

**GOA STATE
BIODIVERSITY STRATEGY
AND ACTION PLAN**

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Acknowledgements

The following persons comprised the members of the Goa Steering Committee which worked on the various issues covered in the Goa SAP.

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The Conservator of Forests (representing the Forest Department, Government of Goa, nodal agency)

The Goa Foundation acknowledges its profound debt to the conscientious work of the persons and departments listed above.

A good deal of the credit for this report goes to the people at the grassroots who have guarded valuable traditional knowledge and practices and have

provided much of the information contained in this report. Their names are contained in Annexure 8 of this report.

The following persons took time off at short notice to look at the draft before it could be finalised, and made critical suggestions and corrections:

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The draft final SAP was written by a sub-group of the Steering Committee which included Dr Manoj Borkar, Vidyadhar Gadgil and Dr Claude Alvares. The drafting group was assisted in the preparation of authoritative lists of species by various scientists whose names are individually acknowledged at the appropriate places.

The project was handled with great competence at the Goa Foundation level by Vidyadhar Gadgil. Chhaya Chodankar carried out the formatting of the final report with her usual competence.

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1.0 Introduction

1.1 Brief background to the SAP

The subject of this report is the status, conservation and sustainable use of biodiversity in the state of Goa, one of the smallest states of the Indian Union. Goa presents an astonishing diversity of endemic species, habitats and ecosystems. Due to historical reasons, the region remained relatively 'undeveloped' till fairly recently, and therefore appeared to have suffered less of the gross forms of environmental damage almost routinely associated with development elsewhere. But with 40 years of development now behind it, the impact on biodiversity in this region is visibly noticeable and worrying.

The concern with biodiversity has crystallized world-wide with the adoption of what is known as the Biodiversity Convention. Tragically, the growing awareness of its significance for the survival of all living beings on the planet is coinciding with a very real and threatening reduction in biodiversity indices across the world. Biodiversity, at its simplest, means the diversity of all living beings in the world. All over the world, neglect of biodiversity concerns has led to situations in which the astonishing variety of life is being permanently and adversely compromised.

The impetus for this work on the biodiversity of Goa came from the National Biodiversity Strategy and Action Plan (NBSAP). One of the heartening features of the NBSAP has been its serious effort not to remain at the level of a government exercise. In fact, in Goa, NGOs, individual scientists and professionals individually committed to biodiversity conservation have provided critical direction to the process, with the cooperation of government departments. The Goa Foundation, an environmental NGO, and the Forest Department, Government of Goa, were the nodal agencies for the preparation and implementation of the Goa Strategy and Action Plan (SAP). As part of the process, a number of individuals, not affiliated formally with NGOs or formal research/teaching institutions, were also encouraged to play an active part in the process.

1.2 Scope of the SAP

The scope of the Goa State BSAP was expanded to assess the status of biodiversity from a number of different levels and a variety of perspectives.

1. *Biomes, Ecosystems and Habitats*: Goa is under the influence of two global biomes – the marine biome of the Arabian sea and the terrestrial forest biome of the Western Ghats. Within this geographical canvas are a wide range of ecosystems and habitats e.g. forests, ghats, alluvial plains, coasts, rivers, estuaries, mangroves, wetlands etc. The ecophysiology of the habitats is governed by complex ecological and meteorological conditions. There are normal habitats and extreme habitats (like the rock pools and the salt pans). There are microhabitats which are equally important – e.g. the termite mounds which play a significant role in the decomposition of plant litter. The status of biodiversity in each of these habitats varies, based on a variety of genetic and environmental factors. Each habitat faces its own peculiar mix of pressures on its biodiversity, and consequently, different strategies for conservation are required. An proper understanding of these habitats and ecosystems is essential to conservation of their biodiversity.
2. *Species and varieties*: Although incomplete, an exhaustive listing of species has been done from the available published and unpublished sources (see Annexure 6).
3. *Agro ecosystems*: There has been specific focus on the biodiversity of agricultural ecosystems. We have studied the centuries-old system of the khazans, the *puran sheti* method of farming, fishing practices etc. Within this area, we discussed species of domestic animals, and cultivars of various agricultural crops.
4. *Ecotheology*: This report also examines practices and beliefs relating to nature, with impact on biodiversity and its sustainable use. The process of preparation of the action plan was based on an intensive study of indigenous knowledge, and whether such use of biodiversity was in itself sustainable.

5. *Impacts of Human Activities on Biodiversity:* We support development. However, we found we could question the necessity for continuing with the present form of development which necessarily requires the destruction of biodiversity, or is based on its unsustainable exploitation. Hence, we decided to list all those processes and forces associated with development agendas that threatened or destroyed biodiversity in new, unforeseen and thoughtless ways in the State.

1.3 Objectives

The principal objectives of the Goa State BSAP are:

- 1 To document, assess and review the present status of biodiversity of Goa at ecosystem and species level.
- 2 To understand, document and popularise time-tested (sustainable) natural resource management practices and the rich ecotheological traditions of the people of this region.
- 3 To study the causes for the decline of traditional knowledge, and to evolve mechanisms to reverse this trend, and to protect and disseminate this knowledge.
- 4 To study the impact of human activity and development generally on biodiversity.
- 5 To understand the causes of biodiversity degradation, identify the hotspots of biodiversity erosion and to work out ways to combat these.
- 6 To prioritise the choice of ecosystems, species and habitats for directing conservation efforts and to lobby for the maintenance of gene pools in labs and in fields.
- 7 To study the legal and administrative framework governing biodiversity and suggest methods for strengthening it.
- 8 To work out implementable mechanisms for conserving the biodiversity of Goa, with active participation of all stakeholders, including the public, NGOs, government etc. so as to mitigate the worst kind of excesses meted out to biodiversity in the past 40 years.

- 9 Increase the awareness of the importance of biodiversity, and disseminate the knowledge regarding the same, among the public at large.
- 10 To encourage new initiatives in biodiversity research and promote scientific research for full cataloguing of the biodiversity of the state, ensure its sustainable utilisation and to protect the biointellectual property rights of the local communities.

1.4 Guiding Principles

The principles have guided the work on the Goa State BSAP:

1. A healthy respect for traditional knowledge (including oral) regarding the sustainable uses of biodiversity, and the need for its protection and revival.
2. Vulnerable groups and women within such groups are invariably more dependent on biodiversity and they are therefore to be considered its most crucial stakeholders.
3. The work should be carried out in the local vernacular language in which the common people speak.
4. The work should be carried out as a result of a participatory process, with widespread involvement of people. Also, the effort should be to examine these issues in a non-anthropocentric fashion and see them as well from below. The SAP should never degenerate into a pure academic exercise. It should fairly reflect the views of all actors and it should discuss the all-important political realities. It should frankly address issues relating to equitable access to biodiversity.

1.5 Methodology

An attempt was made to make the process of preparation of the Goa SAP as democratic and participatory as possible. Also, specific thrust was given to not keeping work on the project confined to the professional academic and research community, but to generate material from within the communities themselves. In fact, some of the sub-reports have been prepared either in Konkani, or in Marathi,

and are based on active contributions from the communities themselves. The fairly large amount of material already available in English was also used during the work.

The work on the Goa SAP began through a process of consultation involving NGOs, research and academic institutions, government, and individuals knowledgeable about biodiversity in their areas. On the basis of this preliminary consultation, a Steering Committee (SC) was formed. The SC first met on 8th December 2000, and four times thereafter. During the first meeting, major issues and geographical areas to be covered were considered and decided. Before the second meeting, the SC was expanded and specific areas of work were allotted to the members. Around this time, a press conference was also held, and detailed articles on the Goa SAP appeared in all local newspapers. People who expressed interest at this stage were also included in the SC, subject to their willingness to take up specific assignments.

It is the primary consultations done through this process that have been the most important aspects of this project in Goa. They form the base upon which this report rests. Detailed research on specific aspects or topics was carried out, based on the geographical and thematic divisions decided upon in the SC. Researchers fanned out in Goa's villages, and met people for whom biodiversity is of vital importance in their own domains in remote areas. Eventually, over 500 persons in different villages were accosted and they spoke on biodiversity to the members of the team.

Members of the SC who had been given specific assignments then completed their work under the overall guidance and supervision of Dr. Nandkumar Kamat. During meetings of the SC, progress was reviewed and suggestions made. The members interacted with the Supervisor on a regular basis.

In May 2001, a one-day workshop was convened to consider the work done till date, to identify gaps, and to work out the framework of the draft SAP. Based on this, some preliminary drafting was done. Feedback from members of the public which came in was incorporated. Dr. Nandkumar Kamat guided most of the work up to this stage.

Much of the information collected by the various members of the SC as part of the process has never been systematically documented before. A brief description of each of the research studies is given below:

Dr. Kasturi R. Desai prepared a check-list of Goa's biodiversity. This check-list covered species of plants and animals, recorded so far in Goa from published and unpublished literature. The check-list also listed various habitats. This data was then verified against available field reports generated by scientists under the final supervision of N Janardhanam, a plant taxonomist from Goa University and the revised lists have been attached to this report as Appendix _____. This list comprises only those species from the plant kingdom that have been verified through field visits.

The following biodiversity reports, which were novel initiatives for Goa, were prepared under the supervision of Dr Nandkumar Kamat. The information documented therein was not recorded earlier in a scientific and organised manner.

- SACRED GROVES AND WATER RESOURCES

Rajendra P. Kerkar prepared a report on the sacred groves based on primary information, and the rivers of mostly north Goa district. This is part of a larger project of documenting all the sacred groves in Goa, on which work is proceeding. The research uncovered the vital role of traditional beliefs and practices, and the underlying conservation principles, that had led to the protection of these forested stretches. It also evaluates the status of such groves: which of them are still intact, and which have been subjected to disturbance and why.

- TRADITIONAL NATURAL REOSURCE MANAGEMENT, ETHNO TECHNOLOGY AND COMMUNITY BASED PLANT GERM PLASM CONSERVATION

Mahendra Phaldessai and Vaijayanti Prabhugaonkar worked in the three southern talukas of Goa: Canacona, Quepem and Sanguem. They generated primary information o traditional occupations, wild crop seeds, biodiversity, and traditional nature conservation principles in this area. Their report (in Marathi) gives a picture of biodiversity-based traditional practices.

- ETHNO-ICTHYOLOGY

Dr. Manoj R. Borkar documented the community knowledge of lesser-known fauna in Mormugao and Salcette talukas, with emphasis on marine species, based on primary data. The work went beyond this towards identifying biodiversity conservation related threats and opportunities, and has also thrown up valuable insights regarding strategies that could be employed for conservation.

- TRADITIONAL KNOWLEDGE OF BIODIVERSITY AND SOCIO-LINGUISTICS ASPECTS OF RESOURCE KNOWLEDGE

Dr. Bernadette Gomes collected primary information on biodiversity and resource use in the areas of Salcette, Quepem and Sanguem. She documented practical uses of little-known biodiversity by communities in these three talukas, with special focus on marginal groups and women.

- TRADITIONAL KNOWLEDGE OF BIODIVERSITY, ETHNO-TECHNOLOGY AND RESOURCE GEOGRAPHY

Prakash Paryenkar generated primary information on biodiversity, traditional knowledge and traditional occupations in Sattari and Sanguem talukas. His work (in Konkani) has shed valuable light on little-known traditional knowledge concepts and occupations, particularly in the areas of agricultural systems.

- ETHNO-HERPETOLOGY

Nirmal Kulkarni prepared a report on human-animal and human-reptile relationships in Sattari taluka. He has also stressed the importance of environmental education and suggested simple programmes which could be easily implemented.

Bhalchandra Mayenkar recorded the reptile diversity and ecological aspects from the areas left uncovered by Nirmal Kulkarni.

- AVIFAUNA

Harvey D'souza catalogued the diversity of birds and their behaviour and identified the habitats of migratory birds as well as the pressures on wetlands from primary experience.

Besides the overall supervision of the preparation of the above reports, Dr. Nandkumar Kamat compiled the basic categorisation of some of the different ecosystems, the specifics of the agroecosystem known as the *khazan* and prepared the tables listing threat perceptions and neglected habitats.

The following significant aspects of biodiversity in Goa and unique to the State have been culled from the various reports listed above:

- Fifteen villages in Goa are named after the mango tree, two after the kokum. There are villages named after the Banyan, the Tamarind and the Tulsi.
- Ten villages are named after the tiger, three after peacocks, five after snakes. Villages are named after anthills, forest land, gardens, waterfalls and water bodies.
- The replacement of forest and natural vegetation by large plantations, especially cashew, has eliminated wildlife habitats in several areas.
- The population of monitor lizards has declined because there is no control exercised over the use of their skins for making drums (*ghumot*).
- After several decades Olive Ridley Turtles have returned to nest on several Goan beaches, after a successful conservation programme was initiated by NGOs, local village communities and the Forest Department.
- *Puran Sheti* is a form of agriculture unique to Goa in which fields are created on the banks of river beds which have run dry. Such fields disappear with the onset of the monsoon.
- Wildlife worship in Goa includes the worship of crocodiles (*mangge thapnee*) and termite mounds. Celebrations of Ganesh Mahotsav in Goa has a unique feature of '*Matoli* ' a display of seasonal fruits and vegetables hung over the idol.
- Among butterflies, the biggest (Common Birdwing) and the smallest (Grass Jewel) are to be found in Goa.

- 52% of the forest area of Goa falls under Wildlife Sanctuary notifications. 84% of existing forests in Goa belong to the Government.
- Iron ore contaminated sediments from mining areas have formed a film in the estuarine areas and destroyed the clam beds.
- The Wroughton's Free Tailed Bat, endemic Chiropteran species found only in this area would become extinct if a Karnataka Government proposal to divert water from the Madei river is allowed.
- Certain wild mushroom species are in danger of extinction due to indiscriminate commercial exploitation.
- Frogs are illegally served in some Goan restaurants under the nomenclature of 'jumping chicken'.
- Kumeri (slash-and-burn agriculture) has been finally stopped in Goa and officially no longer exists.
- *Ganv Bhovni*, village based hunting of wild life for ritual purposes, continues in a few areas despite being in violation of the Wildlife Protection Act, 1972.
- Interestingly, Goa's marine resources are also being shared by immigrants from the neighbouring states. An interesting case is that of the Pachangrais, a nomadic fishing tribe of Mysore district in Karnataka, who seasonally migrate into Goa for fishing activities. However, these are not viewed as a threat by the local fishermen, as the species which they catch are not desired by the locals.
- Fourteen distinct eco-systems can be found in the 3702 sq.kms. which is the total area of Goa State, ranging from mangroves, tidal rivers and evergreen forests.
- Neither the Regional Plan of Goa 2001 nor the draft Regional Plan for Goa 2010, which of which purport to control land use in the State, make any reference to biodiversity.

- There are a large number of agro systems designed by local people to suit different ecological niches/needs, each with its own local name.
- 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.
- Large development projects like the Selaulim and Anjunem dams were constructed without an EIA and without considering impacts on the biodiversity of the areas in which they are located.

Various measures to elicit public participation were also resorted to. The “Call for Participation” was distributed in English and Konkani at meetings organised by the WWF, Goa University etc. No public hearings were, however, held.

Dr Manoj Borkar, a Member of the SC attended a Mid-term Review Meeting cum Workshop at INSA auditorium at New Delhi in June 2001 and presented a consolidated status report on the work of the Goa State BSAP. In November 2001 Dr Kasturi Desai represented the Goa SC at the Western Region NBSAP meeting at Ahmedabad. They were able to provide valuable feedback to the SC to help align the work with the overall national perspective. On January 15th, 2002, Dr Kamat presented the summary of the Goa BSAP work in the workshop organised at Donapaula, Goa, by the CEE for western region to discuss Rio+10 issues.

In October 2001, the Goa State Steering Committee organised a workshop on Coastal Biodiversity in association with the West-Coast Eco-Region Group. This one-day meeting was well attended, both by persons from Goa and resource persons from the TPCG who gave valuable feedback on the whole process.

A draft report was prepared in March 2002. Thereafter, the report was drafted and circulated to independent scientists for checking of the species inventories. Corrections and modifications were incorporated in the month of March/April 2002.

The Draft Final Report was printed and circulated officially to all Government departments, NGOs and experts for final reading and comments. The Report was

discussed and adopted formally at a meeting of all stakeholders held in June 2002. The immediate plan is to have the information presented in the form of a mobile exhibition which will be taken to different villages and towns of Goa, not only to enhance awareness but to solicit public cooperation at all levels in the biodiversity conservation programme.

2.0. Profile of area

2.1 Geographical Profile (Size, Location, Latitudes / Longitudes, etc.)

Goa is situated along the Central west coast of India lying in between latitudes 15° 48' 00" and 14° 43' 54" and longitudes 74° 20' 13" to 73° 40' 33"E .The altitude ranges from sea level to above 600 mts above sea level in the western ghats.

The State comprises 11 talukas, out of which Tiswadi, Bardez, Pernem, Bicholim, Satari and Ponda talukas comprise North Goa district (1736 sq km) and Mormugao, Salcette, Canacona and Quepem make up South Goa district (1966 sq km). North to South, the length of Goa State is 105 km from North to South and 60 km from east to west. The geographical area of Goa State is 3702 sq km.

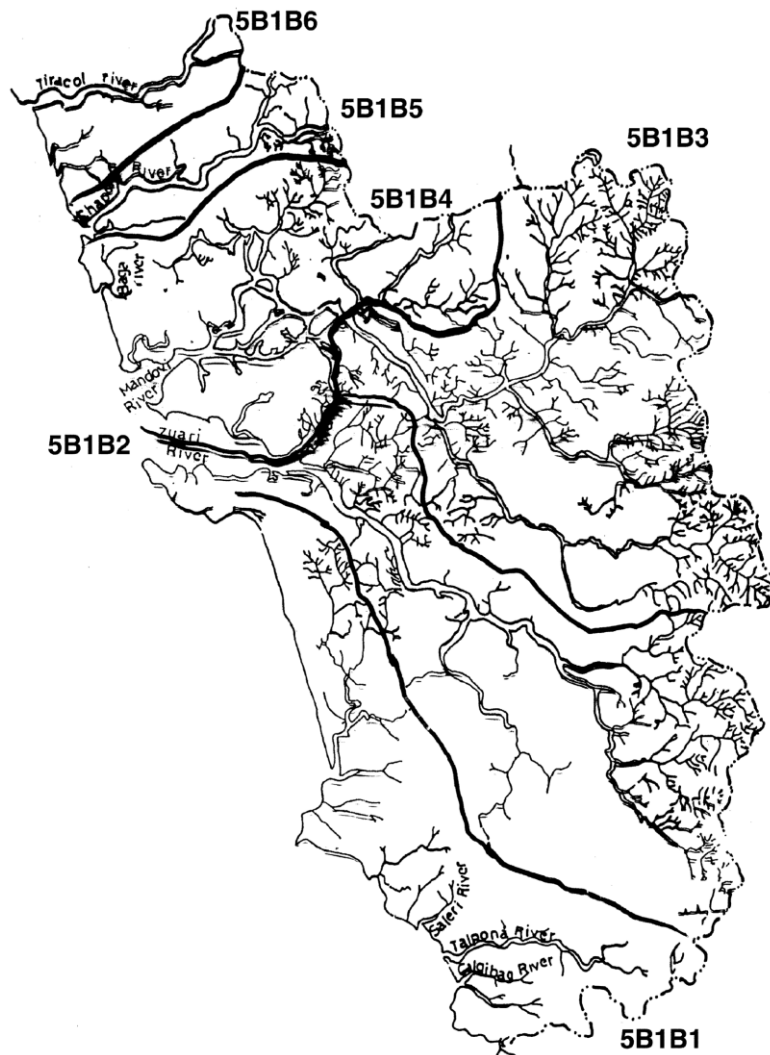
Geology

The principal geological feature of the land is the extensive laterization which occurs because of Goa's position in the tropical moist climate, subject to vast seasonal changes. The laterite caps are extensive over most of the terrain, mountains, plateaus or plains and they have by and large determined the nature of the region's vegetative cover.

Specifically, the State is predominantly covered by the rocks of the Goa Group belonging to Dharwar sub-group of Archean to proterozoic age, except for a narrow strip along the northeastern corner occupied by the Deccan traps. The Goa group consists of green schistic facies of metamorphic rocks and have been folded and intruded by granite gneiss, feldspar gneiss, hornblende granite and porphyritic granite followed by basic intrusives. The rocks of Goa group are broadly comparable and correlated with the rocks included in the Chitradurga group of Dharwar Super Group of Karnataka. During the sub-recent to recent times, the rocks have been subjected to laterisation resulting in 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.

2.2 Socio-Economic Profile

In terms of conventionally perceived socio-economic indicators, Goa does fairly well compared to many other Indian states.

The per capita income of Goa is the highest in the country. This is due, partly, to better compliance and reporting, but the general prosperity is undeniable if one does not move out of the highly developed coastal belt. After a period of high population growth, the previous decade (1991-2001) witnessed a

decadal growth rate of 14.89%. However, statistics conceal more than they reveal. There is serious enough unemployment and poverty in the State.

In terms of other socio-economic indicators as well, Goa's performance is rated good. Literacy levels are over 80% overall, though for women the rate is about 75%.

In terms of health and infrastructure indicators also, Goa performs substantially well.

Socio-Economic Indicators in Shorthand

- **Population** (2001 Census)

Total: 1,343,998 (13.43 lakh) persons

Proportion: 658,381 (6.58 lakhs) females, 685,617 males. Sex Ratio 960. Declined from 967 in 1991.

Decadal Growth Rate: 14.89%

Density: 363 per square kilometre. Goa's population density is one of the highest of all states.

Child (0-6years) population: 142,152

Sex Ratio in child population: 933 (much less than in total population!)

Scheduled Castes comprise just over 2% of the total population. The population of *Scheduled Tribes* is negligible, but communities like Kunbis, Gawdas, Velips and Dhangars, widely considered Goa's original tribes and estimated at 30% of population are not included in this category.

Goa is today a highly urbanised state in India. This makes it a special case for conservation because haphazard and unsustainable urbanisation over past 50 years has severely impacted natural ecosystems and biodiversity.

- **Education**

Literacy (2001 Census): 82.32% (88.88% for males, 75.51% for females)

Primary Schools (1999-00): 1281 (100639 students)

Middle Schools (1999-00): 444 (71636 students)

Secondary Schools (1999-00): 365 (62718 students)

Higher Secondary Schools (1998-99): 81 (21612 students)

Colleges (1998-99): 41 (18296 students)

Goa is second only to Kerala in terms of literacy.

As on 31st Dec. 1997, the number of job seekers on the live register of the employment exchange was about 18% of the population in the age group of 15 to 39 years. This indicates that a substantial number of able-bodied people are unemployed.

- **Essential Services**

Piped Water: Capacity 299 MLD, consumption 263 MLD (1998-99). While these statistical realities appear to indicate a comfortable scenario, large areas of Goa go without water in the summer months.

Power: 1066 million kilowatt hours (1999-00) Industrial to total consumption—47.44% Transmission and distribution losses are estimated at 27%.

- **Health**

Birth Rate: 14.3 (1994)

Infant Mortality: 18.8 per 1000 live births (1991 census)

Death Rate: 6.55 (1994)

Government Hospitals/ Health Centres [with beds] (1999-00): 32 Beds: 2,874

Private Hospitals (1999-00): 106 Beds: 1,936

Government Health Centres/Sub-centres/Dispensaries [without beds] (1999-00): 200

Doctor to Population Ratio: 1:750 (1989-90)

- **Communications**

TV: 1 Relay Transmitter, 2 Channels. Receivers unknown.

Radio: 1 Broadcasting Station, 2 Channels. Receivers unknown.

Print: Newspapers and periodicals 34 (1992-93) Readers unknown.

Telephone connections: 129348 as on 31.08.00.

Public Call Offices: 2623 as on 31.08.00.

Post Offices: 258, letter boxes: 814 as on 31.03.00

- **Transport**

Roads: Length—9240.49 km (as on 31.3.1999)

Main Waterways (1999-00): 23

Passengers ferried (1996-97) : 6921477

Vehicles in operation (as on 31.03.2000): 318299; two-wheelers: 227933

Bus Routes: 599

- **Economic Indices**

Net State Domestic Product (1997-98): Rs. 321235 lakhs.

Per Capita NSDP (as above): Rs 24,610

No. of banking offices: 375 (1996)

Bank Deposits: Rs. 3714.31 crores (1996)

Bank Credits: Rs. 1248.11 crores (1996)

2.3 Political Profile

It is well-known that the Portuguese captured Goa in 1510 and continued to rule the State till 1961. An indigenous freedom struggle for liberation from Portuguese rule challenged the legitimacy of the Portuguese as long-standing rulers. The Indian Army marched into Goa against little resistance on December 19, 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.

The highlights of the ensuing years were: the first panchayat elections, the ascendancy of the MGP to power, the formation of land reforms commission, the

passing of the Goa agricultural tenancy act , 1964 and the land revenue code, 1968; an historic Opinion Poll (in 1967) in which Goans voted against merger with neighbouring Maharashtra; the agitation by the traditional fishermen, students, the fall of MGP and ascendancy of Congress, passing of the tree conservation act and establishment of Goa university in 1985, and an unprecedented massive, sustained movement from 1984 which culminated in 1987 in official language status being conferred on Konkani and co-language, non-official status for Marathi.

The Panchayat was the first democratic entity in Goa soon after independence. The administration was run through Block Development Committees, which were a sort of bridge between the Panchayat and the Government.

The scenario changed 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.

The most noticeable feature of post-statehood has been chronic political instability. During the 25 years between 1964 and 1989 Goa had just three chief ministers. After the 1989 elections, there have been no less than thirteen in the space of eleven years, some with terms lasting as little as a few months, and one surviving for just four days! This has had serious negative consequences on the economy and ecology of the State.

After the 73rd and 74th Constitution amendments were adopted by Parliament in 1992, Goa was required to have a three-tiered political set-up, with decentralisation of political powers to local authorities. Government enacted the Goa Panchayati Raj Act in 1993 to enable panchayats to have exclusive jurisdiction over several local issues. It also amended the Goa Municipalities Act, 1968, to bring that Act in line with the Constitution's requirements. The middle tier comprising of Zilla Parishads have only just come into existence.

In the older dispensation, there were 374 revenue villages, divided into 183 village panchayats, in turn divided into 10 'development blocks'. The administration was run through the Collector at the district level, the Mamlatadar at the taluka level and Sarpanch at the panchayat level. There are also 13 municipal towns administered by Municipal Councils and Chief Officers. The

Municipal Councils came under the Director of Municipal Administration in Panaji. Though legally the Panchayats and Councils have new, enlarged and sweeping powers and separate jurisdiction after the Constitutional amendments, they continue to operate mentally under the old dispensation.

The major political parties today are the Congress-I and the Bharatiya Janata Party (BJP). But most MLAs are members of their parties only in name and will ditch their party whenever they are promised power by a rival group.

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 and 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 corrupted these terms to 'comunidades' meaning 'village communities'.

The comunidades were actually the custodians of Goa's natural resources and biodiversity for more than 3000 years. The institution, 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 spreading 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 & Bardez having largest paddy area, the comunidades hold over 55% of land (Ilhas-55%, Salcette-51% & Bardez-56%). In Marmagao taluka, where the total paddy area available is 1019 ha, the Comunidades have 62% land.

2.4 Ecological Profile

During its relative isolation when under Portuguese rule from the rest of the country, Goa was, by the standards of most other imperial powers, benignly governed. A Portuguese empire in its decline did not place too many demands on the State's natural resources, but considerable damage was nevertheless caused.

The Portuguese, for example, paralysed the Comunidades, with adverse effects on local control over the environment. They introduced vast monocultures of an exotic species like cashew. Cashew plantations have very poor biodiversity. The Portuguese also gave liberal and rampant mining concessions and leases to the private investors/prospectors. These concessions became the foundation of Goa's privately owned mining industry which till today follows no environment laws. Thus, the Portuguese are responsible for the destruction of forests and vegetation in the areas leased out before 1961.

The Portuguese also ignored land reforms, and created the system of 'morgados' referred to and criticized by Francisco Luis Gommes in the 19th century. The Portuguese also imported, alongwith many economically useful exotic plant species, plant and animal pathogens, weeds etc.

Liberated from Portuguese rule in 1961, Goa has been induced to rapidly become a part of the national mainstream, while struggling to retain, in some measure, its unique charm as one of the most attractive bioregions of the country.

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 portion of the Sahyadris lying in Goa, which comprise the *first* ecozone, has an area of about 600 sq.km. and an average elevation of 600 metres. The crestline extends in an arc for about 125 km. This area, part of the Western Ghat region, is the catchment area of seven out of the nine rivers in Goa and nature has covered the area generously with forests. These forests protect the land from heavy monsoon precipitation (5000 mm) and ensure that the water does not run off immediately taking much of the soil along with it. They conserve much of the rain water and are prime sources of the major Goan rivers, the lifeline of the land.

The Western Ghats are one of the richest reservoirs of biodiversity in the world. The sections that lie within Goa (the Sahyadris) and which dominate its ecosystems readily reflect this bewildering complexity in plant, animal and bird life.

Official recognition of the ecological value of this area has come in the form of gazette notifications declaring huge areas as sanctuaries or biosphere reserves.

In the year 2001, a confederation of environmental NGOs from Goa, Karnataka and Maharashtra proposed the creation of a new ground reality, the Sahyadri Ecologically Sensitive Area or SESA, to be notified by the Ministry of Environment and Forests under the provisions of the Environment Protection Act, 1986.

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, especially 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, Chimbhel, 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.

2.5 Brief History

Footprints of prehistoric humans in Goa have been dated to 100 millennia before the present. The migration took place from the valleys of Ghatprabha and Malaprabha and the first human camps were established in the paleolithic age by *homo sapiens*. A very interesting finding has been the discovery of rich rock art in Goa in 1993. This rock art gives insights into the state of the ecosystem and biodiversity in prehistoric times.

There can be little doubt that Goa was among the most important *entrepôts* of the ancient and medieval world. The index of its stature was the internationally acceptable gold currency in use around the 10th century, embossed with the regal leonine crest of the ruling Kadambas and their patron deity, Saptakoteshwara.

When the Portuguese arrived five centuries later, Goa was under Muslim rule. The city and port had shifted north, to the banks of the Mandovi. Before Portugal discovered its own sea route to India, trade between Occident and Orient was monopolised by the Arabs. When Albuquerque seized Goa (and then Daman and Diu), the Arabs' sources were cut off. Portugal took control of trade and built its empire—until the Dutch, French and English made inroads and the Portuguese empire began its irreversible decline as a world power.

The Portuguese doctor, Garcia de Orta, is famous for compiling the first major list of plants called *Colloquios dos simplices and drogas e cousas medicinais da India* (1567). It was perhaps the first modern effort at an inventory of plants.

Imported plants, brought in by the Portuguese, have enriched local plant diversity. Five hundred years ago, India had no potatoes, groundnuts, tomatoes or chillies. These important crops were relative newcomers to Indian fields and cuisine.

Ports on the West Coast of India—Surat, Bombay, Dabhol, Goa, Honavar, Mangalore and Cochin—played a major role in the import and dispersal of these useful exotic plants. Before medieval times, Goa traded with African coast, Egypt, the Persian Gulf and S.E. Asia. Oceanic and maritime trade brought exotic species to Indian shores and diversified regional plant gene-pools. The growing demand for novel crops (such as tobacco and pineapple) led to the establishment of experimental nurseries and plantations, mostly by missionaries. The novelty and utility of many exotic plant species brought a change in the agricultural economy, food habits and cultural practices of the Western Ghats and India as a whole.

By the early 18th century, the cultivation of tobacco, chillies, chickoos, guavas, sitaphals, pineapples, oranges, cashews, papayas, and breadfruit was established in South India, including Goa. India became one of the world's largest producers of some of the imported crops.

3.0 Current (known) Range and Status of Biodiversity

Table 1

Goa's biodiversity at a glance

Taxa	Catalogued No.	Comments
Plants	1804	Well explored
Mammals	45	do
Reptiles	49	do
Birds	260	do
Amphibians	35	Need more work
Fish	205	Well explored
Crabs	82	do
Bivalves	28	do
Gastropods	63	do
Cephalopods	02	do
Nematodes	10	
Insects	700	Underexplored
Spiders	30	Need more surveys
Algae	82	Need more surveys
Diatoms	103	do
Phytoplanktons	76	do
Dinoflagellates	12	Well explored
Higher Fungi	500	Underexplored
Micro Fungi	1000	Need more surveys
Yeasts	150	Underexplored
Actinomycetes	70	Do
Bacteria	150	do
Viruses	30	do

**Many of the categories and figures given above will be modified after scientists and experts have completed their individual verification.*

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.

Box 4: Traditional ways of catching fish:

Kaalo kondo and gile (EòÉ³ýÉä EòÉåb÷Éä, MÉä³äý): This is a type of wild plant. When it dries, it can be crushed into a powder which is then thrown into the pond. The powder releases some sort of toxic chemical which kills the fish.

Paalne ({{ÉÉ³ýhÉå): A type of a cradle made of cane used for catching fish.

Khunkut (JÉÖhÉÉÚò]ö): a trap of cylindrical shape and made of cane sticks.

Khun (JÉÖhÉ): A trap which is a little bigger in size than a JÉÖhÉÉÚò]ö.

Kul (EÚò³ý): Larger than a khun, and used to catch big fish.

Kiev (EòÓ´É): Equipment used in the summer for fishing when the water level goes down. It is very systematically made equipment and while making this equipment the psychology of the fish is considered. It is a pot shaped instrument placed in the area where the water slopes downwards.

Sherkataavni (¶Éä®úEò]ö´ÉhÉÒ): This is a traditional equipment used for catching crabs in the month of October and November.

Garovani (MÉ®úÉä´ÉhÉÒ): Method used to catch fish like kaaday, vaalay, toki, maral (EòÉb÷-,´ÉÉ²ªÉ, iÉÉàÊEò, ´É®ú±É), in rainy season and taambose, pong, maral (iÉÉÆªÉ°Éä, {ÉÉåMÉ, ´É®ú±É) in the summer season. There are two types of Gaari (MÉÉ®úÒ): Ê¶ÉiÉÉÉ®ú +ÉhÉÒ ±ÉÉÆªÉÉ®ú, shittaari and laambaar.

Deepakaavni (nùÒ{ÉEò´ÉÉhÉ): this method is used in the Mirg season (Ê´ÉMÉÇ) when the river water comes inside the farm along with fish and other underwater organism. kullyyo, tokio, dhade, kaaday, paatkaa, kharchyaandyo, molye (EÖò±±ªÉÉä, iÉÉäEòªÉÉä,vÉÉbä÷, EòÉb÷-, {ÉÉiÉEòÉÆ,JÉ®úSªÉÉÆb÷-Éä, ´ÉÉä²ªÉä) fish are caught using small nets.

Baale (ªÉÉ±Éå): This is a long net used to catch big fish. This net is spread from one side of the river to the other

Gelatine: The simplest (crudest) way though banned, but used clandestinely by the fishermen is bursting gelatine in the water.

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. *Micrococcus*, *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 *Nitzschia*, followed by *Bacillaria*, *Coscinoidiscus* and *Cymbella*. Other forms like *Biddulphia*, *Diplonies Mastgloia* and *Thalassiothrix* occur only rarely.

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/m². 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.

Box 5: Types of fish found in rivers and nallahs:

Molyo: black (᳚᳚᳚᳚᳚᳚᳚᳚), kaaday: black (EòÉb÷-), shengaali: black (᳚᳚᳚᳚᳚᳚᳚᳚᳚᳚), vaalay: light turmeric (᳚᳚᳚᳚᳚᳚), maral: black (᳚᳚᳚᳚᳚᳚), taambose: head, eyes and stomach is red (iÉÉ᳚᳚᳚᳚᳚᳚᳚᳚), dhado: white (vÉÉàb÷É᳚), gholshi: white (PÉÉ᳚᳚᳚᳚᳚᳚᳚), pong: white (᳚᳚᳚᳚᳚᳚᳚), bel: white (᳚᳚᳚᳚᳚᳚), baanakcho: black and yellow spots (᳚᳚᳚᳚᳚᳚᳚᳚᳚᳚), buraato:white (᳚᳚᳚᳚᳚᳚᳚᳚᳚᳚), daanay: whitish on the back black (nùÉhÉ᳚᳚᳚), karankaatko: black (Eò᳚᳚᳚᳚᳚᳚᳚᳚᳚᳚), chingul: white (᳚᳚᳚᳚᳚᳚᳚᳚᳚᳚), shivad: white (᳚᳚᳚᳚᳚᳚᳚᳚᳚), kaalundar: black (Eò᳚᳚᳚᳚᳚᳚᳚᳚᳚᳚), toki: white (iÉÉ᳚᳚᳚᳚᳚᳚), hayar: black (᳚᳚᳚᳚᳚᳚᳚᳚᳚᳚), lendi: black (᳚᳚᳚᳚᳚᳚᳚᳚᳚᳚), paakaa: white (᳚᳚᳚᳚᳚᳚᳚᳚᳚᳚), kharchyandi: yellowish black (JÉ᳚᳚᳚᳚᳚᳚᳚᳚᳚᳚), khube: black (JÉ᳚᳚᳚᳚᳚᳚᳚᳚᳚᳚), kulli: black (E᳚᳚᳚᳚᳚᳚᳚᳚᳚᳚), kaasav: black/white (Eò᳚᳚᳚᳚᳚᳚᳚᳚᳚᳚),

- 7. 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- Choraó, 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.

- 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).
- 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).

8. **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.
9. **Khazan lands-saline agroecosystems of Goa:** 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 fields.

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.

10. 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).

11. 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:

12. 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*.

Box 3: Different types of grass (Eò®úb÷) and their use:

- Motho Gondyo: (¨ÉÉà`öÉä MÉÉâb÷-Éä): used as a cattlefeed.
- Baarik Gondyo: (æÉÉÊ®úEò MÉÉâb÷-Éä): used for cattlefeed or to make cattleshed or small hut.
- Karpil (Eò®úÊ{É±É): A type of thin grass used for cattle feed.
- Dhavi (vé´ÉÒ), and taambdi phuli (iÉÉÆæÉb÷Ò jÖò±ÉÒ): White and red grass. It is used as a cattle feed.
- Bimal (ÊæÉ¨É±É): Usually seen in Puran and Vaingan farming, this dry grass can also be used as a cattlefeed.
- Darbh (nù|ÉÇ): This type of grass is found on the riverside.
- Taamet (iÉÉ¨Éä]ö): There are two types of grass: long and short. This grass is used while construction the wall of the house.
- Bhaalo (|ÉÉ±ÉÉä) : Literally it means spear. It is type of small grass which does not dry in summer and normally used as a cattle feed.
- Haryaali (½p®úªÉÉ³ýÒ): a type of grass found in the cool places.
- Muyno (¨ÉÖªÉhÉÉä): this type of grass is found in the vaingan farms.
- Polle ({ÉÉä±±Éå): this type of grass is found in the vaingan farms.
- Phonyaare (iòÉähÉªÉÉ®åú): this type of grass is found in the Puran farms.
- Jivnal (véÒ´ÉxÉ³ý): this type of grass is found near the riverside.

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.

Some interesting aspects of Goa's ethnomycology

As a part of resource rich Konkan, Goa has a diverse flora of macrofungi. It is common to find several species of bracket fungi, agarics, puffballs, stinkhorns, earth stars and bird's nest fungi in any fairly pristine vegetation. Goa's rich ethnomycological heritage dates back to mesolithic (6-8000 B.C.) period. Perhaps the Knowledge of the wild mushrooms was used by the hunter food-gatherer tribes which were controlled by the shamans. Mistaken as a spear, the carving of a campanulate mushroom species at mesolithic rock art site of Usgalimol in south Goa shows uncanny morphological similarity with the wild hallucinogenic *Psilocybe* sp. Similar carvings have been found at Tassili-n-Ajer in north Africa. The Goans are mycophagic and consume local wild edible species which they commonly call "olmi". Add to this their fondness for making wines from local fruits using either wild or commercial yeasts. They distinguish the edible and toxic fungi on the basis of traditional knowledge of habitat, morphology and season. The forest dwelling OBC community of Goa-the Velips consume *Russula* sp. The species of bolete, which sprout with first showers, are known as '*Bhuifod*' (Earth-boil) or '*Fuge*' (Baloon mushroom). Some specimens of boletes weigh more than a Kg. Fused fruit bodies are common. The termitophilic species abound in Goa and are locally known as '*Roen olmi*' (termite hill mushrooms) . Owing to habitat erosion the diversity of these species is threatened. The most dominant species are *Termitomyces heimii* Natarajan ,*T. striatus* Heim, and *T. clypeatus* Heim. These occur in July-August. Interestingly, the habitat of these species is also venerated as the abode of the most popular goddess of Goa- Santeri. At the end of the SW monsoon, the short-lived , small, epigeal species of *Podabrella microcarpa* appear in large numbers in most unlikely places such as a courtyard plastered with cow-dung slurry or on wet mud walls. These species are locally known as '*Shiti*' or '*shitol olmi*'. The Goans cook at least 50 delicious recipes from wild edible mushroom species. Besides edible macrofungi , people collect and use bracket fungi and cup fungi for making handicrafts. The ectomycorrhizal species of *Pisolithus tinctorius* has invaded the Eucalyptus and Australian acacia stands. Local people have no knowledge of many such introduced species. Lately the cultivation of Oyster mushrooms has become popular and a modern factory with 750 Mt/yr capacity has been established in south Goa to produce Button mushrooms.

Compiked by Dr. Nandkumar Kamat

I) ESTUARINE VEGETATION OF MANGROVES ALONG SWAMPY RIVER BANKS:

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 populnea*, *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 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 fruticosa*, *Grewia tilifolia*, *Vitex negundo* and species of *Calogropis*, *Zizyphus*, *Cassia*, *Ixora*, *Acacia*, *Albizia*, *Terminalia* and *Crotalaria*.

Box 6: Creepers, Leaves and Ropes

‘Éä±ÉÒ, nùÉä®ú, +ÉÊxÉ {ÉÉxÉÉÆ (creeper, thread or rope and leaves) creeper: there are three types of creeper found in the forest area: sarpaati vel (°É®ú{ÉÉÊ]õ ‘Éä±É), gharvel (PÉ®ú´Éä±É), paalkone ({ÉÉ±ÉÉÒÉähÉå)

Ropes: there are five types of thread of rope used for different purpose:

EÖò´ÉÉÉÉä nùÉä®ú, Eäð´ÉÊhÉÉÉä nùÉä®ú, Eäð³ÿÒÉä nùÉä®ú, +hÉÊ¶ÉÉÉÉ {ÉÉiÉÉÉÉä nùÉä®ú, Ê|É±±Éä ´ÉÉb÷ÉÉÉÉ ¶ÉäÉ±ÉÉä nùÉä®ú*

Leaves:

ghuramvelichi (PÉÖ®ú´É´Éä±É) paan: thread is made of this plant named ghuram (PÉÖ®ú´É),

kumyaachi paan: (EÖò´ÉÉÉÉÉÉ {ÉÉxÉÉÆ), kelichi paan:banana leaf (EäðÉ³ÿÉÉÉ {ÉÉxÉÉÉ), chudtaa (SÉÖb÷]õÉÆ) coconut leaves, kudyaachi paan: (EÖòb÷-ÉÉÉÉ {ÉÉxÉÉÆ), jackfruit leaves ({ÉhÉ°ÉÉÉÉÉ {ÉÉxÉÉÆ), karmalaachi paan (Eò®ú´É³ÿÉÉÉÉ {ÉÉxÉÉÉ), andaachi paan (BÆb÷ÉÉÉÉ {ÉÉxÉÉÆ), pipal tree leaves (Ê{É{É³ÿÉÉÉÉ {ÉÉxÉÉÆ),

- 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*, *Dillenia 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*, *Lansea coromandelica*, *Bombax ceiba*, *Careya arborea* and *Dillenia pentagyna*. Common associates are *Xeromphis spinosa*, *Zizyphus*

xylopyrus, *Z. caracutta*, *Calycopoteris floribunda*, *Helicteres isora* and *Moullava speicata*.

Box 1: Wild leafy Vegetables: (Raas Bhaaji)

- The following kinds of edible plants are collected from the wild:
- Taaykilo: This wild vegetation is grown as soon as the Mirg (the period before the monsoon) arrives. The leaves of this plant are cooked for eating.
- Terein:
 1. Kaale Terein (Black): This vegetable is found in open lands or in orchards.
 2. Jhaadgein Terein: This wild vegetable is white in colour.
- Bonkalo: This vegetable is planted in the rainy season. The young buds or shoots are cooked for eating.
- Muddo-Tendlo: (a type of gourd) This vegetable is grown near the riverside or in the marshy land. Young bud of the plant is plucked and cooked as a vegetable.
- Kuddukechi Bhaaji: This plantation is done on the border area of the farmland during rainy season.
- Naavool: Shoots of this vegetable are used to cook bhakri (bread).
- Aankoor: This vegetable can be found during April-May month in the forest and is red in colour. The vegetable is cooked in curry or eaten raw.
- Kanakiche Comb: In August-September month, small buds appear on the Kanaki (Bamboo), which are cut and either eaten raw, or cooked in a curry or used in making pickles.
- Loot (mourning): This vegetable plantation is done during rainy season, and the buds of the plant are cooked for eating.

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 *Calycopteris floribunda* and *Holarrhena pubescens*.
- 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 troglitic communities which are not well known. A rare amblypygid (*Phrinyxus phipsoni*) has been recently reported from one such cave in Goa. The Chiropteran segment of the cave fauna is also underexplored.

Diverse Agro-ecosystems

Besides the above recorded eco-systems there are several agro-ecosystems exploited by farmers with specific agricultural technologies. These may not have been academically studied.

- **Sarad (°ÉñÇù) and Marad (°É°úþ÷) Farming:** This is the principal farming season, coterminous with the monsoon period, stretching from June till September, known in the rest of India as *kharif*. Before the onset of the monsoon, the land is burnt and tilling is done on it. The food production, which largely involves rice, is entirely depended on the monsoon rainwater and is carried out on the flat lands in the forest, in the plains and other flat lands, and involves the use of the plough and natural manures including dung. *Marad* farming is a label for paddy cultivation on higher lands, including terraces on slopes. The land is ploughed thrice and it is traditionally termed as *Eò°ÉÉ* (kasaa).
- **Vaingan Farming (°ÉÉ°ÉÆMÉhÉ):** Vaingan farming is farming done post-monsoon (referred to as *rabi* in the rest of India). It commences after the monsoon and completes before March end. Water resources impounded generally in tanks are used for supplying the water. There are two type of Vaingan: Bhadde and Baambara.
- **Kumeri Cultivation (EÖð°Éä°úÒ ¶ÉäiÉÒ):** This method of farming was carried on the slopes of the mountains for centuries. Velip (°ÉäÊ³ý{É), Gaavkar (MÉÉÆ°ÉÉð°ú) and Jalami (VÉ±É°ÉÒ) tribes belonging to Kulambi (EÖð³ÆýÆÉÒ) community settled in the hilly regions know this method of farming best. Villagers first collectively felled the plants and trees on a plot on the hill slopes, burned the dried vegetation and then with the help of traditional tools (+°ÉVÉÉ°ú- EÖðþ÷°ÉhÉ, EÖðnù³ý, {ÉÉxÉEÖðnù³ý, ðè°Éþä÷, etc) tilled the land and sow various varieties of seeds. These included rice, *naachani* (xÉÉSÉhÉÒ), °ÉÊ°ú, EðÉÆMÉÖ, iÉÖ°ú, ¡ÉÉÆMÉ°úEðbÂ÷b÷Ò, °ÉÉ³ý, etc. The cultivated land area was changed after three-four years of farming with the cultivators shifting to another patch on the slopes. This collective farming effort was termed *saavad* (°ÉÉ°Éþ÷), while the farming method was known as *kumeri*. Though *kumeri* has now been banned, some sporadic *kumeri* patches can still be observed when the burning takes place just before the arrival of the monsoon.
- **Sarvo (°É°ÉÉæ) :** The method of farming is similar to *kumeri*, but simpler. It is carried out wherever natural water resources are available on the flatter

regions of the forest. The land thus cultivated is called Sarvo. One major species grown in this system is *canga*. The farm land is fenced with the rough stone boundaries and trees like *“ÉÉb÷, EòÉVÉÖ, +ÉÆᄁÉä, jòhÉᄁÉ, Eäð³ýÒ, and +É³Öý, EòÉÆ®úÉÆnäù, EòhÉMÉÉÆ, ᄁÉÖ®úhÉ, ÊSÉ®úEäð, ZÉÉb÷EòhÉÆMÉÉÆ, etc are cultivated.*

- **Mutlo Farming:** This method of farming, which resembles Sarvo, is used to grow *naachane* (millet).
- **Toraap Farming:** In this method of farming, various types of *naachane* (fine and saline) are grown. Every year the crop pattern changes, and this goes on for three to four consecutive years. If in one year "Kharo Nachno" is grown, in another "Sayo Nachno" is grown and so on. After this cycle, cultivation is stopped for at least five years as the productivity of the soil gets exhausted during the cycle.
- **Kaas Farming:** Farming specific to the plateaus. Cleaning of the land is done by tilling the land twice or thrice to remove all the plants. Farming is done by the rotating the crop pattern. Every year different cereals are sown.
- **Khazan (JÉÉVÉxÉ) farming:** During high tide, salt sea water enters the farmland and the salinity in the soil increases. To restrict salt water ingress, special gates are used, called manashi (*“ÉÉxÉᄁÉÖ*). These farm lands are all near the sea or tidal rivers. Khazans cover some 18,000 hectares in Goa.
- **Puran (ᄁÉÖ®úhÉ) farming:** The wet riverbed of the river that has dried is chosen for rice cultivation and this is called *puran sheti*. The silt deposit is called *puran* or *purni*. In one season, a *puran sheti* plot can produce approximately twenty "khaandis" of rice. There are three types of *Puran*: 1) *Povodaachyo* 2) *Jhotichyo* and 3) *Phaatanchyo*. Largely practised in Sattari, away from the coastal belt.
- **Kaamat (EòÉ“ÉiÉ):** Cultivation of vegetable, green vegetable, flowers, fruits and chilli on the mountain slopes is called Kaamat farming. The farm land is fenced (*EÖÆò{ÉhÉ*) by locally available stems and cane sticks and a loft (*“ÉÉ³ýÉä, “ÉSÉxÉ*) is erected to guard the farm land. One person is stationed

round the clock to restrict the entry of animals. Chilli is one of the major items grown with other fruits, green vegetable and flowers such as $\text{ÊSÉ}\text{æ}\text{É}\text{Ö}\text{b}\text{÷}$, $\text{¨}\text{É}\text{É}\text{ä}\text{M}\text{É}\text{ä}$, $\text{i}\text{É}\text{´}\text{É}\text{¶}\text{¶}\text{ä}$, $\text{P}\text{É}\text{É}\text{ä}\text{º}\text{É}\text{É}\text{³}\text{ä}\text{ý}$, $\text{¨}\text{É}\text{É}\text{]}\text{Ä}\text{ö}\text{]}\text{Ö}\text{ö}\text{P}\text{É}\text{É}\text{à}\text{º}\text{É}\text{É}\text{³}\text{ä}\text{ý}$, $\text{E}\text{ò}\text{É}\text{®}\text{´}\text{ú}\text{É}\text{í}\text{É}\text{ä}$, $\text{E}\text{ò}\text{É}\text{ä}\text{E}\text{ò}\text{h}\text{n}\text{Ö}\text{ù}\text{v}\text{É}\text{Ö}$, $\text{n}\text{Ö}\text{ù}\text{v}\text{É}\text{Ö}$, $\{\text{É}\text{b}\text{÷}\text{´}\text{É}\text{³}\text{ä}\text{ý}$, $\text{E}\text{Ö}\text{Æ}\text{ò}\text{´}\text{É}\text{É}\text{³}\text{ä}\text{ý}$, $\text{´}\text{É}\text{É}\text{Æ}\text{Ê}\text{M}\text{É}$ (all vegetables), $\text{n}\text{ä}\text{ü}\text{`}\text{ö}\text{É}\text{ä}$, $\text{Ê}\text{S}\text{É}\text{b}\text{÷}\text{E}\text{ò}\text{Ö}\text{¨}\text{É}\text{b}\text{Ä}\text{÷}\text{E}\text{ò}\text{Ö}$, $\text{Ê}\text{´}\text{É}\text{®}\text{´}\text{ú}\text{É}\text{É}\text{±}\text{É}$, $\text{+}\text{³}\text{ý}\text{º}\text{É}\text{Æ}\text{n}\text{ä}\text{ü}$, $\text{´}\text{É}\text{É}\text{³}\text{ý}\text{S}\text{É}\text{Ö}$ (all green vegetable), $\text{Z}\text{É}\text{ä}\text{b}\text{Ö}\text{÷}$, $\text{æ}\text{É}\text{Ö}\text{i}\text{É}\text{É}\text{Æ}\text{´}\text{É}$, $\text{E}\text{ò}\text{É}\text{ä}\text{æ}\text{º}\text{É}\text{É}\text{¶}\text{¶}\text{ä}\text{E}\text{ò}\text{´}\text{ú}\text{É}\text{Æ}$, (all flowers), cultivated in this method of farming. The chilli cultivated in this type of farming is of a special character.

- **Kulagar:** On the hill slopes terrace farming is taken up where mainly coconut and areca nut plantations are present along with some climbers like betel leaves and pepper. At the top of the Kulagar is the dwelling of the owner $\text{pplkklll};\text{l}$. Uses natural water resources available. Coconut, banana, mango, jackfruit, pineapple, kokum, $\{\text{É}\text{É}\text{à}\text{j}\text{ò}\text{³}\text{ý}\text{Ö}$, $\text{¨}\text{É}\text{É}\text{´}\text{É}\text{É}\text{³}\text{ý}\text{M}\text{É}$, $\text{V}\text{É}\text{É}\text{Æ}\text{æ}\text{É}$, $\text{Ê}\text{x}\text{É}\text{®}\text{´}\text{ú}\text{j}\text{ò}\text{h}\text{É}\text{º}\text{É}$, $\text{+}\text{É}\text{ä}\text{j}\text{ö}\text{æ}\text{É}$, $\text{i}\text{É}\text{É}\text{ä}\text{Ë}\text{®}\text{´}\text{ú}\text{M}\text{É}$, $\{\text{É}\text{ä}\text{¨}\text{ü}$, $\text{E}\text{ò}\text{É}\text{ä}\text{à}\text{Ê}\text{j}\text{ò}$, $\text{Ê}\text{¨}\text{É}\text{É}\text{®}\text{´}\text{ú}$, $\text{Ê}\text{´}\text{É}\text{b}\text{÷}\text{¨}\text{E}\text{à}\text{S}\text{É}\text{Ö}$ $\{\text{É}\text{É}\text{x}\text{É}\text{ä}$, $\text{E}\text{ò}\text{®}\text{´}\text{ú}\text{´}\text{É}\text{±}\text{É}$, $\text{Ê}\text{æ}\text{É}\text{¨}\text{´}\text{É}\text{±}\text{É}$, $\text{®}\text{´}\text{ú}\text{É}\text{V}\text{É}\text{É}$ $\text{+}\text{É}\text{Æ}\text{´}\text{É}\text{É}\text{³}\text{ä}\text{ý}$ are also cultivated. Recently chilli, turmeric, $\text{´}\text{É}\text{ä}\text{±}\text{É}\text{n}\text{ü}\text{É}\text{ä}\text{b}\text{ä}\text{÷}$, $\text{E}\text{ò}\text{b}\text{÷}\text{Ö}\{\text{É}\text{k}\text{É}\text{É}$, $\text{i}\text{É}\text{É}\text{®}\text{´}\text{ú}\text{´}\text{É}\text{É}\text{]}\text{ö}$ $\text{Ê}\text{¨}\text{É}\text{Ì}\text{S}\text{É}$, $\text{V}\text{É}\text{É}\text{æ}\text{É}\text{j}\text{ò}\text{³}\text{ý}$, $\text{n}\text{ü}\text{É}\text{±}\text{É}\text{Ê}\text{S}\text{É}\text{É}\text{x}\text{É}$, $\text{±}\text{É}\text{´}\text{É}\text{Æ}\text{M}\text{É}$, $\text{+}\text{É}\text{±}\text{É}\text{ä}$ spices are also cultivated on a large scale.
- **Baagaa (æÉÉMÉÉ):** Apart from Kulagar, large nurseries of banana, pineapple, and $\{\text{É}\{\text{É}\text{æ}\text{É}\text{É}$ is cultivated and these farms are called Baagaa.

Box 2: Traditional Horticulture:

- Naal (Coconut): Farmers involved in coconut plantations either sell the produce in the village itself or give it on contract system. Some dry the coconut and extract oil out of it.
- Supaaryo (betel nut): The farmer sells all the produce to the co-operative society.
- Kaaji (cashewnut): The produce is either sold in the open market or to the horticulture societies. The fruit is first smashed, and then fermented and made into liquor (*soro*).⁷
- Banana: Three types of Banana plantations are grown: Raspaali, Saaldati and Saavarboni, often seen in many places in Sattari and Sanguem
- Fanas (jackfruit): this plantation is done on a large scale in the months of April, May and June. There are two types of Fanas – kapa and rasaal – (watery). During the rainy season, the flesh of the Fanas is removed and the salted-dried seeds are cooked for eating, whereas most of the rasaal Fanas are destroyed for lack of demand.
- Bhinnaa and Bora: Bhinnaa are used for making kokam juice or can be used as an ingredient in cooking curries. The seeds of the Bhinna fetches good monetary returns. Borra are also used for similar purposes and also to make pickle.
- Toraa (raw mango): The raw fruits of mango trees grown along the riverside areas are plucked and sold in the market.
- Ananas (pineapple) and chiku: This plantation is not done in the large scale, except in a few areas.
- Rubber and Palm Plantation: There are a few plantations of rubber and palm. The products, latex and oil palm fruit are largely sold in the market.

- **Veli (Éä³ÿÖ)**: Maadaa (ÉÉb±É) plantation is carried out on the slopes and flat land near the seashores traditions. With the natural water resource available in plenty this cultivation is done faster and also has good yield. This plantation is called Veli.
- **Shetod** This eco-system is also on the plains. Here coconut plantations are used as bunds in between paddy fields to conserve and protect the soil. Between the bunds of coconut plantation water bodies may be present where fishing is undertaken which is called “*Shetka*”. Such ecosystem is present in Merces and Durbhat.

- **Malle:** This is the plain with sandy soil in the coastal talukas of Tiswadi, Salcette, Marmugao where different vegetables like Brinjal, Onion, *Vaal*, *Amaranthus* of both varieties red and white, Radish are grown.
- **Antodd:** Behind the house there are trees of Mango, Jackfruit and herbs like *Vetiver* or Ganjan. This area is fenced with the help of small pieces of laterite stones traditionally called 'Ada'
- **Visoll :** This is the land extending upto the top of the hills mixing up with the general forest area. Here the trees found are Cashew, Garcinia, Arjun, Hydrocarpus, different species of Terminalia etc.
- **Aado (+Éb÷Éä):** The high rise or flat land adjacent to the farmland is used for cultivation of coconut and in some cases for mango and jack fruit plantation.
- **Commercial Flora plantation:** Preparing garlands of flowers such as *VÉÉ<Ç*, *+æÉäÊ±É*, *¨ÉäMÉÊ®ú*, *¶Éä´ÉÆÊiÉ*, *+Éä´É³äý*, *ºÉÖ®úMÉä* -- Jae, aboli, mogari, shevanti, ovale (babul), surange, and selling them in the open markets which is carried out commercially at many places in Quepem and Sanguem taluka. The demand of Jae is more in the market. In Canacona, garlands of aboli are sent to Karwar. In festival like navratri, dassera etc jhende flower is used in pooja and other religious rituals.
- **Talpaavaril sheti (iÉ³ý{ÉÉ´ÉÊ®ú±É ¶ÉäÊiÉ):** Patches of soil are laid on the flat rocky land and in the rainy season, rice cultivation is done in this method of farming.
- **Shel:** Farming which is done on damp lands.
- **Porsu ({Éä®úºÉÖÆ):** Cultivation of vegetable and green vegetable done near the village house is called parasbaug ({É®úºÉæÉÉMÉ). This is done in large scale for commercial purpose also. In this plantation, traditional manures such as cow dung and ripe farm produce like leaves and plant are used to cultivate chilli, onions, cabbages, watermelons, tomato, turmeric, groundnut and vegetables, and fruits, such as *®úiÉÉ³äý*, *xÉ´É±ÉÉÈòÉä±É*, *¨ÉÖ³ýÉ*, *±ÉÉ±É |ÉÉÊVÉ*, *ºÉÉÊVÉ |ÉÉÊVÉ*, *näù`äö*, *¨ÉÈòÉ*, *Ê´É®ú´ÉÉ±É*, *+É±Éå*. These type of large farms are

found in Sulkarn (Quepem), Rivan (Sanguem), and Shigaon (Kale). Waste water from the house is used.

- **Paavshaale Porsu (monsoon gardens):** This type of plantation is done in the months of June-July. Lady finger, cucumber, mash melon, bottle-gourd, bitter gourd, long beans, chilli, maize, etc are planted.
- **Gimaalein Porsu: (summer gardens):** This plantation is carried out in December-January, usually near a pond or by a rivulet or besides the river flow. In this method of plantation, mirsaango, onions, vaali, vayangik (brinjal), tambdi bhaji, mulo, chitki, gadde are grown. Water is sprinkled every morning and evening. Cow dung is used largely in such plantations. Sometimes, farmers use chemicals as well.
- **Mirsaango (chilli):** Mirsaango are planted in large quantities. Before the plantation is commenced, the land is traditionally set on fire.
- **Kaantya Kangyo, Konaa and Kaaraande:** These are three types of tuber crops. The crop is tried with wheat grass and kept suspended, for purposes of preservation.
- **Kaalein Aaloon (Black tropical vegetable):** Seeds of black tropical vegetable called arecanut are first preserved. After the buds sprout, they are buried in the soil.
- **Tavshi, Dhodhgi, Dudhi, Kuvaalein, Vaali:** Seeds of these crops are planted in rows made of earth and a small quantity of ash is sprinkled on the rows. A different method is used in the case of *tavshi* and *chibuud* (mash melon). The seeds of these vegetables are mixed with ash and planted on the "vanteer". They are kept in this condition till the Mirg (period before the arrival of monsoon) arrives. *Tavshi*, *Dudhi* and *Kuvaalein* are hung from the ceiling for long preservation.

Mango in Goa

Goa is associated with the choicest and sweetest of quality mangoes. The Kadambas (1000-1350 A.D.) and later the governors of Vijayanagara empire (1380-1472 A.D.) promoted mango orchards in Goa close to temple complexes and in their capital cities. The local self-governing village associations of Goa - the gaunkaris – also brought huge areas under mango cultivation.

Goa has over 100 cultivars of mango grown over an area of 3700 hectares and yielding about 35-40,000 MT. The diversity of mango cultivars reflects the years of efforts in grafting. Although crude methods of grafting were already known in India, the Portuguese perfected the art of mango grafting in Goa.

Today, only the dominant and popular varieties enter the market. These include *mankurad*, *hilario*, *salcete mussarat*, *bardez mussarat*, *malgesh*, *nicolau afonso*, *xavier*, *udgo*, *culas*, *fernandin*, *goa alfonso*, *karel*, *furtad*, *costa*, *sakri*, *rosa*, *bishop*. Mankurad is very popular as table fruit. Hilario is the sweetest mango in India. Karel is preferred for pickles. Mussarat is good for jams and jellies.

Garcia de Orta in his *Colloquios* devotes an entire chapter to the mango. He reports the medicinal uses of mango: the use of baked mango seeds for congestion and the bitter mango kernel as an intestinal deworming agent. A British traveller, Dr. John Fryer (1673), East India company surgeon, praises the mango varieties found in Goa. Captain Alexander Hamilton (1727) wrote “The Goa mango is reckoned the largest and most delicious to the taste of any in the world and the wholesomest and best tasted of any fruit in the world.” The French doctor Bernier (1765) after tasting the mango jam/jelly wrote: “There is no more delicious jam or jelly in the world.”

The Mango in diplomacy:- Mango diplomacy is something unheard of in India. But the documents in Goan archives tell a different story. Renowned Indo-Portuguese historian Pandurang Pissurlenkar has reported that during the 16-17th century Alfonso mangoes were sent to Delhi for obtaining the favours of Moghul emperors and their influential nawabs. The Bhonsules of Sawantwadi also engaged in such mango diplomacy. The Portuguese

governors in Goa used to send baskets of Goan Alfonso and Fernandin mangoes to the Peshwas of Pune. Portuguese diplomat at Pune, Vithalrao Valaulikar wrote in 1792 to the governor in Goa to ban all private trade in mangoes from Goa to Deccan markets so as to increase the novelty and value of Goan mango varieties.

The Portuguese introduced a system of special permits for private traders to export prized varieties of mangoes from Goa.

Goan mango grafts:- It is not known whether the permit system was applicable to Goan mango grafts. The work done by the Portuguese missionaries and the Goan cultivators popularized Goan mango grafts. The first reference to the grafting of mango trees is to be found in a 1710 publication by Jesuit priest Francisco de Souza. Father Clemente da Ressureicao in his *Tratado de Agricultura* (1872) describes grafting techniques. Bernardo Francisco da Costa in his manual *Practico do Agricultor Indiano* (1872) writes on mango cultivation methods.

He founded the first canning factory in India in 1882 and made a case for exporting Goan mangoes in the shape of slices in syrup as well as jelly form. Bernado da Costa could be considered the pioneer of modern mango processing in India.

Another Portuguese mango-lover, General Joao de Sampayo (1902) in his booklet *A mangueira* lists 33 mango varieties in Goa.

A recent publication by ICAR-Goa Centre, lists more than 100 varieties. Mangoes from Goa were exported to Brazil in 1811. The British took the Goa Piree variety to Bombay. It came to be called "Bombay pairi". From Bombay the mango reached the islands of the West Indies under British control. Famous voyager Captain Cook found mangoes in Jamaica in 1788. The Jamaican still call their mangoes "Bombay mangoes".

From the preface to the book Nilima's Mango Recipes by Dr. Nandkumar Kamat

4. Statement of Problems relating to biodiversity

4.1 Proximate causes of the loss of biodiversity

We have built certain scenarios on basis of the reports prepared by the Goa NBSAP team. On basis of such scenarios the threat perception is presented in the table.

Table 2

Threats perception-ecosystems and biodiversity of Goa

Type of Ecosystem	Existing and perceived Threats
Continental Shelf	Supertanker traffic, oil pollution, bilge washings, overfishing, depleting fisheries stocks, agricultural run-off, red-tides. Sediment plume with heavy metal oxides, clay colloids, sewage
Beaches and sand dunes (4000 hectares)	Mass tourism, water sports, constructions, sand removal, solid waste, sewage discharges, dumping of constructional debris, exotic weeds, land levelling
Intertidal rock pools (Vagator, Anjuna, Palolem, Verem)	Oil pollution, solid waste, sewage
Estuarine islands (Tiswadi, Divar, Chorao, Jua, Cumbarjua, Corjuve, Capao, Rane's Jua, Saint Jacinto)	Breaches in embankments, flooding, exotic weeds, dumping of waste, cutting of mangroves, destruction of watersheds
Marine islands (St. George, grande, pequeno)	Cutting of trees, fires, solid waste
Mangroves (2000 hectares, 9 tidal rivers)	Oil pollution, dumping of plastic waste, constructional debris, fire, deforestation and land reclamation, exotic weeds
Khazans (saline coastal paddy fields spread in 8 talukas over 17,000 hectares)	Damage to bundhs, sluice gates, flooding, illegal pisciculture, soil erosion, land filling and reclamation, solid waste dumping, scrapyards
Riverbanks and floodplains (about 5000 hectares)	Encroachments, blast fisheries, solid waste and sewage disposal, oil pollution
Lateritic grasslands (plateaus)	Deforestation, housing, industries, fires, exotic weeds
Forests (1250 sq. kms.)	Deforestation, mining, quarrying, dams, roads, kumeri cultivation, monoculture plantations, artificial breaks, exotic weeds, fires, floods, soil erosion, poaching

Myristica swamps in western ghats	Human interference, solid waste, fire
Lotic freshwater (rivers)	Alluvial sand mining, Sediment from mining rejects, high turbidity, oil, grease, heavy metals, nitrates, sewage, solid waste, blast fisheries
Lotic freshwater (springs, fountains)	Watershed destruction, housing, industries, Washing of vehicles, sewage
Lentic freshwater(natural lakes)	Eutrophication, reclamation, encroachments, impact of religious practices (immersion of idols)
Caves (limestone, lateritic)	Mining, slope instabilities, solid waste
Salt pans (agors)	Oil, PHC, heavy metals, sediments, solid waste, flooding, erosion
Wind blown cliffs	Deforestation, quarrying, constructions
Waterfalls	Quarrying, deforestation

Proximate Causes of the Loss to Biodiversity

The State of Goa is part of the Western Ghats' ecosystem and has been subjected to a lot of developmental pressures. These pressures have been existing since the intensification of agricultural pastoralism and the rising density of human settlement mostly in the river valleys and near the estuaries. Progressive human interference in the ecosystems of Goa has caused their fragmentation and has led to significant impacts on the wild biodiversity.

Although it is not possible to create an index of the fragmentation of ecosystems, generally the causes could be identified and categorized as follows:-

i) Deforestation: This has caused progressive loss of forest cover and artificial vegetation breaks, impacting the wild habitats and the biodiversity. Most of these hotspots are found in the Western Ghats forests and foothills. The practice of traditional burning and shifting cultivation, locally known as *kumeri*, now banned, has also resulted in artificial vegetation breaks, and unbroken forest canopies have caused a change in vegetation dynamics. The practice of clearfelling of the trees after 1962-63 and the emergence of forest contractors lobbies also caused tremendous deforestation during the last 40 years. Only a marginally small patch of virgin forest has been left along the Goa-Karnataka border, which supports some last patches of wild habitats and species.

There are many drivers which accelerated deforestation, for example, clearance of forest for mining activity, monoculture plantations such as eucalyptus, rubber and their location, etc. Activities such as quarrying, construction of roads and highways, digging trenches for water supply pipelines, etc. have also impacted on the forest areas during the past 40 years.

ii) Soil Erosion: Soil erosion is another cause of loss of precious habitats and biodiversity. Soil erosion is generally caused due to the loosening of topsoil on gradients after cutting of the hills and removal of vegetation. The National Bureau of Survey of Lands and Soils in India, Nagpur in their 1995 report on Soils of Goa, have identified the Taluka-wise areas where serious soil erosion is a major problem. The loss of topsoil and the organic fraction is a major reason for diminishing soil biological diversity. There are some 25 different soil types in Goa which have not been explored for their *in situ* biodiversity, so very little knowledge exists about the real impact of soil erosion on loss of biodiversity.

iii) Mining and Quarrying: A large part of Goa, about 6-7 percent of the geographical area, has been leased out for iron ore mining in the 20th century. Since biodiversity mapping exercises were not conducted before the operation of the lease, it is difficult to identify the type of wild biodiversity which has been listed in the mining belt. Some studies have identified metal tolerant plants in the mining areas. The real impact of the mining activity seems to be the terrestrial and aquatic food chains. This impact is clearly visible in the Talukas of Bicholim, Sattari and Sanguem.

Mining in Goa is open cast type with typical bench and slope configuration. It involves systematic removal of overburden by performing bench and slope method along hilltops and slopes, as iron ore deposits lie under a thick mantle of laterite. Mining operation involves drilling, blasting, ripping, dozing, loading, waste disposal sizing and washing of ores in beneficiation plants (Reddy, 1985).

Subsequent Impact Of Mining On Marine Environment:

- Turbidity increases with higher concentration TSM and reduces amount of light to planktonic life and therefore productivity decreases.

- The suspended matter and soluble Iron affects the quality and the quantity of phytoplankton in the water bodies.
- Mine tailings deposited in the estuarine zone suffocates the benthic fauna.
- Metals like Fe, Mn, Cr, Ni, Co, Zn, Pb which are carried by adsorption from mines on clays settles within the estuary due to high salinity.
- Various organisms are known to bio-accumulate heavy metals.
- High turbidity also creates siltation problem.

iv) **Land Use Change**: This a major and serious issue in Goa because environmental and ecological concerns are not taken into account before permissions are granted for change of land use. Areas once rich in biodiversity have been converted as settlement areas or industrial areas. Especially in the coastal talukas of Goa, land use change is impacting heavily on the vulnerable habitats of terrestrial wildlife and on many critical species like the birds, the amphibians, the reptiles, the wild mammals, the beneficial insects and ecologically improved microbiota. One of the most serious problems one is the concrete jungles that crop up incessantly everywhere. These are particularly dangerous, since land use changes from one form of cultivation to another will have less impacts than this total loss.

As far as aquatic resources and ecosystems are concerned, the terrestrial land use change extends its impact directly or indirectly over these resources because the ecosystems are interdependent. Reclamation of mangrove and khazan lands near the estuaries has impacted the food chain in the estuaries and the breeding cycles of fish and shellfish. Again very few studies exist to pinpoint the exact nature of such impacts.

v) **The Growth of Industrial Estates**: The industrial estates in Goa are general over a large area, anywhere between 50 hectares to 500 hectares, selected on the basis of availability of the land at cheap rates and in so-called degraded condition. Most of the industrial estates are located in areas which were originally village commons. Many of these areas were orchards or common pastures. Thus industrial estates which exist on plateaus such as Verna, Pilerne, Kundaim,

Sancoale have come up with the elimination of typical, tropical seasonal grassland ecosystems. With fragmentation of habitats, these areas have lost their wild biodiversity. Most of these plateaus were known for a large number of seasonal wild flowers and insects.

vi) Impact due to Tourism: Mass tourism has left its significant impact on local ecosystems and habitats. The major impact is in coastal areas where the destruction of sand dunes has caused loss of wild biodiversity. Land reclamation in tourism areas has also destroyed the wild habitats of many animals, specifically of the pangolin or ant-eater, which is on the verge of local extinction. Before community education campaigns were conducted, conservation of the Olive Ridley turtles was a big problem in coastal areas. The coastal turtle habitats in north and south Goa were threatened because of poaching of the turtle eggs by the locals. Tourism has also put pressure on the last surviving wild population of the Muggur (*Crocodylus palustris*) in the mangrove fringed Cumbarjua canal. Fisheries resources in the estuarine and marine areas have also been adversely affected. There are reports of hunting of dolphins and sea otters in the coastal waters. Illegal poaching of corals from marine islands is also a new activity endangering coral resources.

vii) Developmental Projects & Biodiversity: The development and relative affluence of Goa has come at a price often subsidized by sacrificing wild habitats and species. A huge network of roads was built after liberation of Goa to connect even the remotest areas to the towns except for a small corridor along the Western Ghats that is inaccessible. Almost the entire forest area has been made accessible through a network of forest roads. Such road construction activity has fragmented the forest ecosystems, which has permitted colonization by non-local species. Besides roads, ecosystems get affected because of earth excavation for laying water links, electricity cables or telecom lines. Many of these communication-linked projects or infrastructural projects do not take into account their impact on ecosystem, habitat and species. The two medium irrigation projects: Anjuna in North Goa and Selaulim in South Goa submerged huge areas in the reservoir before any biodiversity impact assessment was made. Consideration of habitat loss and changes in species diversity are not taken into account in developing lands for big housing projects, bus stands, markets, play

grounds, stadiums, etc. The wild biodiversity near urban areas is under tremendous pressure because of such land development activity.

viii) Urbanization & Biodiversity: Major cause of worry regarding the integrity of wild habitats & species in Goa is a rapid rate of urbanization. Urban areas or man made artificial ecosystems, these need to co-exist with the natural ecosystems. The life support systems within the urban areas of Goa are under considerable stress. Specifically vulnerable habitats are the urban wet lands, the fringing mangroves, the khazans, paddy fields, the sand dunes, the intact water sheds, the urban springs & fountains and the natural water courses flowing through or passing by the urban areas of Goa. Urbanization is a very major driving force positively impacting wild habitat & species in more than 30% of geographical area of the state.

ix) Wild Life Poaching & Biodiversity: Until banned by the Wild Life Protection Act, poaching of wild life was a tolerable practice in several parts of Goa. There were elaborate rituals like the 'ritual hunts' or '*Bhovni*' was a traditional practice to chase and hunt wild animals in the name of the deity. Fire arms legally or illegally acquired are still popular in the forest areas of Goa and are still used to kill the wild life. Although the official animal census of the Forest Department does not indicate the impact of wild life poaching on the population of large game, there are any number of local reports from the talukas of Sattari, Sanguem, Quepem & Canacona which clearly point to the popularity of wild meat among the locals and sanctification of such ecologically harmful practices by both the killers of wild life and the consumers of wild meat. Another problem that has been encountered is the use of explosives and booby traps to kill wild animals in forests.

There are certain illegal practices which are also impacting the aquatic life e.g. the use of explosives such as gelatine, a common explosive substance used during the mining operations in Goa for the purpose of 'blast fisheries'. Such dangerous activities are totally banned under the Indian Fisheries Act 1897 but are still popular in the villages close to mining areas and on the banks of the rivers like the Madei, Chapora, Khandepar, Kushavati or Bardori Sareli, Talpona, and Galgibag. Besides killing the fish, the explosives cause tremendous damage to the aquatic habitat and nearby vegetation.

x) **The growing menace to exotic weeds:** Although Goa is considered as a tropical botanical garden on account of an interesting and economically useful integration of the Indian and Continental flora, there was very little problem of exotic weeds suffocating the habitats and the ecosystems. The chemicalized agriculture promoted through government subsidies in the 70's altered the ecological equation and balance. Heavy use of fertilizers like urea caused nutrient overloading in aquatic ecosystems. There are 3 major aquatic weeds that are endangering the aquatic and agricultural ecosystems in Goa. These are (1) the water roses or *Salvinia*, (2) water cabbage or *Pistia* and (3) water hyacinth or *Ecchornia*. These three species grow very fast and choke up the ecosystem. Carpets of *Salvinia* & *Pistia* have become very common during the past 5 to 10 years and in almost all the water lakes and ponds. This is a sign of nutrient overloading and eutrophication.

What is true for the aquatic ecosystem is also true for the traditional ecosystem: the movement of goods vehicles carrying food grains along the national and state highways could be a likely cause of the emergence and spread of a dominant weed like eupatorium species locally known as '*ranmar*'.

Monoculture plantations and their impacts on habitats & biodiversity

The monoculture crops of Goa are cashew, coconut, Australian eucalyptus, arecanut, bananas, rubber, oil palm and mango. Of these, cashew, rubber and oil palm are exotic crop species. More than 50,000 hectares of land in Goa are under cashew plantation. It is often observed that cashew plantations have very less biodiversity as compared to similar mixed natural areas. The acidic and phenolic cashew litter is difficult to get naturally degraded. In eucalyptus plantations cultivated by the Forest Department, the species diversity is reportedly less. Monoculture plantations do not integrate positively within the natural ecosystems of which these are a part. A reduction in the diversity of habitats and species is a common impact associated with the promotion of monocultures in Goa.

Domesticated Biodiversity

As far as domesticated biodiversity is concerned, the major impact is felt by the gene pool of traditional crops. For example, after the introduction of hybrid variety of seeds, the traditional varieties of rice were threatened. The example of salt tolerant rice varieties of Goa can be given. There are more than 30 such salinity resistant, traditional, domestic rice varieties. Many of these are adapted races of the wild rice which was growing in coastal areas of Goa near the wetlands and marshes. The first farming communities experimented with this race of wild rice and domesticated the salinity resistant strains. These strains have been passed on from generation to generation over the past 3000 years. With the growing popularity of hybrid rice seeds and subsidised cultivation packages, there is a tendency to ignore the conservation of traditional rice strains.

Similarly with the case of another crop, the mango. The original diversity of mango cultivars is also under threat from a few wild strains of mango which were found in Goa. The Portuguese botanist experimented with different grafts and contributed to more than 100 additional cultivars. This is a big genetic wealth of Goa but there is very little awareness about conservation and popularisation of domesticated mango cultivars. The Indian Council of Agricultural Research (ICAR) at Old Goa in its monograph has documented 16 different cultivars of mango in Goa. Many of these mango cultivars are found in a few talukas and few villages which means that with the killing and cutting of those trees, the mango strains may be lost forever.

There is another dimension of the loss of domesticated crop biodiversity. Goa has a basket of traditional wild flowers, fruits and vegetables. Many of these are not systematically cultivated. Many strains of monsoon vegetables cultivated by *molekars* or *kamatkars* in Ponda, Sanguem, Quepem and Canacona Talukas have not been conserved scientifically. For example, a small plot of local vegetables in Canacona Taluka may cultivate more than 20 different species of traditional vegetables. These are rarely seen in modern farms and urban markets. As a result of increasing pressures on the land and lack of incentives to conserve the wild germ-plasm, the domesticated crop biodiversity is likely to be lost in the near future.

4.2 Root causes of the loss in Biodiversity

As has been explained in Sub Section 1, in the proximate cause of the loss in biodiversity, root causes are not very different. The major problem is the change in the traditional natural resource management history. The village communities in Goa locally known as *comunidade* or *Gaonkars* used to maintain their community natural resources for centuries. The code of *comunidades* in 1961 elaborates the procedures for maintaining of the community's natural assets. As long as the system delivered the goods there was very little impact on the wild or domesticated biodiversity. The opening of mining industry in 1946 changed the overall land resources situation, and the labour equations. The transaction from community based administration to the village panchayat based administration was not smooth. Within the same social and political space the village panchayats and the *comunidades* struggle had to co-exist. This led to confusion about the respective roles and responsibilities of these institutions in natural resources management. The very complex nature of tenureship of land also complicated the problem of ecosystem, conservation habitat protection and species survival. Land reforms are still incomplete in Goa and have not realised their full potential. In fact, the Land to the Tiller Act (1964) -- also known as Agricultural Tenancy Act 1964 -- did not look at the problem of agricultural land resources and agricultural ecosystem management. Only attempts were made to resolve the issue of agricultural land ownership. The original ecological security ensured by the *comunidades*, the private owners and other state holders was not continued after the government transferred the ownership of the cultivated lands to the tenants. Together with critical ignorance of the available natural assets and the indifference about interference with fragile ecosystems, the problem of habitat conservation and species survival has become complicated in Goa.

Another root cause of loss of biodiversity is tremendous pressure caused by three driving agents (1) Rapid urbanization (2) Expansion of mining activities (3) Unsustainable tourism. All these drivers have no doubt created some wealth and affluence but this has resulted into growing consumerism, changes in consumer life styles and the consequent neglect of local natural resources. One example could be the pressure on amphibian diversity. The Government of India in 1985

declared a ban on catching and killing of wild bull frogs which were hunted in the wild during monsoon. Catching, killing and consumption of the wild bullfrog was the common activity during monsoon in Goa despite the ban. The killing of wild frogs especially from coastal areas caused a tremendous imbalance in the local food chain. Since the wild frog consumed a large number of mosquito larvae, the natural control on mosquito population was lost. Since tourism influence encouraged exotic foods, suddenly there was a new demand from hotels for serving various preparations made from the wild frog. These preparations are locally popular as “jumping chicken”. Traditionally these used to be cooked at domestic level but the demand from urban consumers and tourists resulted in the inclusion of “jumping chicken” in the menus of various hotels in coastal areas. This was the significant change induced by tourism related consumer based, ecologically destructive life style change. It is no doubt that wild frog population in Goa has decreased significantly whereas cases of malaria have gone up significantly.

Urbanization is heavily impacting the existing biodiversity in urban areas especially the protection and conservation of the wealth of trees in these cities. In rural areas there is still a lot of pressure on forest for exploitation of the fuel wood. This has depleted mangrove forests on many islands and marginal forests in other areas. So the rural energy issue or rather the rural energy supply issue is closely linked to the loss of biodiversity.

Rapid industrialisation has been another major problem, particularly in the vicinity of big towns and the industrial estates.

There are many role-players in the area of natural resource management. The most important Act is the Town & Country Planning Act, 1974, as amended, which has wide powers for surface utilisation of the State. Regional plans are prepared under this Act and some attention is paid to ecosystems and habitats but in practice there are frequent changes made in the original land use plans which cause tremendous loss to the habitats. There is also the problem of inappropriate land classification. For example, traditional pastures and vegetated areas and grasslands are combined under ‘orchards’. This is not supported by detailed biodiversity studies. Plateaus which are seasonal grasslands with less number of trees but more number of shrubs, grasses and other plants, are highly

productive in biodiversity but their wrong classification as degraded lands often leads to habitat destruction and biodiversity erosion.

There are provisions like the Marine Fisheries Regulation Act 1989 which specifies the mesh size for fishing nets but these Regulations are not implemented. In the area of biodiversity conservation there is no coordination between several government departments and this is one of the major reasons for habitat destruction and species loss.

The Agricultural Department is supposed to make the best efforts to conserve agricultural lands and crop biodiversity but it has no voice when agricultural lands are converted for non-agricultural purposes.

The Revenue Department administers the coastal khazan lands but it has no knowledge of the agricultural operations, credit resources or sources of income from land. The Fisheries Department has no knowledge of fisheries resources from the interior water resources. Such examples of departmental indifference are very common in Goa which makes the issue of biodiversity conservation a challenging problem for all stakeholders.

5.0 Major Actors and Their Current Roles Relevant to Biodiversity

5.1. Environment Related Agencies

Government: (State)

- **Forest Department:** Over 33% of the Goa State area is comprised of forest and 52% of forest area is under jurisdiction of six wildlife sanctuaries. Of total forest area, nearly 86% of forest land is government owned. Of course, much of the forest land is heavily degraded and is forest only in terms of its land use classification. This is an unprecedented situation for biodiversity conservation. The Goa Forest Department therefore has a major role in the conservation of biodiversity (wild) in the State. The department has a working plan division, and has been following a regime of conservation-oriented forestry since the promulgation of the Forest Conservation Act in 1980.
- **Forest Development Corporation:** An independent institution set up by the Goa Government, the Corporation manages the plantations raised in forest areas. It is headed by a senior forest official. Its role is important in view of the findings of the Goa SAP that increase in plantation activity impinge negatively on natural habitats of wild life.
- **Department of Science, Technology and Environment (DSTE):** The DSTE looks after several aspects of environmental management and promotion of S&T activities in the State. The Goa State Pollution Control Board (GSPCB), the Goa State Council of Science & Technology (GSCST), The Goa State Remote Sensing Center, (GSRSC), the Goa Coastal Zone Management Authority (GCZMA) and the Goa Environment Protection Council (GEPC) are various statutory/advisory bodies which come under the purview of the Department. The Department also deals with various legislations pertaining to environmental protection in the, State. The DSTE is the Nodal Agency in the State for the Integrated Coastal and Marine Area Management (ICMAM) Project under the auspices of the Department of Ocean Development (DoD), New Delhi, and various other projects/schemes promoted by the Union

Ministries of Environment and Forests, Science & Technology, Non-Conventional Energy Resources, Space, etc.

The DSTE, Govt. of Goa, has been promoting several projects, directly relevant to Biodiversity, in collaboration with various educational, research institutions including Goa University and National Institute of Oceanography (NIO).

A brief description / summary of such projects is as under:

1. Title: Phytosociological studies of Goan vegetation with the help of aerial photographs, remote sensing technology and ground truth data, for mapping out medicinal, wild edible and threatened plant species.

Results: Thirty-three species of wild edible plants alongwith thirty-one species of medicinal plants have been enlisted and described. The report has also identified fourteen endangered plant species and has mapped the distribution of plant species studied.

2. Title: Medicinal pants of Goa - Chemical examinations in search of bioactive compounds.

Results: The chemical extraction of the dried leaves yielded a compound (on purification) having the melting point of 78⁰C, indicating it to be a mixture of stearic acid (A) and Stearyl alcohol (B). These two compounds were not reported earlier from any of the Uvaria species.

3. Title: Survey, Screening & selection of metal tolerant native plant species for launching of an effective revegetation programme on Iron ore mines.

Results:

- A. A total of 412 species (ferns, grasses, herbs, shrubs and trees) belonging to 299 genera and 94 families were recommended for revegetating reject dumps. They were further divided into 7 classes based on site-specific criteria such as soil character/slope of reject dumps and natural barren plateaus around mining areas. *Leucaena glauca* was found to be an ideal species for revegetating mining reject dumps.

- B. A total of 26 species belonging to 25 genera and 16 families were also recommended as most probable species for revegetating abandoned tailing sites.
4. Title: Survey and identification of edible mushrooms of Goa and assessment of their cultivation potential.

Results: Various species of mushrooms were collected and identified: Certain species were reported for the first time. Observations made during the mushroom survey have brought out the escalating danger to mushroom diversity of Goa on account of unregulated over-exploitation of prized species, land development, deforestation, soil erosion etc. in certain areas. It was recommended that certain traditional collection areas in the forests and the adjoining habitation of the villages of Tiswadi, Ponda, Sanguem, Bicholim, Satari, Canacona, Mormugao and Quepem talukas should be protected.

5. Title: Survey, study and collection and documentation of Plant diversity of Goa.

Results:

- a. 637 species were collected from various habitats.
 - b. 452 specimens belonging to 381 species were identified.
 - c. 177 specimens were screened for their economic use.
 - d. Out of the 381 species, 61 species were reported for the first time in Goa.
 - e. The study underscored the importance of various habitats of Goa and the need for their conservation.
 - f. The information on economic uses (including medicinal use) phonology and ecology was complete.
- **Goa State Environment Protection Council:** Headed by the Governor, this 40 member Council of the most important functionaries and NGOs of Goa State dealing with environment, is an advisory body. It often discusses specific biodiversity issues.

- **Goa Coastal Zone Management Authority:** Headed by the Chief Secretary, but appointed by the Ministry of Environment and Forests pursuant to directions of the apex court, the GCZMA's mandate and jurisdiction is the 500 metre stretch from the High Tide Line (HTL) and river stretches subject to tidal influence. The present GCZMA was appointed in January 2002 with a term of three years. Its terms of reference are contained in the order appointing it, while the Coastal Zone Management Plan it must implement was approved by the MoEF on 27.9.1996.
- **Goa State Pollution Control Board:** The Board is vested with powers to manage the implementation of all pollution control statutes, including the Water Act, 1974, the Air Act, 1981 and the Environment Protection Act, 1986 and several other laws. However, it does not have a mandate to deal with biodiversity.
- **Inspectorate of Factories and Boilers, and Institute of Safety, Occupational Health and Environment:** The Institute had began a PG diploma course in Environmental pollution control technology (PGDEPCT) since 1993-4 which trained more than 75 students. This course resulted in documentation of many ecological and environmental issues.
- **Department of Education:** Environment Education Cell of the Department of Education, Govt. of Goa conducts teacher training workshops in collaboration with a number of academic and research institutes for capacity-building in environmental education (EE) of which biodiversity conservation is an integral component. The State Institute of Education also plays a role in this regard.
- **State Wildlife Advisory Board:** The Board is set up under the provisions of the Indian Wildlife Act, 1972 and is charged with the responsibility of overall supervision of the condition of wild life in the State. It is usually chaired either by the Chief Minister or the Forest Minister. Under the Act, several Honorary Wild Life wardens have been appointed to protect the interests of wildlife in the State. The Act has not been sufficient to protect forest in Goa. It has also often marginalized the forest dwellers in exercising their age-old rights and practice in maintaining the forest and wild life.
- **Goa University:** The Goa University has several post-graduate departments, particularly the Departments of Zoology, Microbiology, Botany and Marine

Sciences and Marine Biotechnology which carry out biodiversity-related and biodiversity specific research projects. The faculty of Life Sciences and Environment in Goa University has several ongoing projects and many which have been already completed with full project reports related to biodiversity inventory.

The Department of Botany has a Memorandum of Understanding with the Forest Department to work on plant and fungal resources of Goa. Besides it has a well known plant herbarium, algal and mushroom collection and hundreds of fungal species in the unique culture collection facility, helping to conserve the microbial fungal and mushroom biodiversity 'ex situ'. The University also has an Intellectual property rights (IPR) cell to address patent issues.

Fairly detailed studies of the wetlands and the avifaunal biodiversity which use these wetlands as habitats have been done by the Zoology Department of Goa University. Several individual faculties from various colleges affiliated to Goa University have also conducted specific biodiversity projects. For instance, Dr Manoj Borkar of the Bio-diversity research Cell of Carmel College, Nuvem has conducted research on the Marsh Crocodile or Mugger in Goa. Dr Phatak has done field studies on Wild Orchids. PES College, Ponda has conducted research on Sand Dune Vegetation. Dhempe college Miramar, Panaji had judged the impact of the mining activity on the western ghats ecosystem of Goa and is presently engaged in mapping the diversity and use of shellfishes of Goa. Four senior teachers from this college have extensively worked to map freshwater algal diversity (Dr. Hiremath), fouling algae and diatoms (Dr. Pangoo), marine diatoms (Dr. Kelkar), insects (Dr. Ganihar), generating useful knowledge on biodiversity. Information about all these studies is yet to be collated in any systematic manner by the University or the government agencies. However, a preliminary attempt has been made through the Goa SAP. Considerable expertise on local biodiversity lies untapped in the affiliated colleges. A case in point is the Biodiversity Research Cell (BRC) of the Carmel College for Women, Nuvem, Goa. The cell has an MOU with state and national organisations like NIO, ZSI, BNHS, ICAR and other such research organisations and has taken up the task of

inventorising the biodiversity of the State. A considerable database on different elements of biodiversity such as butterflies, moths, spiders, fishes, birds and reptiles is available with the BRC. Baseline data on floristic biodiversity is also being generated and so far orchids, bryophytes, pteridophytes, and lichens have been inventorised. The cell is currently researching the spiritual tenets of biodiversity and in this regard surveyed the state for documenting traditional conservation practices of tribes and forest communities. Information is available on biodiversity of sanctified areas such as sacred groves. The Department of Botany at the Goa University has an ongoing programme on mycodiversity for which purpose a fungus culture facility has been established.

- **Department of Tourism:** The rapid expansion of tourism in the coastal belts, and now, through eco-tourism, into the forested stretches, has had major negative impacts on biodiversity which do not appear to have been even considered by the Department.
- **Department of Industries and Mines:** The Department controls the grant of licenses for mining. In Goa, most iron ore and manganese mines occur either in forested stretches, in Western Ghat zone and in wild life sanctuary limits. The list of conditions imposed on the mine-lessees do not include any related to biodiversity conservation though biodiversity is the major casualty on most mining leases.

Government: (Central)

- **The Integrated Coastal & Marine Area Management Project Directorate:** This is a major project of the Department of Ocean Development in Chennai. At a two-day workshop held in August 1999, several aspects of biodiversity conservation were discussed and papers submitted. (These have been listed in the bibliography to this report.)
- **National Institute of Oceanography (NIO):** Like the ICMAM Project Directorate, the NIO is mainly focussed on the coastal environment and has considerable expertise in biodiversity aspects relating to the sea, tidal rivers, mangrove forests etc. The NIO however is not only focussed on the State of Goa but also conducts research on similar aspects of other coastal areas of

the country. (It therefore falls in the category of national organisations.) A Marine Taxonomy Centre has been established here, housing “type specimen” of the marine biodiversity. Both benthic and pelagic components of the sea have been fairly well represented.

- **The Botanical Survey of India:** The first scientific organisation to publish a two-volumed work on the Flora of Goa. Its work is on-going.
- **The Zoological Survey of India:** The ZSI has on-going work in Goa.
- **The Aquaculture Authority of India:** Located in Chennai, the AAI was set up pursuant to directions issued by the apex court. It deals with environment issues raised by aquaculture farming. Its recent EIA report indicates that it has poor knowledge of biodiversity issues raised in the context of shrimp farming.
- **Fishery Survey of India—Mormugao Operational Base:** The Fisheries Survey of India under the administrative control of Ministry of Agriculture has its operational base in Mormugao. The Zonal office of the FSI in Goa surveys coastal, neretic, pelagic, deep sea and continental slope resources. As identifying the components of marine biodiversity is a basic requirement for conservation and monitoring of biodiversity and sustainable use of its components as enunciated in the Global Convention on Biodiversity, the FSI has a mandate for building up a species inventory of marine fishery resources in the EEZ off the Goa coast.

5.2 Development Related Agencies

Government: (State)

- **Agriculture Department:** As with other states, the Agriculture Department deals with biodiversity-related aspects of agriculture and horticulture in the State. As Goa is largely a paddy growing area, biodiversity related work is focussed on rice varieties. Kitchen vegetable gardens that come up in rice fields after the main harvest are also a good source of biodiversity but these are at the community level, with very little inputs from the Department. The Department is also responsible for the introduction of new horticultural varieties including hybrid cashew plants and more recently, oil palm. There is

an increasing awareness and need felt to document the traditional crops and seed varieties as also the traditional knowledge of agriculture.

- **PWD/Irrigation:** These two departments impact a great deal on biodiversity in the State. The construction of Goa's largest dam in South Goa was a severe threat to a very vast forest area which was destroyed without any consciousness of biodiversity loss. PWD engineers are also notorious for taking roads through biodiversity-rich forest areas without considering any biodiversity conservation aspects.
- **Department of Industries & Mines:** The Department is responsible not only for location of industries but also for issuing licences for operating mining leases. The impact of location of industrial estates and operation of mining leases on biodiversity is only partially documented through academic studies in the State.
- **Goa state land use board:-** A statutory board established to implement the centrally sponsored national land use policy. Though chaired by the Chief Secretary, it remains passive. More than Rs. 200 lakhs have been used by the Town and Country Planning department in the name of this Board to appoint staff, purchase hardware and software without coming out with any land resource management report.
- **Town and Country Planning Department, TCP board, NGPDA and SGPDA:** Their decisions impact on the land-use and hence, ecosystems and corresponding biodiversity. These agencies are crucial to regulate urbanisation. However, they have succumbed to arbitrariness and corruption.

Government: (Central)

- **Indian Council of Agricultural Research (ICAR):** The ICAR maintains a research station at Ela, Old Goa where it conducts research on food crops and horticulture crops useful to the State. There is considerable ongoing research in the field of food borne pathogenic microbial diversity. The ICAR also maintains a good database on domestic biodiversity including breeds of cattle, pigs, rabbits and evaluates their performance under coastal climatic conditions.

5.3 Law Enforcement Agencies:

Government: (State)

- **Goa Police:** All law enforcement in the State is carried out through the auspices of the Goa police.
- **Collectorates:** There are two Collectorates, North Goa and South Goa, which also have machinery for implementing various legislations and orders issued by Government from time to time.
- **Forest Department:** The Department's officers are equipped with police powers to arrest persons found violating biodiversity related provisions of Wild Life Acts in force in the State.
- **Fisheries Department:** The Department has been given responsibility for fisheries and aquaculture development in the State. It is responsible for implementation of biodiversity-related legislation including control on fish mesh size, trawling, ban on monsoon fishing, and enforcement of environmental conditions imposed on aquafarms by the Aquaculture Authority of India. The Department has however ignored and failed to document the fishing crafts and gears and indigenous fish harvest methods. There is also a failure on the front of maintaining reliable records on qualitative and quantitative aspects of fin and shellfishes.
 - **Captain of Ports:** This authority regulates the use of various craft both in the open sea and the rivers, used for fishing and other activities.
 - **Goa Coastal Zone Management Authority:** Referred to earlier, the GCZMA has powers to issue directions under Section 5 of the Environment Protection Act, 1986 and to file cases in courts to bring environmental offenders to book when they violate coastal laws, many of which deal with different aspects of biodiversity.
 - **Goa State Horticulture development corporation:** It is engaged in promotion of horticulture, floriculture, sericulture and apiculture and conducts regular and popular training programmes in mushroom cultivation, kitchen gardening etc.

Government: (Central)

- **Coast Guard:** In areas outside the immediate jurisdiction of the State's shores, the Coast Guard, which has an office in Goa, is responsible. For example, arrival of turtles for nesting on beaches, monitoring and control of oil discharges, which have an impact on biodiversity, fall within the Coast Guard's operational mandates.
- **National Antarctic Research Centre, Vasco** is engaged in work related to marine biodiversity.
- **IPSEM (Institute for Petroleum Safety and Environment Management):** This was established by the ONGC. It is dedicated to marine safety, oil pollution, marine environment management vis-à-vis oil wells and off-shore platforms, and marine disaster management. Their work is indirectly related to biodiversity through conservation of marine ecosystems and marine biodiversity.

5.4 Citizens' Groups and NGOs

There are a large number of environmental NGOs in the State of Goa but very few have projects connected with specific biodiversity related issues. Since Goa is a very small place, local NGOs also tend to take on a State-level orientation in some of their campaigns. There are NGOs which concern themselves with wildlife protection, action against poaching and illegal capture of wildlife, protection of crocodiles and snakes, protection of green areas and vegetation. The following organisations have done significant work on biodiversity related issues:

- **The Goa Foundation** has done considerable work on biodiversity issues and published several studies and documents on such issues. The Goa Foundation's premier contribution to biodiversity, *Fish Curry and Rice*, was first prepared in 1989 (under GRID), published in final form in 1993 as an Ecoforum product, and is now entering its fourth edition.
- **The Botanical Society of Goa** organises exhibitions every year on domesticated plant diversity and encourages people to work with plant material. It vociferously protests tree-felling.

- **The All Goa Association of Zoologists** is a registered body of zoologists of the state and has been organising a number of workshops to acquaint the people with the local fauna and conserve the same, besides lobbying with the statutory academic bodies for incorporation of issues of contemporary relevance in the curriculum.
- **The All Goa Association of Microbiologists** is a registered body of zoologists of the state and has been organising a number of workshops to acquaint the people with the local microfauna and conserve the same, besides lobbying with the statutory academic bodies for incorporation of issues of contemporary relevance in the curriculum.
- **World Wide Fund for Nature, India**, also has an office in Panaji and has worked on documenting biodiversity status in a significant initiative several years ago. WWF for Nature, India, Goa Division, and International institute for Rural Reconstruction, Philippines, jointly organised a 17-day workshop in January 1994 with the contribution of over 250 participants, observers and reviewers to produce an information kit on biodiversity in the Western Ghats. The kit has information on 77 topics related to biodiversity being contributed by 99 authors. This kit is a fairly comprehensive document on biodiversity of Western Ghats and has a significant incorporation of information on Goa's ecosystem diversity and biodiversity. The WWF also published a package of 9 booklets and 9 colourful posters in October 2001, under Indo-Canadian educational facility (ICEF) titled "understanding our nature and environment". This package is to be used by the nature club in-charges and students and catalogues more than 700 species of Goa. The WWF is also in the process of developing a center for conservation education in Goa, funded by the UNDP comprising of exhibit galleries at Goa State Museum to depict the natural heritage of the State of Goa.
- **Sahyadri Ecologically Sensitive Area (SESA) Campaign:** At the interstate level, the Sesa Campaign has thrown open the resources of a cross alliance of NGOs from Karnataka, Maharashtra and Goa, all interested in biodiversity conservation issues. The Sesa Campaign is lobbying for declaration of an 8000 sq.km. of forests and mountains in a contiguous stretch that begins in Maharashtra, includes Sanctuary areas in Goa, and ends in Karnataka.

- **Centre for Environmental Education, Goa:** The CEE with its head office in Ahmedabad has recently opened its office in Goa. Currently it implements a school environment education programme (SEEPG). It targets educating schoolchildren on Goa's biodiversity. It has also launched a World Bank funded initiative on 'greening' the school curriculum. The CEE facilitated a workshop on Regional consultations for preparation of the World Summit on Sustainable Development at Johannesburg, September 2002. At the workshop two members of the Goa State Steering committee made their presentations on the biodiversity issues facing Goa.
- **Swami Vivekanand Environmental Awareness Brigade:** This Sattari-based NGO has taken up the task of documenting the biodiversity of sanctified areas (sacred groves) and is also researching biodiversity as it reflects in the cultural ethos of Goa.
- **Southern Birdwing:** This NGO has been accredited by the State Forest Department to conduct ecotourism and birdwatching packages.
- **Peaceful Society:** The Peaceful Society coordinated the Save Western Ghats March in the mid-eighties and has subsequently undertaken a number of environmental initiatives.
- **Goa River Conservation Network (GORICON):** Goa River Conservation Network is an initiative of riverine people of Goa to conserve and protect the unique ecological and cultural heritage of Goa's river basins and the sustainable economic activities dependent upon them and their life-support systems. GORICON has decided to prepare a database of knowledgeable people from all riverine areas and form a library of photographs and documents and to bring out a handbook on 'Eleven rivers of Goa - their ecological, economic, social and cultural importance'.
- **Nirmal Vishwa:** Nirmal Vishwa, the oldest of the existing local environmental NGOs of Goa was formed for dissemination of environmental awareness in Goa. It has been actively involved in environmental work and has taken up a number of biodiversity related projects.

A more complete list of Goan environmental NGOs is provided in Annexure

7.

5.5 Local Communities

- **Comunidades:** Though in a dilapidated and much maligned state, the Comunidades control vast lands containing wild vegetation and wildlife. These areas have yet to be identified and declared as private forests and work in this direction is continuing under the auspices of a committee appointed by the Goa government.
- **Local Communities including Individuals:** The most outstanding utilisation of biodiversity at the rural level in the more developed areas of Goa are the kitchen gardens, some of them specifically devoted to individual crops. For example, the village of Parra is known for its watermelons and the village of Moira is known for a particular variety of bananas. Benaulim and Calangute are known for much preferred varieties of coconut seedlings.
- Some of the agrarian tribes and forest communities of the state have made seminal contributions to conservation of natural resources. These communities have their code of socio-cultural and religious ethics with a built-in ecological restraint on use of natural resources. The scientific community is increasingly taking cognisance of these folk-religious responses and their role in biodiversity conservation.
- Some of the agrarian tribes are key players in conservation of faunal diversity of Goa. The Hindu Gavdas who reside along the Cumbarjua canal, the last refuge of the marsh crocodiles in Goa, have sanctified the crocodiles and protected them from poachers.
- Many of the coastal talukas have very rich clam beds whose proprietary rights rest with the communities there. Since time immemorial, these resources are being sustainably exploited without any violations of the resource renewal, e.g. the clam beds at Dabolim in Mormugao taluka and Betul in Salcette, have been supporting sustenance shell fisheries by coastal fishing communities, who have their own system of exploitation and sale of the shellfish, that has no place for the market forces.
- Goa, one of the states that receives the migratory Olive Ridley, has also been in focus for the participatory role of people in conserving this reptile in collaboration with the State Forest Department. The statutory agencies have

involved the socio-religious authorities such as the church in soliciting the involvement of local people. This has greatly alleviated the poaching pressures on the eggs and the adult turtles, and the hatching success has steadily improved over the years.

- The people of Goa unanimously opposed the move to privatise a small stretch of the coastline near the capital city. This was an extraordinary display of solidarity on environmental issues. Recently, there has been a spontaneous agitation to protect the rain trees in the capital city which were under threat from a road-widening scheme of the PWD.
- It has also been noticed that the traditional fishing communities of Goa practice mandatory resource resting by keeping away from the sea during certain seasons when they do not fish at all. This allows natural resource renewal.
- Sacred groves are also fairly common and venerated in Goa. This sacred status has translated into their being repositories of some rare species. (See Annexure)
- Goans have their own dietary codes; the Goan food culture is replete with ethnomedicinal values, e.g. certain fishes are recommended to nursing mothers as a dietary necessity to promote milk production, whereas others assumed to have medicinal properties are prescribed for the ailing and the old. There is a conventional ban on consumption of certain fish during certain seasons. Thus, the food culture of the state is replete with customs having conservation value.

5.6 Industries and Corporate Sector:

1. **The Tata Energy Research Institute (TERI)**, Delhi, maintains a regional office in Goa which does considerable amount of research on environmental issues. TERI, however, has not conducted any specific work on biodiversity and has concentrated largely on Environment Impact Assessment relating to tourism and the mining industries.

6.0 Ongoing Biodiversity Related Initiatives and their Efficacy

6.1 Government

The Goa Government till date does not have any recognisable programme for conservation and use of biodiversity. Neither do planning documents indicate any thinking in this regard. There is a complete dearth of policies. The only serious attempt was M.S. Swaminathan's Task Force report under the Planning Commission in 1982. The Regional Plan for Goa, 2001 A.D. touched on some issues of habitat conservation but the plan was altered several times. A new draft plan for 2010 has now been prepared.

However, biodiversity issues have recently been taken up within the framework of the ICMAM project. It may be noted that this project is largely focused on the sustainable development of *coastal areas only*.

At the policy and legal levels certain observations can be made.

Fishing

The State Government has a specific law that forbids use of fishing nets below a specific mesh size in order to allow small fish to get out of the nets. There is also a policy relating to ban on trawling within specified limits from the shore in order to protect traditional fishing. There has been a ban in force prohibiting mechanised fishing during the monsoon period. Traditionally fishing has never been conducted between June and September 31st. All these policies reflect concern for marine ecology and maintenance of a steady and utilisable population of fish stocks.

Efficacy: However, due to recent pressures from the trawler owners (some of whom are Members of the Assembly), efforts have been successfully made to reduce the period first to the 31st of August and thereafter to the 24th of July each year. In June 2000, the High Court intervened and banned fishing upto 15th August each year. The State Assembly thereafter unanimously passed a law whose intent was to take the matter out of the jurisdiction of the Courts. The Governor however refused to sign the bill. As of now, the Interim Ban upto August

15th is prevailing. The State Government is now keen on finalising the date as July 31st or *Narali Poornima*.

The NIO submitted detailed data to the High Court explaining that the ban was necessary to protect the fish during the breeding season for the principal varieties that constituted the main staple for Goans, e.g mackerel and sardines.

The State Fisheries Department acknowledges that the seas off Goa are saturated with trawlers and that the government is now maintaining a fixed limit of trawlers. However, it claims it is unable to enforce the High Court ban on fishing during the monsoon since it does not have adequate staff or patrol boats.

The Ministry of Agriculture is yet to inform the Court whether it wants a uniform monsoon ban for all the coastal states on the West coast. Consensus among fishing authorities is that such a ban is absolutely necessary, since fishing boats can always fish in waters of other states.

Aquaculture:

There are two forms of aquaculture in the State of Goa. One is the traditional aquaculture operated through natural energy of the tides. The other is the more recent version which is generally called semi-intensive or intensive. The latter kind has been banned from 1996 by the Supreme Court due to various reasons, one of them being the impact of pollution and disease from aqua-farms on wild stocks. The Supreme Court also considered the impact of collection of wild fry and the impact of these practices on decline in the wild stocks.

While traditional aquaculture is based on a mixed bag of fish varieties, modern aqua-farms only use one or two species. Thus, the expansion of modern farms vis-a-vis the traditional farms is not desirable since it leads to rapid decline of biodiversity.

The State Government has brought in a Brackish Water Farming Act in 1992 to regulate modern aqua-farms. However, after the Supreme Court Judgement and the setting up of the Aquaculture Authority of India at Chennai, the Act has become largely redundant.

Efficacy: Recently the aqua-farms banned and closed by the Supreme Court in 1996 have been reopened as “traditional improved aquafarms” by the

Aquaculture Authority of India which has become the major lobby for the promotion of shrimp aquaculture in the country.

Agriculture

The Agricultural Department for the last 30 years has a one-point programme for substituting the indigenous varieties of rice with exotic hybrid varieties, even though the records of the department indicate that the indigenous varieties performed better than the high-response varieties. The department does not have any focus on preservation of indigenous rice seeds and several of the native varieties, for example, the purple varieties of rice have disappeared from cultivation in as recent a past as the last 3 to 4 years. The department as a matter of policy feels that its only mission is to replace the local biodiversity species with 2 or 3 varieties from agricultural labs, even if those practices have had a highly negative impact on indigenous rice varieties.

Efforts to protect, for example, local millets are practically non-existent. There is not even documentation available on the different types of millets grown in Goa particularly by the tribal communities. The production of *ragi* for instance has registered a sharp and consistent decline.

In the sphere of horticultural produce, the department has attempted to propagate 2 or 3 varieties of mango; similarly with coconut and cashew. The basic intent has been to *reduce* the space occupied by indigenous varieties which were exceedingly diverse. There was no effort made to preserve germ-plasm of the wild varieties. In some areas like coconut, because the new varieties have failed, the department has now reverted to local varieties particularly from Calangute and Benaolim.

Over the last 10 years the department has even sought to introduce exotic oil palm to cater to the needs of an industrial house (Godrej).

The department does not have any policy in relation to conservation of vegetables traditionally grown in Goa and the biodiversity of vegetables is maintained by individual persons who provide their seeds for sale in the local markets and who maintain local vegetable gardens during the rabi season.

Forests

There are several legal regimes protecting the forests and forest areas in Goa. The Forest Conservation Act does not permit any diversion of forest land to non-forestry purposes without prior approval from the Central Government. The Goa Trees Act, 1984 does not permit felling of trees in private properties without permission from the Tree Authority. By orders issued by the Goa government under the Indian Forest Act, 1927, no person may even break open ground in any private forest without prior approval from the forest department.

However, the most significant legal tool which has been used in Goa in this context is the Wildlife Protection Act, 1972. Under this Act, 52% of the forest area has been declared or notified as wildlife sanctuary or national park. Under this legislation, except for illegal poaching, almost absolute protection is available to the plant and animal stock from depredation by human beings.

Efficacy: The State Government notified the Madei and Netravalli wildlife sanctuaries in June 1999. The notifications specifically state that these areas are being carved out for protection because of their enormous significance as hotspots of biodiversity. However, due to apprehensions of people that their lives and livelihood were threatened by the notifications, and also due to pressures from the mining lobby, the State Government took a decision to denotify in July 2001, 75% of the areas of both these wildlife sanctuaries notified in June 1999. The decision, however, has to be ratified by the Indian Board of Wildlife and also consented to by the Supreme Court of India. Till that happens, the denotification decision remains a piece of paper, since no formal notification denotifying the areas can be issued.

In relation to private forests, the State Government set up an Expert Committee in January 1997 to demarcate forests, degraded forest areas and plantations in the State of Goa. The Committee identified 47 sq.kms. of private forests in its final report. Subsequently a new Committee has been set up, which is now going into additional areas, particularly vast areas owned by Comunidades.

Other Biodiversity Rich Areas:

In September 1996 the Coastal Zone Management Plan for the State of Goa was approved by the Central Government under the provisions of the Environment Protection Act, 1986. In the order approving the Plan, the Central Government has required the State Government to demarcate all ecologically sensitive areas on the basis of the following sources of information:-

National Parks, Sanctuaries and Marine Parks – Information published/available with the Ministry of Environment & Forests (MOEF), Govt. of India (GoI).

All reserve forests and protected Forests – As marked in the Forest Atlas updated through Biennial Forest Report Status published by Forest Survey of India (scale 1:50,000).

Mangroves, Mudflats, Corals – Maps prepared on the basis of Satellite Imagery in the scale of 1:25,000 by Space Application Centre, Ahmedabad and the information as published by MOEF, GoI.

Breeding grounds for turtles – Wildlife Institute, Dehradun.

Areas rich in genetic diversity – Information published/ available with the MOEF, GoI.

In addition to these, mangroves upto 1000 mts. from the HTL have also been classified as CRZ I.

Sand Dunes

The case of sand dune vegetation needs separate documentation. Sand dune vegetation is characteristic of sand dune areas and its role in stabilising sand dunes is well recognised. The major assault on sand dunes has come from the tourism industries which has removed them for construction of resorts. A protection regime for the sand dunes has come only with the approval of the Goa Coastal Zone Management Plan in which sand dunes are declared as CRZ I category.

Efficacy: Despite such statutory protection, the sand dune areas are not being demarcated. The GCZMA had asked the NIO to do the demarcation but

since the NIO requires to be paid for this work, it remains undone with the result that in many areas sand dune vegetation continues to be regarded as a weed to be removed for other purposes. The GCZMA is a poorly equipped and poorly staffed authority which is largely preoccupied with approvals of constructions within the CRZ and with violations. It has yet to formulate plans for the protection of ecologically sensitive areas.

The above comprises the final policy and legal regime for protection of biodiversity in the State of Goa.

6.2 NGOs

There are several initiatives at the NGO level which have emerged in recent years. Sacred groves, for example, have been listed and documented largely by NGOs. Such groves have now been declared as ecologically sensitive by the Expert Committee of the Ministry of Environment.

Similarly, on three Goan beaches, Morjim, Agonda and Galgibag, local communities together with NGOs and assisted by the Forest Department, have initiated a successful programme for the conservation of the Olive Ridley Turtles' nesting sites and this has happened over the last 3-4 years with the number of sites increasing every year.

A major NGO initiative has been the proposal to declare certain stretches of the Western Ghats as ecologically sensitive areas. The NGO initiative seeks to combine the resources of environment groups of Goa, Maharashtra and Karnataka to successfully lobby with Government for declaring approx. 8000 sq.kms. of the Western Ghat areas as "Sahyadri Ecologically Sensitive Area" (SESA). The proposal is now in the final draft stage and is expected to be submitted to the Central Government by the end of May 2002.

Efficacy: NGOs have been fairly successfully in highlighting several major biodiversity issues facing the State from extinction of mushrooms and rain trees, to successful campaigns to protect the nesting sites of the Olive Ridley. The State of Goa is considered the environmentally most aware state in the Indian Union and this environmental awareness is seen as part of the positive ecological endowment of the State.

7. Gap Analysis

7.1 Gaps in Information

A. Gaps in Information about biodiversity for which research is required:

There are serious gaps in terms of the following:

1. Gaps in inventory: Except for higher plants, mammals, reptiles, birds, amphibians, crabs, bivalves and gastropods (as shown in Table 1 page no. 28) there is no good inventory on other taxonomic groups. Even the basic data, such as their name and their presence in Goa, is not available.
2. Gaps in habitat-specific listing: An habitat-specific inventory is lacking, even for those groups for which a proper taxonomic inventory has been done. (Biological organisms are habitat specific and not distributed evenly. For example, even the exact list of plants in each of the habitats is not available even though we may have a general understanding of their distribution).
3. Gaps in phenology / temporal variation: Utilization of biodiversity depends on the knowledge of the existence of various individual species in time and space. In plants, for example, knowledge of their phenology (leaves, flowering, fruiting, seeds, seedling stage etc.) is extremely important. The phenology of plants also influences the distribution of animals and their life cycle. Their population size and even their presence or absence depends on these factors.
4. There is no comprehensive document on use (“for what” and “how”) of plants and animals (traditional knowledge). The man-biosphere interaction has evolved through this. This knowledge is important as the rural socio-economy rests on this interaction.
5. There is gap in knowledge with regard to the future requirements of the society from these biological resources. (For example, requirement of timber, green manure, fuel wood, etc. for the next 10, 20, 50 years).

6. There are no village level registries on biodiversity (both list and usage).
7. Knowledge on the requirements of industries, especially medicinal plants etc. is also lacking.
8. Knowledge and understanding of the impact of exotic weeds on the local biodiversity and economy is lacking.

Table 3

Habitats so far poorly explored to document biodiversity

1	Waterfalls in the western ghats and rocks subjected to dry/wet cycles
2	Wind blown sea-side cliffs and vertical forests in the western ghats
3	Khazan agroecosystems
4	Intertidal rock pools and rock niches
5	Marine islands
6	Myristica swamps
7	Hypersaline environments of salt pans
8	Mineral springs
9	Sacred groves
10	Caves-natural and man-made, caverns and tunnels
11	Various soils, sediments, sands and fossil beds

Presented by Dr.Nandkumar Kamat, Goa University, Jan. 2002

B. Gaps in Availability of Information to Key Actors

At Scientific Level:

There are serious gaps in information flow within the formal set up existing in the State. For example, Goa University does not have in one place the reports on the studies conducted by it, by its different researchers and departments, on biodiversity related issues. Information is scattered in various documents (most of them unpublished). There are no pointers to this specialized data, hence key actors are often not aware of these resources.

Availability of information at a single source also will not solve the problem, as there is no trained manpower to interpret the available data. Even where the expertise is available it is not immediately available due to various intrinsic factors.

There is still too little or no interaction between various agencies that generate data and who seek to utilize or apply the data. There could be far better interaction between the University and its affiliated colleges. If one takes the case of fishing alone, there is little or no interaction or sharing of knowledge between the Goa University, the NIO, the Directorate of Fisheries and the Central Marine Fisheries Institute at Mangalore and Kochi. While there is some interaction between the ICMAM project and the DSTE, this interaction does not involve the Goa University or the NIO in any formal way. There is no exchange between NGOs and the formal knowledge set-up; it is very difficult for NGOs and members of the public to access data with these institutions. For this reason, there is enormous duplication of efforts and waste of time and public money.

At the General Level:

The Goa Steering Committee, like perhaps other steering committees dealing with SAPs, is firmly convinced that more serious efforts need to be made to make available information relating to biodiversity to many key actors defined as village communities, urban wards, comunidades, academically active sections, entrepreneurs, citizens' groups and NGOs. This is because, in a project of this kind, it is far easier to circulate such information put together by the project through the Internet where it will circulate (and be readily exploited) by powerful, organised groups than it is among the informal sectors. The latter are usually ignored by default. If knowledge about biodiversity in the State of Goa is readily made available only to formal sectors with no prior emphasis given to the non-formal sectors, this would defeat the purpose of the entire initiative. One method to tackle this would be to come out with a number of small booklets on local area biodiversity in the vernacular for use by communities.

Much of the knowledge on biodiversity remains with the grassroot level stakeholders, viz. the forest and coastal communities and can be accrued only by facilitating an interaction between the scientific community and lay people. This would require mandatory participation of user groups in generating a database, with an assured backflow of information and protection of community intellectual property rights.

Historically, however, there has also been very little interaction between the formal knowledge systems and key actors within local communities and NGOs.

The two continue to live in separated worlds. This leads to the creation of two separate bodies of knowledge relating to biodiversity — one which is purely formal, text- and report-oriented and the other which remains at the verbal or oral level and is not available beyond the local community or NGO. The result is that neither set of actors benefits from the other's activities and each operates in its own vacuum. Those who consider themselves as experts within the modern knowledge system tend to retain a superior attitude which is possible and goes unchallenged due to the clout of the middle class sections of the population, even while most persons are willing to concede that persons from the village and tribal communities have a far greater knowledge of the possible and potential uses of biodiversity resources in their environments.

These gaps are primarily due to the manner in which the education system is organised in this country. If the biodiversity project can overcome these hurdles in making available information to key actors, it would also thereby help modify many current educational prejudices and biases, and this would be a lasting contribution indeed.

7.2 Gaps in Vision

Biodiversity studies are carried out based on various parameters such as expertise, need and funding. Many a times it is an individual's interest (based on expertise) which determines the type of work on biodiversity. A single agency that visualizes the various aspects of biodiversity at broader level and that realises the need for the study and generation of data is lacking at the present moment. And there is no suitable mechanism to co-ordinate, fund research as well as develop expertise in the areas where it is lacking. The gap in this integrated approach is too wide.

There is in reality a major chasm between those involved in official decisions either in Government or in industry and those whose survival depends on their ability to exploit biodiversity. The recent discussion on biodiversity is largely located within urban and university sectors with some of it overflowing into the NGO sector. Many NGOs working on biodiversity issues are also urban-based. The result is that much of the biodiversity documentation exercises have been largely carried out by such urban based agents or actors, educating themselves

about such issues without they being actually affected or having any day-to-day interaction with them.

As a result of these biases, much discussion on biodiversity has been at the level of listing of various species. Such lists by themselves have no inherent value except for production in EIAs where they have been included generally to inflate the physical volume of the reports. They have, in any case, very little value for those involved in the daily uses of biodiversity.

As those involved in serious biodiversity discussions have only recently educated themselves about such issues, there is admitted inability to either look at such issues in the long term or even consider the inherent value of such biodiversity resources. This is even more so with the Government sector. Almost all the departments, with the exception of the Forest Department, have a predominantly development approach. This is clearly seen in the case of Fisheries and Agriculture where the dominant trend continues to be replacement of biodiversity with monocultures (one or two species of shrimp and a few high response varieties of rice). In such cases, even the very capacity for vision has been seriously dented, since such authorities have long since either relegated the tasks related to biodiversity (if they are aware of them) to formal scientific institutions like gene banks or are long since convinced that all indigenous genetic resources have at some stage to be replaced by the products of modern scientific research institutions or modern technology.

7.3 Gaps in Policy and Legal Structure

The lack of vision within the Government system in relation to biodiversity is naturally reflected in the total absence of public policy regarding biodiversity issues. Critical departments like agriculture, fisheries and the PWD continue to plan, design and execute their projects without even the awareness, let alone acknowledgement, of their impacts on biodiversity. There are no discussions on biodiversity in any of the Goa Planning documents and none of the development plans which include the regional plans regulating land use in the State or even the Outline Development Plan reflect awareness of such issues.

The gap in policy is consistent in practically all sectors except perhaps at the level of the Forest Department. There too, there is no clear focus on biodiversity

conservation as such or perhaps it is not seen clearly under that label since many of the activities of the Department in fact deal with conservation of such biological resources. However, it would be helpful if even in such departments there evolves a focus, which compels them to think in such terms.

In comparison to policy, there is a far better legal structure in force for conservation of biodiversity. For example, the Goa Wildlife Act, 1965 and the Wildlife Protection Act, 1972 provided a very elaborate protection of species to be found not only in protected areas but elsewhere as well. The various schedules of the Wildlife Protection Act apply in the State of Goa just like they apply in other parts of India as well. In Goa, in addition, specific Government orders have been issued in the past for protection of very specific biodiversity rich resource areas or habitats. For example, there is a detailed Government order banning the felling of mangrove species listed in the order. There is also a detailed order issued by the Ministry of Industries at the Central Government, which in Goa protects the Western Ghat area from possible location of ecologically destructive industries within such an area. Also the CRZ Notification and the Goa Coastal Zone Management Plan are statutory and provide ample protection, where needed, for biodiversity rich areas.

As stated earlier, 52% of Goa's government's own forest area has been granted legal protection as wildlife sanctuary (some as recent as June 1999) but there are, in addition, various protections available under the Forest Conservation Act, 1980, the Indian Forest Act of 1927 and the Trees Act, 1984. However, such protections are largely available only to forest stretches and sanctuaries and therefore one has to look elsewhere for biodiversity resources outside these areas. For example, the schedules given in the Wildlife Protection Act deal with species whose protection is required at the national level and therefore such lists do not necessarily include species of importance to local biodiversity endowments.

Finally, there are also the local bodies, which have been delegated, under the 73rd and 74th Constitutional Amendments, wide-ranging powers to deal with biological resources within their respective jurisdictions. However, neither the Goa Panchayat Act, 1993 nor the Municipalities Act, 1968, reflects any concern about biodiversity conservation nor do they empower these local bodies with

specific powers to deal with biodiversity issues. This is a serious lacunae. Statutory civic authorities like the panchayats, zilla parishads and municipal councils have to be sensitised to the biodiversity resource potential of the areas in their jurisdiction, to enable them to perform better as custodians of this living wealth. This may require the existing legislations to incorporate issues concerning Biodiversity. Knowledge about this should be part of their sensitisation and training before they assume office.

7.4 Gaps in institutional and human capacity

The goals of institutions are varied. Depending on such goals, they either carry out intensive biodiversity research or deal only at the peripheral level. Institutions like the Botanical Survey of India and the Zoological Survey of India have a direct interest in biodiversity and hence have a built-up capacity to do biodiversity inventorisation. Even so, because of lack of adequate human resources and due to the broader geographical area they must cover, their research is restricted to only a few selected groups.

The goal of academic institutions is mainly imparting education and doing research. Due to smaller sizes of the departments and due to various sub-disciplines in biological sciences, it is hard to see a person who specializing in biodiversity which by definition almost is a multidisciplinary area. Even if one is available, field intensive studies required to be done are problematic to carry out due to his/her regular academic schedule. Any research in academic institutions is supposed to be carried out without disturbing the regular academic calendar. Hence, even the meagre expertise available is also incapacitated.

Biodiversity research should be supplemented with the construction of herbaria, museums, databases etc. for quick retrieval of information stored. As most biodiversity research is carried out in project mode (a maximum of three years), there is no resource capacity to maintain such projects after they are completed.

Basic research into biodiversity does not attract students as it involves difficult fieldwork. The bureaucratic procedures of institutions further dampen the spirit of biodiversity researchers.

A serious issue that has come to the fore in recent years are new CSIR regulations that control institutions like the NIO, which require payment for research conducted by the organisation. Since such institutions are now forced to raise resources themselves, either through EIAs or consultancy studies, the focus invariably is only on those aspects of work that will generate income. This also affects the quality of research produced. Reports paid for, are not allowed to be circulated, despite the fact that the professionals in such institutions are paid from the public exchequer. It is essential that EIA reports and consultancy studies be made available to the communities themselves.

The principal problem among the government departments relates to the collection of primary data. While in other States, primary data on agricultural and fish production is collected from the field, in Goa such a system does not exist, and if it did, it has now fallen into disuse. There is a whole lot of secondary data circulating within the departments and between those who are dependent on such data, and it drives out any need to generate empirically verified data. Most data is now generated on desk, in the office, even though TA/DA bills are regularly submitted by inspectors.

In relation to human capacity, the trend in education is away from biodiversity related research. Because of the predominance of the electronic media, particularly computers, more emphasis is now placed on research that fits the electronic format which is best suited for data processing. This has devalued actual data collection and field research and visits. While physics and chemistry and computer sciences take the bulk of students, botany and zoology departments find it difficult to attract students. This is bound to have serious impacts on our ability to raise knowledgeable professionals aware of biodiversity issues and able to monitor them on behalf of society.

Finally, we can note that staff and volunteers attached to various NGOs are inhibited due to lack of formal training and lack of resource material in carrying out biodiversity related surveys and works, even if they wished to.

8. Major Strategies and Actions to fill these Gaps and Enhance/ Strengthen Ongoing Measures

The gaps enumerated in (7) above relate to research and availability of information to key actors, gaps in policy and legal structures and institutional and human capacity.

Considering the details discussed above, it is quite obvious that several strategies will have to be laid out.

1) Sensitising the Government System

The preliminary exercise will have to be in the direction of exposing the perceptions of the official system to issues raised in the Goa SAP report. Only after such legitimacy has been established, can we expect some significant progress in handling these issues.

A major objective in this exercise will be to keep the government system, including the administration, continually abreast of biodiversity issues as these have been discussed within the framework of the Biodiversity Convention. The Forest Department has cooperated fully in the preparation of the SAP, but the Department of Environment has not had the time to get fully involved. This is because it is already heavily engaged in several environmental problems and taking on an additional task does not appear feasible at this stage.

There is a formidable knowledge vacuum existing within the government system that must be remedied and filled. This can be achieved by calling for an official discussion on the Goa SAP once this is finalised and submitted. The Monitoring Committee can undertake a publication of the main features of the report in English and Konkani. This can be made available to all government departments and their advice sought on the report. The mobile exhibit also planned will take the main report to the villages and communities for enrichment and endorsement. Once the major stake-holders are aware of the Goa SAP, there is far better feasibility of its being implemented through the official system.

Efforts will have to be made to get the Goa government to adopt the SAP as a policy document of the State. This can be achieved by having formal and

informal consultations on the final SAP with different departments involved in biological resources.

In concrete terms, this would involve the following actions:

- 1) Discussion of the State Plan in detail with Government and procuring Government acceptance of the SAP. Copies to be forward to all the agencies enumerated above, to be followed up for comments and collaborative projects. Sensitising of government officials to biodiversity-related issues will have to be an ongoing process. Mechanisms need to be evolved within the government to address this.
- 2) Continuing interactions on biodiversity related issues with the public, NGOs, media, government officials and academics.
- 3) NGOs and researchers will be encouraged to submit proposals to the Goa government on biodiversity issues for financial support. The government should specifically make budget allotments for biodiversity-related issues.
- 4) Periodic review of Government initiatives by the Monitoring Group.

2) Completing Biodiversity Inventory

The work on the Goa SAP and review of work already carried out by professionals earlier have thrown up significant gaps in our knowledge of aspects of biodiversity in the State. If there is a focus on the unknown or little known areas, with the University requested to deal with such areas within the framework of its on-going research activities, a more complete picture will be available.

In this context, the following specific actions are needed:

Synthesis of existing data and removal of uncertainties and ambiguities. This can only be done by a body or a consultant or a Board devoted exclusively to the conservation of biodiversity endowments of the State. Pending the constitution of a biodiversity board, this action should be initiated by the State Government.

Inventorisation in mission mode is the need of the hour. Commissioning of surveys in areas where biodiversity is least documented. This is best achieved

through the University research framework, with major departments given the responsibility for generating specific research projects.

Re-assessment of habitat extents and changes, including changes which are in the nature of threats to specific species. Clam and mushroom population studies are good examples. GIS can be used as a tool in this process.

Review of the current uses of habitats and impacts. This is important from the view of their sustainable uses and for enforcing limits where it is deemed to be required.

Assessment of future requirements of society in terms of biodiversity and executable plans for achieving goals.

3) Sustainable use of marine biodiversity

The present crisis in fisheries has thrown up major problems related to biodiversity. As of now, the fish basket available to the coastal population has reduced considerably. Not only has the quantity of fish available declined, but number of species available for consumption has also declined. Bulk of fish consumed today is largely two varieties: sardine and mackerel. Protection for these two species is now grudgingly available with the monsoon ban. However, none of the other varieties of fish that breed outside the monsoon period are protected by bans that protect their breeding periods.

Several important new actors have created problems for marine biodiversity which should be mentioned:

- a) Joint Venture vessels which now come into the rivers and estuarine areas and drain the entire ecosystem of marine fish. A good proportion of fish is trashed, thus creating problems in the food supply of marine hierarchies themselves.
- b) Bottom trawl methods are still in use and must be effectively banned since it is scientifically established that such trawling constitutes major disturbance of marine environments, affecting generation of fish stocks. Trawling may not per se affect generation of fish stocks (except when overfishing happens) but it does destroy a lot of benthic habitats and organisms.

The following specific actions are therefore needed:

- 1) Reassessment of fisheries potential.
- 2) Reassessment of fishing practices, destructive or otherwise, including stakes in rivers. Ban on joint venture vessels.
- 3) Enforcement of codes for responsible fishing (including controls on size of mesh, strict implementation of monsoon ban etc)
- 4) Assessment of carrying capacity of marine habitats (especially in terms of tourism)

4) Strengthening the base of traditional knowledge and practices

Traditional knowledge and practices are declining for a variety of reasons, even though they have proven their value in terms of required conservation ethics and meeting the demands of human welfare. A multi-pronged strategy is needed to revitalise these knowledge systems and practices. *The following actions need to be taken:*

- 1) Documenting and disseminating details of traditional practices and knowledge with focus on their conservation value. Particular emphasis must be placed on practices that recognise environmental limits to sustainable to exploitation of the resource. This must be done urgently, as much of such knowledge is fast disappearing and will soon be lost to humankind.
- 2) Documenting traditional practices and knowledge with focus on their use value.
- 3) Documenting traditional practices and knowledge with focus on their sustainability.

5) Policy Changes:

There are several policy changes required to give effect to these strategies and action points.

The Biodiversity Convention already mandates governments to undertake specific programmes for conservation of biodiversity. But this is yet to be reflected in the municipal law and development programmes in the State of Goa. A

comprehensive biodiversity law is therefore a paramount need of the hour. Statutes are important because they compel the government to carry out certain measures irrespective of section interests. The Panchayat and Municipal Acts must be amended to compel the local authorities for conducting adequate programmes for protection of biodiversity within their respective jurisdictions. *The following actions need to be taken:*

- a) A comprehensive State law to be introduced on conservation and sustainable use of biodiversity endowments of the State. Such a law would also provide for protection of such endowments from piracy. A Central biodiversity bill would enable the state boards to uniformly apply Central rules, and the state law will have to be more site-specific, taking into account local problems. For example, in the case of Goa, one could regulate the increasing monoculture of cashew and minimise its impacts, and exploitation of fisheries could be regulated with regard to biodiversity.
- b) Amendments to Panchayats and Municipal Acts, enabling the local authorities set up under these Acts to incorporate biodiversity aspects within the framework of their development plans. Relevant amendments would also enable local bodies to claim ownership, if necessary, of biodiversity resources as an integral part of the public trust doctrine.

8.2 Specific actions:

The declaration of the Madei and Netravalli Wild Life Sanctuaries was done only after the government was fully convinced of their utter significance in terms of biodiversity conservation. The Goa government has not provided any reasons why it has decided to de-notify bulk of the area of the two sanctuaries.

The two sanctuaries, together with the four declared earlier, bring the area under WLS to 52% of the forest cover of the State. 85% of forest land is owned by the Government of Goa. This is automatic legal protection afforded to the State's wild biodiversity, particularly its wild plants and animals. The Madei/Netravalli areas are ecologically sensitive from several indicators. Therefore it is important to work for a scenario where the protection envisaged is restored, but with the participation of the people in the areas concerned.

Stricter enforcement of Wild Life Protection laws is required in Goa to prevent continuing capture and destruction of wildlife. Every week, for example, dozens of wild snakes are brought to the flea market at Anjuna for the entertainment of tourists. Despite repeated efforts which have involved seizure of the snakes and setting them free in the jungle area, the trade continues. The Forest Department is considerably weak in law enforcement, and more often too soft with such enforcement as well.

No development of any sort should any more be considered for location in biodiversity rich areas unless it is able to meet the ESA criteria laid down by the National Committee set up by the Ministry of Environment and Forests.

The Goa SAP steering committee has worked on the concept of a mobile exhibition to deal with the specific problem of making biodiversity and knowledge about biodiversity available to key actors from local communities, urban wards, comunidades and NGOs. (A detailed idea of the mobile exhibit is provided in the Annexure 9). Government funding for the exhibit has been sought and is under consideration.

As there is no nodal authority or agency dealing with biodiversity within the State, we have recommended the establishment of a Goa Biodiversity Board, under a separate legislation. It will probably devolve on this Authority to undertake to remove many of the institutional gaps that have been described above. Since the proposed Biodiversity Board is designed to have on it representatives from all the major stakeholders in the State, coordination will be improved once the Board is set up and starts functioning.

In the interim period, the Goa Government should direct Goa University to pool its considerable data on biodiversity from its different departments and from the affiliated colleges and have this evaluated. This need not be a costly effort, as the principal departments involved are Zoology, Botany, Microbiology and Marine Sciences. The help of village panchayats can be taken for maintaining biodiversity registers.

The Government must take a serious enough view on the status of traditional knowledge. Right now, the area is open for grabs, with corporates foraging in such traditions for dollar spinning ideas and without having to pay or even acknowledge them. It is therefore mandatory that local biodiversity knowledge

registers are prepared. Once such registers have been prepared, these should be declared as public heritage by the statutory bodies in the area particularly panchayats and Councils, so that they cannot be privatised and exploited for profit. Present patent and copyright laws allow mere declaration of ownership to be adequate for the purposes of preventing companies or corporates from stealing, and later patenting, such information.

Basic to proper implementation of sustainable use of biological resources, is some understanding of the availability of the resource, whether it is renewable, prolific, or in decline due to over-exploitation. The case of mushrooms, for example, is a good illustration. Some species are certainly endangered due to over-exploitation. Similarly with canes in the forest, where some controls have now been imposed. Unless there is a body of research opinion on what constitutes sustainable use, policies in this regard would be difficult to justify or implement. We feel that in all such discussions, those utilising biological resources should as a rule be actively involved in evaluating the sustainability of the resource, though this has not worked in the case of fishing, where powerful trawler owners have insisted that there is no danger to fish stocks from fishing in critical spawning periods.

In this context, the following specific actions are needed:

- a) Improve implementation of wild life laws, especially those relating to illegal possession and poaching of wild life.
- b) Setting up of a Goa Biodiversity board, with representation from all stakeholders.
- c) Till the Board is set up, Goa University will be asked by the Goa government to complete the overall inventorisation of biodiversity in the State, including data from existing studies.
- d) A special cell should be set up within the Department of Science, Technology and Environment for documentation of traditional knowledge and sustainable uses of biodiversity.
- e) Sustainability studies to be carried out by professionals regarding exploitation of certain controversial species including clams, mushrooms, wildlife, marine species, wild plants and herbs.

8.3 Actions to conserve and sustainably use agro-ecosystems and domesticated plant and animal diversity.

It is imperative that there is radical shift in the present agricultural policies which are based on gradual replacement and extinction of local biological resources. While there can be no objection to introduction of new varieties, care must be taken to ensure that older cultivars and varieties do not go out of use. This can be done by identifying certain groups of farmers who will continue to grow older native varieties, if necessary, with monetary support. The concept of *in situ* gene banks is well-established.

In the case of domesticated animals, Goa does not have recognised breeds of indigenous cattle. Whether one speaks of cattle, and other bovines, and poultry, the breeds that have been popular are local, nondescript breeds with no special features. However, the characteristic feature of these breeds is that they are highly resistant to some of the diseases that affect introduced species. Hence it is necessary that they are given protection and that there are appropriate programmes to ensure their improvement and conservation through selective/cross breeding programmes.

One very effective means of highlighting conservation of biodiversity, particularly regarding food crops, is the organising of food *melas* that are devoted almost exclusively to the preparation and sale of such local foods. Such events organised in Delhi have been not only appreciated, but been financially successful as well. The food *mela* can be organised over three days and would encourage people who attend the *mela* to sample the richness of the biodiversity basket used by the tribals and communities in the State. The Tourism Department of the Goa Government every year organises a food festival. It began as a sea food festival, but since sea foods have depleted, this was changed to a food festival, where today largely chicken and liquor and ice-cream are served, mostly by resorts who open stalls. There are no Goan foods or recipes offered. The kind of food festival organised is clearly a symptom of the deeper malaise.

The Goa SAP committee should also oversee the publication of a directory of seed-keepers. These should include all those local actors, particularly women, who have been traditionally maintaining and selling local seeds, ranging from

vegetables to horticultural crops including coconut. It should also document other specific local varietal innovations including species of mango and coconut.

In this context, the following specific actions are needed:

- a) *In situ* conservation of crop varieties to be initiated by the Department.
- b) Three day food mela every year, featuring preparation and sale of indigenous foods to emphasize aspects of biodiversity.
- c) Animal Husbandry Department to have a cell that initiates programme for conservation of local breeds, use of such gene pools as a base for improvement of breeds. Similar programmes for country chickens.
- d) Monitoring Committee of Goa SAP to bring out a directory of traditional seed-keepers of Goa State.

8.4 Actions to conserve and sustainably use micro-organisms.

No action has been done in respect of conservation and sustainable use of micro-organisms in the State of Goa by the Goa SAP. However, the Microbiology Department of Goa University and ICAR, Old Goa, have competence to deal with this issue, as and when it is taken up by the Monitoring Committee or the Biodiversity Board.

8.5 Actions to achieve equitable decision-making, people's (including women's) empowerment and participation; equitable sharing of benefits, cross-sectoral integration, policy and legal changes, financial measures and other such steps

Gender participation and sharing of benefits from biodiversity use is often best ensured by legal means. Gender representation of women in the Panchayat in terms of percentage of membership, chairpersonship of the Panchayat, etc have had certain significant consequences.

Women must be nominated to the Biodiversity Board and to other institutions being created for the conservation and use of biodiversity, as they handle a great deal of the operations dealing with conservation of biological resources. Their

role in conservation and use of such biological resources must be documented and disseminated. They must be given charge of village level biodiversity registers.

In the State of Goa, due to the provisions of the Civil Code in operation from Portuguese times, women already have automatic 50% of the share of total marital assets by law. Such automatic guarantee of shares in biodiversity endowments, schemes and projects would go a long way to ensure equitable sharing of benefits.

In this context, the following specific actions are needed:

- a) Critical involvement of women in Goa in conservation and use of biodiversity and its sustainable uses especially biodiversity registers.
- b) Legal provisions to be enacted that ensure automatic sharing of such resources by women in the State.

9. Follow Up

The Goa SAP envisions the setting up of a **Goa Biodiversity Board** which should be constituted under a separate law. The Board should comprise of:

- members from Government departments directly dealing with biodiversity particularly the Forest, Fisheries and Agriculture Departments as well as the Directorate of Panchyats;
- NGOs involved in biodiversity issues including wild life conservation;
- Research institutions including Goa University and NIO;
- outstanding Goan scientists with expertise in biodiversity; and,
- outstanding individuals from the rural communities who are knowledgeable about biodiversity or are repositories of traditional knowledge.

It will be the paramount duty of the Board to prepare and get published an annual Status Report on Biodiversity in Goa. The Report will emphasise specific problem areas. The Board should have both scientific programmes for investigating biodiversity issues raised in the gap analysis section of this SAP, but it may also propose development programmes based on utilisation of biodiversity reserves.

The Board should also ensure that all department projects take biodiversity parameters into consideration while designing and implementing development works at the design stage itself.

The **Steering Committee of the Goa SAP** should be reconstituted as a much smaller group which will now function as a monitoring group. The monitoring group can meet once in six months and generally act as a pressure group for the purposes of highlighting biodiversity issues and demanding that any such issues should be kept in mind when deciding (particularly large) development projects. The nodal agency, Goa Foundation, will take responsibility for communicating to the various stake-holders and the general public the various issues raised in the SAP, through publications, mobile exhibitions and other effective means.

10. Bibliography, references, annexures etc.

10.1 Reports generated during the Goa BSAP process

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10.3 List of Annexures

1. Press note—call for participation
2. Newspaper cuttings on Goa State BSAP
3. Minutes of meetings of the Steering Committee
4. Minutes of one-day workshop to discuss draft reports
5. Minutes of workshop on Coastal Biodiversity of Goa
6. Check list of species biodiversity
7. List of environmental NGOs in Goa
8. List of individuals and groups contributing to the Goa State BSAP process
9. Proposal for biodiversity exhibition
10. List of members of Steering Committee
11. Village name associations with flora and fauna
12. List of medicinal plants and therapeutic uses.