

ORISSA STATE BIODIVERSITY STRATEGY AND ACTION PLAN

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ABBREVIATIONS

BSI	Botanical Survey of India
CBD	Convention on Biological Diversity
CGIAR	Consultative Group on International Agricultural Research
CICFRI	Central Inland Capture Fisheries Research Institute
CIFA	Central Institute of fresh-water Aquaculture
CMFRI	Central Marine Fisheries Research Institute
CRRI	Central Rice Research Institute
DPF	Demarcated Protected Forests
FRI	Forests Research Institute
FSI	Forests Survey of India
GSDP	Gross State Domestic Product
HYV	High yielding Variety
ICAR	Indian Council of Agricultural research
ICFRE	Indian Council of Forestry research and Education
IUCN	International Union for Conservation of Nature and Natural Resources
JFM	Joint Forest Management
JGSY	Jawahar Gram Samridhi Yojana
KBK	Koraput Bolangir Kalahandi Districts of Orissa
MOEF	Ministry of Environment and Forests
NBPGR	National Bureau of Plant Genetic Resources
NBSAP	National Biodiversity Strategy and Action Plan
NIO	National Institute of Oceanography
NRSA	National Remote Sensing Agency
NSDP	Net State Domestic Product
NWCSO	Nature and Wildlife Conservation Society of Orissa
OBSAP	Orissa Biodiversity Strategy and Action Plan
RPRC	Regional Plant Resource Centre
RRL	Regional Research Laboratory
SAP	Strategy and Action Plan
SDP	State Domestic Product
SFP	Social Forestry Project
SIDA	Swedish International Development Agency
SLSC	State Level Steering Committee
SGSY	Swarnjayanti Gram Swarozagar Yojana
TRIPS	Agreement on Trade Related Aspects of Intellectual Property Rights
UNEP	United Nations Environment Programme
VFC	Village Forest Committee
VFPC	Village Forest Protection Committees
VSS	Vana Samrakshyan Samittees
WALMI	Water and Land Management Institute
WHO	World Health Organisation
WII	Wildlife Institute of India
WTO	World Trade Organisation
ZSI	Zoological Survey of India

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Chapter 1

Introduction

1.1 Brief Background to the Strategy and Action Plan

1.1.1. During the course of evolution and because of excellent topographic and varied environmental condition vast array of diversity in agricultural and horticultural crops have originated in Orissa. Thus it is a potential region for occurrence of diversity in crop plants and centre of diversity for many agri-horticultural plants, native/primitive cultivars, land races and wild relatives of crop plants. Richness of the diversity of the agri-horticultural crops is exhibited in crops like rice, maize, millets (*Panicum miliare*, *P. miliaceum*, *Echinochloa*, *Setaria italica*, *Paspalum scrobiculatum*), legumes (*Vigna unguiculata*, *Cajanus cajan*), vegetables (pumpkin, cucumber), oilseeds (Sesame, castor), fibre crops (jute, cotton,) spices and condiments (turmeric, ginger) horticultural crops (mango, jackfruit), and wild relatives of crop plants.

1.1.2 Biological diversity is the sum total of species richness, that is the number of species of plants, animals and micro organisms living in a community or an ecosystem (Khoshoo,1991). The International Convention of Biological Diversity (1992) define the term as “the variability among living organisms from all sources including, *inter-alia* terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part, this includes diversity within species, between species and of ecosystems”. Cultivated plants, domesticated animals, genetic material like seeds and germplasm and the variability within and between each other, all come within biodiversity.

1.1.3 Biodiversity is a treasure which has come about over billion years of evolution, struggle for survival against gradual and catastrophic climate changes, genetic plasticity, natural selection and adjustment to every conceivable habitat niche that were made available by climatic factors. This evolution process was however, begun to be influenced by man over the last tens of thousand years. His weapons and tools, wild fires, clearance of natural vegetation, his domestic animals, all shaped the present biodiversity. In the present juncture, biodiversity is not only threatened but getting destroyed at an alarming rate of 140 plant and animal species every day in the World scene . Hence, the concern for conservation.

1.1.4 Bio-diversity occur at three different levels, viz.(I) species diversity (ii) genetic diversity and (iii)ecosystem diversity.

Species diversity is manifestation of morphological, physiological and genetic variability within and between species.

Genetic diversity means number of species in a region plus successional gradients of a species in a evolving ecosystem from pioneer stage to climax stage. It covers genetic and other variation within a species, ecotypes, provenances, variety, sub-species etc.

Ecosystem diversity refer to diverse biogeographic zones, viz. Forests, grass lands, lakes, Coasts and estuaries.

1.1.5 Diversity is the life and blood of natural ecosystems. More the variability, more complex is the ecosystem; larger are the energy path ways . Diversity contributes to the stability of ecosystem and its degree, is an indicator of its successional age. It harbours an enormous diversity of plants, animals and microbes, both domesticated and wild and impressive array of genes species and ecosystems. This biodiversity sustains at present the food, medicinal, clothing, shelter, spiritual, recreational, moral and other needs of Indian people. It also has the potential for all future needs. India’s biodiversity is now very seriously threatened due to human-induced changes and has to be conserved and protected at whatever cost. Thus, there is an urgent need to formulate strategies and action plans at all levels involving the entire cross-section of the people of various

categories to assess, document, protect, conserve and sustainably use our biodiversity and equitably share the benefits arising from such sustainable use.

1.2 Scope

1.2.1 Although the present interest in biodiversity conservation seems to be mainly due to apprehended use of India's genetic resources elsewhere, it is to be remembered that our very existence depends, in the long run on the conservation of our diverse genetic resources. At the beginning of the third millennium it has been now well experienced that there is enormous pressure on various ecosystems. Therefore separate Orissa Biodiversity Strategy and Action Plans (OBSAP) are necessary to protect and conserve fragile ecosystems of Orissa's terrestrial, aquatic and coastal zone for the continued survival of diversity of plants and animals which they support.

1.2.2 In the Strategy and Action Plan (SAP) there are separate themes covering forests, agriculture, domesticated animals, terrestrial fauna (wildlife) as well as fish and fisheries (aquatic fauna). Separate themes are for water resources management practices with emphasis on large and medium dams as well as mineral resources management with respect to biodiversity in Orissa. While prioritising different themes for the National Biodiversity Strategy and Action Plan (NBSAP) it was decided to have a separate themes to deal with the coastal aquatic fauna with emphasis on king crabs, turtles, waterfowls and dolphins and orchids amongst floral diversity as well as for soil microbes and invertebrates. There are many threats faced by the specific target groups such as orchids, king crabs, turtles, water birds and mammals including aquatic mammals inhabiting the coastal habitats of Orissa. Therefore, scope remains for focussed attention on some unique taxonomic groups viz, king crabs, turtles, waterfowls, orchids, cultivated races of agricultural & horticultural species, domesticated animals and marine mammals like dolphins etc. occurring and or migrating to the state. This has brought about the importance of regions of ecologically fragile, but with rich biodiversity like Satkosia, Gandhmardan, Mahendragiri, Pradhanpat, Malyagiri and others having scope for biosphere reserves. Scope on re-introduction of biodiversity relevant to understanding has also been generated.

1.2.3 Analysis of legal instruments, religious & cultural instruments for biodiversity conservation for SAP has also been done. Legal protection to the habitats of the species and their proper implementation need the political will power and support of people. Therefore, it is necessary to make them aware about the present status of these aquatic fauna at global, national and regional level and the need of various other aspects of conservation. This action plan will hopefully provide strategy for conservation of floral and faunal diversity of Orissa.

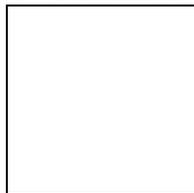
1.2.4 The SAPs bring with itself immediate scope of actions in following directions :-

- To take immediate steps to carry one fresh status survey of the target groups and their habitats (water bodies such as forests, groves, ponds, rivers, reservoirs lagoons, estuaries, sea grass beds, coral reefs and mangrove areas) through appropriate short term, medium term and long term research project.
- To take immediate steps to monitor, evaluate and improve existing research, protection and conservation programmes.
- To conduct awareness programmes involving all stakeholders.
- To identify the species specific and habitat specific threats and their mitigation.
- To declare important floral and faunal rich areas as wildlife sanctuaries / National Parks.

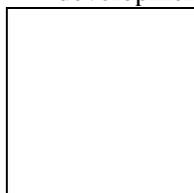
1.3 Objectives

1.3.1 The main objective of the present attempt is to prepare a State Biodiversity Strategy and Action Plan for Orissa with respect to its richness in biodiversity in terrestrial ecosystems, aquatic ecosystems; biodiversity rich regions, forests, wetlands, marine environment sustaining economy and livelihood; as well as for administratively functional units like district for implementation to achieve the desired goal.

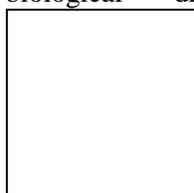
◆ Sustainable Development - District, Region and State



Sustainable Use of Biodiversity- To address people's problems and issues related to biodiversity in livelihood and economy, cultural linkages, importance in present biotechnological development and habitat restoration;



Conservation of Biodiversity To conserve, protect and propagate the entire range of biological diversity, their habitats & ecosystem for the benefit of human community;



Sustained yield from natural resources - To ensure participation of all sections of local community in bio-diversity conservation and related policies and programmes.

1.4 Contents

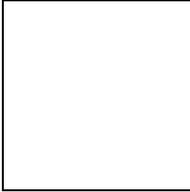
1.4.1 The status of biodiversity in its almost all aspects like forests, agriculture, water, coastal ecosystems have been extensively documented. Floral and faunal wealth of Orissa has been polled together. The specific important taxa, threatened species with their habitats have been also given emphasis. Ecologically fragile regions have been also identified for immediate actions. The Chapter 2 provides a complete profile of state of Orissa. The guiding principles of this document have been convergence of various aspects of biodiversity in the concepts of conservation and sustainable use, economy and livelihood mechanisms, public participation and coordination, women and equity, training and awareness, legal, ethical, religious, cultural issues, planning and policy mechanisms for SAP development. With increasing decimating factors and population of man and his livestock, sustaining of development and conservation has become gigantic task. The strategies and action plans have been developed for the state on cross cutting basis for development sectors, for the terrestrial and aquatic ecosystem on regional basis and for the districts as implementing units of administration in present political set up.

1.5 Methodology

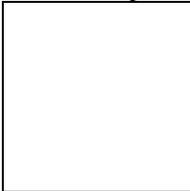
1.5.1 The State Level Steering Committee (SLSC) deliberated upon the identification of broad cross cutting themes for Strategy and Action Plan (SAP) covering whole of Orissa, on representative, unique regions and districts for SAP of the area. Various classification and terminology like forest types, ecotones, agroclimatic zones, biogeographic regions, zoogeographic islands, hotspots of biodiversity, ecoregions, ecodiversity regions, watersheds formed the basis. Out of 18 important biodiversity themes, 12 cross cutting themes developed and experts known in the field were made Co-ordinators with working group members from academicians, government departments, non-governmental organizations as their associates(see Annexure 1.1). For ecologically important areas, two such representatives – one each from terrestrial and aquatic ecosystem were finalized for SAP by the Nodal Agency of the state. For SAP of artificial boundary unit like district, four districts formed the District Advisory Committee(DAC) with nodal agency and finally 3 representative districts (Angul – with rich biodiversity and industries, mining and irrigation projects, Deogarh

– with rich biodiversity region like Pradhanpat with negligible industrial, mining activity, and Sambalpur – with growing industries and urbanization) developed SAPs. List of cross cutting themes for which SAPs have been formulated is at Annexure 1.

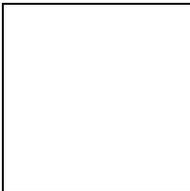
1.5.2 The approach has been multi-pronged for wider base and participation. Efforts were made for greater participation by school children, teachers, tribal and rural women during public hearing programmes and informal contacts for awareness and collection of information. The primary data has been collected through



state level workshop of representatives of all sectors concerning biodiversity, where 40 participants representing various stakeholders and experts (NGOs, Government Departments, Research and development Institutions and individuals) attended.



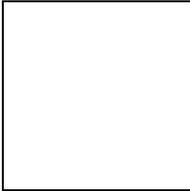
Questionnaire in Oriya was circulated to all the respondents for the programme through advertisement, formal and informal communications for collecting information on present practices and knowledge related to biodiversity aspects of agriculture, forests & wildlife, aquatic fauna and fishery, domesticated animals, water resources, mining and industries, orchids, crabs , soil microbes, conservation systems related to religious, cultural, ethical and social aspects of nature and natural resources.



Six regional level public hearing, meetings and excursions were organized (see box next). Three such programmes were at the local schools involving school children also (see Annexure 1.2). Local NGOs, school teachers, officials of forest department with other department representatives and village leaders actively contributed to organization and information/ data collection. Records of such programmes at Annexure 1.3

Districts Covered	Venue	Date and Time	No of Participants
Khurda, Cuttack	Nandankanan High School, Nandankanan	05.06.2001 08.00 AM- 01.00 PM	75
Bhadrak, Balasore, Jajpur, Kendrapada	S D J High School, Balipokhari	01.07.2001 12.40 PM- 05.30 PM	180
Ganjam (21-23 September)	Tribal Villages Jakaraapalli, Bellogodo,	22.09.2001 09.00 AM – 01.00 PM 03.00 PM – 07.00 PM	320 112
Ganjam, Gajpati (21-23 September)	Chaitanya Vidyapeeth, Pudemari	23.09.2001 10.00 AM – 03.00 PM	515
Deogarh, Sambalpur (04-07 October)	Kendujhari village	07.10.2001 10.30 AM – 03.00 PM	350
Sambalpur, Jharsuguda, Bargarh (04-07 Oct.)	Gopalpalli village	07.10.2001 05.00 PM – 08.30 PM	35

Angul, Dhenkanal	Orissa Forest Rangers College, Angul	10.11.2001 10.00 AM – 03.00 PM	32
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informal discussions and interviews with district and state level government officials, school teachers, lecturers, village panchayat functionaries and local knowledgeable persons identified during public hearing, by experts and contacts.

1.5.3 Secondary data has been collected through communications, reports and documented records with government departments, institutions and libraries by the coordinators and rich reference base is now available with this document. Orissa Forest Department in October 2001 has also published a ‘Bibliography on Wildlife of Orissa’ with total 1171 references in English and Oriya. A varied and rich database is maintained by large number of institutions, many of them have been listed in this document for future consultations and activities.

1.5.4 There were 4 meetings of SLSC, 2 meetings of coordinators, and 8 meetings of core groups to harmonise and finalise SAPs.

1.6 Key Participants

1.6.1 Key participants to the preparation of this document are the SLSC Members, Coordinators & working group members. District nodal agency and the 5 members ‘Core Group’ of state nodal agency have contributed in all organization, travel, communications, documentation of the whole process of SAP (see list at Annexure 1.4).

Chapter 2

Profile of Orissa State

2.1 Geographical Profile

2.1.1 Orissa is located between 17° 50' – 22° 30' N latitude and 81° 24' –87° 28' E longitude lies on the east coast of India and covers an area 1,55,707 sq. km. Out of the total cultivable area about 46% are under highland, 31% under medium land and 23% under lowland. The area is enriched by discontinuous hill ranges extending from Similipal hill ranges in the north and eastern ghat in the south and interspersed with rivers in the western to eastern wardly direction in the central tableland and coastal plain region.

2.1.2 Orissa, comprising 4.74% of India's landmass and with 36.7 million people (2001 Census), accounts for 3.57% of the population of the country. Nearly 87% of its population live in rural areas and depend mostly on agriculture for their livelihood. The State has abundant resources of minerals including precious and semi-precious stones. It has also abundant water resources. According to the estimate of the Central Ground Water Board, the total replenishable ground water resources from normal recharge in Orissa in 1992 were 16,48,573 hectare meter. The gross annual draft in 1992 was 1,66,875 hectare meter. Accordingly 10.12 percent of ground water resources had been harnessed till 1992. The total cultivable land of the State is nearly 65.59 lakh hectare of which only 24.85 lakh hectare were irrigated by the end of 1999-2000. Planned exploitation and optimum utilization of rich mineral, land, water and other resources including human resources holds the key to rapid economic development of the State.

2.1.3 The land can be classified into three categories, low (25.6%), medium (33.6%) and up-lands (40.8%) with various types of soil like red, yellow, red-loamy, alluvial, coastal alluvial, laterite and black soil etc. with low and medium texture. Characteristics of different agro-climatic zones in Orissa are shown in Box 2.1. The distribution & spread of zone in Orissa can be seen at Fig. 2.1. Districts and Blocks covered under an agroclimatic zone are shown at Table 2.1.

Box 2.1 Agro-climatic Zones in Orissa

Sl No.	Agro-climatic zone	Climate	Mean annual rainfall(in mm)	Soil group
1	2	3	4	5
1	North western plateau	Hot and moist	1648	Red and Yellow
2	North central plateau	Hot and moist	1535	Red loamy
3	North eastern coastal plain	Hot and moist sub-humid	1568	Alluvial
4	East and south eastern plain	Hot and humid	1449	Coastal alluvial saline (near the coast line)
5	North eastern ghat	Hot and moist sub-humid	1597	Laterite and brown forest
6	Eastern ghat high land	Warm and humid	1522	Red
7	South eastern ghat	Warm and humid	1522	Red, mixed red and yellow
8	Western undulating	Warm and moist	1527	Black, mixed red and black
9	West central table land	Hot and moist	1527	Red, heavy textured colourous.
10	Mid central table land	Hot and dry sub-humid	1421	Red loamy, laterite mixed red and black

Land in Orissa is shared by activities like forests, agriculture, wetlands, water resources, living spaces, industrial and commercial purposes, transport, pastures etc. utilization pattern is given in Box 2.2.

Box 2.2 **Land Utilisation** (1997-98)

<i>Land use</i>	<i>Area in '000 ha</i>
Forests	5606
Misc Tree crops & groves not included in net area sown	774
Permanent Pasture & other grazing land	534
Cultivable waste	445
Land put to non-agricultural uses	866
Barren & un- cultivable land	590
Current fallow	267
Other fallows	336
Net Area sown	6122

2.1.4 Other geographical features

	Coast Line -	482 km
	Continental Shelf Area-	32,270 sq km
	Forest area-	58,135 sq km
	Length of roads-	2,22,303 km
	Length of Railway line-	2,173 km
Climate	Maximum temperature	49.6 ° C (Titilaharh, May, 1997)
	Minimum temperature	2.6 ° C (Phulbani, Dec, 1997)
	Humidity (Maximum)	86% (July- August)
	Average rainfall	127.98 cm
	Normal Rainfall	148.2 cm
Season	Winter season	November to February
	Summer season	March to June
	Rainy season	July to October
Others	Lakes, rivers, mountains, cities, water falls, hot springs (see Table 2.2)	

2.2 Demographic Profile

2.2.1 Demographic profile has an important bearing on the development process. The population of Orissa increased from 263.70 lakh in 1981 to 316.60 lakh in 1991 and to 367.06 lakhs in 2001 and constitute 3.57% of India's population (Bose, 2001). The decennial growth rate of population of Orissa during 1981-91 was 20.06%, 1971-81 was 20.17% and 15.94% in 1991-2001 with decline of 4.2 % during 1991-2001 decade against marginal decline previously, which may be attributed to the rise in literacy rate, effective dissemination of the message about benefits of small family, and the drive launched by the State Government to provide access to family planning measures. The sex ratio in the State i.e number of females per 1000 males declined from 981 in 1981 to 971 in 1991 as compared to the all India average which declined from 933 to 927 during the corresponding period. The density of population which was 169 persons per Sq. km in 1981 increased to 203 per sq.km in 1991. The urban population of 11.8% in 1981 increased to 13.38% in 1991. On the literacy front, the achievement has been noticeable as the literacy rate increased from 34.2 % to 52.1% at the national level during the same period. The male and female literacy rates which were 47.1% and 21.1% in 1981 have increased to 63.1% and 34.7% respectively in 1991 (see Table 2.3).

2.2.2 Scheduled castes and scheduled tribes, as per the 1991 Census, constitute 16.20% and 22.21% respectively of the total population of the State. The scheduled areas cover nearly 45% of the total geographical area. The literacy rate of scheduled caste and scheduled tribe populations was 36.78% and 22.31% respectively according to 1991 Census. Of the 62 million tribals and 426 ethnic communities in India, Orissa is home to 7 million tribals constituting 62 different ethnic communities. The tribes of Orissa are classified into 6 types, considering their traditional practices. Hunting, Collecting and Gathering type tribes of Orissa are mankadia, mankidi, Birhor and khadia who mainly live in the forests of Mayurbhanj, Keonjhar and Sundargarh. The lone pastoral and cattle-herder tribe 'Koya' of Orissa inhabits Malkangiri district. Mahali and Kollohara tribes are artisan groups practicing craft like basketry and blacksmithry respectively for their neighbouring tribes. Shifting cultivating tribes are many in Orissa. Kandh, Saura, Koya, Paraja, Didayee, Dharua and Bonda, of Southern Orissa and Juang and Bhuyan of Northern Orissa are engaged in this practice. Saura and Kandh and Gadaba tribes construct terraces in hill areas to conserve soil and water through stone and boulder packing. Settled cultivation is practiced by a number of large tribes such as Santal, Munda, Ho, Bhumij, Oraon, Gonda, Mirdha etc. The list of scheduled tribes, scheduled castes and economic backward class includes 61, 93 and 181 communities respectively. Total castes and subcastes found in Orissa is also recorded for total 7558 numbers. The population profile in the Scheduled Area is given at Table 2.4.

2.3 Socio-economic Profile

2.3.1 This economic review of Orissa 2000-01 presents an account of the State's efforts in the pursuit of transformation of its economy and the progress achieved in this regard. The recurrent natural calamities like cyclone, drought, flood coupled with the persistent resource constraint have been the major inhibiting factors for the growth and revival of the economy. Orissa, despite being a land of the exquisite art, craft, architecture and rich cultural and maritime heritage, has been wading through unending poverty and unemployment. The State's economy is characterized by low per-capita income, low capital formation, inadequate exploitation of plentiful natural resources and inadequate development of socio-economic infrastructure. However, the State is in the process of building up a sound socio-economic infrastructure for self sustaining economic growth with equity by way of adoption of new economic reforms and reorientation of district administration through successive Five Year Plans. Table 2.5 to Table 2.15 gives an overall view of socio-economic progress in Orissa.

2.3.02 SOCIO-ECONOMIC BACKDROP

2.3.02.1 **EMPLOYMENT SITUATION** : With the increase in population and consequent addition to the labour force, the supply of labour continues to outstrip demand resulting in accentuation of the problems of unemployment and under-employment. The occupational classification as per 1991 census data shows that the total workers in the State account for 118.83 lakh constituting 37.53% of the total population of the State. Out of the total number of workers, main workers accounted for 87.33%. The main workers comprised cultivators (44.31%), agricultural labourers (28.68%), household workers (3.13%) and other workers (23.88%).

2.3.02.1.1 The unemployment situation is a formidable problem for the State. It has been estimated that the total backlog of unemployment at the beginning of 1999-00 was of the order of 8.27 lakh. The employment generation during 1999-00 and 2000-01 is estimated at 3.05 lakh and 4.20 lakh respectively. Keeping in view the backlog of unemployment at the beginning of 1999-00, the average annual addition to the labour force at the rate of 2.62 lakh, and the employment generation during 1999-00 and 2000-01 is expected to be around 7.84 lakh and 6.26 lakh respectively. To tackle the problem of un-employment, the wage employment and self-employment programmes that were implemented during the Eighth Plan would continue during the Ninth Plan with special emphasis on generation of employment opportunities through innovative schemes in the secondary sector.

2.3.02.2 **STATE INCOME** : The Gross State Domestic Product (GSDP) of Orissa increased from Rs.18,213.08 crore in 1993-94 to Rs.23,007.11 crore (quick estimate) in 1999-00 at 1993-94 prices, showing a

compound annual growth rate of 3.97 percent over the period. The Net State Domestic Product (NSDP) commonly known as State income increased from Rs,15,861.30 crore in 1993-94 to Rs.19,329.31 crore (quick estimate) in 1999-00 at 1993-94 prices. The per capita income at 1993-94 prices has been estimated at Rs.5,411.00 in 1999-00 against Rs.4,797.00 in 1993-94. the increase in NSDP in 1999-00 over the corresponding figure for 1993-94 is mainly attributable to the increase in SDP of Tertiary sector as well as Finance and Service sector.

2.3.02.3 **AGRICULTURE** : Agriculture continues to be the main-stay of the State's economy with contribution of about 30% to NSDP during 1998-99. Taking into account the high contribution of this sector to the State's income and the large percentage of people dependent on this sector, the State Government have formulated the Agriculture Policy 1996 with the main objectives of doubling the production of food grains and oilseeds by the end of the Ninth Plan, to adopt agriculture as the main route for eradication of [poverty. The Agricultural Policy 1996 is expected to provide the much needed boost to this sector for all-round development of the agricultural sector. Agriculture has been given the status of an industry under the new Agricultural Policy.

2.3.02.3.1 Due to increase in population, per capita availability of cultivated land in the State which was 0.39 hectare in 1950-51 declined to 0.17 hectare in 1999-00 and per capita food grain production declined from 230.44 kg to 153.93 kg per annum during the same period. The average yield rate of rice in Orissa was 12.12 quintal per hectare which was much below the national average of 19.30 quintal per hectare during 1998-99. However, the average yield rate of rice in Orissa decreased from 12.12 quintal per hectare in 1998-99 to 11.27 quintal per hectare in 1999-2000. Consumption of fertilizer in the State was 40.6 kg per hectare during 1999-2000 in comparison to 36.2 kg per hectare during 1998-99.

2.3.02.4 **IRRIGATION** : In the absence of adequate irrigation facilities, agriculture is pathetically dependent upon monsoon. As a result of the erratic behaviour of the monsoon, agricultural production fluctuates widely from year to year. The net irrigation potential created by the end of 1999-00 from all sources was 24.85 lakh hectare which is 42.12% of the total irrigable area of the State. Out of 24.85 lakh hectare of irrigated area, 11.56 lakh hectare of land are irrigated through major & medium irrigation projects, 4.41 lakh hectare through minor (flow), 3.31 lakh hectare through minor (lift), and 5.58 lakh hectare through other sources which include private tanks, pond, dug wells, water harvesting structures and the like. However, assured irrigation is available through major and medium irrigation projects which accounts 46.52%. This underscores the need for boosting the assured irrigation potential in order to insulate agriculture from the vagaries of monsoon.

2.3.02.5 **FISHERIES** : With a coast line of 480 km. and continental shelf area of 24,000 sq km, there is excellent scope for marine fish production in the State. The inland fishery resources of the State include fresh water area of 7.06 lakh hectare and brackish water area of 4.18 lakh hectare. The State has thus vast scope for development of fish industry. The total fish production in the State was 2.61 lakh tonne in 1999-00 of which the marine fish accounted for 48.21%, brackish water fish 4.00% and fresh water fish 47.79%. Export of fish to other States and Countries during 1999-00 was estimated at 0.84 lakh tonne. The total fish production in the State was 1.59 lakh tonne in 1990-91 which increased to 2.61 lakh tonne in 1999-00. The per capita consumption of fish in the State has decreased from 8.23 kg. In 1998-99 to 7.33 kg. In 1999-00.

2.3.02.6 **ANIMAL RESOURCES** : Animal resources sector plays an important role in providing and supplementing income of rural households. The total livestock population in the State was 250.20 lakh as per livestock census of 1995 which cattle population accounted for 147.66 lakh buffaloes 16.52 lakh, goats 54.12 lakh, sheep 18.65 lakh, pig 5.72 lakh. The total milk production in the State in 1999-00 was 8.48 lakh tonne, with per-capita availability of 62 gm per day. The production of milk during 1999-00 was 1.80 % higher than the production of 8.33 lakh tonne in 1998-99. Egg production in 1999-00 was 8222.10 lakh showing a decline of 12.55% over the production level of 9,402.30 lakh during 1998-99. Meat production in 1999-00 was 43 thousand tonne in comparison to 40 thousand tonne in 1998-99. there were 541 Veterinary Hospitals and

Dispensaries and 2939 Livestock Aid Centres in the State by the end of 1999-00. During 1999-00, 106.89 lakh animals and birds were treated against diseases and 15.44 lakh castrations were done. The number of Milk Producer's Cooperative Societies in the State was 1044 at the end of 1999-00 with procurement of 69.56 MT milk per day on an average during 1999-00.

2.3.02.7 **EDUCATION** : Education is an indispensable input for development of human resources. While the overall literacy rate in 1951 was 15.8 %, it was only 4.5% among females. The overall literacy rate in Orissa has increased to 49.1% and that for females to 34.7% as per 1991 census. The literacy rate of scheduled caste and scheduled tribe population were comparatively low being 36.8% and 22.3% respectively as per the 1991 census. A major factor responsible for low educational level among females and persons belonging to Scheduled castes and Scheduled tribes is the high drop-out rate at primary level especially in tribal and inaccessible areas.

2.3.02.8 **POWER** : During 1999-00, State's share in installed capacity in the State sector was 2498.88 MW (hydro 1618.88 MW and thermal 880.00MW) against which power was available to the extent of 1108.13 MW . In addition to this, 19.33 MW of power was received from Central Sector Projects towards State share and 79.16 MW of power was purchased from captive power plants installed in the state by different industries. Thus, from all sources, 1206 MW power was available against the estimated demand of 11270 MW. Out of 46,989 villages in the State, 35190 villages including 10466 tribal villages and 6290 scheduled caste villages/bastis have been electrified by the end of 1999-00.

2.3.02.9 **HEALTH SERVICES** : The National Health Policy aims at providing universal health care and access to medical services, covering preventive, promotive and curative aspects to all sections of the society. By end of 199-00, there were 180 Hospitals, 157 Community Health Centres, 184 Public Health Centres (PHCs), 1168 PHCs (New) and 14 Mobile Health Units in the State providing curative health services, Apart from 14 established mobile health units in the State 80 more mobile health units are also operating in KBK districts with assistance from Government of India, which 44 are in tribal and 36 in non-tribal areas. In addition to these institutions there are 5 Ayurvedic Hospitals, 519 Ayurvedic Dispensaries, 9 Unani Dispensaries, 4 Homoeopathic Hospitals and 460 Homoeopathic Dispensaries. Health care and population control are the two main objectives of the Ninth Plan. The Family Welfare Programme is being implemented by the State Government with the objective motivating eligible couples to adopt spacing and terminal methods and ensuring child survival through universal immunization. The number of persons cumulatively covered under the Family Welfare Programme increased from 104.84 lakh in 1994-95 to 145.17 lakh in 1999-00 registering an increase of 38.47% over these years. The death rate per thousand has been brought down from 21.6 in 1951 to 10.6 in 1999 and the infant mortality rate has been reduced from 188 to 97 per thousand during the same period.

2.3.02.10 **MINERALS** : The state is endowed with vast mineral deposits like coal, iron ore, manganese ore, bauxite, chromite etc. According to All India Mineral Resources Estimates, the mineral deposits of Orissa in respect of chromite, nickels, cobalt, bauxite, iron ore were about 98.4%, 95.1%, 77.5%, 52.7% and 33.4% respectively of the total deposits of India. Other important mineral resources of the State are limestone, china clay, quartz, precious and semi-precious stones, copper, vanadium etc. However, the rate of exploitation of different minerals is much below the potential. During 1999-00, the minerals and ores to different countries during the same period was 18.25 lakh tonne valued at Rs. 425.89 crore. Mining revenue and cess collection during 199-00 stood at Rs. 320.46 crore as against Rs. 315.96 crore in 1998-99 showing an increase of 1.42%.

2.3.02.11 **INDUSTRIES** : With vast mineral resources, abundance of raw materials and comfortable power situation, the State has an immense potential for industrialisation. Large industries like Rourkela Steel Plant, National Aluminum Company, Indian Charge Chrome Ltd., Paradeep Phosphate and coal based power plants at Talcher, Kaniha and Banharpali have been set up in the State during different Plan periods. At present, three nodal agencies namely Industrial Promotion and Investment Corporation Ltd. (IPICOL), Industrial Development Corporation Ltd. (IDCOL) and Orissa State Electronics Development Corporation

(OSEDC) are engaged in promoting large and medium industries with an investment of Rs. 1880.36 crore and employment potential for 82,533 persons.

2.3.02.11.1 In recognition of the importance of small scale and village and cottage industries, efforts have been made to provide institutional and financial support, in addition to various incentives and concessions, for promoting this sector. By the end of 1999-00, 62,552 small scale industries with an investment of Rs.1,396.02 crore were operating in the State providing employment to 4.18 lakh persons. Besides, 15.11 lakh cottage industries had been set up in the State with an investment of Rs.556.96 crore and provision of employment to 26.37 lakh persons by the end of 1999-00.

2.3.02.12 **RURAL DEVELOPMENT** : As per the latest estimates of Planning Commission available for the State, the percentage of population below the poverty line was 49.72 in rural areas and 41.64 in urban areas in 1993-94. Several anti-poverty and wage employment programme are being implemented in the state since 1980-81 to create income generating assets and employment on daily wage basis for identified beneficiaries of target groups so as to enable them to cross the poverty line. These anti poverty programmes like Integrated Rural Development Programme (IRDPA), Development of Women and Children in Rural Areas (DWCRA), Training of Rural Youth for Self Employment (TRYSEM), Supply of Improved Toolkits to Rural Artisans (SITRA), Ganga Kalyan Yojana (GKY) and Million Well Scheme (MWS) were merged into a single new scheme called “Swarnjayanti Gram Swarozgar Yojana” (SGSY) with effect from 1.4.1999. During 1999-00, 74.633 families have been assisted with income generating assets under SGSY with an investment of Rs.148.37 crore. A centrally sponsored wage employment scheme called “Jawahar Gram Samridhi Yojana” (JGSY) was launched by the Government with effect from 01.04.99 by restructuring the erstwhile “Jawahar Rojagar Yojana”. During the year 1999-00, 212.12 lakh mandays of employment was generated under JGSY with an investment of Rs. 137.51 crore.

2.3.02.13 **DEVELOPMENT OF WOMEN** : Several welfare programmes are being implemented in the State which include setting up of women’s training centers, provision of short stay homes for women, rehabilitative services for women in distress, provision of old age pension etc. The female literacy rate in the State has increased from 4.5% in 1951 to 34.7% in 1991. The proportion of women to total employees in the organized sector has increased from 8.77% in 1990 to 11.65% in 1999. To increase the number of women in public services, 30% of the vacancies in the State Government Departments in Group B, Group C and Group D services/posts to be filled up by direct recruitment have been reserved for women candidates. Under State Old Age Pension Schemes 3.02 lakh women beneficiaries were covered during 1999-00. Similarly under National Old Age Pension Scheme 1.55 lakh women were benefited. Under DWCRA programme, financial assistance amounting to Rs. 407.94 lakh has been provided to 2,637 DWCRA groups benefiting 34,921 women during 1998-00. The scheme has been merged into a new scheme namely “Swarna Jayanti Gram Swarozgar Yojana” (SGSY) with effect from 1st April, 1999.

2.3.02.14 **WELFARE OF SCHEDULED CASTES AND SCHEDULED TRIBES** : One of the major concerns of the State has been the welfare and development of scheduled tribes and scheduled castes who together constitute 38.41% (STs 22.21% and SCs 16.20%) of the total population of the State as per 1991 census. For historical reasons, this segment of the society has remained socially and economically backward and concerted efforts have been made under different Plans to bring them into the mainstream of society. The State Government is committed to the development of these communities and special programmes have been launched for their benefit which include legal aid, rehabilitation of victimized STs and SCs, housing facilities, establishment of special employment exchanges, reservation in employment etc.

2.3.02.14.1 The Tribal Sub-Plan approach was adopted in the Fifth Plan and the Special Component Plan for SCs in the Sixth Plan. Allocations are being earmarked for the Tribal Sub-Plan and Special Component Plan apart from the general programmes of economic development undertaken by the Government which are also available to the members of these communities.

2.3.02.15 **EXTERNALLY AIDED PROJECTS (EAPs)** : The State avails external assistance in the form of Additional Central Assistance (ACA) for implementation of Externally Aided Projects (EAPs) in the State External agencies such as World Bank. United Nations International Children's Emergency Fund (UNICEF) and agencies of different countries such as Germany, Denmark, Switzerland, Sweden, Norway, U.K. etc. have extended financial assistance in selected areas for economic development.

2.3.02.15.1 During the Ninth Plan, it has been envisaged to allocate Rs.4,344.34 crore for Externally Aided Projects in the State out of the total State plan outlay of Rs.15,000 crore. It is expected that an amount of Rs.3,935.39 crore of ACA will be made available to the State during the Ninth Plan Period. Additional Central Assistance to the tune of Rs.535.54 crore, Rs.415.83 crore and Rs.661.21 crore have been received during the years 1997-98, 1998-99 and 1999-00 respectively. For the year 2000-01 a provision of Rs.1040.59 crore had been earmarked under State Plan for execution of 17 Externally Aided Projects in the State. It has been projected that Additional Central Assistance to the tune of Rs. 887.13 crore would be received during the year 2000-01. Some of important EAPs presently under implementation in the State are Orissa Power Sector Restructuring Project, Orissa Health System Development Project, Orissa Water Resources Consolidation Project, Second National Highway Project and Super Cyclone Disaster Management Project.

2.3.02.16 Orissa State Disaster Mitigation Authority (OSDMA) aims at restoring livelihood, reconstructing damaged infrastructure caused due to Super Cyclone, and preparing the State to face natural calamities in future. The organization, though small, has already become the focal point of all cyclone reconstruction work undertaken by government and non-government agencies.

2.4 Political Profile

2.4.1 Orissa occupies the 10th position in the country both in territory & population. The history of Orissa as well as her glory go back to the distant past and her glorious heritage inspires all the inhabitants of the state. The present Orissa was created as a separate province in 1936. When the Constitution of India was enforced from 26th January, 1956, there were 24 native states within the territory of Orissa and two more Oriya-speaking states, Sareikala & Kharsuan in Bihar. From 1st January, 1948, 25 states including Sareikala & Kharsuan and excluding Mayurbhanj were merged with Orissa and Mayurbhanj merged from 1st January 1949. Subsequently in May 1948, Sareikala & Kharsuan were detached from Orissa and included with Bihar. After the re-organisation of states from 1st November, 1956, Orissa continued as one of the leading constituent state of the Indian Union. Between 1952 and now, there has been President Rule in Orissa on 6 occasions and rest of the period elected representative as Chief Minister has administered the state. After independence till date, 18 incumbents have been the Chief Minister of Orissa state.

2.4.2 Like each of the states in India, the administrative system of Orissa is headed by the Governor. There is an Orissa Legislative Assembly consisting of 147 members and there is no second chamber in the state. The Assembly is the legislative organ of the state. There is a High Court of twelve Judges headed by a Chief Justice and though Bhubaneswar is the capital of the state, the seat of the High Court is at Cuttack which is 29 Kms. from Bhubaneswar. The Orissa Secretariat is at Bhubaneswar.

2.4.3 The State is divided into 3 divisions for the purpose of Revenue & General Administration and each division is headed by a Revenue Divisional Commissioner (RDC) who is the chief executive authority in charge of general & revenue administration of the division subject to the overall control of the Board of Revenue and the State Government. Revenue administration in Orissa has a one member, Board of Revenue at the apex who has the power of superintendence of the administrative work of the RDCs and the Collectors and the other Revenue officers of districts in respect of revenue matters. The central division comprises the districts of Cuttack, Puri, Balasore & Mayurbhanj. The district of Sambalpur, Bolangir, Sundargarh, Keonjhar and Dhenkanal are in the northern division and the districts of Ganjam, Koraput, Phulbani & Kalahandi constitute the southern division.

2.4.4 There are 30 districts (see Fig. 2.2). Each district is headed by a Collector. He is also designated as the District Magistrate (DM) under the criminal procedure code. The Judicial wing is headed by the District and Session Judge and he is assisted by Additional and Subordinate Judges, Munsifs, a Chief Judicial Magistrate, Additional Chief Judicial Magistrate, Sub divisional Judicial Magistrate and Magistrate of 1st and 2nd class. The District Magistrate and Collector who is the executive head of the district has under him a sub-divisional officer, now designated as Sub-Collector, in each sub-division and one or more Additional District Magistrate (ADM) and a number of deputy collectors, some of whom are vested with magisterial powers to facilitate administration of law & order. They are called Executive Magistrates under Criminal Procedure Code. The D.M. is also the head of the Community Development & the Chairman, Zilla Parishad for Panchayat Raj administration in the district. The district is divided into a number of Community Development Blocks. Development administration is at present centered around blocks under a B.D.O. In order to make the developmental activities more democratic, these blocks are under Panchayat Samities which are constituted with local elected representatives headed by an elected Chairman. The B.D.O. is the *ex officio* executive officer of the Panchayat Samiti. The political and administrative units are given at Fig 2.2.

2.5 Ecological profile

2.5.1 As in any other State in the peninsular India, in Orissa also most of the forests are now mostly relegated to the hills only: the plains and flat grounds having been put under plough for agriculture and other non-forestry practices. These hills represent relic patches which are still the natural habitats for indigenous genetic species of flora and fauna. Many of these species have entered the IUCN Red Data Book under categories such as 'Endangered', 'Rare', 'Vulnerable', 'Indeterminate', etc. These sites still have the potency to regenerate the lost species in their pre-historic status, once protected properly. National parks and sanctuaries have been created in some sites and a single biosphere reserve is created in the state (see Fig 2.3). There are 18 wildlife sanctuaries. Part of Bhitarkanika has been declared as National Park while the core area of Similipal, as National Park has been notified. These Protected Areas (PA) are dedicated for the purpose of Conservation, propagation, perpetuation of all forms of wildlife together with the forest ecosystem that harbour them. Together, these constitute 6,059 sq.km., which is about 10% of total forest area and within 4% of geographical area of the State. The list of PA and their indicative flora and fauna is given Table 2.16.

2.5.2 The distribution of the forests (see forest cover map at Fig 2.4) within the state is uneven; the coastal region has no forests, except small patches of littoral and swamp forests. Even the vast expanse of plain area is either devoid of forest or bears only scrubs. The forest concentration is found mostly in the hilly regions. Sal forests occupy most part of the state. The state is the southernmost limit of sal, which is completely replaced by miscellaneous species from near Maikangiri in erstwhile Koraput district. The forests broadly fall under 5 out of the 16 groups differentiated by Champion & Seth (A Revised Survey of the Forest Types of India. 1968) i.e. 1. Tropical Semi-evergreen forests, 2. Tropical Moist Deciduous forests, 3. Tropical Dry Deciduous forests, 4. Subtropical Broad leaved Hill forests, and 5. Littoral and Swamp forests (see Table 2.17).

2.5.3 The major forest types and their subsidiary and seral types are (see Annexure 2.2 for detailed description):

- | | |
|--|------------------------|
| 1. Tropical Semi-evergreen forests: | 9. Coastal Sal forests |
| 2. Tropical Moist Deciduous forests | 10. Bamboo formations |
| 3. Tropical Dry Deciduous forests | 11. Teak forests |
| 4. Sub-tropical Broadleaved Hill forests(Central Indian Sub-tropical Hill forests) | |

5. Littoral forests
6. Mangrove forests
7. Dry Sal forests
8. High Level Sal forests

12. Grasslands
13. Scrub forests

2.5.4 Orissa's coastal areas have been one of nature's best kept secrets. Its lovely beaches provide ideal nesting habitats for endangered sea turtles for which Orissa is globally known. The lapping waters of Bay of Bengal pay homage to their beauty along the 480km long coastline creating delightful estuaries and lagoons. Asia's largest brackish water lagoon, Chilika is the destination of several hundred thousands of migratory birds who fly in winter from far off areas. A narrow isthmus separates Chilika from the waters of the Bay of Bengal. Spread over an area of about 1100 sq km, the lagoon is an internationally important wetland (Ramsar site). Orissa's ancient past is closely linked to its coastal zone. The glorious countryside of coastal Orissa is dotted with numerous wetlands. The wetland resources of Orissa is given at Table 2.18. This along with the mangrove mud flats, tidal rivers estuaries sea grass beds and coral reef areas provide shelter to numerous aquatic fauna. Notable among them are salt water crocodiles, fresh and brackish water terrapins, sea turtles, waterfowls, king crabs as well as marine mammals like dolphins, porpoises etc. The dynamic topographical variations of coastal Orissa form unique natural landscapes. This dynamically varied terrain have incredible aquatic wildlife. A brief account of ecologically identified plant groups in Orissa is given at Annexure 2.1.

2.5.5 The Chilika is Asia's biggest brackish water lake. The aquatic and terrestrial vegetation, the migratory and resident birds; fishery resources, terrestrial wildlife are unique in the lake's ecosystem. A small area of only 10 sq km. of Nalabana island, said to be the abode of birds, has been declared as a bird sanctuary.

2.5.6 The Bhitarkanika represents the only mangrove swamp in the state on the Bay of Bengal coast. It is enriched with varieties of mangrove species and with the estuarine waters which provide an ideal habitat for rearing the rare salt water crocodiles. A sanctuary has been declared here. Within Bhitarkanika wildlife Sanctuary in Gahirmatha area on the ay of Bengal coast, lakhs of Olive Ridley Sea turtles migrate annually to hatch eggs. It is the largest turtle rookery in the world.

2.5.7 The Similipal Massif is a compact biome of moist deciduous and mixed tropical forests. It is an ideal habitat for varieties of wild plants and animals. There are about 3,000 flowering plant species and 90 orchid species in this forest. A tiger project was established here in 1973 in the National Park area. The Similipal-Meghasani Complex has been suggested to be elevated as a biosphere reserve but as yet no action has been taken in this regard.

2.5.8 The Gandhamardan Hill system is the abode of varieties of faunal and floral species including medicinal plants and in its rocks are heavy deposits of Bauxite (Aluminium ore). Peoples' resistance against mining bauxite by BALCO has saved this unique hill complex from exploitation. Yet a national park or a sanctuary has not been declared here.

2.5.9 The Mahendragiri-Singaraj- Deogiri Hills system represents the transitional flora between southern peninsula and northern Himalayas. More than 600 angiospermic species including 38 orchid species have been recorded here. None of the conservation measures like national park, sanctuary, biosphere reserve has been effected here.

2.5.10 **Biogeographic Zones:** The geographic area of the state is 15.57 million hectares, which constitute 4.74% area of the country. This maritime state can be divided in to 4 distinct physiographic regions viz. Northern plateau, Eastern hills (ghats), Central table land and Coastal plains. The Northern plateau is undulating with mass of hills with steep slopes to east and north. The Eastern Ghats stretch in NE-SW direction south of Mahanadi river. The Central tableland is intersected by river valleys of Baitarani, Bramhani, Mahanadi. The coastal plains are very narrow along the Bay of Bengal which stretch for about 480

km out of the country's coastline of 7,516 km. Bio-geographically, the State has been classified as shown in Table 2.19 (Rodgers & Panwar, 1988).

2.5.11 For the biodiversity and ecologically important state like Orissa, the development has to be sustainable. In this context conservation and protection environment has to be given due priority. Rise in population, urbanization, vehicular traffic, industrial and mining activities etc. tends to create pollution. Deforestation also contributes to pollution, 24,124.20 hectares of forest land have been diverted to non-forest use as on 31.01.2000 for a variety of reasons. Hence, environmental planning, joint forest management (that is management of forests by involving people as well as Government agencies), and wildlife conservation need to form an integral part of development strategies in the State.

2.5.12 Frequent occurrences of natural calamities like drought, flood and cyclone stand as a barrier to economic progress of the State. Major natural disasters which occurred in Orissa within last two centuries is given in Box 2.3.

Box 2.3 Major Natural disasters in Orissa

Year	Disaster type	Year	Disaster type
1866 AD	Extremely severe famine (<i>Nanaka Durvikhya</i>)	1974-75 AD	Famine
1942 AD	Cyclone	1976 AD	Severe Cyclone
1955 AD	Severe Flood	1981 AD	Severe Tornado
1965 AD	Severe famine	1982 AD	Severe Flood
1967 AD	Flood	1995-96 AD	Famine
1968 AD	Cyclone	1999 AD	Super cyclone
1971 AD	Severe flood & cyclone	2000 AD	Severe Drought
1972 AD	Severe Flood	2001 AD	Severe Flood

2.5.12.1 The super cyclones of 1999 in the coastal districts of the State, severe drought of 2000 in the Western Orissa followed by unprecedented floods in coastal Orissa in 2001 have pushed the economy of the State back by many years. In order to take up immediate cyclone relief measures, Government of India, the State Government, some other State Governments and others have provided funds and materials. But huge financial resources are required to take up rehabilitation, restoration and reconstruction work with a view to put the State's economy back on a path of growth. Considering the weak financial position of the State, substantial resources from outside will be required.

2.5.13 Agriculture is the backbone of economy and provides maximum employment. Major cereals cropping is practiced over 50,000 sq km, pulses grown over 1000 sq km, oilseeds over 4500 sq km. Production however is low and one of the biggest drawback is over 50 % holdings being below one ha. Major crops and horticulture practices in Orissa is shown at Table 2.20 & 2.21. Fertiliser consumption in 1999-2000 was @ 39 MT per ha for 'Kharif' crops over 62091.9 sq km and @ 50 MT per ha for 'Rab' crops over 23146.7 sq km (source- Orissa Agricultural Statistics, 1999-2000). Annexure 2.3 and 2.4 gives details on varieties of cultivated plants and domesticated animals respectively in Orissa.

2.5.14 The total water resources in the State, both from surface water and ground water has been estimated as 114,00,000 ham, of this 70,03,000 ham is proposed to be utilized under surface water source and 19,00,000 ham from ground water sources. The rivers of Orissa can be divided into three groups according to the size of their catchments viz :-

Large rivers - River basins with catchment of 20,000 sq km and above e. g. Mahanadi, Brahmani, Indravati, Kolab.

Medium rivers - River basins with catchment of 2,000 sq km and 20,000 sq km e. g. Baitarini, Subarnarekha, Budhabalang, Rushikulya, Vansdhara and Nagabali.

Minor rivers - River basins with catchment of 2,000 sq km and below e.g. Bahuda, Salia, Hoskura, Jambira and others.

2.5.14.1 Rivers along with their basins and location of irrigation projects are shown in Fig. 2.5 and 2.6. Out of total cultivable area of about 66 thousand ha, 59 lakh ha can be brought under irrigation. It has been assessed that 70.19 lakh ham of surface water can irrigate about 49.19 lakh land. The Major and Medium irrigation sector offers the largest potential for irrigation in the state. However, large portion of submerged land mass in these projects were covered with forests and thus major activities affecting biodiversity. The irrigation development (potential and achieved) under different categories of schemes to be undertaken in the state is presented at Table 2.23. The submergence of land area by major and medium irrigation projects is represented in Table 2.24.

2.6 Historical Changes

2.6.1 Orissa is situated almost in the tropical belt of India. Its ancient geological history extends to the Pre-Cambrian period, some 5,000 million years ago and Orissa is considered to be an extension of the Deccan Plateau, one of the most ancient rock systems of the world. Archaean granite gneiss, Gondwana land rocks and laterite caps on hill tops and the coastal alluvium, coupled with varied topography, ranging from sea-level to about 1,700m altitudes, offer varied geological or edaphic factors. Aided by high temperature, moderately high annual rainfall and humidity, with a net-work of river systems, Orissa is credited with a rich vegetation and flora, comparable to any other region of India, excluding of course the Eastern Himalaya-Meghalaya sector.

2.6.2 Orissa is a fascinating state with diverse geological history spanning over a vast period from 38000 million years till the present time. In the distant past, it was a part of mega continent known as Gondwana lying in proximity with the Eastern Antarctica. Many foreigners come to Orisaa to study its geology to make a correlation with Eastern Antarctica. The state shows varied topography and terrain condition controlled by the rock types structural elements and operating geological agents. These morphological features control land use and biodiversity. The high level plateau(s) and ridges are most suitable for forest growth and associated biodiversity features. Mineral exploitation is generally done in hilly and forest covered areas where minerals occur and is one of the major cause of degradation of biodiversity in mining terrain.

2.6.2.1 Orissa has varied geology represented by many types of rocks dating back to 3800 million years. Rocks can be classified into a geological column on the basis of their relatives as shown in Table 2.22. The geological map (Fig. 2.7) shows the distribution of different rocks.

2.6.3 Orissa possesses five of the 16 major forest types occurring in India. It harbours an estimated number of 3,000 species of angiosperms, as against a total of 15,000 – 16,000 species for the whole of India. We may take legitimate pride in the fact that: (a) this represents about 20 per cent o of the total flora of India; (b) Orissa is credited with 127 species of Orchids, some 12 per cent of the total orchid flora of India; (c) The Southern Orissa is a part and parcel of the Deccan Endemic Centre and the Mayurbhanja-Sundargarh districts are encompassed within the Bihar-Orissa Endemic Centre ; (d) Since Orissa is the meeting ground of the flora of the North and North-Eastern India and the largely endemic flora of the Southern India, flora of Orissa offers an ideal data-base for the phytogeographical analysis of the flora of the Indian subcontinent, in as much as many Malaysian elements extend their range to Orissa. Occurrence of some Himalayan and South Indian species on the hill tops of Mahendragiri (Ganjam), Meghasani (Similipal-Mayurbhanj), Deomali (Raygada) and Malaygiri (Dhenkanal) suggest that for the flora of South India and of the Himalayas, Orissa must be treated as a meeting ground. The State is also the southern most limit of sal. Occurrence of natural teak and sal in close association is another peculiarity in the flora of Orissa.

2.6.4 Though flora of the state has been brought out (Saxena & Brahmam, 1994-96), and floristic studies by several workers have yielded several new records for the State and some for India and plant taxa new to science, undoubtedly, many more such plants are expected from the unexplored/ under explored regions of this State, if these are extensively studied with special emphasis on potential forest areas of plant biodiversity. All these are sufficiently illustrative of the historical importance of the vegetation and flora of Orissa in the all India context and demands special attention for study and documentation before the indigenous germplasm is

lost forever in the face of extensive loss of habitats, over-exploitation and other biotic interferences of several categories and magnitudes.

2.6.5 Geographic and political outline of Orissa from 7th century till date in brief is given here. During 7th century mainly it was divided into 4 parts - Tosali (Northern Orissa), Trikalinga (Western Orissa or south Kosal), Kongad (Central Orissa) and Kalinga (Southern Orissa). During 1202 AD, the boundary was upto Triveni to Bisanpur in North, Godavari river in South, Hugli, Medinipur & sea coast in East and Singhpur to Sonapur, Bastar in West over an area of 39,407 sq miles. The ruler was Maharaja Anangabhimadev. Special province of Orissa was created on 1st April, 1936 over an area of 36,681 sq miles with population of 81,74,000 (Hindu- 58,24,000 & Muslims- 1,31,000). The number of districts then were six namely, Koraput, Ganjam, Puri, Cuttack, Balasore, and Sambalpur. Till 1992, there were 13 districts only in Orissa. Most of the erstwhile districts have been divided into new districts except Sundargarh, Mayurbhanj, Keonjhar, and now there are 30 districts in Orissa..

Chapter 3

Status of Biodiversity in Orissa

3.1 Biodiversity of India

3.1.1 Forests :

3.1.1.1 India possesses a distinct identity, not only because of its geography, history and culture but also because of the great diversity of its natural ecosystems. The panorama of Indian forests ranges from evergreen tropical rain forests in the Andaman and Nicobar Islands, the Western Ghats, and the north-eastern states, to dry alpine scrub high in the Himalaya to the north. Between the two extremes, the country has semi-evergreen rain forests, deciduous monsoon forests, thorn forests, subtropical pine forests in the lower montane zone and temperate montane forests (Lal, 1989). One of the most important tropical forests classifications was developed for Greater India (Champion, 1936) and later republished for present-day India (Champion and Seth, 1968). This approach has proved to have wide application outside India. In it 16 major forests types are recognised, subdivided into 221 minor types. Structure, physiognomy and floristics are all used as characters to define the types.

3.1.2 Wetlands :

3.1.2.1 India has a rich variety of wetland habitats. The total area of wetlands (excluding rivers) in India is 58,286,000ha, or 18.4% of the country, 70% of which comprises areas under paddy cultivation. A total of 1,193 wetlands, covering an area of about 3,904,543 ha, were recorded in a preliminary inventory coordinated by the Department of Science and Technology, of which 572 were natural (Scott, 1989). Two sites - Chilka Lake (Orissa) and Keoladeo National Park (Bharatpur) - have been designated under the Convention of Wetlands of International Importance (Ramsar Convention) as being especially significant waterfowl habitats. The country's wetlands are generally differentiated by region into eight categories (Scott, 1989): the reservoirs of the Deccan Plateau in the south, together with the lagoons and the other wetlands of the southern west coast; the vast saline expanses of Rajasthan, Gujarat and the gulf of Kachchh; freshwater lakes and reservoirs from Gujarat eastwards through Rajasthan (Keoladeo Ghana National park) and Madhya Pradesh; the delta wetlands and lagoons of India's east coast (Chilka Lake); the freshwater marshes of the Gangetic Plain; the floodplain of the Brahmaputra; the marshes and swamps in the hills of north-east India and the Himalayan foothills; the lakes and rivers of the montane region of Kashmir and Ladakh; and the mangroves and other wetlands of the island arcs of the Andamans and Nicobars.

3.1.2 Marine Environment

3.1.2.1 The nearshore coastal waters of India are extremely rich fishing grounds. The total commercial marine catch for India has stabilised over the last ten years at between 1.4 and 1.6 million tonnes, with fishes from the clupeoid group (e.g. sardines *Sardinella* sp., Indian shad *Hilsa* sp. and whitebait *Stolephorus* sp.) accounting for approximately 30% of all landings.

3.1.3.2 Coral reefs occur along only a few sections of the mainland, principally the Gulf of Kutch, off the southern mainland coast, and around a number of islands opposite Sri Lanka. This general absence is due largely to the presence of major river systems and the sedimentary regime on the continental shelf. Elsewhere, corals are also found in Andaman, Nicobar and Lakshadweep island groups although their diversity is reported

to be lower than in south-east India (UNEP/IUCN, 1988). Indian coral reefs have a wide range of resources which are of commercial value. Exploitation of corals, coral debris and coral sands is widespread on the Gulf of Mannar and Gulf of Kutch reefs, while ornamental shells, chanks and pearl oysters are the basis of an important reef industry in the south of India. Sea fans and seaweeds are exported for decorative purposes, and there is a spiny lobster fishing industry along the south-east coast, notably at Tuticorin, Madras and Mandapam. Commercial exploitation of aquarium fishes from Indian coral reefs has gained importance only recently and as yet no organised effort has been made to exploit these resources. Reef fisheries are generally at the subsistence level and yields are unrecorded.

3.1.3.3 Other notable marine areas are seagrass beds, which although not directly exploited are valuable as habitats for commercially harvested species, particularly prawns, and mangrove stands. In the Gulf of Mannar the green tiger prawn *Penaeus semisulcatus* is extensively harvested for the export market. Seagrass beds are also important feeding areas for the dugong *Dugong dugon*, plus several species of marine turtle.

3.1.3.4 Five species of marine turtle occur in Indian waters: Green turtle *Chelonia mydas*, Loggerhead *Caretta caretta*, Olive Ridley *Lepidochelys olivacea*, Hawksbill *Eretmochelys imbricata* and Leatherback *Dermochelys coriacea*. Most of the marine turtle populations found in the Indian region are in decline. The principal reason for the decrease in numbers is deliberate human predation. Turtles are netted and speared along the entire Indian coast. In south-east India the annual catch is estimated at 4,000-5,000 animals, with *C. mydas* accounting for about 70% of the harvest. *C. caretta* and *L. olivacea* are the most widely consumed species (Salm, 1981). *E. imbricata* is occasionally eaten but it has caused deaths and so is usually caught for its shell alone. *D. coriacea* is boiled for its oil which is used for caulking boats and as protection from marine borers. Incidental netting is widespread. In the Gulf of Mannar turtles are still reasonably common near seagrass beds where shrimp trawlers operate, but off the coast of Bengal the growing number of mechanized fishing boats has had the effect of increasing incidental catch rates (Kar and Bhaskar, 1981).

3.1.4 Species Diversity

3.1.4.1 India contains a great wealth of biological diversity in its forests, its wetlands and in its marine areas. This richness is shown in absolute numbers of species and the proportion they represent of the world total (see Table 3.1). Orissa also has a great many scientific institutes and university departments interested in various aspects of biodiversity (see Box 3.1). A large number of scientists and technicians have been engaged in inventory, research, and monitoring. The general state of knowledge about the distribution and richness of the country's biological resources is therefore fairly good. Inventories of birds, mammals, trees, fish and reptiles are moderately complete.

3.1.5 Endemic Species

3.1.5.1 India has many endemic plant and vertebrate species. Among plants, species endemism is estimated at 33% - 140 endemic genera but no endemic families (Botanical Survey of India, 1983). Areas rich in endemism are north-east India, the Western Ghats and the north-western and eastern Himalayas. A small pocket of local endemism also occurs in the Eastern Ghats (MacKinnon & MacKinnon, 1986). The Gangetic plains are generally poor in endemics, while the Andaman and Nicobar Islands contribute at least 220 species to the endemic flora of India (Botanical Survey of India, 1983).

3.1.5.2. Endemism among mammals and birds is relatively low. Only 44 species of Indian mammal have a range that is confined entirely to within Indian territorial limits. Four endemic species of conservation significance occur in the Western Ghats. They are the Lion-tailed macaque *Macaca silenus*, Nilgiri leaf monkey *Trachypithecus johni* (locally better known as Nilgiri langur *Presbytis johnii*), Brown palm civet *Paradoxurus jerdoni* and Nilgiri tahr *Hemitragus hylocrius*. Only 55 bird species are endemic to India, with distributions concentrated in areas of high rainfall. They are located mainly in eastern India along the

mountain chains where the monsoon shadow occurs, South-West India (the Western Ghats), and the Nicobar and Andaman Islands (ICBP, 1992).

3.1.5.3 In contrast, endemism in the Indian reptilian and amphibian fauna is high. There are around 187 endemic reptiles, and 110 endemic amphibian species. Eight amphibian genera are not found outside India. They include, among the caecilians, *Indotyphlus*, *Gegeneophis* and *Uraeotyphlus*; and among the anurans, the toad *Bufoides*, the microhylid *Melanobatrachus*, and the frogs *Ranixalus*, *Nannobatrachus* and *Nyctibatrachus*. Perhaps most notable among the endemic amphibian genera is the monotypic *Melanobatrachus* which has a single species known only from a few specimens collected in the Annamalai Hills in the 1870s (Groombridge, 1983).

3.1.6 Threatened Species

India contains 172 species of animal considered globally threatened by IUCN, or 2.9% of the world's total number of threatened species (Groombridge, 1993). These include 53 species of mammal, 69 birds, 23 reptiles and 3 amphibians. India contains globally important populations of some of Asia's rarest animals, such as the Bengal Fox, Marbled Cat, Asiatic Lion, Indian Elephant, Asiatic Wild Ass, Indian Rhinoceros, Markhor, Gaur, Wild Asiatic, Water Buffalo etc. and many of them are found in Orissa. The number of species in various taxa that are listed under the different categories of endangerment is shown in Table 3.2.

3.1.7 Biodiversity database

3.1.7.1 Survey and inventorisation of the floral and faunal resources are carried out by the Botanical Survey of India (BSI) established in 1890, and the Zoological Survey of India (ZSI) established in 1916. Forest cover assessment to develop an accurate database for planning and monitoring is undertaken by the

Box 3.1 - IMPORTANT INSTITUTIONS WITHIN ORISSA RELEVANT TO BIODIVERSITY RESEARCH, EDUCATION AND MONITORING

➤ Sri Ananta Tripathy Ayurvedic College, Bolangir	➤ State Museum, Bhubaneswar.
➤ Govt. Ayurvedic College, Ankushpur, Ganjam	➤ Nandankanan Zoological Park
➤ Govt. Arts & Crafts College, Khallikot, Ganjam	➤ State Botanical Garden / Silviculture Gardens
➤ Gopobandhu Ayurvedic College, Puri	➤ Nabakrushna Choudhury Centre for Development Studies, Orissa, Bhubaneswar
➤ Nrusnghnath Ayurvedic College, Paikmal, Dist-Bargarh..	➤ Regional Plant Resource Centre, Bhubaneswar
➤ Orissa University College of Agriculture & Technology, Bhubaneswar.	➤ Orissa Bigyan Academy, Bhubaneswar
➤ Utkal University, Vani Vihar, Bhubaneswar.	➤ Institute of Life Science, Bhubaneswar
➤ Sambalpur University, Jyoti vihar, Burla., Sambalpur	➤ Directorate of SCS & STS Research & Training Institute, Bhubaneswar
➤ Berhampur University, Bhanja Vihar, Berhampur, Dist- Ganjam	➤ Directorate of Academy of Tribal Dialects and Culture, Bhubaneswar.
➤ Utkal University of Culture, Bhubaneswar.	➤ water and Land Management Institute, Orissa, Pratapnagari, Cuttack.
➤ Fakir Mohan Univerisity, Balasore.	➤ Central Rice Research Institute, Cuttack,
➤ North Orissa University,	➤ Central Institute of Fresh Water Aquaculture,

Baripada.	Bhubaneswar. ➤ Regional Research Laboratory, Bhubaneswar.
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Forest Survey of India(FSI) established in 1981. The Wildlife Institute of India(WII) undertakes studies of endangered species of animals and critical ecosystems. The survey and collection of genetic material from wild races and cultivars is vested with National Bureau of Plant Genetic Resources (NBPGR), an institution of Indian Council of Agricultural Research (ICAR). Monitoring of coastal and marine biodiversity is being done by organizations such as National Institute of Oceanography (NIO) and Central Marine Fisheries Research Institute (CMFRI).

3.2 Floristic Wealth of Orissa

3.2.1 Statistical analysis of the flora:

3.2.1.1 The number of plant species occurring in Orissa has been estimated at 2754. Of these, 2576 are flowering plants, 168 species belong to pteridophytes and 10 taxa are gymnosperms. The composition of the flora is presented in Table 3.2. The ten dominant plant families in the flora of Orissa in terms of species richness and as compared to the flora of India is presented in Table 3.3.

3.2.1.2 Agricultural development depends on thorough study of the cultivated and wild and related taxa. Therefore, it is desirable to mention the floristic wealth of Orissa so that collection, conservation efforts can be concentrated on those species. The floristic wealth of Orissa indicates that there are about 2630 angiospermic species belonging to 194 families and 1060 genera. Out of which 1868 are dicot, 762 monocot. Among the cultivated species there are 121 dicot species, 38 monocot and 7 gymnosperm. . The ten dominant families are Poaceae (265), Fabaceae (254), Cyperaceae (140), Orchidaceae (129), Asteraceae (117), Euphorbiaceae (108), Rubiaceae (89), Acanthaceae (82), Lamiaceae (59) and Scrophulariaceae (56). The other economic families are convolvulaceae (52), Malvaceae (38), Amaranthaceae (28) and Solanaceae (27). The list of economic plants in agriculture/ horticulture is shown at table 3.4.

3.2.1.3 There are about 29 endemic taxa reported from the state of Orissa of which 27 species under 27 genera and 14 families belong to angiosperms (see Box 3.2). It is also estimated that 144 species (ca 5.5 % of total species of state) distributed within 119 genera and 41 families of flowering plants occur either as rare or endangered. According to red data book, the following species like *Rauvolfia serpentina*, *Aristolochia indica*, *Gloriosa superba*, *Gymnema sylvestre*, *Urginea indica*, and *Curculigo orchioides* are endangered and vulnerable where as *Cajanus cajanifolia*, *Rhynchosia suaveolens*, *Acacia donaldii*, *Acacia tomentosa*, *Desmodium ritchei*, *Eleiotis sooria*, *Erythrina resurpinata*, *Tephrosia roxburghiana*, *Dimeria acutipes*, *Dimeria mahendragiriensis*, *Dimeria trimenii* are threatened. Besides, there are few other species which extend their range of distribution to the neighbouring states of Andhra Pradesh, Madhya Pradesh and Bihar. *Acacia donaldii*, *Albizia orissensis*, *Atylosia cajanifolia*, *Dimeria mooneyi*, *Hypericum gaitii*, *Lasianthus truncates*, *Lasiococca comberi* and *Maytenus bailadillana* are some apparent endemic taxa described above.

3.2.2 The Flora of Orissa by H.O. Saxena and M. Brahman(1994-1996) running in four volumes, deals with the systematic account of 2727 species of Angiosperms, Gymnosperms and Pteridophytes, including 166 species of cultivated plants. Arrangement of families is broadly according to Bentham and Hooker's system of classification, except for Gymnosperms which have been dealt after Angiosperms. Concept of delimiting the families is after Hutchinson (The Families of Flowering Plants, 1973). Systematic treatment follows usual pattern with the keys to the families, genera and species; descriptions of the families and genera. Account of species includes the valid name with the original reference, common synonyms and references to J.D. Hooker's Fl. Brit. India; Haines' Bot. Bihar & Orissa and is supplement to Mooney, Gamble's Fl. Madras; standard floristic works of the neighbouring region (Steenis, Fl. Males. and Dassan. & Fosberg, Rev. Handb. Fl. Ceylon; monographs and taxonomic revisions and standard published illustrations, followed by vernacular names (Oriya, Hindi, Telugu, Bengali, English and local tribal names), detailed description, notes on

occurrence in the area, phenology and distribution in India and world, taxonomic notes and important uses have been given in some cases. Old collections of plants from Orissa

Box 3.2 ENDEMIC PLANTS OF ORISSA

Aspidopterys tomentosa (Bl.) A.Juss. var. *hutchinsonii* (Haines) Srivastava
Bulbophyllum panigrahianum S. Misra
Combretum albidum G .Don var. *cooperi* (Haines) Saxena & Brahmam
Cycas circinalis L. var. *orixensis* Haines,
Dimaria orissae Bor
Diospyros ebenum Koenig ex Retz. var. *acuminata* Haines
Eria meghasaniensis (S.Misra) S. Misra
Eriolaena hookeriana Wight & Am. var. *viridis* Haines
Eusteralis griffithii (Hook.f.) Panigr.
Flacourtia indica (Burm.f.) Merr. var. *innocua* (Haines) Saxena & Brahmam
Gardenia gummifera Linn. f. var. *gummiferoides* Haines
Habenaria panigrahiana S. Misr
Habenaria panigrahiana S. Misra var. *parviloba* S. Misra
Hedyotis grammifolia L.f. subsp. *arenaria* (Haines) Deb & Dutta
Heritiera kanikensis Majumdar & Banerjee
Homonoia intermedia Haines
Liparis vestita Reichb. f. subsp. *seidenfadenii* S. Misra
Oryza jeyporensis Govind. & Krishnam,
Rhynchosia hainesiana Satyan. & Thoth.
Selaginella nayarii Dixit
Tephrisia purpurea (L.) Pers. var. *maritima* Haines
Themeda mooneyi Bor
Themeda sexicola Bor
Aspidopterys tomentosa (Bl.) A.Juss. var. *hutchinsonii* (Haines) Srivastava
Bulbophyllum panigrahianum S. Misra
Combretum albidum G .Don var. *cooperi* (Haines) Saxena & Brahmam
Cycas circinalis L. var. *orixensis* Haines,
Dimaria orissae Bor
Diospyros ebenum Koenig ex Retz. var. *acuminata* Haines
Eria meghasaniensis (S.Misra) S. Misra
Eriolaena hookeriana Wight & Am. var. *viridis* Haines
Eusteralis griffithii (Hook.f.) Panigr.
Flacourtia indica (Burm.f.) Merr. var. *innocua* (Haines) Saxena & Brahmam
Gardenia gummifera Linn. f. var. *gummiferoides* Haines
Habenaria panigrahiana S. Misr
Habenaria panigrahiana S. Misra var. *parviloba* S. Misra
Hedyotis grammifolia L.f. subsp. *arenaria* (Haines) Deb & Dutta
Heritiera kanikensis Majumdar & Banerjee
Homonoia intermedia Haines
Liparis vestita Reichb. f. subsp. *seidenfadenii* S. Misra
Oryza jeyporensis Govind. & Krishnam,
Rhynchosia hainesiana Satyan. & Thoth.
Selaginella nayarii Dixit
Tephrisia purpurea (L.) Pers. var. *maritima* Haines
Themeda mooneyi Bor
Themeda sexicola Bor

present in other Indian Herbaria were also examined and a good number of species reported by the previous authors on the basis of wrongly or doubtfully identified specimens have been excluded or listed as doubtful. Nomenclature of the taxa has been made as up-to-date as possible. Eight new combinations of plant names have been made. Lists of endemic and threatened plants have been provided.

3.2.3 Potential centres of plant diversity: Certain forest pockets have been identified as the potential centers of plant biodiversity. Each centre has few species specific to that locality and are not found elsewhere in the state. The potential and rich biodiversity areas those need to be preserved through habitat conservation are; Similipal Hills (1076 species), Gandhamardan Hills (920 species), Bhitarkanika (63 species of mangroves and their associates), Mahendragiri Hills in Gajapati district, Sunabeda plateau including Deomali Hills (Rayagada district), Chilika lake (711 species), Malyagiri (510 species).

3.2.3.1 Examples of some plant species specific to these areas and not to be found elsewhere in Orissa are given in Box 3.3.

Box 3.3

Similipal Hills	Ganghamardan Hills	Deomali Hills	Mahendragiri Hills	Chilika lake
<i>Dichrocephalus integrefolia.</i>	<i>Erythrina resupinata</i>	<i>Habenaria grandifloriformis</i>	<i>Stemona tuberosa</i>	<i>Cassipourea ceylanica</i>
<i>Hyperium gaitii</i>	<i>Tylophora fasciculata</i>	<i>Emilia zeylanica</i>	<i>Senecio candicans</i>	<i>Macrotyloma ciliatum</i>
<i>Cyathea spinulata</i>	<i>Heterostemma piperifolium</i>	<i>Gyanura lycopersicifolia</i>	<i>Senecio corymbosa</i>	<i>Neptunia triquetra</i>
<i>Gomphostemma parviflorum</i>	<i>Heterostemma tanjorensis</i>		<i>Senecio nudicaulis</i>	<i>Halophila ovalis</i>
<i>Neocinnamomum caudatum</i>	<i>Atylosia sericea</i>		<i>Sophora interrupta</i>	<i>Halophila beccarii</i>
<i>Sophora bakeri</i>			<i>Peperomia dindigulensis</i>	<i>Ruppia maritime</i>
<i>Taxocarpur kleinii</i>			<i>Anaphalis lawii</i>	<i>Najas graminea</i>
			<i>Syzigium cuneatum</i>	<i>Potamogeton octandrus</i>
			<i>Tephrosia roxburghii</i>	<i>Potamogeton crispus</i>
				<i>Diplachne fusca</i>

3.2.4 RARE/ ENDANGERED/ THREATENED PLANTS

3.2.4.1 Besides the endemic species listed above, following are the other threatened plants of the state belonging to different status categories of Red Data Book (see Box 3.4).

3.2.5 ORCHIDS OF ORISSA

3.2.5.1 Orchids, which have aroused a lot of interests because of their importance from conservation point of view and the potential for commercial exploitation are fairly common in different ecological habitats throughout the State. Of an estimated 1,200 species of orchids in India, 129 species have been reported to occur only in Orissa including several rare ones (Sarat Misra, 1982, 1996, 2000). The list of wild orchids of Orissa based on the work of Sarat Misra (1968-2001) is given in Table 3.5. Orchids are distributed mainly in the montane forests of Orissa lying within 300-1500m altitude. Such uplands are mostly confined to the (i) Northern plateau and the (ii) Eastern hills of the state and to a lesser degree in the (iii) Central river basin followed by the (iv) Coastal plains. Similipal forests alone houses 93 orchids many of which are rare and ornamental. Consequent upon deforestation activities, the delicately balanced habitats of the orchids in the forests are shrinking fast, rendering them endangered, vulnerable or rare. Orchids status is as placed at Annexure 3.

3.2.5.2 Orchids are fascinating group of flowering plants from botanical as well as horticultural point of view. Orchidaceae is one of the largest family of plant kingdom with about 19,000 species with terrestrial, saprophytic and epiphytic / lithophytic habits. Orchid flowers have unique quality of interbreeding liberally resulting in interspecific and intergeneric hybrids. This is why they are increasingly being cultured throughout the world. We have to however preserve our stock in the wild and in orchidaria through conservation *in situ* and *ex situ*.

Box 3.4 RARE/ ENDANGERED/ THREATENED PLANTS

<p><i>Acacia donaldii</i> Haines <i>Acacia tomentosa</i> Willd. <i>Acampe rigida</i> (Buch.-Ham.ex Sm.) Hunt <i>Acanthephippium sylhetense</i> Lindl. <i>Aerides crispum</i> Lindl. <i>Aglaia cucullata</i> (Roxb.) Pellegrin <i>Aglaia elaeagnoidea</i> (Juss.) Benth. <i>Albizia orissensis</i> Sahni & Bennet <i>Alocasia montana</i> (Roxb.) Schott <i>Alphonsea madraspatana</i> Bedd. <i>Anaphalis lawii</i> (Hook.f.) Gamble <i>Atylosia cajanifolia</i> Haines <i>Atylosia sericea</i> Griff. <i>Balanophora polyandra</i> Griff. <i>Bulbophyllum crassipes</i> Hook.f. <i>Bulbophyllum guttulatum</i> (Hook.f) Balak. <i>Bulbophyllum macraei</i> (Lindl.) Reichb. <i>Bulbophyllum polyrhizum</i> Lindl. <i>Cassipourea ceylanica</i> (Gardn.) Alston <i>Cryptocarya amygdalina</i> Lour. <i>Cryptocoryne ciliata</i> (Roxb.) Schott. <i>Dendrobium cathcartii</i> Hook.f. <i>Dendrobium peguanum</i> Lindl. <i>Dendrobium regium</i> Prain <i>Desmodium ritchiei</i> Sanjappa <i>Dimeria acutipes</i> Bor <i>Dimeria lehmanii</i> (Nees ex Steud.) Hack. <i>Dimeria mahendragiriensis</i> Ravi, Saxena & Brahman <i>Dimeria trimenii</i> Hook.f. <i>Dimeria mooneyi</i> Raizada & Mooney <i>Dimorphocalyx glabellum</i> Thw. <i>Diplopora championii</i> (Lindl.) Hook.f. <i>Dracaena spicata</i> Roxb. <i>Elaeotis sororia</i> (L.) DC. <i>Eria bambusifolia</i> Lindl. <i>Eriocaulon echinulatum</i> Mart. <i>Erythrina resupinata</i> Roxb. <i>Eulophia dabia</i> (D.Don) Hochr. <i>Fimbristylis sericea</i> R.Br. <i>Fimbristylis tristachya</i> R.Br. <i>Flemingia nilgheriensis</i> (Baker) Wight ex Cooke <i>Gnetum montanum</i> Markgraf</p>	<p><i>Goodyera thailandica</i> Seidenf. <i>Gynura nitida</i> DC. <i>Halophila beccarii</i> Asch. <i>Heterostemma tanjorensis</i> Wight & Arn. <i>Hypericum gaitii</i> Haines <i>Intsia bijuga</i> (Colebr.) Kuntze <i>Lasianthus truncatus</i> Bedd. <i>Lasiococca comberi</i> Haines <i>Leucas clarkei</i> Hook.f. <i>Liparis resupinata</i> Ridley <i>Luisia primulina</i> Par.& Raichb.f. <i>Malaxis purpurea</i> (Lindl.) Kuntze <i>Maerua oblongifolia</i> A. Rich. <i>Maytenus bailadillana</i> (Narayan. & Mooney) Raju & Babu <i>Micrococca mercurialis</i> (L.) Benth. <i>Neanotis montholoni</i> (Hook.f.) Lewis <i>Nervilia punctata</i> (Bl.) Makino <i>Nothopegia heyneana</i> (Hook.f.) Gamble <i>Oberonia gammiei</i> King & Pantl. <i>Ormocarpum cochinchinense</i> (Lour.) Merr . <i>Nogra grahamii</i> (Wall.ex Benth.) Merr. <i>Pachystylidium hirsutum</i> (Bl.) Pax & Hoffm. <i>Pavetta brevifolia</i> DC. var. <i>ciliolata</i> Gamble ex Bl. <i>Peristylus parishii</i> Reichb.f. <i>Phoenix paludosa</i> Roxb. <i>Pomatocalpa decipiens</i> (Lindl.) J. J.Sm. <i>Premna calycina</i> Haines <i>Psoralea corylifolia</i> Linn. <i>Rhaphidophora decursiva</i> (Roxb.) Schott. <i>Rhynchosia suaveolens</i> (L. f.) DC. <i>Senecio candicans</i> DC. <i>Senecio corymbosus</i> Wall.ex DC. <i>Smilax lancifolia</i> Roxb. <i>Sophora bakeri</i> C. B. Clarke ex Prain <i>Stemona tuberosa</i> Lour. <i>Strobilanthes circarensis</i> Gamble <i>Strobilanthes jeyporensis</i> Bedd. <i>Tainia hookeniana</i> King & Pantl. <i>Tephrosia roxburghiana</i> Drumm. <i>Toona ciliata</i> Roem. var. <i>pubinervis</i> (C. DC.) Bahadur <i>Tragia bicolor</i> Miq.</p>
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<i>Gnetum ula</i> Brongn.	<i>Wendlandia gamblei</i> Cowan <i>Zeuxine lindleyana</i> N.Rao
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3.2.6 **Sabai grass** Sabai grass (*Eulaliopsis binata*) which can find a number of applications in different cottage industries, grows enormously in Mayurbhanj and particularly, in Similipal . The tribal and locals use it for rope-making for their own use (Patro, 1995). Such ropes have very high tensile strength and can be used in packing industry, sofa-making and many other purposes. Therefore, the tribals should be given incentives to prepare such ropes in commercial scale and can be trained to make it in proper fashions to suit different industries.

3.3 Ethno-medicines

3.3.1 Eighty percent of rural people depend on traditional ethno-medicines for their day-to day health care – WHO estimates (Mukhopadhyaya, 1998). Orissa also has ancient history of use of medicinal plants in traditional ethno medicine. The recipes and formulae of the ethno-medicines have been handed down orally for generations. The rural poor also do not have easy access to the codified medical system i.e. ayurveda, unani, sidha, amchi, homeopathy etc or modern system of medicine which have sophisticated theoretical foundations. These medicines are mostly prepared from 8000 medicinal plants throughout the country (FRLHT, 2000) and some from animals, birds, reptiles, minerals etc. As most of medicinal plants are not commercially cultivated but gathered from wild sources without ensuring the regeneration, this has resulted over exploitation of the floristic and faunal wealth and subsequent threat to many species (see Table 3.6 & 3.7) . Therefore there is urgent need for conservation of medicinal plants.

3.3.2 Threat assessment: The factors responsible for man made threat on medicinal plants, animals, birds and reptiles are given below.

- a) Unlawful over exploitation of medicinal plants for commercial production of Ayurvedic, Allopathic, Unani and Homeopathic medicines.
- b) Cultivation of medicinal plants for commercial production by pharmaceuticals has not yet been started. No Govt. agency, Institution and company have initiated any action in the matter in the state of Orissa.
- c) Due to lack of awareness on the value of medicinal plants, the rural people indulge in unlawful destruction of medicinal plant growth.
- d) Inefficient implementation of Forest act, rules and policies in conservation of biodiversity.
- e) Lack of opportunities for the forest dwellers has resulted in unlawful destruction biodiversity.
- f) Some medicinal plants are also being exploited to meet industrial needs i.e bark of phanaphana, maida (medha) and lodhra being used in Agarbatti industry.
- g) The forest fire and continuous over grazing have badly affected the natural regeneration of the medicinal plant species resulting in threat of plants.

3.3.3 Dependence on wild resources for procurement of raw materials without raising any captive plantation/cultivation by the pharmaceuticals in the state of Orissa has caused increased pressure on natural wealth resulting in threat of medicinal plants

3.4 Forests ecosystem

3.4.1 The recorded forest area is 5.72 million ha, which constitute 36.73% of the geographic area of the State. With varied and diverse physiography, climate and edaphic conditions, the State harbours 4 major forest types. These are Tropical Semi Evergreen, Tropical Moist Deciduous, Tropical Dry Deciduous and Littoral and Swamp Forests.

3.4.2 The Forest cover based on satellite data (Nov.-Dec. 1995) is however 47,033 sq.Km., which constitutes 30.21 % of the geographic area. Based on crown cover density, extent of forest cover is given in the following Box 3.5 (FSI 1999)

Box 3.5 Forest Cover Assessment of Orissa

Cover density class	Extent in sq.Km.	Percent of geographic Area.	Percent of Forest cover	Percent of Recorded Forest Area.
1	2	3	4	5
Dense Forest (>40% crown cover)	26,073	16.74	55.45	45.6
Open Forests (10- 40% crown cover)	20,745	13.32	44.1	36.3
Mangrove	215	0.14	0.45	0.37
Total Forest cover	47,033	30.21	100	
Scrub (>10% crown cover)	5,439	3.49	-	9.5

3.4.2.1 Compared to 1997, during 1999, assessment, there was an overall decrease of 28 sq.Km dense forest, increase of 116 sq.Km. open forest, increase of 4 sq.Km. Mangrove, reflecting an overall increase of 92 sq.Km. forest.

3.4.3 District wise forest cover: In terms of extent of forest cover, 10 districts beginning from the highest are – Phulbani (5,116 sq.Km), Sundargarh (4,011 sq.Km), Mayurbhanj (3,942 sq.Km), Keonjhar (3,546sq.Km) Sambalpur(3,172 sq.Km), Rayagada(2,700 sq.Km), Angul(2,511 sq.Km.), Gajapati (2,445sq.Km), Malkangiri (2,285 sq.Km) and Ganjam(2,160 sq.Km). These 10 districts account for more than two-third of state's (67.8%) forest cover. Forest deficient 5 districts are in coastal plains, starting from the lowest, these are Bhadrak(18sq.Km), Jagatsinghpur (28 sq.Km), Puri (124 sq.Km), Jajpur (174 sq.Km) and Kendrapara(198 sq.Km.). These contribute to only 1.1% of the total forest cover (FSI 1999). Increase of 90 sq.Km. forest cover respectively in Mayurbhanj and Bolangir Districts are attributed to secondary coppice growth resulting from community participation in forest management.

3.4.4 Bio diversity of Forest ecosystems: Champion and Seth (1968) based on physiognomy, structure, function, floristics, dynamics, environment (soil, climate etc.) and history, classified Indian forest ecosystems to 6 major groups and 16 forest types. Forest type is a vegetation unit which possesses characteristics in physiognomy and structure distinctly pronounced from other units. Actually, there is a continuum from one type to other and the Zone of gradual change is known as ecotone or transitional zone. Orissa forests has been grouped as shown in Table 2.17. Characteristics, designated plant communities, species association and distribution of each type is given in Annexure 2.2.

3.4.5 Small remnants of rain forest are found in Orissa state. Semi-evergreen rain forest is more extensive than the evergreen formation partly because evergreen forests tend to degrade to semi-evergreen with human interference.

3.4.5.1 Floral Assemblage: As with the Indian flora, Orissa presents admixture of tropical South-East Asian and Malayan elements, which dominate the taxa. High hills of Deomali (1673m), Turia Konda (1599m), Singharaj (1515m), Mahendragiri (1500m), Khairiburu- Meghasini (1165m) in Eastern ghats have several sub-tropical and temperate taxa of Himalayas and several south Indian hill species. The occurrence of Himalayan & South Indian hill species have been explained as :

- (i) High hills of Orissa served as stepping stones for migration of species from the highlands of the peninsula in western ghats to the newer Himalayas and vice-versa through Assam bridge (Haines, 1925).

- (ii) Relict taxa, from the time Deccan Peninsula had land connection with Indo Malayan region (Biswas & Sampatkumaran, 1949)
- (iii) High attitude SE Asian and Himalayan flora is because of convergence in evolution. The present disjunction is because of favourable ecological niche obtaining in these hill tops. (Nayar,1977).

Himalayan taxa: *Ajuga macrosperma*, *Galium asperifolium*, *Ophiopogon intermedius*, *Phoebe lanceolata*, *Rhus chinensis*, *Plectranthus japonicus*, *Rhamnus nepalensis*, *Rubus ellipticus*, *Thalictrum foliolosum*, *Zanthoxylum armatum*.

South Indian hill species: *Anaphalis lawii*, *Desmodium ritchiei*, *Diospyros candolleana*, *Flemingia nilgherrensis*, *Indigofera wightii*, *Plectranthus nilgherriensis*, *Senecio candicans*, *Tephrosia roxburghiana*, *Wendlandia gamblei*.

Assam species: *Acampe rigida*, *Bulbophyllum crassipes*, *Cissus assamica*, *Elaeocarpus Wallichii*, *Licuala peltata*, *Litsea laeta* *Natsiatum herpaticum*, *Syzygium cuneatum*.

3.4.5.2 Mangroves of Orissa : The State of Orissa has coastline of about 480 km stretching over Balosore, Bhadrak, Kendrapara, Jagatsinghpur, Cuttack, Puri and Ganjam districts and is interrupted by several rivers and rivulets of which Mahanadi, Brahmani, Baitarani, Budhabalang, Rushikulya and brackish water Chilika lake deserve special mention. This interruption has greatly influenced the coastal vegetation of Orissa to give rise to a richest variety of mangrove communities. The tidal and littoral swamp forests extend from Chandipur coast in Balasore district to Gopalpur of Ganjam district either as continuous belt or in scattered patches and blocks, The mangrove forests at their luxuriance are confined to two places of Cuttack district namely Kanika and Kujang ex- Zamindari areas, the former being situated along the river Dhamara and the latter in the Mahanadi Delta. Littoral scrub jungles with some specific plant characteristics to deltaic swamps also occur in salt marshes near Chandipur, Astaranga, Gopalpur, rocky faces of Chilika Lake and few other localities. Compared to the total of 76,500 sq. km. forest cover in Orissa, only 212 sq km area is under mangroves in districts of Bhadrak Kendrapada and Jagatsinghpur and a total of 215 sq km overall, which is quite insignificant. But they enjoy quite a different status and constitute a distinct type of forests by themselves.

3.4.5.2.1 The mangrove flora of the state is very rich in comparison with the Sundarbans, Godavari, Cauveri and Andaman-Nicobar islands and maximum number of species i.e. 63 out of 65 species found in India, occur in Orissa. They belong to 37 genera under 25 diverse plant families. *Blepharistemma corymbosa* reported from the West Coast and *Nypa fruticans*, common in the Sundarbans are absent in the Orissa coast. Occurrence of *Rhizophora stylosa*, *Sonneratia griffithii*, *Avicennia marina* var. *acutissima* and *Heritiera globosa* are new records for India and are of considerable phytogeographical significance. *Heritiera kanikensis* (Majumdar and Banerjee,1987), a new species has recently been described from Bhitarkanika area. List of Mangrove species can be seen at Annexure 3.3.

Box 3.6 Diversity of mangrove species in Orissa and other parts of India

Country/ Region	No. of Species
India	65
Sundarbans (Indian portion)	56
Orissa Coast	63
West Coast	33
Andaman & Nicobar Islands	37

3.4.5.2.2 On the contrary, the vulnerable mangrove ecosystem of Orissa is poised with the threat of extinction at an alarming rate and their renewability is being lost. Apart from the natural threats like cyclones and floods this vulnerable habitat suffers from rapid destruction and degradation due to over exploitation; habitat destruction through industrialization, network of transport systems, mass encroachment of lands. Overgrowing population and cattle, hectic search for new land for paddy cultivation and shrimp culture have brought once luxuriant mangrove vegetation of Orissa coast to almost a disaster. Thus, after being constantly depleted, these interesting communities have reached an extremely fragile state needing immediate attention of ecologists, environmental biologists and nature - lovers. All such deteriorations have resulted in severe imbalances in the pre-existing meteorological, climatic and ecological conditions of the coastal belt. There is already alarming reports about coastal erosion north to Paradeep, which about one or two decades ago was in a depositional phase. Repeated occurrences of severe cyclones along the coastal tracts and the recent super-cyclone of 29th October, 1999 have demonstrated the ecological roles the mangrove forests can play by acting as wind barriers and in shore-line protection and coastal erosion control. However, the 1999 assessment of FSI has shown increase of 4 sq km over 1997.

3.4.6 Preservation plots & sample plots: Representative areas set aside in different forest types for permanent protection with a view to study ecological succession and attainment of climax vegetation are known as preservation plots. Sample plots, on the other hand, are plots in different forest types under ideal conditions of management with a view to have periodic measurements of growth. These serve as insitu biodiversity conservation areas. The state has 5 preservation plots and 27 sample plots. The details of preservation plots in Orissa along with species diversity recorded over years can be seen with Table 3.8 & 3.9.

3.4.7 Community Conserved areas in Orissa. The State is pioneer in implementing participatory forest management under Joint Forest Management (JFM) resolution of the Government. Although the efforts made by village protection groups can not be categorised strictly under community management, it is participatory management with government facilitation. As of now, 6,686 Vana Samrakshyan Samittees (VSS) have been formed involving 6,346 sq.km. forest land. Similarly, 4928 Village Forest Protection Committees (VFPC) had been formed who protect 10,077.05 sq km of degraded forests, mostly secondary natural forests of coppice origin. The wave started in 1988 and picked up momentum in 1993 because of government facilitation. But, earlier to this date also, examples of community participation 50 years old or more is not uncommon, particularly, in ex-state areas. The growth of secondary forests through sheer protection from felling, fire and grazing for 3 years resulted not only in generation of adequate biomass in shape of fuel & fodder for the villagers but, unwittingly contributed to the biodiversity of both plants and animals. Village Doctors throughout the State tribal belt, have testified that medicinal plants which were thought to have been wiped out from their areas have reappeared after such protection.

3.4.7.1 Under SIDA sponsored Social Forestry Project (SFP), 9141 Village Forest Committees (VFC) have been formed which protect 1181.22 sq km Village Woodlots, mostly plantations of quick growing species like *Eucalyptus*, *Acacia*, *Cassia*, *Peltophorum* and bamboo etc. These plantations have significantly modified the village skyline and added to the bio diversity by providing shelter to different species of bird life. Awareness generated through this programme has also contributed largely to farm forestry, institutional planting and avenue plantation initiatives of committees and individuals. This has also helped generate people's support for natural forest conservation and 'Joint Forest Management'.

3.4.7.2 Details of VSS, VFPC, unregistered groups are given in Table 3.10 and that of VFCs in Table 3.11. Despite intense pressure on land and dwindling traditional values of land ethics, conservation of all life in nature and feelings of custodianship bestowed by the Almighty, there are certain glaring examples of community conserved areas, which stand apart. These are enumerated in Annexure 3.2. The riches of the areas mentioned in Annexure 3.2 need immediate protection, before they loose their character altogether alongwith their rich biodiversity due to biotic interference.

3.4.8 Threat perceptions: Human actions have been altering the natural environment and biodiversity. The impacts are largely adverse, although, few examples are available which have led to its promotion. Agricultural extension and intensification, industrial and urban developments, depletion and degradation of natural landscapes through over use of the resources these treasure and their fragmentation through developmental processes have all contributed to the loss of biodiversity. Even, production forestry, its reliance on monoculture plantations or a set of species in natural management systems has its share in biodiversity loss. Lack of foresight, awareness, knowledge in evaluation of bio resources and over all understanding of natural processes appear to be reasons enough for looking back and review of our actions and relationship with nature. This review, brought to surface, the processes affecting biodiversity, which is summarized in Table 3.12.

3.4.9. Ex-situ conservation Centres : Places important for ex-situ conservation centers for floral diversity are discussed here.

3.4.9.1 **State Botanical Garden, Baranga:** Situated 14 Km. from Bhubaneswar, this is a part of Krushnanagar D.P.F. on the northern bank of Kanjia lake. Spread over 74.74 ha, it contains important ornamental, forest, fruit and shade bearing species. Its salient features are placed at Annexure 3.4.

3.4.9.2 **Ekamra Kanan:** Regional Plant Resource Centre in Bhubaneswar carved out of Bharatpur RF and also known as Ekamra Kanan is spread over 257ha garden and is now a regional centre for conservation of wild and cultivated plant genetic resource. This center has a collection of 3250 species of plants including 14230 tree species in an arboretum. The latter contains 110 species of timber and 45 species of firewood. Besides, 61 species of bamboos and 112 species of palms have been preserved here. It also has over 2000 species of garden plants including 250 species orchids, 75 species Dahlia, 150 species Chrysanthemum, 1050 species cactus and succulents. Among the medicinal plants, the centre has 160 species. In the field of propagules, 165 species tree seeds and several tissue of ornamental and banana have been preserved.

3.4.9.3 **Herbal (Medicinal plant) Garden, Narsingnath :** About 500 species of medicinal plants have been preserved at this centre and also propagated and distributed for cultivation. This is run by the Herbalists Association, Narsingnath. They bring out a monthly journal giving utility of each plant and techniques of its nursery, planting and aftercare. This oriya journal is titled 'Banoushadi'.

3.4.9.4 **Silvicultural gardens/ Research stations :** There are 31 silvicultural gardens/ research stations over the length and breadth of the state, where indigenous as well as exotic fast growing species have been tried to evaluate their growth and productivity for field trials, collection of seeds, genetic research, development of clones. Research on productivity of medicinal plants have also been taken up. Germplasm banks of *Casuarina equisetifolia*, *Dalbergia sissoo*, *Tectona grandis*, *Gmelina arborea* & *Eucalyptii* have been established. These stations can serve as excellent ex-situ conservation centres in different phytogeographic zones. Four of these need specific mention like Kalinga (Kandhamala), Patnaikia (Puri), Dhaltangarh (Jagatsinghpur) and Bhubaneswar (Ghatikia). There are many formal or informal medicinal gardens in different levels of maintenance.

3.5 Wildlife in Orissa

3.5.1 Orissa has wide variety of wildlife and remarkable for its natural beauties. In true sense wildlife refers to both flora and fauna in wild state. In the following paragraphs, some representative aspects of fauna have been covered, which however amply reflects the association of these fauna with flora, their interdependence and range of habitats and wildlife ecosystems. In older days the state was covered with forests which abounded in wild animals of various types. Wild animals were reported to have been prevalent in the forests of coastal districts and elephants were common in Balasore District as late as 1840. With gradual expansion of agriculture, infrastructure development, irrigation dams, industries, settlements and urbanization, the wild animals were either destroyed or driven out to interior. Several of species which were in abundance got extinct or are on the verge of extinction. Last cheetah was reported on Orissa- Andhra border at Malkangiri

(James Milne) in 1952. One species of mammal (Cheetah) and four species of birds(Pink- headed duck, the Great Indian Bustard, European white stork, Common crane) are now extinct from Orissa and occurrence of wildbuffalo and hard ground barasinga, marbled cat, caracal, batagur terrapin and Forest spotted owlet is doubtful. Situation has been getting alarmed with increasing human and cattle population. The value of wildlife in maintaining the balance of nature is of considerable importance. Wildlife is also a source of attraction for tourists and provides good opportunities for Eco-tourism. Time has come to realize that wildlife is also an important natural resource which if conserved and carefully managed can promote good biodiversity. The fauna of the area has been well explored in recent years by the scientists of the Zoological Survey of India, Sambalpur University, Utkal University. The ZSI has done excellent service in this regard.

3.5.2 The existing wildlife in Orissa is classed under the *Indian Peninsular sub region which forms part of the Oriental Zoo-geographical Realm of the World*. The animal life of this tract is characterized by absence of many of these Indo-Chinese species which abound in the hill forests of the Himalayas. It is the home of the true Indian fauna, of which the spotted deer, the Nilgai (*Boselaphus tragocamelus*), the Balckbuck (*Antelope cervicapra*), the four horned antelope or Chowsingha and the sloth bear are typical representatives. Besides, these are also other important animals viz Elephant (*Elephas maximus*), Tiger (*Panthera tigris*), Panther (*Panthera pardus*), Bison (*Bos gaurus*), Sambar (*Cervus unicolor*), Barking deer (*Muntiacus muntjak*), wild buffalo (*Bubalus bubalis*) etc.

3.5.3 The present thrust on conservation of wildlife started from 1973 with the creation of Simlipal Tiger Reserve, starting of UNDP assisted Crocodile Project from 1975 and creation of separate wildlife wing of the Forest Department in March, 1976. The wildlife (Protection) Act 1972 was adopted wef August 1974 with separate rule s framed therein. The new Code of Management Plan Procedure 1990 provided for the long felt need to include Wildlife Management in Working Plans in a separate Wildlife Managment Circle. Nandankanan Biological Park (now renamed as Nandankanan Zoological Park)which was recognized as a 'B' Class Zoo in 1973 by the Expert Committee on Zoos appointed by the Government of India, is now amongst the 16 Large Zoos of the country.

3.5.4 For effective protection and management, biodiversity rich and unique areas have been brought under the category of National Parks and Sanctuaries as detailed in para 2.5.1. Wildlife conservation projects have also been taken up and being implemented successfully. Some important ones of them are Project Tiger 1973, Project Elephant 1991, three research projects (Integrated Crocodile and Seaturtle Conservation and Research Project 1975; Ecology of Aquatic Birds in Chilika Lake 1992-93; and study on population, habitat preferences, feeding and survival of Blackbucks in Balipadar-Bhetnoi Game Reserve of Ganjam Dostrict 1994), rearing and rehabilitation programme of three Crocodilian species along the captive breeding programme at Nandankanan. All the 3 crocodileans on captive rearing have been released into the river systems in the protected areas. Spotted deer and Blackbucks also on captive breeding have been released to protected raes for increasing the prey base for predators. Various biodiversity sustaining projects and programs are in progress throughout the country. In Orissa they can be listed as :

1. Biosphere Reserves.
2. Wetlands, Mangroves and Coastal Reefs.
3. Forest Conservation,
4. Joint Forest Management
5. Wildlife Conservation, Protected Area Network,
6. Development of National Parks and Sanctuaries.
7. Eco-development in and around National Parks & Sanctuaries.
8. Project Turtle
9. Project Tiger
10. Project Elephant
11. Biodiversity Conservation.

3.5.5 The extent of wild animal diversity is shown in Box 3.7. The coastal fauna also being very rich in diversity and details with threat perceptions are placed at Annexure 3.5. The Orissa coast provide the largest nesting sites for Olive Ridley Turtle (see Fig 3.1)

Box 3.7 Wild animal biological diversity in Orissa.

TAXA	ORISSA	INDIA.
Amphibia	19	206
Reptilia	110	485
Aves	473	1228
Mammalia	86	372
Total	688	2,291

3.5.6 Careful examination of status of wild animals reveals that 23 species of mammals (6 orders and 13 families), 16 species of birds (8 Orders and 11 Families) and 17 species of Reptiles (3 Orders and 8 families) are considered threatened in Orissa. In all 56 species of vertebrates (17 Orders and 32 families) are known to be threatened in the State. The list is placed with Table 3.13. Horse shoe crab found in Bhitarkanika and Chandipur coast, Fresh water Eel and Fresh water Ray are threatened in coastal waters. Herds of Dwarf Elephants (*Gunthuni Hati*) with maximum shoulder height 195 cm to 215 cm have been reported from Satakosia Wildlife Sanctuary. Further studies are required like genetic finger printing to establish if these can be given a sub species status.

3.5.7 The important ex- situ conservation areas are Nandankanan Zoological Park and Mini Zoos as well as Deer Parks situated throughout the state. Besides captive breeding they also function as rescue & rehabilitation centers for animals in distress. A brief account of them is provided here.

3.5.7.1 **Nandankanan Zoological Park**, one of the major tourists attractions of Orissa near Baranga Railway Station which is in between Cuttack and Bhubaneswar cities of Orissa. It was established on 29th December,1960. In the year 1979, two Demarcated Protected Forests (DPF) blocks Krishnanagar and Jujanagarh alongwith Kanjia Lake, a natural water body and some private lands and government wastelands over 437 ha were notified as Nandankanan Sanctuary and within its perimeter, the Zoological Park covers 362 ha of undulating forested areas, natural wetland and the Kanjia lake which itself covers 66 ha. It has the distinction of being the host zoo in the world for captive breeding of white tiger out of normal coloured parents independent of Rewa origin as well as for first ever captive breeding of Gharial in the year 1980. Nandankanan has been internationally acclaimed for its highest collection of white tigers in the world. Nandankanan is the only place available in the state for capture, management, *ex-situ* conservation and rehabilitation of problem population of wild animals. It is a rescue centre for abandoned, injured and incapacitated animals. In future, the problem from such animal is likely to increase due to rapid depletion of their habitat and as a result their management would demand additional resources. Zoos are very important for the conservation of biodiversity, referring to the range of life forms on earth. Several measures have been taken to protect biodiversity. These include legal measures, *in-situ* and *ex-situ* conservation efforts.

3.5.7.1.1 The Nandankanan Zoological Park has been contributing to wildlife conservation, captive breeding of endangered species, creating empathy towards wildlife, promoting tourism and recreational

aspects in and around Bhubaneswar. The zoo has to provide satisfactory conditions to the animals, their caretakers and the visitors on a well planned and run factors of **enclosures, space, food, water and rest days**. The recent developments have emphasised on improvement of animal housing, health care and the security at the zoo. Nandankanan has also to improve, develop on its existing facilities and environment to cater to conservation needs and education, research as well as legal purposes on wildlife management. Besides, the discerning visitors to the zoo can avail their recreational time in a clean environment, aesthetic surroundings, with barriers and fences to their safety, listening to nature's sound and movement in pollution & noise free environment.

3.5.7.1.2 In its pursuit to achieve the objectives, the park has been exchanging various wild creatures, rescued or bred under captivity to countries and institutions within India and abroad in exchange of similar endangered species. It has the distinction of releasing cheetal, black buck and crocodiles bred within park to nature. Though the park is not managed for earning revenue to the exchequer, some entrance fees are collected from the visitors in order to discourage non-serious visitors and unnecessary crowding. Present visitorship to the zoo is between 10-12 lakhs per year

3.5.7.2 **Deer Parks/Mini zoos:** There is a mini zoo in the Indira Gandhi Park at Rourkela and 7 Deer parks at Harishankar (Bolangir district), Papadahandi (Nowrangpur district), Kuanria (Nayagarh district), Taptapani (Parlakhemundi district), Raj Bhawan, Bhubaneswar, Motijharan (Sambalpur), Kapilas (Dhenkanal). The last two also house some other animals. These deer parks can act as centre of captive breeding for rehabilitation of endangered species in the wild. It can also serve as a centre for propagation of herbivores in habitats having carnivores but low prey base to build up the latter. However, several deer parks are facing financial and management problems and these need to be addressed urgently. A proposal to establish a large zoo in Lakhmidungri, shifting molijharan deer park there is under active consideration of the Government.

3.5.8. **Tasar :** There are a number of species of silkworms, but only a few are used for sericulture. Those include Mulberry silkworm (*Bombax mori*), Tasar silkworm (*Antheraea paphia*), Mug silkworm (*Antheraea assama*), Eri silkworm (*Attacus ricinii*), Oak silkworm (*Antheraea pernyi*), Giant silkworm (*Attacus altas*), etc. Out of these Mulberry silkworm, a native of China, which can be totally domesticated is widely used for sericulture. In our state it has been introduced in a number of places including undivided Koraput and parts of Mayurbhanj district. The natural food of this worm is mulberry leaf. Muga silkworm, a native of Assam is semi-domesticated in nature and Eri, which feeds on castor leaf can be reared easily in Orissa. However, Tasar silk worm, a wild species, is endemic to Similipal forests, but, now by cross breeding it has been possible to produce varieties that can be reared and domesticated.

3.5.8.1 In Orissa, it is commercially exploited mostly in the district of Mayurbhanj, in which Similipal is situated. According to survey conducted in mid-80s, more than 12,000 tribals of Mayurbhanj were engaged in rearing tasar silkworm and many more in yarn and fabric production (Satpathy *et.al*, 1985). The "golden fibres" as tasar is usually referred to due to its brilliant golden colour. Out of the several wild species of silkworm that spin tasar, 8 are available in India and only one of those, *Antheraea mylitta* has been so far commercially exploited. Its larvae, which spin the cocoon, primarily depends upon 3 food plants, Sal (*Shorea robusta*), Asan (*Terminalia tomentosa*) and Arjuna (*Terminalia arjuna*) and a number of secondary food plants.

3.5.8.2 Nearly 40 eco-races of tasar silkworm are known, of which four, namely Godamodal, Boge, Sukinda and Nalia are seen in Orissa and the first one, endemic in Similipal forest, is considered to be the best, when the main commercial characters are taken into consideration. Therefore, experts suggest that extensive measures should be taken for efficient commercial exploitation and domestication of Godamodal and Boge races.

3.5.8.3 The population of the silkworm is sharply declining in Mayurbhanj as well as in Similipal due to denudation of sal flora on one hand and mass plucking of dispausing cocoons in the other hand. At present,

Godmodal silkworm is confined to Similipal forest areas. Therefore, massive programme should be undertaken through research, transfer of knowledge and public awareness, not only to protect it, but also to increase its population. Areas should be identified and preserved to allow the species to live and breed in natural environment. Captive breeding and rearing of the insect and reforestation of the denuded sal forest may also go a long way in achieving it. Mulberry cultivation in the periphery where the forest has been completely denuded can also be carried on for rearing of mulberry silkworm.

3.5.9 Honey bee : In Orissa 13 species of honey bee have been recorded, out of which 10 are wild species and 3 are social bees, which include *Apis cerena*, *Apis dorsata* and *Apis florea*. The wild bees are economically important not only for honey or wax production, but also as pollinators of crops. The important flowering plants, which serve as bee forage are eucalyptus, *Erassica*, Reciduous fruits, willows, Tamarind, Leucinia, Arjun, cucurbits, Ber, Acacia, Barbary, Berseem, Jamun, Shisham, Sunflower, Niger, Pigeo pea, etc. (Panda, 1996). Many varieties of honey bees, which include rock bee or Baghua (*Apis dorsata*), chitrala, Machia and Kanjia are seen here. Out of those the first one, a very furious and aggressive species, is considered to be the best, because of the quantity as well as quality of honey it produces. Due to shrinkage of forest, human interference and over exploitation the population of honey bees of all kinds is declining.

3.5.9.1 Besides honey and wax, the extracts from bee-venom, the so-called royal jelly (the food of the larvae) and queen pheromones have been found to have a number of therapeutic properties. Of course, little sophistication is necessary for this purpose, but the extraction work can be carried on in the peripheral region or just outside it, which can be sent for refinement elsewhere.

3.5.10 Lac : India is the most important lac producing country (50-60%) in the world and in our state the districts of Mayurbhanj and Cuttack (undivided) produce substantial quantity of it. Lac is secreted by a minute, resinous, crawling scale insect called *Tachardia lacca* or simply lac insect, which inserts its beak into plant tissues, sucks juices and grows. The commercial lac is produced in large quantities by a female insect as a protecting cover of its body (Sukla & Upadyay 1995).

3.5.10.1 The lac insects have as many as 113 host plants, out of which 14 are very common in India and Orissa. Those are Kusum (*Schleichera oleosa*), babul (*Acacia nilotica*), Ber (*Zizyphus mauritanias*), Palas (*Butea monosperma*), Ghont (*Zizyphus xylopyra*), Khair (*Acacia catechu*), Peepal (*Ficus religiosa*), Gular (*F.glomerata*), Pakapi (*F.virens*), Patkal (*F.globella*), Mango (*Mangifera indica*), Sal (*Shorea robusta*), Shishum (*Dalbergia sissoo*) and Fig (*Ficus indica*). Many of these occur in similipal forests.

3.6 Wetlands in Orissa

3.6.1 The Indian Subcontinent has a large variety of freshwater, saline and marine wetlands. Whereas the mangroves are relatively well documented, very little is known about the other wetlands, with few exceptions. During the past two decades wetlands have received increasingly greater attention, from the viewpoint of their ecology as well as conservation. Once treated as transitional habitats or several stages in succession from open water to land, the wetlands are now considered to be distinct ecosystems with specific ecological characteristics. The theme co-ordinators have defined wetland for Orissa as *any area retaining water- saline, brackish or fresh , for at least 2 months of the year irrespective of size, shape or depth of the area*. West Bengal Government prohibits filling up of any wetland more than 3.5 ha. Aquatic ecosystems vary widely even within a small area and is unlike terrestrial ones.

3.6.2 The wetland resources in Orissa can be seen at Table 2.18. The Wetland ecosystems of Orissa have represented by mostly the five important river systems besides vast 480 km long coastal and Chilika lagoons. These wetlands are ecologically very sensitive and biologically very rich. The fish fauna from these wetlands has been considered as the source of one of major livelihoods. It also earns a major chunk of revenue for the

state. Wetlands are important as repository of fresh water, brackishwater fauna and provides feeding grounds of migratory animals. These are highly productive systems and need conservation. A list of natural and man made wetlands is placed at Table 3.14, 3.15.

3.6.3 Present Status : River Systems

3.6.3.1. **Mahanadi System :** Mahanadi is two hundreds and forty miles long with deep pools and rapids. The number of fish species identified seems to be on the lower side, as Ganges has 382 and Brahmaputra 126. Production of carps from the river has progressively gone down as evidenced from the casual markets. 99 different fish species have been identified of which 4 are reported to be endangered and 9 are to be kept under watch. Though no literature has been available on sectoral environmental analysis of this river but it has been found that the Pollution load on this river has depleted the diversity of fish and other fauna. 16 coal mines in the IB valley, caustic soda factory, Tata Refractory at Belpahar, Bhaskar Textile Mills, Orissa Potteries at Jharsuguda, Oswal Chemicals and Fertilizers at Paradeep have carried a lot of pollution load into the river water.

3.6.3.2 **Brahmani System:** Since 1970's there has been heavy pollution from steel plants, thermal power plants explosive factories, heavy water units. Aluminum and Chemical Plants and others have made the Brahmani most polluted river in Orissa. Fish kills have been reported in Talcher and Rourkela and the spawn collection has been abandoned.

3.6.3.3 **Baitarani System:** This is reported to be less polluted than the others and there was no sizeable spawn collection from this river.

3.6.3.4 **Rushikulya River System:** This river water carries pollution with mercury, which is found absorbed by fish flesh. Fish kills have been reported from some villages.

3.6.3.5 **Subarnarekha River System:** On the boarder line of Bengal Subarnarekha receives polluted water from Bihar. It was reported to carry the best quality of carp spawns prior to 1970.

3.6.4. Important Wetlands: Lakes and Reservoirs

3.6.4.1 **Chilika Lake:** It is a wetland of international importance on the Bay of Bengal. The maximum length of the lake is 64 km, maximum width 18 km and the lake area varies from 740 km in summer to 1165 km (rains). It is a Ramsar site for, over a million migratory water fowl and waders winter here. It is also a hotspot of biodiversity. It has an assemblage of phytoplankton- 43 species , Algae-22 species, Vascular plants- 150 species, Protozoa-61 species, Nematode-37 species, Platyhelminthes- 29 species Polychaetes-31 species, Brachyura- 28 species, Decapoda- 30 species, Mollusca-136 species, fish-225 species, Amphibia & reptile- 37 species, Birds-156 species and mammals –18 species(Source : Chilika Development Authority,1999).

3.6.4.1.1 Flocks of migratory waterfowl arrive here for wintering from caspian sea, Lake Baikal, Aral Sea, Russian, Kirghiz steppes, Central and South East Asia, Ladakh and Himalayas. Of total 151 species of avifauna, Ducks & geese 22 species, plovers and sand pipers- 52 species gulls and terns- 14 species, eagles-13 species and herons, egrets-11 species comprise the predominant population of birds. Many rare and threatened species have been recorded here, which inhabit the lake for a part of their life cycle. The rare Barkudia limbless skink is endemic to the sandbars and islands of the lake. During January 2002, 16 lakhs of birds have been counted in Chilika. List of birds at Chilika lake is given at Annexure 3.6.

3.6.4.1.2 The Lagoon is identified as a priority site for conservation and management by the National Wetlands, Mangroves and Coral Reef Committee(NWMCC) of the MOEF, Government of India .

3.7.4.2 **Bhitarkanika:** This is a sanctuary, the core area of which is a National Park. It harbours 63 species of Mangroves and classed as a reptilian paradise. It is home to world's largest salt water crocodile (6.8 metres length) whose population stands at 1200+. It also holds sizeable population of smooth coated otter, fishing cat and common vulture. More than 190 species of birds have been recorded here, predominantly of storks, herons, egrets, ibises, Cormorants, darters, pelicans and bitterns, which nest here during monsoon months, whose population is around 60,000. Other species of importance are Bramhiny kite, Sand pipers, plovers, stints, white bellied Sea eagle etc. Black necked storks and Dalmatian pelicans have also been sighted. Large numbers of (1,00,000) barheaded geese, Common shel duck, teals also visit the estuarine water(river mouths). The sanctuary is internationally famous to have the largest rookery of sea Turtles (Olive Riddleys), on the sea shore flanking the Gahirmatha marine sanctuary.

3.6.4.3 **Jatadhari Muhan:** This area is close to Paradip, on the south of river Mahanadi. This is an estuary which supports large congregation of waterfowl in winter(50,000+). It is supposed that migratory waterfowl on their way to Chilika use this as a stopover. It also shelters a part of the ducks and geese throughout the winter.

3.6.4.4 **Hirakud Reservoir:** The largest manmade lake of the state on river Mahanadi. It has been identified as a wetland of National importance. Some 75,000 + birds mainly ducks, geese, waders visit the lake every year in winter. This also supports 147 variety of fishes. A special case study of Hirakud Reservoir is placed at Annexure 3.7.

3.6.5 Many wetlands of the State face threats of choking with weeds (mainly water hyacinth), siltation (because of Podu, Mining in catchments) and unsustainable agriculture, less of forest cover etc.), encroachments, water pollution (from industrial effluents, pesticides and fertilisers from fields, urban sewerage, over fishing and intensive brackish water aquaculture, poaching etc). Conservation programmes have been introduced in several areas which comprise of survey and documentation of the area, fencing, afforestation, wildlife Conservation, dredging of silt, Control of water hyacinth, water pollution monitoring, watershed management, public awareness and education.

3.7 Sacred Grove & Biodiversity

3.7.1 Sacred groves are tracts of virgin forest ranging from a few trees to dense forests of hundreds of hectares. These are people's forests; the community designates a forest area as protected. Each grove is dedicated to a deity. All vegetation belongs to it. Grazing and hunting are prohibited and only dead wood can be removed. Sacred groves reflect what ecologists call social fencing. Previously in the absence of written laws, religion played an important role in enforcing social norms and codes. The stronger and more malevolent a deity, the greater its protection. Sacred groves are usually revered as the abode of certain gods, deities and spirits and are generally located in the areas away from human settlements.

3.7.2 Sacred groves appear in different forms in different parts of India. They are called '*kaavus*' and '*pambukaavus*' in Kerala, 'Koilkaadu' in Tamilnadu, 'Devarakaadu', 'Kaanu', 'pavithra vana' in Karnataka, 'Law kyntangs' or 'Lyngdoh' in Meghalaya, 'Vanis', 'Kenkris', 'Oraans', 'Shamlat dehs' in Rajasthan and 'Jahera' 'Gunghi', 'Penu', 'Sarna', 'Gudi' in Orissa. Several hypotheses have been put forward to relate the genesis of sacred groves in the present context. However, the seemingly strong motive behind establishing a

sacred grove is the sense of fear shown by the local communities especially the tribal groups towards a god or a deity.

3.7.3 Since the sacred groves are not disturbed and are the surviving pieces of natural climax vegetation, they are the priceless treasure houses of certain rare and important flora and fauna. Be it a patch, a single or cluster of sacred trees, a lot of conservation concern has been imbibed in to the concept of sacred groves. People exhibit several strong emotional bonds attached to the grove. The area is always treated as a sanctum sanctorum.

3.7.4 Despite carrying a great tradition behind them sacred groves today are facing various threats. Change in the values, change in the living styles and certain economic forces have greatly contributed to the decline in the status of the sacred groves, particularly in tribal areas of Orissa. Large scale land conversion is seen in many sacred groves. Even though the sacred groves have established their virtue as a rich repository of ecological, cultural and sociological information they are not being given enough attention by the government agencies.

3.7.5 Though Orissa has a rich tradition of having sacred groves since ages and people do have socio-economic and religious sentiments to protect and worship these groves, but due to lack of depth research, we do not have much more information about it. The institution of sacred groves in the state is recognized by various names like *jahera*, *Thakurnama*, etc. Maximum 322 sacred groves are recorded from Semiliguda block of Koraput district and from 192 groves, dead wood and several non-timber forest produces are gathered (Malhotra *et al.* 2000).

3.7.6 Significance of sacred groves

3.7.6.1 The sacred groves have multifarious values for more than one reason. People strongly believed that the grove is the abode of deities who looks after the welfare and well being of the local people. The utility and importance of sacred groves can broadly be summarized and grouped in the following two headings :

- i) Ecological and environmental importance,
- ii) Socio-cultural importance

3.7.6.1.1 Ecological and Environmental Importance : Groves protected through religious beliefs play catalytic role in ecological and environmental management tuned to the region. Ecologists and environmentalists believe that groves are repository of gene pools and act as reservoir of biological diversity because these are protected since olden days and act as 'climax forest', which harbour variety of flora. Such island of climax vegetation amidst a degraded landscape can be seen in many parts of Koraput and Kalahandi districts.

3.7.6.1.2 Groves harbour variety of wild animals. Poachers do not dare to enter in these protected areas, therefore, it acts as a reservoir of wild life. These relict forests are paradigm of repository of wild germ plasm of the area, which could be exported to and used in afforestation programmes of damaged sites.

3.7.6.1.3 Socio-cultural importance : The groves play a number of socio-cultural functions, which are not easily discernible. Villagers feel that village would be protected by the deity against famine and epidemic diseases. The ritual significance helps in curbing mental agonies and anxieties and gives a moral confidence to the people. It psychologically prepares them to encounter the nature and natural calamities and disasters with a

greater confidence and courage. The rituals connected with the groves also provide chance to the people to spare few moments from their busy daily routine to be devoted to religious purposes. The groves also play a catalytic role in the social dynamics at both intra and inter village level stability.

3.7.7 Some tribes who have beliefs on scared groves : The tribal people of Orissa worship nature and believe that nature is to be kept satisfied if it is to provides all their needs. The sun, the earth, hills, rivers, streams, rain, forests and trees etc are objects of common worship.

3.7.7.1 Pauri- Bhuyan , Kandhs Santals, Oraons and Mundas and *sarna dharma* (sacred groves)
The concept of Sarna dharma originates from the common traditional religious institution of "sacred grove" found in the tribal village, which is regarded as the seat of one or more than one important village level deities including the village tutelary designated differently among various Mundari and Dravidian speaking tribes of Chhotanagpur and surrounding regions, comprising a large contiguous tribal belt covering parts of the states of West Bengal, Jharkhand, Orissa and Madhya Pradesh . Literally, the term Sarna is a Mundari word meaning the "Sacred grove" and the term Dharma is an Indo-Aryan linguistic term, ordinarily meaning "religion". A tree in a Sarna may not be damaged or felled without the leave of the *Pahan* (Village Priest) who however, would first offer a sacrifice in the Sarna where the trees stand.

3.7.7.2 Noted ethnographer Dr. S.C Roy observed that every Oraon (one of the tribes) village has the super natural institution of Sarna of grove of sal trees dedicated to their mighty tutelary deity "Chhala Pacchho"(or the old lady of the grove) who is also known by other names such as Sarna burhia and Jhakra burhia. "Chala Panchho" the chief deity of Sarna ordinarily resides in the sacred Chala-Kuti the holy compartment inside the house of the village Pahan. During the annual Sarhul festival she represented by the Sarna-sup is led in a procession by the Pahan accompanied by the villager to the Sarna.

3.7.7.3 The Munda, an important Kolarian speaking one of the major tribes of Orissa who are also the immediate neighbours of Oraons, share the common holy institution of Sarna with the latter, though there are difference in their nature of religious beliefs, rituals as well as orientations. The Munda pantheon is composed of their supreme deity, Sing Bonga (The Sun god) at the apex, the nature gods, ancestral sprits, village deities. These deities or gods save the village from diseases and calamities and bring prosperity. In a Munda village, according to Dr. Sachidananda "Sarna" and "Jayar" is a protected place situated between thickly grown trees, which are forbidden to be cut.

3.7.7.4 The concept and practice of Sarna extends to another major and important Mundari speaking tribe the Santal, living in the same habitat and eco-cultural region as those of the Oraon and Munda. This holy institution in a Santal village is called Jaherthan in shortcut Jahera (Holy grove). The Santals believe that deities residing in the Holy grove do welfare for the Santal villages. Most tribes believe that the sun god is the creator and master of the universe and call it by many names. The Juangs and Bhuyans call it "Dharam Devta", the Kohla and Santals " Sing Bonga". Other tribes worship other deities from nature as the creators of the Universe. The worships of the earth is common. Called the "Basumata" by Santals, Bhuyans and Juangs "Dharani" by Kandhs : "Basuki thakurani" by Kolhas, the worship of the earth goddess acquires special significance, since rituals of worship, for a good harvest starts every cultivation.

3.7.7.5 Food for the tribals consist of roots, leaves, flowers and fruits that they get from the forests. They therefore, not only worship the forests, but also revel in religious ceremonies and festivals connected with it. Bhinjals and Parajas call their forest god "Danger Devta" Bandas, 'Uga" and "Remngbori", Kolhas "Bura Bonga" Khandhs "Laipenu" and soon. Considering nature as their creator, sustainer and provider, the tribals have imbibed a deep love for nature that is primeval and instinctive.

3.7.7.6 The months of March-April and May-June provide occasions for festivities as fruits and flowers are harvested. Bhattaras and Koyas celebrate the first eating of mangoes after offering them to deities

in the "Chaita-Parab" and "Bijja Podu" festivals respectively. Binjhals and Santals observe the first eating of Mohua flowers during the "Makulbhaja Parab" and "Baha Parab". Sal, Neem and Asan trees are considered sacred, "Zahira" by both Santals and Kolhas, because their village deities dwell in it. Rivers, streams and hills are also the objects of tribal worship. Bandas call their stream deities' "Kapur chuan" and "Doliang" and Kandhs "Gungipenu". The deity is variously called "Buru Borga" by Santals "Vinding" by the Bandas and "Bhinapenu" by the Kandhs.

3.7.7.7 Karma is a beautiful example of tree worship among the tribal people in central and eastern India. Karma festivals though it is more a tribal festival it is well within the fold of the Sambalpur folk tradition. The numerous tribes of the states namely, Bihar, Madhya Pradesh, Orissa and West Bengal celebrate the festival. The adorable deity of Karma festival is Karamsani who is represented by a twig branch called Karma dal. This type of personification of a branch as devi is not surprising as trees have held a special place in the spiritual tradition of Ancient India. Karam Sani has been regarded as the goddess of vegetation, fertility and destiny. It may be noted here that Karam Sani can be identified with a twig branch of different trees in the same of different places. For example, in Sambalpur, a branch of Sal tree represents the deity. The Nagesia from Chhatishgarh and the Oraons, Mundas and Santals of various places worship *Adina cordifolia* (Kurum).

3.7.7.8 Forest dependence : Tribal dependence on forest is symbiotic. The relation between the tribals and forest is like that of fish and water says Prof. Radha Mohan. Forests are not only one of the major sources of their subsistence, but are also significantly related to their religion and mythology. The Kandhs of Ganjam claim descent from a woman, whose body parts are supposed to be made of Bel fruit, Sandalwood and Kawal mushrooms. Tribals of Kalahandi believe that their ancestors survived by drinking the juice of "Salap" tree after a catastrophe of "Ban Devta" the forest as a god to be appeased ensures the renewal of the species while working as a self-imposed law against the destruction of forest.

3.8 Tribal Culture and Biodiversity

3.8.1 Tribes in tribal habitats live in harmony with nature. There seems to have very positive links between tribal culture and biodiversity. Tree worship is part and parcel of tribal culture and some major tribes call their religion *Saran Dharam*, meaning worship of trees. Sal tree is often worshipped by the 'Santhals' and its leaves are must for any kind of worship. Tribals grow trees all around 'jahira' – their place of worship. Tribals are well acquainted with medicinal plants in forests and till today they mostly depend on these herbal medicines for treatment of any kind of ailments. All such positive links of tribal culture with biodiversity can be used as positive resources to conserve biodiversity in tribal areas (for forest cover in tribal districts of Orissa – see Table 3.16). But there are also some aspects of tribal culture which adversely impact biodiversity – tribal annual hunt (*Sandrakarka*) and podu cultivation. In the past when there was immense forest coverage and unlimited wild forest animals, these did little harm. But in the present context these aspects of tribal culture are to be restrained, may be through persuasion and awareness raising.

3.8.2 The symbiotic relation between the tribals and natural environment is disappearing fast due to the loss of beliefs, change in crop as well as fooding patterns. Tribals were well acquainted with medicinal plants in forests and were depending on these herbal medicines for treatment of all kind of ailments. But with rapid change in their behaviour and attitude they moved from indigenous herbal practices to modern day medicines, hence those indigenous practices as well as the list of priceless ethnomedicinal plants have lost. In addition to that, weakening of religious beliefs and the changing attitude of the communities are adversely affecting the traditional ways and means of effective conservation practices. That leads to extinction of more rare and endangered flora and fauna.

3.8.3 In overall, the tribal cultural traits go well with conservation of biodiversity. In fact they are the right people to work for it. The tribal love for tree and religious association with tree can positively be used for plantation and protection of forests. They can also be trained to grow medicinal herbs. Tribals do have the age old practices of water harvesting and management, which can be taken into watershed activities. Now the time

has come to think over the betterment of the original inhabitants of the land, water and forests as it indirectly serve the concept of sustainable development. A special pro-tribal policy is necessary to protect and promote their livelihood system, relationship with nature, autonomy equity and culture.

3.9 Agricultural Biodiversity

3.9.1 During the course of evolution and because of excellent topographic and varied environmental condition in Orissa, vast array of diversity in agricultural and horticultural crops have originated. Thus it is a potential region for occurrence of diversity in crop plants and centre of diversity for many agri-horticultural plants, native/primitive cultivars, land races and wild relatives of crop plants. Richness of the diversity of the agri-horticultural crops is exhibited in crops like rice (see Table 3.17), maize, millets (*Panicum miliare*, *P. miliaceum*, *Echinochloa*, *Setaria italica*, *Paspalum scrobiculatum*), legumes (*Vigna unguiculata*, *Cajanus cajan*), vegetables (pumpkin, cucumber), oilseeds (Sesame, castor), fibre crops (jute, cotton,) spices and condiments (turmeric, ginger) horticultural crops (mango, jackfruit), and wild relatives of crop plants (see Table 3.18).

3.9.2 With the increase in demographic pressure, monocropping of modern cultivars, change in cropping pattern, indiscriminate use of chemical fertilisers, pesticides, campaign for popularization of HYV without conservation efforts in one hand and deforestation, over exploitation, grazing, shifting cultivation, natural calamities (cyclone, flood, forest fire etc) and migration of artisans to cities considering agriculture as a non profitable business the present day agriculture is a threat to Biodiversity and its survival.

3.9.3 **Diversity in agricultural crops :** Genetic diversity is the basic raw material for present and future crop improvement programme. The genes necessary for crop improvement are contained in a broad array of plant materials, which when used in breeding or genetic research are termed germplasm. It includes older and current crop varieties, specialised breeding lines used to develop new varieties and hybrids landraces of crops that have emerged over centuries of selection by farmers, wild plants related to individual crops, and mutant genetic stocks maintained for research germplasm collection can range from plants maintained in green house or field plantings, to dried seeds in sealed envelopes held at few temperatures, to *in vitro* cultures of tissues or buds (cryopreservation). The farmers of Orissa are cultivating traditional cultivars since time immemorial. During the evolutionary process the varieties may have developed *in-built* resistance to biotic and abiotic stress situations. In Orissa efforts have been made to collect, characterize, maintain, document and conserve the plant genetic resources of Orissa by the National Bureau of Plant Genetic Resources, OUAT and Central Rice Research Institute. Nature and extent of diversity in both cultivated and wild types and distribution of important crop plants are at Annexure 2.3. Tables 2.20 and 2.21 provides agroclimatic zone wise growing of agricultural and horticultural crops.

3.10 Microbial diversity

3.10.1 Microbial diversity is an unseen national as well as international resource that deserves greater attention. Microbial diversity encompasses the spectrum of microscopic organisms including bacteria, fungi, algae, protozoa and virus. These organisms populate the soil, water and air that surround us as well as unusual environments such as boiling water of hydrothermal vents, deep ocean trenches and alkali lakes. Microorganisms have been evolving for nearly 4 billion years and are capable of exploiting a vast range of energy sources and thriving in almost every habitat. For 2 billion years microbes were the only form of life on

earth and during this period all life forms are considered to have developed from these microbial ancestors. Microorganisms represent by far the richest repertoire of molecular and chemical diversity in nature. They underlie basic ecosystem processes such as the biogeochemical cycles and food chains, as well as maintain vital and often elegant relationships between themselves and higher organisms.

3.10.2 Not much work has been carried out on the diversity of soil microorganisms and invertebrates in Orissa. However, sufficient information is available for some groups, namely Oligochaeta, Nematoda, Mollusca, and insects like Dermaptera and Isoptera. Soil microorganisms are the main players in mineralisation that occur in soil, capable of decomposing any kind of natural substrate with very short time even in days but associated with a slow turnover time of 6-18 months indicating a major component of the biomass in inactivity. Large soil invertebrates participate in the soil primarily through their mechanical activities such as tunneling, turnover, aeration, macro-aggregation and transport. Small soil invertebrates contribute as a linkage between the mineralisation by microorganisms and mechanical activities of the large soil invertebrates.

3.10.3 The diversity and populations of these beneficial soil microorganisms and invertebrates are fast declining because of frequent exposure to the consequences of both human and climatic forces. The rich and unique soil biota of Orissa is under tremendous stress due to demographic pressure and various developmental activities in the state. However, main threats to their existence are from rapid change in land-use pattern, habitat degradation, and large-scale use of poisonous pesticides and inorganic fertilizers, introduction of exotic species and changes in cropping pattern through out Orissa.

3.10.4 A perusal of literature shows that species diversity is known only for some groups of soil microorganisms and invertebrates (Table 3.19).

3.10.4.1 **Soil Microorganisms:** Microbial diversity encompasses the spectrum of microscopic organisms including bacteria, fungi, algae, protozoa and virus. These organisms populate the soil, water and air that surround us as well as unusual environments such as boiling water of hydrothermal vents, deep ocean trenches and alkali lakes. They represent by far the richest repertoire of molecular and chemical diversity in nature. They underlie basic ecosystem processes such as the biogeochemical cycles and food chains, as well as maintain vital and often elegant relationships between themselves and higher organisms.

3.10.4.1.1 Work on cataloguing microbial diversity in Orissa has been few and far between. Apart from a few reports of cataloguing algal flora from Chilka Lake and other aquatic environments of Orissa, no information is available on the microbial diversity in natural ecosystems. A few reports are, however, available on record of soil microbial diversity in different agricultural ecosystems with special reference to rice ecosystem, the major cropping system of the state. Interestingly, a major portion of the cyanobacterial germplasm of Orissa state is maintained in the Department of Botany, Utkal University, Bhubaneswar (Adhikary, 1998).

3.10.4.1.2 So far, 48 species of bacteria, 49 species of fungi, 28 species of Protozoa and 2 strains of virus have been listed from Orissan soils (Table 3.19).

3.10.4.2 **Soil Invertebrates:** Soil invertebrates like earthworms, nematodes, snails, some insects, etc. play an important role in maintaining various ecosystem functions. The greatest pool of genetic diversity lies among these animals. But in terms of conservation policy and biodiversity studies they are most neglected. Status of soil invertebrate species is largely unknown, although some are disappearing very fast. They are, however, indirectly conserved by way of habitat protection in the wildlife sanctuaries and national parks, and also through traditional practices. Since population studies have not been carried out on majority of these animals, it is not possible to identify species threatened with extinction. The soil invertebrates are under great risk in agroecosystems primarily due to increased application of toxic pesticides and inorganic fertilizers. Species composition of various soil invertebrates groups known from Orissa has been tabulated (Table 3.19).

3.10.5 Endemic Species: A complete list of endemic soil microbes and soil invertebrates of Orissa is not available. Several endemic species of various some soil animals are known to have evolved in the area (Table 3.20). The area is considered as a centre of evolution of some earthworm species of *Lenngaster*, *Octochaetona*, *Ramiella*, *Glyphidrilus*, *Eutyphoeus* and *Thatonia*. Almost all pot-worms (Family Enchytraeidae; Oligochaeta) are endemic in the region. Of 9 enchytraeids known from Orissa, 7 species are endemic there, constituting 77.7 % of pot-worm diversity. This high endemism in enchytraeids is possibly due to highly acidic soil conditions. The percentages of endemic species for Dermaptera and Isoptera are 21.5 and 12.9 respectively (Table 3.20).

3.10.6 Problems relating to soil microbes and soil invertebrates biodiversity

3.10.6.1 Habitat Destruction and Conversion

3.10.6.1.1 Forests : The forests harbour a rich and diverse soil biodiversity. They have suffered tremendous loss and degradation primarily to meet various demands for increasing human population and developmental activities in Orissa. The following activities have significantly contributed towards the loss and degradation of forests in the state:

- Expansion of agriculture. – Change in land-use pattern shows that there is a significant increase in net sown area from 36.17% to 40.77% of its total from 1972-73 to 1991-92 (Pradhan, 1994).
- Demands for fuel wood and timber.
- Submergence of forests in man-made reservoirs – Vast tracts of forests have been lost due to submergence in reservoirs of Hirakud, Indravati, etc. formed due to damming of rivers.
- Extensive grazing of cattle and goats – About 90% forests are used for grazing through out the year, resulting in damage to seedlings, decline in productivity and proliferation of inferior grasses.
- Forest fires – Each year large tracts of forests are destroyed due to both accidental and intentional fires (for collection 'kendu' leaves and shifting cultivation).
- Mining – The mining activity causes ecological degradation of natural ecosystems including deforestation. Being a major producer of minerals in the country, the state of Orissa has several hundreds of mines that have contributed to general soil degradation and loss of biodiversity.

3.10.6.1.2 Pastures : Pastures and grasslands support a host of endemic species of soil invertebrates like earthworms, enchytraeid worms, termites, etc. There is a general decline and degradation of these wild habitats. The situation is very acute because of a significant increase in grazing livestock population. The density of cattle per square km. was about 82.98 in Orissa against the national figure of 58.41 1982. Data on livestock population in Orissa shows an increase of about 3.5% of livestock between 1982 and 1991 (Anonymous, 1994). A sharp increase in the population of grazing livestock has also exerted an intense pressure on the soil invertebrate diversity in the grasslands. Often overgrazing by livestock reduces the value of pastures to invertebrates. The following are the main problems linked with the degradation of pastures and loss of soil invertebrate biodiversity in Orissa:

- Formation of gullies in tracks frequented by grazing livestock.
- Losses of soil organic matter and soil moisture.
- Loss of soil porosity and macro-aggregation.
- Enhancement of soil compaction
- Soil erosion.

3.10.6.1.3 Cultivated Lands : The present day arable lands in Orissa, once covered with natural vegetation, are permanent changes of the original ecosystems. Estimates show that 42.84% of its geographical area is under cultivation (Anonymous, 1994). Increased use of toxic and non-biodegradable pesticides in agroecosystems of the state has adversely affected not only the target species but also the entire faunal community including

useful soil fauna. Intensification of agriculture with excessive use of pesticides and inorganic fertilizers has reduced species diversity of all groups of soil animals.

3.10.6.2 Introduction of Exotic Species : Almost no reports are available on the impact of introduced exotic species of plants and animals on the soil microbes and soil invertebrates in the area. However, the populations and diversity of soil invertebrates declined in some habitats by the introduction of exotic soil animals and exotic plants.

- Exotic soil animals are carried, though unintentionally, in soil around roots of plants from other regions. For example, peregrine and more adventurous exotic earthworms like *Polypheretima elongata* and *Pontoscolex corethrurus* were possibly brought to India and Orissa in this manner (Julka, 1988). These exotic earthworms have become dominant in some agro-forests. Studies are, however, needed to investigate competitive interactions between native and exotic species of earthworms.
- The invasion of exotic weeds such as lantana and *Parthenium* sp. at some places has degraded the quality of natural habitats of native soil invertebrates.
- A decline of about 80% in earthworm diversity has been recorded in an area planted with exotic *Eucalyptus tereticornis* (Behera *et al.*, 1999).

3.11 Biodiversity of Domesticated Animals

3.11.1 About 80% of the rural households of Orissa own domestic animals, one species or the other which provide livelihood support and supplement to their income. Domestic animal wealth of the state is impressive in number across all species constituting a natural resource base with immense livelihood implications even though productivity levels are low. Further they are responsible for maintaining a natural balance in the ecosystem. The distribution of livestock population in the State into various species in the years 1982, 1991 and 1995 is indicated in Table 2.7. The livestock population of the State was 242.67 lakh as per the livestock census held in 1995. Out of the total livestock population, cattle population was 147.66 lakh (60.8%), buffaloes 16.52 lakh (6.8%), goats 54.12 lakh (22.3%), sheep 18.65 lakh (7.7%) and pigs 5.72 lakh (2.4%). Apart from this, population of other animals including dogs figures at 8.32 lakh. The population of cattle, buffaloes, goats and sheep in 1995 is estimated to have increased by 8.8, 9.5, 12.7 and 1.3% respectively over the livestock population in 1991 while the population of pigs decreased by 3.1%. The production of cross-bred cattle population to total cattle population in the state increased from 4.2% in 1991 to 5.0% in 1995. It was estimated that the live stock population in the State will reach 280 lakh by the year 2001 (not yet published though census completed).

3.11.2 In India there are 26 well defined breeds of cattle, 7 of buffaloes, 40 of sheep, 20 of goats, 4 of camels, 6 of horses, 3 of pigs and 18 of poultry (Acharya and Bhat, 1984). The recognised breeds constitute about 20% of total population. The rest of the animal have not been properly evaluated but they play an important role in the economy of rural population of the locality. Though there are very few recognised

breeds native to Orissa, there are several strains/types of different species of domestic animals and birds in different parts of the state under different names synonymous to the locality of their distribution. The vast diversity of genetic resources available among domestic animals of Orissa have considerable adaptability to the local geo-climatic conditions. The local strains are well known for their resistance to diseases, economic production and draught power.

3.11.3 Genetic up-gradation programme of the local breeds of domestic animals for improving milk and meat production during the last several decades has been undertaken without taking into account the conservation of local strains/ types of different domestic species. This has resulted in some degree of genetic erosion and is likely to threaten the long term viability of animal husbandry system existing in the state.

3.11.3 It is gratifying to note that attempts have been made by the Faculty of Veterinary Science and Animal Husbandry, Orissa University of Agriculture & Technology to study some of the available strains/types of domestic animals, native to Orissa particularly in cattle, buffalo, sheep and goat. Kornel Das (1999) has documented extensively the livestock and poultry genetic resources of south Orissa in his book titled "Livestock and Poultry Genetic Resources in Orissa".

3.11.4 **BUFFALO**

3.11.4.1 The domestic buffaloes are closely related to wild buffaloes, now in existence in certain forest areas of India. They are of two basic types i.e. riverine buffaloes and swamp buffaloes. The riverine buffaloes are found in India, Pakistan, Egypt and Mediterranean region and swamp buffaloes are found in south-east Asia. The buffaloes of Indian peninsula is further classified into 3 types.

1. Western type
2. Northern type
3. Southern, Central and Eastern type.

3.11.4.2 There are about 7 recognised breeds of buffaloes in India and none in Orissa. Cytological investigations with regard to buffalo population in Orissa revealed that there are two types of indigenous buffaloes existing in Orissa. One type possesses 50 chromosomes and the other type possesses 48 chromosomes. The local buffaloes of coastal Orissa (Cuttack, Balasore and parts of Puri, Ganjam and Dhenkanal districts) have $2n=48$ chromosomes. The buffaloes of other areas (Keonjhar, Phulbani, Kalahandi, Koraput, Sundargarh, Sambalpur and parts of Dhenkanal, Puri and Ganjam districts) have $2n=50$ chromosomes. These studies indicate that both riverine and swamp buffaloes are available in Orissa.

3.11.4.3 Orissa has a buffalo population of 1652050 heads. The contribution of milk from buffaloes is around 20% of the total milk production of the state. Buffaloes are reared in Orissa for dual purpose, milk production and draught power. Though there are no recognized breeds in Orissa, there are several strains/types of buffaloes distributed in different parts of the state under different names synonymous to the locality of their occurrence. They are known differently because of slight variation in physical characters due to their adaptation to the geo-climatic condition of the area of their occurrence. They are

1. Paralakhemundi
2. Manda
3. Jirangi
4. Kalahandi
5. Sambalpur
6. Kujang
7. Chilika

3.11.5 CATTLE

3.11.5.1 Cattle form the largest population amongst various species of domestic livestock available in the state. They are uniformly distributed all over the state contributing to the livelihood of the rural population. They are maintained for milk, draught power, organic manure and fuel purpose. Religious sentiments are intimately connected with cattle rearing.

3.11.5.2 There is no recognised breed of cattle in Orissa and majority of them are of non-descript type. However, there are different local strains/types of cattle named after the area of their distribution. The well known strains are

1. Binjharपुर
2. Ghumsari
3. Khariar
4. Mottu

3.11.6 GOAT

3.11.6.1 The Goat is usually reared by the assetless poor as a source of their livelihood in Orissa. These animals adapt well to all agro-climatic areas of the state. It is hardy, prolific breeder and can be reared without any investment in bushes, jungles and waste land existing around the villages. Goats are mostly used

for meat purpose in Orissa as people have a preferred taste for goat meat. However, some areas like Ganjam district, milk is also consumed by some sections of the population.

1. Ganjam
2. Bengal
3. Other local types

3.11.6.2 There are many other minor types/strains of goat which are also found in the state. They need detail study to establish their identity :

- (i) Malkangiri goat
- (ii) Raighar goat.
- (iii) Gunupur goat
- (iv) Narayanpatna goat
- (v) Hill goat of Koraput
- (vi) Gua or Kujibihana goat

3.11.7 SHEEP

3.11.7.1 Sheep are reared in Orissa by the rural poor mainly for mutton, as the climatic conditions i.e. high rainfall and high humidity are not conducive for rearing woolly variety of sheep. There are certain well known local types of sheep in the state which are as follows.

1. Ganjam
2. Bolangir
3. Dharmgarh
4. Koraput

3.11.8 PIGS

3.11.8.1 Pigs found in Orissa are primitive and non-descript type. Pig rearing is mostly confined to scheduled castes and scheduled tribes and is entirely based on scavenging. They are kept for meat purpose. However, few local types of pig from south Orissa have been reported. They are as follows :

Koraput Burudi
Pondi or Jhinga
Ganjam Village Gola

3.11.9 POULTRY

3.11.9.1 Over 82 percent of poultry bird population in Orissa are of non-descript (indigenous) type and are entirely raised on backyards of households. Though there are 18 recognised breeds of poultry in India, only

2 breeds are known to occur in Orissa. But there are several other local types/strains of poultry birds in the state.

Aseel

Naked Neck

Other local types of poultry birds

- (i) Kalahandi
- (ii) Vezaguda
- (iii) Dhinki

3.12 Biodiversity of fishes and aquatic fauna in Orissa state

3.12.1 The Wetland ecosystems of Orissa have represented by mostly the five important river systems besides vast 480 km long coastal and Chilika lagoons. These wetlands are ecologically very sensitive and biologically very rich. The fish fauna from these wetlands has been considered as the source of one of major livelihoods. It also earns a major chunk of revenue for the state.

3.12.2 Rivers not only have a variety of fish populations but are the agents of their dispersal to all communicable waters. Wetlands with their variable environment harbour and nurture these fishes in some form or other and maintain the diversity subject to a favourable situation in the water area. All the rivers mentioned above apart from carrying many species of fishes and their seed produce valuable spawn of Indian major carps. The percentage of the spawn of Indian Major Carps was between 80 to 90 per cent till 1970. With the percentage declining to less than 10% after 1970, the hormone breeding replaced collection of spawn from the rivers. This change has not affected the situation regarding the number of species but has placed carps in the list of threatened fishes.

3.12.3 As early as 1987 the National Agricultural Commission recommended stocking of the rivers. Riverine fisheries development is reportedly included in the Tenth Plan. Now Central Inland Capture Fisheries Research Institute (CICFRI) at barrackpore has developed technologies of bio-assays on the effect of industrial pollution on fishes. The only genetic information available is that the Mahanadi Stock of Rohi (*Labeo rohita*) is different from that of Ganga and Brahmaputra which have the same stock. Years back the fishermen themselves had voluntarily observed a close season for breeders in rivers during the monsoons. This has been abandoned. On the other hand, with the introduction of improved fishing gear there has been intense fishing activity and mass scale destruction of brood fish and juveniles all through the year

3.12.4 **Estuaries** carry a load of pollution from rivers but the major part comes from Industries releasing their effluents, some to the estuarine channels and others directly to the sea. Several pollution points have been identified by the Regional Research Laboratory (RRL) at Bhubaneswar. They are the estuary mouths of Mahanadi at Paradeep, Rusikulya in Ganjam, Brahmani, Baitarani, Budhabalanga stuaries and other creeks in Balasore district. In fact, the sea water of Paradeep coast was found to be totally unsuitably for the shrimp hatchery at Paradeep for breeding marine prawns. Mass kills of fish has been reported frequently from several places of all types of waters but seems to have come down lately apparently due to the efforts of the State Pollution Control Board. The Central Pollution Control Board has proposed criteria for fisheries with respect to five critical parameters for fish life. But the maximum damage by pollution in rivers has been wholesale destruction of fish spawn which are much more delicate than fish. A separate criteria is required for the spawn of fishes breeding in the rivers. This needs close collaboration of the State Fisheries Department with the State Pollution Board.

3.12.5 **Reservoir** : After the decline of riverine fisheries, reservoirs came into focus for fish production purposes. This was initiated in Orissa in 1986-87 and reportedly every year one thousand hectares of reservoir area are being stocked with carp fingerlings. Reservoirs may be called the store house of diverse fishes, some of which enter from rivers and some breed in reservoir itself. Hirakud the largest reservoir in Orissa, followed the usual pattern that is low trophic level then by a high one finally remaining in a plateau. Initially the catfishes almost disappeared probably due to certain change in water pressure. A large nursery farm for carps had been prepared before impoundment and stocking with carp seeds had been started soon after. Trophic level being low, growth of carps was not satisfactory. Detailed survey of the bed right up to the source indicated a number of species having their own niches both for feeding and breeding. The present trend shows that carp production as in case of rivers has declined progressively. As has been pointed out, this is a warning that depletion of carp stock below a certain level would render them to be classified as endangered species.

3.12.5.1 The situation in Hirakud is that after it was declared a free fishing area, intensity of fishing has caused depletion and it has not been possible to take up management. There is a Research station reported to be functioning at Hirakud. *Interference in regulating management of the fish population in all capture fisheries like rivers, reservoirs, open estuarine waters, lakes and coastal area is necessary. It raises a question whether Government can impose conservation regulations in an area declared to be free for fishing or permanent fishing rights have been given on fixed terms.* There has been no enumeration of species of fish in the reservoirs.

3.12.6 **Swampy and derelict fresh and brackish water wetlands**: It has been estimated that about 2,60,000 ha of fresh water swampy lands and 30,000 ha. Of brackish water swamps are available for development. On an extensive survey of some of these swampy areas in undivided Cuttack and Puri Districts, the Co-ordinator has opined that about 40% can be used for fish culture. The rest can harbor diverse species. The idea of combining fish culture with conservation of bio diversity is not new to Orissa. As early as 1958 one square mile of deeply silted swamp was economically reclaimed by developing a new technique of construction of fishery tanks on deeply silted land without using piles. This reduced the capital cost to 10% of the estimate with piles and a farm could be created with nurseries etc but a terminal channel of a width of 300' and length of 3000' with connection to the Daya river was kept to receive all types of spawn from the river and maintain diversity mainly for the purpose of studying their reaction with the major carps.

3.12.7 **Coastal belt and estuaries**: 480 kilometres of coastline has varied environments. These are depositional beaches with heavy minerals, non-vegetated wetlands, mangroves and lagoons. Three zones may be considered as ecosystems namely sandy beach areas, river mouths and mangrove belts. The Orissa coast is prone to cyclones, which makes important changes to the environment for a short period. There are also problems created by fishing harbors with pollution from the power vessels, facilities for defense testing, urban development and shrimp culture. Mariculture and culture of seaweed have not yet been started in Orissa. Mangroves with rich tropic zones and breeding grounds of several species of fish and shellfish occupied a substantial portion of coastline, but have been depleted to an appreciable extent. Replanting has been in progress.

3.12.7.1 Estuarine waters are reported to have the maximum number of fish species but census of the same is not available for Orissa. Shrimp farming has been taken up in Orissa by means of leases of mangrove area taken from the Zamindars. Mangroves have been destroyed with impunity and mostly converted to paddy fields and shrimp farms. In Balasore district shrimp farmers have used the land bordering the coastal canal up to the tidal zone resulting biodegradation of the paddy fields. Construction of bundles across creeks for shrimp culture has resulted in heavy silting of the channels. Estimators use local names of fishes in collection of statistics of the coastal catches. Fisherman often uses the same local name for different species and even genera. The enumerators need training in Taxonomy of the coastal fishes. Some guidelines are available from the Andhra coast and the Hooghly estuary from which a tentative list of species likely to occur in the estuaries and the coastal waters can be prepared.

3.12.8. **Chilika lagoon:** It has been reported that around 158 species of fish fauna have now been identified. Until genotypes are studied it will be difficult to know the exact number of species. The census of the fish population of the lake was taken decades back and without a fresh enumeration and it is, therefore, not possible to assess the current situation re extinct or endangered species. However, the active programme of the Chilika Development Authority (CDA) in increasing salinity and maintaining the mouth is reported to have brought back some of the migratory species from the sea. Chilika presents a unique challenge to Management in that it has not only to protect the environment, encourage more migrations of birds, conserve species of fish fauna and aquatic animals, and increase production beyond the average of 4000 MT per annum to improve the economic condition of the growing number of fishermen. Each is an ecosystem by itself and only planning on that basis will be fruitful. Several scientists have warned that any activity aimed at one direction may cause incalculable harm to others.

3.12.9 **Endangered species :** P. Das, retired Director of the National Bureau of Fish Genetic Resources (NBFGR, est, 1983) has stated in 1999 that out of 79 species tested 4 were endangered, 21 vulnerable, 2 rare, and 52 were indeterminate. The NBFGR is conducting surveys mainly in the riverine areas enumeration of fish genetic resources but the progress has not been rapid as the institute does all the samplings by itself. At this rate preparation of a census of fish genetic resources for India will be delayed so much as to make the whole exercise infructuous. In another report from Chidambaram (1999) the red book maintained by ICUN reports that out of 327 species of freshwater fish sampled as many as 98 were endangered and 82 vulnerable. Pollution combined with intensive fishing must have been responsible for extinction or placing on the danger list substantial percentage of fish species, not yet quantitatively estimated. All this clearly point out to the fact that the percentage of fish species endangered is quite high which does not seem to have been apprehended so far. Apart from the need to maintain diversity for the very survival of a bio-population through the ages, more information is coming in regarding therapeutic use of fishes (gall bladder of Rohu used in Orissa) and allied animals. The very fact that fishes appeared in the scene of life early and has survived so many catastrophes makes the genetic material valuable for future use.

3.13 Women and Biodiversity

3.13.1 The close association of women and natural resources is valid more in the rural context, where because of socio-economic roles through generations women are required to provide food, water, fuel, fodder and income from the surrounding biodiversity base. Fulfillment of these goals has given them a special understanding of natural resources and led them to adopt more biodiversity conscious attitude. This has been enforced repeatedly during public hearing programmes at different regions during 2001 by the rural women, who have been concerned with the degradation of biodiversity resulting in interference with women's responsibilities towards domestic sphere. This has been affecting them both physically and psychologically. The women linkages and their development with biodiversity locally can be summarized in following hierarchy –

- Performance of specific tasks over several years
- Knowledge base and skills of natural resource management,
- Better managers of natural resources,
- Sensitive attitude towards biodiversity and environment,
- High ecological consciousness.

3.14 ECOREGIONS

3.14.1 A list of ecologically important areas has been given at Annexure 3.2 in brief detailing about the local community involvement in conservation and about their biodiversity richness. The important eco-regions identified to be included for biodiversity strategy and action plans at regional level are included here, though specific study and reporting under this programme had not been taken up. Only two regions of importance one from terrestrial ecosystem point of view (for Mahendragiri) and other from aquatic ecosystem point of view (Chilika Lake) have been two ecoregions for which documentations have been taken up by the Orissa Environment Society and Chilka Development Authority respectively.

3.20.2 MAHENDRAGIRI: THE PRIDE OF EASTERN GHATS IN ORISSA

3.20.2.1 The Mahendragiri-Devagiri-Singaraz region in the southern reach of the Eastern ghats of Orissa is an unique micro-environmental region of tropical deciduous vegetation in the Parlakhemundi sub-division of Ganjam district of Orissa (see Fig. 3.2). The region has a diverse variety of tropical flora and fauna besides its historical and archaeological significance . But, however, with the characteristics of the agricultural negativity, the very location of this sparsely populate micro-region close to a densely populated historically significant seat of Gajapati Kingdom of Parlakhemundi have provided a paradoxical situation of spatial interaction to this region. The aboriginal tribal settlers (Sauras of the region) and infiltrating population of the adjacent areas have plundered the tropical forests and cleared the hill-slopes for shifting and terrace cultivation and other economic activities. Such activities are a threat to its environment and the eco-system. Over the years due to man's activities it has been transformed from a dense tropical semi-evergreen forest to a shrubby and bushy forest. In view of these facts, an attempt is being made to present a broad geographic information on this micro-environmental region which will be of great help in formulating the planning and management strategies for conservation of its biotic diversity, historical antiquity and archaeological monuments. The mountains abound in the area as can be seen in Box 3.8 below.

Box 3.8 Important Mountain Peaks of the Mahendragiri System

Sl.No.	Name	Relative Location	Altitude in M.
1	Somgaraz Parbat	To the north of Mahendragiri hills	1,516
2.	Mahendragiri	To the north-east of Koinpur near Burikhatta pass	1,501
3.	Devagiri	Near Ajoyagad to the south of Gumma	1,382
4.	Badadeba	To the east of Ramagiri-Udayagiri	1,364

5.	Idongiri	To the west of Mahendragiri & north of Koinpur	1,323
6.	Luaba Hill	To the southeast of R.Udayagiri	1,260
7.	Seranga Hill	To the north of Seranga	1,150
8.	Gumma Hill	To the south-east of Gumma	1,094

3.20.2.2 Natural Vegetation : This region provides the tropical example of a tropical deciduous forest with the predominant species of sal (*Shorea robusta*) in association with bamboo and kusum. But gradually on the higher hill slopes the dry deciduous character merges with the tropical semi-evergreen species. This is associated with the thick undergrowth of evergreen species and deciduous upper canopy with the absence of bamboo. The cool climate of the high mountain peaks represent a transitional character to the tropical environment and provides an ideal condition for association of the tropical and high altitude floral characteristics. The clearing of the virgin forests and rampant shifting cultivation by the tribals of the area have degraded the forest environment of this region to great extent.

3.20.2.3 This region which was once a territory of the elephants has shrunk to a smaller area around Gandahatti Reserved Forest. Hence this region which has all the potentialities of an environmental entity should be developed through the measures of conservation into a National Park, Elephant Reserve or Biosphere Reserve. The strategy of environmental management of this region should also look into the economic rehabilitation of the tribals who are solely depending on the forests for their livelihood, failing which the region will face fast decadence.

3.20.2.4 **Phytogeography** : The flora of Mahendragiri is quite interesting because its subtropical climate has favoured the development of some temperate taxa. Several species of the lower Himalayas and the south Indian mountains make their presence in mahendragiri, thereby indicating that these hills form an intermediate step for the migration of species from lower Himalayas to South Indian mountains and/or vice versa.

3.20.2.4.1 The characteristic Himalayan species occurring on Mahendragiri are : *Maoutia puya*, *Viola serpens*, *V.betonicalycina*, *Clematis roylei*, *Rhamnus nepalensis*, *anotis calycina*, *ajuga macrosperma*, *thalictrum foliososum*, *Rbus ellipticus*, *rubia cordifolia*, *Sarcococca trinervia*, *Zanthoxylum armatum*, *Ophiopogon intermedius*, etc. The important South Indian species represented in these hills are : *Tephrosia roxburghiana*, *Sida rhombifolia ssp. Retusa*, *Toddalia asiatica*, var. *obtusifolia*, *Sophora interrupta*, *Wendlandia gamblei*, *Pavetta brevifolia*, *Anaphalis lawii*, *Senecio candicans*, *Diospyros candolleana*, *Peperomia portulacoides*, *Neolitsea zeylanica*, *Molineria finlaysonianana*, *Clausena heptaphylla*, etc.

3.20.2.4.2 It is curious to note the presence of some Assam species, such as *Syzygium cuneatum*, *Linociera macrophylla*, *Litsea laeta*, etc. and some species f of Burma and Java, such as *Psychotria fulva* Ham. *Ophiorhiza trichocarpa* Bl. etc. on Mahendragiri in spite of the general preponderance of south Indian taxa.

3.20.2.4.3 The forests of the hill range are unique due to their ecological relevance, genetic diversity and they harbour both Himalayan and Nilgiri flora. The vegetation of the area is under tremendous pressure due to over-exploitation and the wasteful practice of shifting cultivation. Therefore, a broad stratification of vegetation classes is made in order to provide basic information (see Box 3.9 below) required for planning and protection of this environmentally endangered area. Mahendragiri hill range is bestowed with 703.67 sq km of forest land (including grass lands), representing 69.08% of the total geographical area. The central part of the hills is dominated by dense wooded forests covering 11.49% of the total area. Open forest covers the maximum area (76.38%) of the forested land and it is 52.80% of the total geographical area. The scrubjungle and grasslands occupy 4.28% and 0.51% of the total area respectively. The non-forests occupy 30.92% of the geographical area, out of which the forest blank, shifting cultivation and barren rocky area account for 0.17%, 0.16% and 0.41% respectively. Agriculture land, covering mainly the southern and northern parts of the

region, occupies 29.73%. Other non-forest landuses which include settlements and water-bodies spread respectively over 0.30% and 0.15% of the total geographical area.

3.20.2.4.4 The vegetation of Mahendragiri hills belongs to northern tropical deciduous forest intermediate between dry and moist types, (Champion and Seth, 1968), *Shorea Terminalia-Adina* series (Legris and Meher-Homji,1982).

3.20.2.5 **Flora** : Total number of angiosperm species reported from Bihar and Orissa by Haines (1921-25), Mooney (1950) and Panigrahi et al. (1964) is 2,730. Therefore the record of 640 species from Mahendragiri hill only is interesting, as it accounts for more than 23% of the flora of Bihar and Orissa and about 35% of the flora of present Orissa State (see Box 3.10).

3.20.2.6 **Closed Forest** : This type of forest is predominant in the valleys and hill slopes. The Mahendragiri, Indongiri and Singaraj hill complex forming a continuous belt present the physiognomy of closed dense forest. Tangiri hill and other few areas along streams belong to this kind of forest cover. Here the vegetation density is more than 40 per cent canopy cover. The pure Sal community may be as high as 60-70 per cent. It gains dominance over the other miscellaneous species, and ascends even to the tops of high hills. Sal forests occurring close to the moist valleys come under the tropical moist deciduous forests. Three distinct storeys are recognized.

Box 3.9 Area distribution of various landuse/vegetation types

Landuse/vegetation types	Area in sq km.	% of total geographical area
Forest		
1. Closed forest	117.00	11.49
2. Open forest	537.87	52.80
3. Scrub land	43.62	4.28
4. Grass land	5.18	0.51
Total	703.67	69.08
Non -forest		
1. Forest blank	1.75	0.17
2. Shifting cultivation	1.68	0.16
3. Barren rocky area	4.18	0.41
4. Agriculture land	302.81	29.73
5. Settlements	3.06	0.30
6. Water body	1.56	0.15
Total	315.04	30.92
Grand Total	1018.71	100.00

Box 3.10 Flora of Mahendragiri

CLASS	Families	General	Species
GYMNOSPERMAE	2	2	2
ANGIOSPERMAE :			
DICOTYLEDONAE	99	359	516
MONOCOTYLEDONAE	17	86	124

TOTAL	118	447	642
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3.20.2.6.1 Plants like *Shorea robusta*, *Terminalia alata*, *T. arjuna*, *Haldina cordifolia*, *Pterocarpus marsupium*, *Madhuca longifolia*, *Dalbergia latifolia*, *Anogeissus latifolia*, etc. form the luxuriant tree cover of the top storey. It is more closed and has a maximum height of 25-30 m. The middle storey is composed of small trees or large shrubs like *Cassia fistula*, *Embllica officinalis*, *Semecarpus anacardium*, *Lagerstroemia parviflora*, *Bauhinia racemosa*, *ardisia solanacea* and few others which attain 6-8m height. The undergrowth is formed of shrubs, undershrubs and climbers of which *Indigofera cassioides*, *Ixora arborea*, *Carissa spinarum*, *Bauhinia vahlii*, *Milletia auriculata*, *Dioscorea wallichii*, *Combretum roxburghii* are of profuse occurrence.

3.20.2.7 Open Forest : The greater part of the region is under this type of forest. The steeper drier slopes and places at lower elevations are occupied by this type of forest. The canopy cover is less dense, i.e, below 40 per cent. The floristic composition remains more or less same as that of closed forest. The physiognomy is the result of the degradation of the dense forest. Only two strata can be distinguished; (1) a continuous under-growth of shrubs in association with climbers, and (2) emergence of tall trees at a distance from each other.

3.20.2.8 Scrub Forest : In foot-hills and other places, the forest cover has been subjected to human interferences of several categories and magnitudes, as a result of which the natural vegetation has changed drastically to form scrub jungle. Thorny shrubs and coppice shoots of unarmed trees occur in the thicket. The canopy cover is less than 10 per cent and the plants reach a maximum height of 4 meters. Species like *Casearia elliptica*, *Ziziphus mauritiana*, *Woodfordia fruticosa*, *Holarrhena pubescens*, *flacourtia indica*, *Capparis brevispina*, *Maytenus emerginatus*, *Dendrocalamus strictus* are the notable components frequently met with in such localities.

3.20.2.9 Grasslands : The uppermost slopes and their adjacent flat-summits of Mahendragiri and singaraj hills are bare and open lands clothed with natural grass cover. The vegetation of this altitude (above 1300 m) consists of grassy mountain meadows interspersed with very few thorny scrubs. The grasses like *Themeda triandra*, *Aristida adscensionis*, *Cymbopogon martini*, *Apluda mutica*, *Eragrostis ciliaris*, *E.uniloides*, *Dichanthium pertusum*, *Ishaemum rugosum*, *Arthraxon lancifolius* and *Pennisetum setosum* are notable in respect of their abundance. With the approach of monsoon the grasses form a cover of variable size. During summer the habitat becomes more xeric resulting in unfavourable growth conditions.

3.20.2.10 Forest Blanks : These are the openings within the forest areas generally devoid of any vegetation and comprise rocky outcrops, precipitous slopes, slips, excavated lands, etc.

3.20.2.11 Shifting Cultivation : The tribals predominantly Sauras, Khonds and Pulians living on the hill slopes follow slash and burn technique, which is locally called 'Podu'. It is one of the most prevalent forms of agriculture. It is variously named as Swidden cultivation, Jhum cultivation, forest fallow cultivation, etc. In extreme cases due to pernicious practice of shifting cultivation the vegetation has been completely vanished causing exposure of soil and erosion thereby creating barren lands. In these areas the tribals use a number of crops such as *Panicum miliare* (little millet), *P.miliaceous* (common mallet, O-Kangu), *Guizotia abyssinica* (Niger, O-Asi), *Pennisetum typhoides* (spiked millet), etc.

3.20.2.12 Barren rocky/ stony waste : These are the rock exposures of varying lithology often barren and devoid of soil cover and vegetation. They mostly occur in hill peaks and upper slopes as openings and isolated exposures of loose fragments of boulders, pebbles and sheet rocks.

3.20.2.13 Agriculture Land : These are the cultivated lands basically used for production of food especially cereal crops. These are found in plains and near the settlements.

3.20.3 GANDHAMARDAN

3.20.3.1 The Gandhamardan range bordering Bargarh and Bolangir Districts contains a broken mountain system. The range are delimited by Borasambar, Malda, Paikmal and Manbhanga in the north and Amarakhol- Batipathar- Brahmini- Harishankar and Chandil in the south. It comprises of low undulating hills and valleys ranging from 2020m to 1060m, the highest at “Satyamba Pat”. The area enjoys a typical monsoon climate with 1250-1500mm at Borasambar (Bargarh) and 2200 mm at Harishankar (Bolangir). The maximum temperature and relative humidity are about 40° c and 80% respectively. Gandhamardan is believed to be part of mythical hill that ‘Hanuman’ carried is also called ‘Ayurved’d Paradise’. Rich in biodiversity and bauxite, the hills have growth of rare medicinal plants that are slowly vanishing. In recent past it was a center of people’s struggle to conserve forests and livelihood, which led to BALCO to abandon its operation to mine 213 million tones of bauxite.

3.20.3.2 Vegetation : Four different types of vegetation between foot hills (30m) and the flat pat (1000m), are met with. The dry deciduous type forests characterizes the plains and the foot-hills and bamboo forests ascend upto 700m. The high altitudes from 700-900m, present evergreen forests.

1. Tropical dry deciduous forest : The exposed hills near Harishankar and low hills of Malda and Batipathar are secondary type due to human interference. ‘Sal’ is associated with various other species of ‘Asan’, ‘Bija’, ‘Mahua’, ‘Dhaura’, ‘Bheru’, ‘Khaira’ and ‘Karda’ with a shub layer of *Zizyphus Grewia* etc. The middle layer often presents a tangled mass with twining stems of lianes and climbers comprising of *Mucuna*, *Cissus*, *Dioscorea* etc.
2. Bamboo Forest : From the base of the hills up to 700m., the dominant bamboo *Dendracalamas strictus* forms a consocieties with a few deciduous elements like ‘Sal’, ‘Bija’, ‘Asan’, etc. The middle storey comprises of a shrubby layer with *Hollarrhena antidysenterica* and *Helicteres isora* where as the ground layer comprises mainly of *Trimfetta pilosa*, *Curculigo orchioides*, *Asparagus racemosus* etc.
3. Semi-evergreen Forest: The high altitudes between 700-900m, as also the valley in Batipathar- Amarakhol-Borasambar-Kapildhar areas present the physiognomy of tropical semi-evergreen type with thick growth of lianes covering the trees having buttressed trunks. The chief tree components of this formation are *Diospyros macrophylla*, (Mankada Kendu-Oriya), *Mangifera indica* (wild mango), *Careya arborea*, *Astonia scholaris* mixed with *Murraya paniculata*, *Ardisia solanace* etc., among the climbers. It occurs all along the course of streams up to the highest altitude (900m). The highest reach of Gandhamardan is a flat plain of about 3Km. broad at Satyamba Pat. This is covered by reddish brown lateritic caps and ferruginous clays. *Cymbipogon martinii* (Roshha grass) occurs here on the ‘Pat’ which is commercially used as raw material for the famous essential oil ‘Roshha grass oil’. Geraniol, the principal constituent of this oil is used in blending perfumes to soaps and other products.

3.20.3.3 Several epiphytic orchids like *Dendrobium herbaceum*, *Aerides maculosa* and terrestrial orchids like *Euloophia ochreata*, *Nervilia crocififormis*, *N.plicata* and *Seidenfia rheedii* have been recorded from this range. *Euloophia ochreata*, a ground orchid growing as under growth among shrubs in moist soil, is represented in Orissa only from this locality and therefore its habitats should be protected.

3.20.3.4 Grass lands : The extensive flat plateau running through the whole length of the Gandhamardan range presents a grassland formation with luxuriant growth of various grass species attaining a

height of 2-3m. At several places exposed haemitite rock surface with hardly any soil cover are met which are inhabited by varieties of stunted grasses used for filling mattresses etc.

3.20.3.5 The low foothills are denuded of forest species and are made up with alluvial soils. These are covered by species of *Pogostemon*, *Brachiaria*, *Dicanthium* etc. Several weeds like *Gelosia argentea* (introduced) pose great nuisance in the abandoned fields. The low lying lands comprise of tanks, ditches and swamps and are characterized by a community of hydrophytic species in the Permanent pools or swamps and hygrophytic flora in the borders of pools and dried up muddy places.

3.20.3.6 The forests of Gandhamardan hills possess a diversified floristic composition and vast economic potential. The Gandhamardan Hill range is one of India's richest biodiversity reserves for medicinal plants. Recurrent drought, illegal felling of trees, exploitation of forest resources and faulty methods of harvesting medicinal plants have been taking their toll on biodiversity despite its abundant water resources. In winter, nomadic communities from Rajasthan drive thousands of goats, sheep and camels to Gandhamardan for grazing, thereby causing harm to its sensitive ecology. The BSI has reported existence 220 species of medicinal plants. In the past few decades the vegetation picture of the hills has undergone considerable changes due to deforestation consequent upon pressure of urbanization. Recently ecological status study of the area has been undertaken through remote sensing technique (Mishra, R.C. & G.C.Behera, 1998). They have identified 3 broad areas.

- A Eco-Sound areas (>40% canopy). This includes the (i) Semi-evergreen forest (6.47%), (ii) Mixed dry deciduous dense forest 26.19%), (iii) Bamboo forest (5.02%)
- B Eco-Sensitive areas (<40% canopy). This includes the (i) Mixed dry deciduous open forest (15.9%), (ii) The shrub-wood land (22.13%).
- C Eco-Fragile areas. This includes- (i) Open scrub (21.41%), (ii) Grass land (2.24%) (iii) Plantation and orchids (0.51%) and forest blank (0.12%)

3.20.3.7 The study recommends urgent need for preservation/conservation of natural habitats of eco-sound zones and provides information for planning future reforestation of eco-sensitive and eco-fragile areas. In light of this the area should immediately be brought under the protected areas in Orissa (see Fig 3.3). Such is the richness in medicinal plants that more than 100 local practitioners flourish in the region providing ethnomedicine to about 50,000 tribals. This also helps as laboratory to two Ayurvedic Colleges located in Bargarh and Bolangir districts.

3.20.4. PRADHANPAT

3.20.4.1 The Pradhanpat Reserved Forest is situated in the Deogarh District near the Deogarh town, being adjacent to its northern fringe(this also forms the part of Deogarh District's Biodiversity Strategy and Action Plan proposed for with projects to be undertaken). This was notified as Reserved Forests(RF) in the pre-independence period by the ruler of Bamara estate in 1926-1927. At present it covers a total area of 103.861 sq.kms. The proposal for declaration of Pradhanpat as a wildlife sanctuary, under the provision of the Wild Life Protection Act, 1972 is under process (see Fig 3.4) . The whole area is a hilly terrain interspaced by valleys, and where in between valleys large chunks of plain lands are also available. There are four revenue villages namely Nalabandha, Koidonta, Betei and Chingudijharan inside the RF. There are 14 perennial streams in the RF. The general height of the area is 270m from the mean sea level. The highest peak is "Kaidonta" located at a height of 801m. from mean seas level. The rock system belongs to the Archean era. The area receives an average annual rainfall of 1500 to 1600 mm. The mean average maximum temperature is 42° C and the mean average temperature is 22° C.

3.20.4.2 Pradhanpat is a thickly wooded hill block with considerable stretches of plains in between valleys. The foothills and the plains are comparatively more thickly wooded that the slopes and the ridges and comes under the forest type of Tropical dry deciduous to Tropical moist deciduous. The vegetation contains trees, herbs, shrubs, grasses, climbers etc. with sporadic patches of Salia bamboo,. Sal trees are found in abundance. Also found are the Bija, Asan, Dhaura, Kendu, Bandhan, Bheru, Mundi, Gambhar, Mango, Semul, Tamarind, Sidha, Karada, Rohini, Dhoben, Sisoo, Siris etc. Medicinal plant like Asoka, Vasanga, Harida, Bahada, Amla, Khaira, Agnijhal, Purang, Sunari, Girdhini, Paldhua, Tinospora etc. are also found. Once not long back, Pradhanpat supported a good deal of fauna. But now due to retrogression the population has decreased. Still if care is taken the fauna population can be rehabilitated within short period. The following species are found in the Pradhanpat Reserve Forests.

- A) Mammals like elephants, spotted deer, sambar, barking deer, blue bill, mouse deer, tiger, bear, leopard, hyena, wolf, fox, jungle cat, wild dog, ratel, monkeys, wild boars, squirrels.
- B) Reptiles like pangolin, snake, chameleon etc.
- C) Birds like cuckoo, fowls, peacocks, hornbill, cranes, doves, sparrows, woodpecker, vultures etc.

3.20.4.3 The Gaint Flying Squirrel is found at Pradhanpat and if one is really lucky they will be treated to such a sight. There are some other places of nature which are worth mentioning. They are :

Pradhanpat Waterfall: It is situated at a distance of 2 kms, north of Deogarh town. The water falls down from a height of 323 m. in a straight stream. There is a small cave here. The waterfall,. The sights of the hill, stream and natural beauty of the place makes it aesthetically unique.

Kurodhot : Situated at a distance of 4 kms from Deogarh town, it is a perennial stream, emerging out of the saddle and valley arrangement of Pradhanpat hill block. It is of historical importance because it is believed that hydroelectricity was generated from the perennial stream in the Darbar period, which was the first of its kind in India.

Kailash: It is the right place where the beauty of Pradhanpat hills can be enjoyed and the eventual watching of wild life can be done. There is an old bungalow of the Darbar period constructed in Chinese art. Presently the bungalow is in a dilapidated condition but still its balcony provides an excellent lookout for wild life, with a perennial stream nearby.

Koidanta: This is by far the best location in the sanctuary for watching wildlife as there is a water hole which is frequently visited by the wild life, during summer, for drinking and cooling off. In the Darbar period this place was considered as an excellent spot for game hunting due to its unique location.

3.20.5 MALYAGIRI

3.20.5.1 Malyagiri Reserved Forest Block is located in the Pallahara Sub-division of Angul district. It was declared a Reserved Forest during the pre-independence period, on 14th May 1906, originally occupying an area of 11,913 ha and on subsequent de-reservations the present area comes to 11,432.3 ha (approximately 114.323 sq.kms). Under the administrative control of the Pallahara Range under Deogarh Forest Division, the proposal for declaration of Malyagiri as “Wild Life sanctuary” under provision of Wild Life Protection Act 1972 is under process (see Fig 3.5).

3.20.5.2 The whole area is picturesque, with undulating hills interspersed with small plains and winding strips of valleys. These hills are North-East group of hills which is an extension of Bhuiyanpirah region of Keonjhar. The hills are rocky with steep slopes, which are thickly wooded and ragged. The Malayagiri hills run over a distance of about 22 Kms in the North-east direction, the highest point being 1187.18 m above mean sea level. There are quite a few perennial streams in this hilly tract and a number of which are a great necessity for the wildlife. The rock system of Malayagiri belong to the Archean era and are largely of Quartz-schist and Lateritic.

3.20.5.3 The flora of Malayagiri, comprises mostly of trees, shrubs and herbs bearing the characteristic of high forests. The forest is partly of the moist mixed deciduous and partly of the dry deciduous type. The vegetation is tropical, varying with the ground configuration and the quality of vegetation also exhibits marked local variations. Irrespective of this the most predominant species is ‘sal’ which is found all over Malayagiri except for small patches of bamboo and some trees of the moist, mixed deciduous type. The other species found here are : Gambhar, asan, Sisoo, Bija, Dhaura, Mahul, Mendu, Bandhan, Dhoben, Karda etc. there are two to three patches of *Mesua fera* (Nageswar) forest, in the reserve forest which are of floral and some trees of the moist deciduous type. The other species found here are: interest. There are also a number of species of plants of medicinal interest like *Rawolfia*, gymnema, Satabari, chereita etc. The wildlife is varied, and it ranges from cats to reptiles, ungulates, apes etc., because of the suitable habitat conditions. The presence of a large number of hill Mynas is one of the major attractions. Broadly one can encounter the following animals like the elephant, tiger, leopard, wild boar, pangolin, bear, giant squirrel, sambar, barking deer, spotted deer, ratel, hyena, porcupine, fox, monkey, rat, bison, wild dog and hares. In addition to the above species reptiles like

snakes (python, vipers, cobra, kraits etc.), chameleon, monitors etc and birds like peacock, jungle fowl, wood pecker, jungle myna, babbler, blue jay etc are seen.

3.20.5.4 Some other places of interest inside Malayagiri which are worth mentioning are:

Khuludi a site of historical importance. A temple dedicated to Lord Shiva with a perennial stream with a beautiful waterfall is the major attraction of the spot. The place also has aesthetic importance. A fair is celebrated in the month of January-February every year. Khuludi is approachable from the Pallahara side, as it is located at a distance of 18 km. But there is no common mode of public transport.

Jamara: A Hot Water spring compounded with the scenic beauty of nature spread all around you makes it a spot worth visiting. This site is located at a distance of 12 km from Pallahara, and is one the route to Khuludi.

Nageswar plantation: Patches of Nageswar trees. In the innermost point of Malayagiri, is of interest from the academic point of view, as this is an uncommon type of vegetation in this region. This spot is located at a distance of 2 to 3 Kms from Khuludi on top of the hill.

3.20.6 CHILIKA LAKE

3.20.6.1 Chilika, the largest brackish water lagoon in India is a hot spot of biodiversity. The lagoon is on the terminus of the migratory flyways and is the habitat for the largest congregation of aquatic birds in India. Chilika hosts approximately 160 species of birds during peak migratory seasons of which 97 are intercontinental migrants. Irrawady dolphin is an elusive species found in various parts of the Chilika Lagoon. The unique spatial and temporal salinity gradient gives rise to a multitude of niches inhabited by large diversity of plant and animal species. Chilika Lagoon is extremely important to local inhabitants and provides fish, fodder and fuel. About 70% of this population depends upon fishing as the only means of livelihood. Fisheries directly support a population of 127,000 people, while associated industries and marketing operations support at least another 50,000. In addition, over 50,000 cattle graze in and around the lagoon. The biodiversity aspects and conservation aspects have been placed in details at Annexure 3.7.

3.20.6.2 Biodiversity in Abstract

A home of Migratory and Resident Birds	–	167 species (both aquatic and terrestrial)
Fishes	-	225 species
Animal life	–	> 800 species Rare and endangered species of Barakudia limbless Skink and Irrawady Dolphin
Flowering plants	-	706 species Including 9 endemic species

3.20.6.3 The increasing human population and diversification of their activities coupled with natural factors have led to the following changes in biodiversity of Chilika Lagoon

- Changes in fish diversity and yield due to overexploitation, conversion to prawn culture and changes in hydrological regimes.
- Decrease in bird diversity and population of migratory waterfowl due to poaching and habitat destruction.
- Decrease in faunal diversity and disappearance of sensitive species.
- Drastic reduction in the migratory fish species such as *Hilsa ilisha*
- Enhancement of freshwater weeds and changes in floristic composition

3.20.6.4 Realizing the problems of Chilika Lagoon, the Government of Orissa has undertaken several measures for management of the lagoon ecosystem. The opening of a new mouth though has brought fresh hopes to the people through enhancement of fish yield and increase in their incomes but the benefits from the restoration measures is organically linked with involvement of communities in planning and management, optimizing hydrological regimes, habitat restoration, sustainable resource and overall institutional development.

Chapter 4

Policy and Programmes concerning Biodiversity

4.0 Background

For addressing the issues of environment and development holistically, a mix of interventions are required. They may be policies, programmes and action plans. Some aspects require legislative measures. Government of India in Ministry of Environment and Forests has enunciated several policy measures _

National Conservation Strategy and the Policy statement on Environment and Development
National Forest Policy, 1998,
Policy Statement on Abatement of Pollution, 1992

4.1 The Wildlife (Protection) Act, 1972 has substantially helped to save many threatened species and habitats. Legislation has to take care of both sides of biodiversity conservation and livelihood security. They provide a mechanism and a framework for conservation of biodiversity, sustainable use of its components and equitable sharing of benefits arising out of its use. Activities related to biodiversity conservation within the country have international ramifications. The Government of India has introduced the Biodiversity Bill in the Lok Sabha on the 15th May, 2000. The Biological Diversity Bill seeks to implement the principles (See Box 4.1) of the Biodiversity Convention through domestic law. The three objectives of CBD are : a) Conservation of Biological Diversity, b) Sustainable use of components of biological diversity, c) fair and equitable sharing of benefits arising out of the utilization of genetic resources. The focus of the proposed Biological Diversity Bill is “ to access to genetic resources and associated knowledge by foreign individuals, institutions of companies, so as to ensure equitable sharing of benefits arising out of the use of such resources and knowledge to the country and the people”.

4.1.1 India is a member of the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) of the World Trade Organisation (WTO) and the Convention on Biological Diversity (CBD). It is seeking to implement its obligations concerning these two agreements and bills have been introduced. The Parliament has finally passed the Plant Variety Protection and Farmers' Rights Act, 2001 and Patents (Amendment) Act 2001. TRIPS which deals with the protection of new plant varieties, offers three options. Protection will have to be granted by a patent, an effective *sui generis* system or by combination of both. Thus India has put in place a law to grant Plant breeders' Rights on new varieties of seeds for the first time. It has simultaneously provided a Farmers Right. The amendment to Patents act relate to regulation of patent agents, introduction of prescribed patent forms for compliance and general streamlining of patent processes.

4.1.2 All the above legislations have their own distinct focus but they share in common an attempt to define property rights over biological resources (real property rights) and property rights over knowledge or inventions related to biodiversity (intellectual property rights). The allocation of real and intellectual property rights over biological resources has become an important issue both in India and abroad recently. This is

linked to increasing concerns over the conservation of biological and genetic resources and to increasing economic values to these resources. On the whole, the current international legal framework favours the appropriation of biological resources and related knowledge through sovereign rights and private property rights. It is encouraging

Box 4.1- Actions from the Convention on Biological Diversity

<p>Article 1-5 Deal with objectives, use of terms, principle, scope and co-operation.</p> <p>Article 6 Preparation of country study/status report. Review of policy, legislation and institutional framework through widespread consultations, so as to ensure strengthening of ongoing activities of conservation and sustainable use and their integration with sectoral and cross-sectoral plans and programmes.</p> <p>Article 7 Identification of gaps in survey, identification, monitoring and characterization of floral and faunal resources presently being done, and accordingly strengthen these efforts.</p> <p>Article 8 Examination of issues related to selection, establishment and management of protected area in order to identify the gaps <i>in situ</i> conservation and taking up of measures to plug these gaps.</p> <p>Expansion of eco-development activities.</p> <p style="text-align: center;">In order to control the adverse impacts of introduction of alien species, the existing quarantine measures for screening of biomaterials entering the country to be reviewed and revised, if necessary.</p> <p>Harmonise present uses of other natural resources specially land and water to make them compatible with biodiversity conservation, through wide ranging consultations at the Central and State levels.</p> <p>Article 9 Need to respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities and encourage the equitable sharing of benefits arising from the use of such knowledge, innovations and practices.</p> <p>Develop or maintain necessary legislation and other regulatory provisions for protection of threatened species.</p> <p>Intensification of <i>in situ</i> conservation measures through adequate financial support.</p>	<p>Article 10 Interactions with agencies concerned to internalize the various actions points for ensuing sustainable use of biological resources to ensure proper integration into national and state level decision making.</p> <p>Article 11 Identify further incentives for conservation and sustainable use of biodiversity.</p> <p>Article 12 Review and strengthen research and training and identifying thrust areas for the same.</p> <p>Article 13 Review and strengthen ongoing activities for promoting education and awareness.</p> <p>Cooperate with other States, regional networks for development of educational and public awareness programmes.</p> <p>Article 14 Ensure implementation of safeguards suggested in impact assessments for minimizing threats to biodiversity.</p> <p style="text-align: center;">Article 15</p> <p>Facilitate access to genetic resources and ensure benefits to the country as the country of origin.</p> <p>Article 16 Cooperate with other Parties to work out operational modalities for transfer of technologies.</p> <p>In accordance with the national legislation and international law, take measures to ensure that IPRs are supportive of the convention.</p> <p>Article 17 Cooperate with other parties for exchange of information.</p> <p>Article 18 Work out priorities for technical and scientific cooperation with other Parties.</p> <p>Article 19 Ensure safe handling, use, storage and transfer of living modified organisms.</p>
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commercial exploitation of these resources and knowledge. A major casualty of the whole process is common property rights which are still very important in many rural communities for the fulfillment of basic food and health needs. Further asserting of sovereign rights over biological resources and related knowledge is partly irrelevant today given the quantity of resources and information having already gone out of the country.

4.1.3 Sovereignty has remained the fundamental principle around which the conservation and use of bio diversity is based. In fact, the assertion of sovereignty over natural resources has been the centre of economic independence. Despite this, in the past there was a broad consensus amongst nations for sharing resources, in particular in the field of agriculture. It is on this basis that international gene banks were set up, for instance, under the auspices of the Consultative Group on International Agricultural Research (CGIAR). The principle governing these gene banks was that states would freely contribute specimens and in turn be able to freely draw upon the accessions kept there. One of the reasons for countries willingly contributing resources to these collections was that most countries are dependant on other areas of the world for some of their main food crops.

4.1.4 The trend after these international conventions reverses a century of developments in intellectual property law. Nature and nature – related knowledge used to be excluded from patentability but recent developments go a long way towards accepting the patentability of life forms. In India, management of biological resources is directly related to livelihood and survival, food and health of major sections of country's population. If patents on life forms are first controversial at a conceptual level, there are a host of other issues of concern. For India and economically backward states like Orissa though being very rich in biodiversity, this has critical significance for vital sectors like food and health. Biotechnology has made it possible to transfer genes conferring advantageous traits to food and cash crops from any source as against conventional plant breeding which could transfer genes within related species only. Thus biotechnology has revolutionised the production of those drugs which were originally obtained from animal and human tissues. Thus the tussle for institutional control over genetic resources is gaining momentum for obvious reasons. Biodiversity-rich states like Orissa and countries like India have raw materials but do not have the technological tools that can convert these genes to products.

4.1.5 A number of other treaties which are equally relevant, such as human rights treaties recognising fundamental rights like right to food. Therefore, a broader perspective of the situation between control of biological resources and food security is to be taken. It is imperative to recognise basic importance of these resources to the direct survival of people of the state, instead of mainly looking from the angle of trade and markets or environmental concern. Indigenous people strongly reject the notion of intellectual property rights, including patents, on life forms, and on knowledge relating to biodiversity. All such knowledge must be in the public domain, and indigenous and local community must be protected through alternatives regimes of collective knowledge rights. The Biological Diversity Bill 2000 is potentially a powerful tool for the conservation of biodiversity and protection of local community livelihoods especially of adivasi based on biodiversity; but to achieve its full potential, it needed to include provision for : prior informed consent of communities before accessing biodiversity and related knowledge from their territories, principle of consensus decision making through the 'gram sabha' and identifying *ex-situ* biodiversity heritage sites besides others.

4.2 International Programmes and Conventions

4.2.1 India participates with many international agreements and programmes concerned with aspects of nature conservation and sustainable development. These range from legal instruments such as the *Convention on Biological Diversity*, which place obligations on those nations which become contracting parties, to scientific programmes such as the *UNESCO Man and the Biosphere Programme*, a global programme of international scientific cooperation. Examples of agreements and programmes with which India is collaborating include:

4.2.1.1 Convention on International Trade in Endangered Species (CITES)

Since India became a party to CITES on 18th October 1976 it has provided data annually to the CITES secretariat on the trade of endangered species through its CITES [Management Authority](#).

4.2.1.2 World Heritage Convention

India ratified the [World Heritage Convention](#) in 1977 and since then five natural sites have been inscribed as areas of 'outstanding universal value'. These sites are:

- Kaziranga National Park
- [Keoladeo](#) National Park
- [Manas](#) National Park
- [Sundarbans](#) National Park
- [Nanda Devi](#) National Park

4.2.1.3 Convention on Biological Diversity

India signed the [Convention on Biological Diversity](#) on 5th June 1992, ratified it on 18th February 1994 and brought it into force on 19th May 1994. This convention will provide a framework for the sustainable management and conservation of India's natural resources.

4.2.1.4 Ramsar (Wetlands) Convention

India has been a contracted party to the [Ramsar Convention](#) since 1st February 1982. India has now six sites covering some 192,973 hectares of important wetlands. These sites are;

- [Chilka Lake](#)
- [Keoladeo](#) National Park
- [Wular Lake](#)
- [Harike Lake](#)
- [Loktak Lake](#)
- [Sambhar Lake](#)

4.3 Legislative Framework

4.3.1 Environment, Forests and Wildlife – subjects concerning biodiversity figure in the Concurrent List of the Constitution of India. Both the central Government and the State Government legislate and formulate policies and programmes on the subject. In addition to major Central Acts – the Indian Forest Act 1927, the Forest (Conservation) Act 1980, the Wildlife (Protection) Act 1972 and the Environment (Protection) Act 1986 having direct bearing on biodiversity issues, there are many other important Central Acts on the subject (see Box 4.2).

4.3.2 The various Central Acts are supported by a number of state laws and statutes concerning natural resources. The 73rd Amendment Act 1992 of the Constitution of India on Panchayats, which adds as eleventh Schedule in the Constitution, has eight entries(viz 2,3,6,7,11,12,& 29) which are linked to biodiversity conservation. Similarly entry 8 of the Twelfth Schedule added to the constitution by 74th Amendment Act 1992 for constitution of Urban and local bodies assigns

Box 4.2 Important Acts having relevance to biodiversity

<ul style="list-style-type: none"> ❖ The Indian Fisheries Act 1897 ❖ The Indian Port Act 1901 ❖ The Explosives Act 1908 ❖ The Destructive Insects and Pests Act 1914 ❖ The Inland Stream Vessel Act 1917 ❖ The Indian Boilers Act 1923 ❖ The Indian Forest Act 1927 ❖ The Agricultural Produce (Grading and Marketing) Act 1937 ❖ The Motor Vehicles Act 1938 ❖ The Indian Coffee Act 1942 ❖ The Bihar Waste Land (Reclamation, Cultivation & Improvement) Act 1946 ❖ The Import and Export (Control) Act, 1947 ❖ The Rubber (Production and Marketing) Act 1947 ❖ The Mines and Minerals (Regulation and Development) Act 1947 ❖ The Industries (Development & Regulation) Act 1951 ❖ The Tea Act 1953 ❖ The Acquisition of land for flood control and prevention of erosion Act 1955 ❖ The River Boards Act 1956 ❖ The Merchant Shipping Act 1958 ❖ The Ancient Monuments and Archeological Sites and remains Act 1958 ❖ The Prevention of Cruelty to Animals Act 1960 ❖ The Customs Act 1962 ❖ The Atomic Energy (Radiation Protection) Act 1962 ❖ The Major Port Trusts Act 1963 ❖ The Cardamom Act 1965 ❖ The Seeds Act 1966 ❖ The Beedi and Cigar Workers Act 1966 ❖ The Urban Land (Ceiling and Regulation) Act 1970 ❖ The Cattle Trespass Act 1971 ❖ The Wildlife (Protection) Act 1972 and Wildlife (Protection) Amendment Act 1991 ❖ The Marine Products Export development Authority Act 1972 	<ul style="list-style-type: none"> ❖ The Orissa Forest Act, 1972 ❖ The Water (Prevention and Control of Pollution) Act 1974 ❖ The Tobacco Board Act 1975 ❖ The territorial Water, Continental shelf, Exclusive Economic Zone and other Maritime Zones Act 1976 ❖ The Water (Prevention and Control of Pollution) Cess Act 1977 ❖ The Coast Guard Act 1978 ❖ The Coconut development Board Act 1979 ❖ The Maritime Zones of India (Regulation and Fishing by Foreign Vessels) Act 1980 ❖ The Forest (Conservation) Act 1980 ❖ The Air (Prevention and Control of Pollution) Act 1981 ❖ The Orissa Protection of Scheduled Castes and Scheduled Tribes (Interest in Trees) Act, 1981 ❖ The Orissa Marine Fishing Regulation Act 1982 ❖ The National Oilseeds and vegetable Oils Development Board Act 1983 ❖ The Agricultural and Processed Food Products Export Development Authority Act 1985/1986 ❖ The Environment (Protection) Act 1986 ❖ The Spices Board Act 1986 ❖ The National dairy development Board Act 1987 ❖ The Coastal Regulation Zone Notification 1991 and as amended thereafter ❖ Foreign Trade (Development and Regulation) Act 1992 ❖ The National Environment Tribunal Act 1995 ❖ The National Environment Appellate Authority Act 1997 ❖ The Plant Variety Protection and Farmers' Rights Act, 2001 ❖ The Patents (Amendment) Act 2001
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its function of 'Protection of Environment and Promotion of Ecological Effects' to these bodies. Our commitment of protection of environment is very clear in Part IV of the Constitution. Directive Principles of State Policy sets the tone. Articles enjoin the state to raise the level of nutrition and standard of living and to

improve public health. Article 48-A was specifically introduced by the 42nd Amendment of the Constitution to ensure improvement of environment and safeguarding the forests and wildlife. Article 51 A(g) makes it the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers, wildlife and to have compassion for living creatures.

4.4 Biological Diversity Bill

4.4.1 The concerns and contradictions arising out of the Biodiversity Bill were expressed by many persons representing NGOs, government officials, teachers, farmers and panchayat functionaries throughout Orissa during public hearing programmes undertaken by the Nodal Agency. The loss on account of illegal patenting of traditional practices and exploitation from protected areas were mainly focussed. Many felt about the negation of impacts of Wildlife (Protection) Act on conservation of wilderness areas by the proposed Biodiversity Bill to be wanton.

4.4.2 Besides, the proposed Bio diversity Act has left many loopholes which may not be overcome by making regulations and framing guidelines after its enactment. Natural biodiversity is preserved and conserved *in-situ* as National Capital, and its free access, indiscriminate exploitation of natural wealth will hamper regeneration and sustained accrual of benefits arising out of their use. Specific ambiguities in the Bill should be addressed such as : a) management authority of heritage sites versus the current authority of national parks and sanctuaries ; b) the degree of unrestricted powers given to the local level keeping in mind that early losses of biodiversity and dilution of our protected area system will result unless local bodies can resist local pressures.

4.4.3 These can be overcome by introducing regulatory mechanisms for artificially or laboratory generated products of natural biodiversity in *ex-situ* conditions and identifying such products as tradable biological resources)proposal to amend definition of “biological resources” under section 2). Suggestions have also been made to make the National Biodiversity Authority an advisory body to Central Government, to provide under section 59 for taking cognisance of offence by court by police officers or forest officers or by a person having given notice for not less than 60 days of the alleged offence with intention to make complaint to the Central Government against the present provision for cognisance of complaints made by National Biological Diversity Authority or State Bio diversity Board. As per proposed draft act, making National Biodiversity Authority, a corporate body with powers of civil and criminal courts to deal with specified matters is contradictory and may be self defeating. It has been also suggested to make the NBA accountable to any risk that accrues from decisions taken by it if the authority is to be a statutory agency for negotiating terms and conditions, and receiving of financial returns from negotiation with foreign agencies for transfer of biological resources, research findings, knowledge and IPRs. Other provisions which are not in consonance are provision of only intimation for free access to biological resources to any citizen or body registered in India, and superceding Acts like Wildlife (Protection) Act, 1972 or Forest (Conservation) Act, 1980 in many ways over protected areas.

4.5 Policies of the State

4.5.1 Agriculture, livestock, fishery, forestry, industries, mining, urbanization, irrigation, transport, tourism, science and technology, information technology, rural & tribal development and other sectors influence various aspects of biodiversity. Financial and taxes control measures of the state and center further impact biodiversity. The Central Government policies and State Government policies and programmes have been receiving changes periodically. State policies including proposed ones concerning biodiversity have been discussed and are placed at **Annexure 4.1**.

4.5.2 On the one hand the Policies and Acts become instruments to be implemented by one and certain sectors of government machineries whereas other sectors encourage activities against its own laws. The problem arising out of the aquaculture promotion and the Coastal Regulation Zone Notification are well known now. Statutes for conservation such as Forest (Conservation) Act and the Wildlife (Protection) Act are under severe pressure from state governments and other sections like private / public sectors and NGOs for using forestlands and protected areas for developmental projects and livelihood activities. Similarly other laws are also invariably ridden with problem of content or implementation with frequent dilution of spirit and substance of these laws. Contradictions are growing between conservation and development laws, and between conservation and livelihood related laws. Unless these counter trends and contradictions are arrested, the initial gains with laws could well be lost in a very short time. Various proposed statutes like Forest Bill and Biodiversity Bill are growing with potential contradictions and conflicts- essentially built on discourse of human rights and protection of nature itself.

4.6 Problems and Prospects

4.6.1 The State of Orissa presents a paradoxical picture of poverty amidst plenty. Despite her vast natural and human resources and substantial progress achieved during the past 50 years of planned development, Orissa continues to be one of the less developed States with a high incidence of poverty. High dependence on the low productivity primary sector has resulted in significant fluctuations in the growth rate from year to year with a bad crop year pushing the growth rate down.

4.6.2 While the Gross State Domestic Product (GSDP) increased from Rs.18,213.08 crore in 1993-94 to Rs. 23,007.11 crore in 1999-00 at 1993-94 prices registering a compound annual growth rate of 3.97%, the NSDP (GSDP minus consumption of fixed capital) commonly known as the State Income, increased from Rs.15,861.30 crore in 1993-94 to Rs.19,329.31 crore in 1999-00 at 1993-94 prices with a compound annual growth rate of 3.35% over the period. The per capita income at 1993-94 prices increased from Rs.4,797 to Rs. 5,411 during this period. The difference between the per capita income at State and National levels for 1998-99 stood at Rs.4475 at 1993-94 prices.

4.6.3 The State has been under fiscal stress for several years and is currently facing a fiscal crisis. The fiscal position worsened sharply in 1998-99 largely on account of a sudden increase in liabilities for salary payments when the fiscal deficit rose from 7.8% in 1995-96 to 16.9% of the GSDP. However, the fiscal deficit of Orissa declined to 14.2% of the GSDP in 1999-00. The increase in Non-Plan revenue expenditure arising out of substantial increase in salaries and pensions and increasing gap between Non-Plan revenue expenditure and receipt have necessitated higher borrowing and higher debt servicing liabilities,. The fiscal situation in the State led the Ninth Finance Commission to observe that “the vicious circle of excessive growth of revenue

expenditure, meager or negative return from public enterprises, growing revenue deficit and large scale public borrowing resulting massive rise in interest burden, which, in turn, accentuates revenue deficit leading to higher borrowing must be broken". If the increasing dis-equilibrium between the revenue expenditure is not effectively revised, it may be increasingly difficult to discharge the social and economic responsibilities of the Government.

4.6.4 Though the share of the agricultural sector in NSDP has declined from 38.95% in 1993-94 to 32.88% in 1999-00 at 1993-94 prices, this sector continues to dominate State economy. Agriculture provides employment to 65.75% of the workforce directly or indirectly. In the absence of adequate irrigation facilities, agriculture is largely dependent on the monsoon. As a result, agricultural production fluctuates. Owing to the large contribution of the agricultural sector to NSDP and owing to large linkage between this and other sectors of the economy, these fluctuations influence the overall growth rate of the State's economy to an appreciable degree.

4.6.5 The productivity of foodgrains in Orissa during 1998-99 was 1083 kg per hectare which is much lower compared to some of the more developed States like Andhra Pradesh, Gujarat, Haryana, Karnataka, Kerala, West Bengal and Uttar Pradesh and also below the national average of 1620 kg per hectare. The consumption of fertilizers at 40.6 kg per hectare, was also much below the national average of 95.3 kg per hectare during 1999-00. Hence, there is substantial scope for raising agricultural productivity, particularly that of food grains by adopting a multi pronged strategy including extension of the area under assured irrigation, application of recommended dose of fertilizers, use of HYV seeds, and application of modern technology. The varied agro-climatic conditions of the State provide good scope for horticulture,. Cultivation of vegetables, plantation crops, spices, flowers and medicinal herbs. Suitable cropping patterns have to be designed taking into account the agro-climatic conditions of different zones in the State, both for agriculture and horticultural crops. Agro-based industries have to be set up to absorb the unutilized manpower from the agricultural sector, generate income through value addition and to reduce unemployment, underemployment and disguised unemployment in the rural areas. These issues have been addressed in the Agricultural Policy 1996.

4.6.6 The main objectives of the Agricultural Policy 1996 are to double the production of food grains and oilseeds by the end of the Ninth Plan, make agriculture profitable and commercially viable, carry modern farming technology to the farms, encourage entrepreneurship and establish agro-based and food processing industries, achieve self sufficiency in fruits, flowers, vegetables,. Poultry and dairy products, provide irrigation to 50% of the cultivated area and orient agriculture towards export.

4.6.7 The strategies proposed to be adopted to achieve the objectives of the new Agricultural Policy include production and supply of quality seeds, efficient distribution of fertilizers, production of bio-fertilisers through women's societies and NGOs, supply of soil health cards to each farmer, involvement of private sector for production of agricultural implements,. Giving more attention to commercial crops, reclamation of problematic soils, provision of adequate agricultural extension services, coverage of more crops under crop insurance and taking up several programmes for fisheries and animal resources development. Government have established Agricultural Promotion and Investment Corporation of Orissa Ltd. (APICOL) on the pattern of Industrial Promotion and Investment Corporation Limited (IPICOL) for promoting investment in agriculture and agri-business. This new policy visualizes revamping of the existing administrative structure and establishment of Agricultural Aid Centres at the block level. Agriculture has been given the status of an industry under the new Agricultural Policy.

4.6.8 The annual per capita availability of milk and eggs was 22.6 kg and 22 numbers respectively in the State during 1999-00 which was much below the national average of 74.5 kg and 30 numbers respectively in 1997-98. There is ample prospect for increasing production of these items in the State.

4.6.9 While Orissa occupied sixth position at all India level in the production of inland fish during the year 1995-96, it ranked eighth in terms of marine fish production. In view of long coastline of 480 km there is considerable potential for both inland and marine fish production. Higher production will help boost exports and earn more foreign exchange. With a view to increasing fish production in the state, a comprehensive policy has been formulated which emphasis adoption of scientific methods of pisciculture, provision of assistance to fishermen, intensive fishing operations in deep sea, imparting training to fishermen both for culture and capture fish and establishment of fish feed mills.

4.6.10 The rate of exploitation when compared to total reserves is quite low for most minerals. During the year 1999-00, except for lead ore, manganese ore and graphite, the rate of exploitation of minerals remained below 1.00%. In case of some important minerals such as chromite, iron ore, bauxite and coal, the rate of exploitation was only 0.92%, 0.34%, 0.17% and 0.09% respectively of the total reserves. The mining sector contributes substantial income to the State exchequer. During the year 1999-00, it contributed Rs.320.46 crore to the State revenue which is about 36% of the State's own non-tax revenue. Mineral exploitation also generates large employment. There is need to attract greater investment in this sector so as to increase the rate of exploitation and generate further employment.

4.6.11 The new Industrial Policy 1996, formulated in the context of the ongoing economic liberalization, reflects the State Government's commitment to growth and development of industries. The objectives of the new Industrial Policy are to exploit available natural resources to accelerate industrial growth with protection of environment, provide linkages between agriculture and agro and food processing industries, attract investment from outside, generate employment opportunities through industries like small scale industries, village and cottage industries, sericulture, handloom and handicrafts and strengthen and upgrade entrepreneurial skills.

4.6.12 In order to achieve these objectives, the strategies to be adopted by the State Government include measures to develop infrastructural facilities like power, railways, telecommunication, road network, ports, airport and banking facilities, improve industrial climate, provide support to export oriented units,. Provide incentives to industries generating large employment opportunities, rehabilitate sick industries, lay emphasis on quality, productivity and skill development and mobilize additional resources from outside the State and private sector in view of constraints to generation of internal resources. With the introduction of the new

Industrial Policy, there has been surge in investment proposals in private sector particularly in the areas of steel, power generation, aluminum, sugar and oil refining.

4.6.13 Power is a basic requirement for development. The availability of power in the state was 1,207 MW during 1999-00. The State Government have undertaken pioneering steps for reforming the power sector by enacting the Orissa Electricity Reforms Act, 1995. Private investment in power sector is being encouraged. Consequently, a number of private investment proposals for setting up power projects in Orissa have been received. In addition, the Central Government and the State Government have proposals for installation of power projects of 1,694 MW capacity by March, 2002. After completion of these projects, the State will be in a better position in respect of power generation.

4.7 Development of Women

4.7.1 Despite various measures taken, the status of women continues remain relatively backward. With gradual spread of education and empowerment, the position of women has begun to change. It is the policy of Government to bring them fully into the mainstream.

4.7.2 FEMALE LITERACY: Female literacy rate in the State has consistently been lower than the literacy rate among males. Though the female literacy rate in the State increased from 4.5% in 1951 to 34.7% in 1991 (51 % in 2001), it was lower than the national average of 39.31%. In rural areas, the female literacy rate is only 30.79%. For development of female education, educational institutions have been established exclusively for girls including Kanyashrams in low literacy tribal areas for SC/ST girls. Education for girls, from primary to post graduate level, has been made free. ITIs for women have been opened to provide professional training to them.

4.7.3 WOMEN IN WORK FORCE.: According to 1991 census, only 27.28% of the total workers in Orissa are women. The main workers and marginal workers among female constitute 58.2% and 41.8% of the total female workers respectively. The un-organized primary sector, which includes agriculture, animal husbandry, fishery, forestry, mining and quarrying, plantations and allied activities absorbs as much as 82.7% of the total female main workers. Nearly 5.2% of the female main workers are engaged in household industries, and other sectors of the economy provide employment to 12.1% of female main workers. Women constitute an important segment of the labour force. The unpaid economic activities of women and their contribution in the domestic sector remain un-reported and go largely un-recognised.

4.7.4 EMPLOYMENT OF WOMEN IN AGRICULTURE AND ALLIED SECTORS : Women play an important role in agriculture, animal husbandry and other related activities, which include marketing of produce, food processing and the like. According to 1991 census, 80.9% of the female work force was engaged in agriculture. 25.8% as cultivators and 55.1% as agricultural labourers. Women as agriculture workers generally participate in all operations except ploughing. They are engaged in transplanting weeding, applying fertilizers, and also in harvesting the produce. A large number of female workers are also engaged in marginal occupations such as collection of fish, firewood, cowdung, fetching of drinking water, maintenance of kitchen gardens, tailoring, weaving etc. in order to supplement the family income.

4.7.5 Important components of the strategy proposed to be adopted for development of women are as follows :-

- 1) Political and administrative measures will be taken to minimize gender bias in recruitment and to improve working conditions.
- 2) Women's education and eradication of illiteracy among girls will be given high priority.
- 3) A life cycle approach to women's health with focus on reproductive health will be adopted.

- 4) Efforts will be made to improve their skills and capacity to earn by way of providing vocational training in various fields.
- 5) Women's associations and societies will be organized to enable women to get part-time employment in productive activities.
- 6) Steps will be taken for projecting a positive image of girls and women.
- 7) With a view to ensuring flow of adequate resources and benefits for women from all developmental programmes, funds will be earmarked for the women component.

4.8 Water Resources Projects and Biodiversity

4.8.1 Water is basis of life and biodiversity. The management of water through rivers, dams, lakes, reservoirs etc influences the prevalence and distribution of biodiversity in its various asoects. The irrigation projects have been influencing these in various ways(See Table 2.23.& 2.24). Submergence of forest area, siltation of reservoirs, thinning of stream size, water logging etc,. are some of the effects of Water Resources Projects which can not be avoided altogether. So, attempts are made to decrease the severity of their impacts to make the projects sustainable

4.8.1.1 **Compensatory Afforestation:** Irrigation projects submerge large tract of forest area by their reservoir, destroy vegetation through construction of roads and canals as the head works of most of these projects are situated in remote thickly forested land. 5405.09 ha of forest area was used for irrigation purpose during 1997 only (see Box 4.3).

Box 4.3 Forest Area Diverted to Non-Forest use in Orissa. Sector-wise during 1997.

Name of Sector	Area Diverted (ha)
Irrigation	5405.09
Mining/Quarrying	5349.94
Transmission and Thermal	2206.71
Road and Bridge	208.51
Railways	1886.91
Defence	3865.25
Miscellaneous	479.45

(Source : Status Report on Orissa Forest – 1997)

4.8.1.1.1 It is estimated that nearly 5,80,890 ha land area is submerged by the existing major and medium irrigation projects while more area than this may be submerged by construction of all proposed future major and medium projects (see Table 2.24). It is obvious that a large portion of submerged land mass is covered with forests.

4.8.1.1.2 With a view to accommodate the displaced wild life from the submerged area and to compensate the loss of green coverage to preserve ecological balance, plantation of indigenous plants are undertaken. The compensatory afforestation programme forms an integral part of the proposed irrigation developmental activities. State Forest Department and Soil Conservation Dept. undertake afforestation work in collaboration with irrigation Department.

4.8.1.2 **Catchment Treatment :** Construction of Irrigation projects in remote areas improve communication facility which promotes felling of trees in the catchment area making the land susceptible to soil erosion. Deforestation and changed land use pattern in the catchment of the project causes siltation of almost all reservoirs encroaching upon their economic life. The annual designed rate of silt inflow to Hirakud reservoir was 3.69 ha.m/year/100 Sq.Km. But the actual silt inflow has been recorded as 4.0 ha.m/year/100 sq km. At this rate of siltation, the life of this reservoir would be only 76 years as against the estimated life of 111 years. (Environmental Assessment of Mahanadi Basin, OWPO, 2001).

4.8.1.2.1 De-siltation and dredging operations being very expensive, the only alternative left to tackle the problem of silt in flow and sediment deposit is through soil conservation programme in the catchment. In Orissa, the Directorate of Soil Conservation under Agriculture Dept. is the nodal agency to execute programmes for soil erosion control. There is need to study the soil conservation need in the catchment of other irrigation projects as done for Hirakud Dam.

4.8.1.3 **Reservoir Fishery Development :** The per capita annual consumption of fish in the State was 8.23 Kg./ in 1998-99 which was much less than the per capita consumption in states like Assam, Tripura, West Bengal and Arunachal Pradesh. In order to raise the per capita annual consumption of fish in Orissa to 11 Kg. which is the recommended per capita level of requirement of fish it is targeted to increase the production from present level of 2,84,230 MT to 3,87,000 MT by the end of the Ninth Plan. (Economic Survey, 1999-2000)

4.8.1.3.1 The reservoirs created in Irrigation Projects offer great potential for pisciculture development.. It is estimated that 1,97,198 ha of water spread area available from 1442 major, medium and minor irrigation projects in the State. Though these fresh water bodies are capable of producing 82,000 MT of fresh water fish and shrimp, only 15000 MT are presently produced due to poor management practices.

4.8.1.3.2 Reservoir fisheries development is gaining attention these days. The World Bank funded a five year programme (1992-97) to develop small reservoir fisheries covering following aspects.

- 58 small reservoirs covering 19500 ha.
- Estimated yields from 60 Kg/ha/yr from 300-1000 ha. Reservoirs and 240 Kg/ha/yr from reservoirs less than 100 ha.
- Reservoirs allocated for offish production from OID to DOF of fisheries management.
- Leasing of reservoirs or major section there of to local fishermen's cooperative.
- Localised production of finger lings of proper size by the DDF in off reservoir ponds and/or in reservoir pens.

4.8.1.3.3 A state level workshop was organized on Reservoir Fisheries Development in Orissa at Bhubaneswar from 5-6th May, 1999 by the World Bank assisted project on Shrimp and Fish culture where the State Reservoir Fisheries Policy was proposed and discussed. Important features of the proposed policy is annexed (see Annexure 4.1).

4.8.1.3.4 The project objectives of World Bank assisted Shrimp and Fish Culture Project are given below.

1. To develop fish stock in irrigation Reservoirs in order to achieve average sustainable yield of 160 Kg/ha/year as against the present low yield of 10 Kg/ha/year.
2. To strengthen fishermen cooperative societies/organizations for their effective involvement in the project implementation.
3. To enhance annual average income of each active fishermen member's of the society fishing in the reservoirs to Rs.24400/- and there by to improve their socio-economic conditions.
4. To introduce scientific management package including conservation measures in the development of fisheries in the reservoirs.
5. To introduce better marketing system for disposal of reservoir catches in order to fetch better price of fish.
6. To provide adequate credit assistance to the projects fishery co-operatives for procurement of boats, nets, construction of nearing ponds and pen enclosures.
7. To provide infrastructure facilities to the project reservoirs such as approach roads, fish landing sheds.
8. To provide training to fishermen members of the co-operatives fingerling production fishing and conservation measures involving selected NGOs.
9. To promote women participation in project activities.

4.8.1.4 Watershed Development : Watershed development project is going on in the state through Watershed Mission. Watershed, comprising of the area draining by common outlet is considered as an ideal hydraulic unit for more efficient utilization of available natural resources. The watershed approach is considered more rational because land and water resources have optimum interaction and synergetic effects when developed on watershed basis. The soil and water conservation measures undertaken on watershed basis will check soil erosion, enhance soil productivity, conserve rain water and meet the fuel and fodder requirement of the community. Arable land,. Non-arable lands and drainage lines should be simultaneously treated from ridge to valley with the following soil conservation measures in each Watershed.

Biological Measures.

- Vegetative filter strips
- Vegetative contour hedges
- Small vegetative check dams
- Vegetative contour bunding with vetiver (VCB)
- Silvi Pasture, Pasture land development
- Silvi-Horticulture Pasture
- Agro horticulture
- Agro forestry
- Dry land horticulture
- Stream Bank plantation
- Plantation like sisal, Misc. Gree, Mixed Orchards, Sabai, Cashew etc.

Mechanical Measures.

- Contour trenches
- Brush wood check dams
- Loose boulder check dams
- Gully control structures
- Dug out/sunken structures
- Earthen check dams
- Run off storage structure
- Percolation tanks/cluster percolation tanks
- Farm ponds
- Low cost Water Harvesting Structures

- Diversion weirs.

4.8.1.4.1 Attempts are made to form and register watershed associations by the members of the community who directly and indirectly depend on the watershed. These associations are designated as “*Bhumi Panchayats*” and are working as vital organisations to meet the food, fuel and fodder requirements of the locality. The distribution of watersheds in different districts is listed in Table 4.1.

4.8.1.5 **Waterlogging and Salinity** : The problems of water logging and soil salinity, though different in their origin and physico-chemical attributes, are often regarded as one problem. Water logging is resulted mainly due to seepage of water from canals and irrigated fields, while soil salinity is caused due to low rainfall and high evaporation conditions. States like Punjab, Haryana, Rajasthan where rainfall is less and evaporation is high, soil salinity and water logging problems are experienced simultaneously.

4.8.1.5.1 But in Orissa, rainfall being of high order (1482 mm) does not allow salt to build up in irrigated commands, as a result soil salinity is not observed in any of the irrigation commands. But, salinity problem is experienced in coastal belt of Orissa, mainly due to sea water inundation during monsoon season and use of brackish groundwater for irrigation.

4.8.1.5.2 The conveyance loss in most of our canal distribution system is very high and only 25 to 30 percent of water released from head works reaches the crop field. The rest reaches the ground water through percolation. The general pattern of ground water rise in irrigation commands when the water table reaches 2 metres from the ground surface, the productivity of land decreases and the land is regarded as water logged. Beside rise in ground water, the ditches and low lying areas are filled with canal water and develop permanent stagnant water bodies which makes the land unsuitable for cultivation.

4.8.1.5.3 Extensive cultivation of paddy in canal irrigation commands contributes significantly to ground water rise. In Hirakud command, the practiced cropping pattern shows that paddy is the dominant crop and is preferred over other crops. It is grown over more area than planned.

4.8.1.5.4 In the major Irrigation Projects of Orissa, water logging problems have been observed. It is reported that nearly 1,00,000 ha of total CCA of 3,00,000 ha in Mahanadi Delta Irrigation system (Both Stage I and II) is adversely affected by water logging. Extensive water logging has occurred in low lying areas of Hirakud Irrigation Project and nearly 15 to 20% of the area has gone out of cultivation. Such problems are likely to crop up in newly commissioned major Irrigation Projects like Upper Kolab, Upper Indravati etc. The tail end portion of Upper Kolab Project in, the Kotpad area is relatively flat and semi permeable in nature. The

area is flood prone due to spill of river Indravati, so the area is likely to be water logged in near future. Similarly, the head reach area of Hati barrage in Kalahandi district is relatively flat and has black cotton soils which are highly impermeable. After few years of canal irrigation, the area may develop water logging problem.

4.8.1.5.5 As the state can not afford lining of the vast network of distribution system because of the prohibitive cost involvement, seepage from the earthen canals will continue. Only operational losses and seepage loss from crop fields can be checked to some extent by adoption of suitable cropping patterns, scientific water management practices etc. The surface drainage network has to be improved and maintained.

4.8.1.5.6 The State has taken steps to involve beneficiary farmers in operation and maintenance of canal as well as drainage systems through organization of 'Pani Panchayats' in major and medium Irrigation Projects. Volumetric supply of water in canals, crop diversification etc. are some of the innovative practices which will be introduced among the farmers very shortly which will reduce the wastage of canal water and will improve the water use efficiency.

4.8.1.6 Water Pollution : The river water gets polluted by untreated effluents from major industries and municipality discharge of the big cities situated on the bank of the rivers. The surface water bodies and ground water sources in irrigation commands are primarily contaminated with the residues of the agrochemicals applied to the field crops. Under assured irrigation condition, farmers apply more of fertilizers and pesticides to augment the yield. The water quality situation throughout Orissa is becoming critical. Particularly in view of the large potential expansion in the mineral resources and industry sectors. Their activity plus the pulp and paper and chlor/alkali industries are major sources of local and regional pollution, particularly in the upper and mid-Brahmani, the IB river and mid reach of Mahanadi and lower reach of Rushikulya river. The city sewerage water of Cuttack and Bhubaneswar pollute the water of Kathajodi and Kuakhai system during post monsoon period making it unsuitable for human consumption. While the SPCB focuses on known critical industrial source water quality problem areas, there is also evidence of other problems which need to be investigated and assessed to predict water quality including.

- Biological effects of contaminated water (e.g. treated and untreated release from mining and industrial waste disposal operation on river aquatic ecology including bottom fauna and fisheries and ground water contamination).
- Potential public health effects of localized high water table due to irrigation or urban drainage (e.g. Sambalpur, where installation of septic systems are not effective due to high ground water table, so open surface drains are used for domestic sewerage disposal).

- Bio-accumulation effects of contaminants (e.g. heavy metals and use of indicator species for assessing known or as yet undermined long term impacts on aquatic life and productivity).

4.8.1.6.1 Water pollution problems in irrigation commands of the State is not conspicuous as the rate of application of fertilizer, pesticide and other agrochemicals is much less. The per hectare consumption of fertilizers in Orissa was 30.5 Kg in 1996-97 which was much below the national average of 77.5 Kg and lower than the consumption rate in all the states except Assam. The fertilizer consumption rate in Punjab, Andhra Pradesh, Haryana, Tamilnadu were 160.5 Kg/ha 135.6 Kg/ha, 131.7 Kg/ha 114.8 Kg/ha respectively. The pesticide consumption rate in the state is negligible. However, it is understood that the fertilizer and other chemicals are consumed in higher amount in irrigated areas though project wise consumption rates are not available. In districts like Sambalpur, Baragarh Balasore, Bhadrak etc. where paddy is grown more intensively in both of the seasons over large area, the fertilizer consumption rate is comparatively high. So, in these districts, where surface drainage is impaired, the surface and ground water sources may be contaminated with nitrate. In irrigation projects of other districts, similar problems may come up with increase in fertilizer and pesticides use.

4.9 Major actors and their current roles relevant to biodiversity

4.9.1 Governmental

4.9.1.1 State Government

- Department of Science, Technology and Environment

Role: It funds research projects relating to studies on various aspects of biodiversity along with other technical matters in Orissa.

Perception: Animal biodiversity is a resource, which is to be utilized in a sustainable manner. There is an urgent need for its conservation through active participation of all stakeholders.

- Department of Forests

Role: Its main role is restricted to protect forests along with management including JFM and conservation of biodiversity on forestlands and in a network of protected areas.

Perception: The wild animal biodiversity is usually identified as large mammals, birds and some reptiles, and the main thrust of its activities is on the conservation of these animals. There are no programmes and efforts for the conservation and propagation of soil microbe and soil invertebrate biodiversity.

- Department of Agriculture

Role: To increase production in arable fields through increased use of soil microbes like cyanobacteria, hybrid seeds, trans-genic varieties and extensive input of pesticides and fertilizers.

Perception: Main thrust is on the control of insect and other animal pest diversity to obtain higher production of crops and vegetables. There is very little concern on the effect of toxic pesticides on the non-target vital soil microbes and invertebrates. Least importance is given to the maintenance of organic matter, which is very vital for development of diversity of soil microbes and invertebrates.

- State Pollution Control Board

Role: To regulate various types of pollution affecting the quality of plant and animal habitats.

Perception: Both organic and inorganic pollution of terrestrial habitats directly affects biodiversity.

4.9.1.1.1 Other State Government Departments having very important role in biodiversity conservation are:-

- *Education Department*
- *Energy Department*
- *Fisheries and Animal Resources Development Department*
- *Family and Welfare Department*
- *Housing and Urban Development Department*
- *Information Technology Department*
- *Industries Department*
- *Panchayati Raj Department*
- *Planning & Coordination Department*
- *Rural developemtn Department*
- *Steel and Mines Department*
- *S T and SC Development Department*
- *Tourism and Culture Department*
- *Water Resources Department*
- *Works Department*
- *Women and Child Development Department*

4.9.1.2. Central Government

- *Planning Commission*
- *Ministry of Environment and Forests*
- *Ministry of Agriculture*

- *Ministry of Chemicals and Fertilizers*
- *Ministry of Commerce and Industries*
- *Ministry of defence*
- *Ministry of Health and Family Welfare*
- *Ministry of Human Resource developemtn*
- *Ministry of Non-Conventional Energy Sources*
- *Ministry of Industries*
- *Department of Ocean development*
- *Ministry of Power*
- *Ministry of Railways*
- *Ministry of Science and Technology*
- *Ministry of Steel*
- *Ministry of Surface Transport*
- *Ministry of Tourism*
- *Ministry of Water Resources*

4.9.2 Non-governmental Organisations (NGOs)

4.9.2.1 Several NGOs are very active in carrying out public awareness on environment including importance and threats to biodiversity in Orissa. They have also developed into federations with member NGOs numbering above 100. The WWF has also compiled a list of such NGOs in Orissa in a publication titled “Environmental NGOs in India : A Directory 1999”.

Role: Conduct awareness on biodiversity among people; assessment of threats habitats in the state.

Perception: Success of biodiversity conservation efforts requires extensive awareness programmes among masses on various aspects of biodiversity.

4.9.2.2 Some of these NGOs federations are listed below:-

- ❖ Oriss Jungle Manch (with over 113 NGO members)
- ❖ SAMASTEE
- ❖ CENDRET, XIM
- ❖ CYSD

4.9.3. Local Communities

Role: Since time immemorial, tribals and traditional societies have maintained and conserved natural habitats as sacred groves. These sacred places harbour a diverse plants and animals. They have been using biodiversity as source for their nutrition, livelihood and economy. They also utilize some plants and animals as ethnomedicine.

Perception: Local communities consider that they have inherent rights to use natural resources as a gift of nature. They are concerned for the fast dwindling biodiversity.

The cash crops like vegetables fetch good price in the market. The main thrust of the farmer community is, therefore, to obtain maximum yield by application of pesticides for the control of pests and inorganic fertilizers for enhancing soil fertility. They look at arable lands only from economic angle without any concern for the harmful effects these practices that may have on beneficial soil animals.

4.9.4. Donors

4.9.4.1 The following National and International agencies are funding/sponsoring a number research projects on biodiversity matters:

National

1. University Grants Commission, New Delhi
2. Department of Science & Technology, New Delhi
3. Council of Scientific Industrial & Research, New Delhi
4. Indian Council of Agricultural Research, New Delhi
5. Indian National Science Academy, New Delhi
6. Department of Environment, New Delhi
7. Defence and Research Development Organisation
8. NABARD

International

1. European Economic Community (EEC), Brussels
2. Institut francais de recherche scientifique pour le development en cooperation (IRD), Paris
3. Tropical Soil Biology & Fertility Programme (TSBF), UNESCO, Kenya
4. Global Environment Fund
5. UNICEF India
6. Swiss Agency for Development & Cooperation (SDC)
7. World Bank
8. Asian Development Bank
9. DFID
10. OECF
11. Sida

4.10 Root Causes of Loss of Wild Animal Biodiversity

4.10.1 Lack of Public Interest and Awareness: Generally, majority of the people is not aware of various ecological benefits of conserving soil, water and biodiversity. The local economy and livelihood concerns overawes the conservation concerns. This makes them oblivious to an understanding and awareness of the values of conservation of the whole range of floral and faunal

diversity of some sites such as wastelands, arable fields, pastures and grasslands, wetlands, forests and coastal environment.

4.10.2 Indifferent Attitudes of Developmental Departments/Agencies for Protection and Conservation of Biodiversity

4.10.2.1 Different departments of Central and State Government and other agencies are carrying out various developmental works in the state. Some of their activities are detrimental to the maintenance and propagation of biodiversity. Large quantity of fly ash is generated in thermal plants and dumped over various habitats. The fly ash decreases the porosity of soil, thereby affecting aerobic soil invertebrates. Similarly, the mining agencies involved in open cast mines deposit the over burden in open areas; thus affecting all types of soil diversity. Land abuse in absence of a land use policy has been mostly occurring. The Forest (Conservation) Act, 1980 and its guidelines have though mostly inbuilt the required biodiversity conservation action plans in to the developmental projects, the implementations have not been as committed to biodiversity concerns, the reason may be even inadequate will, attitude and finances.

4.10.2.2 The Department of Agriculture recommends periodic application of inorganic fertilizers and toxic pesticides to enhance production in cultivated lands, with out any concern for the damage these chemicals may cause towards the loss of non-target beneficial soil biota.

4.10.2.3 The main thrust of the Department of Wildlife is on the protection and conservation of animals mostly listed in the Schedules, although other animal life is also incidentally conserved in the protected areas like wildlife sanctuaries, national parks and biosphere reserves. There is very little concern for the propagation and protection of soil microbes, invertebrates, plants and animals as a whole outside the protected areas.

4.10.2.4 The Annexure 4.2 summarizes the various activities and their historical/ root causes for adversely affecting biodiversity and conservation in an ecosystem, identified by regional groups.

4.11 Gaps in wild biodiversity conservation.

4.11.1 Gaps in information:

- i. Information gaps exist between local communities, researchers and Forest and Wildlife Department. This need to be properly integrated, co-ordinated exchanged and documented.
- ii. Information on species, genetic variability, macro and micro habitats, key stone species, bio indicators are incomplete.
- iii. Information on lower plants and animals, forest insects etc. are inadequate.
- iv. There is no effective and long duration dissemination mechanism.
- v. Scientific information is needed on the distribution and populations of almost all species of plants and animals.
- vi. Information is scarce on faunal composition, especially endemic species, of various habitats in certain remote areas.
- vii. There is inadequate information on the effect of toxic pesticides on non-target soil fauna.

4.11.2 Gaps in vision

- i. Welfare programmes involving/ infringing biodiversity concentrate on immediate benefits and bypass long term sustainability of ecosystems. The trend needs to be remedied.
- ii. Economic development of the state by way developmental projects sometimes obscures biodiversity concerns and issues.
- iii. Some exotic species are stocked and cultured in local natural systems.
- iv. There is a shortage of funds and financial investment in animal biodiversity related programmes as compared to developmental projects.

4.11.3 Gaps in institutional mechanism.

- i. Lack of understanding of biodiversity concerns amongst various departments. There is a need to include adequate coverage of biodiversity issues in the functioning and activities of all government or semi-government departments/agencies that are carrying developmental work in the state.
- ii. Lack of trained personnel. Correct identification of animal species is foremost requirement for developing strategies for their propagation, management and conservation. There is a great shortage of taxonomists at the state and national level who could undertake such work especially on soil microbes and soil invertebrates.
- iii. Failure to integrate biodiversity concerns/ programmes in developmental plans.
- iv. Dearth of long term committed N.G.Os/ Village Communities focussing biodiversity issues.

4.11.4 Gaps in Policy and Legal structure.

- i. Lack of implementation/ awareness of legal framework.
- ii. Lack of Policy for biodiversity conservation outside PAs, eg. In JFM areas and other forest blocks.
- iii. Lack of legal frame in protection of biodiversity in wetlands not included under PA systems with resultant submergence of biodiversity rich areas. Existing animal biodiversity conservation efforts are directed towards forest ecosystem and designated protected areas. There are no policies for the propagation and conservation of faunal diversity in other vital animal habitats like cultivation and orchards, pastures, grasslands, water bodies, road sides, wastelands, dead wood, etc.

4.11.5 Gaps in linkages : Inter and intra department co-ordination must be remedied urgently to prevent implementation of programmes for cross purposes. Each stake holder operates in compartmentalised manner resulting in duplication of efforts by related departments. This necessitates inter and intra departmental co-ordination.

4.11.6 Gap in Awareness.

- (i) Lack of awareness on importance of biodiversity on ecosystem stability.
- (ii) Lack of biodiversity content in educational syllabi.
- (iii) Lack of effort in linking biodiversity conservation with livelihoods of community.

Chapter 5

Orissa State Biodiversity Strategy and Action Plan

5.0 Background

5.1 The overall strategy of any biodiversity plan is to promote long-term survival of populations, including the sustained recovery of depleted stocks and safeguarding of critical habitats, integrating with the well being and needs of human communities with which they interact. They should include –

- i) Identification of populations
- ii) Assessment of the conservation status of the population throughout its range and identification of key recruitment areas (regeneration, breeding and nesting sites)
- iii) Regular monitoring of populations (to assess trends)
- iv) Effective protection of natural regeneration areas, important nesting/ feeding/ migratory corridor areas
- v) Implementation of sufficient regulatory framework
- vi) Regulation of domestic and international commerce in species, their parts and products
- vii) Achieving and perpetuating public support for programmes, goals and objectives.

5.1.1 Therefore, the strategies are to focus on parallel strategies of

- Research and Monitoring
- Integrated management for sustainable development
- Building capacity for conservation, research and management
- Public awareness, information and education
- Community participation in conservation
- Evaluation of stakes, and
- Cooperation and funding.

5.1.2 Several strategies in this document can be considered as tools for implementing other strategies e.g. funding, building capacity and community participation in conservation can be tools for implementing strategy of sustainable development. However, these tools can be elevated to strategy status to facilitate effective development and use for application of other strategies (also see Annexure 5.1).

5.1.3 Biodiversity Conservation encompasses the entire landscape and ecosystem conservation, Cutting across several conflicting and mutually exclusive interests. Instances are also available, where mutually inclusive interests of various sectors are on the same plane. Therefore, rationalisation of interests in the first case and reinforcement of actions in the second case is desirable involving multipronged and cross sectoral approaches. Needless to say that public at large, NGOs, the Government, the industry, the farmer and the researchers should all contribute to the success of the programme. After many deliberations, cutting across several stakeholders, following strategy has been developed.

5.2 General Strategy of Biodiversity Conservation:

1. Status Survey of all wild floral and faunal resources. Both within existing Pas and potential habitats for Conservation management.
2. Identification of all potential habitats having assemblage of rare and critically endangered ecosystems and species.
3. Enumerating criteria for economic evaluation of wild natural resources including intangible benefits
4. Developing technologies which makes least dent on the wild natural resource.
5. Encouraging community participation in policy decisions, identification of site specific projects and community implementation.
6. Development policies/ regulations for access to genetic resources and its sustainable use including *ex-situ* conservation at community level
7. Developing welfare schemes linking wild biodiversity issues and concerns.
8. Complete EIA before launching of all welfare schemes to exclude possible adverse impact .
9. Inclusion of biodiversity issues in school/ College/ Adult literacy and other non formal education programmes.
10. Capacity building of community/ forest and wildlife staff through training and symposia on various issues affecting conservation of wild biodiversity.
11. In depth need based research/ Consultancy for inventory of elements of biodiversity, documentation of uses, technologies for management and setting criteria for evaluation of action plan implementation.
12. Punishment for destructive activities and incentives for activities promoting wild biodiversity .

5.3 General Action Plan

5.3.1 Coordination: Concept of integrating management is crucial in several ways. Integrating biodiversity sensitivity into all sectors of planning and development shall be life sustaining, especially those sectors like mining, industry and urbanization, which mostly destroy biodiversity. The sectors within government, non-government sector and local bodies have the need to mainstream concerns of biodiversity conservation in their respective planning. However, linkages have to be developed at the District Planning Committee (DPC). Besides, for regional level, linkages with biodiversity –rich contiguous patches of the adjoining district need also be established. This should be the basis of regional/ zonal/ eco-regional planning.

The key partners/ stakeholders of the district/ region whose actions have definite bearing on the conservation of biodiversity need to be identified, threats analysed, and impacts of ongoing programmes critically assessed. The action plan developed therefore shall have these gaps plugged.

This shall be facilitated if a ‘district biodiversity resource book’ is developed. The resource book shall deal with a range of biodiversity in the district. It should try to answer the question of where and what of biodiversity and also prioritize the areas/ species within district for greater focus. Linkages with adjoining districts’ biodiversity concerns shall also be spelt out. This can be taken up by the ‘District Environment Society’.

5.3.2 Training and Internship Programme: Biodiversity areas (Protected Areas, Biodiversity Heritage sites) can provide students practical experience for the formation of future conservationists and managers of natural resources. Normally, an academic course does not provide practical aspects of community participation and other priority aspects for the development of conservation activities. The training has to include not only specific aspects of biology, but also the participation in day-to-day activities and challenges of a conservation programme.

The 'National Green Corps' scheme in schools all over the country to spread environmental awareness and carry out action based programmes for the protection and improvement of the environment through 'Eco-clubs' need to be strengthened in this direction.

Similarly, the National Social Service (NSS) for college and university students need to be built around environmental action programmes.

5.3.3 Awareness: It is essential to use all communication tools to promote and develop conservation programmes on biodiversity. The majority of biodiversity develop in remote places where access is difficult. The developments like legal instrumentation, economic activities adversely harnessing the biodiversity need to be sensitized to public groups locally. Organising exhibitions, lectures, production of educational materials and mass information, incorporating images of nature and concepts of conservation in campaigns, events shall attract the interests of society and shall benefit the local community in their own activities. The strategy therefore shall emphasize in following directions:-

Improve information base of local community

Promote and facilitate conservation as an integral part of community development

Identify and promote economic alternatives to exploitation and economic incentives to conserve species in danger

Facilitate establishment of a small grants programme for activities at the community level.

5.3.3.1 The action plan shall include - encourage local meetings
- exchange materials/ information
- collaborate with existing education and information programme and network.

5.3.3.2 There is a National Environment Awareness Campaign (NEAC) which is in operation since 1983, under which small NGOs are funded by Govt. of India (Rs.5000/- to Rs.20,000/-) annually for specific awareness programmes in the village, town level. This can be enhanced into a National biodiversity & environment awareness programme to facilitate funding of local, grass root funding of biodiversity conservation efforts.

5.3.4 Preventive methodologies : Precautionary Principle and Principle of Polluter pays to be essential ingredients for sustainable development. A state integrated land and water use plan need to be formulated to prevent ecologically and culturally sensitive areas from destructive mechanisms. The action plan shall be to ensure that all development projects and processes (tourism, mining, power and irrigation projects, infrastructure projects, wildlife trade, fishing and aquaculture, industries, commercial plantations, urban growth) conform to the land and water use plan.

5.3.5 Consolidation of National legal and policy framework on biodiversity and environment

Laws that protect habitats (terrestrial, coastal, aquatic etc.), that protect species, regulate trade in biodiversity products/ transport and storage of biological products are so many including laws that regulate zonation of biodiversity areas and activities therein. Besides, there are numerous law implementing bodies with commercial promotion bodies of state, center and local self government with overlapping jurisdiction and more often acting against the interest of establishing their own authority in area. Therefore, ongoing strategy and action plan shall advocate legislation/ enforcement sensitive to biodiversity conservation of the area.

- Evaluate policies, programme and legislation (including trade) and to provide legislative advice.

- Advocate integration and enforcement of existing legislation.
- Oppose those actions do not comply with sound principles of sustained management.
- Create local, regional and state support & efforts for biodiversity protection.

5.4 Specific Strategies for Conservation of Wild biodiversity

Wild habitat degradation and fragmentation is the consequence of all human related perturbations leading to the loss of species, populations, community and even ecosystems. The following strategies are suggested under forests and wildlife sector.

- 1) **Identification, documentation & Conservation of Critically endangered species/ ecosystem:** There are several ecosystems lying without protection and managerial intervention. Serious studies should be initiated to identify, document and conserve such locales, tracts harbouring endangered species.
- 2) **Survey, demarcation and notification:** All forest lands, proposed for reservation, demarcated/ undemarcated protected forests, village forests in revenue land, forest areas in revenue land by whatever name designated, as per the interim judgement of Supreme Court should be surveyed, demarcated and notified within a time frame .
- 3) **Consolidating gains made in Social Forestry:** All Village Woodlots/ pasture developed under Social Forestry schemes should be consolidated with involvement of Communities. Locally growing species should be promoted on such village forests.
- 4) **Additional notification of PAs and Closed Areas:** Many valuable habitats with endangered/ threatened species exist all over the state. After identification and demarcation, these should be notified as PAs, closed areas.
- 5) **Joint Forest Management:** The approach has given excellent dividends in several districts. There is a need for management intervention and capacity building of all stakeholders. Wherever possible, action plans will have to be based on this approach. Involving communities in PA management in certain problematic areas need be given a trial with due care to laws necessary for protection.
- 6) **Eco-Development :** This is ecological development or eco-regeneration through economic development involving village communities. It has two sub- approached viz., beneficiary oriented activity and community oriented activity. Activities are directed in two planes, viz., institutionalising ecofriendly avocation and creation of alternative resources or alternatives. This should be taken up in a vigorous manner for reducing the dependence of community on the resources of the PAs.
- 7) **Watershed development :** Efforts should be directed to restore all depleted/ degraded habitats of their forest cover. Indigenous trees, particularly dominant ones should be propagated with moisture and soil conservation measures associating local community within a specific time frame as a pre requisite to promote wild biodiversity .
- 8) **Record keeping of all forest/ wildlife habitats:** There is urgent need to have a Record cell in Forest Directorate for the purpose. A few officers/ staff need to be trained on this score for proper documentation/ retrieval of data. This nucleus will train staff at Divisional level. All Divisions in the State should be connected to the Directorate through MIS. Records of all forest blocks need to be properly maintained after demarcation and survey and information maintained centrally.

- 9) **Eviction of encroachments:** Encroachments in forest areas is a reality. Old encroachments become a bane to conservation initiatives. This is perpetrated due to legal lacunae, lack of adequate powers with managers for eviction and political support/ promise/ hope of their regularisation. No encroachments in PAs should be regularised. Attempts should be initiated for their eviction/ resettlement. For institution of eviction proceedings , forest officers need to be given required powers under law.
- 10) **Relocation of village- Exclusion from PAs. :** Experience have reinforced the view that aspirations of people in enclosed habitations within PAs and the objectives of the latter not only clash but cross each other. This clash has laid to annihilation of biodiversity. Hence, centrally located villages should be relocated outside the PA, or at least in the peripheral areas of PA. In the latter case, the new habitation will have to be excluded from the PA limits by readjustment of boundaries.
- 11) **Survey of Corridors:** For long ranging animals like elephants and colonisation of adjacent habitats by the surplus population proliferating from the PAs, corridors need to be identified linking two habitats. Corridors, themselves, may or may not be habitats but should provide safety during travel and migration. These need to be urgently identified and delineated on the map as well as in the field for protection. Where Government lands are not available, some private crucial lands may have to be acquired. This will reduce man-animal conflict.
- 12) **Fire Protection :** In the state, almost half the forests get burnt every year. There is no mechanism for reporting and advance planning to contain forest fire. Undoubtedly, this is the single most scourge affecting maintenance of biodiversity. A system of rewards/ incentives involving adjacent communities need be tried .
- 13) **Alternate strategy for PODU:** Podu has been a destructive factor south of Mahanadi, viz., Kondhmals, Gajapati, Koraput, Rayagada, Malkangiri, Nowrangpur and Kalahandi Districts and in Keonjhar. Traditional approaches for motivating tribals for settled agriculture and SALT (sloped Area Land Technology) methods have not yielded desired results and almost 1/6th forests are burnt every year. Alternate strategy may include rationalising/ dovetailing the practice in small timber fuel wood production system involving the perpetrators. This approach, certainly would contribute to biodiversity .
- 14) **Capacity building of stakeholders / Publications:** There should be regular participatory/ interactive seminar/ workshops on wild biodiversity for exchange of information. Monthly Publication in Oriya, will reinforce the process.
- 15) **Regulation/Control of destructive fisheries:** This will include prescribing the prohibited seasons (breeding season of fish), minimum mesh size, minimum size of harvestable fish use of turtle excluder device and putting in place a system of implementation and monitoring involving fishermen co-operative societies, N.G.Os and Govt.. All incidental catch should be released back to nature. Use of chemicals / pesticides for fish catching should be completely prohibited as this affects shortage of food for fish dependant fauna.
- 16) **Demarcation of CRZ (Coastal Regulation Zone):** There are well laid out criteria for what constitutes coastal zone and its type I, II and III. Certain disruptive activities are prohibited in such zones. This zone all along the coast, lagoon, estuaries and upstream rivers up to tidal influence need to be demarcated on the ground with signage of prohibited acts therein for wide publicity. District revenue/ fishery authorities and wildlife authorities (with PA.s) should monitor cases of violation and be empowered to enforce.
- 17) **Progressive** minimisation of use of fire wood/ Timber: Fire wood is consumed extensively round the clock in roadside Dhabas. Similarly timber, particularly Teak is extensively used in urban areas

leading to the disappearance of valuable forests and sacrilege of biodiversity. Not only there should be a blanket ban on use of fire wood in roadside 'Dhabas', but the use of alternatives be made mandatory. As regards timber, no timber should be used in Govt. buildings in future constructions. As a sequel, sincere attempt should be made to develop and popularise cost- effective and durable alternatives like fibre particle and chip boards, ply wood and fibre glass.

- 18) **Eco-tourism:** Eco tourism is an activity which disseminates sound/ authentic information about a wild land/ species in a natural on –the- spot setting to of nature lover and sends off a friend. Committed to conservation ethics. It has the potential to give a philip to the local economy and opening up avenues of employment for the local people. Such activity can also minimise destructive activity by increased surveillance and providing alternate source of income to local youth.
 - 19) **Cattle immunisation/ Breed improvement :** The first one is a statutory requirement while the second one isw an ecological necessity. Ownership of large herds of cattle need to be discouraged unproductive cattle can be replaced with good breeds for higher yields of milk, which will pave the way for stall feeding and fodder development around PA.s. However, care should be taken to preserve local breed if any .
 - 20) **Mining Plans:** Rudimentary mining plans do-exist but the provisions relating to compensatory afforestation is not rigidly followed. There is a need to have eco- friendly mining plans after detailed study of habitat impact in adjoining area. Such areas around PAs need attention as first priority mines.
 - 21) **Organic farming around PA.s :** Intensive agriculture, its reliance on a set of high yielding varieties, tremendous energy subsidies inform of lift irrigation, use of inorganic fertilisers and pesticides, tractorisation etc. have had its impact on biodiversity. Not only the soil has been rendered marginal by drain of nutrients but elements of biodiversity and bio-indicators like wild fish, birds like patridges and quails small mammals like hares, mangoose, jungle cat and foxes have all vanished. It is now being felt that we have achieved progress at the cost of diversity and quality of life. There is rethinking to revert to organic farming, which may pave way for the return and foster wild biodiversity. At least within enclosed villages of PAs and within a belt of 5Km. from PAs, organic farming with use of bio-fertilisers and bio-pesticides, use of traditional variety of crop and cash crop, not attractive to wild animals need to be made mandatory.
 - 22) **Commercial cultivation of medicinal plants:** Community based commercial farming of medicinal plants need to be encouraged as a matter of State Policy to relieve the PA environs of continued pressure for collection of such plants from the wild. Linkages with user agencies need to be facilitated through CD block, forest and wildlife authorities, N.G.Os. etc.
 - 23) **Biodiversity fund :** A biodiversity fund may be operated in Forests & Environment Department by pooling resources say 0.5-1% of budget of departments using or affecting biodiversity. Such departments may include National High ways, Irrigation, industry, Agriculture, Revenue, Power and Corporate Sector. This will generate substantial amount for study/ research/ taking of pilot projects/ generation of database/ dissemination of knowledge on biodiversity.
- 5.4.1 At the beginning of the third millennium it has been experienced that there is enormous pressure on the wildlife habitats of coastal zones. Therefore separate Strategy and Action Plans for coastal biodiversity are necessary to protect and conserve these fragile ecosystems of Orissa's coastal zone for the continued survival of diversity of plants and animals which they support. They are detailed in next paragraph .
- 5.4 Strategy for coastal aquatic fauna with emphasis on king crabs, turtles, water birds & aquatic mammals

1. Survey, identification, mapping and characterisation of all potential aquatic habitats of the state containing faunal assemblages and faunal biodiversity.
2. Prioritising important coastal aquatic habitats taking into consideration (i) large population size of specific groups of fauna and (ii) occurrence of rare, endangered and threatened species for designating those areas as Protected Areas for initiating conservation action.
3. Investigation of current status, ecology and population size of all coastal aquatic fauna including documentation of types of threats and their magnitude and preparation of State Action Plans for each taxonomic group for focused attention.
4. Implementation of protective legislation, participatory action and conservation awareness programs at all known habitats of all taxa.
5. Protection, restoration and propagation of mangrove ecosystems, sea grass beds and coral reef areas.
6. Initiate collaborative multidimensional research and conservation programmes on coastal aquatic fauna of the state with recognised local and foreign institutions and NGOs by establishment of a Directorate of Coastal Systems Research to take the lead as a Nodal Agency.
7. Initiate specific conservation programmes in-situ for all taxa occurring in the region and ex-situ conservation programmes where necessary and if scientifically proven to be of value.
8. Monitor and evaluate ongoing captive breeding programmes in commercial farms close to all aquatic habitats as there is possibility of introducing parasites and or bacteria to wild populations of coastal aquatic fauna in the course of release.
9. Organise international, national and regional workshops and symposia etc. on each major groups of coastal aquatic fauna and conduct educational programmes at schools and community centres where exploitation is widespread and threat to the local taxons are very high.
10. Periodical assessment and evaluation of all coastal aquatic ecosystems for recommendation of these sites to be designated as 'World Heritage Site/Ramsar Site/ Wilderness areas/ Marine Sanctuary/ Marine National Park/ Biosphere Reserve/ Closed Area etc. based on scientific data.

5.5 Plan of Action on Biodiversity for a Tribal area: Any plan of action of biodiversity for tribal area needs to be preceded by a thorough survey of the area which should include a study of the local culture, beliefs and religious practices and a thorough survey of the fauna and flora of the locality. This is to be followed by a suitable training of tribals. The tribal culture's positive links with biodiversity are to be exploited and their negative cultural traits are to be carefully restrained. In all these steps the tribals need to be consulted and treated as equal partners. The approach should be one of the bottom-up, in no case top down. The tribals themselves will promote conservation of biodiversity with suitable instruments and get benefit out of its sustainable use.

5.6 Strategies for Conservation Ethnomedicinal Biodiversity

5.6.1 Conservation activities for this aspect of biodiversity can be classified into three fundamental area of activities :-

1. *In situ* Conservation including threat assessment.
2. *Ex situ* Cultivation/Plantation including development of effective marketing system.
3. Other allied activities to support the conservation programme.

5.6.1.1 ***In situ* Conservation of Medicinal Plants:** On site (*in situ*) conservation of medicinal plant species in its own natural habitat is the key of success in the process of conservation. Successful *in situ* conservation requires detailed survey, identification, assessment of population, density, growth pattern, stock mapping of medicinal plants and its effective protection and prevention against damage due to various factors including active participation of local inhabitants and NGOs. The following Key areas for *in situ* conservation measures have been identified in the Eastern Ghats Eco-region covering the state of Orissa keeping in view of the rich biodiversity of such areas.

- a) Gandhamardan forest in Bargarh and Bolangir District.
- b) Malyagiri forest in Angul District.
- c) Similipal forest in Mayurbhanj District.
- d) Mahendragiri hills in Parlakhemundi District.

5.6.1.1.1 **Activities for *in situ* conservation:** Keeping in view of the historical, religious and social importance along with rich resources of medicinal plant species, special emphasis is being given for *in situ* conservation of biodiversity of Gandhamardan Hills. Similar action plan can also be made for other key *in situ* conservation areas of the state as mentioned above.

- a) Protection of *In situ* conservation area of Gandhamardan Hills –
It is suggested to identify and demarcate four sample areas of Gandhamardan hills (2 in either side of the Hill Range) for *in situ* conservation measures covering over an area of 16 Km² in each patch. Thus 64 Km² of Gandhamardan forest area out of 300 Km² can be well protected with barbed wire fence along the periphery of the *in situ* conservation area.
- b) it is suggested that *Bambusa arundinacea* or any thorny medicinal plant species like *Ceasalpinia crista* etc. shall be planted along the barbed wire fence of the *in situ* conservation area to develop effective fence.
- c) The area has to be well protected from fire.
- d) The *in situ* conservation area shall be protected with the active participation of local forest community (JFM).
- e) Silvicultural operations like pruning, multiple shoot cutting and provision of earthen mounds etc. shall taken up to promote population and growth of medicinal plant species in the *in situ* conservation area.
- f) Enrichment plantation with medicinal plant species shall be done in the openings exceeding 0.5 ha *in situ* conservation areas so as to enrich the medicinal wealth.

5.6.1.2 ***ex situ* conservation of medicinal plants :**

5.6.1.2.1 **Establishment of Permanent Nursery and Training Centre:** At least two permanent Nurseries along with training centres near each *in situ* conservation area long with herbal garden should be maintained to extend support to farmers for cultivation of commercially important medicinal plants. Further, one permanent nursery along with a training Centre should also be established in each district.

5.6.1.2.2 **Establishment of Herbal garden:** At least one herbal garden in each block should be established not only to conserve medicinal plants, but also to create awareness amongst people regarding value of medicinal plants, Seedlings can also be supplied to interested farmers for cultivation. The species (see table

5.1) are recommended for cultivation on priority basis in the state of Orissa. The list also includes some of the species recommended by planning commission and Government of India, Health Department for cultivation.

5.6.1.3 Strategy for marketing of medicinal plants :

5.6.1.3.1 There is substantial volume of internal trade in medicinal plants in Orissa. A typical chain of transaction starts from primary collectors, followed by local agent, whole sale market at the nearest town, then to whole sale market at the nearest city and then to whole sale market at the important city in the country and finally to the pharmaceuticals. Such chains of transactions in the medical plant trade is further compounded by the general attitude of secrecy for which it is difficult to collect dependable data regarding the trade. In the process, the primary collectors are the worst sufferers and they hardly get 5 to 15% of market price. 85 to 95% of the cost of raw material goes to the middle men/traders (see Table 5.2).

5.6.1.3.2 It is therefore absolutely necessary to provide direct market linkage to the primary collectors/cultivators that with the manufacturers. This would also help in improving the economic condition of the rural poor. There is also need to establish medicinal plant growers co-operative societies to provide effective marketing linkage. This would prevent adulteration of crude drugs by the middle men/traders and help th manufacture quality medicines. The Pharmaceuticals units should be asked to meet at least 50% of their requirement of raw materials from captive plantations/cultivation of medicinal plants.

5.6.1.3.2 Other Activities For Conservation Of Medicinal Plants:

5.6.1.3.2.1 **Documentation Of Knowledge On Ethno-Medicine :** Ethno-botanical information including knowledge on ethno-medicines in respect of the state of Orissa have been documented since 1942. S. Binu *etal* (1992) have already reported in their paper “An outline of ethno-botanical research of India” published in the Journal of Economic and Taxonomic Botany, additional series number 10, (1992), reprinted in Ethno Botany in India 1993 by J.K. Maheswari *etal* regarding the literatures published from 1942 to 1990 on ethno botanical studies in Orissa. In addition to the literatures cited by Binu *etal* (1992) as above, studies on ethno botany including ethno medicine of Orissa have also been reported by Patnaik 1956, Girach and Aminuddin 1988, Girach and Aminuddin 1989, Pal 1992, Satapathy and Panda 1992, Mishra 1992, Hota 1998, Sen *etal* 2000, Sen *etal* 2001. Still there is vast scope to document rich knowledge available with folk practioners in the State of Orissa. It is observed that they do not usually share their knowledge with outsiders till they develop confidence. Keeping this problem in view, a society of traditional healers has been established under the name “Herbalist Association, Narasinghnath” based at Padampur in the district of Bargarh. A bimonthly magazine ‘Banashudhi’ in Oriya language is being published by the society. Indigeneous knowledge on ethno-medicine is being documented regularly in all the issues of the magazine since 1994 till date. But the information is mostly limited to Bargarh, Bolangir, Sonapur, Sambalpur, Napada and Kalahandi District. The significant aspect of the documentation is that due credit is given to the informants. Their name and address is reported in the magazine. Therefore they generously continue to share the knowledge. However, systematic study of such rich knowledge is still necessary fur further research regarding ethno-medicine.

5.6.1.3.2.2 Amendment Of Forest Policies :

- i. The forest area for Joint Forest Management (JFM) should be increased from 200 ha to 500 ha Wherever possible.
- ii. Traders of Non Timber Forest Produce (NTFP) should be punished for payment below minimum support price to the primary collectors.
- iii. Minimum support price for other medicinal plant products not included in the list mentioned in the Government Policy of 31st March 2000 should be notified to ensure proper payment to the primary collectors. E.g. Pengu, Vidanga etc.

- iv. There is need to establish a number of medicinal plant growers society for effective marketing system.
- v. The abandoned panchayat orchards can be utilised for cultivation of medicinal plants.

5.6.3.2.2.3 **Awareness Generation :**

- (i) The local NGOs should be involved in creation of awareness amongst people for conservation of medicinal plants.
- (ii) It is urgently required to generate awareness amongst people to stop felling of medicinal trees like Aonia, Harida, Phanaphana etc to prevent further destruction.
- (iii) The District Sakhuarata samiti where in the Collector in the Chairman can be involved in creating awareness amongst people.
- (iv) People's movement through rallies, exhibition, meetings, work shops, seminars, cultural activities, media should be organized to create awareness amongst people on conservation of medicinal plants. This would create new positive link between people and Bio-Diversity.
- (v) There is need to launch massive public awareness on use of medicinal plants for primary health care so as to strengthen the conservation efforts and also to meet the day to day health care needs of the people.

5.6.3.2.2.4 **Research Activities :**

- (i) It is necessary to conduct research to develop agro-technologies for some of the slow growing medicinal plants like Harida, Bahada etc.
- (ii) It is also necessary to study the efficacy of medicinal plants being used in ethno medicine.
- (iii) Study of marketing channel of various medicinal plants for realistic assessment of the price.

5.6.3.2.2.5 **Action to reduce negative links :**

- i. Traders and smugglers are cutting fruit bearing trees such as Aonla, Harida etc. for easy collection of fruits and also for collection of bark such as Phanaphana, Lodhra, Maida, Chhatian etc.
- ii. Deterrent punishment to the offenders, cancellation of trade license, black listing the traders and developing positive attitude amongst the local people through awareness generation can help to reduce negative links.
- iii. There is urgent need for capacity building and orientation programme for the forest staff to face the present crisis and to prevent further degradation of the bio-Diversity.

5.7 **Strategy and Action Plan for Conserving Sacred Groves Biodiversity :**

5.7.1 Important ecological services provided by sacred groves and reported in the literature are – **Recharge of aquifers and soil conservation and in nutrient cycling.** These factors indicate that the conservation of sacred groves is essential for maintaining local/ regional biodiversity, the comprehensive health of a landscape and preserving the socio-cultural integrity of local communities. The existing sacred groves thus provide far greater benefits than their small size otherwise would indicate.

5.7.2 The ownership of a sacred grove has a profound effect on its condition. Groves may be on private land, on property owned by temple trusts or by governmental agencies such as the forest or the revenue department. Observers are divided in their opinion over whether the forest department should own and notify sacred groves. The other way is to empower the communities to treat the sacred groves as their own resources and exercise the ecological understanding they have had in the past.

5.7.3 Indigenous people have a vast wealth of knowledge about their environment built up over centuries. There is strong need to promote such indigenous people's based packages for further rejuvenation of the traditional ways and means of biodiversity conservation. Such socio culturally protected areas would have been more conducive if one could value biodiversity in terms of utility, culture and religion. The values may change with time as when allopathic drugs supplement with the use of herbal remedies. These local systems would guide to organise a local, regional, national and global effort for conservation of biodiversity (Singh, G.S. 1997). Such system would supplement with the modern ways of protecting sanctuaries, national parks and biosphere reserves.

5.7.4 In addition to that Traditional Resource Rights (TRR) system is need to be implemented for the indigenous communities for a better management and conservation of natural resources. Recognizing local community rights over common pastures, forest and water bodies, would be a powerful incentive to these communities to conserve. But at the same time the communities should not forget to follow their responsibilities strictly in preserving their forest and biodiversity.

5.8 Strategies and action plan for conserving agri-diversity

- ◆ Collection and conservation priorities should be established to address collection completeness including close wild relatives and non-crop-related species that may possess useful genes from different agro-ecosystems of the state.
- ◆ Policy should be developed for collecting crop genetic resources i.e. Land races / primitive cultivars, under utilised and lesser Known plants, wild relative crops viz., *Oryza rufipogon*, *Cajanus cajanfolia*, wild economic plants, lesser known economic plants, ethnobotanically important taxa/crops and the endangered plant species and unattended including aquatic, industrial plants etc. including endangered species of native and exotic taxa and should include consideration of *in situ* conservation where appropriate.
- ◆ Documentation of the existing ethno-botanical, traditional and indigenous knowledge related to Plant Genetic Resources.
- ◆ Collection must be maintained in both state and national repositories and plan should be developed for monitoring, supporting and conserving important collections. The collections should characterised in areas that are ideal for their growth and performance.
- ◆ Promulgation of a law recognizing the rights of the state over all genetic material.
- ◆ Identification of elected panchayats as the agency to issue licenses for collection with the provision for sharing with higher agencies.
- ◆ Special agencies and funds to train people in surveying and utilizing the genetic wealth.
- ◆ Regeneration, maintenance and preliminary evaluation of collected germplasm for biotic/abiotic stresses and quality traits can be carried out including biochemical evaluation where needed.
- ◆ Development of database on collection, characterisation, utilization of crop plant and their wild relatives.
- ◆ Medium and long term storage of collected/evaluated material in the form of seeds should be conserved in the state gene bank. In vitro conservation of germplasm of various vegetatively propagated species (tuberous, bulbous, spices and tropical and temperate fruits) and recalcitrant/suborthodox seeds and pollen using cryo preservation technique.
- ◆ Combined conservation strategy; encourage on farm *in situ* dynamic conservation.
- ◆ Eco-development and wetland conservation, establishment of botanical gardens, Zoos, protected areas, biosphere reserves, ecological hot spots etc.
- ◆ Promoting income generating activities among farming/tribal communities and motivate youth generation (educated/uneducated) to take up agriculture as a means of livelihood.
- ◆ Establishment of sustainable agriculture training centre involving village farmers educated youth and scientists.
- ◆ Networking of surplus agricultural commodities, marketing, value addition etc.

- ◆ Establishment of community gene centres for preserving agri-diversity.
- ◆ Registration of important genetic material, patents etc.
- ◆ Awareness programmes at grass root level, public campaign, organization of diversity fair, exhibition, plantation, programme etc.

5.9 Strategies for Soil and Microbial Biodiversity

- Encourage people's participation in conservation efforts, and in restoration of lost and degraded habitats of soil organisms.
- Intensify education and awareness programmes on all aspects of biodiversity among all sections of local communities.
- Encourage studies and researches on soil organisms with emphasis on their taxonomy, zoogeography, ecology, life cycle pattern and application of developed technology like use of bio-fertilizers, vermicomposting, etc.
- Encourage capacity building in the field animal taxonomy and conservation of soil organisms.
- Determine exotic species of soil invertebrates and their impact on native species and ecosystem functioning.
- Encourage effective enforcement of acts and laws aimed at animal biodiversity conservation.
- Provide liberal funds for soil biodiversity related programmes and projects.

5.10 Strategy for Domesticated Animals

- Identification and documentation of local strains/types of different species of domestic animals and birds of the different regions of the state.
- Recognizing the role of indigenous strains/types in the socio-economic status of the rural household.
- Different animal husbandry systems practiced in the different areas has to be identified and evaluated.
- While taking up genetic up-gradation programme for improvement of production of the indigenous domestic animals, care should be taken to conserve the local strains/types.
- Planned breeding by rigorous selection methods and using progeny tested bulls be adopted on priority basis among the existing local strains/types for their conservation.
- Awareness creation among the rural mass regarding the importance of biodiversity among domestic animals is needed.
- Research investigations on biodiversity of domestic animals be encouraged at all levels, particularly at the State Agricultural University as follow up programme to works already undertaken by various workers.

5.11 Strategy and Action Plan for Biodiversity of Fishes and Aquatic Fauna

5.11.1 Government of Orissa having declared fish culture as an industry should have policy and strategy now to serve both the needs of conserving biodiversity of fishes and of increasing economic production. An action plan has been detailed in Annexure 5.2.

- Census of fish species and allied animals in wetland areas limited by considerations of habitat. This will facilitate establishment of sanctuaries, common analysis of environmental parameters in wet lands, apportionment of wetland for culture or biodiversity maintenance or to combine both in some cases for economic sustainability.
- Both conservation and propagation of fishes require certain amount of legal support like closed areas and seasons to fishing, regulation of fishing boats and gear, controlling irrational fishing methods and controlling pollution.
- All fisheries officers, particularly FEOs and Assistant Directors should be trained in fish taxonomy with assistance from ZSI.
- Detailed effect of all types of pollution will be studied by fishery officers and bioassay experiments conducted with assistance from CICFRI.
- Development of rivers to be given the highest priority.
- Potential of reservoirs to produce fish seeds will be utilized.
- A working group to prepare comprehensive development plan of wetlands with ecosystem planning.
- List of fishes correlated with environment will be prepared with the assistance of the Bureau of genetics, Lucknow.

5.12 Strategy for Water Resources

5.12.1 The present study has attempted to establish the fact that Major and Medium Irrigation Projects are indispensable for the State and the State must continue its endeavour to construct more and more new projects to sustain its development. Besides providing assured irrigation for agriculture production, they will continue to play key roles in flood control, power generation and fish production.

5.12.2 Besides it has also emphasized on the adverse impacts of these large Irrigation Schemes should not be under estimated and ignore. The increased deforestation and accelerated soil erosion in the catchment area caused rapid siltation of the reservoirs and jeopardize the economic benefits to be obtained from these costly projects. Similarly, the food crisis in the irrigation commands may be solved by these projects but due to faulty irrigation practices, the soil productivity and drinking water sources may be irreversibly affected making them unsuitable for use. In order to sustain the overall usefulness of these projects, mitigative measures must be taken in true spirit. These precautionary measures are much discussed, but less attended to. Policy measures and inter departmental linkages must be strengthened to alleviate the environmental impacts of the Water Resources Projects.

“Experience tells- Many civilizations flourished due to water and many of them perished due to water.”

5.13 Strategy on mineral resources of orissa, their exploitation and impact on biodiversity

5.13.1 Mining leads to ecological degradation causing a great damage and loss of biodiversity but we can not do away with mining. Therefore solution, must be found out to allow mining with minimum damage to our biological resources. And the problem can be solved if the following practices are followed strictly.

(i) Top soil management in the mining site: In the mining site suitable methods of top soil management and restoration of natural vegetation should be made. It has clearly been mentioned in the mining Act 1960 that the top soil removed in the mining area while refilling it should be spread over on the top of barren soil, so that natural vegetation can come up. But in no mining site this practice is being followed. It seems the mines ignore the importance of top soil and dump it wherever they like and at times even cover it with the soil coming from under ground. Therefore, the top soil which acts as a natural seed bank becomes useless and on the barren soil on the top no species can grow.

These the mines plant source exotic species on it for the sake of plantation and claim that they are also during compensatory afforestation. It should be kept in mind that a natural vegetation and balanced ecosystem can not be compensated through man made afforestation. So on the properly n utilized top soil native species should be allowed to grow naturally.

(ii) Peripheral Development:- It is very common that mining attracts other industries (small or big) to develop nearby. A lot of building, long roads and extensive transportation are made in the mining site. Human population in the mining area (which was originally a patch of forest) increases. Human population exerts much pressure on the forest for its various demands from the forest directly or indirectly affects the forest vegetation and biodiversity.

So, miners should find every ways by providing all the facilities to the increased human population so that they become least dependant and exerts no pressure to the adjoining forest areas. It has been observed that to satisfy the political desires and for publicity much of the work in the name of peripheral development is done in the urban areas giving least importance to the disturbed area.

(iii) Development of Nursery : The hills produced as overburden in the mining site should be tried for afforestation of indigenous species grown, developed and acclimatized in the locality.

(iv) Public Surveillance : The mining site should properly be inspected at regular interval by Government, non-Government and NGOs to see whether the miners stick to the regulations or not.

(v) Preservation of Sample areas through diversified island protection: In each and every mining site at least 5,10 or 15% of the leased area should be kept undisturbed and protected which shall remain as an eye opener for the miners, beneficiaries and general public to compare past with the present and predict the loss we are making to our bio-resources.

(vi) Provision of academic support: Academic support should be provided by the mines to researchers to make taxonomic compilation and scaling of diversity (indexing) by adopting different evaluation procedure and recommending suitable measures to check the loss to our Biodiversity from time to time.

5.14 Strategy for Women in Biodiversity

To promote dissemination of gender relevant knowledge and valuations of women's roles through formal and non-formal education,

- To increase the proportion of women in decision making, planning and management of Biodiversity (in sectors and regions),
- To facilitate factors for development of women for biodiversity conservation (main factors are economic, demographic, social, legal, situational, institutional and technological).

5.15 STRATEGY FOR BIODIVERSITY CONSERVATION IN ECOREGIONS

5.15.1 MAHENDRAGIRI

5.15.1.1 Certain steps should be taken to rehabilitate the ecosystem, archaeological wealth and economic condition of the tribes in and around Mahendragiri system. Mahendragiri-Singaraj-Deogiri complex forming the Mahendragiri system spreads over an area of approximately 2,000 sq km. Mahendragiri occupies a unique place in the ecological map of the country. But years of degradation of its resources has made the Mahendragiri an ecologically fragile area. Hence immediate steps should be taken for its ecological resurrection and for the maintenance of its ancient monuments. Efforts should also be taken to develop it as a complex of eco-tourism or Eco-tourist center.

1. A thorough survey of flora and fauna may be done and 'Rare', 'Endangered', 'Threatened' and 'Vulnerable' species be identified to be listed as per the IUCN Red Data Book.

Appropriate measures be taken immediately to protect and conserve the wildlife by bringing the area under a sanctuary. The elephant population is more than 40; therefore, in fitness of things, an elephant reserve may be created immediately.

2. With primitive tribes residing here, the area offers tremendous scope for ethno-botanical exploration.

3. Horticultural, silvicultural and agroforestry operations be taken up to rehabilitate the degraded forest (due to 'Podu' and other operations) as well as the economy of the tribes. Added to this, forest based traditional cottage industries or tribal trades like bamboo and crane crafting, mohua, honey, oil, medicine, leaf-cup making, etc., may also be encouraged to step up the economy of the people so that the pressure on natural resources of the forest is reduced.
4. The existing archaeological monuments may be properly protected and intensive excavation works be undertaken to discover ancient archaeological structures. This should boost up the prospects of tourism.
5. Educational and awareness programmes may be taken up to raise the level of eco-consciousness and also to eradicate social evils like drinking which ruins the socio-economic life of the tribal poor.

5.15.2 CHILIKA LAKE

5.15.2.1 A participatory approach to Chilika lake for biodiversity conservation has already been put to action plan (see Annexure 3.8). The overall strategy for conservation of Chilika Biodiversity is

- ❑ Adopting river basin approach for management of wetland biodiversity
- ❑ Integration of biodiversity into district/ region/state/ national level planning to minimize impacts of developmental activities
- ❑ Participatory approaches involving local communities, scientists, NGOs and concerned organizations to ensure sustainability of activities
- ❑ Adopting preventive measures by combating the problems at source level to minimize recurring costs
- ❑ Revival of indigenous knowledge and traditional practices which are cost effective for management of wetland biodiversity
- ❑ Application of knowledge based techniques for restoration through research and development activities
- ❑ Periodic monitoring and evaluation with focus on achieving the goals and objectives rather than mere activities.

5.16 DISTRICTS STRATEGY AND ACTION PLAN

5.16.1 SAPs for three representative districts namely Angul, Deogarh and Sambalpur have been prepared and they are placed at Annexures 3.9, 3.10 & 3.11 respectively. These districts have significance of being extremely biodiversity rich areas with industries & mining activities, no industrial & mining activities of significance and developing urbanization with mining respectively.

5.17 INDICATORS OF PROGRESS TOWARDS GOAL

- **Greater consumer demand for organic , biodiverse food and agro produce**
- **Greater stocking of local and diverse produce – grain bank, seed bank etc.**
- **Greater outflow of varieties from gene banks to farmers**
- **Increased demand for certification of organic produce and forest produces**
- **Greater documentation of traditional knowledge and success stories**
- **Drop in demand for chemical fertilizers and pesticides**

- **Evaluation of biodiversity and environmental quality at various sites**
- **Emergence and use of viable alternatives**
- **Greater levels of community participation**
- **Increasing environmental auditing and media coverage : quantum & quality**
- **Environmental cells created within development sectors and departments - monitoring and decisions on biodiversity conservation**
- **EIA guidelines changes towards biodiversity integration**

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