CHAPTER - I

NATURAL RESOURCE ASSESSMENT: ENDOWMENTS, UTILISATION AND DEGRADATION

Natural resource is the base on which development takes place, particularly at the early stage. The most important of such base is of course agricultural land. The earliest civilisations came up in the fertile river valleys. And, in contemporary times, fertility of the soil has been the single most important factor in determining the "carrying capacity" of land and hence population density. Though the importance of natural resources declines with growth of "footloose" manufacturing industry in advanced countries, natural resources, besides having economic value for export, provide basic livelihood support to a large number of people in developing countries.

A broad definition of natural resources has therefore always emphasised their human usefulness aspect. Thus: "Natural resources could refer to all the living and non-living endowment of the earth, but traditional usage confines the term to naturally occurring resources and systems that are useful to humans or could be under plausible technological, economic, and social circumstances" (Howe 1979 : 1). The above definition also emphasises the fact that natural resources would become useful for human beings under certain technological, economic and social circumstances and hence through active human intervention.

Table - 1.1

Types of Natural Resources

Renewable		Non-renewable		
Critical Zone	Non-critical Zone	Consumed by Use	Theoretically Recoverable	Recyclable
Fish	Solar Energy	Oil	All Elemental Minerals	Metallic Minerals
Forest	Tides	Gas		
Animals	Wind	Coal		
Soil	Surface Water	-		
Water in Aquifers	Air	-		

Source: Rees, Judith (1985), *Natural Resource: Allocation, Economics and Policy*. London : Methuen.

From the point of view of sustainable utilisation (as stocks are not unlimited), the standard distinction within natural resources is that between renewable and non-renewable. Table-1.1 presents illustration of these two types of natural resources.

A look at this table suggests that within the group of renewable resources, there are certain categories (fish, forest, soil, ground water etc.) which are potentially vulnerable to depletion due to overexploitation, mismanagement or neglect: in such cases renewability is not guaranteed and there are known instances of running down of resource stocks. On the other hand, within the group of non-renewable resources, there are those that are simply consumed by use (such as coal, petroleum, natural gas) while there are those (all minerals) which are theoretically (i.e. provided requisite technology is available and cost price conditions make it economically feasible) recoverable for use as intermediate inputs after necessary processing. Within the group of minerals, metallic minerals are potentially recyclable (e.g. as metallic scrap).

This chapter has been divided into two parts. In Part I, we deal with the estimated stock and rates of utilisation of five major minerals having commercial value : agricultural land; mineral; forest; water, and fishery (inland and marine). In Part II, we go into the question of degradation of the following resources which are critical and particularly severe in the case of Orissa : forest; land; minerals, water and air. While the degradation of the first three resources have a

disruptive effect on livelihood options, in the case of last three, there is an environmental cost which affects the entire society in different ways.

PART I : NATURAL RESOURCE ENDOWMENTS AND UTILISATION

LAND RESOURCE

Information on land resource by soil type is given for an area 15.48 million hectares. Out of this, net sown area of the state was 5.06 million hectares in 1990-91.

Table - 1.2

Broad Classification of Soil Types of Orissa

Sl. No.	Types of Soil	Approximate Area ('000 Ha)	Percentage Distribution
1.	Red loam and red sandy soils	7050	45.54
2.	Mixed red and yellow soils	5440	35.14
3.	Black soils	960	6.20
4.	Laterite and lateritic soils	700	4.52
5.	Deltaic alluvial soils	670	4.33
6.	Coastal saline and sandy soils	390	2.52
7.	Brown forest soils	170	1.10
8.	Mixed red and black soils	100	0.65
Total Area		15480	100.00

Source: *Agriculture in Orissa*; Directorate of Agriculture and Food Production, Orissa, Bhubaneswar.

As can be seen from Table- 1.2, as much as in 45% of area, the soil is of the red loam and red sandy variety and another 35% is of mixed red and yellow variety. Thus there is a predominance of light textured red soil in the state. Fertile alluvial soil accounts for only a little more than 4% of the area.

Thus, in terms of the relative soil quality index, we can see (Table- 1.3) Orissa's position is the fourth lowest among the 17 major Indian states.

Table - 1.3

Quality of Soil – Indian States, 1976/77

States	Quality of Soil Means (Index)	States	Quality of Soil Means (Index)
Andhra Pradesh	0.73	Madhya Pradesh	0.37
Assam	0.73	Maharashtra	0.37
Bihar	0.58	Orissa	0.54
Gujarat	0.61	Punjab	1.09
Haryana	0.99	Rajasthan	0.40
Himachal Pradesh	0.73	Tamil Nadu	0.87
Jammu & Kashmir	NA	Uttar Pradesh	0.75
Karnataka	0.68	West Bengal	0.79
Kerala	1.22	India	0.65

Source: Bhalla, Surjit S. (1988) : "Does Land Quality Matter? Theory and Measurement" *Journal of Development Economics*, Vol. 29, No. 1, pp. 45-62.

Apart from the intrinsic quality of the soil, there are two characteristics of the land resources that need to be considered: water retention capacity of the soil and erodibility of the soil. As regards water retention capacity the two predominant types of soil in Orissa have rather low capacity to hold water for long periods (though slightly higher than that of laterite and lateritic soils), because of their highly porous nature. Other things remaining the same (such as slope of land, existence of watersheds), the erodibility of these two types of soil is also high because of their light textured nature and weak granular structure.

MINERAL RESOURCE

Alongwith the states of Bihar and Madhya Pradesh, Orissa is one of the most mineralised states in India. Its share in all-India estimated stock of some important minerals may be seen from Table- 1.4. In all cases, this share is much greater than the state's share in all-India area.

From Table- 1.4, we find that, for a number of important minerals, Orissa's share in all-India output is much less than her share in all-India resource stock, implying thereby a relatively a lower rate of exploitation in the case of Orissa, which is particularly true of bauxite, coal and iron ore. It is also of concern that in the 1990s the share of Orissa in all-India output has declined in the case of coal, dolomite, fireclay, graphite and iron ore (during the first half of 90s).

Table - 1.4

Share of Orissa in All-India Resource Stock and Output, 1991-92 to 1999-2000

Minerals	Share (%) of Orissa in all-India					
	Resource Stock			Output		
	1991-92	1994-95	1999-00	1991-92	1994-95	1998-99
Bauxite	69.7	52.66	59.50	38.9(1)a	43.88	43.65
Chinaclay	10.8	17.31	31.50	1.4	1.37	1.08
Chromite	98.4	98.39	98.40	92.2(1)	*98.25	98.87
Coal	23.8	23.63	24.80	19.2(4)	10.70	14.83
Copper ore	0.9	0.82	b	b	0.00	0.00
Dolomite	12.2	15.26	17.90	55.1(1)	42.01	31.75
Fireclay	12.5	26.52	25.60	19.8(2)	23.26	1.42
Graphite	32.6	16.86	71.00	89.0(1)	80.00	67.00
Iron ore	26	33.41	32.90	15.5(5)	12.42	16.30
Limestone	1.6	1.62	2.10	2.8(8)	2.39	16.31
Manganese ore	31.8	29.09	67.60	12.3(1)	34.52	33.27
Nickel ore	95.2 c	95.09	91.80	b	b	b
Total	18.5	17.34	19.72	9.7	10.00	31.97

Note: a : Figures in parentheses refer to Orissa's rank among the states of India in terms of production.

b : Not yet exploited.

c : Orissa's resource stock is a high 220 million tonnes out of the estimated all-India figure of 231 million tonnes.

Source: 1. For the year 1991-92 (resource stock and output), the data has been taken from Government of Orissa (1992), *Mineral Statistics of Orissa*. Directorate of Mining and Geology, Appendix IX, p.15,33.

2. For the year 1994-95 (resource stock and output), from *Economic Survey , 2000-2001*, Government of Orissa, Directorate of Economic and Statistics, Planning and Coordination Department, Govt. Orissa.

3. For the year 1998-99 (output), from *Indian Mineral Yearbook 1998-99,* Indian Bureau of Mines, Nagpur.

4. For the year 1999-2000 (resource stock), unpublished data of Directorate of Mining, Bhubaneswar.

At the same time, in absolute terms, output - resource stock ratio has been well below one percent for all important minerals except graphite and manganese ore (Table- 1.5): cumulative extraction over the 45 year period has also been pretty low (Table - 1.5).

Table - 1.5

Rate of Extraction of Important Minerals in Orissa

Minerals	Rate of Extraction (Output to Resource Stock Ratio, 1990-91)	Cumulative Extraction (1947-1992) as % of Total Resource Stock (as of 1991)
Bauxite	0.11	N.A
Chinaclay	0.03	N.A
Chromite	0.5	6.2
Coal	0.04	0.3
Dolomite	0.26	4.1
Fireclay	0.14	N.A
Graphite	4.00	53.3
Iron Ore	0.27	7.6
Limestone	0.26	9.8
Manganese Ore	1.28	40.8

Source: Govt. of Orissa, *Mineral Statistics of Orissa, 1991-92*, pp. 2-3; 79, Directorate of Mining and Geology.

In this connection, it is important to make one point, which could partly explain a low rate of exploitation. This point rests on an essential distinction between “resources” and “reserves”. The most important term is “resources”, which refers to all deposits, whether geologically identified or simply speculated to exist and whether economically exploitable with present technology and market conditions or not. “Reserves” is a term restricted to deposits that are geologically identified and are currently economically exploitable. In short, “resources” are a function of exploration technology while “reserves” is a function of market condition.

We may point out the following factors to explain a low rate of exploitation.:-

- unfavourable cost-price conditions
- excess supply
- poor forward linkages within the state.

Mineral appears in their elemental state and need to undergo several stages of processing before final use; by their very nature, there is lot of scope for value addition here. However, value addition per unit of output is poorly developed in the state (Table- 1.6), mainly because value-adding industries (such as coal washeries; benificiation and pelletisation plants; crucible-making industries) are either non-existent or poorly developed within the state.

Table - 1.6

Relative Value-added Output Ratio, Orissa and all-India, 1991-92 (Mining and Quarrying Sector)

Share(%) of Orissa in all-India	
Value Added	Output
4.1	9.7

FOREST RESOURCE

Unlike mineral resources, forest resources are renewable, but there is a critical zone (see Table- 1.1 above) in the sense that depletion can result if the rate of utilisation exceeds the rate of regeneration. Moreover, what is crucial in the case of forest resources is not simply the area under forests, but the density of tree cover- this essentially determines the quality of forests, though not necessarily its commercial value.

Apart from the commercial value of various kinds of forest produce and the significant livelihood support that it provides, forest cover plays a unique and critical ecological role in regulating natural run-off of water, thereby checking soil erosion in the catchment areas of major rivers, and floods in the deltaic regions.

Table - 1.7

Actual Forest Cover Based on Satellite Data, Orissa (Sq. kms.)

Year	Total Geograph -ical Area	Area under Closed Forest	Area under Open Degraded Forest	Area under Mangrove Forest	Total Forest Area	Forest area as % of Geograp- hical Area	Closed Forest Area as % of Geographical Area
1972-75	155707	37320 (77.13)	10829 (22.38)	234 (0.48)	48383 (100.0)	31.07	23.97
1980-82	155707	28812 (73.08)	10386 (26.34)	227 (0.58)	39425 (100.0)	25.32	18.50
1990-91	155707	27349 (57.94)	19661 (41.65)	195 (0.41)	47205 (100.0)	30.32	17.56
1995	155707	27163 (57.66)	19749 (41.92)	195 (0.41)	47107 (100.0)	30.25	17.44
1997	155707	26101 (55.60)	20629 (43.95)	211 (0.45)	46941 (100.00)	30.15	16.76

Note: 1. Closed forest refers to forest with more than 40% crown density, whereas Open degraded forest refers to forests with less than 40% crown density.

2. Figures in the parentheses indicate percentage share to total forest area.

Source: For the first two time points, Govt. of Orissa, Remote Sensing ApplicationCentre, Dept. of Science, Tech. and Environment. For the last three time points, Govt. of India, *Forest Survey of India* (the state of Orissa Forest Report), 1991, 1995, 1997.

It is interesting to note from the relevant data on the extent and status of forest in Orissa (Table- 1.7) that the area under forest as such has remained around 30 percent between 1972 and 1997 which is close to the recommended norm. However, this is misleading. This does not say anything regarding the extent of degradation of forest resources and hence the extent of effective forest cover. These are provided by satellite data (see Table- 1.7, last two columns). As per the extent of degradation, this is captured by closed forest area as percent of total forest area: we find that this has come down to 55.6 percent in 1997 from 77.13 percent during 1972-75 (Table- 1.19). In other words, nearly half the forest area is degraded. Thus, closed forest area as percent of total geographical area - a measure of *effective* forest cover - has become only about 17 percent. (A detailed analysis of degradation has been presented in Part II).

Looking at the individual districts, we find (Table- 1.8) some inter-district variations. Taking the districts with more than 30 percent of area under forest, we find that the extent of degradation is relatively more in all the districts (Koraput, Ganjam, Phulbani, Kendujhar), compared to the

state as a whole and is relatively much less in Mayurbhanj and Sundargarh.. Effective forest cover (closed forest area, as percent of total geographical area) has thus become particularly low for certain districts with large percent of geographical area under forest : Koraput (12.27); Kalahandi (13.52); Ganjam (15.08). On the other hand, in the case of Mayurbhanj and Phulbani districts, effective forest cover has remained close to one- third of geographical area.

Table - 1.8

Districtwise Proportion and Distribution of Closed Forest (1997)

Districts	Percentage of Closed Forest Area to Total Forest Area	Percentage of Closed Forest Area to Total Geographical Area	Total Forest as % of Total Geographical Area.	Percentage of Closed Forest Area of the District to Total CFA of the State	Percentage of Total Forest Area of the District to Total Forest of the State
1. Baleswar	54.18	2.77	5.12	0.67	0.69
2. Bolangir	48.35	6.99	14.46	2.20	2.52
3. Cuttack	50.63	4.33	8.54	1.85	2.03
4.Dhenkanal	63.14	20.95	33.18	8.69	7.65
5. Ganjam	41.08	15.08	36.72	7.26	9.82
6. Kalahandi	51.99	13.52	26.01	6.10	6.52
7. Kendujhar	49.08	20.94	42.67	6.66	7.55
8. Koraput	43.80	12.27	28.01	12.67	16.09
9. Mayurbhanj	84.03	31.07	36.97	12.40	8.21
10. Phulbani	51.28	29.70	57.92	12.62	13.69
11. Puri	59.14	12.04	20.36	4.70	4.42
12. Sambalpur	63.87	21.00	32.88	14.09	12.27
13. Sundergarh	65.67	27.12	41.30	10.09	8.54
Orissa	55.60	16.76	30.15	100.00	100.00

Source: Govt. of India, *State of Forest Report, 1991,1997*, Ministry of Environment and Forest.

WATER RESOURCE

In tropical monsoonal agriculture, artificial irrigation is absolutely essential for crop survival and optimum crop growth for a number of crops. This is particularly true of new varieties for certain

crops. So much so that in the context of Asian agriculture, irrigation has been termed the 'leading input'.

Table -1.9

Per capita Ultimate Irrigation Potential for Orissa and Low-income States

States	Ultimate Irrigation Potential, Major, Medium & Minor (In Million Ha.)	Total Population (2001) (In Million)	Per capita Ultimate Irrigation Potential (In Ha.)
1. Orissa	8.803	36.71	0.24
2. Bihar	13.347	82.88	0.16
3. Madhya Pradesh	17.932	60.38	0.30
4. Uttar Pradesh	30.499	166.05	0.18
5. Rajasthan	5.128	56.47	0.09
All India	139.893	1027.01	0.14

Source: Planning Commission, Govt. of India.

Orissa has a total ultimate irrigation potential of 8.8 million hectares. In per capita terms, Orissa has better endowment than other low-income states (except Madhya Pradesh) and all-India (Table- 1.9). However, what is relevant is to see whether, in relation to cultivable land, there is an 'abundance' of water resource. In other words, the question is, which is a more scarce resource: land or water?

According to one estimate, in the case of Orissa, when the ultimate potential is fully utilised, it can irrigate about 90 per cent of total cultivable area. Thus, water resource endowment for the purpose of irrigation can be said to be a strong point of Orissa.

Out of the total ultimate irrigation potential, 61 percent is accounted for by major and medium (i.e., mostly surface water) potential and the rest 38.98 percent by minor (i.e. mostly ground water) irrigation potential. There is thus a greater weight of major and medium irrigation potential and smaller weightage of minor irrigation potential in Orissa as compared to other low-income states and all-India (Table- 1.10).

Table - 1.10

Percentage of Major, Medium and Minor Irrigation Potential in Total

(in Million Ha)

States	Major and Medium Irrigation Potential	% to Total Ultimate Irrigation Potential	Minor Irrigation Potential	% to Total Ultimate Irrigation Potential
1. Orissa	3.6	61.02	2.3	38.98
2. Bihar	6.5	52.42	5.9	47.58
3. Madhya Pradesh	6	58.82	4.2	41.18
4. Uttar Pradesh	12.5	48.64	13.2	51.36
5. Rajasthan	2.75	53.4	2.4	46.6
All India	58.465	51.51	55.047	48.49

Source: CMIE, *Basic Statistics Relating to Indian Economy*, September 1994.

Out of this, by 1997, a little more than 33 percent of ultimate irrigation potential was exploited in the case of Orissa. The extent of exploitation was much less than other low-income states (except Madhya Pradesh) and about half than that of all India relative to the potential (Table - 1.11).

Table - 1.11

Extent of Irrigation Potential Exploited, Major + Medium and Minor (Up to March 1997)

States	Major + Medium		Minor		Total		% of Potential Exploited
	Ultimate Potential	Potential Created	Ultimate Potential	Potential Created	Ultimate Potential	Potential Created	
Orissa	3600	1558	5203	1357	8803	2915	33.11
Bihar	6500	2803	6847	5108	13347	7911	59.27
Madhya Pradesh	6000	2318	11932	2658	17932	4976	27.75
Uttar Pradesh	12500	7043	17999	20451	30499	27494	90.15
Rajasthan	2750	2274	2378	2421	5128	4695	91.56
All India	58465	32954	81428	53305	139893	86259	61.66

Source: Planning Commission, Govt. of India.

As per utilisation of groundwater in particular, the rate of exploitation in the case of Orissa is both absolutely and relatively low (Table 1.12). The main reason for this could be that it is a domain of private investment and there is a shying away of such investment because of the uncertain nature of groundwater as well as its poor discharge capacity.

Table -1.12

Ground Water Availability and Utilisation for Orissa and Low-income States, 1998

States	Total Repl-enishable Ground Water Resource (MCM/Yr.)	Provision for Drinking Industrial and Other Uses (MCM/Yr.)	Utilisable Ground Water Resource	Net Draft as on 1992.	Balance G.W Available (MCM/Yr)	Level of G.W Exploitation
1. Orissa	20128.7	3019.3	15398.4	2603.7	14505.7	15.22
2. Bihar	26979.6	4047	20639.4	8252.7	14680	35.99
3. Madhya Pradesh	34818.6	5222.8	26636.2	7384.6	22211.2	24.95
4. Uttar Pradesh	82545.9	12381.9	63147.6	29761.9	40402.1	42.42
5. Rajasthan	12602.1	1997.7	9544	7724.5	2879.9	72.84
All India	433859.3	71265.5	326334.5	135040.4	227314.5	37.24

Source: Planning Commission, Govt. of India.

FISHERY RESOURCES

MARINE FISHERY

Orissa is the only low-income state which is not land-locked and hence has access to marine fishery potential. The length of its coastline is 480 kms, and its inshore zone (reckoned in terms of a depth range of 50 mts) continental shelf area is 15,000 sq. kms. Among nine maritime states, Orissa stands sixth in terms of the length of its coastline and fifth in terms of its continental shelf area. (Kurien 1993)

The resource potential for marine fisheries is usually given for individual states under the assumption that the potential resources of any state are by and large harvested by the fishermen of that particular state. It is within this inshore zone that “informal territorial rights" are well-defined. On the other hand, beyond the inshore zone (i.e; beyond the 50mt depth line) “informal territorial rights" can be hardly maintained, and hence for the offshore zone (depth ranges 51-100 mts.), estimates of marine fishery resources potentials can be given only for coastal regions rather than individual marine states. Table - 1.13 gives the relevant data.

Table - 1.13

Maritime State-wise (Inshore) Marine Fishery Resource Potential

Region	States	Resource Potential ('000 tonnes)	Resource Potential per sq. km. of Continental Shelf Area (tonnes per sq. km.)
North Western Coastal Region(NWCR)	Gujarat, Maharashtra	385 155	5.92 5.96
South Western Coastal Region(SWCR)	Goa Karnataka Kerala	90 230 380	30.0 28.75 29.23
Lower Eastern Coastal Region(LECR)	Tamil Nadu Andhra Pradesh	280 200	11.66 11.76
Upper Eastern Coastal Region(UECR)	Orissa West Bengal	300 240	20.0 20.0

Source: John Kurien, *Ibid*, p.10.

As can be seen from Table 1.13, in terms of aggregate resource potential at 3 lakh tonnes, Orissa occupies the third position behind Gujarat and Kerala. In relation to continental shelf area (which can be said to measure the richness and density of resource potential) the Upper Eastern Coastal Region (UECR) to which Orissa belong has the second highest resource potential per sq. km. of continental shelf area, next to the South Western Coastal region (SWCR).

INLAND FISHERY

In the case of inland fisheries, the total resource potential is obtained on the basis of estimated yield per unit area and total area for different inland sources. The relevant data are presented in Table- 1.14.

Table -1.14

Inland Fisheries Resource Potential

Source	Water Area (in Ha.)	Estimated Potential Yield/Ha (in kg.)	Total Resource Potential (in tonnes)
1.Tanks/Ponds	78,979	200	157958
2.Reservoirs	256,000	50	12800
3.Lakes, Swaps and Bheels	180,000	50	9000
4.River and Canals	155,400	20	61636
5.Brackish Water	-	-	-
Total	670379	320	244502

Source: Unpublished data, Directorate of Fisheries, Govt. of Orissa.

RATE OF UTILIZATION RELATIVE TO RENEWABLE RESOURCE STOCKS: EXTENT OF PRESSURE ON RESOURCE POTENTIAL

What is the rate of utilization of fishery resources in Orissa relative to resource potential? The relevant data are presented in Table - 1.15.

Table 1.15

Output-Resource Stock Ratio 1995-2000

(in tonnes)

Category	Output	Resource Potential	Ratio(%) of Output to Resource Potential
Marine	132200.4	3,00,000	44.07
Inland	93325.8	2,44,502	38.17
Total	188208.6	5,44,502	34.55

Source: Kurien, *Ibid*., and same as Table 1.14.

Thus less than half of the marine resource potential is exploited annually. Referring to Table 1.15 we find that as regards inland fishery resource, less than 50 percent of fresh water resource potential is utilised annually, whereas the same is only about one-fifth in respect of brackish water fishery. Thus, on the whole, only about 39 percent of inland resource potential is annually exploited. (This more or less agrees with estimates given in Table - 1.14). However,

it should be mentioned that there is a discrepancy between the estimate of inland fishery resource potential given in Table- 1.14 and Table- 1.16.

Table -1.16

Alternative Estimates of Output-Resource Stock Ratio of Inland Fisheries Separately for Fresh Water and Brackish Water

	Water Area (Ha.)	Resource Potential (in tonnes)	Level of Output* (in tonnes)	Output Resource Stock Ratio (%)
Fresh Water	706222	307282	130400.55	42.44
Brackish Water	417537	65935	13600.64	20.63
Total Inland	1123759	373217	127045.6	38.58

Note: * Average of five year ending in 1995-2000.

Source: For resource potential, *Hand Book on Fisheries Statistics Orissa, 1996-97;* Govt. of Orissa, Directorate of Fisheries, Orissa.p.17 & 39; for output figures *Economic Survey 2000-2001,* Govt. of Orissa.

Rather low rate of utilisation of the renewable resource stock, both in the case of inland and marine fisheries resources, it appears, is not due to any severe demand constraint within the state. This is suggested by data on proportion of fish - eating population and per capita fish consumption.

Table -1.17

Annual Per Capita Consumption of Fish in Major States of India

States	Quantity (0.00K.G)	Fish Consumption per 1000 Households	Quantity (0.00K.G)	Reporting Fish Consumption per 1000 Households
Andhra Pradesh	0.84	240	0.96	221
Gujarat	0.24	79	0.24	87
Karnataka	0.96	116	0.84	114
Kerala	12.72	829	19.08	812
Maharashtra	0.96	160	1.68	253
Orissa	2.4	517	3.84	614
Tamil Nadu	0.24	206	1.32	320
West Bengal	5.64	848	7.92	784
Goa	14.64	926	16.56	723

Source: NSS of India; cited in *Handbook on Fisheries Statistics, Orissa, 1996-97*, Directorate of Fisheries, Govt. of Orissa. P. 135.

On the other hand, there appears to be operating supply constraints, particularly in the marine sector.

While the data on per capita fish production shows that it is relatively low in the case of marine fisheries and on the higher side in the case of inland fisheries, (Table - 1.18) Orissa is still a net importer of fresh fish.

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Table - 1.18

Levels and Per Capita Output of Fish in Major Fish-Producing States

States	Fish Production(Million Tonnes)			Per capita Fish Production(in Tonnes)		
	Marine	Inland	Total	Marine	Inland	Total
Andhra Pradesh	15.2	20.40	35.60	0.21	0.28	0.49
Gujarat	60	0.6	60.60	1.32	0.01	1.33
Karnataka	21.75	0.87	22.62	0.44	0.02	0.46
Kerala	53.3	0.49	53.79	1.72	0.02	1.74
Maharashtra	38.7	0.77	39.47	0.45	0.01	0.46
Orissa	12.32	13.49	25.81	0.36	0.39	0.75
Tamil Nadu	34	10.8	44.80	0.57	0.18	0.75
West Bengal	15.3	74	89.30	0.21	0.99	1.20
Goa	8.42	0.36	8.78	6.06	0.26	6.32

Source: Same as Table 1.17 p.120 and 122.

In the case of inland fishery resources a major factor behind low utilisation rate could be poor management and maintenance of inland water bodies affecting yield rates and catch per unit effort. For marine fishery resources, low yield rate and low catch per unit effort seem to be mainly due to a very low degree of mechanization of fishing crafts (Table - 1.19).

Table - 1.19

Degree of Mechanisation of Marine Fishing

States	Motorised Traditional Crafts to Total Traditional Crafts (%)	Mechanised Boats to the Total Fishing Crafts (%)
Gujarat	33.85	39.80
Maharashtra	2.86	44.26
Karnataka	9.05	21.76
Kerala	31.66	9.35
Tamil Nadu	16.65	20.42
Andhra Pradesh	5.71	13.46
Orissa	2.63	13.98
West Bengal	6.19	30.12
Goa	45.00	29.82

Source: Same as Table 1.17, p. 126.

There is no direct estimate available of the number of fishermen in the state. We have arrived at an indirect estimate by applying the proportion of value added in fishing within the primary sector to the total number of rural main workers in the primary sector. This gave a figure of 3.59 lakhs fish workers (both inland and marine). This is a large number and what our above analysis shows is that there is considerable scope for increasing employment and earnings in the fishery sector of the state.

PART II : DEGRADATION OF NATURAL RESOURCES : CAUSES AND CONSEQUENCES

The status of natural resources depends on the pattern of economic development of a region. The growth process causes continuous depletion and degradation of natural resources. As long as economic activities in a region are at a level below the regenerative capacity of natural environment, there is no secular decline in the quality and quantity of natural resources. The problem arises, however, when these limits are crossed and when secular decline in the quality and quantity of natural resources takes place (Hirway and Mahadevia 1999). The problem can arise in two respects: (i) when natural resources are over used, that is the rate of use is more than the rate of regeneration, and (ii) when the discharges from economic activities are more than abating capacity of the nature. In both the cases, natural resources are depleted, degraded or polluted, which puts limit to the sustainability of the growth process

(ibid.). The limit put to the sustainability of growth process, however, is more in the case of non-renewable natural resources than the limit put by the renewable natural resources.

In Part II of this chapter, we make an attempt to find out the degree of natural resource degradation and the causes and consequences of such degradation in the state of Orissa. For this purpose, we limit our analysis to the following main natural resources: (i) forest, (ii) land, (iii) minerals, (iv) water, and (v) air. While some of these are undergoing severe degradation, others are under serious threat of degradation.

FOREST RESOURCE

As already pointed out, forests are important natural resources of Orissa. They have a moderating influence against floods and thus they protect the soils against erosion. Forests also influence climate and rainfall. They provide raw materials to a number of industries. But the crisis in forest environment is manifest in the dwindling forest cover of the state.

According to the estimate of the Forest Survey of India (FSI), the forest area in Orissa remains around 30 per cent (Table- 1.7). Over a period of 25 years, there is marginal decline in the share of forest area. But there is steady decline in the area under 'closed forest' both absolutely and relatively. Its share has declined both in the total forest area (by about 21 percentage points) and in the total geographical area (by about 7 percentage points). At the same time, there is decline in the area under ‘mangrove forest’, which is found in the coastal region of the state. The decline in the closed forest area has resulted in the increase in the area under 'open degraded forest' during the period 1972-75 to 1997.

The region-wise[1] comparison shows that the northern plateau region has the highest proportion (40.12 per cent) of forest cover in the state followed by the eastern *ghat* region (34.20 per cent) (Table- 1.20). The coastal plain region has the lowest proportion (19.80 per cent) of forest cover. Considering the closed forest cover, with more than 40 per cent of crown density, it is found that the northern region has about 27 per cent of the total geographical area, followed by the central tableland region. The eastern *ghat* region, with about 34 per cent

[1] The state can be divided into four broad natural/ecological regions, viz. the coastal plains, the central tableland, the northern plateau, and the eastern ghat.

of total forest cover, has only 16.45 per cent of closed forest. The open degraded forest is found to be highest in the eastern *ghat* region, which is more than the area under closed forest. This shows that there is severe degradation of forest in this region. The northern plateau region, which has the highest forest cover, has also shown severe degradation of forest. Hence, the region with more forest cover faces severe degradation of forest in Orissa.

Among the different districts of Orissa, Phulbani has the maximum proportion of forest cover in the state followed by Kendujhar, Sundargarh and Mayurbhanj of northern plateau region (Table- 1.20). However, considering the share of closed forest area, it is lower in Phulbani district (29.70 per cent) compared to that in Mayurbhanj district (31.07 per cent). This is due to a very large percentage of open degraded forest area in Phulbani district (28.22 per cent) compared to that in Mayurbhanj district (5.90 per cent). In Kendujhar district, though the share of forest cover is highest next only to Phulbani, there is severe degradation of forest. The share of open degraded forest is 21.73 per cent, which is next to Phulbani. Koraput and Kalahandi have forest cover only in scanty patches in the southern, south-western and Northern parts of Koraput and in the extreme eastern and western parts of Kalahandi (CPSW 1994). It can be noticed that though area-wise Koraput has the maximum forest cover (7553 sq. kms), its share of forest cover is just 28 per cent while that of Phulbani is 57.9 per cent. Further, the share of closed forest in Koraput district is lower compared to its open degraded forest area, indicating severe degradation of forest in this district. The coastal districts of Baleswar and Cuttack are markedly devoid of forest cover. Ganjam district, which has remarkable share of forest cover, faces severe degradation of forest. Its share of open degraded forest is 21. 63 per cent, which is quite high.

It can be found that the forest cover of different districts has declined in 1997 compared to 1991, except in the districts of eastern *ghat* region (Table- 1.20). The highest decline in forest cover is found in the district of Sambalpur followed by Puri, Mayurbhanj and Kendujhar. This decline is observed mostly in the case of dense forest having crown density of more than 40 per cent.

Table - 1.20

District-wise and Region-wise Forest Cover of Orissa (in sq. km)

District/ Region	Total Geogra phi-cal Area	Forest Cover (1997 assessment)				% to total Geogra-phical Area	% of Closed Area in Geo. Area	% of Open Degraded Area	Change of Forest Cover in 1997 over 1991
		Dense	Open	Mangr-ove	Total				
Coastal Plains	**40191**	**3777**	**3970**	**211**	**7958**	**19.80**	**9.40**	**9.88**	**- 497**
Baleswar	6311	175	128	20	323	5.1	2.77	2.03	- 48
Cuttack	11142	482	279	191	952	8.5	4.33	2.50	- 107
Ganjam	12556	1894	2716	-	4610	36.7	15.08	21.63	- 88
Puri	10182	1226	847	-	2073	20.4	12.04	8.32	- 254
Nothern Plateau	**28433**	**7610**	**3796**	**-**	**11406**	**40.12**	**26.76**	**13.35**	**- 399**
Kendujhar	8303	1739	1804	-	3543	42.7	20.94	21.73	- 187
Mayurbhanj	10418	3237	615	-	3852	37.0	31.07	5.90	- 210
Sundargarh	9712	2634	1377		4011	41.3	27.12	14.18	- 2
Central Tableland	**36536**	**6519**	**4017**	**-**	**10536**	**28.84**	**17.84**	**10.99**	**- 372**
Bolangir	8193	573	612	-	1185	14.5	6.99	7.47	+ 117
Dhenkanal	10827	2268	1324	-	3592	33.2	20.94	12.23	- 74
Sambalpur	17516	3678	2081	-	5759	32.9	21.0	11.88	- 415
Eastern *Ghat*	**49827**	**8195**	**8846**	**-**	**17041**	**34.20**	**16.45**	**17.75**	**+ 1004**
Kalahandi	11772	1592	1470	-	3062	26.0	13.52	12.49	+ 296
Koraput	26961	3308	4245	-	7553	28.0	12.27	15.74	+ 239
Phulbani	11094	3295	3131	--	6426	57.9	29.70	28.22	+ 469
All	**155707**	**26101**	**20629**	**211**	**46941**	**30.1**	**16.76**	**13.25**	**- 264**

Source: Govt. of India, *Forest Survey of India*, Ministry of Forest and Environment, 1991, 1997.

Causes of Deforestation

A number of factors are responsible for the degradation of forests. The earlier studies have identified the following three main activities which have contributed to deforestation in the developing countries: i) logging, ii) agricultural/pastoral encroachment and expansion, and iii) fuelwood collection (Duraiappah 1996). However, data for deforestation due to these activities are not available. But these activities are driven mostly by the government policies as well as the population pressure. Although the earlier studies failed to identify the magnitude of these contributing factors towards deforestation, the majority of studies highlighted the prominent

role institutional and market failure played both as a catalyst as well as a direct factor causing deforestation (*ibid*).

Besides these factors responsible for deforestation, there are also other factors, which contribute to deforestation. In developing states, governments undertake a number of developmental projects, which directly contribute to deforestation. In Orissa, a significant forest area is lost due to such activities (Table- 1.21). The major activities responsible for such deforestation were river valley projects and subsequent resettlement of displaced persons up to the early 80s. But in the last two decades, mining activities were mostly responsible for deforestation. This is followed by the irrigation projects. These together contribute more than half of the total deforestation.

Table- 1.21

Extent and Factors Contributing Towards Deforestation

Deforestation since Independence Till 1984-85				Deforestation Between 1980 (Dec.) and 2000 (Jan.)			
Sl. No.	Purpose of Deforestation	Total Area (in sq. km)	% of total	Sl. No.	Purpose of deforestation	Area (ha)	% of total
1	River valley project and resettlement of displaced persons	1855.76	89.48	1	Irrigation	5616	23.28
2.	For industrial purposes	34.48	1.66	2	Mining	7397	30.66
3.	For capital conservation	20.93	1.01	3	Industries	2367	9.81
4.	For railways	24.20	1.17	4	Power transmission	2270	9.41
5.	For minor irrigation projects	11.41	0.55	5	Railway line	1910	7.92
6.	Public purposes	80.24	3.87	6	Defence	3865	16.02
7.	For roads	0.23	0.01	7	Road and building	216	0.90
8.	Miscellaneous purposes	46.72	2.25	8	Misc.	483	2.00
	Total	2073.97	100.00		Total	24124	100.00

Source: Office of the PCCF, Bhubaneswar, quoted in CPSW, *State of Orissa's Environment – A Citizen's Report*, Bhubaneswar, 1994.

Hence, the developmental activities of the government as well as the commercial interest and livelihood activities of the people are responsible for the deforestation in Orissa.

Consequences of Deforestation

The devastation caused to the economy by continued and excessive deforestation is indeed enormous. Reviewing earlier studies *ibid* identified the following major negative effects of deforestation: i) loss of watershed protection, ii) soil erosion, iii) destruction of a safety buffer, iv) shortage of fuelwood supply, and v) productivity drop.

Since forests serve as important water catchment areas, loss of forest cover disrupts hydrological cycle (*ibid*). Continued depletion of forests has affected the environment adversely by changing the rainfall and climate pattern in Orissa. This can be well imagined by the unusual summer of 1998, which has taken more than 2000 lives because of sunstroke (Meher 2000). At the same time, the loss of vegetative cover has exposed the soil to erosion. This not only resulted in loss of soil fertility, thereby a drop in agricultural productivity, but also increased water run-off to lower elevation plots. This increases the risk of flooding (Adelman *et al* 1997). Vohra (1987) finds the strong correlation between floods and soil erosion and states that the best insurance against floods is the prevention of soil losses. Further, the ground water table has been affected adversely due to the loss of vegetative cover, which reduces the retention and percolation of water. This has resulted in water scarcity in the rainfed areas. Orissa, therefore, has been facing flood and drought in almost every year since 1965 (Meher *Op.cit*). The ground water scarcity in upland areas due to the loss of soil has been observed by a number of studies (Bandyopadhyay 1987; Chengappa 1995).

Deforestation has also entailed increasing suffering to the rural poor and indigenous tribes who are fast losing their traditional sources of livelihood provided by the forests. Besides the livelihood problem, increasing deforestation also makes fuelwood shortages, which have dire consequences for the poor.

The loss of forest also increases the time taken to collect fuelwood as well as non-timber forest products, indicating that less time is available for both economic and other household activities. This results in productivity drop as well as suffering of the female members, who have to go long distance for collecting fuelwood and non-timber forest products.

Continuing deforestation, therefore, brings a major ecological and socio-economic crisis. The worst affected are the people in the low income group.

LAND RESOURCE

Land resources of Orissa have both low and high agricultural production potential. The state has, however, scarcity of land. Due to increasing population, the average size of land decreased from 1.89 hectares in 1970-71 to 1.34 hectares in 1990-91. Not only is the per capita availability of land in the state low but also the degradation of land is severe. During 1985, it was estimated that about 50 per cent of the geographical area were degraded (Table 1.24). The degradation of land was highest due to soil erosion, followed by shifting cultivation and degraded forest. The degradation from these three sources combinedly comes to about 46 per cent of the total geographical area and 92.29 per cent of the total degraded land. The other reasons of land degradation were water salinity (2.6 per cent), water logging (0.44 per cent) and ravine (0.7 per cent).

The degradation of land has, however, declined from 50.1 per cent in 1985 to 37.3 per cent in 1994. But the proportion of land degradation remained higher than that of all- India (32.7 per cent). The estimate shows that land degradation due to soil erosion, ravines, salinity and shifting cultivation has declined in 1994 from 1985. It is surprising to observe that land degradation due to shifting cultivation has declined significantly from 17 per cent in 1985 to 1.2 per cent in 1994. Similarly, salinity has also declined significantly (Table 1.24). But the degradation due to soil erosion has declined marginally and still remained at a high level. On the other hand, land degradation due to degraded forest and waterlogged area has increased significantly. Further, mine and quarry waste has added to the degradation of land. As per 1994 assessment, land degradation due to degraded forest and soil erosion together comes to about 90 per cent of the total degraded land and about 34 per cent of the total geographical area. At the same time, quarry and mine waste and waterlogging have emerged as potential threat to the land degradation.

Table - 1.22

Status of Land Degradation in Orissa (Area in Lakh Ha.)

Sl. No.	Type of Degradation	1985 Assessment	% of Geographical Area	1994 Assessment	% of Geographical Area
1.	Soil erosion				
	a. Water	27.71	17.8	25.70	16.50
	b. Wind	-	-	-	-
2.	Ravines	1.13	0.7	0.18	0.1
3.	Saline	4.03	2.6	1.35	0.9
4.	Water Logged	0.60	0.40	1.42	0.9
5.	Mine and Quarry Waste	-	-	0.97	0.6
6.	Shifting Cultivation	26.48	17.0	1.84	1.2
7.	Degraded Forest	18.07	11.6	26.56	17.1
8	Total Orissa	78.3	50.1	58.02	37.3
9	All-India	1721.75	52.8	1074.30	32.7

Source: Government of India, *Draft Report on States of Land Degradation in India,* Department of Agriculture and Co-operation (Soil and Water Conservation Division), Ministry of Agriculture, 1995.

Therefore, it is clear from the above discussion that there is severe degradation of land in Orissa. The degradation of land is, however, mostly in the shape of soil erosion and degraded forest. These two are inter-linked and have cumulative effects.

Causes of Land Degradation

Orissa suffers from varying degrees of soil erosion and degradation mainly due to rapid rates of deforestation, poor irrigation and drainage practices, inadequate soil conservation, steep slopes and overgrazing. Land degradation results from displacement of soil nutrients mainly through water run-off and from biophysical and chemical deterioration.

Besides, rapid population growth in Orissa results in heavy pressure on land. It accelerates the process of poverty-induced degradation of the environment. As the resource base of the poor becomes sub-divided and fragmented, intensive and often-inappropriate land use becomes imperative for immediate survival. The poor are more seriously affected by land degradation

since they depend on the most marginal lands for their livelihood. Population pressure forces them to clear forestlands for cultivation resulting in deforestation.

There is also lack of secure land tenure system. Due to non-existence of secure land tenure the poor farmers cultivate their lands excessively to exhaustion, for the simple reason that they have no vested interest in preserving an asset which they do not own.

Further, the increased dependence on intensive agriculture and irrigation results in degradation of land. Inappropriately managed or excessive irrigation leads to water logging, salinisation, and alkanisation of soil, which ultimately results in loss of land. There are also loss of fertility and productivity of irrigated lands due to the inappropriate use of fertilisers (disproportionate NPK combination) and pesticides. Soil-acidity is another major factor for low productivity of land.

Consequences of Land Degradation

The effect of land degradation is the drop in agricultural productivity due to the loss of soil fertility. Degradation of soil fertility can be reversed in the short-run. But, reversibility of soil erosion and salinisation has to rely on prevention. Once topsoil has disappeared, soil erosion becomes almost impossible to reverse. This is because, under natural condition on vegetation cover it can take between 100 to 500 years for the formation of 1 cm of topsoil (Dasgupta and Maler 1997). Once soil has become sufficiently saline it becomes permanently incapable of cultivation (Adelman *et al* 1997: 166).

MINERAL RESOURCE

Mineral is an important non-renewable natural resource of Orissa. The state has nearly 20 per cent of India's total mineral resources which include 98 per cent of chromite, 70 per cent of bauxite, 38 per cent of graphite, 26 per cent of iron ore and 24 per cent of coal (Govt. of Orissa 1998-99). During the year 1995, mineral reserve in the state was 54599.9 million tonnes and its exploitation was 50.97 million tonnes (i.e. less than one per cent of the total reserve), showing a very low average rate of exploitation. Assuming that this rate (i.e., the rate of 1995) of exploitation of minerals will continue, it would take more than one thousand years to exhaust all the minerals (Table 1.23), provided that no new reserves of minerals are discovered.

However, minerals like graphite and lead ore would exhaust within two-to-three decades if the present rate of exploitation continues. The position regarding others is more comfortable.

Table - 1.23

Mineral Reserves (1995), Their Exploitation (1995) and the Years Left for Exhaustion at the Current Rate of Exploitation

Mineral Ores	Reserve of Mineral (Million tonnes)	Annual Extraction (Million tonnes)	Rate of Exploitation (%)	Time left for Exhaustion (Years)
Coal	46527	32.65	0.07	1425
Bauxite	1670	2.42	0.14	690
Chromite	183	1.65	0.90	111
Copper Ore	4.7	-	-	-
Iron Ore	3120	9.33	0.30	334
Lead Ore	2.6	0.09	3.46	29
Manganese Ore	49	0.63	1.29	78
Nickel	285	-	-	-
Vanadium	3.4	-	-	-
China Clay	157	0.01	0.006	15700
Dolomite	1171	1.34	0.11	874
Fire Clay	108	0.09	0.08	1200
Graphite	1.5	0.09	6.0	17
Lime Stone	1212	2.38	0.2	509
Mineral Sands	82	0.11	0.13	745
Pyrophyllite	8.6	0.03	0.35	287
Quartz & Quartzite	15	0.15	1.0	100
Taeic/Soap Stone	0.1	-	-	-
All	54599.9	50.97	0.09	1071

Source: (I) Directorate of Mining and Geology, Government of Orissa;
(2) S. Meher, 'Status of the Natural Resource Environment in Orissa', *Working Paper No. 48*, NCDS, Bhubaneswar, July 2000.

However, the problem is that the rate of exploitation of minerals is increasing rapidly over time, posing danger in the future. The exploitation of minerals in the state has increased from 2.8

million tonnes in 1947 to 51.32 million tonnes in 1995-96, i.e., by about 18 times (Table- 1.24). The exploitation is much higher in the 90s than the earlier periods. Therefore, the low average rate of exploitation cannot be a sign of relief to the state. Rather the increasing exploitation can pose a potential threat in the future.

Table - 1.24

Mineral Production in Orissa (in Million tonnes)

Sl. No.	Year	Mineral Production
1	1947	2.8
2	1956	4.05
3	1961	8.85
4	1969	12.45
5	1980	14.59
6	1985	18.14
7	1990	31.08
8	1995-96	51.32

Source: Govt. of Orissa, Mineral Statistics of Orissa, (mimeo), Directorate of Mining and Geology, undated.

The mineral resources are found in almost all the undivided districts (except Baleswar) in the State. But most of the mineral reserves are in the tribal belt and forest areas of the state posing a danger of deforestation and livelihood of the locals.

Factors Underlying Increasing Mineral Exploitation and Degradation

The rapid increase in the exploitation of minerals is mostly due to the increasing revenue interest of the state. Besides, increase in the number of mineral-based industries in the state has also attracted more exploitation of minerals. The illegal and indiscriminate mining in the state has also added to the increased mineral exploitation. Overexploitation of these mineral resources has adversely affected land, forests, water and air.

Consequences

As the demand for minerals grows, the area of mining expands at a faster rate, threatening increasingly larger areas of landscape, soil degradation, a widening circle of deforestation, air pollution and distress to the population affected. Extraction of a large quantity of minerals not only depletes the non-renewable resources but also creates problems of second and third order effects in the form of irreversible environmental reactions over both short- and long-terms.

Mining and loss of land are closely correlated. Land is lost due to mining, both directly and indirectly. The direct loss is due to the land leased for mining operation as such and indirect loss is caused by the area that is used for the construction of the infrastructure required for mining namely, roads, railways, stockyards, etc. (Viegas and Menon 1989). Due to intensive mining not only is the land lost but also it leads to large-scale displacement. The indiscriminate quarrying and mining both by lease holders and public sector miners have caused irreversible environmental and ecological damage.

Agricultural uses of land are automatically eliminated by the mining activity, which churns up much sub-soil and dumps it on the top of the ground or digs great pits deep into the sub-surface up to bedrock formations. Frequently, great piles, ridges and mounds of infertile sub-soil are left adjacent to the large borrow pits, creating a landscape far different from the original rolling or level land. The lives of thousands of people from the surrounding villages have been threatened owing to the debris running down the rich agricultural land, turning it into wasteland (Dwivedi, Chari and Mohapatra 1992).

The method and technology of mining has special bearing on the environment and sustainability of natural resources. As most of the mining in Orissa are open cast mines there is the danger of environmental degradation in and around the mining areas. Everything in and around the mines gets covered with dust, leading to deterioration of air quality. The severity is observed in case of coal mines. Huge clouds of dust with suspended particles raise sharply the atmospheric toxicity causing respiration ailments among the inhabitants living in and around the mining areas. The respiratory dust problem has long term effects on the health of mine workers (Meher *op cit*). The technological advances in the know-how for extraction and

discovery of new and cheaper sources of energy for extraction have made it possible to utilise the lower than the lowest grade ore leading to reduction in balance life of minerals and also cause greater pollution.

Orissa being the largest repository of power grade coal (ash content of 40 per cent or more) attracts large scale coal based thermal power plants. As far as thermal power plant is concerned, ash disposal poses the single largest environmental problem (State Pollution Control Board, Orissa 1998).

WATER RESOURCE

Water is another important natural resource of the state. With an annual rainfall that offers 23.46 mham (metre hectare metre) of water per year, 11 major rivers that have a total yield of 78190 million cusecs and a ground water potential of 23.279 lakh hectare meters, Orissa can rightly be described as opulant in water resources. But the water resources in the state are becoming polluted. While the pollution has become serious as far as surface water is concerned, it has not yet aggravated in the case of ground water in the state.

Surface Water Pollution

There are broadly three sources of water pollution. They are domestic, industrial and non-point sources. In Orissa none of the 103 Urban Local Bodies have sewage treatment system (Dash undated). Wastewater from these sources generally contains many organic faecal matters along with disease-carrying coliforms. The industrial wastewater is likely to contain various types of pollutants depending upon the industrial process. Some of them are toxic and not easily biodegradable. The non-point sources of water pollution consist of run-off from agricultural field containing large quantities of chemical fertilisers and pesticides and faecal matters.

Waterlogging and Salinity

Besides the above, inappropriate use of water can also lead to water pollution. Farmers at the head of canal irrigate their crops intensively, use much more water than required, thereby, causing water logging and salinity. This has become a serious problem in the coastal region of the state. In Orissa about 379 sq. km are waterlogged (Table- 1.25). Out of this, Coastal districts have the maximum share (94.20 per cent). This has adversely affected agriculture in

the coastal area. Besides, the coastal districts also face the problem of salinity. An area of about 1.49 lakh ha in this region is saline (Table- 1.26). The waterlogging and salinity both have serious consequences in the coastal area. Hence, there is an urgent need to check these types of pollution, which adversely affect the agriculturally prosperous coastal districts. While there is need to make drainage line to reduce waterlogging, plants like strychnous potatorum can reduce salinity.

Table- 1.25

District-wise (Undivided) Waterlogging Area in Orissa

(In sq. km)

Baleswar	68.38
Bolangir	0.17
Cuttack	89.44
Dhenkanal	0.50
Ganjam	24.11
Kalahandi	0
Kendujhar	3.72
Koraput	5.48
Mayurbhanj	2.62
Phulbani	0
Puri	175.18
Sambalpur	6.49
Sundargarh	3.01
All	379.10

Source: Wasteland Atlas of India, Ministry of Rural Development and NRSA Hyderabad, 2000.

Table - 1.26

District-wise Saline Area in Orissa

(In ha)

Baleswar	54930.59
Cuttack	48956.6
Ganjam	12153.62
Puri	33430.87
All	149471.68

Source: National Bureau of Land Use Planning (ICAR), 2001.

Water Quality of Major Rivers

The presence of industrial complexes in the banks of major rivers in Orissa is causing serious damages to the aquatic region. Some of the major rivers and the quality of its water have already become poisonous. Brahmani River, among others, is most polluted and poisonous due to the industrial waste dumped into it. A number of industries which discharge wastewater into this river are Rourkela Steel and Fertiliser Plant (Rourkela), Fertiliser Corporation of India (Talcher), Talcher Thermal Power Station (Talcher), National Aluminium Company Smelter and Captive Plants (Angul), ORICHEM Ltd. (Talcher). They discharge around 298001 KL of wastewater daily into this river (see Annex Table 1.1). There are 21 mines in the basin which discharge 29434 KL of mine drainage water daily (Orissa Pollution Control Board, 1998). Besides, sewage water of 26 urban settlements in the basin enters into the river. They discharge around 74460.4 KLD (Kilo litre per day) of wastewater (see Annex Table 1.2). The river in the lower reaches passes through very populated areas from where domestic pollution load into the river is expected to be high. The water of this river is not suitable for use as potable water. It is also not classified as a source of direct drinking water without any kind of treatment or disinfection. Further the stretch of river that was classified as 'Class-C' (source of drinking water supply with conventional treatment and distinction) has ceased to be so with regard to BOD (Bio-chemical oxygen demand) (see Annex Table- 1.3). Hence, Brahmani water does not represent a healthy aquatic ecosystem.

Besides, water of the river Mahanadi is also polluted. Industrial pockets like Brajarajnagar, Sambalpur, Hirakud, Choudwar, Jagatpur at Cuttack pose environment threats to this river. The wastewater discharge from major industries is around 66717 KLD (see Annex Table 1.4). Similarly, there are 10 coal mines which discharge around 33065 KLD of wastewater during the monsoon (see Annex Table 1.5) and pose a serious threat due to the presence of heavy metals and compounds of sulphur. Domestic sources are a major contributor of the wastewater to the river. There are around 34 urban settlements in the basin discharging around 266332 KLD of wastewater daily (see Annex Table 1.6). Though Mahanadi has been designated as Class-C river basing on designated best use classification, yet the water quality data shows that the river largely belongs to Class-D category (see Annex Table 1.7), indicating that the water is not suitable for purpose of drinking and bathing.

Besides the pollution of rivers, community resources like ponds and tanks are polluted due to their misuse and continuous neglect. The industrial and domestic waste, large quantities of pesticides and agro-chemicals find their way to different rivers and streams, thereby polluting the surface water.

Ground Water Pollution

Rainwater entering the sub-surface ground water reservoir by way of percolation contributes mainly to recharge of ground water. Canal irrigated area, flood in river system, inland water bodies also contribute to this recharge. The annually utilisable ground water resources, which can be safely utilised for the development of irrigation and other purposes in Orissa have been estimated at 19. 787 lakh hectare metres out of the total potential of 23.279 lakh hectare metres. However, the exploitation of ground water in the state is very low, i.e. 7.1 per cent (Govt of India 1994). But in the coastal districts (except Puri) the exploitation is significantly higher than the state average. Due to over-exploitation of ground water in the coastal area, there is possibility of saline intrusion. Further, groundwater with high water table in coastal districts can be polluted by leaching, containing various pollutants like fertilisers and pesticides used in the agricultural fields, organic matter from abandoned pits, wastes of industries containing toxic substances stored in unlined pits, etc. (State Pollution Control Board, Orissa undated).

Even though ground water exploitation in the state is very low, the pollution of ground water is found due to a number of factors. However, no systematic study has been made in this respect. But there are some indicators, which confirm ground water pollution in the state. The iron content in groundwater is found to be very high in some areas of Mayurbhanj, Kendujhar and Sundargarh districts. It is as high as 34 mg/lit against the recommended standard of 0.3 mg/lit. Water in shallow aquifers in deltaic and coastal areas has dissolved solids, hardness, bicarbonates and chlorides (State Pollution Control Board, Orissa Undated). Fluoride contamination of groundwater is a possibility in the areas of aluminium smelter and phosphoric fertiliser plant established at Angul and Paradeep respectively. Fluoride pollution of shallow groundwater in a limited area in Hirakud has already been reported - caused by the haphazard disposal of rejected pot linings of an aluminium plant in the past (*ibid.*). Contamination of groundwater by hexavalent chromium (which is a known toxic substance) due to the use of

chromite ore by many industries in Orissa cannot be avoided. All these show that even though no systematic estimate of groundwater pollution has been made in the state, yet the above discussion brings some evidences about the groundwater pollution in the state.

Consequences of Water Pollution

The increasing water pollution may lead to the following consequences:

1. One of the major problems associated with polluted water is the spread of diseases. The World Health Organisation highlights four forms of diseases caused by water pollution from human and animal waste: waterborne, water-washed, water-based, and water-related. It is estimated that four million children die from diarrhoea, a waterborne disease, each year and is a leading cause of child and infant mortality (Duraiappah *op cit*). The contamination of water supplies by industrial and agricultural pollutants can also have detrimental health effects.
2. Pollutants like pesticides and other chemicals, which include compounds such as nitrates, organic herbicides and pesticides, get assimilated by vegetables and other agricultural products, making these products unfit for consumption.
3. Water pollution also affects marine and aquatic life, which provides a cheap but highly nutritious source of protein such as fish.
4. Apart from contaminated water, the shortage of ground water is also a major threat to mankind. The shortage of ground water leads to less availability of water for irrigation and drinking purposes, which poses a threat to survival and creates situations like drought and famine.

AIR POLLUTION

Air pollution has not posed a serious concern in the state of Orissa. The concentration of pollutants like sulphur dioxide, oxides of nitrogen etc. remains below the prescribed standard. However, suspended particulate matter (SPM) concentration exceeds the standard in some places, especially in Bhubaneswar and other towns. This is largely due to construction work and roads with lots of dust on either side or bad roads (Dash undated). Even though the air pollution level is low in the state it is aggravated by the use of energy-inefficient technologies

with no pollution controls and by the use of cheaper, high-sulphur contents, low quality coal and fuel oil, especially for heating and transport.

In rural areas, air pollution is in the form of particulate, organic matter and various oxides. This results seasonally from burning grasslands and from forest clearing for cultivation, grazing and collection of minor forest produce like *mohua*. Indoor air pollution from cooking with organic fuels or coal or energy-inefficient stoves without proper venting are endemic which have led to dangerous indoor concentrations of carbon monoxide particulate and hydrocarbons (Adelman *et al* 1997). The highest concentration of pollutants actually occurs in rural indoor-environment. They come from burning bio-fuels such as wood, agriculture crop residues and dung cake, which are used by mass households in Orissa. Pollution released indoors is far more likely to reach people's lungs than if released outdoors.

In urban areas, on the other hand, the atmosphere is being polluted due to discharge of gases from industries, congestion, and garbage disposal in the open. Even though the number of industries in Orissa is not too large, yet there are a number of polluting industries, which pose serious concern for the state. Industries like cement, paper, iron and steel, aluminium, and other ancillary industries emit poisonous smoke to the atmosphere and create a deadly situation for living beings. Excess emission of carbon monoxide, nitrogen oxide and sulphur dioxide and hydrogen carbons sometimes leads to acid rains which are dangerous for the fertility of the soil. In Orissa, though the problem is not yet aggravated, yet the problem needs to be tackled so as to avoid any serious consequences. Increasing use of automobiles in urban areas of the state not only poses the problem of congestion but also air pollution. For controlling pollution in the state no programme with severe penalty has been launched. The state's Pollution Control Board with its limited resources is unable to tackle the problem. High growth in the number of motor vehicles has contributed to increase in air pollution in two ways: (1) rapid growth in the number of vehicles has resulted in increased fuel consumption leading to increase in emissions, and (2) growth in vehicles per kilometre road length has caused road congestion leading to increased fuel consumption and pollutant emissions. The major pollutants emitted by motor vehicles include carbon monoxide (CO), nitrogen oxide (NO_x), sulphur oxide (SO_x), hydro carbons (Hc), and suspended particulate matter (SPM). The pollutants have damaging effect on both human health and ecology.

Consequences of Air Pollution

1. The human health effects of air pollution vary in degrees of severity, covering a range of minor effects to serious illness as well as premature deaths in certain cases. Most of the conventional air pollutants are believed to directly affect the respiratory and cardio-vascular systems. In particular high level of SO_2 and SPM are associated with increased mortality, morbidity and impaired pulmonary function. Lead prevents haemoglobin synthesis in red blood cell in the bone marrow, impairs liver and kidney function and causes neurological damage. The excess emission of carbon monoxide can effect the central nervous system, impairing physical co-ordination, vision and judgement, creating nausea and headaches, reducing worker productivity and increasing personal discomfort. Nitrogen oxide may indirectly increase susceptibility to infections, pulmonary diseases, impairment of lung function and eye, nose and throat irritation (Pandey 1998).

2. Nitrogen oxide, Nitrogen dioxide and sulphur oxide can contribute significantly to acid deposition, damaging aquatic eco-system and other eco-systems such as forests.

3. High exposure to pollutants emitted from bio-fuels, cow dung and energy-inefficient stoves has been associated with serious health problems such as acute respiratory infections (ARI), chronic obstructive lung disease such as chronic bronchitis and lung cancer and possible tuberculosis (TB), adverse pregnancy outcomes, blindness, heart disease and asthma (Parikh *et al* 1999).

CONCLUSION

Orissa's mineral deposits are large, and as a per cent of all-India resource stock, there is fairly heavy concentration in respect of Bauxite, Chromite, Graphite, Manganese, Nickel ore. Coal and Iron ore also have a significant share, though they are not of high grade variety. However, the rate of cumulative exploitation (output-resource stock ratio) has remained low, except in the case of Graphite and Manganese ore. However, this has not provided a sufficient condition for the establishment of metallurgical and non-metallic mineral based industries on a large scale. Even value addition within the state has remained relatively low.

The quality of soil, in general, is rather low, except in the coastal districts which contains highly fertile alluvial soil and the soils of the river valleys. This is a natural weakness of the state's economy as agriculture is its mainstay.

Forest resources, though deposited, still have a high crown density in the north and north-west parts of the state. Sal and bamboo forest predominate and the state does not have evergreen forest – mostly semi evergreen and deciduous varieties.

The state has rich irrigation potential, both flow and groundwater and these have so far been underexploited, partly because of spreading resources too thinly over too many major and medium projects, many of which have not become fully operational due to non-completion of the canal network.

Again, marine fishery resource potential is relatively significant. However, in the case of both marine and inland fishery, the ratio of output to resource potential suggests underinvestment in this sector where large gainful employment opportunities could be created.

Though Orissa boasts of rich natural resources, these are being degraded over time. While forests, land and surface water resources are undergoing severe degradation, ground water, minerals and air are under serious threat of degradation. Not only the different patterns of development in the state have led to the degradation of these natural resources but also other factors like the growth of population and the unsustainable activities adopted by them have become crucial for the degradation of valuable natural resources in the state. The adoption of unsustainable activities is, however, driven by the market and institutional failure. It provides incentives to the poor to have short time preferences and to the rich to exploit the resource base at unsustainable rate.

The degradation of natural resources has not only corroded the economic base of the state but has also adversely affected the environment. The adverse impacts like change in climatic condition, increased flooding, productivity drop, water shortage, increased infant mortality and morbidity rate, etc. are some of the outcomes of continuing degradation. In the absence of

proper measures to reduce the degradation of natural resources the problem will be aggravated. Therefore, formulation of a well-defined policy in this regard is of utmost importance.

REFERENCES

Adelman, Irma, Habib Fetini and Elise Hardy Golan (1997). 'Development Strategies and the Environment', in Dasgupta and Maler (eds**),** ***The Environment and Emerging Development Issues*****,** Vol. 1, Oxford University Press, New York.

Bandyopadhyay, J. (1987). 'Political Economy of Drought and Water Scarcity: Need for an Ecological Water Resources Policy', ***Economic and Political Weekly*****,** 12 December.

Bhalla, Surjit S. (1988) 'Does Land Quality Matter? Theory and Measurement'. ***Journal of Development Economics*****,** Vol. 29, No. 1

Chengappa, R. (1995). 'Paradise', ***India Today*****,** 15 August.

CMIE (1994). ***Basic Statistics Relating to Indian Economy*****,** September.

CPSW (1994). ***State of Orissa's Environment: A Citizen's Report*****,** Bhubaneswar.

Dash, Madhab C. (Undated). ***Environment in Orissa*****,** *(mimeo),* State Prevention and Control of Pollution Board, Bhubaneswar.

Dasgupta, Partha and Karl-Goran Maler (1997). 'The Resource Basis of Production and Consumption: An Economic Analysis', in Dasgupta and Maler (eds**),** ***The Environment and Emerging Development Issues*****,** Vol. 1, Oxford University Press, New York.

Duraiappah, Anantha (1996). Poverty and Environmental Degradation: A Literature Review and Analysis, ***CREED Working Paper*** Series No. 8, Amsterdam, October.

Dwivedi, R. P., K. N. Chari and G. N. Mohapatra (1992). ***Problem Lands of Orissa***, Department of Agriculture and Rural Development, Government of Orissa.

Indian Bureau of Mines. ***Indian Mineral Yearbook****: (1998-99)* Nagpur.

Government of India. ***Forest Survey of India (Various issues),*** Ministry of Forest and Environment, New Delhi.

_____(1994). ***Ground Water Statistics: 1994*****,** Central Ground Water Board, Ministry of Water Resources, New Delhi.

_____(1995). ***Draft Report on State of Land Degradation in India*****,** Dept. of Agriculture and Co-operation (Soil & Water Conservation Division), Ministry of Agriculture.

Government of Orissa. ***Economic Survey of Orissa: 1998-99*****,** 200-2001.

_____. ***Annual Report: 1999-2000*****,** Office of the PCCF, Aranya Bhawan, Bhubaneswar.

_____(Undated). ***Mineral Statistics of Orissa*****,** (Different Issues), *(mimeo),* Directorate of Mining and Geology, Bhubaneswar.

_____ . ***Agriculture in Orissa,*** Directorate of Agriculture and Food Production, Bhubaneswar.

_____ . ***Handbook of Fisheries Statistics Orissa,*** *1996-97*, Directorate of Fisheries; Bhubaneswar.

Hirway, Indira and Darshini Mahadevia (1999). ***Gujarat Human Development Report,*** *1999*, Mahatma Gandhi Labour Institute, Ahmedabad.

Howe, Charles W. (1979). ***Natural Resource Economics : Issues, Analysis and Policy,*** John Wiley and Sons, New York.

Kurien, John (1993). 'India's Fish Economy: An Assessment of the Natural Resources, Human and Technological Potentials', (*mimeo)*, ***Ph. D. Coursework Papers,*** Tata Institute of Social Sciences, Bombay.

Meher, Shibalal (2000). 'Status of the Natural Resource Environment in Orissa', ***Working Paper No. 48,*** Nabakrushna Choudhury Centre for Development Studies, Bhubaneswar.

NRSA (2000). ***Wasteland Atlas of India*** (in collaboration with Ministry of Rural Development), Hyderabad.

Pandey, Rita (1998). 'Fiscal Options for Vehicular Pollution Control in Delhi', ***Economic and Political Weekly*****,** Nov-7.

Parikh, Jyoti, Kirk Smith and Vijaya Laxmi (1999). 'Indoor Air Pollution: A Reflection on Gender Bias', ***Economic and Political Weekly*****,** Feb-27.

Rath, N. and A. K. Mitra (1989). 'Economics of Irrigation in Water-scarce Regions: A Study of Maharashtra' , ***Artha Vijnana,*** Vol. XXXI, No. 1, March.

Ress, Judith (1985). ***Natural Resources : Allocation, Economics and Policy,*** London : Methuen.

State Pollution Control Board, Orissa (1998). ***Paribesh Samachar*****,** Vol. 5, No. 1, June.

_____(1999). ***Paribesh Samachar*****,** Vol. 6, No. 3, Sept.

State Pollution Control Board, Orissa (Undated). ***State of Environment in Orissa-I: Water Resources*****,** SPCPB, Bhubaneswar.

Viegas, Philip and Geeta Menon (1989). ***The Impact of Environmental Degradation on People*****,** Indian Social Institute, New Delhi.

Vohra, B.B. (1987). 'Water Resources: Land Management Holds the Key'*,* ***The Economic Times*****,** New Delhi, September.

ANNEXURE

Annex Table - 1.1

Water Consumption and Wastewater Discharged into Brahmani River from Different Industries

Sl. No.	Name of the Industries	Products	Capacity	Water Consumption KLD	Wastewater Generation KLD	MINAS
1	Rourkela Steel Plant	Iron & Steel	1.8MT/Annum 4931.5 T/day	265580	120,000	16m^3/ton of finished steel i.e. 78904 M^3/Day
2	Rourkela Steel Plant	Fertilizer CAN	4,60,000 T/Year 1260.2 T/day	28807	7920	5m^3/ton of product i.e. 6301 M^3/Day
3	Fertilizer Corporation	Fertilizer (Urea)	1500 TDP present production is 18% of the capacity i.e. 270 TPD	45883	16608	5m^3/ton of product i.e. 1350 M^3/Day
4	National Aluminium Company- Smelter Unit	Aluminium	2,30,000 MT/Annum	5066	4900	
5	National Aluminium Company-Captive Power Plant	Electric Power	720 MW	135000	90,000	
6	ORICHEM Ltd.	Sodium dichromate Basic Chromate Sulphate Yellow Sodium Sulphate	300 MT/M 60 MT/M 190 MT/M	170	10	
7	Talcher Thermal Power	Electric Power	480 MW	13227	6483	
8	Talcher Super Thermal Power Plant NTPC Kaniha	Electric Power	1000 MW	137099	52080	
		TOTAL		6308320	298001	

Source: State Pollution Control Board, Orissa, *Paribesh Samachar*, Vol.5, No.1, June 1998.

Annex. Table - 1.2

Water Consumption and Waste Water Discharged into Brahmani River from Urban Settlements

Sl. No.	Name of the City/Town	Water Consumption KLD	Population	Estimated Wastewater Discharge (80% of Consumption) in KLD	Estimated BOD Load 25g/Capita/Day (OPOB Ref) Approx T/Day
1	Rourkela Steel City	33561	2,14,521	26848	5.36
2	Rourkela Civil Township	21560	173374	17248	4.33
3	Biramitrapur	1130	30495	904	0.762
4	Rajgangpur	2270	39528	1816	0.988
5	Deogarh	680	17,271	544	0.431
6	Talcher	1753	26,806	1402	0.67
7	Angul	1835	26,752	1468	0.67
8	Talcher Thermal Township	1896	5,400	1516.8	0.135
9	MCI Colliery Talcher	10,142	13,096	8113.6	0.327
10	FCI Township	2700	6,000	2160	0.15
11	Bhuban	850	18,966	680	0.474
12	Kamakhya Nagar	500	12,832	400	0.32
13	Dhenkanal	3360	46,314	2,688	1.15
14	NTPC, Kaniha	5341	2,500	4272	0.062
15	NALCO Township	5500	2,500	4400	0.062
	TOTAL	93078		74460.4	15.891

Source: State Pollution Control Board, Orissa, *Paribesh Samachar*, Vol.5, No.1, June, 1998.

Annex Table - 1.3

Water Quality Status of Brahmani River

Sl. No.	Location	Desired Class	Existing Class					Critical Parameter				
			1990	1994	1995	1996	1997	1990	1994	1995	1996	1997
1	U/S Panposh	C	C	D	D	D	D	--	BOD	BOD	BOD	BOD
2	D/S Panposh	C	D	D	D	D	D	BOD	BOD	BOD	BOD	BOD
3	FD/S	C	D	D	D	D	D	BOD	BOD	BOD	BOD	BOD
4	Panposh	C	C	D	C	C	D	--	BOD	--	--	BOD
5	Banaigarh	C	D	D	C	C	D	BOD	BOD	--	--	BOD
6	Rengali	C	C	D	D	D	D	--	BOD	BOD	BOD	BOD
7	Samal U/S	C	C	D	D	D	D	--	BOD	BOD	BOD	BOD
8	Kamalanga D/S	C	D	D	D	D	D	BOD	BOD	BOD	BOD	BOD
9	Kamalanga	C	C	D	D	D	D	--	BOD	BOD	BOD	BOD
10	Bhuban	B	D	D	D	C	D	BOD	BOD	BOD	BOD	BOD
11	Dharmasala Pattamundei	B	D	D	D	D	D	BOD	BOD	BOD	BOD	BOD

Source: State Pollution Control Board, Orissa, Paribesh Samachar, Vol.5, No.1, June 1998.

Annex Table - 1. 4

Wastewater Discharged into Mahanadi River from Different Industries

Sl. No.	Name of Industry	Location	Product	Capacity	Water Consumption (KLD)	Waste Water Generation (KLD)
1	Orient Paper Mill	Brajrajnagar	Paper	76000MT/Y	28464	18273
2	INDAL	Hirakud	Aluminium	20000TPA	1911	
3	INDAL CPP	Hirakud	Power	67.5 MW	4968	961
4	OPGC	Brajrajnagar	Power	2*250 MW	88450	26932
5	TATA Refractories	Brajrajnagar	Refractory	12750 MT/M	2852	1188
6	IDCOL	Bargarh	Cement	960000MT/Y	3900	2120
7	ICCL	Choudwar	Chargechromed	4170 MT/M	1634	15
8	BILT	Choudwar	Paper	1800MT/M	15800	14000
9	OTM	Choudwar	Textile	70000MT/D	52875	900
10	PPL	Paradeep	DAP	60000MT/M	2044	No discharge
			SAP	60000MT/M	815	2
			PAP	22500MT/M	5964	
11	ECBDL	Paradeep	Beer	50000HL/Y	186	150
12	Shakti Sugar	Badamba	Sugar	2700 MT/M	231	400
13	ICCL CPP	Choudwar	Power	60 Million KWH	11556	1776
14	L & T	Jharsuguda	Cement	2000 TPD	0.567	No discharge
				Total	221651	66717

Source: State Pollution Control Board, Orissa, *Paribesh Samachar*, Vol.5, No.3, Sept.1999.

Annex Table - 1.5

Coal Mines in the Mahanadi Basin

Sl. No.	Name of the Mines	Location	Total Area (ha)	Type of Mines	Coal reserve (Million tonnes)	Mines water discharge (KLD)	
						Summer and other	Monsoon
1	Lajkura	IB Valley	668.10	OCP	14.08	25	1085
2	Belpahar	IB Valley	1301.37	OCP	48.63	65	5746
3	Samaleswari	IB Valley	906.41	OCP	55.98	55	2976
4	Lilari	IB Valley	216	OCP	13.58	50	950
5	Lakhanpur Hirakhand	IB Valley	1260	OCP	200	150	4770
6	Bundia	IB Valley	10995.69	UG	---	672	862
7	Himgiri Rampur	IB Valley	1095.69	UG	14.80	4800	6500
8	Orient Collierry I & II	IB Valley	1150.37	UG	---	3432	4576
9	Orient Collierry III	IB Valley	1377.42	UG	64.24	3000	3600
10	Orient Colliery IV	IB Valley	519.47	UG	19.60	1730	2000
	Total					13979	33065

Source: State Pollution Control Board, Orissa, Paribesh Samachar, Vol. 5, No. 3, Sept. 1999.

Annex Table -1.6

Water Consumption and Wastewater Discharged into Mahanadi River from Different Urban Settlements

Sl. No.	Name of the Town	Status of Urban Local Bodies	Water Consumption KL/D	Population 1991 Census	Estimated Discharge (80%) KL/D	Estimated BOD Load T/Day
1	Sundargarh	Municipality	3540	30352	2832	0.759
2	Sonepur	Municipality	750	14409	600	0.360
3	Tarava	NAC	350	7466	280	0.187
4	Binika	NAC	150	12955	120	0.324
5	Burla	NAC	4000	31083	3200	0.777
6	Hirakud	NAC	360	24049	288	0.601
7	Brajarajnagr	Municipality	500	69667	400	1.742
8	Sambalpur	Municipality	16342	131138	13074	3.278
9	Nayagarh	NAC	1135	10464	908	0.262
10	Khandapara	NAC	90	7522	72	0.188
11	Khurda	NAC	2270	30591	1816	0.765
12	Jatni	NAC	1360	48042	1088	1.201
13	Bhubaneswar	Corporation	147350	411542	117880	10.289
14	Belpahar	NAC	230	27174	184	0.679
15	Jharsuguda	Municipality	4080	65054	3264	1.626
16	Paradeep	NAC	13620	48104	10896	1.203
17	Jagatsinghpur	NAC	800	25016	640	0.625
18	Athagarh	NAC	1632	13661	1306	0.342
19	Banki	NAC	682	14350	546	0.359
20	Choudwar	Municipality	680	36877	544	0.922
21	Cuttack	Corporation	97385	403418	77908	10.085
22	Puri	Municipality	16978	125199	13583	3.130
23	Boudgarh	NAC	600	9295	480	0.232
24	Barapali	NAC	400	12971	360	0.324
25	Padampur	NAC	1350	16378	1080	0.409
26	Bargarh	Municipality	2630	51135	2104	1.278
27	Bolangir	Municipality	3600	43066	2880	1.077
28	Bhawanipatna	Municipality	2992	51062	2394	1.277
29	Junagarh	NAC	1886	12974	1509	0.324
30	Khariar Road	NAC	720	14027	576	0.351
31	Kesinga	NAC	540	14127	432	0.353
32	Titilagarh	NAC	900	13364	720	0.334
33	Kantabanji	NAC	800	9791	640	0.245
34	Patnagarh	NAC	2160	8432	1728	0.211
TOTAL			332862		266332	

N.B : Estimated BOD load @ 25 gm per capita per day with reference to CPCB guidelines
Source: State Pollution Control Board, Orissa, *Paribesh Samachar,* Vol. 5, No. 3, Sept. 1999.

Annex Table - 1.7

Water Quality Status of River Mahanadi

Sl. No	Location	Desired Class	Existing Class			Critical Parameters		
			1990	1994	1998	1990	1994	1998
1	Sundargarh	C	C	D	D		BOD	BOD
2	Jharsuguda	C	C	D	D		BOD	BOD
3	Brajarajnagar U/S	C	C	D	D		BOD	BOD
4	Brajarajnagar D/S	C	D	D	D	BOD	BOD	BOD
5	Hirakud Reservoir	C	C	D	D		BOD	BOD
6	Sambalpur U/S	C	C	D	D		BOD	BOD
7	Sambalpur D/S	C	C	D	D		BOD	BOD
8	Sonepur U/S	C	D	C	D	BOD		BOD
9	Sonepur D/S	C	D	D	D	BOD	BOD	BOD
10	Tikarpada	C	D	D	D	BOD	BOD	BOD
11	Narasinghpur	C	D	D	D	BOD	BOD	BOD
12	Cuttack U/S	C	D	D	D	BOD	BOD	BOD
13	Cuttack U/S	C	D	D	D	BOD	BOD	BOD
14	Bhubaneswar U/S	C	D	D	D	BOD	BOD	BOD
15	Bhubaneswar U/S	C	D	D	D	BOD	BOD	BOD
16	Cuttack D/S	C	D	D	D	BOD	BOD	BOD

Source: State Pollution Control Board, Orissa, *Paribesh Samachar,* Vol. 5, No. 3, Sept. 1999.