Environment in Karnataka

A Status Report

Ecological Economics Unit
Institute for Social and Economic Change, Bangalore

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This paper presents an overview of the present status of the natural resource environment in Karnataka, namely, forest cover and pastures, land use, soil erosion, watershed development, livestock and fisheries, reserves of mineral ores and their exploitation, industrial pollution and urban environment. Apathy of the government machinery towards these environmental problems has provoked popular movements linked to people's access to natural resources and to health concerns. But an institutionalised approach to these problems is needed.

I
Introduction

THIS paper presents an overview of the present status of the natural resource environment in Karnataka, raising also some of the critical environmental issues which have emerged and responses to the same. Environmental problems arise both because of resource depletion and negative externalities caused by development processes and projects. To meet the goal of sustainable development, it is necessary to address both types of problems adequately. While it is difficult to give definite guidelines about what proportion of exhaustible resources can be exploited by the present generation for its own use and consumption, there is some consensus about renewable resources like fisheries and forests that their exploitation should be limited to the rate of regeneration. Even about exhaustible resources, we should periodically review the rate of their exploitation as against the stocks available, so that an informed judgment can be made about what the present generation should use as against what can be bequeathed to the future generations. Negative externalities like water and air pollution inflict severe welfare losses and reduce output as well (for example, cement dust and air pollution reducing crop yields). While quantifying the impact of these externalities is beyond the scope of this paper, their magnitude would be assessed. Wherever appropriate or feasible, we also compare the situation in Karnataka with the country as a whole.

Cecil Saldanha brought out six state of environment reports on Karnataka, the last one released in 1993. Each of these reports carried specialised articles on a few selected aspects of environment in Karnataka. The present report is inspired by Saldanha's work but has a different format, being a synoptic overview of environment, trying to do justice to most aspects within one paper using latest available information. Regrettably, issues related to management of water and energy could not be included here, though water pollution is discussed.

The paper is organised as follows. In Section II, we deal with the state of land use including forests and grazing land. We do not go into details of cropping pattern, but restrict ourselves to broad categories of land use. This leads us to a programme of arresting soil erosion and promoting water conservation through watershed development in Karnataka in Section III.[1] In Section IV, we deal with the state of livestock and fisheries, which are renewable resources. Mineral ores and their exploitation come under exhaustible resources, dealt with in Section V. This leads us to Sections VI and VII, respectively on state of industrial pollution and urban environment in Karnataka. In dealing with these issues, we also comment upon official response to environmental issues in respective sectors. Environment is too serious a matter to be left to official bureaucracy alone. Environment lobbies and NGOs have also played an important role in alerting officials and people at large about environmental problems. This will be dealt with in the concluding section.

II
Land Use, Forests and Pastures

Agriculture constitutes the major use of land both in Karnataka and the country as a whole, but more so in Karnataka. Taking together net sown area and current fallows, it accounted for 59.1 per cent of total geographical area in 1958-59 and 56.9 per cent in 1995-96 in Karnataka, as against 48.7 per cent and 51.3 per cent in India in the respective years. Though the proportion of land under agriculture has declined slightly in Karnataka, and increased slightly in India over these years, it still remains larger in Karnataka (Table 1). The proportion of land under forests, as per legal status (not necessarily under actual tree cover), increased both in the state and the country as a whole, from 14.4 per cent to 16.1 per cent in Karnataka, as against 17.9 per cent to 22.4 per cent in India during the same years. In spite of our western ghats, the proportion of area under forests is thus seen to be lower than the country's average.

Permanent pastures, cultivable wastes and other fallows taken together can be said to constitute broadly common property resources used for grazing. At least as per official data, the proportion of such lands declined only slightly from 15.4 per cent in 1958-59 to 14.5 per cent in 1995-96 in Karnataka, but a little more significantly from 15.7 per cent to 11.6 per cent during the same years in India. The role of such common property resources as a source of fodder has been declining over the years, and correspondingly the role of fodder raised in private holdings, including fodder crops raised commercially, has been increasing. With population increase and economic development, prices of livestock products have increased significantly enough over the years to make such a shift affordable to farmers, though this would have certainly affected landless labour and marginal farmers who have little or no land of their own as a source of fodder. Irrespective of trends as seen from official data, common property resources appear to have declined both in quantity and also in quality and productivity. There is reason to believe that land under agriculture is underestimated and that area under grazing lands is overestimated, mainly because encroachments into the commons for cultivation are not reflected in official land use data. This was corroborated from a micro level study in Karnataka [Nadkarni and Pasha 1991].

This observation could apply equally to forests, encroachments into which are also common. This is quite apart from the fact that even unencroached lands legally under the forest department may have lost tree

cover due either to officially permitted clear felling or to unauthorised cutting and exploitation by people around the forests. There are also other factors due to which the official land use data on forests do not really report the physical condition of land. This results in errors in both directions. In Uttara Kannada district, for example, due to some legal quirk, forest land submerged under reservoirs or leased out for cultivation totalling over 1,000 sq kms was still reported as forest land in land use statistics [Reddy et al 1986:2 and 3]. On the other hand, in Shimoga, Chikmagalur and Dakshina Kannada, these statistics underestimate the extent of forest cover. This is because significant fractions of physically forested land are under the jurisdiction of the revenue department; only land under the forest department is counted as forest land in official statistics whatever its physical condition. Not an insignificant part of the increase in the area under forests in Table 1, is because of transfer of lands from the revenue department to the forest department.

With the emergence of remote sensing technologies, it was hoped that an 'objective' and 'accurate' method of delineating land cover was now available. However, forest cover statistics by different (and sometimes the same) agencies show dramatic differences that cannot be explained simply on the basis of difference in definition. For example, the state of forests reports of the Forest Survey of India have indicated that 81 per cent of Kodagu district is under forest cover, though cultivated area as per official land statistics accounts for more than 36 per cent. Forest Survey of India's own maps published at 1:2,50,000 scale for 1990 indicate only 35 per cent area under forests including scrub vegetation. In general, reliable information on forest condition at the meso-scale is still scarce [Lele et al 1998a].

The most recent and reliable estimate of forest cover – natural and artificial, dense and open – in Karnataka as a whole comes to 13 to 14 per cent of the state's geographical area [NRSA 1983; Sinha 1988]. The forest cover estimated by NRSA for India as a whole is also 14 per cent. The districtwise distribution is not reliably known for the reasons stated above, but the districts with greatest proportion of forest cover are Uttara Kannada (70 per cent), Dakshina Kannada (60 per cent), Shimoga (40 per cent), Chikmagalur (35 per cent), Kodagu (35 per cent) and Mysore (30 per cent). [Menon and Bawa 1998; Bannur and Sharatchandra 1997].

Over the years, there has been a considerable loss of forest cover in the state. Taking a long period of 1920-90 in five western ghats districts, Menon and Bawa (1998) concluded that the extent of forest loss varied from 13 to 53 per cent, due mostly to extension of cultivation and coffee plantations and very little to submergence under reservoirs (Table 2). The largest loss of forest is seen to be in Chikmagalur and Kodagu district where coffee plantations now dominate. Estimates of loss of forests in the state as a whole are available from official sources for the periods 1956 to 1981, and from 1981 to 1998 (Table 3). In both periods, extension of cultivation has accounted for the largest share among all factors, accounting for almost two-thirds during the latter period, and development projects accounting for one-third of the loss. These figures do not indicate net loss of forest area, for some of it has been compensated by increase in forest area at least in quantity (area) if not in quality.

Between 1975 and 1982, however, the extent of forest cover in the state seems to have declined by only 1 per cent [NRSA 1983] as compared to a decline of 3 per cent for the country. Subsequently, the forest cover appears to have remained constant or even increased slightly. But this increase comes in the form of forest plantations (typically monocultural and often using exotic species) resulting from afforestation activities, while the extent of natural forests continued to decline.[2] Afforestation activities since the early 1980s attempted to promote mixed plantations, although with limited success [Saxena et al 1997]. The long-term trend appears to have been one of shift from closed canopy forest to open canopy forest, and from evergreen to moist-deciduous vegetation types. Standing stock may not have declined in the same proportion as forest canopy, since human use results often in disproportionate pruning of crowns [Lele et al 1998b].

The plant species composition has definitely become less 'rich' as many rare and endangered plants were lost or rendered scarce. This happened during a prolonged phase of 50 years or more up to mid-eighties, during the drive towards replacing natural forests by timber and other commercial wood plantations. The decline in wild animal populations has been even more dramatic and visible [Gadgil 1984; Daniels 1993]. At least one bird (the Great Indian Bustard) is reported to be on the verge of extinction, and the Bengal Tiger is surviving only in protected areas. The reasons for this are a disproportionate increase in forest fragmentation, erosion of habitat quality due to changes in composition and densities, and significant poaching pressures.

Forest degradation has also adversely affected the availability of fuelwood and small timber to local communities dependent on them in certain areas. The ban on green felling has reduced the official supply of commercial fuelwood and timber also. Certain species like bamboo had depleted significantly even before the ban on green

TABLE 1: LAND UTILISATION PATTERN

(Area in '000 hectares)

	Total Geographical Area	Forest	Non-Agricultural Use	Barren	Miscellaneous Trees and Groves	Cultivable Waste	Permanent Pastures and Grazing	Other Fallows	Agricultural Use
1958-59									
Karnataka – Area	18735	2702	804	885	370	663	1769	474	11068
Percentage	100	14.4	4.3	4.7	2.0	3.5	9.4	2.5	59.1
India – Area	293972	52675	13563	32879	5711	20610	13112	12286	143136
Percentage	100	17.9	4.6	11.2	1.9	7.0	4.5	4.2	48.7
1995-96									
Karnataka – Area	19050	3076	1230	801	326	444	1048	1284	10838
Percentage	100	16.1	6.5	4.2	1.7	2.3	5.5	6.7	56.9
India – Area	304863	68421	22035	18975	3657	14468	11176	9703	156428
1993-94 percentage	100	22.4	7.2	6.2	1.2	4.7	3.7	3.2	51.3

Note: Agricltural use = current fallows + net cultivated area.

Source: *Karnataka at a Glance 1995-96*, Directorate of Economics and Statistics; *Fertiliser Statistics* 1963-64 and 1996-97, FAI, New Delhi.

felling (around 1983) as the then system offered bamboo to paper mills at a nominal price and there was no incentive for regeneration [Gadgil and Prasad 1978]. The same thing happened in a number of non-timber forest species like Cinnamomum sp and Myristica sp and a host of medicinal plants (K S Murali, personal communication to Lele; FRLHT unpublished data). The overall impression is unmistakable that the long-term sustainability of these forests, especially in terms of quality is in serious doubt.

A few comments on the official responses to the forest situation are in order. Till at least the mid-eighties, afforestation efforts were mainly oriented towards meeting commercial species like timber, softwood and fuelwood, reflected in the plantations of teak, eucalyptus and casurina. Even under social forestry phase from 1983 to 1992, the focus on these species was not changed. In many cases, social forestry plantations reduced the availability of grazing lands to villagers, who had to be content with lops and tops. This led to protest movements led by NGOs like Samaja Parivartan Samudaya and led to a change of policy towards promoting mixed species plantations. Till 1992, however, the agencies of afforestation were the Karnataka forest department and such other government departments, operating in a centralised, bureaucratic, prohibit-and-police manner.

From 1993 onwards, however, there has been a visibly increased focus on the involvement of local communities in afforestation mainly under joint forest planning and management (JFPM). This is supported by a £24 mn 'Western Ghats Forestry Environment Project' funded by the UK. The progress under the scheme has, however, been rather slow due to several factors: (a) restriction of the JFPM to only 'degraded' areas, which form a small fraction of actual forest used by local communities; (b) inadequate devolution of control to local communities, (c) poor fit with social realities;[3] (d) problem of ensuring adequate incentives to locals; and (e) lack of enthusiasm among implementing forest staff [Saxena et al 1997]. The number of village forest committees set up under this project up to September 1998 was only 400 in Karnataka, which compares poorly with the more than 2,000 set up in neighbouring Andhra Pradesh in a shorter time.

A clearly defined access to and exclusive control of the resource by local users may be a necessary but not a sufficient condition for sustainable management. For instance, many 'betta' lands in Uttara Kannada where areca gardeners had exclusive access if not ownership were degraded due to indifference to regeneration [Nadkarni et al 1989; Lele et al 1998b]. 'Baane' lands in Kodagu under privatised access have all been converted to coffee plantations, and 'kumki' lands in Dakshina Kannada have in many places been converted to cashew or ther plantations. This highlights the basic tension between different roles of forests, valued differently by different interest groups. Institutional innovations that enable local communities to be compensated for providing global benefits from forests, and a political environment and process committed to fairness and sustainability – both still largely missing – will be necessary for a successful resolution of these tensions.

In sum, though Karnataka has been endowed with a particularly rich forest flora and fauna and widely distributed network of pasture lands (including Amrut Mahal Kavals[4]), Karnataka's post-independence record of conserving them has hardly been encouraging. Forests and pastures have declined significantly particularly in quality, and regeneration efforts have had only a marginal success in addressing the problems.

III
Soil Erosion and Watershed Development

Soil erosion is a major problem affecting the state particularly in its dry or rainfed areas. According to official sources (*Indian Agriculture in Brief*, 25th ed 1994, pp 22-25], 11.4 million hectares out of the total geographical area of 19.05 million hectares, i e, 59.8 per cent was degraded in Karnataka during the early 1990s. This proportion is more than in the country as a whole, where the problem area is 53.2 per cent. The problem area includes both cultivated and uncultivated areas. Karnataka is a pioneering state in taking up soil conservation programmes, but only 30.6 per cent of the problem area was treated up to 1992-93. Though it is higher than in the country as a whole (20.9 per cent), there is still a long way to go. The old approach focused only on soil conservation which was not very effective. It has now given place to a more comprehensive and integrated approach of watershed development which includes soil and water conservation in dry and semi-arid areas.

Watershed development is a holistic approach to improve and develop the economic and natural resource base of economically disadvantaged and ecologically fragile regions such as the dry and semi-arid areas. Instead of an administrative region, watershed is the

TABLE 3 : LOSS OF FOREST IN KARNATAKA, 1956-1981 AND 1981-1998

Purpose	Area Lost (Hectares)	Percentage to Total Area Lost
From 1956 to 198)		
Hydel project	41068	18.4
Direct submersion	35840	16.1
Rehabilitation of the displaced	25820	11.6
Power lines	1688	0.8
Colony roads and townships	2121	1.0
Mining	42676	19.2
Other non-agricultural use	6297	2.8
Extension of cultivation	67217	30.2
Total	222727	100.0
From 1981 to March 1998		
Hydel projects	5184	17.6
Irrigation projects	667	2.3
Laying of railways	359	1.2
Laying of transmission lines	399	1.4
Construction of roads	14	0.0
Mining/quarrying project	3343	11.4
Others (including extension of cultivation)	19460	66.1
Total	29426	100.0

Source : 1956-1981 : Karnataka State Gazetteer, 1982; 1981-1998 : Monitoring Report, Karnataka Forest Department

TABLE 2 : LOSS OF FORESTS IN WESTERN GHATS DISTRICTS

(*Area in sq kms*)

District Name	Area	Extent of Forest and Scrub				Forest Loss Due to Per Cent to Total Loss		
		1920		1990		Agriculture	Tea and Coffee	Reservoirs
		Area	Per Cent to Total	Area	Per Cent to Total			
Chikmagalur	7184	5068	71	2500	35	55.8	42.0	2.2
Hassan	6818	2205	32	721	11	81.0	18.3	0.7
Kodagu	4098	3622	88	1464	36	28.0	71.5	0.5
Shimoga	10556	6330	60	4637	44	93.1	0.0	6.9
Uttara Kannada	10251	9134	89	7806	76	92.6	0.0	7.4

Notes: (a) 1920 areas are estimated using Survey of India toposheets and hence should be considered as approximate. Data for 1990 were obtained from 1:250,000 FSI forest vegetation maps produced from interpretation of 1987, 1989 and 1991 imagery.
(b) Though tea and coffee plantations are clubbed together, area under tea is not significant.
Source: Menon and Bawa (1998).

unit of area for development. At least in Karnataka, watershed development projects seek to improve all types of lands, both government and private, cultivated and uncultivated. It is not a mere soil and water conservation or forestry programme, but a strategy to increase the overall productivity of the region as a whole.

Karnataka launched the district watershed development programme (DWDP) in 19 selected watersheds, one in each district from 1983-84 onwards. In addition, there are programmes as under national watershed development projects for rainfed Areas (NWDPRA), a model watershed development programme sponsored by ICAR/CRIDA, projects under rain-gauge stations, also an NGO sponsored programme like the PIDOW project in Gulbarga district. The agency, the approaches and manners of implementation of the projects differ. A unique feature of DWDP is that it is managed by a single agency – the dryland development boards, where all the concerned departments of the government are represented so as to promote integration and co-ordination. Until recently, the government sponsored watershed development projects followed a top-down approach, but people's participation is now being emphasised.

Starting from 1984, around one lakh hectares of rainfed areas have been treated every year under the programme, the cumulative total up to 1997 being 14.41 lakh hectares. The average cost of treatment per hectare worked out to be only Rs 2,825 (State Watershed Cell, 1997). The area treated so far (up to 1997) under watershed development programmes (excluding areas treated under earlier soil conservation programmes) works out to be only 7.5 per cent of the total geographical area of the state. But this is still significant considering that it is confined to dry and semi-arid tracts (which constitute about two-thirds of the total area of the state). However, there is still a lot more area to be covered.

A recent evaluation study of 20 watersheds in Karnataka based on satellite remote sensing techniques has shown some encouraging and at the same time some disturbing findings [RRSSC-STDP 1998]. The study involved a comparison between 1988 and 1996 imageries. In most of the treated watersheds, there was an improvement in agriculture, horticulture and forestry sectors; increase in irrigated area and water bodies; increase in yields; and decrease in fallows and extent of wastelands. Gullies and ravines were treated with vegetative checks to arrest soil erosion. Afforestation and gap filling activities increased biomass output as well. The overall improvements were rated among the 20 watersheds as ranging from 7 to 27 per cent. There were also a few worrisome things like encroachments into non-arable lands, illicit cutting and unregulated grazing there. Even if non-arable areas are brought under forest cover, there was no assurance that it would remain there since people's participation and commitment in the use and management of common or public lands was not forthcoming to the desired extent. A similar need was felt in the maintenance and protection of development works undertaken. Frequent transfers, untimely release of funds and inadequacy of funds also affected the programme.

Other studies of the impact of watershed development on crop yields, income, employment, stability of yields, and water tables have shown significantly positive results [Deshpande and Nikumbh 1993; Ninan and Lakshmikanthamma 1994; Lakshmikanthamma 1997]. An economic analysis of a watershed (Mittemari) showed that after deducting all the costs including public capital investment and opportunity cost (due to grazing opportunity foregone by people as a result of the project), the internal rate of return was found to be 13.5 per cent, which is encouraging [Ninan and Lakshmikanthamma 1998]. We do not have to compare this with high nominal rates of interest; since the cash flows were in real terms. They can be compared with real rates of interest of 5 or even 8 per cent quite favourably. Besides, the benefits taken here include only the increased production in agriculture and the forestry sector, and indirect environmental benefits are ignored. If they are valued and taken note of, the rate of return would be higher still. It was also found that small farmers have shared in the gains. The lack of effective participation of people in watershed development has, however, been a constraining institutional factor in government sponsored projects. Efforts are being made now to give more voice to local level people's groups and NGOs in watershed development.

IV
Livestock and Fisheries

Almost all families living in rural areas depend directly or indirectly on livestock resources for their living. There exist strong complementarities between livestock and crop husbandry. Though in terms of value added by livestock, its contribution to national and state domestic product is now about 8 per cent and 6 per cent respectively, its economic importance is far greater than what is indicated by these figures. It is still a significant source of draught power, and organic manure obtained from this source is needed as a supplement to chemical fertilisers. The contribution of livestock sector to total agricultural inputs, however, has been declining since the last two decades or more, thanks to subsidised chemical fertilisers and tractorisation.

The livestock population, however, has continued to increase both in Karnataka and the country as a whole, though not sharply. Total livestock (covered by livestock census, excluding poultry) increased by 32.3 per cent in India and by only 12.2

TABLE 4: (A) RESERVES OF MINERAL DEPOSITS (1995-96), (B) THEIR ANNUAL EXTRACTION (1995-96), AND (C) THE NUMBER OF YEARS FOR WHICH THE RESERVES MAY LAST AT THE PRESENT LEVEL OF EXTRACTION

Mineral Ores	Reserves of Mineral (Million Tonnes)	Annual Extraction (Tonnes)	Time Left to Exhaustion (Years)
Bauxite	28.00	69,617	402
Chromite	0.85	77,840	11
Copper	0.966	87,802	11
Dolomite	325.00	46,693	6960
Feldspar	164.64(tonnes)	1.201	137
Fire Clay	8.44	2238	3771
Fuller's Earth	1.30	N A	N A
Gold	13.61(tonnes)	1.45	9
Iron Ore	929.00	11.609 (mn tonnes)	80
Kaoline	94.46	4808	19646
Kyamite	1360(tonnes)	2.848	478
Lime stone	17,253	8.023 (mn tonnes)	2150
Lime Shell	NA	52.2	NA
Magnesite	1.17	26,200	44.7
Manganese	65.0	4,15,070	157
Quartz	26.8	24,412	1098
Vanadium	20,387 (tonnes)	NA	NA

Notes: * Time left to exhaustion, is obtained by dividing reserves by annual extraction both taken in same units.
NA – data not available.
Source: Department of Mines and Geology, Government of Karnataka.

TABLE 5: PROPORTION INDUSTRIAL UNITS WITH POLLUTION TREATMENT PLANTS

(Per cent)

Industries	As on March 31, 1991	As on March 31, 1996
For water pollution control		
Large industries	65.8	73.2
Medium industries	65.0	67.6
Small industries	NA	62.7
For air pollution control		
Large industries	33.8	73.2
Medium industries	33.5	69.1
Small industries	NA	64.5

Source: Annual Reports of Karnataka State Pollution Control Board (KSPCB), 1990-91 (pp 8-10) and 1995-96 (p 13).

per cent in Karnataka between 1961 and 1990. Though Karnataka accounts for 6.2 per cent of the total area of the country, its share in the livestock population of the country was only 5.2 per cent in 1990. There is thus a little less pressure of livestock population on land in Karnataka than in the country as a whole. The density of livestock per hectare of land taking only forests, agricultural land including current fallows, pastures, cultivable waste and other fallows, was only 1.38 in Karnataka in 1990 (14th livestock census) whereas it was 1.71 in India as a whole.

The population of sheep and goats is 37 per cent of total livestock in Karnataka, which is slightly more than 35 per cent for India as per the latest livestock census (14th). The population of sheep actually declined slightly (by 8 per cent) in absolute terms in Karnataka between 1960 and 1990, but the population of goats increased by 34.3 per cent, which was much more than the rate of growth in total livestock (viz, 12.2 per cent) noted above. The role of goats as a source of milk has declined relatively sharply; they are used mainly as a source of meat.

Growth in milk production has been much more spectacular than growth in the number of female bovines. The latter (over 3 years of age) increased only by 26.1 per cent between 1961 and 1990 in Karnataka, while production of milk increased by a phenomenal 160 per cent between 1976-77 and 1995-96. Cows accounted for 54.9 per cent of total milk production in 1995-96 (indigenous cows 35.4 per cent and crossbred cows 19.5 per cent), and buffaloes contributed 44.76 per cent. The share of goats is a negligible 5 per cent [GOK 1995-96]. The present per capita per day availability of milk at 192 grams, though higher than earlier, is still lower than the ICMR norm of 250 grams. Much of the increase in milk production has been achieved through a push to commercialisation of the dairy sector, involving a shift from CPRs as a source of fodder to crop residues and commercial fodder and feeds. The role of CPRs in animal husbandry remains important mainly for the poor and for indigenous cattle and small ruminants.

The growth of poultry has been more spectacular than that of livestock, but less so in Karnataka than in India. The total number of poultry increased by 77.4 per cent in Karnataka between 1961 and 1990, and by 141 per cent in the country as a whole.

Livestock pressure on land has been a traditional source of worry to environmentalists and foresters in India. Forest policy in India since its early days has sought to regulate this pressure. There is evidence of such pressure having an adverse effect on regeneration capacity and composition of forests, as seen from a case study in Haliyal division (Uttara Kannada) in Karnataka [Rai 1985]. While livestock is allowed to grow, and is promoted even in poverty alleviation schemes, pastures and other common lands to support them are shrinking as noted above. Northern Maidan seems to be facing this problem more acutely than other regions as seen from an analysis of village grazing lands in Karnataka [Nadkarni 1990]. This is tried to be made good by using crop residues and other commercial fodder. Since cows of local breed and small ruminants continue to depend on common lands, an increase in such livestock may call for some measures for regulating grazing like rotational grazing and for sustainable management of pastures. It is difficult, however, on the whole to establish that either in Karnataka or India, there is overpopulation of livestock. In fact, human population has increased much faster and there has been no serious scientific investigation to support such a generalisation [Mishra 1995:258].

Coming to fisheries, world fisheries are in a state of crisis and India and Karnataka may be no exception. 'Fish have never been more popular as sea food, nor more threatened as marine wildlife...Scientists warn that fish population and marine ecosystems are in serious trouble' [*Samudra* July 15, 1996:15]. This is because 70 per cent of the world's commercially important marine fish stocks are overexploited, and modern fisheries are enormously destructive. It is estimated that about one-third of their fish catch is wasted. Marine biodiversity is under threat because of them (ibid:15). Modern technologies, moreover, opened up fishing even during the monsoons, which has led to overexploitation. There have been protests in India against the opening of the fisheries sector to multinationals and foreign vessels [Kurien 1995]. They do not confine to deep sea fishing and intrude into coastal zones reserved for country boats. On the whole, fishery managers are oriented more to maximising commercial exploitation and hardly evolve strategies for sustainable exploitation. Even the regionwise or countrywise data necessary to monitor current exploitation in comparison with sustainable fish catch or with regeneration, are hardly gathered and published. Giving greater scope to country fishermen and preventing or regulating wasteful practices could mean both greater income and employment to the fishermen and also sustainable exploitation of fisheries.

Fisheries contribute only 71 per cent to state domestic product in India, which is not very different from 77 per cent at the national level. However, it is a source of livelihood to many fishermen particularly in the coastal districts of Uttara Kannada and Dakshina Kannada. Inland fisheries provide seasonal and subsidiary income and employment, but their role also is considerably less in Karnataka than in states like Kerala and West Bengal.

The state has a coastal length of 300 kms, 27,000 sq kms of continental shelf and 87,000 sq kms of exclusive economic zone (EEZ), with about 3.03 lakh marine fishermen living in 202 fishing villages. Marine fish catch increased in the state from 1.61 lakh tonnes in 1980-81 to 2.23 lakh tonnes in 1996-97, an increase of 39 per cent. This can be compared with the estimated total resource potential of 4.25 lakh tonnes per annum in the EEZ and the annual catchable potential at 0-50 fathom depth range is estimated at only 2.7 lakh tones. [GOK 1997:10-11]. In the country as a whole also as against the actual level of exploitation of marine fish or 2.71 million tonnes, the potential available for exploitation is 3.92 million tones. All of this potential cannot, however, be considered as available for sustainable exploitation. Regrettably, estimates of annual rate of regeneration of marine fish and of what can be considered as sustainable exploitation are not available.

The sources of inland fisheries in Karnataka are 4,695 major tanks, 21,801 minor tanks, 61 reservoirs and around 9,000 kms of rivers and canals. The maximum waterspread area of tanks and reservoirs is about 4.15 and 2.16 lakh hectares respectively [GOK, 1997]. Only 87,675 fishermen are reported to be active in inland fisheries.

Inland fisheries production increased from 46,652 tonnes in 1980-81 to 101,654 tonnes in 1996-97, i e, by 118 per cent which is much more than the rate of increase in marine fish catch during the same period (viz, 39 per cent). What is remarkable is that this increase has come about inspite of a decline in the number of tanks and shrinkage in their spread. Most of the inland fish is captured and traded in an informal and unorganised way by poor people. Since mechanised trawlers are not used in inland fisheries, the technology used is much more sustainable here. Even then there has been a worry about the survival of river fish such as mahseer, which is hunted for sport by adventure-

seeking rich and not as a source of livelihood.

The state also has about 8,000 hectares of brackish water, out of which 4,200 are estimated to be suitable for aquaculture. Of this, only 1,000 hectares are developed. At present, the average production of culture is around 800 kg per hectare. There seems to be some unutilised potential in brackish water in Karnatak. But this should be done very cautiously, without ever extending brackish water into paddy lands and contaminating ground water. It is necessary to remember that acquaculture has produced high and irrecoverable environmental costs where its expansion has been at the expense of cultivated or cultivable lands by pumping in sea water. In response to a writ petition, the Supreme Court has ordered that no further shrimp or aquaculture farms be permitted, that no groundwater be drawn for acquaculture and that no part of agricultural lands and salt pans be converted to commercial acquaculture farms [Samudra 17, March 1997:37].

V
Mineral Exploitation and Environmental Impact

As observed in the introduction above, it is a difficult task to judge what rate of exploitation of minerals is advisable to take care of the problem of depletion and reconcile the interests of the present generation with those of the future generations. It helps, however, to compare the present rate of exploitation with the reserves still available for exploitation. The number of years for which reserves will last at the present rate of exploitation can be directly computed from the above two. Table 4 here gives this picture about the mineral ores in Karnataka in 1995-96. A few minerals are approaching exhaustion within about a decade, which are chromite and copper (11 years each), and gold (9 years). The position regarding others is more comfortable. A debate is needed about whether it is worthwhile pushing exploitation of the former group of minerals to exhaustion so soon, and whether we are getting corresponding returns from it which justify such exhaustion.

Karnataka is estimated to have 1,092 billion tonnes of granite (including coloured) on site, of which 391 billion tonnes are stated to be recoverable. There is no information on the production or actual exploitation of granite, but 408,583 tonnes were reported to have been exported from Karnataka in 1992-93 (Department of Mines and Geology, GOK). Coloured granites are scarce but no separate figures could be obtained on their reserves.

Apart from depletion, another problem with mineral ore exploitation is the adverse environmental impact it creates [Saldanha 1987]. This is also a cost to be reckoned while judging the worthwhileness of mineral exploitation. The responsibility of taking precautionary steps to avoid or minimise the impact is on the miners. Mining generally causes deforestation as the miners are most often in forest areas. Not only the mining sites, but also other sites used for dumping waste, constructing roads and colonies for miners and such other uses also take up land and lead to deforestation. Open cast mining also leads to land degradation, silting of reservoirs, tanks and rivers downstream, and landslides. There are other effects like air pollution due to dust and noise pollution, which affects the health of miners. Often the miners work in miserable conditions. Though risk to life may be reduced, risk to limbs and to their health are hardly taken care of. As a result, many workers suffer from serious debilitating diseases within a few years of their joining the mines, and some of them may be compelled to stop work. This is so not only in mineral exploitation but also in granite and other stone quarries. Few labour inspectors ever visit such sites or try to improve the working conditions of miners.

Kudremukh is one of the well known mining sites in Karnataka for extracting and exporting iron ore. Kudremukh Iron Ore Company Limited (KIOCL) was set up in 1976 and started functioning effectively from 1982. The site is estimated to have 700 million tons of weathered ore and 450 million tons of primary ore. It has a lease area of 4,000 hectares, of which 1,452 hectares are now under active mining. The ore to waste ratio is presently 2:1. It has almost all the environmental problems expected in a mining project in a hilly forest area. Heavy rainfall in the area further contributes to soil erosion and siltation washing the dug up soils down the hill. KIOCL, therefore, took up several environmental measures to minimise these problems.[5] One of the important measures was to dig trenches around the hills, 10 metres wide and 2 metres deep, at the contours of 1,000, 500 and 200 metres altitude. On the upward side, trees like sisal, eucalyptus, acacia, cassia, mahogany, casuarina were planted. Fast growing trees and grass are also planted in between trenches. Tree belts up to 200 metres were created on either side of the rivers and streams. Two rock-filled dams have been built to prevent mine wash from polluting river Bhadra. A 100 metre high Lakhya dam has also been built to contain the tailings generated from the project. The company is reported to have won several awards in recognition of the measures taken. It is hoped that other mining companies also take similar measures. The annual ore production now is 7.5 million tonnes per year.

VI
Industrial Pollution

Though policy and legislation for the control of industrial pollution may look stringent on paper, there is many a slip in execution. The implementation of pollution control in the nineties is certainly more effective than in the eighties, and far more so as compared with the seventies. Even then we cannot say that all the pollution standards are followed by all the industries. Even though pollution control boards have the powers to close down offending industries, the action is hesitant and lax particularly because of the fear of causing unemployment and distress.

It would be useful to have some indication of hard figures of how far pollution control laws are put into effect, taking the case of Karnataka. One such indication is how many industrial units have at least set up treatment plants. This can be seen from Table 5.

Though Table 5 relates to treatment plants actually in operation, they may not necessarily be operated all the while. This is done to save energy which is scarce and costly. Even where the industries actually operate the pollution control plants, all of them do not meet the standards prescribed. A recent study comparing pollution control status in Karnataka with Netherlands

TABLE 6: TRENDS OF POLLUTANTS IN RIVERS IN SELECTED LOCATIONS IN KARNATAKA

Rivers/Location	Period	Dissolved Oxygen	Biochemical Oxygen Demand	Total Coliform
Krishna at Tintini Bridge	1979-91	NT	DN	UP
Tungabhadra at Ullanur	1979-91	NT	DN	UP
Bhadra D/S of KIOCL	1979-91	NT	DN	UP
Cauvery at KRS dam (Balamurikshetra)	1980-91	UP	NT	UP
Kabbani	1987-91	NT	UP	UP

Note: NT - No trend in the parameter; UP - upward trend; DN - downward trend.
Source: CPCB Annual Report 1992-93, pp 24-26 (extracted).

showed that though in general the standards were more lax in the former, compliance was also more lax, particularly in respect of small industries [Kuik et al 1997]. What is the regulatory machinery doing about it then?

As per the annual report of Karnataka State Pollution Control Board (KSPCB) for 1995-96 (the latest available at the time of writing), only 97 prosecutions were launched under Water Pollution Act and 40 under the Air Pollution Act since the inception of the board in 1981. These cover the cases of highly polluting and also other industries. The number of industries ordered to be closed down for non-compliance was only 22 till March 1994, which increased to 76 under both Water Pollution Control Act and Air Pollution Control Act together. As a result of stricter implementation of the law among 17 industries identified as highly polluting, the rate of compliance of pollution control is reported to have improved from 27.9 per cent in 1991 to 81.2 per cent in 1996 (as seen from KSPCB annual reports for 1991 and 1996).

The extent of implementation of pollution control is reflected in ambient air and water quality. Illustrative information for Karnataka is presented in Table 6 here for water quality (information on air quality in cities is presented in the next section). It shows deterioration in water quality at all locations in regard to coliform, and either no trend or upward trend for dissolved oxygen, and a mixed picture for biochemical oxygen demand. This is hardly a rosy picture.

A major problem with pollution control boards is inadequate finance and inadequate technical staff to monitor all the industrial units. They also take on the unnecessary burden of giving technical advice or guidance and take the blame if technology suggested does not deliver the goods. There are now consultants available on pollution control implementation who can take over this work, and leave the task of monitoring and taking legal action to KSPCB.

There are still several problem areas in the state due to continued water and air pollution. A few illustrative examples are given here, separately for water and air pollution based on a districtwise report by KSPCB on the status of industrial pollution in Karnataka [KSPCB 1995].

Both rivers and the sea are polluted noticeably in Karnataka and some of the problem spots are identified as Bangalore (Vrishabhavati), Bhadravati, Dandeli, Davanagere, Harihar, Karwar, Kollegal, Kudremukh, Nanjangud, Shimsa and Srirangapatna. We take four examples here: (i) pollution generated by a group of industries (including small) in one location; (ii) pollution generated by one or two large industrial units; (iii) pollution generated by a plantation industry (coffee estates); and (iv) marine pollution.

Peenya in Bangalore is one of the biggest industrial areas in Asia, housing many industries of various sizes including small industries. Most of them have no or inadequate treatment facilities, especially for small industries. Some 79 units let out over 5 million litres of effluents per day into the river Vrishabhavati which skirts the city on the western side and then joins Arkavati, which is a tributary of Cauvery. Vrishabhavati was a clean perennial stream only 20 years ago, and now stinks so much that it is a nuisance to neighbouring residents. It was used for recreation (picnics) by city dwellers and fishing by villagers earlier. Now, there is a fear that pollutants reach even aquifers and Cauvery. Most of the layouts near Vrishabhavati have no access to municipal drinking water and have to depend only on ground water. The authorities concerned have shown callous disregard of this problem and have not done anything to reduce the pollution. Some of the pollutants are toxic, including lead. The concentration of lead is assessed to be as high as 7.5 times the pollution standard. Other heavy metals like cadmium, chromium, mercury and nickel are also present. These metals are absorbed by crops and animals and enter food chain [Nag et al 1995].

Bhadravati is a major industrial centre in Karnataka, located on the banks of river Bhadra. There are two major public sector industrial units – Visvesvaraya Iron and Steel and Mysore Paper Mills. Though both have installed pollution treatment plants, they are not able to change the brownish colour of effluents reportedly due to non-availability of viable technology. To make matters worse, sewage water of the town and untreated effluents of smaller industrial units are also let out into the river, making it into a problem area. The air pollution caused by VISL is another dimension of the problem. There are similar water pollution problems in Harihar, Davangere, and Nanjangud.

Plantation industry can also be a major source of river pollution. The pulp separated from coffee seeds is an organic waste, which is not found suitable for use as a fertiliser and is hence thrown into streams. As a result, the BOD level in some of the streams randomly tested was found to be as high as 2,000-4,000 mg/litre as against the permitted standard of 3 mg/litre for drinking water sources.

Compared to other major coastal states, the discharge of industrial and sewage discharges into the coastal waters of Karnataka is not high.[6] We cannot take comfort from the fact that Andhra Pradesh, Gujarat, Tamil Nadu, Kerala and Maharashtra discharge much more waste than Karnataka. Mangalore and Karwar are two problem areas of marine pollution. Mangalore is fast urbanising and both municipal and industrial effluents are released into the sea, causing both thermal and chemical pollution. Sewage is hardly treated before being released into the sea. Industrial units further compound the problem in a region which is considered ecologically sensitive and fragile. The caustic soda factory in Karwar is a major source of pollution, releasing mercury and chlorine into the environment. Marine pollution, it is feared, may affect both the quality and quantity of fish catch.

The air pollution problem is also illustrated with a few typical examples. The stone crushing industrial units around Bangalore are a significant source of air pollution. The stone dust is known to cause silicosis, a lung related health problem. Most of these units are small and scattered and do not find it viable to install equipment to prevent or at least minimise stone dust. One of the solutions to the problem is to restrain any unit from functioning which is not able to do so. But this means discouraging small units and raises equity issues because other firms causing other forms of pollution are not similarly restrained. A cement factory near Tumkur also is considered a major source of air pollution, affecting crop yields and health of both humans and animals in the area. Though equipment to minimise air pollution is installed, the problem of irregular supply of power and low quality of coal supplied are reported to be coming in the way of effective pollution control. The same problem also arises in Gulbarga district which also has cement manufacturing units.

The state has a significant deficit in power supply. However, power generating projects also create significant environmental problems. Major hydroelectric projects can lead to submergence of forests rich in biodiversity and also of agricultural lands and settlements, raising problems of rehabilitation and resettlement. Hence more attention is given now to thermal power stations. But they also create the problem of fly ash, not only polluting air but also requiring land for depositing fly ash. Raichur Thermal Plant and also the Cogentrix Plant well illustrate this

dilemma. Though both of them have equipment to reduce air pollution, the use of waste ash continues to be a problem. There is need for further research into the use of this because of the fear that the bricks made out of fly ash develop cracks after some time. There is little demand for bricks made of fly ash, and transport costs excerbate the problem. According to newspaper reports, research has shown some scope for using treated coal ash as fertiliser in cultivated areas. In semi-arid areas, this is reported to be increasing the capacity of the soil to absorb and conserve moisture and increase crop yields. If true, this is a promising breakthrough, illustrating how waste can be converted into an economic good while also solving environmental problems.

VII
Urban Environment

Rapid urbanisation in Karnataka, as elsewhere, has accentuated the problems of urban environment on all the three main fronts – water, air, and solid waste. Though the rate of growth of urban population has slowed down as revealed by the 1991 census, the urban environmental deterioration does not appear to have slowed down, thanks to accelerating vehicle population and inability of municipal corporations to cope with environmental problems. The major problem areas of urban environment in Karnataka are Bangalore, Hubli-Dharwar, Mangalore and Bhadravati. Gulbarga is also catching up in this regard. One prominent feature of these problems is that they are not confined to municipal limits and engulf periurban and rural areas as well, affecting not only agricultural lands but also acquifers contaminating the only source of drinking water (viz, groundwater) in such areas. We briefly present these problems – water, air and solid waste. There are other problems also like sanitation particularly in slum areas and traffic congestion, which are not dealt with here.

Karnataka has 172 corporations and municipalities of which 139 have no underground drainage and not even primary treatment plants. Among the remaining 33 municipalities, 26 have functional underground drainage facilities and only 15 have primary treatment plants [Saldanha 1992]. The bulk of the sewage water is let out on land or into streams without any treatment, polluting drinking water sources. The perception that water is scarce is yet to take hold both among the city dwellers and their representatives in municipalities and the bureaucrats manning them.

Bangalore which had a population of 4.13 million in 1991 and 4.85 million in 1995 (estimated), receives 705 million litres per day (MCD) of fresh water or 145 litres per day per capita. The supply position is much better now compared with per capita per day supply of 71 litres in 1961 and 102 litres in 1981, though this is less than the prescribed norm of 200 litres per day per capita for Class I cities as per international standards. The total sewage flow was estimated at 438 MLD (62 per cent of water received).[7] The water supply as given above does not include ground water exploited. Similarly, sewage put into soak pits also is not included in the sewage flow as given above. The Bangalore Water Supply and Sewage Board (BWSSB) was in established 1964 which is responsible for both water supply and sewage disposal and treatment. The main city, though not the outskirts, had a fairly well managed sewage system installed in 1950s, which has now become worn out and damaged in several places. The abuse of sewers by dumping solid waste has exasperated the problem. There are three sewage treatment plants, which are being upgraded. Their combined treatment capacity is only 346 MLD (79 per cent of sewage flow), which is being expanded to 458 MLD. The latter is slightly above the present sewage flow. There are facilities for both primary and secondary treatment., The sludge removed from the primary and secondary clarifiers is used as fertiliser and brings some revenue to BWSSB (Rs 1.04 lakh in 1994-95). There are plants to set up tertiary treatment whereby the treated water can be recycled for industrial use. The outskirts of the city and slum areas do not have satisfactory sewage system, though the main city also has problems, particularly mixing up of storm water drains and sewage lines.

The situation is even more dismal in other cities and towns. Mysore gets 112.45 MLD (as in 1997) or 148 per capita per day. It is reported to generate 35.65 MLD of sewage,[8] only 31.7 per cent of which is treated and that too at the primary level. Both the treated and untreated wastes are discharged on land, to keep the river Cauvery from being polluted. In the twin city of Hubli-Dharwad, the water supply is 85.35 MLD, which is 119 litres per day per capita. It generates 82 MLD of sewage. The city is yet to establish proper treatment plants, and a part of the untreated sewage is treated as fertiliser and a part let out into streams and tanks. This may have affected the quality of groundwater.

Since small industries discharge their waste water into municipal sewage or drains, it aggravates the problem of waste water treatment. The municipalities have the burden of cleaning it up. They can charge a user fee for this service to small industries, and improve their financial resources to effectively treat waste water.

The quality of air in most of our towns and cities has worsened significantly in the last two decades mainly due to vehicular emissions. In cities like Bhadravati, industrial pollution is also an additional factor. Both Bangalore and Mysore are covered under the national ambient air quality monitoring programme. The main pollutants monitored under the programme are suspended particulate matter (SPM), sulphur dioxide and oxides of nitrogen. Bangalore has shown higher levels of SPM than standards prescribed during peak hours, though on average it is close to maximum permitted limit. (A major problem in assessing these figures is the large variation in readings both over space and time.) Only three spots in Bangalore are monitored – Anand Rao Circle, Amco Batteries, and Graphite India, but other spots are also emerging as highly polluted (e g, Richmond Circle, Sirsi Circle, and Chord Road in Vijayanagar). Average SPM levels at Anand Rao Circle are above permitted levels. Even by the end of 1980s, an area as large as 21 sq kms in the central and south-central region of the study was found to have air pollutants above limits permitted for residential areas [IISc 1990]. The situation must have worsened today both in intensity and area covered.

An indication of the impact of air pollution in Bangalore comes from a paper presented at a conference in Bangalore in December 1998 by C Rajashekara Murthy which showed that blood samples of Bangaloreans had a lead concentration of 20 micrograms per decilitre, which is twice the permitted levels. Lead in blood beyond certain levels is feared as leading to brain damage. Another paper by H Paramesh at the same conference showed that the incidence of asthma in Bangalore among school children in the age-group of 6 to 15 years was as high as 24.5 per cent, which is attributed mainly to the air pollution (*Deccan Herald*, December 14, 1998, p 4). Regrettably, similar information on other cities is not available.

Several suggestions have been made to reduce air pollution in cities – better traffic management to relieve congestion, including more roads and flyovers, stricter implementation of emission standards on vehicles, phasing out leaded petrol by the year 2005, replacement of two-stroke engines by four-stroke engines, and prohibition on diesel based passenger cars.[9]

Solid waste is not only a nuisance

aesthetically but also a serious health hazard. It increases rat population and spreads disease. When dry waste is not collected, it is burnt by neighbourhood people in unscientific ways releasing a lot of smoke and toxic gases in the air. Hospital waste is a particularly serious health hazard, since crows and other birds scatter the waste from the dumped sites. There have been newspaper reports that used syringes and other gadgets are recycled by unscrupulous traders.

It is estimated that generation of solid waste in major cities is around 50 kg per capita per day. The solid waste generated in Bangalore is upwards of 2,180 tonnes per day. About 8,000 workers are employed by the corporation and 5,000 more by private contractors to collect and dispose of the waste. There are about 12,500 garbage bins and 2,000 more are being added. The collection of waste is almost absent in outskirts and slums though the corporation levies all the charges – property taxes and betterment levies – on the outskirts.

The incompetence of the corporation has induced several voluntary efforts at waste collection in neighbourhood areas, backed by financial contribution and sometimes organisational help of NGOs. In such areas, the citizens are persuaded to separate dry waste from organic waste and hand them over in separate bags to the boys who come to collect the waste. But the boys have often to separate the waste themselves, for which they are provided with hand gloves. (Such voluntary efforts however are yet to spread, because of the general feeling that when citizens pay property taxes to the municipal corporation, the corporation should exercise this responsibility.) The organic waste is composted by the voluntary groups which partly finances their endeavour.

The corporation also uses organic waste for composting. But only 80 tonnes of waste per day is treated this way. The corporation no longer has landfill sites to dump waste and has to find other ways of waste disposal. Other cities also are facing similar problems. Mysore is estimated to generate about 295 tonnes of waste per day (about 0.39 kg per capita), while Hubli-Dharwar generates about 215 tonnes per day (0.3 kg per capita). The problems of Bangalore are thus much bigger both in terms of per capita waste and total waste generated. But the other cities have not created the same facility for recycling (like converting organic waste into compost) as Bangalore. There should also be concerted efforts to reduce per capita waste generated, such as discouraging plastic bags, throw-away cans and cups, and recycling packaging material.

Hospital waste is becoming a serious problem in cities. Let alone small nursing homes, even bigger hospitals dump waste untreated. Instead of acting as healing centres, hospitals themselves become a source of disease. Bangalore alone is estimated to generate 1,400 kgs of medical waste everyday. The corporation workers handle this waste without the protection of gloves and proper shoes. A mechanism is urgently needed for collecting this waste separately from other waste and from all hospitals, nursing homes and clinics and incinerating them scientifically and letting off burnt air and gases through high chimneys. This waste should not enter organic waste used for composting.

VIII
Concluding Observations

Apathy of the government machinery towards environmental problems faced by people has since long provoked several popular movements in Karnataka. Two types of movements could be discerned: (a) those involving livelihood issues linked to people's access to natural resources; and (b) those involving health concerns, combined also with aesthetic considerations.

A major example of the former is Kusnoor Satyagraha and the struggle of the Samaj Parivartan Samudaya against taking over of common property resources like grazing lands for planting commercial species required by industries. The opposition to planting of commercial species in the name of social forestry led to a significant change of policy. The earlier bureaucratic approach gave way to involving people in managing 'waste lands' or grazing lands and in reforesting them with mixed species which people desired. Other examples are protests by fishermen and other local people against marine pollution by Caustic Soda Factory and MRPL pipeline, protests against development projects in ecologically fragile areas such as in the western ghats and the coastal district of Dakshina Kannada. Such projects could deprive the local people of their access to forests, their paddy lands and arecanut gardens, apart from affecting drinking water in some cases. Shivaram Karanth, one of the most eminent writers in Kannada, was in the forefront of some of these movements, particularly in rallying people against the Kaiga Nuclear Power Plant in an ecologically fragile region of Uttara Kannada. SPS led a struggle against river pollution by Harihar Polyfibres.

An example of the second type of popular protest is the struggle against a further denotification of 30 acres of what has remained of the well known Cubbon Park in Bangalore, an important lung space for the city. It forced the 92 year old Justice Nittur Srinivasa Rao to join the protest in the street, in which he was accompanied also by eminent persons like Girish Karnad. Even D M Nanjundappa, deputy chairman of the state planning board, issued a public statement against the denotification. This protest succeeded in making the state government withdraw the denotification. There were similar protests against the construction of a film complex at Sankey Tank in Bangalore, which would have destroyed many trees and habitat of birds in the city.

There have also been constructive movements like the voluntary efforts at waste collection and recycling in Bangalore referred to above, which, however, are yet to spread wider.

While popular movements can force government machinery to shake off its apathy and also make people environment conscious, they are not by themselves a solution to environmental problems. Their major limitation is that it takes time to organise them and the damage may be done in the meanwhile, though some of them emerged quickly enough to stall official moves as in the case of Cubbon Park and Sankey Tank. Such organisation may be more difficult in rural areas with scattered villages. It is necessary to take care of environmental problems on a more institutionalised, regular, automatic basis instead of relying on occasional knee-jerk reactions. Tightening up of environmental legislation and its stricter implementation is called for, combined with economic disincentives and incentives to make compliance more automatic. A wider sensitisation to environmental concerns is also necessary among city dwellers, medical personnel, municipal councillors, government officials and political leaders, more than among the rural masses.

Notes

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1 The issue of water management and irrigation is tackled in a separate chapter of the Karnataka Development Report 1999 (in progress at ISEC).

2 Between 1987 and 1997, 63,071 hectares were afforested in the state (which is only a little over 2 per cent of area under forests as per

industrial units – Visvesvaraya Iron and

official land use data). Of this, the bulk of 36,477 were afforested by Karnataka forest department, 10,371 hectares under joint forest management (1992 to March 1998), 7,989 hectares by Mysore Paper Mills, 5,513 hectares by Karnataka Cashew Development Corporation, 1,889 hectares by Karnataka Forest Development Corporation and 833 by Dryland Development Board (which co-ordinates and undertakes watershed development projects).

3 Though reservation for women and scheduled castes and tribes is provided for in the constitution of village forest committees, caste rivalries can pose a problem. Moreover, even farmers with exclusive access rights on forests under traditional institutional systems like 'baanes' and 'bettas' have the same access and rights to forests under VFCs. This can create bitterness and conflict. The JFM structure is unable to distinguish between sections with different levels of dependence on the forests.

4 Under the erstwhile princely state of Mysore, there was a network of pasture lands ('kavals') maintained particularly to promote a species of bullocks (Amruth Mahal) prized highly for sturdiness and draught power. They were administered by the animal husbandry department. Many of these kavals have now remained only in name, being heavily encroached upon.

5 The measures stated in the text were as reported by KIOCL officials, and as published in their brochures.

6 In million litres per day, the waste water discharged into the sea in descending order of the states is as follows: Andhra Pradesh – 2,466 (of which 2,116 are from acquaculture); Gujarat – 566; Tamil Nadu – 378; Kerala – 151; Maharashtra – 80; Karnataka – 43; West Bengal – 22, Goa – 12; Pondicherry – 6; Orissa – 1 (*Source:* Central Pollution Control Board, as published in *CSO 1997*).

7 This seems to be an underestimate since about 80 per cent of water received is expected to flow into sewage.

8 See note 7 which is applicable here too.

9 Diesel is significantly subsidised and produces more carbon monoxide. While there may be some justification for diesel-based heavy public transport on social grounds, there is none for light motor vehicles.

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