पारिस्थितिक संवेदी जोन में भवनों, संरचनाओं, शिल्प-तथ्यों, क्षेत्रों और ऐतिहासिक, वास्तु-शिल्पीय, सौन्दर्य विषयक और सांस्कृतिक महत्व की प्रसीमाओं की पहचान की जाएगी और उनके संरक्षण के लिए इस अधिसूचना के प्रकाशन की तारीख से छह मास के भीतर प्लान बनाया जाएगा और जोनल मास्टर प्लान में सम्मिलित किया जाएगा ।

(6) राज्य सरकार का पर्यावरण विभाग, वायु (प्रदूषण निवारण और नियंत्रण) अधिनियम, 1981 (1981 का 14) के उपबंधों तथा उसके तहत बने नियमों के अनुसार, पारिस्थितिक संवेदी जोन में, ध्वनि प्रदूषण के नियंत्रण के लिए मार्गदर्शक सिद्धांत और विनियम की विरचना करने वाला प्राधिकरण होगा ।

(7) राज्य सरकार का पर्यावरण विभाग, वायु (प्रदूषण निवारण और नियंत्रण) अधिनियम, 1981(1981 का 14) के उपबंधों तथा उसके तहत बने नियमों के अनुसार, पारिस्थितिक संवेदी जोन में, वायु प्रदूषण के नियंत्रण के लिए मार्गदर्शक सिद्धांत और विनियम की विरचना करने वाला प्राधिकरण होगा ।

(8) पारिस्थितिक संवेदी जोन में उपचारित बहिस्राव जल का निस्सारण जल (प्रदूषण निवारण तथा नियंत्रण) अधिनियम, 1974 (1974 का 6) के उपबंधों तथा उसके तहत बने नियमों के अनुसार होगा ।

(9) ठोस अपशिष्टों का निपटान निम्नानुसार किया जाएगाः-**(i)** पारिस्थितिक संवेदी जोन में ठोस अपशिष्ट का निपटान समय-समय पर यथा संशोधित अधिसूचना सं. का.आ. 908(अ) तारीख 25 सितंबर, 2000 द्वारा केन्द्रीय सरकार के तत्कालीन पर्यावरण मंत्रालय द्वारा प्रकाशित नगरपालिक ठोस अपशिष्ट (प्रबंध और हथालन) नियम, 2000 के उपबंधों के अनुसार किया जाएगा;

(ii) स्थानीय प्राधिकरण जैव निम्नीकरणीय और अजैव निम्नीकरणीय संघटकों में ठोस अपशिष्टों के संपृथकन के लिए योजनाएं तैयार करेंगे ;

(iii) जैव निम्नीकरणीय सामग्री को अधिमानतः खाद बनाकर या कृमि खेती के माध्यम से पुनःचक्रित किया जाएगा ;

(iv) अकार्बनिक सामग्री का निपटान किसी पर्यावरणीय स्वीकृत रीति में होगा ।

(10) पारिस्थितिक संवेदी जोन में जैव चिकित्सीय ठोस अपशिष्ट का निपटान समय-समय पर यथा संशोधित अधिसूचना सं. का.आ. 630 (अ) तारीख 20 जुलाई, 1998 द्वारा केन्द्रीय सरकार के तत्कालीन पर्यावरण और वन मंत्रालय द्वारा प्रकाशित जैव चिकिसीय अपशिष्ट (प्रबंध और हथालन) नियम, 1998 के उपबंधों के अनुसार किया जाएगा ;

(11) परिवहन की यानीय क्रियाकलाप आवास के अनुकूल विनियमित होंगे और इस संबंध में जोनल मास्टर प्लान में विशेष उपबंध अधिकथित किए जाएंगे और जोनल मास्टर प्लान के तैयार होने और पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय के अनुमोदन के दौरान, राज्य स्तरीय पारिस्थितिक संवेदी जोन मानीटरी समिति यानीय गतिविधियों को विद्यमान नियमों और विनियमों के अनुसार मानीटर करेगी ।

4. पारिस्थितिक संवेदी जोन में प्रतिषिद्ध या विनियमित किए जाने वाले क्रियाकलापों की सूची - पारिस्थितिक संवेदी जोन में सभी क्रियाकलाप पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) के उपबंधों द्वारा शासित होंगे और नीचे दी गई सारणी में विनिर्दिष्ट रीति में विनियमित होंगे, अर्थात् :--

सारणी

क्रम सं.	**क्रियाकलाप**	**टिप्पणी**
(1)	(2)	(3)
प्रतिषिद्ध क्रियाकलाप		
1.	वाणिज्यिक खनन, पत्थर की खदान और उनको तोड़ने की इकाइयां	सभी प्रकार के खनन (लघु और वृहत खनिज), पत्थर की खानें और उनको तोड़ने की इकाइयां का तत्काल प्रभाव से प्रतिषेध है।
2.	आरा मशीनों की स्थापना ।	लागू कानून के तहत अन्यथा प्राविधित को छोड़कर प्रतिशिद्ध।

3.	जल या वायु या मृदा या ध्वनि प्रदूषण करने वाले उद्योगों की स्थापना करना ।	लागू कानून के तहत अन्यथा प्राविधित को छोड़कर प्रतिशिद्ध।
4.	वाणिज्यिक होटल और सैरगाह की स्थापना करना ।	पारिस्थितिक संवेदी जोन में तत्काल प्रभाव से कोई नया वाणिज्यिक होटल और सैरगाह प्रतिषिद्ध होंगे ।
5.	जलाने के उपयुक्त लकड़ी का वाणिज्यिक उपयोग ।	लागू कानून के तहत अन्यथा प्राविधित को छोड़कर प्रतिशिद्ध।
6.	नए बृहत जल विद्युत परियोजना का स्थापना	पारिस्थितिक संवेदी जोन में नए जल विद्युत परियोजना संयंत्रों (बांध, सुरंग बनाने और जलाशय के संनिर्माण) की स्थापना और विद्यमान संयंत्रों के विस्तार के सिवाय सूक्ष्म जल विद्युत परियोजनाओं (100 किलोवाट तक) या लघु विद्युत परियोजनाओं (101 किलोवाट से 2000 किलोवाट तक), जो स्थानीय समुदायों की ऊर्जा की आवश्यकताओं को पूरा करेगी, संबधित ग्राम सभा और अन्य आवश्यक अनापत्तियों के अध्यधीन रहते हुए प्रतिषिद्ध होगी ।
7.	किसी खतरनाक पदार्थ का प्रयोग या उत्पादन	लागू कानून के तहत अन्यथा प्राविधित को छोड़कर प्रतिशिद्ध।
8.	प्राकृतिक जल निकायों या सतही क्षेत्र में अनुपचारित बहिर्स्राव और ठोस अपशिष्टों का निस्सारण	लागू कानून के तहत अन्यथा प्राविधित को छोड़कर प्रतिशिद्ध।
9.	नई लकड़ी आधारित उद्योग	पारिस्थितिक संवेदी जोन की सीमाओं के भीतर नई लकड़ी पर आधारित उद्योगों की स्थापना प्रतिषिद्ध होगी ।
10.	संनिर्माण क्रियाकलाप	पारिस्थितिक संवेदी जोन में सिवाय, स्थानीय निवासियों की घरेलू आवश्यकताओं, जिसके अंतर्गत मद संख्या 26 मद संख्या 28 और मद संख्या 31 में सूचीबद्ध क्रियाकलाप भी हैं, किसी प्रकार का नया संनिर्माण तत्काल प्रभाव से प्रतिषिद्ध होगा और मद संख्या 24 में सूचीबद्ध क्रियाकलाप के मामले में संनिर्माण क्रियाकलापों को विनियमित करते हुए उन्हें न्यूनतम स्तर पर रखा जाएगा ।
11.	प्लास्टिक के थैलों का उपयोग	लागू कानून के तहत अन्यथा प्राविधित को छोड़कर प्रतिशिद्ध।
12.	भट्ठे	लागू कानून के तहत अन्यथा प्राविधित को छोड़कर प्रतिशिद्ध।
विनियमित क्रियाकलापः		
13.	वृक्षों की कटाई	(क)राज्य सरकार के सक्षम प्राधिकारी की पूर्व अनुमति के बिना वन या सरकारी या राजस्व या निजी भूमि पर वृक्षों की कटाई नहीं की जाएगी ; (ख) संबंधित केंद्रीय अधिनियम या राज्य अधिनियम और उसके अधीन बनाए गए नियमों के उपबंधों के अनुसार वृक्षों की कटाई विनियमित की जाएगी ।
14.	वाणिज्यिक जल संसाधन जिसके अंतर्गत भूजल संचयन भी है ।	(क) भूमि के अधिभोगी की वास्तविक कृषि और घरेलू खपत के लिए जल का निष्कर्षण सतही और भूमिगत जल अनुज्ञात होगा ; (ख) औद्योगिक या वाणिज्यिक उपयोग के लिए सतही और भूमिगत जल का निष्कर्षण, जिसके अंतर्गत निष्कर्षण किए जा सकने वाले जल की मात्रा भी है, के लिए संबंधित विनियामक प्राधिकरण की पूर्व लिखित अनुमति अपेक्षित होगी ; (ग) सतही या भूजल का कोई विक्रय अनुज्ञात नहीं होगा ; (घ) जल के संदूषण या प्रदूषण, जिसके अंतर्गत कृषि भी है, को रोकने के लिए सभी उपाय किए जाएंगे ।
15.	बिजली के तारों और दूर संचार टावरों का संनिर्माण ।	अंडरग्राउंड केबिलिंग को बढ़ावा देना ।
16.	विद्यमान होटलों और विश्रमालयों के परिसरों पर बाड़ लगाना	लागू नियमों के तहत विनियमित।

17.	विद्यमान सड़कों को चौड़ा करना और उन्हें सुदृढ करना तथा नई सड़कों का संनिर्माण	उचित पर्यावरण समाघात निर्धारण और उसमें कमी करने के लिए के लागू होने वाले उपायों के अनुसार करना होगा ।
18.	रात्रि में यानिक यातायात का संचलन	वाणिज्यिक प्रयोजन के लिए लागू नियमों के तहत विनियमित।
19.	विदेशी प्रजातियों का प्रवेश	लागू नियमों के तहत विनियमित।
20.	पर्यटन संबंधी क्रियाकलापों जैसे राष्ट्रीय उद्यान क्षेत्र के ऊपर गर्म हवा के गुब्बारों द्वारा उड़ान भरना, आदि व्यापारिक कार्य ।	लागू नियमों के तहत विनियमित।
21.	पहाड़ी ढलानों और नदी के तटों का संरक्षण	लागू नियमों के तहत विनियमित।
22.	प्राकृतिक जल निकायों या सतही क्षेत्र में उपचारित बहिर्स्राव का निस्सारण	उपचारित बहिर्स्राव के पुनर्चक्रण को प्रोत्साहित करना और अवमल या ठोस अपशिष्टों के निपटान के लिए विद्यमान विनियमों का अनुपालन करना होगा ।
23.	वाणिज्यिक साइनबोर्ड और होर्डिंग	लागू नियमों के तहत विनियमित।
24.	प्रदूषण कारित नहीं करने वाले लघु उद्योग	पारिस्थितिक संवेदी जोन से गैर प्रदूषण, गैर परिसंकटमय, लघु और सेवा उद्योग, कृषि उद्यान, कृषि या कृषि आधारित देशीय माल से औद्योगिक उत्पादों का उत्पादन उद्योग और जो पर्यावरण पर कोई विपरीत प्रभाव नहीं डालते हैं ।
25.	वन उत्पादों और गैर काष्ठ वन उत्पादों का संग्रहण	लागू नियमों के तहत विनियमित।
26.	पारिस्थितिक पर्यटन क्रियाकलापों जिसके अंतर्गत पारिस्थितिक पर्यटन मकानों, रेस्टोरेंट और आमोद-प्रमोद की सुविधाएं भी हैं जिसमें स्फूर्ति, तैराकी पूल, व्यायाम शाला भी हैं जो कपड़े या लकड़ी या बोर्ड कणिका जैसे टेंट आदि की अस्थायी संरचनाओं में बने हैं ।	जोनल मास्टर प्लान के अनुसार ।
	संवर्धित क्रियाकलाप	
27.	स्थानीय समुदायों द्वारा प्रचलित कृषि और बागवानी प्रथाओं के साथ पशुपालन, पशुपालन कृषि, जल कृषि और मछली पालन	लागू नियमों के तहत अनुज्ञात।
28.	वर्षा जल संचयन	सक्रिय रूप से बढ़ावा दिया जाएगा ।
29.	जैविक खेती	सक्रिय रूप से बढ़ावा दिया जाएगा ।
30.	सभी क्रियाकलापों के लिए हरित प्रौद्योगिकी को ग्रहण करना	सक्रिय रूप से बढ़ावा दिया जाएगा ।
31.	कुटीर उद्योगों जिसके अंतर्गत ग्रामीण कारीगर आदि भी हैं	सक्रिय रूप से बढ़ावा दिया जाएगा ।

5. राज्य स्तरीय पारिस्थितिक संवेदी जोन मानीटरी समिति- (1) केंद्रीय सरकार के पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय ने गोवा राज्य के राष्ट्रीय उद्यान और वन्य जीव अभयारण्य के चारों ओर के पारिस्थितिक संवेदी जोन के प्रभावी मानीटरी के लिए एक समिति जिसका नाम राज्य स्तरीय पारिस्थितिक संवेदी जोन मानीटरी समिति (रा स्त पा सं जो मा स), का गठन भारत के राजपत्र, असाधारण, संख्यांक का.आ 221(अ), तारीख 23 जनवरी, 2015 को भाग 2, खंड 3 के उपखंड (ii) में प्रकाशित अधिसूचना द्वारा किया गया है जो निम्नलिखित से मिलकर बनी है, अर्थात् :-

(i) मुख्य सचिव, गोवा सरकार - अध्यक्ष;

(ii) पर्यावरण, वन और जलवायु मंत्रालय, का एक प्रतिनिधि - सदस्य;

(iii) सदस्य सचिव, राज्य प्रदूषण नियंत्रण बोर्ड - सदस्य;

(iv) पर्यावरण के क्षेत्र में कार्य करने वाले गैर सरकारी संगठनों का गोवा राज्य सरकार द्वारा नामनिर्दिष्ट एक प्रतिनिधि (एक वर्ष की अवधि के लिए) - सदस्य;

(v) राज्य सरकार द्वारा नामनिर्दिष्ट समुदाय आधारित संगठन का एक प्रतिनिधि (एक वर्ष की अवधि के लिए) - सदस्य;

(vi-xiv) गोवा सरकार के पर्यावरण एवं वन, ग्रामीण विकास, कृषि, शहरी विकास, आवास, खनन, पत्तन, परिवहन तथा राजस्व विभागों के प्रमुख सचिव-सदस्य;

(xv) गोवा की ख्याति प्राप्त संस्था या विश्वविद्यालय से पारिस्थितिक का गोवा राज्य सरकार द्वारा नामनिर्दिष्ट एक प्रतिनिधि (एक वर्ष की अवधि के लिए)- सदस्य;

(xvi) मुख्य वन संरक्षक, (वन्य जीव) और मुख्य वन्य जीव वार्डन, गोवा सरकार - सदस्य-सचिव ।

(2) राज्य स्तरीय पारिस्थितिक संवेदी जोन समिति इस अधिसूचना के उपबंधों के अनुपालन को मानीटर करेगी ।

(3) इस अधिसूचना के पैरा 4 के अधीन सारणी के स्तंभ (3) में यथा विनिर्दिष्ट प्रतिषिद्ध क्रियाकलापों के सिवाय, भारत सरकार के पर्यावरण और वन मंत्रालय की अधिसूचना संख्यांक का.आ. 1533, तारीख 14 सितंबर, 2006 की अनुसूची के अधीन ऐसे क्रियाकलापों जिन्हें सम्मिलित किया गया है तथा पारिस्थितिक संवेदी जोन में आते हैं ऐसे क्रियाकलापों की वास्तविक विनिर्दिष्ट स्थलीय दशाओं पर आधारित राज्य स्तरीय पारिस्थितिक संवेदी जोन मानीटरी समिति द्वारा संवीक्षा की जाएगी और उक्त अधिसूचना के उपबंधों के अधीन पूर्व पर्यावरण निकासी के लिए केन्द्रीय सरकार के पर्यावरण और वन मंत्रालय को निर्दिष्ट की जाएगी ।

(4) इस अधिसूचना के पैरा 4 के अधीन सारणी के स्तंभ (3) में यथा विनिर्दिष्ट प्रतिषिद्ध क्रियाकलापों के सिवाय, भारत सरकार के तत्कालीन पर्यावरण और वन मंत्रालय की अधिसूचना संख्यांक का.आ. 1533, तारीख 14 सितंबर, 2006 की अधिसूचना के अनुसूची के अधीन ऐसे क्रियाकलापों, जिन्हें सम्मिलित नहीं किया गया है, परंतु पारिस्थितिक संवेदी जोन में आते हैं, ऐसे क्रियाकलापों की वास्तविक विनिर्दिष्ट स्थलीय दशाओं पर आधारित राज्य स्तरीय पारिस्थितिक संवेदी जोन मानीटरी समिति द्वारा संवीक्षा की जाएगी और उसे संबद्ध विनियामक प्राधिकरणों को निर्दिष्ट किया जाएगा ।

(5) राज्य स्तरीय पारिस्थितिक संवेदी जोन मानीटरी समिति का सदस्य-सचिव या संबधित कलक्टर या संबंधित उद्यान का भारसाधक किसी ऐसे व्यक्ति के विरुद्ध, जो इस अधिसूचना के उपबंधों का उल्लंघन करता है, पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) की धारा 19 के अधीन परिवाद फाइल करने के लिए सक्षम होगा ।

(6) राज्य स्तरीय पारिस्थितिक संवेदी जोन मानीटरी समिति विषय-विषय आधारित अपेक्षाओं पर निर्भर रहते हुए संबद्ध विभागों के प्रतिनिधियों या विशेषज्ञों, औद्योगिक संगमों या संबद्ध पणधारियों के प्रतिनिधियों को अपने विचार-विमर्श में सहायता के लिए आमंत्रित कर सकेगी ।

(7) राज्य स्तरीय पारिस्थितिक संवेदी जोन मानीटरी समिति प्रत्येक वर्ष 31 मार्च तक के कार्यकलापों का विवरण उसी वर्ष के 30 जून तक केन्द्रीय सरकार के पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय को उपाबंध 4 में दिए गए प्रोफार्मा के अनुसार अपनी वार्षिक कार्यवाही रिपोर्ट प्रस्तुत करेगी ।

(8) केन्द्रीय सरकार का पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय समय-समय पर राज्य स्तरीय पारिस्थितिक संवेदी जोन मानीटरी समिति को अपने कृत्यों के प्रभावी निर्वहन के लिए निदेश दे सकेगा ।

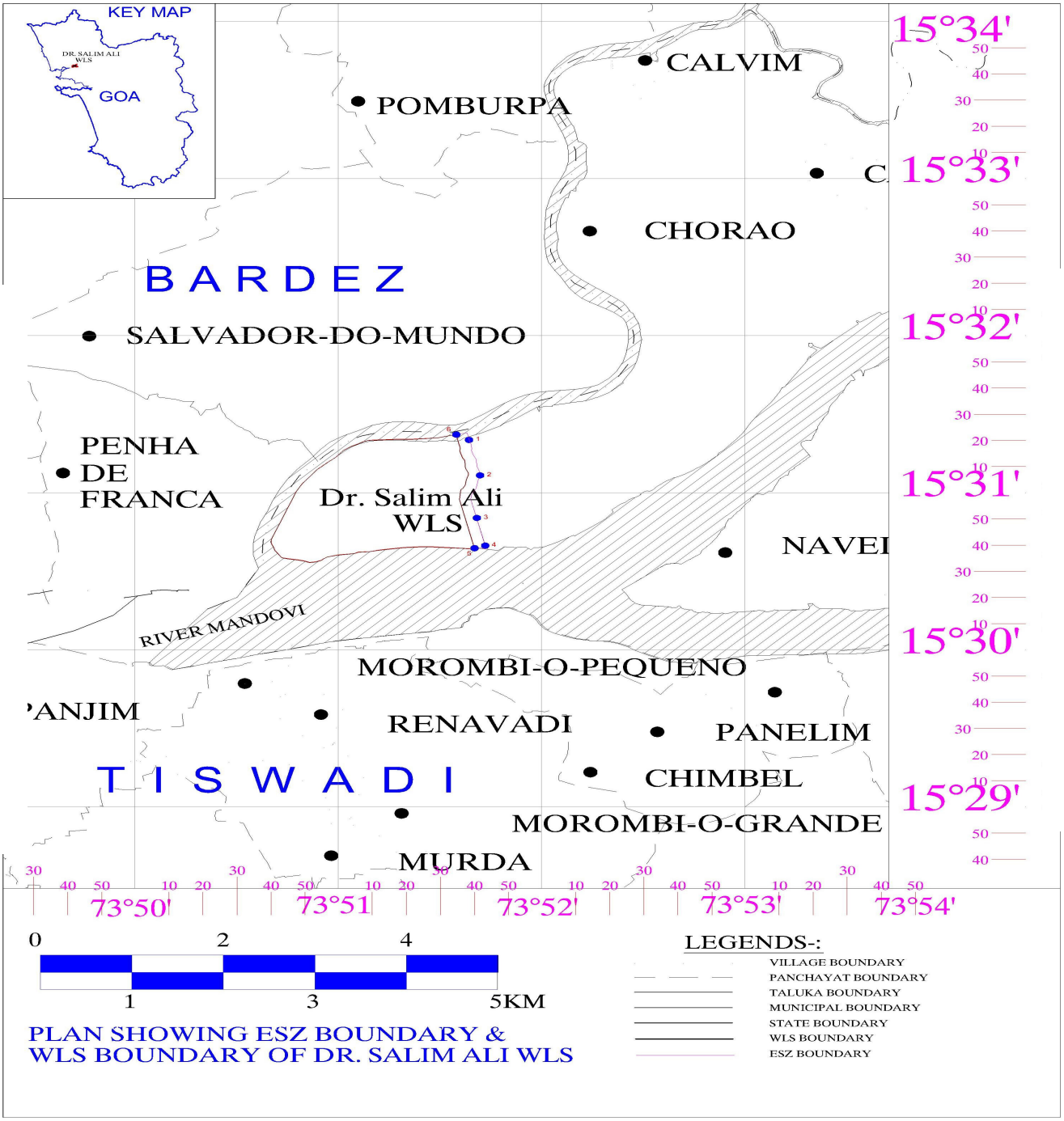
6. इस अधिसूचना के उपबंध अधिसूचना में सम्मिलित विषयों की बाबत भारत के माननीय उच्चतम न्यायालय, उच्च न्यायालयों या राष्ट्रीय हरित अधिकरण द्वारा पारित आदेशों, यदि कोई हों, या पारित किए जाने वाले आदेशों के अधीन होंगे ।

[फा. सं. 25/37/2013-ईएसजैड-आरई]

डॉ. जी. वी. सुब्रहमण्यम, वैज्ञानिक 'जी'

उपाबंध- 1

अक्षांश और देशांतर दर्शित करने वाला डॉ. सलीम अली पक्षी अभयारण्य पारिस्थितिक संवेदी जोन का मानचित्र



उपाबंध-2

डॉ. सलीम अली पक्षी अभयारण्य पारिस्थितिक संवेदी जोन के निर्देशांक

क्रम सं.	अक्षांश	देशांतर
1.	15°31'24.88" उ	73°51'43.03" पू
2.	15°31'10.11"उ	73°51'46.43" पू
3.	15°30'53.76"उ	73°51'45.58" पू
4.	15°30'42.97"उ	73°51'48.48" पू
5.	15°31'23.59"उ	73°51'38.88" पू
6.	15°30'41.08"उ	73°51'43.23" पू

उपाबंध-3

डॉ. सलीम अली पक्षी अभयारण्य पारिस्थितिक संवेदी जोन के भीतर आने वाले ग्रामों की सूची

पारिस्थितिक संवेदी जोन सीमा के भीतर भागतः आने वाले ग्रामों की सूची

क्रम सं.	ग्राम का नाम
1	चोराव

उपाबंध 4

कृत कार्रवाई रिपोर्ट का प्रोफार्मा:-
राज्य स्तरीय पारिस्थितिक संवेदी जोन मानीटरी कमेटी.-

1. बैठक की संख्या और तारीख
2. बैठकों के कार्यवृत्त: प्रमुख रूप से उल्लेखनीय बिंदुओं का उल्लेख करें

   बैठक के कार्यवृत्त को पृथक् उपाबंध पर संलग्न करें ।
3. जोनल मास्टर प्लान जिसके अंतर्गत पर्यटन मास्टर प्लान (पारिस्थितिक संवेदी जोन वार) भी है के तैयार किए जाने की स्थिति ।
4. उन मामलों का सार जिसके भू-अभिलेख में प्रकट हुई त्रुटियों का सुधार किया जाना है । (पारिस्थितिक संवेदी जोन वार) ।

   जिसका विवरण उपाबंध के रूप में संलग्न किया जा सकता है ।
5. पर्यावरण समाघात निर्धारण अधिसूचना, 2006 (पारिस्थितिक संवेदी जोन वार) के अधीन उन क्रियाकलापों के लिए जो सम्मिलित किए गए हैं संवीक्षा किए गए मामलों का सार ।
6. पर्यावरण समाघात निर्धारण अधिसूचना, 2006 (पारिस्थितिक संवेदी जोन वार) के अधीन उन क्रियाकलापों के लिए जो सम्मिलित नहीं किए गए हैं संवीक्षा किए गए मामलों का सार ।
7. पर्यावरण (संरक्षण) अधिनियम, 1986 (पारिस्थितिक संवेदी जोन वार) की धारा 19 के अधीन दर्ज किए गए परिवादों का सार ।
8. कोई अन्य महत्वपूर्ण विषय ।

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

NOTIFICATION

New Delhi, the 24th February, 2015

S.O. 607(E).—WHEREAS, a draft notification, for declaration of Eco-sensitive Zone around Dr. Salim Ali Bird Sanctuary in Goa, was published in the Gazette of India, Extraordinary, *vide* notification of the Government of India in the erstwhile Ministry of Environment and Forests number S.O. 634 (E) dated 3rd March, 2014, inviting objections and suggestions from all persons likely to be affected thereby within a period of sixty days from date on which copies of the Gazette containing the said notification were made available to the public;

AND WHEREAS, copies of the Gazette containing the said notification were made available to the public on the 3rd March, 2014;

AND WHEREAS, all objections and suggestions received from all persons and stakeholders in response to the draft notification have been duly considered by the Central Government;

AND WHEREAS, the Central Government considers that the Dr. Salim Ali Bird Sanctuary (hereinafter referred to as Sanctuary), Goa lying between latitudes 15^0 31' 36.03'' N and 15^0 30' 35.35" N and longitudes 73^0 52' 14.31" E and 73^0 50' 44.12" E in the North Goa District of Goa State and extending over an area of 1.78 square kilometres, is a rich mangrove formation at the confluence of Mapusa river and Mandovi river;

AND WHEREAS, the sanctuary exclusively shelters varieties of amphibians, otters, crocodiles and varieties of fish, aquatic birds, shore birds and arboreal birds and reptiles, fruit bat (Pteropus spp.), migratory birds, adjutant storks and raptorial birds like osprey visit the protected area annually;

AND WHEREAS, the mangrove forest of this sanctuary holds and protects the rich soil underneath from washing away and provides exclusively excellent place for the said varieties of wildlife to breed and shelter;

AND WHEREAS, it is necessary to conserve and protect the area the extent and boundary of which is specified in paragraph 1 of this notification around the Dr. Salim Ali Bird Sanctuary as Eco-sensitive Zone from ecological and environmental point of view and to prohibit industries or class of industries and their operations and processes in the said Eco- sensitive zone;

NOW, THEREFORE, in exercise of the powers conferred by sub-section (1), clause (v) and clause (xiv) of sub-section (2) and sub-section (3) of Section 3 of the Environment (Protection) Act, 1986 (29 of 1986) read with sub-rule (3) of rule 5 of the Environment (Protection) Rules, 1986, the Central Government hereby notifies an area up to the river bank abutting the Dr. Salim Ali Bird Sanctuary on the three sides of the said Sanctuary and to the extent of 100 meters on the eastern side towards Chorao village from the Sanctuary in the State of Goa as the Eco-sensitive Zone, details of which are as under, namely:—

1. **Extent and Boundaries of Eco-sensitive Zone.-** (1) The extent of Eco-sensitive Zone shall be upto the river bank abutting the sanctuary on the three sides of the Wildlife Sanctuary and to the extent of 100 meters on the eastern side towards Chorao village from the Dr. Salim Ali Bird Sanctuary within the State of Goa.

(2) The Eco-sensitive Zone is bounded on the three sides i.e, North, West and South by the Mapusa river and the Mandovi river and the village Chorao of Tiswadi Taluka is located towards the Eastern side.

(3) The map of Eco-sensitive Zone boundary is appended to this notification as **Annexure I** and the list of latitudes and longitudes of prominent points on the boundary of the Eco-sensitive Zone is appended to this notification as **Annexure II**.

(4) The list of villages falling within Eco-sensitive Zone boundary is given at **Annexure III**.

(5) The list of villages given in Annexure III shall be further revisited and confirmed by the State Government while preparing the Zonal Master Plan.

2. Zonal Master Plan for the Eco-sensitive Zone.- (1) The State Government shall for the purpose of effective management of the Eco-sensitive Zone, prepare a Zonal Master Plan, within a period of two years from the date of publication of this notification in the Official Gazette, for the consideration and approval of the Ministry of Environment, Forest and Climate Change, Government of India in consultation with local people and all concerned State Departments, such as Environment, Forest and Wildlife, Agriculture, Revenue, Urban and Housing Development, Tourism, Rural Development, Irrigation and Flood Control, Mining and Public Works Department for integrating the ecological and environmental considerations into the said plan.

(2) The Zonal Master Plan shall provide for restoration of degraded areas, conservation of existing water bodies, management of catchment areas, watershed management, ground water management, soil and moisture conservation, needs of local community and such other aspects of ecology and environment that need attention.

(3) The Zonal Master Plan shall demarcate all the existing and proposed urban settlements, village settlements, types and kinds of forest, agriculture areas, horticultural areas, man-made heritage sites, natural heritage sites, mining leases in operation, lakes and other water bodies.

(4) The Zonal Master Plan thus prepared specific to this Eco-sensitive Zone shall be integrated into the regional plan for the State of Goa.

(5) The Zonal Master Plan shall contain the measures as may be specified by the Central Government or the State Government, for regulation of activities specified under column (2) of the table specified in paragraph 4.

(6) The Zonal Master Plan so prepared shall be co-terminus with the regional development plan.

(7) The Zonal Master Plan shall be a reference document for the State Level Eco-sensitive Zone Monitoring Committee (hereinafter referred to as the SESZMC), referred to in paragraph 5, for carrying out its functions of monitoring under the provisions of this notification.

3. **Measures to be taken by State Government.-**The State Government shall take the following measures for giving effect to the provisions of this notification, namely:-

(1) Forests, horticulture areas, agricultural areas, parks and open spaces earmarked for recreational purposes in the Eco-sensitive Zone shall not be used or converted into areas for commercial or industrial related development activities:

Provided that the conversion of agricultural lands within the Eco-sensitive Zone may be permitted on the recommendation of the SESZMC, and with the prior approval of the State Government, to meet the residential needs of local residents, and for the activities listed at item numbers 24, 26, 28 and 31 in column (2) of the Table in paragraph 4, namely:-

(i) Small scale industries not causing pollution,

(ii) Rainwater harvesting,

(iii) Cottage industries including village industries, and

(iv) Ecofriendly cottages for temporary occupation of tourists such as tents, wooden houses, etc. for Eco-friendly tourism activities:

Provided further that no use of tribal land shall be permitted for commercial and industrial development activities without the prior approval of the State Government and without compliance to the provisions of Article of 244 of the Constitution of India or the law for the time being in force, including the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (2 of 2007) as amended from time to time:

Provided also that any error appearing in the land records within the Eco-sensitive Zone shall be corrected by the State Government, after obtaining the views of SESZMC, once in each case and the correction of said error shall be intimated to the Central Government in the Ministry of Environment, Forest and Climate Change:

Provided also that the above correction of error shall not include change of land use in any case except as provided under this sub-paragraph.

(2) The catchment areas of all natural springs shall be identified and plans for their conservation and rejuvenation shall be incorporated in the Zonal Master Plan and the guidelines shall be drawn up by the State Government to prohibit development activities at or near these areas.

(3) The activity relating to tourism within the Eco-sensitive Zone which shall form part of the Zonal Master Plan shall be as under, namely:-

(a) all new tourism activities or expansion of existing tourism activities within the Eco-sensitive Zone shall be in accordance with the guidelines issued by the Central Government in the Ministry of Environment, Forest and Climate Change and by the National Tiger Conservation Authority, with emphasis on eco-tourism, eco-education and eco-development and based on carrying capacity study of the Eco-sensitive Zone;

(b) new construction of any kind shall not be permitted within the Eco-sensitive Zone except for eco-friendly accommodation like tents, wooden houses or thatched roofs for temporary occupation of tourists and for eco-friendly tourism activities;

(c) till the Zonal Master Plan is approved, development for tourism and expansion of existing tourism activities shall be permitted by the concerned regulatory authorities based on the actual site specific scrutiny and recommendation of the SESZMC.

(4) All sites of valuable natural heritage in the Eco-sensitive Zone such as the gene pool reserve areas, rock formations, waterfalls, springs, gorges, groves, caves, points, walks, rides, cliffs, etc. shall be identified and preserved and proper plan shall be drawn up for their protection and conservation, within six months from the date of publication of this notification and such plan shall form part of the Zonal Master Plan.

(5) Buildings, structures, artefacts, areas and precincts of historical, architectural, aesthetic, and cultural significance shall be indentified in the Eco-sensitive Zone and plans for their conservation shall be prepared within six months from the date of publication of this notification and incorporated in the Zonal Master Plan.

(6) The Environment Department of the State Government shall draw up guidelines and regulations for the control of noise pollution in the Eco-sensitive Zone in accordance with the provisions of the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981) and the rules made thereunder.

(7) The Environment Department of the State Government shall draw up guidelines and regulations for the control of air pollution in the Eco-sensitive Zone in accordance with the provisions of the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981) and the rules made thereunder.

(8) The discharge of treated effluent in Eco-sensitive Zone shall be in accordance with the provisions of the Water (Prevention and Control of Pollution) Act, 1974(6 of 1974) and the rules made thereunder.

(9) Disposal of solid wastes shall be as under:-

(i) the solid waste disposal in Eco-sensitive Zone shall be carried out as per the provisions of the Municipal Solid Waste (Management and Handling) Rules, 2000 published by the Government of India in the erstwhile Ministry of Environment and Forests *vide* notification number S.O. 908 (E), dated the 25th September 2000 as amended from time to time;

(ii) the local authorities shall draw up plans for the segregation of solid wastes into biodegradable and non-biodegradable components;

(iii) the biodegradable material shall be recycled preferably through composting or vermiculture;

(iv) the inorganic material shall be disposed of in an environmentally acceptable manner.

(10) The bio-medical waste disposal in the Eco-sensitive Zone shall be carried out as per the provisions of the Bio-Medical Waste (Management and Handling) Rules, 1998 published by the Government of India in the erstwhile Ministry of Environment and Forests *vide* Notification number S.O. 630(E), dated the 20th July, 1998 as amended from time to time.

(11) The vehicular movement of traffic shall be regulated in a habitat friendly manner and specific provisions in this regard shall be incorporated in the Zonal Master Plan and till such time as the Zonal master plan is prepared and approved by the Ministry of Environment, Forests and Climate Change, SESZMC shall monitor compliance of vehicular movement as per the rules and regulations in force.

4. **List of activities prohibited or to be regulated within the Eco-sensitive Zone.-**All activities in the Eco-sensitive Zone shall be governed by the provisions of the Environment (Protection) Act, 1986 (29 of 1986) and the rules made thereunder and be regulated in the manner specified in the Table below, namely:-

TABLE

S. No.	Activity	Remarks
(1)	(2)	(3)
Prohibited Activities		
1.	Commercial Mining, stone quarrying and crushing units.	All new and existing mining (minor and major minerals), stone quarrying and crushing units are prohibited with immediate effect.
2.	Setting up of saw mills.	Prohibited (except as otherwise provided) as per applicable laws.
3.	Setting up of industries causing water or air or soil or noise pollution.	Prohibited (except as otherwise provided) as per applicable laws.
4.	Commercial establishment of hotels and resorts.	New commercial establishment such as hotels and resorts shall be prohibited within the Eco-sensitive Zone with immediate effect.
5.	Commercial use of firewood.	Prohibited (except as otherwise provided) as per applicable laws.
6.	Establishment of new major hydroelectric projects.	Setting up of new hydro-electric power plants (dams, tunnelling, and construction of reservoir) and expansion of existing plants in the Eco-sensitive Zone is prohibited with immediate effect, except the micro hydel power projects (Up to 100KW) or the mini hydel power projects (from 101 to 2000KW), which would serve the energy needs of the local communities, subject to the consent of the concerned Gram Sabha and all other requisite clearances.
7.	Use or production of any hazardous substances.	Prohibited (except as otherwise provided) as per applicable laws.
8.	Discharge of untreated effluents and solid waste in natural water bodies or land area.	Prohibited (except as otherwise provided) as per applicable laws.
9.	New wood based industry.	No establishment of new wood based industry shall be permitted within the limits of Eco-sensitive Zone with immediate effect.
10.	Construction activities	New construction of any kind shall be prohibited within the Eco-sensitive Zone with immediate effect, except for the domestic needs of local residents including the activities listed at item numbers 26,28 and 31 and in the case of activities listed at item number 24, the construction activity shall be regulated and kept at the minimum.
11.	Use of plastic carry bags	Prohibited (except as otherwise provided) as per applicable laws.
12.	Brick kilns	Prohibited (except as otherwise provided) as per applicable laws.
Regulated Activities		
13.	Felling of trees.	(a) There shall be no felling of trees on the forest or Government or revenue or private lands without prior permission of the competent authority in the State Government. (b) The felling of trees shall be regulated in accordance with the provisions of the concerned Central or State Act and the rules made thereunder.
14.	Commercial water resources including ground water harvesting.	(a) The extraction of surface water and ground water shall be permitted only for *bona fide* agricultural use and domestic consumption of the occupier of the land.

		(b) Extraction of surface water and ground water for industrial or commercial use including the amount that can be extracted shall require prior written permission from the concerned Regulatory Authority. (c) No sale of surface water or ground water shall be permitted. (d) Steps shall be taken to prevent contamination or pollution of water from any source including agriculture.
15.	Erection of electrical cables and telecommunication towers.	Promote underground cabling.
16.	Fencing of existing premises of hotels and lodges.	Regulated under applicable laws.
17.	Widening and strengthening of existing roads and construction of new roads.	Shall be done with proper Environment Impact Assessment and mitigation measures, as applicable.
18.	Movement of vehicular traffic at night.	Regulated for commercial purpose as per applicable laws.
19.	Introduction of exotic species.	Regulated under applicable laws
20.	Undertaking activities related to tourism like over-flying the National Park area by hot-air balloons, etc.	Regulated under applicable laws
21.	Protection of hill slopes and river banks.	Regulated under applicable laws
22.	Discharge of treated effluents in natural water bodies or land area.	Recycling of treated effluent shall be encouraged and for disposal of sludge or solid wastes, the existing regulations shall be followed.
23.	Commercial Sign boards and hoardings.	Regulated under applicable laws
24.	Small scale industries not causing pollution.	Non polluting, non-hazardous, small-scale and service industry, agriculture, floriculture, horticulture or agro-based industry producing products from indigenous goods from the Eco-sensitive Zone, and which do not cause any adverse impact on environment.
25.	Collection of Forest produce or Non-Timber Forest Produce (NTFP).	Regulated under applicable laws
26	Eco-tourism activities including eco tourist lodges, restaurant and recreational facilities including spa, swimming pool, gymnasium in temporary structures made of cloth or wood or particle board such as tents etc.	As per Zonal Master Plan.
Promoted Activities		
27.	Ongoing agriculture and horticulture practices by local communities along with dairies, dairy farming, aquaculture and fisheries.	Permitted under applicable laws.
28.	Rain water harvesting.	Shall be actively promoted.
29.	Organic farming.	Shall be actively promoted.
30.	Adoption of green technology for all activities.	Shall be actively promoted.
31.	Cottage industries including village artisans, etc.	Shall be actively promoted.

5. State Level Eco-sensitive Zone Monitoring Committee:- (1)

The Central Government in the Ministry of Environment, Forest and Climate Change, for effective monitoring of the Eco-sensitive Zones around National Parks and Wildlife Sanctuaries, has constituted a Committee called the State Level Eco-sensitive Zone Monitoring Committee (SESZMC) for the State of Goa vide notification number S.O. 221 (E), dated the 23rd January 2015, published in the Gazette of India, Extraordinary, Part II, Section 3, Sub-section (ii) comprising of the following members, and to perform the following functions, namely:-

(i) Chief Secretary, Government of Goa- Chairman;

(ii) representative of the Ministry of Environment, Forest and Climate Change- Member;

(iii) Member Secretary, State Pollution Control Board-Member;

(iv) one representative of Non-governmental Organisations working in the field of environment to be nominated by the Government of Goa (for a term of one year)– Member;

(v) one representative of community based organisation nominated by the State Government (for a term of one year)– Member;

(vi-xiv) Principal Secretaries of the Government of Goa from Departments of Forest and Environment, Rural Development, Agriculture, Urban Development, Housing, Mining, Ports, Transport and Revenue– Members;

(xv) one expert in Ecology from reputed Institution or University of the State of Goa to be nominated by Government of Goa (for a term of one year) - Member;

(xvi) Chief Conservator of Forests (WL) and Chief Wildlife Warden, Government of Goa– Member Secretary.

(2) The SESZMC shall monitor the compliance of the provisions of this notification.

(3) The activities that are covered in the Schedule to the notification of the Government of India in the erstwhile Ministry of Environment and Forests number S.O. 1533(E), dated the 14th September, 2006, and are falling in the Eco-sensitive Zone, except for the prohibited activities as specified in the Table under paragraph 4 thereof, shall be scrutinised by the SESZMC based on the actual site-specific conditions and referred to the Central Government in the Ministry of Environment, Forest and Climate Change for prior environmental clearance under the provisions of the said notification.

(4) The activities that are not covered in the Schedule to the notification of the Government of India in the erstwhile Ministry of Environment and Forests number S.O. 1533(E), dated the 14th September, 2006 and are falling in the Eco-sensitive Zone, except for the prohibited activities as specified in the Table under paragraph 4 thereof, shall be scrutinised by the SESZMC based on the actual site-specific conditions and referred to the concerned regulatory authorities.

(5) The Member Secretary of the SESZMC or the concerned Collector or the concerned park in-charge shall be competent to file complaints under section 19 of the Environment (Protection) Act, 1986 against any person who contravenes the provisions of this notification.

(6) The SESZMC may invite representatives or experts from concerned Departments, representatives from Industry Associations or concerned stakeholders to assist in its deliberations depending on the requirements on issue to issue basis.

(7) The SEZMC shall submit the annual action taken report of its activities as on 31st March of every year by 30th June of that year to the Central Government in the Ministry of Environment, Forest and Climate Change as per pro forma given in **Annexure IV**.

(8) The Central Government in the Ministry of Environment, Forests and Climate Change may give such directions, as it deems fit, to the SESZMC for effective discharge of its functions.

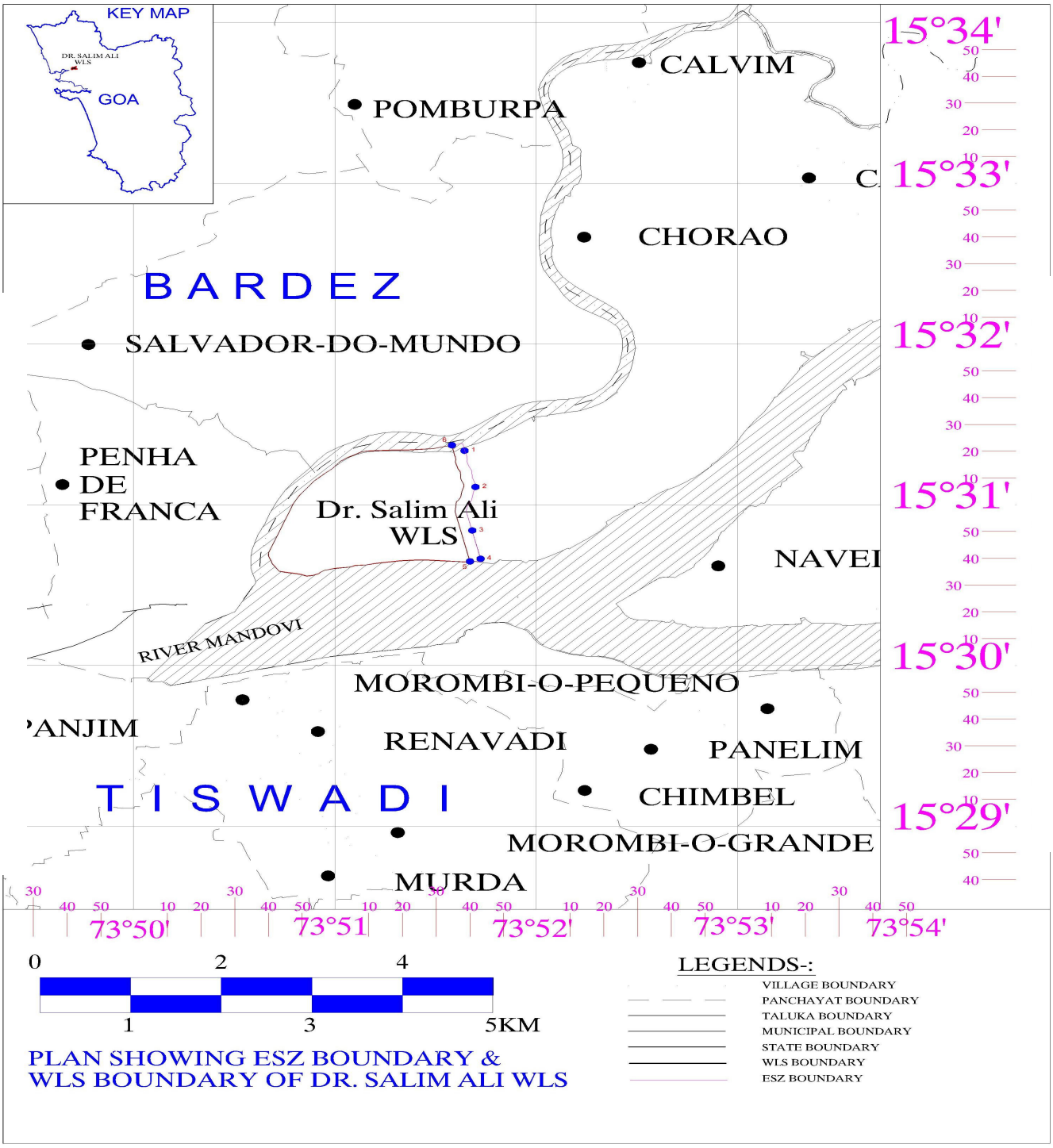
6. The provisions of this notification shall be subject to the orders passed by the Hon'ble Supreme Court of India or the High Court or National Green Tribunal as the case may be, in respect of matters covered under this notification.

[F. No. 25/37/2013-ESZ-RE]

Dr. G. V. SUBRAHMANYAM, Scientist 'G'

Annexure I

Map of Dr. Salim Ali Bird Sanctuary Eco-sensitive Zone showing Latitudes-Longitudes



Annexure II

Coordinates of prominent points on the boundary of Eco-sensitive Zone around Dr. Salim Ali Bird Sanctuary

S.NO.	**Latitude**	**Longitude**
1	15°31'24.88"N	73°51'43.03"E
2	15°31'10.11"N	73°51'46.43"E
3	15°30'53.76"N	73°51'45.58"E
4	15°30'42.97"N	73°51'48.48"E
5	15°31'23.59"N	73°51'38.88"E
6	15°30'41.08"N	73°51'43.23"E

Annexure III

List of villages falling within the Dr. Salim Ali Bird Sanctuary Eco-sensitive Zone

List of Villages partially within the ESZ Boundary

S. No.	**Village Name**
1	Chorao

Annexure IV

Proforma of Action Taken Report: - State Level Eco-sensitive Zone Monitoring Committee.-

1. Number and date of Meetings
2. Minutes of the meetings: Mention main noteworthy points. Attached Minutes of the meeting on separate Annexure.
3. Status of preparation of Zonal master Plan including Tourism master Plan (Eco-sensitive Zone wise)
4. Summary of cases dealt for rectification of error apparent on face of land record. (Eco-sensitive Zone wise).

   Details may be attached as Annexure
5. Summary of cases scrutinized for activities covered under Environment Impact Assessment Notification, 2006 (Eco-sensitive Zone wise).

   Details may be attached as separate Annexure.
6. Summary of case scrutinized for activities not covered under Environment Impact Assessment Notification, 2006 (Eco-sensitive Zone wise).

   Details may be attached as separate Annexure.
7. Summary of complaints ledged under Section 19 of Environment (Protection) Act, 1986. (Eco-sensitive Zone wise).
8. Any other matter of importance.

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COASTAL REGULATION ZONE NOTIFICATION
MINISTRY OF ENVIRONMENT AND FORESTS
(Department of Environment, Forests and Wildlife)

S.O.19(E).- WHEREAS a draft notification under sub-section (1) of section and clause (V) of sub-section (2) of section 3 of the Environment (Protection) Act, 1986 was issued inviting objections and suggestions for the declaration of coastal stretches as Coastal Regulation Zone and imposing restrictions on industries, operations and processes in the CRZ was published vide S.O.No.2291 (E), dated 15th September, 2010.;

AND WHEREAS, copies of the said Gazette were made available to the public on 15th September, 2010.;

AND WHEREAS, the suggestions and objections received from the public have been considered by the Central Government.;

Now, therefore, in exercise of the powers conferred by sub-section (1) and clause (v) of sub-section (2) of section 3 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government, with a view to ensure livelihood security to the fisher communities and other local communities, living in the coastal areas, to conserve and protect coastal stretches, its unique environment and its marine area and to promote development through sustainable manner based on scientific principles taking into account the dangers of natural hazards in the coastal areas, sea level rise due to global warming, does hereby, declare the coastal stretches of the country and the water area upto its territorial water limit, excluding the islands of Andaman and Nicobar and Lakshadweep and the marine areas surrounding these islands upto its territorial limit, as Coastal Regulation Zone (hereinafter referred to as the CRZ) and restricts the setting up and expansion of any industry, operations or processes and manufacture or handling or storage or disposal of hazardous substances as specified in the Hazardous Substances (Handling, Management and Transboundary Movement) Rules, 2009 in the aforesaid CRZ.; and

In exercise of powers also conferred by clause (d) and sub rule (3) of rule 5 of Environment (Protection) Act, 1986 and in supersession of the notification of the Government of India in the Ministry of Environment and Forests, number S.O.114(E), dated the 19th February, 1991 except as respects things done or omitted to be done before such supercession, the Central Government hereby declares the following areas as CRZ and imposes with effect from the date of the notification the following restrictions on the setting up and expansion of industries, operations or processes and the like in the CRZ,-

(i) the land area from High Tide Line (hereinafter referred to as the HTL) to 500mts on the landward side along the sea front.

(ii) CRZ shall apply to the land area between HTL to 100 mts or width of the creek whichever is less on the landward side along the tidal influenced water bodies that are connected to the sea and the distance upto which development along such tidal influenced water bodies is to be regulated shall be governed by the distance upto which the tidal effects are experienced which shall be determined based on salinity concentration of 5 parts per thousand (ppt) measured during the driest period of the year and distance upto which tidal effects are experienced shall be clearly identified and demarcated accordingly in the Coastal Zone Management Plans (hereinafter referred to as the CZMPs).

Explanation.- For the purposes of this sub-paragraph the expression tidal influenced water bodies means the water bodies influenced by tidal effects from sea, in the bays, estuaries, rivers, creeks, backwaters, lagoons, ponds connected to the sea or creeks and the like.

(iii) the land area falling between the hazard line and 500mts from HTL on the landward side, in case of seafront and between the hazard line and 100mts line in case of tidal influenced water body the word 'hazard line' denotes the line demarcated by Ministry of Environment and Forests (hereinafter referred to as the MoEF) through the Survey of India (hereinafter referred to as the SoI) taking into account tides, waves, sea level rise and shoreline changes.

(iv) land area between HTL and Low Tide Line (hereinafter referred to as the LTL) which will be termed as the intertidal zone.

(v) the water and the bed area between the LTL to the territorial water limit (12 Nm) in case of sea and the water and the bed area between LTL at the bank to the LTL on the opposite side of the bank, of tidal influenced water bodies.

2. For the purposes of this notification, the HTL means the line on the land upto which the highest water line reaches during the spring tide and shall be demarcated uniformly in all parts of the country by the demarcating authority(s) so authorized by the MoEF in accordance with the general guidelines issued at Annexure-I. HTL shall be demarcated within one year from the date of issue of this notification.

3. Prohibited activities within CRZ,- The following are declared as prohibited activities within the CRZ,-

(i) Setting up of new industries and expansion of existing industries except,-

(a) those directly related to waterfront or directly needing foreshore facilities;

Explanation: The expression "foreshore facilities" means those activities permissible under this notification and they require waterfront for their operations such as ports and harbours, jetties, quays, wharves, erosion control measures, breakwaters, pipelines, lighthouses, navigational safety facilities, coastal police stations and the like.;

(b) projects of Department of Atomic Energy;

(c) facilities for generating power by non-conventional energy sources and setting up of desalination plants in the areas not classified as CRZ-I(i) based on an impact assessment study including social impacts.;

(d) development of green field Airport already permitted only at Navi Mumbai;

(e) reconstruction, repair works of dwelling units of local communities including fishers in accordance with local town and country planning regulations.

(ii) manufacture or handling oil storage or disposal of hazardous substance as specified in the notification of Ministry of Environment and Forests, No. S.O.594 (E), dated the 28th July 1989, S.O.No.966(E), dated the 27th November, 1989 and GSR 1037 (E), dated the 5th

December ,1989 except,-

(a) transfer of hazardous substances from ships to ports, terminals and refineries and vice versa;

(b) facilities for receipt and storage of petroleum products and liquefied natural gas as specified in Annexure-II appended to this notification and facilities for regasification of Liquefied Natural Gas (hereinafter referred to as the LNG) in the areas not classified as CRZ- I(i) subject to implementation of safety regulations including guidelines issued by the Oil Industry Safety Directorate in the Ministry of Petroleum and Natural Gas and guidelines issued by MoEF and subject to further terms and conditions for implementation of ameliorative and restorative measures in relation to environment as may be stipulated by in MoEF.

Provided that facilities for receipt and storage of fertilizers and raw materials required for manufacture of fertilizers like ammonia, phosphoric acid, sulphur, sulphuric acid, nitric acid and the like, shall be permitted within the said zone in the areas not classified as CRZ-I(i).

(iii) Setting up and expansion of fish processing units including warehousing except hatchery and natural fish drying in permitted areas:

(iv) Land reclamation, bunding or disturbing the natural course of seawater except those,-

(a) required for setting up, construction or modernisation or expansion of foreshore facilities like ports, harbours, jetties, wharves, quays, slipways, bridges, sealink, road on stilts, and such as meant for defence and security purpose and for other facilities that are essential for activities permissible under the notification;

(b) measures for control of erosion, based on scientific including Environmental Impact Assessment (hereinafter referred to as the EIA) studies

(c) maintenance or clearing of waterways, channels and ports, based on EIA studies;

(d) measures to prevent sand bars, installation of tidal regulators, laying of storm water drains or for structures for prevention of salinity ingress and freshwater recharge based on carried out by any agency to be specified by MoEF.

(v) Setting up and expansion of units or mechanism for disposal of wastes and effluents except facilities required for,-

(a) discharging treated effluents into the water course with approval under the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974);

(b) storm water drains and ancillary structures for pumping;

(c) treatment of waste and effluents arising from hotels, beach resorts and human settlements located in CRZ areas other than CRZ-I and disposal of treated wastes and effluents;

(vi) Discharge of untreated waste and effluents from industries, cities or towns and other human settlements. The concerned authorities shall implement schemes for phasing out existing discharge of this nature, if any, within a time period not exceeding two years from the date of issue of this notification.

(vii) Dumping of city or town wastes including construction debris, industrial solid wastes, fly

ash for the purpose of land filling and the like and the concerned authority shall implement schemes for phasing out any existing practice, if any, shall be phased out within a period of one year from date of commencement of this notification.

Note:-The MoEF will issue a separate instruction to the State Governments and Union territory Administration in respect of preparation of Action Plans and their implementation as also monitoring including the time schedule thereof, in respect of paras (v), (vi) and (vii).

(viii) Port and harbour projects in high eroding stretches of the coast, except those projects classified as strategic and defence related in terms of EIA notification, 2006 identified by MoEF based on scientific studies and in consultation with the State Government or the Union territory Administration.

(ix) Reclamation for commercial purposes such as shopping and housing complexes, hotels and entertainment activities.

(x) Mining of sand, rocks and other sub-strata materials except,-

(a)those rare minerals not available outside the CRZ area,
(b) exploration and exploitation of Oil and Natural Gas.

(xi) Drawl of groundwater and construction related thereto, within 200mts of HTL; except the following:-

(a) in the areas which are inhabited by the local communities and only for their use.
(b) In the area between 200mts-500mts zone the drawl of groundwater shall be permitted only when done manually through ordinary wells for drinking, horticulture, agriculture and fisheries and where no other source of water is available.

Note:-Restrictions for such drawl may be imposed by the Authority designated by the State Government and Union territory Administration in the areas affected by sea water intrusion.

(xi) Construction activities in CRZ-I except those specified in para 8 of this notification.

(xiii) Dressing or altering the sand dunes, hills, natural features including landscape changes for beautification, recreation and other such purpose.

(xiv) Facilities required for patrolling and vigilance activities of marine/coastal police stations.

4. Regulation of permissible activities in CRZ area.- The following activities shall be regulated except those prohibited in para 3 above,-

(i)(a) clearance shall be given for any activity within the CRZ only if it requires waterfront and foreshore facilities;
(b) for those projects which are listed under this notification and also attract EIA notification, 2006 (S.O.1533 (E), dated the 14th September, 2006), for such projects clearance under EIA notification only shall be required subject to being recommended by the concerned State or Union territory Coastal Zone Management Authority (hereinafter referred to as the CZMA).
(c) Housing schemes in CRZ as specified in paragraph 8 of this notification;

(d) Construction involving more than 20,000sq mts built-up area in CRZ-II shall be considered in accordance with EIA notification, 2006 and in case of projects less than 20,000sq mts built-up area shall be approved by the concerned State or Union territory Planning authorities in accordance with this notification after obtaining recommendations from the concerned CZMA and prior recommendations of the concern CZMA shall be essential for considering the grant of environmental clearance under EIA notification, 2006 or grant of approval by the relevant planning authority.

(e) MoEF may under a specific or general order specify projects which require prior public hearing of project affected people.

(f) construction and operation for ports and harbours, jetties, wharves, quays, slipways, ship construction yards, breakwaters, groynes, erosion control measures;

(ii) the following activities shall require clearance from MoEF, namely:-

(a) those activities not listed in the EIA notification, 2006.

(b) construction activities relating to projects of Department of Atomic Energy or Defence requirements for which foreshore facilities are essential such as, slipways, jetties, wharves, quays; except for classified operational component of defence projects. Residential buildings, office buildings, hospital complexes, workshops of strategic and defence projects in terms of EIA notification, 2006.;

(c) construction, operation of lighthouses;

(d) laying of pipelines, conveying systems, transmission line;

(e) exploration and extraction of oil and natural gas and all associated activities and facilities thereto;

(f) Foreshore requiring facilities for transport of raw materials, facilities for intake of cooling water and outfall for discharge of treated wastewater or cooling water from thermal power plants. MoEF may specify for category of projects such as at (f), (g) and (h) of para 4;

(g) Mining of rare minerals as listed by the Department of Atomic Energy;

(h) Facilities for generating power by non-conventional energy resources, desalination plants and weather radars;

(i) Demolition and reconstruction of (a) buildings of archaeological and historical importance, (ii) heritage buildings; and buildings under public use which means buildings such as for the purposes of worship, education, medical care and cultural activities;

4.2 Procedure for clearance of permissible activities.- All projects attracting this notification shall be considered for CRZ clearance as per the following procedure, namely:-

(i) The project proponents shall apply with the following documents seeking prior clearance under CRZ notification to the concerned State or the Union territory Coastal Zone Management Authority,-

(a) Form-1 (Annexure-IV of the notification);

(b) Rapid EIA Report including marine and terrestrial component except for construction projects listed under 4(c) and (d)

(c) Comprehensive EIA with cumulative studies for projects in the stretches classified as low and medium eroding by MoEF based on scientific studies and in consultation with the State Governments and Union territory Administration;

(d) Disaster Management Report, Risk Assessment Report and Management Plan;

(e) CRZ map indicating HTL and LTL demarcated by one of the authorized agency (as indicated in para 2) in 1:4000 scale;

(f) Project layout superimposed on the above map indicated at (e) above;

(g) The CRZ map normally covering 7km radius around the project site.
(h) The CRZ map indicating the CRZ-I, II, III and IV areas including other notified ecologically sensitive areas;
(i) No Objection Certificate from the concerned State Pollution Control Boards or Union territory Pollution Control Committees for the projects involving discharge of effluents, solid wastes, sewage and the like.;

(ii) The concerned CZMA shall examine the above documents in accordance with the approved CZMP and in compliance with CRZ notification and make recommendations within a period of sixty days from date of receipt of complete application,-

(a) MoEF or State Environmental Impact Assessment Authority (hereinafter referred to as the SEIAA) as the case may be for the project attracting EIA notification, 2006;
(b) MoEF for the projects not covered in the EIA notification, 2006 but attracting para 4(ii) of the CRZ notification;

(iii) MoEF or SEIAA shall consider such projects for clearance based on the recommendations of the concerned CZMA within a period of sixty days.

(vi) The clearance accorded to the projects under the CRZ notification shall be valid for the period of five years from the date of issue of the clearance for commencement of construction and operation.

(v) For Post clearance monitoring – (a) it shall be mandatory for the project proponent to submit half-yearly compliance reports in respect of the stipulated terms and conditions of the environmental clearance in hard and soft copies to the regulatory authority(s) concerned, on 1st June and 31st December of each calendar year and all such compliance reports submitted by the project proponent shall be published in public domain and its copies shall be given to any person on application to the concerned CZMA.

(b) the compliance report shall also be displayed on the website of the concerned regulatory authority.

(vi) To maintain transparency in the working of the CZMAs it shall be the responsibility of the CZMA to create a dedicated website and post the agenda, minutes, decisions taken, clearance letters, violations, action taken on the violations and court matters including the Orders of the Hon'ble Court as also the approved CZMPs of the respective State Government or Union territory.

5. Preparation of Coastal Zone Management Plans.

(i) The MoEF may obtain the CZMPs prepared through the respective State Government or Union territory;

(ii) The CZMPs may be prepared by the coastal State Government or Union territory by engaging reputed and experienced scientific institution(s) or the agencies including the National Centre for Sustainable Coastal Management (hereinafter referred to as the NCSCM) of MoEF and in consultation with the concerned stakeholders;

(iii)The hazard line shall be mapped by MoEF through SoI all along the coastline of the country and the hazard line shall be demarcated taking into account, tide, waves, sea level

rise and shoreline changes;

(iv)For the purpose of depicting the flooding due to tides, waves and sea level rise in the next fifty and hundred years, the contour mapping of the coastline shall be carried out at 0.5m interval normally upto 7km from HTL on the landward side, and the shoreline changes shall be demarcated based on historical data by comparing the previous satellite imageries with the recent satellite imageries;

(v) Mapping of the hazard line shall be carried out in 1:25,000 scale for macro level planning and 1:10,000 scale or cadastral scale for micro level mapping and the hazard line shall be taken into consideration while preparing the land use plan of the coastal areas;

(vi)The coastal States and Union Territory will prepare within a period of twenty four months from the date of issue this notification, draft CZMPs in 1:25,000 scale map identifying and classifying the CRZ areas within the respective territories in accordance with the guidelines given in Annexure-I of the notification, which involve public consultation;

(vii) The draft CZMPs shall be submitted by the State Government or Union territory to the concerned CZMA for appraisal, including appropriate consultations, and recommendations in accordance with the procedure(s) laid down in the Environment (Protection) Act, 1986;

(viii) The State Government or Union territory CZMA shall submit the draft CZMPs to MoEF alongwith its recommendations on the CZMP within a period of six months after incorporating the suggestions and objections received from the stakeholders;

(ix)MoEF shall thereafter consider and approve the CZMPs within a period of four months from the date of receipt of the CZMPs complete in all respects;

(x) All developmental activities listed in this notification shall be regulated by the State Government, Union Territory Administration, the local authority or the concerned CZMA within the framework of such approved CZMPs as the case may be in accordance with provisions of this notification;

(xi) The CZMPs shall not normally be revised before a period of five years after which, the concerned State Government or the Union territory may consider undertaking revision of the maps following the above procedures;

(xii) The CZMPs already approved under CRZ notification, 1991 shall be valid for a period of twenty four months unless the aforesaid period is extended by MoEF by a specific notification subject to such terms and conditions as may be specified therein.

6. Enforcement of the CRZ, notification, 2011-

(a) For the purpose of implementation and enforcement of the provisions this notification and compliance with conditions stipulated thereunder, the powers either original or delegated are available under Environment (Protection) Act, 1986 with the MoEF, State Government or the Union territory Administration NCZMA and SCZMAs;

(b) The composition, tenure and mandate of NCZMA and State Government or the Union territory CZMAs have already been notified by MoEF in terms of Orders of Hon'ble

Supreme Court in Writ Petition 664 of 1993;

(c) the State Government or the Union territory CZMAs shall primarily be responsible for enforcing and monitoring of this notification and to assist in this task, the State Government and the Union territory shall constitute district level Committees under the Chairmanship of the District Magistrate concerned containing atleast three representatives of local traditional coastal communities including from fisherfolk;

(d) The dwelling units of the traditional coastal communities including fisherfolk, tribals as were permissible under the provisions of the CRZ notification, 1991, but which have not obtained formal approval from concerned authorities under the aforesaid notification shall be considered by the respective Union territory CZMAs and the dwelling units shall be regularized subject to the following condition, namely-

(i) these are not used for any commercial activity
(ii) these are not sold or transferred to non-traditional coastal community.

7. Classification of the CRZ – For the purpose of conserving and protecting the coastal areas and marine waters, the CRZ area shall be classified as follows, namely:-

(i) CRZ-I,–

A. The areas that are ecologically sensitive and the geomorphological features which play a role in the maintaining the integrity of the coast,-

(a) Mangroves, in case mangrove area is more than 1000 sq mts, a buffer of 50meters along the mangroves shall be provided;
(b) Corals and coral reefs and associated biodiversity;
(c) Sand Dunes;
(d) Mudflats which are biologically active;
(e) National parks, marine parks, sanctuaries, reserve forests, wildlife habitats and other protected areas under the provisions of Wild Life (Protection) Act, 1972 (53 of 1972), the Forest (Conservation) Act, 1980 (69 of 1980) or Environment (Protection) Act, 1986 (29 of 1986); including Biosphere Reserves;
(f) Salt Marshes;
(g) Turtle nesting grounds;
(h) Horse shoe crabs habitats;
(i) Sea grass beds;
(j) Nesting grounds of birds;
(k) Areas or structures of archaeological importance and heritage sites.

B. The area between Low Tide Line and High Tide Line;

(ii) CRZ-II,-

The areas that have been developed upto or close to the shoreline.

Explanation.- For the purposes of the expression "developed area" is referred to as that area within the existing municipal limits or in other existing legally designated urban areas which are substantially built-up and has been provided with drainage and approach roads and other infrastructural facilities, such as water supply and sewerage mains;

(iii) CRZ-III,-

Areas that are relatively undisturbed and those do not belong to either CRZ-I or II which include coastal zone in the rural areas (developed and undeveloped) and also areas within municipal limits or in other legally designated urban areas, which are not substantially built up.

(iv.) *CRZ-IV*,-

A. the water area from the Low Tide Line to twelve nautical miles on the seaward side;

B. shall include the water area of the tidal influenced water body from the mouth of the water body at the sea upto the influence of tide which is measured as five parts per thousand during the driest season of the year.

(v) Areas requiring special consideration for the purpose of protecting the critical coastal environment and difficulties faced by local communities,-

A. (i) CRZ area falling within municipal limits of Greater Mumbai;
(ii) the CRZ areas of Kerala including the backwaters and backwater islands;
(iii) CRZ areas of Goa.

B. Critically Vulnerable Coastal Areas (CVCA) such as Sunderbans region of West Bengal and other ecologically sensitive areas identified as under Environment (Protection) Act, 1986 and managed with the involvement of coastal communities including fisherfolk.

8. Norms for regulation of activities permissible under this notification,-

(i) The development or construction activities in different categories of CRZ shall be regulated by the concerned CZMA in accordance with the following norms, namely:-

Note:- The word existing use hereinafter in relation to existence of various features or existence of regularisation or norms shall mean existence of these features or regularisation or norms as on 19.2.1991 wherein CRZ notification, was notified.

I. CRZ-I,-

(i) no new construction shall be permitted in CRZ-I except,-

(a) projects relating to Department of Atomic Energy;
(b) pipelines, conveying systems including transmission lines;
(c) facilities that are essential for activities permissible under CRZ-I;
(d) installation of weather radar for monitoring of cyclones movement and prediction by Indian Meteorological Department;
(e) construction of trans harbour sea link and without affecting the tidal flow of water, between LTL and HTL.
(f) development of green field airport already approved at only Navi Mumbai;

(ii) Areas between LTL and HTL which are not ecologically sensitive, necessary safety measures will be incorporated while permitting the following, namely:-

(a) exploration and extraction of natural gas;
(b) construction of dispensaries, schools, public rainshelter, community toilets, bridges, roads, jetties, water supply, drainage, sewerage which are required for traditional inhabitants living within the biosphere reserves after obtaining approval from concerned CZMA.
(c) necessary safety measure shall be incorporated while permitting such developmental activities in the area falling in the hazard zone;
(d) salt harvesting by solar evaporation of seawater;
(e) desalination plants;
(f) storage of non-hazardous cargo such as edible oil, fertilizers and food grain within notified ports;
(g) construction of trans harbour sea links, roads on stilts or pillars without affecting the tidal flow of water.

II. CRZ-II,-

(i) buildings shall be permitted only on the landward side of the existing road, or on the landward side of existing authorized structures;
(ii) buildings permitted on the landward side of the existing and proposed roads or existing authorized structures shall be subject to the existing local town and country planning regulations including the 'existing' norms of Floor Space Index or Floor Area Ratio:
Provided that no permission for construction of buildings shall be given on landward side of any new roads which are constructed on the seaward side of an existing road:
(iii) reconstruction of authorized building to be permitted subject with the existing Floor Space Index or Floor Area Ratio Norms and without change in present use;
(iv) facilities for receipt and storage of petroleum products and liquefied natural gas as specified in Annexure-II appended to this notification and facilities for regasification of Liquefied Natural Gas subject to the conditions as mentioned in sub-paragraph (ii) of paragraph 3;
(v) desalination plants and associated facilities;
(vi) storage of non-hazardous cargo, such as edible oil, fertilizers and food grain in notified ports;
(vii) facilities for generating power by non-conventional power sources and associated facilities;

III. CRZ-III,-

A. Area upto 200mts from HTL on the landward side in case of seafront and 100mts along tidal influenced water bodies or width of the creek whichever is less is to be earmarked as "No Development Zone (NDZ)",-

(i) the NDZ shall not be applicable in such area falling within any notified port limits;

(ii) No construction shall be permitted within NDZ except for repairs or reconstruction of existing authorized structure not exceeding existing Floor Space Index, existing plinth area and existing density and for permissible activities under the notification including facilities essential for activities; Construction/reconstruction of dwelling units of traditional coastal communities including fisherfolk may be permitted between 100 and 200 metres from the HTL along the seafront in accordance with a comprehensive plan prepared by the State Government or the Union territory in consultation with the traditional coastal

communities including fisherfolk and incorporating the necessary disaster management provision, sanitation and recommended by the concerned State or the Union territory CZMA to NCZMA for approval by MoEF;

(iii) however, the following activities may be permitted in NDZ –

(a) agriculture, horticulture, gardens, pasture, parks, play field, and forestry;
(b) projects relating to Department of Atomic Energy;
(c) mining of rare minerals;
(d) salt manufacture from seawater;
(e) facilities for receipt and storage of petroleum products and liquefied natural gas as specified in Annexure-II;
(f) facilities for regasification of liquefied natural gas subject to conditions as mentioned in subparagraph (ii) of paragraph 3;
(g) facilities for generating power by non conventional energy sources;
(h) Foreshore facilities for desalination plants and associated facilities;
(i) weather radars;
(j) construction of dispensaries, schools, public rain shelter, community toilets, bridges, roads, provision of facilities for water supply, drainage, sewerage, crematoria, cemeteries and electric sub-station which are required for the local inhabitants may be permitted on a case to case basis by CZMA;
(k) construction of units or auxiliary thereto for domestic sewage, treatment and disposal with the prior approval of the concerned Pollution Control Board or Committee;
(l) facilities required for local fishing communities such as fish drying yards, auction halls, net mending yards, traditional boat building yards, ice plant, ice crushing units, fish curing facilities and the like;
(m) development of green field airport already permitted only at Navi Mumbai.

B. Area between 200mts to 500mts,-

The following activities shall be permissible in the above areas;

(i) development of vacant plot in designated areas for construction of hotels or beach resorts for tourists or visitors subject to the conditions as specified in the guidelines at Annexure-III ;
(ii) facilities for receipt and storage of petroleum products and liquefied natural gas as specified in Annexure-II;
(iii) facilities for regasification of liquefied natural gas subject to conditions as mentioned in sub-paragraph (ii) of paragraph 3;
(iv) storage of non-hazardous cargo such as, edible oil, fertilizers, food grain in notified ports;
(v) foreshore facilities for desalination plants and associated facilities;
(vi) facilities for generating power by non-conventional energy sources;
(vii) construction or reconstruction of dwelling units so long it is within the ambit of traditional rights and customary uses such as existing fishing villages and goathans. Building permission for such construction or reconstruction will be subject to local town and country planning rules with overall height of construction not exceeding 9mts with two floors (ground + one floor);
(viii) Construction of public rain shelters, community toilets, water supply drainage, sewerage, roads and bridges by CZMA who may also permit construction of

schools and dispensaries for local inhabitants of the area for those panchayats, the major part of which falls within CRZ if no other area is available for construction of such facilities;

(ix) reconstruction or alteration of existing authorised building subject to sub-paragraph (vii), (viii);

(x) development of green field airport already permitted only at Navi Mumbai.

(IV) In CRZ-IV areas,-

The activities impugning on the sea and tidal influenced water bodies will be regulated except for traditional fishing and related activities undertaken by local communities as follows:-

(a)No untreated sewage, effluents, ballast water, ship washes, fly ash or solid waste from all activities including from aquaculture operations shall be let off or dumped. A comprehensive plan for treatment of sewage generating from the coastal towns and cities shall be formulated within a period of one year in consultation with stakeholders including traditional coastal communities, traditional fisherfolk and implemented;

(b) Pollution from oil and gas exploration and drilling, mining, boat house and shipping;

(c) There shall be no restriction on the traditional fishing and allied activities undertaken by local communities.

V. Areas requiring special consideration,-

1. CRZ areas falling within municipal limits of the Greater Mumbai.

(i) Developmental activities in the CRZ area of the Greater Mumbai because of the environmental issues, relating to degradation of mangroves, pollution of creeks and coastal waters, due to discharge of untreated effluents and disposal of solid waste, the need to provide decent housing to the poor section of society and lack of suitable alternatives in the inter connected islands of Greater Mumbai shall be regulated as follows, namely:-

A. Construction of roads - In CRZ-I areas indicated at sub-paragraph (i) of paragraph 7 of the notification the following activities only can be taken up:-

(a) Construction of roads, approach roads and missing link roads approved in the Developmental Plan of Greater Mumbai on stilts ensuring that the free flow of tidal water is not affected, without any benefit of CRZ-II accruing on the landward side of such constructed roads or approach roads subject to the following conditions:-

(i) All mangrove areas shall be mapped and notified as protected forest and necessary protection and conservation measures for the identified mangrove areas shall be initiated.

(ii) Five times the number of mangroves destroyed/cut during the construction process shall be replanted.

B. Solid waste disposal sites shall be identified outside the CRZ area and thereafter within two years the existing conventional solid waste sites shall be relocated outside the CRZ area.

(iii) In CRZ-II areas-

(a) The development or redevelopment shall continue to be undertaken in accordance with the norms laid down in the Town and Country Planning Regulations as they existed on the date of issue of the notification dated the 19th February, 1991, unless specified

otherwise in this notification.

(b) SLUM REHABITATION SCHEMES,-

1. In the Greater Mumbai area there are large slum clusters with lakhs of families residing therein and the living conditions in these slums are deplorable and the civic agencies are not able to provide basic infrastructure such as drinking water, electricity, roads, drainage and the like because the slums come up in an unplanned and congested manner and the slums in the coastal area are at great risk in the event of cyclones, storm surges or tsunamis, in view of the difficulties in providing rescue, relief and evacuation.
2. To provide a safe and decent dwelling to the slum dwellers, the State Government may implement slum redevelopment schemes as identified as on the date of issue of this notification directly or through its parastatal agencies like Maharashtra Housing and Area Development Authority (MHADA), Shivshahi Punarvasan Prakalp Limited (SPPL), Mumbai Metropolitan Region Development Authority (MMRDA) and the like.:

Provided that,-

(i) such redevelopment schemes shall be undertaken directly or through joint ventures or through public private partnerships or other similar models ensuring that the stake of the State Government or its parastatal entities shall be not less than 51%;

(ii) the Floor Space Index or Floor Area Ratio for such redevelopment schemes shall be in accordance with the Town and Country Planning Regulations prevailing as on the date on which the project is granted approval by the competent authority;

(iii) it shall be the duty of the project proponent undertaking the redevelopment through conditions (i) (2) above along with the State Government to ensure that all legally regularized tenants are provided houses in situ or as per norms laid down by the State Government in this regard.

(c) REDEVELOPMENT OF DILAPIDATED, CESSED AND UNSAFE BUILDINGS:

1. In the Greater Mumbai, there are, also a large number of old and dilapidated, cessed and unsafe buildings in the CRZ areas and due to their age these structures are extremely vulnerable and disaster prone and therefore there is an urgent need for the redevelopment or reconstruction of these identified buildings.

2. These projects shall be taken up subject to the following conditions and safeguards:

(i) such redevelopment or reconstruction projects as identified on the date of issue of this notification shall be allowed to be taken up involving the owners of these buildings either above or with private developers in accordance with the prevailing Regulation, directly or through joint ventures or through other similar models.
(ii) the Floor Space Index or Floor Area Ratio for such redevelopment schemes shall be in accordance with the Town and Country Planning Regulations prevailing as on the date on which the project is granted approval by the competent authority

(iii) suitable accommodation to the original tenants of the specified buildings shall be ensured during the course of redevelopment or reconstruction of the buildings by the project proponents, undertaking the redevelopment through condition 2(i) above.

(d) Notwithstanding anything contained in this notification, the developmental activities for slums and for dilapidated, cessed and unsafe buildings as specified at paras (b) and (c) above shall be carried out in an accountable and transparent manner by the project proponents mentioned therein which shall include the following pre-condition measures, wherever applicable;-

1. (i) applicability of the Right to Information Act, 2005 to all redevelopment or reconstruction projects granted clearance by the Competent Authorities;
(ii) MoEF shall issue an order constituting the CPIO and the first Appellate Authority of appropriate ranks in consultation with Government of Maharashtra;
(iii) details of the Slum Rehabilitation Scheme, including the complete proposal and the names of the eligible slum dwellers will be declared suo-moto as a requirement of Section 4 of compliance of the Right to Information Act, 2005 by the appropriate authority in the Government of Maharashtra in one month before approving it;
(iv) the implementing or executing agency at the State Government with regard to projects indicated at sub-item (b) and (c) of item (iii) of sub-paragraph V shall display on a large notice boards at the site and at the office of the implementing or executing agency the names of the eligible builders, total number of tenements being made, names of eligible slum dwellers who are to be provided the dwelling units and the extra area available for free sale.
(v) Projects being developed under sub-items (b) and (c) of item (iii) of sub-paragraph V shall be given permission only if the project proponent agree to be covered under the Right to Information Act, 2005.

2. MoEF may appoint statutory auditors, who are empanelled by the Comptroller and auditor General (hereinafter referred to as the C&AG) to undertake performance and fiscal audit in respect of the projects relating to redevelopment of dilapidated, cessed and unsafe buildings and the projects relating to Slum Rehabilitation Scheme shall be audited by C&AG.

3. A High Level Oversight Committee may be set up by the Government of Maharashtra for periodic review of implementation of V(iii)(b) and (c) which shall include eminent representatives of various Stakeholders, like Architects, Urban Planner, Engineers, and Civil Society, besides the local urban bodies, the State Government and the Central Government.

4. The individual projects under V(iii)(b) and (c) shall be undertaken only after public consultation in which views of only the legally entitled slum dweller or the legally entitled tenent of the dilapidated or cessed buildings shall be obtained in accordance with the procedures laid down in EIA notification, 2006.

(e) In order to protect and preserve the 'green lung' of the Greater Mumbai area, all open spaces, parks, gardens, playgrounds indicated in development plans within CRZ-II shall be categorized as CRZ-III, that is, 'no development zone'.

(f) the Floor Space Index upto 15% shall be allowed only for construction of civic amenities, stadium and gymnasium meant for recreational or sports related activities and the residential or commercial use of such open spaces shall not be permissible.

(g) Koliwada namely, fishing settlement areas as identified in the Development Plan of 1981 or relevant records of the Government of Maharashtra, shall be mapped and declared as CRZ-III so that any development, including construction and reconstruction of dwelling units within these settlements shall be undertaken in accordance with applicable as per local Town and Country Planning Regulations.

(h) Reconstruction and repair works of the dwelling units, belonging to fisher communities and other local communities identified by the State Government, shall be considered and granted permission by the Competent Authorities on a priority basis, in accordance with the applicable Town and Country Planning Regulations.

2. CRZ for Kerala

In view of the unique coastal systems of backwater and backwater islands alongwith space limitation present in the coastal stretches of the State of Kerala, the following activities in CRZ shall be regulated as follows, namely:-

(i) all the islands in the backwaters of Kerala shall be covered under the CRZ notification;

(ii) the islands within the backwaters shall have 50mts width from the High Tide Line on the landward side as the CRZ area;

(iii) within 50mts from the HTL of these backwater islands existing dwelling units of local communities may be repaired or reconstructed however no new construction shall be permitted;

(iv) beyond 50mts from the HTL on the landward side of backwater islands, dwelling units of local communities may be constructed with the prior permission of the Gram panchayat;

(v) foreshore facilities such as fishing jetty, fish drying yards, net mending yard, fishing processing by traditional methods, boat building yards, ice plant, boat repairs and the like, may be taken up within 50mts width from HTL of these backwater islands.

3. CRZ of Goa.-

In view of the peculiar circumstances of the State Goa including past history and other developments, the specific activities shall be regulated and various measures shall be undertaken as follows:-

(i) the Government of Goa shall notify the fishing villages wherein all foreshore facilities required for fishing and fishery allied activities such as traditional fish processing yards, boat building or repair yards, net mending yards, ice plants, ice storage, auction hall, jetties may be permitted by Grama Panchayat in the CRZ area;

(ii) reconstruction, repair works of the structures of local communities including fishermen community shall be permissible in CRZ;

(iii) purely temporary and seasonal structures customarily put up between the months of September to May;

(iv) the eco sensitive low lying areas which are influenced by tidal action known as khazan lands shall be mapped;

(v) the mangroves along such as khazan land shall be protected and a management plan for the khazan land prepared and no developmental activities shall be permitted in the khazan land;

(vi) sand dunes, beach stretches along the bays and creeks shall be surveyed and mapped. No activity shall be permitted on such sand dune areas;

(vii) the beaches such as Mandrem, Morjim, Galgiba and Agonda has been designated as turtle nesting sites and protected under the Wildlife Protection Act, 1972 and these areas

shall be surveyed and management plan prepared for protection of these turtle nesting sites;

(viii) no developmental activities shall be permitted in the turtle breeding areas referred to in sub-paragraph (vii).

4. (a) Critical Vulnerable Coastal Areas (CVCA) which includes Sunderbans and other identified ecological sensitive areas which shall be managed with the involvement of the local coastal communities including the fisher folk;-

(b) the entire Sunderbans mangrove area and other identified ecologically important areas such as Gulf of Khambat and Gulf of Kutchchh in Gujarat, Malvan, Achra-Ratnagiri in Maharashtra, Karwar and Coondapur in Karnataka, Vembanad in Kerala, Gulf of Mannar in Tamil Nadu, Bhaitarkanika in Orissa, Coringa, East Godavari and Krishna in Andhra Pradesh shall be declared as Critical Vulnerable Coastal Areas (CVCA) through a process of consultation with local fisher and other communities inhabiting the area and depend on its resources for their livelihood with the objective of promoting conservation and sustainable use of coastal resources and habitats;

(c) the process of identifying planning, notifying and implementing CVCA shall be detailed in the guideline which will be developed and notified by MoEF in consultations with the stakeholders like the State Government, local coastal communities and fisherfolk and the like inhabiting the area;

(d) the Integrated Management Plans (IMPs) prepared for such CVCA shall interalia keep in view the conservation and management of mangroves, needs of local communities such as, dispensaries, schools, public rain shelter, community toilets, bridges, roads, jetties, water supply, drainage, sewerage and the impact of sea level rise and other natural disasters and the IMPs will be prepared in line with the para 5 above for preparation of Coastal Zone Management Plans;

(e) till such time the IMPs are approved and notified, construction of dispensaries, schools, public rain shelters, community toilets, bridges, roads, jetties, water supply, drainage, sewerage which are required for traditional inhabitants shall be permitted on a case to case basis, by the CZMA with due regards to the views of coastal communities including fisherfolk.

[F.No.11-83/2005-IA-III]
J. M. MAUSKAR, Addl. Secy.

ANNEXURE I

GUIDELINES FOR PREPARATION OF COASTAL ZONE MANAGEMENT PLANS

I. A. Demarcation of High Tide Line

1. Demarcation of High Tide Line (HTL) and Low Tide Line (LTL) shall be carried out by one of the agencies authorised by MoEF based on the recommendations of the National Centre for Sustainable Coastal Management (NCSCM).
2. Demarcation of the High Tide Line or LTL shall be made on the Coastal Zone Management (CZM) Maps of scale 1:25,000 prepared by the agencies identified by the MoEF.
3. Local level CZM Maps shall be prepared for use of officials of local bodies for determination of the CRZ.
4. The local level CZM Maps shall be prepared on a Cadastral scale in accordance with the CZM Maps approved by the Central Government.

B. Preparation of CZM Maps

5. Base Maps of 1:25,000 scale shall be acquired from the Survey of India (SOI) and wherever 1:25,000 maps are not available, 1:50,000 maps shall be enlarged to 1:25,000 for the purpose of base map preparation and these maps will be of the standard specification given below:

Unit	:	7.5 minutes X 7.5minutes
Numbering	:	Survey of India Sheet Numbering System
Horizontal Datum	:	Everest or WGS 84
Vertical Datum	:	Mean Sea Level (MSL)
Topography	:	Topography in the SOI maps will be updated using latest satellite imageries or aerial photographs

6. The High Water Level (HWL) and Low Water Level (LWL) marked on the Base maps will be transferred to the CZM maps.
7. Coastal geomorphological signatures in the field or satellite imageries or aerial photographs will be used for appropriate adjustment, in the HWL or LWL for demarcating HTL or LTL in accordance with the CRZ notification.
8. The following geomorphological features shall be considered while demarcating in HTL or LTL:
   Landward (monsoonal) berm crest in the case of sandy beaches
   Rocks, Headlands, Cliffs
   Seawalls or revetments or embankments
9. 500 meter and 200 metre lines will be demarcated with respect of HTL.
10. HTL (as defined in the CRZ notification) and LTL shall also be demarcated in the CZM maps along the banks of tidal influenced inland water bodies with the help of the geomorphological signatures or features.
11. Classification of different coastal zones shall be done as per the CRZ notification
12. Standard national or international colour codes shall be used to highlight sub-classification of data.

C. Local level CZM Maps

Local level CZM Maps are for the use of local bodies and other agencies to facilitate implementation of the Coastal Zone Management Plans

13. Cadastral (village) maps in 1:3960 or the nearest scale, shall be used as the base maps.

14. These maps are available with revenue Authorities and are prepared as per standard norms.
15. HTL (as defined in the CRZ notification) and LTL will be demarcated in the cadastral map based on detailed physical verification using coastal geomorphological signatures or features in accordance with the CZM Maps approved by the Central Government.
16. 500metre and 200metre lines shall be demarcated with respect to the HTL thus marked.
17. HTL (as defined in the CRZ notification, 1991) and LTL will also be demarcated along the banks of tidal influenced inland water bodies with the help of geomorphological signatures or features.
18. Classifications shall be transferred into local level CZM maps from the CZM Plans.
19. Symbols will be adopted from CZM Maps.
20. Colour codes as given in CZM Maps shall be used.
21. Demarcation of cadastral maps will be done by local agencies approved by the Central Government. The local agencies shall work under the guidance of the concerned State Government or Union Territory Coastal Zone Management Authorities.

D. Hazard mapping:-

II. Classification of CRZ areas

1. The CZM Maps shall be prepared in accordance with para 5 of the CRZ notification demarcating CRZ I, II, III, IV and V.
2. The CZM Maps shall clearly demarcate the land use plan of the area and lists out the CRZ-I areas. All the CRZ-I areas listed under para 7(I)A and B shall be clearly demarcated and colour codes given so that each of the CRZ-I areas can be clearly identified.
3. Buffer zone along mangrove areas of more than 1000sq mts shall be stipulated with a different colour distinguishing from the mangrove area.
4. The buffer zone shall also be classified as CRZ-I area.
5. The hazard line to be drawn up by MoEF shall be superimposed on the CZM maps in 1:25,000 scale and also on the cadastral scale maps.
6. The CRZ-II areas shall be those areas which have been substantially built-up with a ratio of built-up plots to that of total plots is more than 50%.
7. In the CRZ areas, the fishing villages, common properties of the fishermen communities, fishing jetties, ice plants, fish drying platforms or areas infrastructure facilities of fishing and local communities such as dispensaries, roads, schools, and the like, shall be indicated on the cadastral scale maps. States shall prepare detailed plans for long term housing needs of coastal fisher communities in view of expansion and other needs, provisions of basic services including sanitation, safety, and disaster preparedness.
8. No developmental activities other than those listed above shall be permitted in the areas between the hazard line and 500mts or 100mts or width of the creek on the landward side. The dwelling unit of the local communities including that of the fishers will not be relocated if the dwelling units are located on the seaward side of the hazard line. The State Government will provide necessary safeguards from natural disaster to such dwelling units of local communities.
9. The water areas of CRZ IV shall be demarcated and clearly demarcated if the water body is sea, lagoon, backwater, creek, bay, estuary and for such classification of the water bodies the terminology used by Naval Hydrographic Office shall be relied upon.
10. The fishing Zones in the water bodies and the fish breeding areas shall be clearly marked.
11. The water area shall be demarcated indicating the pollution levels as per Central Pollution Control Board standards on water quality.
12. In the CRZ V areas the land use maps shall be superimposed on the Coastal Zone Management Plan and clearly demarcating the CRZ I, II, III, IV.
13. The existing authorized developments on the sea ward side shall be clearly demarcated.

14. The features like cyclone shelters, rain shelters, helipads and other infrastructure including road network may be clearly indicated on the CZM Maps for the purpose of rescue and relief operations during cyclones, storms, tsunami and the like.

III. CZMPs approved by MoEF in accordance with CRZ notification, 1991

1. While preparing the CZMPs under CRZ notification, 2011, the CZMPs that have been approved under the CRZ Notification, 1991 shall be compared. A justification shall be provided by the concerned CZMA in case the CZMPs prepared under CRZ notification, 2011 varies with respect to the approved CZMP prepared under CRZ notification, 1991.

IV. Public Views on the CZMP.

a) The draft CZMPs prepared shall be given wide publicity and suggestions and objections received in accordance with the Environment (Protection) Act, 1986. Public hearing on the draft CZMPs shall be held at district level by the concerned CZMAs.
b) Based on the suggestions and objections received the CZMPs shall be revised and approval of MoEF shall be obtained.
c) The approved CZMP shall be put up on the website of MoEF, concerned website of the State, Union Territory CZMA and hard copy made available in the panchayat office, District collector office and the like.

V. Revision of Coastal Zone Management Plans

1. Whenever there is a doubt the concerned State or Union territory Coastal Zone Management Authority shall refer the matter to the National Centre for Sustainable Coastal Management who shall verify the CZMP based on latest satellite imagery and ground truthing.
2. The rectified map would be submitted to MoEF for its record.

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Annexure-II

List of petroleum and chemical products permitted for storage in [CRZ except CRZ-I(A)]

(i) Crude oil;
(ii) Liquefied Petroleum Gas;
(iii) Motor spirit;
(iv) Kerosene;
(v) Aviation fuel;
(vi) High speed diesel;
(vii) Lubricating oil;
(viii) Butane;
(ix) Propane;
(x) Compressed Natural Gas;
(xi) Naphtha;
(xii) Furnace oil;
(xiii) Low Sulphur Heavy Stock;
(xiv) Liquefied Natural Gas;
(xv) Fertilizers and raw materials for manufacture of fertilizers.

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Annexure-III

Guidelines for development of beach resorts or hotels in the designated areas of CRZ-III and CRZ-II for occupation of tourist or visitors with prior approval of the Ministry of Environment and Forests

I. Construction of beach resorts or hotels with prior approval of MoEF in designated areas of CRZ-II and III for occupation of tourist or visitors shall be subject to the following conditions, namely:-

(a) The project proponent shall not undertake any construction within 200 metres in the landward side of High Tide Line and within the area between Low Tide Line and High Tide Line;

(b) The proposed constructions shall be beyond the hazard line or 200mts from the High Tide Line whichever is more;

(c) live fencing and barbed wire fencing with vegetative cover may be allowed around private properties subject to the condition that such fencing shall in no way hamper public access to the beach;

(d) no flattening of sand dunes shall be carried out;

(e) no permanent structures for sports facilities shall be permitted except construction of goal posts, net posts and lamp posts;

(f) Construction of basement may be allowed subject to the condition that no objection certification is obtained from the State Ground Water Authority to the effect that such construction will not adversely affect fee flow of groundwater in that area;

(g) the State Ground Water Authority shall take into consideration the guidelines issued by Central Government before granting such no objection certificate;

(h) though no construction is allowed in the no development zone for the purposes of calculation of Floor Space Index, the area of entire plot including the portion which falls within the no development zone shall be taken into account;

(i) the total plot size shall not be less than 0.4 hectares and the total covered area on all floors shall not exceed 33 percent of the plot size i.e., the Floor Space Index shall not exceed 0.33 and the open area shall be suitably landscaped with appropriate vegetal cover;

(j) the construction shall be consistent with the surrounding landscape and local architectural style;

(k) the overall height of construction upto the highest ridge of the roof, shall not exceed 9metres and the construction shall not be more than two floors (ground floor plus one upper floor);

(l) groundwater shall not be tapped within 200metre of the High Tide Line; within the 200metre 500metre zone it can be tapped only with the concurrence of the Central or State Ground Water Board;

(m) extraction of sand, leveling or digging of sandy stretches except for structural foundation of building, swimming pool shall not be permitted within 500metres of the High Tide Line;

(n) the quality of treated effluents, solid wastes, emissions and noise levels and the like, from the project area must conform to the standards laid down by the competent authorities including the Central or State Pollution Control Board and under the Environment (Protection) Act, 1986;

(o) necessary arrangements for the treatment of the effluents and solid wastes must be made and it must be ensured that the untreated effluents and solid wastes are not discharged into the water or on the beach; and no effluent or solid waste shall be discharged on the beach;

(p) to allow public access to the beach, atleast a gap of 20metres width shall be provided between any two hotels or beach resorts; and in no case shall gaps be less than 500metres apart; and

(q) if the project involves diversion of forestland for non-forest purposes, clearance as required under the Forest (Conservation) Act, 1980 shall be obtained and the requirements of other Central and State laws as applicable to the project shall be met with; and

(r) approval of the State or Union territory Tourism Department shall be obtained.

II. In ecologically sensitive areas (such as marine parks, mangroves, coral reefs, breeding and spawning grounds of fish, wildlife habitats and such other area as may be notified by the Central or State Government Union territories) construction of beach resorts or hotels shall not be permitted

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Annexure-IV

Form-I for seeking clearance for project attracting CRZ notification

Basic information:

Name of the Project:-

Location or site alternatives under consideration:-

Size of the project (in terms of total area) :-

CRZ classification of the area :-

Expected cost of the project:-

Contact Information:-

(II) Activity

1. Construction, operation or decommissioning of the Project involving actions, which will cause physical changes in the locality (topography, land use, changes in water bodies, and the like)

S. No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
1.1	Permanent or temporary change in land use, land cover or topography including increase in intensity of land use (with respect to local land use plan)		
1.2	Details of CRZ classification as per the approved Coastal Zone Management Plan?		
1.3	Whether located in CRZ-I area?		
1.4	The distance from the CRZ-I areas.		
1.5	Whether located within the hazard zone as mapped by Ministry of Environment and Forests/National Disaster Management Authority?		
1.6	Whether the area is prone to cyclone, tsunami, tidal surge, subduction, earthquake etc.?		
1.7	Whether the area is prone for saltwater ingress?		
1.8	Clearance of existing land, vegetation and buildings?		
1.9	Creation of new land uses?		
1.10	Pre-construction investigations e.g. bore hole, soil testing?		
1.11	Construction works?		

1.12	Demolition works?		
1.13	Temporary sites used for construction works or housing of construction workers?		
1.14	Above ground buildings, structures or earthworks including linear structures, cut and fill or excavations		
1.15	Underground works including mining or tunneling?		
1.16	Reclamation works?		
1.17	Dredging/reclamation/land filling/disposal of dredged material etc.?		
1.18	Offshore structures?		
1.19	Production and manufacturing processes?		
1.20	Facilities for storage of goods or materials?		
1.21	Facilities for treatment or disposal of solid waste or liquid effluents?		
1.22	Facilities for long term housing of operational workers?		
1.23	New road, rail or sea traffic during construction or operation?		
1.24	New road, rail, air waterborne or other transport infrastructure including new or altered routes and stations, ports, airports etc?		
1.25	Closure or diversion of existing transport routes or infrastructure leading to changes in traffic movements?		
1.26	New or diverted transmission lines or pipelines?		
1.27	Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers?		
1.28	Stream and river crossings?		
1.29	Abstraction or transfers of water form ground or surface waters?		
1.30	Changes in water bodies or the land surface affecting drainage or run-off?		
1.31	Transport of personnel or materials for construction, operation or decommissioning?		
1.32	Long-term dismantling or decommissioning or restoration works?		
1.33	Ongoing activity during decommissioning which could have an impact on the environment?		
1.34	Influx of people to an area in either temporarily or permanently?		
1.35	Introduction of alien species?		
1.36	Loss of native species or genetic diversity?		
1.37	Any other actions?		

2. Use of Natural resources for construction or operation of the Project (such as land, water, materials or energy, especially any resources which are non-renewable or in short supply):

S. No.	Information/checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
2.1	Land especially undeveloped or agricultural land (ha)		
2.2	Water (expected source & competing users) unit: KLD		
2.3	Minerals (MT)		
2.4	Construction material – stone, aggregates, sand/soil (expected source – MT)		
2.5	Forests and timber (source – MT)		
2.6	Energy including electricity and fuels (source, competing users) Unit: fuel (MT), energy (MW)		
2.7	Any other natural resources (use appropriate standard units)		

3. Use, storage, transport, handling or production of substances or materials, which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health.

S. No.	Information/Checklist confirmation	Yes/ No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
3.1	Use of substances or materials, which are hazardous (as per MSIHC rules) to human health or the environment (flora, fauna, and water supplies)		
3.2	Changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)		
3.3	Affect the welfare of people e.g. by changing living conditions?		
3.4	Vulnerable groups of people who could be affected by the project e.g. hospital patients, children, the elderly etc.,		
3.5	Any other causes, that would affect local communities, fisherfolk, their livelihood, dwelling units of traditional local communities etc		

4. Production of solid wastes during construction or operation or decommissioning (MT/month)

S. No.	Information/Checklist confirmation	Yes/ No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data

4.1	Spoil, overburden or mine wastes		
4.2	Municipal waste (domestic and or commercial wastes)		
4.3	Hazardous wastes (as per Hazardous Waste Management Rules)		
4.4	Other industrial process wastes		
4.5	Surplus product		
4.6	Sewage sludge or other sludge from effluent treatment		
4.7	Construction or demolition wastes		
4.8	Redundant machinery or equipment		
4.9	Contaminated soils or other materials		
4.10	Agricultural wastes		
4.11	Other solid wastes		

5. Release of pollutants or any hazardous, toxic or noxious substances to air (Kg/hr)

S. No.	Information/Checklist confirmation	Yes/ No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
5.1	Emissions from combustion of fossil fuels from stationary or mobile sources		
5.2	Emissions from production processes		
5.3	Emissions from materials handling including storage or transport		
5.4	Emissions from construction activities including plant and equipment		
5.5	Dust or odours from handling of materials including construction materials, sewage and waste		
5.6	Emissions from incineration of waste		
5.7	Emissions from burning of waste in open air (e.g. slash materials, construction debris)		
5.8	Emissions from any other sources		

6. Generation of Noise and Vibration, and Emissions of Light and Heat:

S. No.	Information/Checklist confirmation	Yes/ No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data with source of information data
6.1	From operation of equipment e.g. engines, ventilation plant, crushers		
6.2	From industrial or similar processes		
6.3	From construction or demolition		
6.4	From blasting or piling		
6.5	From construction or operational traffic		
6.6	From lighting or cooling systems		

6.7	From any other sources		

7. Risks of contamination of land or water from releases of pollutants into the ground or into sewers, surface waters, groundwater, coastal waters or the sea:

S. No.	Information/Checklist confirmation	Yes/ No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
7.1	From handling, storage, use or spillage of hazardous materials		
7.2	From discharge of sewage or other effluents to water or the land (expected mode and place of discharge)		
7.3	By deposition of pollutants emitted to air into the land or into water		
7.4	From any other sources		
7.5	Is there a risk of long term build up of pollutants in the environment from these sources?		

8. Risk of accidents during construction or operation of the Project, which could affect human health or the environment

S. No.	Information/Checklist confirmation	Yes/ No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
8.1	From explosions, spillages, fires etc from storage, handling, use or production of hazardous substances		
8.2	From any other causes		
8.3	Could the project be affected by natural disasters causing environmental damage (e.g., floods, earthquakes, landslides, cloudburst etc)?		

9. Factors which should be considered (such as consequential development) which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality

S. No.	Information/Checklist confirmation	Yes/ No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
9.1	Lead to development of supporting. lities, ancillary development or development stimulated by the project which could have impact on the environment e.g.: Supporting infrastructure (roads, power supply, waste or waste water treatment, etc.)		

	housing development extractive industries supply industries other		
9.2	Lead to after-use of the site, which could have an impact on the environment		
9.3	Set a precedent for later developments		
9.4	Have cumulative effects due to proximity to other existing or planned projects with similar effects		

III. Environmental Sensitivity

S. No.	Areas	Name/ Identity	Aerial distance (within 15 km.) Proposed project location boundary
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value		
2	Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests		
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration		
4	Inland, coastal, marine or underground waters		
5	State, National boundaries		
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas		
7	Defence installations		
8	Densely populated or built-up area		
9	Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)		
10	Areas containing important, high quality or scarce resources (ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)		
11	Areas already subjected to pollution or environmental damage. (those where existing legal environmental standards are exceeded)		
12	Areas susceptible to natural hazard which could cause the project to present environmental problems (earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions)		

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Appendix V

	Response for Questionnaires for Research Purpose							
Sr.No		**1**	**2**	**3**	**4**	**5**	**6**	**7**
1	**Name of information provider**	Anita Chodankar	Mrs. Reshma Kerkar	Mamata Sawant	Radhika Sawant	Ashok Manohar Megeri	Kishore R. Kubal	Shila M Kunji
2	**Age**	42	48	21	45	43	49	33
3	**Gender – Male / Female**	Female	Female	Female	Female	Male	Male	Female
4	**Family Size**	4	6	4	4	4	8	2
5	**Past system from Year 2000 till Year 2016 and Present System of garbage management at home**	Burning of dry waste and throwing wet waste to the plants	Door to Door collection of waste (Segregated in two types only) started in 2015, previously waste (garbage) was dumped at a destinated site from where it was picked up by Village Panchayat. [* Coconut shells are collected separately and given to a local person for use as final]	Segregation of waste at source by putting bio degradable waste to plants	Past system we use to throw Biodegradable waste to plants and trees and now we give all garbage to Garbage collector	Present system of garbage is better than past system	Previously we used to empty our garbage at certain places where big dustbins were placed. Now door to door collection of garbage is started by village panchayat. We give garbage to the concerned Person on daily basis	Past system garbage was thrown anywhere. Present system- segregation of wet and dry waste collection of garbage is done in each house

6	**Past system from Year 2000 till Year 2016 and Present System of garbage management in village panchayat**	Collection of garbage door to door	2000 to 2015- Village Panchayat collected accumulated waste from common waste dump sites. 2015 onwards- Door to door collection of waste started [two way segregation only]	People use to throw garbage in river and water drain. They continue to do so but at less rate because of door to door collection of waste	Before people use to dispose of their garbage at the backyard or a river, now most of them give it to garbage collector and some continue to throw	Good everyday garbage has been collected on daily basis	Penha de Franca Village Panchayat started door to door garbage collection since last two years for that charges are being levied	
	Specific Information in addition to above for better understanding of the problem		All the dry waste including- paper, metal, plastic, glass is collected separate and wet waste- food waste where even sorted plastic is dumped by the residents of Penha-de-Franca			1. Garbage collector should wait till everybody gives the garbage 2.He should come 7am not when all are sleeping. 3. Bins should be kept around the society area	For so many years no body was serious about the issue. Now awareness is at war footing	Avoid usage of plastic bags for shopping

7	**What was ancestral or traditional method of garbage disposal in your area?**	People use to dispose their garbage at home only rather than littering or accumulating	In my ancestral village (Velim-Salcete) 20-25 years earlier, hardly any waste (paper & plastic) was generated. Waste was consumed by pet animals and crows. Plastic food old newspapers paper and glass was collected or purchased or bartered.	People use to segregate garbage at source and very few used to dispose in the river or water drain	People use to burn dry waste and throw wet waste in backyard to trees	Garbage dumping at particular place	People use to throw garbage in open spaces. Few people use to throw it in dustbins	The dry waste was mostly burned wet waste was either fed to animals or put as manure for plants
8	**When did you feel that the garbage handling, disposal or as problem became prominent? Which year approximately?**	2007	Garbage as a problem started around 1990's but has become very pronounced since 2000, specially with increase in apartment style housing, Mega or super marts using plastic packing material and consumption pattern of public	2006	around 2005	2003 onwards	As far as Porvorim is concerned, population increased like anything since last 10 years. New constructions came up and garbage problems became worst.	The more advance we become, we end up making more garbage. First we use to use cloth bags for vegetable shopping and now we use plastic and then end up throwing it in the dustbin

9	**What is the cause of problem according to you?**	Over population and housing projects	Manufacturing and packers of consumables use plastic in discriminately and have no responsibility towards the waste so created (including pet bottles large quantity of thermocol (polystyrene) used etc.)	Many Housing Complexes without Garbage Management	People learning in urban areas does not have adequate place to throw garbage. People doesn't has a sense of self responsibility	1. People are not aware about types of waste 2. Even if they are aware they don't won't to segregate 3. Careless about disease which is spread through it	1. No Proper Management 2. Landfill site is a mist. Till date not identified 3. If possible garbage treatment plant	Lack of disposal plants. The main cause is dry waste which is non degradable

10	**What could be the best way to solve the problem, according to you?**	by Self-Management	1) Avoid Manufacturing smaller bottles (pet bottles of less volume capacity 250 ml) instead higher volume 500ml or more should be encouraged. 2) Packaging material should be eco-friendly (Card board egg cases for example instead of plastic). Consumables (fresh like eggs, mushrooms, fruit etc. should not be pre-packaged by retailer in paper bags or paper packaging as required- this will decrease the amount of packaging material as well as packer (one person) will be employed. The manufacturers should be made	If people start self-segregation of river waste	I think every person should dig a pit and throw their wet waste in it and dry was should be given to the paper, plastic collectors.	1. Awareness should be spread among the people 2. Garbage bins should be provided to every society 3. Waste Management programs should be conducted 4. He should collect the garbage door to door and not whistling in the society for few minutes	1. Plastic bins should be provided for housing board colonies. So that wet and dry garbage could be accumulated separately and source. 2. Garbage treatment plant	Have disposable plants for dry waste as wet waste can be used to make manure for plants

			responsible to collect back the packaging or at least most of the packaging material specially manufacturers of chips and other edible products, special collection points may be assigned for the same.[soiled paper waste and food waste is composted (remains of food after crows have consumed it). 3) Plastic bags are collected and given to local Grocer for reuse. 4) Tried collecting milk packets (empty); due to space constraints the same are given to collector along with other garbage.					

11	**Is there any effort taken by you, or anyone else in your area, according to you? What was the outcome of the effort?**	Door to Door collection has reduced waste or garbage accumulation	Waste to be segregated into more and more different fractions (instead of just wet and dry waste). This will make recycling more efficient. Neighbours used to give the wate without segregation. The waste collector has been informed not to collect unsegregated waste. This compels the public to segregate at least into wet and dry waste	Village Panchayat door to door collection of garbage	Panchayat has set up garbage treatment plant	Every year as a society we come together and clean our surrounding area. Which creates the healthy environment	Previously people use to throw garbage in open space. Now since there is awareness people give it to the person who comes for collection. Village Panchayat is doing efforts	Very Few people take the initiative to segregate dry and wet waste. People still mix it and give
12	**Did you feel that enough efforts are taken by your local governing body?**	yes	Yes. Door to door collection of segregated waste was a good step	Yes	I think that local governing authority is acting at its best but yet it's not working	No	Yes. Even local MLA consistent about solving problem. He raised issue in Assembly also	They are trying their best but it all will be possible with the support of the people

13	**Do you feel that efforts are taken by your local governing body will become successful?**	Yes if cooperation of people is given	Yes. But support of public is equally important. Some garbage is still thrown in some open spaces in my locality	Yes, If people Participate	it has reduced waste, but people still try to litter which makes the work difficult	May be	1. Landfill site is a must 2. Garbage treatment plant is also need of hour	Let's hope for the best
14	**How much garbage approximately is generated daily from your house? In Kgs.**	1 Kg	Wet waste less then 1/4th Kg Dry waste- one per week	1 kg	Wet and dry waste may be a Kilo or less	1/2 - 1 Kg	Maximum one to one and half kg	1,2 kg wet waste
	do you segregate at source? Yes / No, If no, then Why?	Yes	yes I seggregate and compost too	Yes	Yes	Yes we do segregate the garbage	Yes. Separate Plastic bags are used for wet and dry garbage	yes
	How many categories do you segregate and which are they?	Two (Dry and Wet)	1. Food waste, shell fish, vegetable stalks 2. Plastic 3. Newspaper and Cardboard packaging given for recycling 4.Harzadeous battery (cells) are collected in a plastic bottle once full it is placed with dry waste	Dry and wet waste	Wet and dry waste may be a Kilo or less	Dry and wet	two- wet and dry	Dry and wet waste

	Do you feel that segregation at source is important? Why?	Yes, reduces garbage issues	Yes, Segregation is very important. Now more fractions like glass, plastic will be collected separated so this will help in management of the waste	yes	Yes it is important it in turns reduces the garbage out let problem	Yes. It is very important	Yes. But at the same time Village Panchayat should provide separate dustbins as they are charging us	Yes. Of course its important as the dry waste can be put directly in the plant for disposal
15	**What is your prediction for future of garbage problem in your area?**	I think people will learn to segregate	Still awareness is required, but village panchayat is doing a good job with help of GWMC	I think people won't realise that garbage is a issue and they will continue	I think people should stop throwing garbage in river	It should be free garbage area. Healthy surrounding	The way constructions are carried up it will be worsened	We are Improving
16	**Do you feel that public participation is necessary for the success?**	Yes	Yes public participation and support is required	Yes very important	Yes it is very important	Yes it is very important	Yes, for that awareness is important at the level of government also. Govt. can't be a spectator	Of course

	Any other important view or expectation regarding garbage issue?		More composting units or knowledge can be provided to Housing Societies so that less wet waste is generated and compost can be utilised for gardening. The Housing Societies can be encouraged by providing subsidised units, local grocers and markets should be encouraged to use biodegradable packing material instead of plastic		There is a need for a people to understand that garbage is a problem and given their participation	How the garbage does financially managed which should be addressed to the people. Garbage collection should not go more than the house tax which we are paying. They should provide us a proper system	1. Ban on Plastic Bags below 40 micron should be implemented strictly 2. People throwing garbage at open space should be penalised. Legislation is required for that purpose.	I would prefer more disposal bins on shopping streets and beaches where people tend to throw more plastic

The History of Waste

Do you want to be a garbologist?

By Roberta Crowell Barbalace

Kenneth Barbalace. The History of Waste. EnvironmentalChemistry.com. Aug. 2003. Accessed on-line: 10/12/2017,https://EnvironmentalChemistry.com/yogi/environmental/wastehistory.html, (https://environmentalchemistry.com/yogi/environmental/wastehistory.html)

The study of garbage has given us much insight into civilizations of yesteryear. It has been instrumental in solving crimes. It has even resulted in the fall of an American president.

Humans are by their very nature careless with trash. It is not a trait of the 20th century. Garbologists have discovered that people let trash fall where it may.

As the timeline of garbage history suggests (below), there has been a problem of trash from man's earliest time. Four basic means of dealing with trash have been used over and over in history. 1. Dumping 2. Burning 3. Recycling 4.Waste minimization

The Mayan Indians of Central America had dumps, which exploded occasionally and burned. They also recycled. Homemakers didn't sweep trash under their rugs. Some was trampled under foot and some was swept into corners. When it got too deep, they would bring in dirt to cover it.

Some cultures were very wasteful, considering everything disposable. Many Mayan sites demonstrated such careless consumption. Consumption and waste of resources is probably related to supply available more than any other factor. When gasoline is plentiful and cheap, automobiles get larger (nobody is thinking about future supplies). When it becomes scarce and expensive, automobiles get smaller.

Trash has played a tremendous role in history. The Bubonic Plague, cholera and typhoid fever, to mention a few, were diseases that altered the populations of Europe and influenced monarchies. They were perpetuated by filth that harbored rats, and contaminated water supply. It was not uncommon for Europeans to throw their garbage and even human wastes out of the window. They figured that stray dogs would eat whatever they threw out.

How does the waste we toss today compare to the waste that was thrown away by other civilizations? It is hard to be specific. Until recently trash quantity was calculated by volume not weight. Volume is dependant upon how much the trash is compacted. Weight is influenced by moisture content, which varies greatly depending upon climate and weather conditions. The various studies that have been conducted vary too greatly to get a clear picture of per capita refuse per day.

Studies fail to substantiate the notion that Americans are more wasteful than similar civilizations of the past. Note that the nature of the waste varies greatly from one civilization to another. There is an archeological account of Native Americans in Colorado about 6500 BC who killed 200 buffalo in one day and butchered 150

of them, carrying away enough meat to feed 150 people for 23 days. They left the remains behind (some 18,380 pounds of bones, which had remained for 6500 years. Soft tissue had decomposed years ago). 150 modern day Americans would produce about 14,150 pounds in 23 days, most of which would have decomposed rapidly. Based on the weight of the bones that remained, the Native Americans in that clan produced about 5.3 pounds of waste a day as compared to 2.5 pounds a day, which is a moderate figure for middle class American consumption.

A Timeline of Trash

Date	Location	Notes
6,500 BC	North America	Archeological studies shows a clan of Native Americans in what is now Colorado produced an average of 5.3 pounds of waste a day.
500 BC	Athens Greece	First municipal dump in western world organized. Regulations required waste to be dumped at least a mile from the city limits.
New Testament of Bible	Jerusalem Palestine	The Valley of Gehenna also called Sheoal in the New Testament of the Bible "Though I descent into Sheol, thou art there." Sheoal was apparently a dump outside of the city of that periodically burned. It became synonymous with "hell."
1388	England	English Parliament bars waste dispersal in public waterways and ditches.
1400	Paris France	Garbage piles so high outside of Paris gates that it interferes with city defense.
1690	Philadelphia	Rittenhouse Mill, Philadelphia makes paper from recycled fibers (waste paper and rags).
1842	England	A report links disease to filthy environmental conditions - "age of sanitation" begins.
1874	Nottingham England	A new technology called "the Destructor" provided the first systematic incineration of refuse in Nottingham, England. Until this time, much of the burning was accidental, a result of methane production.
1885	Governor's Island NY	The first garbage incinerator was built in USA (on Governor's Island in NY)
1889	Washington DC	Washington DC reported that we were running out of appropriate places for refuse (sound familiar?).
1896	United States	Waste reduction plants arrive in US. (for compressing organic wastes). Later closed because of noxious emissions.
1898	New York	NY has first rubbish sorting plant for recycling (are we reinventing the wheel?).
Turn of Century		By the turn of the century the garbage problem was seen as one of the greatest problems for local authorities.
1900		"Piggeries" were developed to eat fresh or cooked garbage (In the mid-50's an outbreak of vesicluar exenthama resulted in the destruction of 1,000s of pigs that had eaten raw garbage. Law passed requiring that garbage had to be cooked before it could be fed to swine).
1911	New York City	NYC citizens were producing 4.6 pounds of refuse a day (remember the Native Americans from 6500 BC mentioned above?).

A Timeline of Trash

Date	Location	Notes
1914	United States	there were about 300 incinerators in the US for burning trash.
1920's		Landfills were becoming a popular way of reclaiming swamp land while getting rid of trash.
1954	Olympia Washington	Olympia Washington pays for return of aluminum cans.
1965	United States	The first federal solid waste management laws were enacted.
1968		By 1968 companies began buy back recycling of containers.
1970	United States	The first Earth Day was celebrated, the Environmental Protection Agency EPA created and the Resource Recovery Act enacted.
1976	United States	In 1976 Resource Conservation and Recovery Act (RCRA) was created emphasizing recycling and HW management. This was the result of two major events: the oil embargo and the discovery (or recognition) of Love Canal.
1979	United States	The EPA issued criteria prohibiting open dumping.
Today		The list goes on and on.

Related Resources

- Guide for Handling Household Chemicals
  Things you can do to make your home safer.
- Protecting Wildlife from Trash
  Many solid waste companies and municipal landfills have the situation well in hand; do you?
- How Well Do You Know Recycled Paper
  Just like anything else, the recycled paper you buy may not always be what it seems.
- Plastics - From Recycling Bin to New Product
  If a plastic makes it into the recycling loop, it will go through many processes before it emerges as a recycled product.
- RoHS: Europe's Initiative to Control Technological Waste

  What will be done with the debris of the information age? The European Union (EU) member states are taking action and holding manufacturers responsible for the hazardous materials in their products.

Evaluation of Selected Representative Questionnaire Response

	Question	Response	
2	**Gender**	***Male***	***Female***
		2	5
3	**Age Group**	***Range***	***Average***
		21 to 49	34
4	**Family Size**	***Range***	***Average***
		02 to 08	5
5	**Past system from Year 2000 till Year 2016 and Present System of garbage management at home**	Better at present	
6	**Past system from Year 2000 till Year 2016 and Present System of garbage management in village panchayat**	Better at present	
	Specific Information in addition to above for better understanding of the problem	Appreciable inputs are received and included in the contents of thesis	
7	**What was ancestral or traditional method of garbage disposal in your area?**	Dispose garbage in pits (by less than 5% people) rest in open and **burning of non degradable waste**	
8	**When did you feel that the garbage handling, disposal or as problem became prominent? Which year approximately?**	***Range***	***Average***
		2000 to 2007	
9	**What is the cause of problem according to you?**	Overall failure (both govt and public)	
10	**What could be the best way to solve the problem, according to you?**	Proactive public	
11	**Is there any effort taken by you, or anyone else in your area, according to you? What was the outcome of the effort?**	Commom approach - door to door collection of waste	
12	**Did you feel that enough efforts are taken by your local governing body?**	***Remarks***	***Average***
		Government trying to solve but no outcome	Yes

13	**Do you feel that efforts are taken by your local governing body will become successful?**	***Remarks***	***Average***
		Public corporation and support needed	Yes
14	**How much garbage approximately is generated daily from your house? In Kgs.**	***Range***	***Average***
		0.5 to 2 kg	1 kg
	do you segregate at source? Yes / No, If no, then Why?	Yes	
	How many categories do you segregate and which are they?	Two categories -Dry and Wet	
	Do you feel that segregation at source is important? Why?	Yes	
15	**What is your prediction for future of garbage problem in your area?**	Awareness needed	
16	**Do you feel that public participation is necessary for the success?**	Yes	
	Any other important view or expectation regarding garbage issue?	Inputs given are reflected in the concluding contents	

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42	Mangrove ecosystems under stress. In G. W. Barret and R. Rosenberg (Eds.). Stress effects on natural ecosystems, pp. 129-153. John Wiley & Sons, Ltd. 305 pp. and K. Kathiresan. 2002. Why are mangroves degrading? Current Science, Vol. 83, No. 10, 25 November, 2002, Lugo, G. Cintron and C. Goenaga. 1981.	John Wiley & Sons, Ltd. 305 pp. and K. Kathiresan. 2002	1981, 2002	{Barret and R. Rosenberg, K. Kathiresan. 2002, Lugo et al (1980) 1981, 2002}	PP. 129-153, Current Science, Vol. 83, No. 10, 25	Chapter II
43	Article on internet - A Timeline of Trash, by Roberto Crowell Barbalance, Kenneth Barbalace. The History of Waste. Environmental Chemistry.com. Aug. 2003. Accessed on-line: 10/12/2017, https://EnvironmentalChemistry.com/yogi/environmental/wastehistory.html		Aug. 2003	Article, RCB, Envi. Chem, 2003	Discrete extracts taken and article placed in Appendix VI, Page 1, Line 3, 12, 13, Page 2 & 3	Chapter IV and Appendix VI
44	Environmental Economics - In theory and practice, Nick Hanley- University of Stirling, Jason F. Shogren – University of Wyoming and Ben White – University of New Castle upon type, Macmillan India led. 1999 (reprinted) by permission Copyright licensing Agency 190, Tottenham Court Road, London WIPGHE		1999	Nick Hanley-Jason F. Shogren, 1999	Page 2, line 24, 32, Page 3, line 1, 8	Chapter IV
45	(Source: http://www.lme.noaa.gov/) Updated as on Dec,2017		2017	LMEs - http://www.lme.noaa.gov/	Information is discretely accessed. Referred in thesis	Chapter IV
46	IUCN - International Union for Conservation of Nature, PPT, 04-2, https://unstats.un.org/unsd/environment/envpdf/UNSD_UNEP_ECOWAS%20Workshop/Session%2004-2%20Coastal%20and%20marine%20resources%20(IUCN).pdf		2004	IUCN,PPT 2004	Slide7 of 48	Chapter IV

47	India's Sanitation for All: How to Make it Happen, Asian Development Bank, © 2009 Asian Development Bank, 1 - As measured by purchasing power parity (current international $). 2 - World Development Indicators. 2006 and 3 - Ibid		2006, 2009	ADB, 2009, WDI	Page 10, Line 5-9, Page 10, Line 13, 14	Chapter IV
48	What a waste: A global review of solid waste management. The world bank, March 2012, Urban Development Series		2012	World Bank 2012, GRSWM	Page IX, line 1 - 16, Line 27 -36, Page 16, Line 1 - 5, table 9, Page 30, table 14	Chapter IV
49	Indian municipal garbage: How to manage it? By Gopal Krishna, Published in www.toxicslink.org, 19/07/2005)		2005	Article, Toxicslink, Gopal Krishna, 2005	Discrete extracts taken randomly. Reference is made in thesis	Chapter V
	Other Important Internet links (URLs) and sources of information for photos, images and other matter: STAP Marine Debris : http://www.thegef.org/gef/sites/thegef.org/files/publication/STAP%20MarineDebris%20-%20website.pdf US EPA Marine debris in the North Pacific http://www.epa.gov/region9/marine-debris/pdf/MarineDebris-NPacFinalAprvd.pdf UNEP Marine litter – a global challenge http://www.unep.org/pdf/unep_marine_litter-a_global_challenge.pdf Plastic Ocean report http://www.unep.org/regionalseas/marinelitter/publications/docs/plastic_ocean_report.pdf CZC 2000 paper http://www.unep.org/regionalseas/marinelitter/publications/docs/czc2000_paper.pdf					
	Other Important Reference Sources - UNEP report, 1996, Central Public Health Govt. of India (http://cpheeo.nic.in/swm.aspx), Information collected from GSPCB and Govt. Depts. Personally as well as by verbal Interaction. Govt. of Goa Website - URL is https://www.goa.gov.in/,					

Note: If name of any author or mention of study is found in thesis and is not included in references, then it is due to reason that the contents or statements of that study are not included in the thesis. Researcher has included all the references and the names of authors mentioned in publications. Besides references, there are numerous teachers, trainers, thinkers and speakers who have inspired and enriched the researcher through their thoughts, deliberations and actions during academic, professional training, state/national/international forums and during interaction. Sincere acknowledgement is extended to all of them. Wherever page and line numbers are not mentioned, they are from website and dynamic form of contents but sources are same as mentioned. In few instances details of references are repeated in thesis body for convenience of reader. Proper permissions have been obtained wherever information is accessed from submitted reports by agencies and from eminent scientists. However such content is shorter than a paragraph (30 lines).