CHAPTER 5

ENVIRONMENTAL IMPACT ANALYSIS

The major environmental impacts of coal mining and super thermal power projects in the study area are on land, air and water. Remotely sensed data have effectively been used to assess the impact of these parametres. The impact on the land was studied in terms of land transformation in various landuse/landcover categories over the years. The impact on air and water quality was also studied using satellite data. Pointwise description of impacts due to coal mining and super thermal power projects in the study area is given below:

5.1 LAND TRANSFORMATION

The transformation matrix is computed by spatial intersection of 1986 and 1998 data (Table 5.1, Fig 5.1). The computed matrix explains the built-up area increased from 0.87% in 1986 to 1.75% of total area in 1998 as a result of conversion of previously existing agriculture, forest and wasteland. The town area mainly came up on agriculture and wasteland and upto some extent on forest land. However, thermal power plants engulfed only some of the agricultural land. This is expected in Singrauli area as a result of increasing population pressure due to operation of large scale coal mining and super thermal power projects.

The agricultural land registered an increase of 0.77% of total area from 1986 (768.50 sq km) to 1998 (783.00 sq km). A lot of land

Table 5.1 Change Area Matrix of Land Transformation in Singrauli Coalfields and Surroundins (During 1986 to 1998)

Sy.	1998 1986-->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	TOTAL	% TOTAL AREA
1.	Town/ Village	16.40																	16.40	0.87
2.	Thermal Power Plant		10.65																10.65	0.57
3.	Coal Dump Yard																			
4.	Agricultural Land	11.39	0.95		696.67					12.45	0.45	0.18	3.92		24.37	0.13	4.15	13.84	768.50	40.88
5.	Dense Forest	0.48			31.42	302.85	39.17	22.79	2.35		3.98		6.86		0.60				410.50	21.83
6.	Open Forest	0.35			8.12		53.65	19.08	4.0	5.43	4.38		5.25		0.60			3.44	104.30	5.55
7.	Scrub Forest			0.30	18.58			16 73	6.23	0.78	1.64		2.70		0.55	0.93		0.16	48.60	2.28
8.	Forest Blank				10.93				8.09	0.45			0.20						19.67	1.05
9.	Forest Plantation									6.00									6.00	0.32
10.	Active Mine			0.20							2.75	1.27		1.58					5.80	0.31
11.	Abandoned Mine																			
12.	Mining Dump									0.69			4.00	9.89					14.58	0.78
13.	Mining Dump with Plantation (NCL)													0.30					0.30	0.01
14.	Land with or without Scrub	4.28		0.50	15.93					2.20	0.63		3.07		52.03	0.66	1.69	9.21	90.20	4.80
15.	Barren Rocky/ Stony waste															3.20			3.20	0.17
16.	Fly ash Pond																1.30		1.30	0.07
17.	Tank/ Reservoir				1.35				0.68								0.18	377.79	380.00	20.21
	TOTAL	32.90	11.60	1.00	783.00	302.85	92.82	58.60	21.35	28.00	13.83	1.45	26.00	11.77	78.15	4.92	7.32	404.44	1880.00	
	% of TOTAL AREA	1.75	0.62	0.05	41 65	16.11	4.94	3.12	1.13	1.49	0.74	0.08	1.38	0.63	4.16	0.26	0.39	21.51		100

Sy: [Map Symbol] 1. Town/Village, 2. Thermal Power Plant, 3. Coal Dump Yard. 4. Agricultural Land. 5. Dense Forest, 6. Open/Degraded Forest, 7. Scrub Forest, 8. Forest Blank, 9. Forest Plantation, 10. Active Mine, 11. Abandoned Mine. 12. Mining Dump, 13. Mining Dump with Plantation (NCL), 14. Land with or without Scrub, 15. Barren Rocky/Stony waste/Sheet rock area, 16. Flyash Pond, 17. Tank/ Reservoir.

transformation was noticed during both the years. In 1986, 71.83 sq km agricultural land was lost to built-up land, forest plantation, mining, wasteland, flyash pond and tank/reservoir. However, the area lost was regained in 1998 by encroachment of forest land (69.05 sq km) and reclaiming wastelands (17.28 sq km) in other locations.

The forest area was reduced to 4.51 percent of total geographical area within a span of 12 years and category-wise negative changes were observed for dense forest (-5.72%) and open forest (-0.61%) while positive changes were observed for forest blank (+0.54%) and forest plantations (+0.08%), (Fig 5.2). A careful examination of land transformation map revealed gradual change in one forest category to other i.e. dense to open to scrub to blank and some of the forest land were transformed into built-up land (1.18 sq km), agricultural land (69.05 sq km), mining (25.01 sq km), wasteland (2.68 sq km) and reservoir (3.50 sq km).

It was interesting to note that the forest land lost to mining in 1998 was 1.33% of total area, while gain in vegetation cover after growing plantations on mined out area was only 0.61%. However, the plantations grown on other lands (agriculture and wasteland) covered 0.77% of total area. Thus the loss of forest due to mining could be compensated by growing plantation in other areas. It was also revealed that loss of forest land accounting 4.06% of total area to other land use could not be regained. (Fig 5.3)

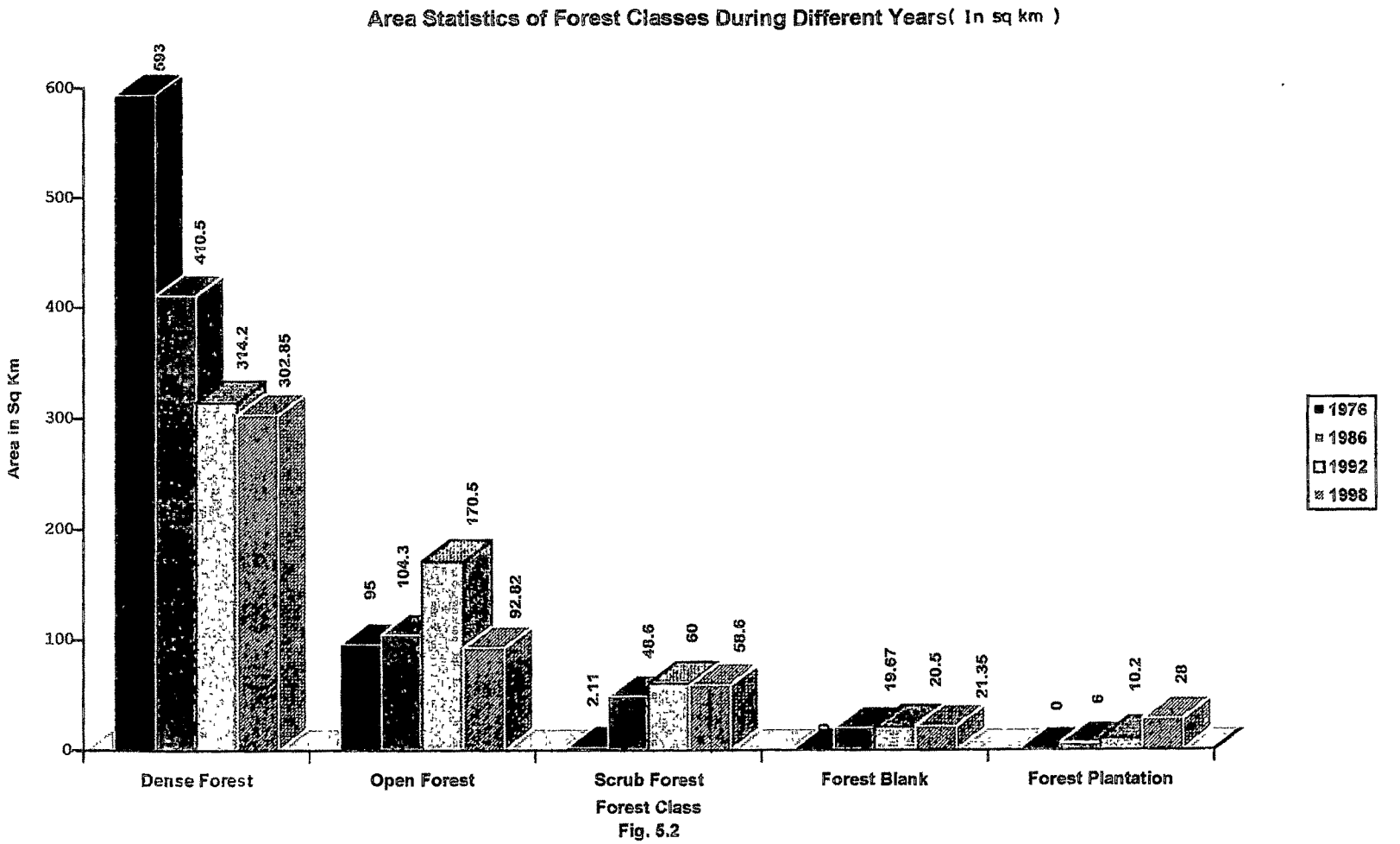
Area Statistics of Forest Classes During Different Years(In sq km)
Area in Sq Km
600
500
400
300
200
100
0
593
410.5
314.2
302.85
95
104.3
170.5
92.82
2.11
48.6
60
58.6
19.67
20.5
21.35
0
6
10.2
28
1976
1986
1992
1998
Dense Forest
Open Forest
Scrub Forest
Forest Blank
Forest Plantation
Forest Class

Fig. 5.2

Area Statistics of Mining Classes During Different Years (In sq km)

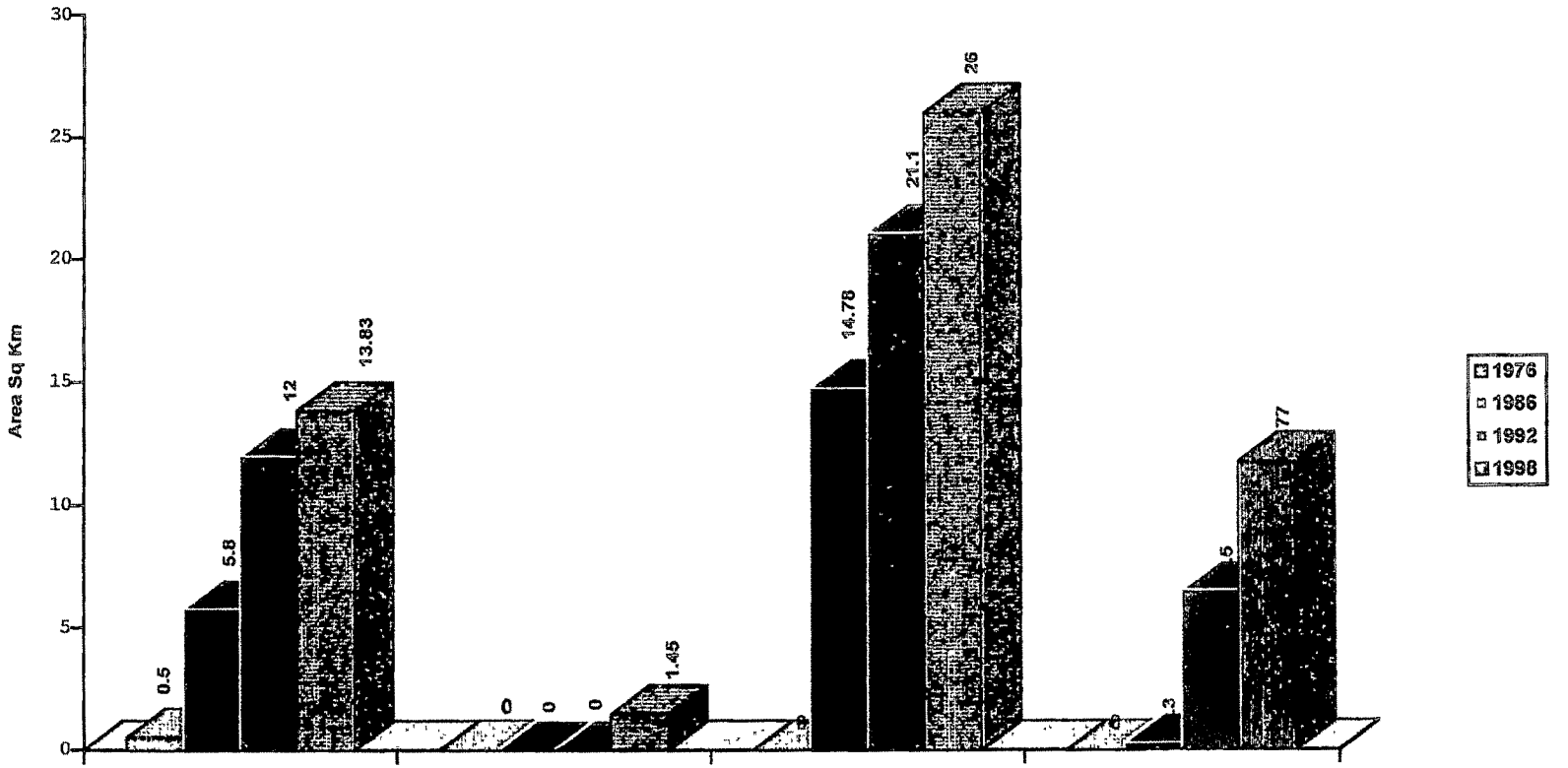

Fig. 5.3

Reservoir in the study area gained 1.3% of total geographical area. The submergence of agricultural land (0.73%), wasteland (0.48) and forest (0.19%) increased the water-spread area of reservoir by 1.42% while loss of reservoir area into agriculture, forest and ash pond accounted 0.12% of total area. Thus the total gain was 1.3% of total geographical area.

5.2 AIR POLLUTION

The main air pollution problems in the study area are dust/flyash emnated from coal mining activities and thermal power plants and gaseous pollutants like Sox, Nox etc. from thermal power plant. The impact of dust pollutants was studied through satellite data. It was noticed that dust deposition was more in 5 km radius than in 10 km radius. Based on the severity of impact the area was divided into four zones (i) areas affected by flyash deposition (A), (ii) Coal mining affected areas (B), (iii) areas severely affected by coal mining and flyash (B+A1), (iv) areas moderately affected by coal mining and flyash (B+A2) Fig. 5.4. The total area affected by dust/flyash deposition was 654.38 sq km accounting of 34.80% of the total geographical area. The maximum area was affected by cumulative affect of dust generated from coal mines and thermal power plant accounting 366.88 sq km of the total area than flyash deposition (194.38 sq km) and coal mine dust (93.12 sq km) Table 5.2.

AIR POLLUTION MAP OF SINGRAULI COALFIEDS AND SURROUNDINGS

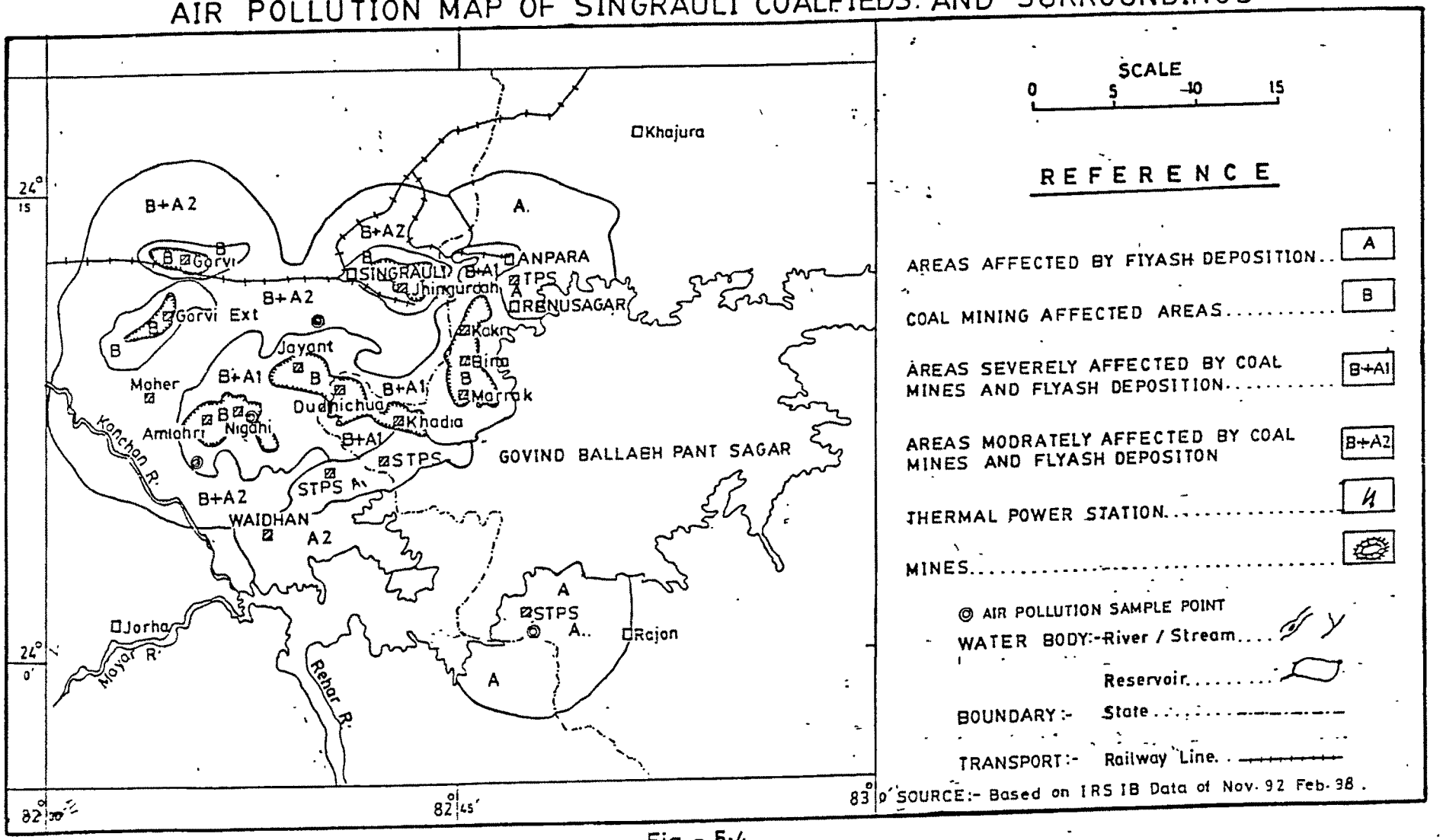

Fig. - 5.4

Table 5.2 Area Affected by Air Pollution in Singrauli Coalfields & Surroundings

S.No.	Zone	Area affected by the air pollution in sq km	% to total geographical area
1.	Area affected by flyash deposition	194.38	10.39
2.	Coal mining affected area	93.12	4.95
3.	Area severely affected by coal mining and flyash deposition	99.38	5.23
4.	Area moderately affected by coal mining and flyash deposition	267.50	14.23
	Total area affected	654.38	34.80

Table 5.3 Air Quality Data of Singrauli Coalfields and Surroundings

S.No	Location	Zone	Date	Suspended Particulate Matter (SPM) $\mu g/m^3$
1.	Rihand Colony	A	21.06.97	160
			22.06.97	187
			21.11.97	200
			22.11.97	181
2.	Goba	A	21.06.97	180
			22.06.97	190
			21.11.97	213
			22.11.97	150
3.	Nigahi Open Cast Project	B	21.06.97	490
			22.06.97	470
			21.11.97	508*
			22.11.97	550*
4.	Nawa nagar	B+A1	21.06.97	608*
			22.06.97	590*
			21.11.97	550*
			22.11.97	507*
5.	Mehrauli	B+A2	21.06.97	180
			22.06.97	212
			21.11.97	202
			22.11.97	198

* Parameters exceeding Maximum permissible limit.

Table 5.4 National Air Quality Standards

Pollutant	Time Weighted Average	Concentration in Air		
		Industrial Area	Sensitive Area***	Residential, Rural & Other Area
Suspended Particulate Matter (SPM)	Annual Average*	360 $\mu g/m^3$	70 $\mu g/m^3$	140 $\mu g/m^3$
	24 hours**	500 $\mu g/m^3$	100$\mu g/m^3$	200 $\mu g/m^3$

* Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

** 24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.

In order to corroborate the results of remote sensing study air quality data of different locations were collected. The data on air quality is presented in Table 5.3. It was noticed that suspended particulate matter (SPM) concentration was more in 'B+A1' followed by 'B' and it was almost comparable in 'A' and 'B+A2'. This is expected as the former zone falls in 5 km radius from coal mines and approximately 10 kms radius from Super Thermal Power Stations (STPS), while the contribution of SPM in latter zone is only from dust generated by coal mining activities. As per the National Air Quality Standards (Table 5.4), the value was well within permissible limit in A,B and B+A2 areas and slightly higher in B+A1 areas.

5.3 WATER POLLUTION

Liquid effluents coming from coal handling plants, workshops and supernatant water overflows from flyash ponds into the natural water courses are the main source of water pollution in the Singrauli area. During precipitation, the mine water, containing different pollutants and eroded material, if not properly treated further intensifies the pollution load is surrounding waterbodies and natrual streams. Thus the major factors affecting surface water quality are suspended sediments, industrial and urban water and other dissolved substances. These inturn changes the quality of surface water in rivers, ponds, lakes and reservoirs. Water quality measurement can be either achieved through analysis of water samples in laboratory or temporal change in surface

water quality as manifested by suspended sediments can be measured through remote sensing technique.

In order to assess the water quality of study area, remote sensing data i.e. satellite data of pre-and-post monsoon in the form of false colour composite were used. Depending upon the tonal variation in satellite data, three zones of water quality could be identified. (i) river/stream affected by mining waste water (ii) reservoir/tank affected by mining waste water/ flyash pond overflows (iii) clear water (Fig. 5.5). The first zone was noticed around coal mining area and consisted of channels and drainages receiving mining and wastes at upstream and flowing to downstream. The runoff from Bina, Kakari. Jayant, Dudhichua goes to Baliya nala while Nigahi and Amlori drain their wastes to different channels leading to Kanchan river and finally both the watercourses meet Govind Ballabh Pant (GBP) Reservoir. Thus major sink of sediments is GBP reservoir in the area. The second zone was observed along the left bank of GBP reservoir. In this zone water was polluted due to discharge of sediments form downstream channels joining the GBP reservoir as well as overflow of supernatants from flyash ponds located along the bank of GBP reservoir. The third zone could be noticed in the GBP reservoir, where water was clear and deep.

In the satellite data the above three zones were distinguished on the basis of distinct tonal variation. The false colour composite (FCC)

WATER QUALITY MAP OF SINGRAULI COALFIEDS AND SURROUNDINGS

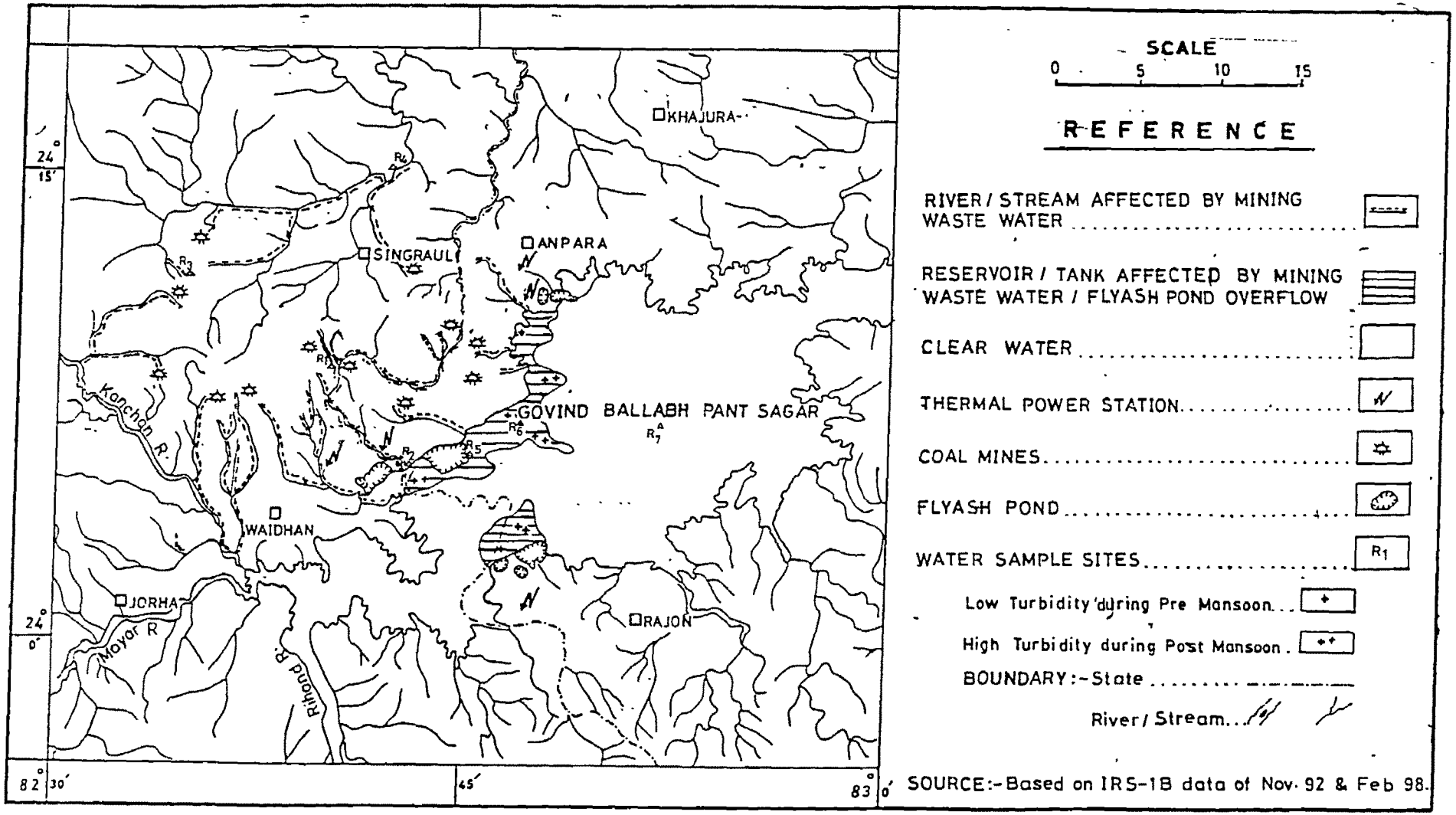

Fig.- 5.5

comprised of Green, Red and Infrared (IR) wavebands. The clear/deep water absorbs maximum energy in IR band and thus appears in black to dark blue tone. With the introduction of sediments in waterbody, the reflectance in IR band increases depending upon the amount of sediments and thus polluted water appears in shades of blue and/or white tone.

Impact of mining activities and thermal power plants on surface water quality was also ascertained by sampling and analysis of water at different locations. The results are presented in Table 5.5. It was found that all the parameters were beyond the permissible limits as per IS: 2490 except Total Disolved Solids (TDS) and BOD which was within the permissible limits. The concentration of TSS was more in post-monsoon season than pre-monsoon season. The concentration of oil and grease was also beyond permissible limit (Table 5.6) except in the centre of GBP Reservoir.

The results of water quality data were correlated with the study done using satellite data. It was observed that sampling points 1-4 came into different locations of first zone, while 5-6 were located in second zone. The sampling point 7 was observed in the zone of clear water. The study revealed that satellite data can be used in the assessment of surface water pollution and zoning of different pollution areas where further water quality analysis can be done in laboratory.

Table 5.5 Water Quality Data of Singrauli Coalfields and Surrounding

S.No	Site		Parameters mg/l Except pH					
			pH	TSS	TDS	BOD	COD	Oil & Grease
1.	Balia Nala upstream	Pre-mon	7.6	223*	340	13	130*	50*
		Post-mon	7.1	380*	420	18	150*	56*
2.	Balia Nala Down stream	Pre-mon	7.8	280*	390	19	160*	120*
		Post-mon	7.3	392*	498	25	190*	170*
3.	Bijul upstream	Pre-mon	7.9	180*	288	15	140*	56*
		Post-mon	7.17	352*	460	20	170*	62*
4.	Bijul downstream	Pre-mon	7.9	198*	302	18	148*	110*
		Post-mon	7.7	370*	480	25	180*	160*
5.	Near Shakti-nagar, Flyash Pond	Pre-mon	7.8	560*	690	20	165*	15*
		Post-mon	7.9	680*	800	32*	190*	20*
6.	Left Bank GBP Reservoir	Pre-mon	-	468*	510	15	120*	30*
		Post-mon		586*	689	18	110*	40*
7.	Centre of GBP Reservoir	Pre-mon	-	196*	120	8	22	5
		Post-mon		196*	115	9	18	8

* Parameter exceeding maximum permissible limit.

Table 5.6 National Water Quality Standard (IS - 2490)

S.No.	Parameters	Permissible Limit IS : 2490, Unit in mg/l Except (pH)
1.	Hydrogen ion concentration (pH)	5.5 to 9
2.	Total Suspended Solids (TSS)	100
3.	Total Disolved Solids (TSD)	2100
4.	Biological Oxygen Demand (BOD)	30
5.	Chemical Oxygen Demand (COD)	25
6.	Oil and Grease	10

5.4 SOCIO-ECONOMIC IMPACTS

The study area comprised of four tahsils viz. Singrauli and Chitrangi (Sidhi District); Ramanujganj (Sarguja District) and Dudhi (Sonbhadra District) falling in Madhya Pradesh and Uttar Pradesh respectively. The total villages during 1981 and 1991 were 266 and 251 respectively. The total population of the area was 313987 and 322685 during 1981 and 1991 respectively. The decadal growth in the population was 2.70 percent. Tahsil wise maximum population was observed for Singrauli tahsil follwed by Chitrangi and minimum in Ramanujganj tahsil (Table 5 7). In general the population of General Caste was more than Scheduled Caste/Scheduled Tribe (SC/ST) except in Dudhi tahsil where trand was reverse during both the years i.e. 1981 and 1991. The population of general caste ranged from 56 to 76% of the total population while it varied from 24 to 44% in case of SC/ST.

Employment wise the total population was divided into agricultural, household/industry, others, marginal and non-workers as per the criteria given in Census of India (1981 and 1991). In these categories maximum population was observed for non-workers followed by agricultural workers, others and marginal workers and minimum by household/industry workers. A careful analysis of population data revealed reduction in agricultural workers and increase in other workers, mainly marginal workers, household/industry workers and other workers during 1981-1991 indicated by lower ratio in the former

Table 5.7 Demographic Data of Singrauli Coalfields and Surroundings (Based on 1981 and 1991 Census Data)

Urban/ Rural	Tahsil/ District/ State	Year	SC/ST	% of Total Popu-lation	General (other than SC/ST)	% of Total popu-lation	Total popu-lation	Agri-cultural workers	% of Total popu-lation	House-hold / Industry workers	% of Total popu-lation	Other workers	% of Total popu-lation	Marginal Workers	% of Total popu-lation	Non-workers	% of Total populatio n
Rural	Chitrangi (Sidhi District, M.P)	1981	8963	43.46	11659	56.54	20622	7474	36.24	98	0.48	1501	7.28	613	2.97	10936	53.03
		1991	13196	44.06	16758	55.95	29954	8852	29.55	209	0.70	2296	7.67	2076 -	6.93	16521 -	55.15
Rural	Singrauli (Sidhi District, M.P)	1981	39615	29.66	93953	70.34	133568	42206	31.60	1088	0.81	13708	10.26	6025	4.51	70541	52.81
		1991	45938	30.81	103150	69.19	149088	42239	28.33	1705	1.14	8728	5.85	9713	6.52	86703	58.16
Urban	Singrauli (Sidhi District, M.P)	1981															
		1991	10113	23.79	32396	76.21	42509	1606	3.78	1271	2.99	11255	26.48	167	0.39	28210	66 36
Urban + Rural	SUB-TOTAL SIDHI DISTRICT	1981	48578	31.50	105612	68.50	154190	49680	32.21	1186	0.77	15209	9.86	6638	4.32	81477	52.84
		1991	69247	31.26	152304	68.74	221551	52697	23.79	3185	1.44	22279	10.05	11956	5.40	131434	59.32

Cont....2

Rural	Ramanuj-Ganj (Surguja District)	1981 1991	140 251	70.71 73.82	58 89	29.29 26.18	198 340	67 182	33.84 53.53	- 8	- 2.35	49 35	24.74 10.29	11 8	5.55 2.35	71 107	35.86 31 48
	TOTAL M.P	**1981** **1991**	**48718** **69498**	**31.56** **31.31**	**105670** **152393**	**68.44** **68.68**	**154388** **221891**	**49747** **52879**	**32.22** **23.83**	**1186** **3193**	**0.77** **1.44**	**15258** **22314**	**9.88** **10.06**	**6649** **11964**	**4.31** **5.39**	**81548** **131541**	**52.82** **59.28**
Rural	Dudhi (Sonbhadra District U.P)	1981 1991	29193 46688	52.53 51.86	26385 43325	47.47 48.14	55578 90013	17261 22288	31.06 24.76	726 2178	1.31 2.42	1378 2801	2 48 3.12	1096 2115	1.97 2.35	35117 60691	63 18 67.35
Urban	Dudhi (Sonbhadra District U.P)	1981 1991	1281 3991	24.58 37.02	3930 6790	75.42 62.98	5211 10781	807 878	15.48 8.14	91 170	1.75 1.58	167 215	3.20 1.99	178 245	3.42 2.27	3968 9273	76.15 86.02
	TOTAL U.P	1981 1991	49999 50679	31.33 50.20	109600 50115	68.67 49.72	59599 100794	50554 23166	31.68 22.98	1277 23.48	0.80 2.34	15425 3015	9.66 2.99	6827 2360	4.28 2.34	85516 69904	53.58 69.35
	TOTAL M.P. + U.P	1981 1991	98717 120177	31.44 37.24	215270 202508	68.56 62.76	313987 322685	100301 76045	31.94 23.57	2463 5541	0.78 1 72	30683 25330	9.78 7.85	13476 14324	4.29 4 44	167064 201445	53.21 62 42

and higher ratio in the latter may be due to plight of agricultural workers to other income groups.

The analysis of socio-economic data revealed that a lot of changes occured in a decade (1981-1991) on account of coal mining, thermal power generation and allied activities. The reduction of number of villages was mainly due to conversion of rural areas into urban areas and start of mining activities in these areas. Out of total number of fifteen villages lost thirteen were transformed into urban areas while remaining two were engulfed by mining areas (Fig. 5.6). The only town in 1981 was Renunagar in Dudhi tahsil of (Sonbhadra district) of U.P., while in 1991 in addition to this Singrauli, Vindhyanagar and Waidhan towns were observed in Singrauli tahsil (Sidhi district) of M.P. This indicated rapid industrilisation and urbanisation in M.P. state as compared to U.P. state.