CHAPTER : V

LAND-USE

INTRODUCTION :

Land is not only a basic resource but also a cherished asset. It has to be utilised in accordance with its suitability and ecological capabilities, which depend on geological and biological factors. However, if unbearable pressures such as of an explosively growing population, as is the case in Baroda, are brought to bear on the land and to over-use it and over-exploit its limited resources, the ecological balance is upset [Valdiya, 1987]. Forgetting responsibility to the posterity, and having learnt no lessons from the consequences of mismanagement of land by their forebears in ancient Phoenicia, Babylonia, the Mayan civilisation, Palestine, and Sindhu-Saraswati valleys, to name a few, the people have been abusing the finite resources including the land. The consequences have resulted in the collapse of various civilisations.

A classic example has been provided by a study of ancient Mayan civilisation in Deevey et al 1979, using the latest techniques of palaeo-ecological research, scientists determined that the number of Mayans in the low lands of Guatemala had expanded continuously over 17 centuries, beginning about the time of Homeric Greece in 800 B.C. Doubling on the average of every 408 years, the population by A.D. 900 had reached five million with a density comparable to that of the most agricultural intensive societies of today.

At this agricultural, cultural and architectural peak, the civilisation

suddenly collapsed. Within decades, the population fell to less then one tenth of what it had been. An analysis of core samplings from two lake beds in the area hints at the reason for this abrupt decline. As population pressure increased, soil erosion gradually accelerated. The topsoil was being washed into the area's lakes, draining the cropland of its productivity and one of the world's early civilisations of its sustenance. Population induced environmental stresses had become intense during the centuries preceeding collapse. They report that the area was almost wholly deforested by A.D. 250. Deforestation and mounting pressure on croplands then led to the loss of topsoil and the gradual decline of the land's productivity in passing, the research team points out that the environmental havoc so discernible from our current perspective may not have been perceptible to the managerial elite or their economic advisors'.

If environmental stresses undermined earlier civilisations, whose population doubling times were measured in centuries, what is their impact now when population doubling time is measured in decades ? Today, world population is expanding at nearly 2 percent per year, and in many countries the rate is 3 percent or more [United Nations, 1979]. Does this comparison suggest that the Mayan's legacy is our own ? That our 'managerial elite' is blind to the environmental signs of our times ? And what are these signs ?

Surely, the proper land-use are two of the most important ones. In the context of the present study, the loss of agricultural land to urban sprawl, is of special relevence. This calls for appropriate land-use planning on optimum use of land in accordance with its suitability and capability. Land should be so managed as to satisfy, at least the basic needs of man - food production, shelter, recreation, communication, transportation, etc. Extreme care in land-use is called for, particularly in selecting sites for industries and in expansion of towns and cities.

Land management embraces planning on rural, urban and regional scales.

In the present context, urban land-use management is of use and importance. The dictum "Because urbanisation is the most important sector in the change in man's habitation pattern, it has become necessary to separate his arena of activity in this setting from his actions in the non-urban region" [Coates, 1973], makes it important to describe the aberration of man where by short sighted objectives yield environmental disruption. Just as the rapid expansion of cities in the twentieth century has led to a unique set of problems, so too man's interference with nature in non-urban regions is no less serious and has reached staggering proportions. Many features of the twentieth century have contributed to an unelevated pace of urbanization - for example, the population explosion, the increasing flexibility in available types of energy, the rapidly accelerating technological advances with related industrialisation. Concomitant with urbanization has been a massive interruption of natural processes and the development of new anthropogenic landscapes. Prior to our present century, the greatest events in the course of human civilisation were the agricultural revolution and the industrial revolution; the twentieth century is depicted as starting the "urban revolution".

Urbanization is perhaps the dominant social, economic, and political movement in contemporary history. Large numbers of people are moving to cities and cities to new locations; considerable acreages of land are converted from rural to urban uses; large capital investments have been made; substantial fortunes have been made through land speculation and development, and some have been lost [Schmid, 1968].

Gullick [1958] analyses the problems of urbanization in a slightly different context and contends: "It is my thesis that urbanization in and of itself, as a pattern of life, increases. The dependence of our culture on the natural resources, and that urbanization further more makes for a revised scale of conservation priorities". He discusses this viewpoint under the major headings of land, air and water pollution, energy consumption, general living standards, recreational opportunities, land and flood control.

The major elements of such a land-use management programme would include :

[i] Preparation of an inventory of land resources, making use of satellite imagery complementary to comprehensive field-work, and then delineation of maps.

[ii] Investigation of various geomorphic, geological, hydrological and pedological properties of the lands.

[iii] Monitoring changes that occur consequent on the use of land.

[iv] Based on the last 30 years Census of India data, land-use and population statistical data have been tabulated to demarcate the changes in the land-use pattern and population growth [Table : 10]. Projections based on this, growth of urban and rural Baroda have been made for the years 1991 and 2001 [Table : 10 and Fig. 15].

DATA USED :

Out of the items listed above, the geology, geomorphology and pedology have been described in detail in preceding chapters. In the present chapter, an effort will be made to delineate and demarcate the fluidity of land-use patterns during the years 1876-78, 1959-60 and 1988, using Survey of India Toposheets for the first two mentioned, and SPOT HRV_2 satellite imagery for the last mentioned.

METHODOLOGY :

A modern nation, as a modern business, must have adequate information on many complex interrelated aspect of its activities in order to make decisions. Land-use is only one such aspect, but knowledge about land-use and land cover has become increasingly important as the nation plans

TABLE : 10

LAND-USE PATTERN AND POPULATION GROWTH FOR STUDY AREA FROM CENSUS REPORTS

SR. NO.	NAME OF VILLAGE/ TOWN/ LOCATION	REF. NO. [as per Fig. 1]	TOTAL AREA sq.km					TOTAL POPULATION					FOREST LAND sq.km				
1	2	3	4					5					6				
			A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
1	Ajitpura	L/20	1.85	1.85	1.87			128	211	176	190	265		-	-		
2	Ajod	G/5	4.01	4.01	4.05			1005	1294	1746	1885	2036			-		
3	Akota	I/11	1.59	*	*	*	*	1803	*	*	*	*	-	*	*	*	*
4	Aladpura	M/15	5.00	5.00	5.06			583	687	800	864	933		-	-		
5	Alamgir	J/17	1.49	1.49	1.50			327	424	540	583	629			-		
6	Amaliyara	M/7	4.77	4.77	4.83			720	852	1276	1378	1488		-	-		
7	Amodar	P/12	3.30	3.30	3.34			777	937	1171	1369	1601			-		
8	Ampad	C/11	4.53	4.53	4.58			583	797	967	1044	1127		-	-		
9	Angadh	C/6	11.22	11.22	11.36		*	5136	6847	9591	1035	*		-	0.26		*
10	Ankhol	N/11	3.67	3.67	3.71			425	579	749	808	873		-	-		
11	Ankodiya	E/9	5.15	5.15	5.21		*	1472	1696	2514	2715	*		-	-		*
12	Asoj	J/4	10.81	10.81	10.94			1813	2498	3203	3459	3735		-	-		
13	Atladara	H/13	5.46	5.46	*	*	*	1729	2608	*	*	*		-	*	*	*
14	Bajwa	F/7	2.16	2.16	1.91	*	*	2405	4436	9294	*	*		-		*	*
15	Bakrol	P/10	6.72	6.72	6.79			461	552	619	724	847		-	-		
16	Bapod	L/11	7.30	7.30	7.38		*	975	884	1887	2037	*		-	-		*
17	Bhavpura	O/6	3.20	3.20	3.20		*	365	447	499	583	*		-			*
18	Bhyali	F/12	18.14	18.14	13.86		*	5224	7156	5307	5731	*		-	-		*
19	Bil	G/14	7.40	7.40	7.48		*	1759	2974	3927	4241	*		-	-		*
20	Chansad	G/17	17.30	17.30	17.31			1832	2028	2291	2657	3082			-		
21	Chapad	H/15	4.90	4.90	4.95			1081	1395	1928	2082	2248			-		
22	Chhani	I/8	10.62	10.62	8.74	*	*	5966	10425	13393	*	*	-	-	-	*	*
23	Chikhodara	L/15	5.84	5.84	5.90			732	846	1050	1134	1224		-	-		
24	Dantesrwar	K/13	3.69	*	*	*	*	3256	*	*	*	*	-	*	*	*	*
25	Darapura	E/16	4.02	4.02	4.07			1694	1892	2608	3025	3509			-		
26	Dasharath	G/6	9.16	9.16	7.64			2986	3930	6126	6616	*		-	-		

Table : 10 contd.

SR. NO.	IRRIGATED LAND BY SOURCE [sq.km]					UNIRRIGATED LAND [sq.km]					CULTURABLE WASTE [INCLUDING GAUCHER AND GROOVES] [sq.km]					AREA NOT AVAILABLE FOR CULTIVATION [sq.km]				
1	7					8					9					10				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
1	-	-	0.05			1.54	1.54	1.46			0.10	0.10	0.20			0.21	0.21	0.16		
2	0.60	0.60	2.55			2.94	2.94	1.34			0.32	0.32	0.16			0.14	0.14	0.09		
3	0.10	*	*	*	*	1.01	*	*	*	*	0.09	*	*	*	*	0.39	*	*	*	*
4	-	-	0.25			4.21	4.21	4.00			0.52	0.52	0.49			0.27	0.27	0.32		
5	0.02	0.02	0.30			1.28	1.28	1.00			0.10	0.10	0.20			0.09	0.09	-		
6	-	-	0.12			3.95	3.95	4.26			0.26	0.26	0.25			0.56	0.56	0.20		
7	0.17	0.17	1.68			2.97	2.97	1.21			0.10	0.10	0.15			0.06	0.06	0.30		
8	0.24	0.24	0.90			2.85	2.85	3.48			0.82	0.82	0.11			0.62	0.62	0.09		
9	0.77	0.77	2.00		*	5.58	5.58	6.63		*	0.49	0.49	0.78		*	4.38	4.38	1.69		*
10	1.15	1.15	0.97			1.89	1.89	2.35			0.45	0.45	0.21			0.18	0.18	0.18		
11	0.67	0.67	3.75		*	3.78	3.78	1.13		*	0.30	0.30	0.27		*	0.40	0.40	0.06		*
12	3.26	3.26	1.36			6.14	6.14	8.82			0.02	0.02	0.54			1.39	1.39	0.22		
13	0.21	0.21	*	*	*	4.27	4.27	*	*	*	0.79	0.79	*	*	*	0.19	0.19	*	*	*
14	0.60	0.60	0.76	*	*	1.18	1.18	0.90	*	*	0.22	0.22	0.01	*	*	0.16	0.16	0.24	*	*
15	-	-	0.25			2.25	2.25	5.93			0.23	0.23	0.23			4.24	4.24	0.38		
16	5.54	5.54	1.51		*	0.73	0.73	3.79		*	0.34	0.34	0.34		*	0.69	0.69	1.74		*
17	0.01	0.01	0.28		*	2.65	2.65	1.96		*	0.14	0.14	0.06		*	0.40	0.40	0.90		*
18	5.27	5.27	0.69		*	10.67	10.67	12.62		*	1.30	1.30	0.44		*	0.90	0.90	0.11		*
19	1.63	1.63	1.11		*	4.80	4.80	6.01		*	0.46	0.46	0.32		*	0.51	0.51	0.04		*
20	3.23	3.23	0.20			9.79	9.79	14.80			1.28	1.28	0.62			3.00	3.00	1.69		
21	0.72	0.72	0.49			3.52	3.52	4.12			0.52	0.52	0.25			0.14	0.14	0.09		
22	1.09	1.09	0.69	*	*	7.25	7.25	4.91	*	*	0.16	0.16	0.23	*	*	2.12	2.12	2.91	*	*
23	-	-	0.20			5.05	5.05	4.92			0.32	0.32	0.63			0.47	0.47	0.15		
24	0.95	*	*	*	*	1.05	*	*	*	*	0.89	*	*	*	*	0.80	*	*	*	*
25	2.73	2.73	2.78			0.69	0.69	0.69			0.03	0.03	0.03			0.57	0.57	0.57		
26	0.56	0.56	3.11			5.82	5.82	3.27			1.58	1.58	0.34			1.20	1.20	0.92		

Table : 10 contd.

1	2	3	4					5					6				
			A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
27	Dena	L/7	4.39	4.39	4.44			809	1325	1342	1449	1565		-	-		
28	Dhaniyavi	M/16	13.40	13.40	13.56			1338	1716	1902	2054	2218		-	-		
29	Dhanora	D/6	3.69	3.69	2.78		*	1319	1548	2946	3181	*		-	-		*
30	Diwalipura	O/15	3.04	3.04	3.08			275	399	519	560	605		-	-		
31	Dodka	E/2	7.60	7.60	7.69			1623	1795	2576	2782	3004		-	-		
32	Dolatpura	K/20	1.26	1.26	1.28			51	61	76	82	88		-	-		
33	Dumad	J/6	12.58	12.58	12.67			2092	3376	3999	4318	4664		-	-		
34	Fajalpur	C/4	6.06	6.06	6.13			1433	1902	2799	3022	3264		-	-		
35	Fatepura	K/19	1.71	1.71	1.73			163	188	191	206	222		-	-		
36	F'nagar	H/7	-	3.20	3.21	*	*	-	5327	5668	*	*	-	-	-	*	*
37	G.I.D.C.	J/14	-	*	*	*	*	-	*	*	*	*	-	*	*	*	*
38	Gokalpura	D/13	1.62	1.62	1.64		*	389	563	648	699	755		-	-		
39	Gorwa	H/9	9.14	9.14	2.15	*	*	220	240	259	*	*		-	-	*	*
40	Gosindra	H/20	7.18	7.18	7.26			679	866	905	977	1055		-	-		
41	Gotri	F/10	7.48	7.48	*	*	*	2316	2816	*	*	*		-	*	*	*
42	G.S.F.C.	G/6	-	*	*	*	*	-	*	*	*	*	-	*	*	*	*
43	Hansajipur	N/17	2.50	2.50	2.53			120	141	174	187	202		-	-		
44	Harni	K/8	17.30	17.30	17.50			1538	2092	3221	3478	3756		-	-		
45	Hetampura	O/16	2.46	2.46	2.48			275	348	378	408	440		-	-		
46	Hinglot	C/12	2.69	2.69	2.72			316	547	582	628	678		-	-		
47	Itola	H/19	15.36	15.36	15.54			2727	3275	3308	3572	3858			-		
48	I.P.C.L.	E/7	-	*	*	*	*	-	*	*	*	*	-	*	*	*	*
49	Jaspur	C/12	15.48	15.48	15.66			2086	4313	5012	5813	6743		-	-		
50	J'nagar	G/7	-	6.94	6.95	*	*	-	5710	7512	*	*	-			*	*
51	J'pura	O/9	2.70	2.70	2.70			397	495	519	609	712	-	-	-		
52	Jobantekri	N/13	0.92	0.92	0.93			140	161	231	249	269		-	-		
53	Kajapur	K/20	2.66	2.66	2.69			287	328	339	366	395		-	-		
54	Kalali	H/14	3.93	3.93	3.98		*	891	1522	1996	2157	*		-	-		*
55	Kanadkoi	N/19	2.75	2.75	2.78		*	223	263	201	217	*		-	-		*
56	Kapurai	M/13	6.10	6.10	6.18			936	1211	3609	3897	4209		-	-		*
57	Karachia	F/6	4.75	4.75	0.95		*	1936	2935	4671	6124	*		-	-		*
58	Karali	H/19	3 13	3.13	3 17			441	646	775	837	903			-		

Table : 10 contd.

1	7					8					9					10				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
27	0.20	0.20	0.20			3.59	3.59	3.82			0.24	0.24	0.24			0.36	0.36	0.18		
28	0.63	0.63	0.09			11.72	11.72	12.79			0.50	0.50	0.51			0.55	0.55	0.17		
29	0.09	0.09	1.34		*	2.33	2.33	0.90		*	0.53	0.53	0.47		*	0.74	0.74	0.07		*
30	-	-	0.03			2.63	2.63	2.63			0.15	0.15	0.08			0.26	0.26	0.34		
31	-	-	1.31			5.40	5.40	5.13			1.00	1.00	-			1.20	1.20	1.25		
32	-	-	0.10			1.02	1.02	0.94			0.06	0.06	0.10			0.18	0.18	0.14		
33	3.67	3.67	5.91			7.20	7.20	5.61			1.41	1.41	0.68			0.30	0.30	0.47		
34	0.35	0.35	1.38			3.80	3.80	2.76			0.63	0.63	1.13			1.28	1.28	0.86		
35	0.04	0.04	0.08			1.49	1.49	1.56			0.17	0.17	0.08			0.01	0.01	0.01		
36	-	0.29	0.22	*	*	-	0.16	0.13	*	*	-	0.03	0.01	*	*	-	2.72	2.85	*	*
37	-	*	*	*	*	-	*	*	*	*	-	*	*	*	*	-	*	*	*	*
38	0.07	0.07	0.12			1.39	1.39	1.36			0.01	0.01	0.16			0.15	0.15	-		
39	0.02	0.02	-	*	*	7.22	7.22	2.13	*	*	1.84	1.84	0.02	*	*	0.06	0.06	-	*	*
40	0.66	0.66	0.69			5.64	5.64	6.13			0.76	0.76	0.44			0.12	0.12	-		
41	0.40	0.40	*	*	*	5.57	5.57	*	*	*	1.03	1.03	*	*	*	0.66	0.66	*	*	*
42																				
43	-	-	0.14			2.30	2.30	2.26			0.09	0.09	0.10			0.11	0.11	0.03		
44	-	-	0.33			13.60	13.60	14.03			3.38	3.38	2.83			0.32	0.32	0.31		
45	0.14	0.14	0.02			1.82	1.82	1.96			0.16	0.16	0.14			0.34	0.34	0.36		
46	0.05	0.05	0.77			2.32	2.32	1.65			0.19	0.19	0.15			0.13	0.13	0.15		
47	8.12	8.12	1.10			5.20	5.20	13.05			1.38	1.38	0.71			0.66	0.66	0.68		
48	-	*	*	*	*	-	*	*	*	*	-	*	*	*	*	-	*	*	*	*
49	2.96	2.96	3.00			6.73	6.73	6.80			2.45	2.45	2.48			3.34	3.34	3.38		
50	-			*	*	-			*	*	-			*	*	-			*	*
51	-	0.66	-			1.07	1.07	2.12			0.59	0.59	0.14			0.38	0.38	0.44		
52	-	-	-			0.77	0.77	0.83			0.04	0.04	0.04			0.11	0.11	0.06		
53	-	-	0.05			2.26	2.26	2.23			0.13	0.13	0.27			0.27	0.27	0.14		
54	0.05	0.05	0.26		*	3.38	3.38	3.46		*	0.12	0.12	0.13		*	0.38	0.38	0.13		*
55	0.01	0.01	0.03		*	2.43	2.43	2.43		*	0.14	0.14	0.14		*	0.17	0.17	0.18		*
56	1.30	1.30	1.37		*	3.81	3.81	3.82		*	0.82	0.82	0.72		*	0.17	0.17	0.27		*
57	0.88	0.88	0.25		*	3.44	3.44	0.25		*	0.41	0.41	-		*	0.02	0.02	0.45		*
58	0.29	0.29	0.18			2.44	2.44	2.68			0.12	0.12	0.18			0.28	0.28	0.13		

Table : 10 contd.

1	2	3	4					5					6				
			A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
59	Karodia	G/8	2.52	2.52	1.99		*	948	1534	2029	2191	*		-	-		*
60	Kashipura	H/20	4.64	4.64	4.69			677	909	1007	1087	1174					
61	Kelanpur	N/15	8.37	8.37	8.47			1045	1371	2009	2169	2343		-	-		
62	Khalipur	H/17	4.79	4.79	4.85			504	694	811	875	946		-	-		
63	Khanpur	F/10	1.90	1.90	1.92			511	749	1061	1145	1237		-	-		
64	Khatamba	N/12	3.68	3.68	3.72			305	397	692	747	807		-	-		
65	Kotali	L/8	3.08	3.08	3.11			505	686	765	826	892		-	-	-	
66	Kotna	B/7	4.08	4.08	4.13			1213	1585	2345	2532	2735		-	-		
67	Koyali	E/7	11.66	11.66	8.55		*	5015	6629	9380	10130	*		-	-		*
68	Kumetha	O/7	7.66	7.66	7.75			659	823	1047	1224	1432			-		
69	Mahapura	D/11	1.28	1.28	1.29			582	738	942	1017	1098		-	-		
70	Makarpura	J/15	5.04	5.04	*	*	*	1832	3664	*	*	*	-	-	*	*	*
71	Maneja	I/15	2.61	2.61	*	*	*	1313	1519	*	*	*		-	*	*	*
72	Manjalpur	J/13	6.03	*	*	*	*	4332	*	*	*	*	-	*	*	*	*
73	Maretha	I/16	2.38	2.38	2.40			513	609	1178	1272	*		-	-		
74	Mastupura	N/19	2.33	2.33	2.35			248	316	445	532	622			-		
75	Morlipura	O/7	3.89	3.89	3.94			461	574	723	845	988		-	-		
76	MuzurGamdi	K/16	2.24	2.24	2.27		*	213	263	338	365	*		-	-		*
77	Nandesari	D/5	7.76	7.76	7.84	*	*	2179	2771	3621	*	*		-	-	*	*
78	Navapura	O/15	1.01	1.01	1.02			159	180	280	302	326		-	-		
79	Nimetha	P/8	13.30	13.30	13.45			1108	1361	1748	2045	2392		-	-		
80	Padmala	F/5	6.87	6.87	6.95		*	1876	2614	3504	3784	*		-	-		*
81	Padra	C/15	8.91	8.91	8.90			17269	24229	30702	38991	49519			-		
82	Patarveni	M/19	3.80	3.80	3.84			521	617	755	815	880		-	-		
83	Patod	F/16	5.05	5.05	5.11			1124	1415	1834	2127	2467			-		
84	Pavlepur	O/12	6.60	6.60	6.68			653	795	945	1105	1292			-		
85	Raghavpura	N/18	3.66	3.66	3.70			587	604	705	761	822		-	-		
86	Ranoli	E/5	6.85	6.84	6.92		*	2850	4908	7439	8034	*		-	-		*
87	Ratanpura	M/14	2.91	2.91	2.94			452	551	694	749	809		-	-		
88	Rayaka	D/3	5.88	5.88	5.95			950	1373	1758	1898	2050		-	-		
89	Sama	K/9	6.22	6.22	6.29	*	*	1162	2378	2897	*	*			-	*	*
90	Samastpura	N/18	3.39	3.39	3.43			629	721	846	913	986			-		
91	Samiyala	E/14	4.93	4.93	4.99		*	1351	2424	3399	3670	*		-	-		

Table : 10 contd.

1	7					8					9					10				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
59	0.30	0.30	0.49		*	1.54	1.54	0.75		*	0.18	0.18	0.13		*	0.50	0.50	0.62		*
60	3.28	3.28	0.88			0.80	0.80	3.25			0.26	0.26	0.52			0.30	0.30	0.04		
61	-	-	0.34			7.03	7.03	6.77			0.46	0.46	0.26			0.88	0.88	1.10		
62	0.38	0.38	0.16			3.55	3.55	4.01			0.44	0.44	0.25			0.42	0.42	0.43		
63	1.07	1.07	0.21			0.65	0.65	1.68			0.04	0.04	0.03			0.14	0.14	-		
64	-	-	0.02			2.96	2.96	2.97			0.69	0.69	0.39			0.03	0.03	0.34		
65	-	-	0.32			2.48	2.48	2.37			0.18	0.18	0.18			0.42	0.42	0.24		
66	0.60	0.60	0.71			2.26	2.26	1.99			0.92	0.92	0.50			0.30	0.30	0.93		
67	0.30	0.30	3.23		*	7.16	7.16	2.12		*	1.45	1.45	0.67		*	2.75	2.75	2.53		*
68	0.01	0.01	0.01			6.52	6.52	6.59			0.40	0.40	0.41			0.73	0.73	0.74		
69	0.96	0.96	0.12			0.23	0.23	1.08			0.03	0.03	0.09			0.06	0.06	-		
70	-	-	*	*	*	3.14	3.14	*	*	*	1.72	1.72	*	*	*	0.18	0.18	*	*	*
71	-	-	*	*	*	2.04	2.04	*	*	*	0.39	0.39	*	*	*	0.18	0.18	*	*	*
72	3.28	*	*	*	*	2.01	*	*	*	*	0.04	*	*	*	*	0.70	*	*	*	*
73	0.99	0.99	0.90			1.92	1.92	1.04			0.13	0.13	0.34			0.32	1.32	0.12		
74	0.67	0.67	0.20			1.23	1.23	1.57			0.11	0.11	0.14			0.32	0.32	0.44		
75		-	-			3.41	3.41	3.41			0.20	0.20	0.04			0.28	0.28	0.49		
76	-	-	0.40		*	1.86	1.86	1.48		*	0.28	0.28	0.23		*	0.10	0.10	0.16		*
77	0.73	0.73	0.56	*	*	4.82	4.82	4.56	*	*	0.88	0.88	0.61	*	*	1.33	1.33	2.05	*	*
78		-	-			0.88	0.88	0.89			0.06	0.06	0.06			0.07	0.07	0.07		
79	0.04	0.04	-			8.26	8.26	8.33			0.20	0.20	0.60			4.80	4.80	4.52		
80	0.63	0.63	3.38		*	5.26	5.26	3.02		*	0.58	0.58	0.40		*	0.40	0.40	0.15		*
81	2.07	2.07	3.94			5.07	5.07	3.07			0.92	0.92	1.42			0.85	0.85	0.47		
82	1.94	1.94	0.11			1.30	1.30	3.29			0.23	0.23	0.25			0.33	0.33	0.19		
83	2.39	2.39	0.30			2.15	2.15	4.30			0.19	0.19	0.13			0.32	0.32	0.38		
84	1.76	1.76	0.15			3.27	3.27	4.86			0.98	0.98	1.03			0.59	0.59	0.64		
85	0.04	0.04	0.51			3.11	3.11	2.97			0.22	0.22	0.21			0.29	0.29	0.01		
86	2.28	2.28	1.01		*	3.25	3.25	4.60		*	0.63	0.63	0.83		*	0.68	0.68	0.48		*
87	0.06	0.06	0.05			2.31	2.31	2.18			0.40	0.40	0.56			0.14	0.14	0.15		
88	0.60	0.60	5.10			3.92	3.92	0.09			1.10	1.10	-			0.80	0.80	0.76		
89	0.80	0.80	1.51	*	*	4.16	4.16	3.29	*	*	0.34	0.34	1.11	*	*	0.92	0.92	0.38	*	*
90	0.06	0.06	0.84			2.93	2.93	2.32			0.16	0.16	0.16			0.24	0.24	0.11		
91	0.12	0.12	0.47		*	4.14	4.14	3.78		*	0.60	0.60	0.61		*	0.07	0.07	0.13		*

Table : 10 contd.

1	2	3	4					5					6				
			A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
92	Sankarda	F/3	7.26	7.26	7.34			3308	4332	5657	6109	6598		-	-		
93	Sangma	D/14	3.25	3.25	3.29			1256	2225	1804	2092	2426			-		
94	Sareja	E/17	1.91	1.91	1.90			39	49	80	92	106			-		
95	Sayajipura	N/10	8.48	8.48	8.58		*	978	1076	1868	2017	*		-	-		*
96	Sevasi	E/11	6.34	6.34	6.41			2512	3360	4392	4743	5122		-	-		
97	S'pura	N/13	3.38	3.88	3.93		*	320	401	510	550	*		-	-		*
98	Sherkhi	D/9	12.20	12.20	12.35			4024	5431	6669	7202	7778		-	-		
99	S'pura	N/9	1.58	1.58	1.60			255	365	541	632	739		-	-		
100	Sindhrot	C/9	10.86	10.86	10.99			2662	3240	4201	4537	4900		-	-		
101	Sisva	I/5	4.13	4.13	4.18			1130	1590	2115	2284	2466		-	-		
102	Sokhda	H/4	11.66	11.66	11.80			6551	8158	9662	10434	11269		-	-		
103	S'khurd	E/15	4.41	4.41	4.46			1133	1510	1892	2194	2545			-		
104	Sukhilpura	L/7	3.21	3.21	3.21			408	526	719	776	838			-		
105	Sundarpura	K/17	3.22	3.72	3.76			564	720	974	1051	1136		-	-		
106	Tajpur	C/14	3.28	3.28	3.32			1269	1393	1604	1860	2157		-	-		
107	Talsat	H/15	2.27	2.27	2.29		*	265	393	622	671	*		-	-		*
108	Tandalja	H/12	4.11	4.11	*	*	*	1069	1744	*	*	*		-	*	*	*
109	Tarsali	L/14	10.32	10.32	6.10	*	*	3291	3008	10408	*	*		-		*	*
110	Tatarpura	O/13	4.71	4.71	4.76			682	827	907	979	1057		-	-		
111	Undera	F/8	4.34	4.34	2.73		*	1461	2027	4135	4465	*		-	-	*	
112	Untiya	J/20	1.96	1.96	1.98			164	201	216	233	251			-		
113	Vadadla	L/14	3.90	3.90	3.94			779	1024	1296	1399	1511		-	-		
114	Vadsala	I/20	6.86	6.86	6.95			955	1006	1268	1369	1478			-		
115	Varnama	I/19	17.41	17.41	17.61			3268	3709	4283	4625	4995		-	-		
116	V'kotariya	H/3	4.93	4.93	4.99			1789	2367	2872	3101	3349		-	-		
117	V'saiyed	G/11	2.74	2.74	*	*	*	1097	1622	*	*	*		-	*	*	*
118	Vemali	J/8	2.89	2.89	2.92		*	699	1083	1344	1451	*		-	-		*
119	Virod	L/5	10.79	10.79	10.92			992	1343	1611	1739	1879		-	-		
120	V'mitri	I/12	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
121	VoraGamdi	L/16	3.88	3.88	3.92			245	302	410	442	478		-	-		
122	BARODA agglomaration (BMC Limit)	-	46.19	57.50	108.26	184.22	347.33	309716	466696	734473	1155840	1826090					
	TOTAL		714.00	714.00	714.00			477774	693657	1020375	1705523	1947638			0.26		

Projections for 1991 & 2001 are as per growth rate (in census handbook 1971 & 1981)

* Comes under Baroda Agglomaration

Table : 10 contd.

1	7					8					9					10				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
92	2.49	2.49	0.90			3.71	3.71	5.36			0.21	0.21	0.37			0.85	0.85	0.71		
93	0.83	0.83	1.14			1.92	1.92	1.78			0.12	0.12	0.10			0.38	0.38	0.27		
94	0.48	0.48	1.00			1.23	1.23	0.74			0.09	0.09	0.07			0.11	0.11	0.09		
95	-	-	-		*	7.36	7.36	7.17		*	0.98	0.98	1.11		*	0.14	0.14	0.30		*
96	3.05	3.05	1.99			2.48	2.48	4.25			0.06	0.06	0.06			0.75	0.75	0.11		
97	-	-	0.03		*	3.61	3.61	3.79		*	0.10	0.10	0.01		*	0.17	0.17	0.10		*
98	8.80	8.80	1.16			0.21	0.21	8.58			2.29	2.29	2.32			0.90	0.90	0.29		
99	-	-	-			1.25	1.25	1.26			0.08	0.08	0.09			0.25	0.25	0.25		
100	0.38	0.38	2.34			4.48	4.48	5.43			0.26	0.26	2.17			5.74	5.74	1.05		
101	0.90	0.90	3.40			2.81	2.81	0.62			0.41	0.41	0.15			0.01	0.01	0.01		
102	7.79	7.79	9.23			2.40	2.40	1.89			0.50	0.50	0.63			0.97	0.97	0.05		
103	0.62	0.62	3.00			2.87	2.87	0.95			0.09	0.05	0.05			0.83	0.83	0.46		
104	0.85	0.85	0.07			1.92	1.92	2.71			0.13	0.13	0.17			0.31	0.31	0.26		
105	0.06	0.06	0.26			2.70	2.70	3.05			0.18	0.18	0.43			0.28	0.28	0.02		
106	1.20	1.20	1.44			1.76	1.76	1.65			0.04	0.04	0.23			0.28	0.28	-		
107	0.23	0.23	0.18		*	1.52	1.52	1.61		*	0.23	0.23	0.21		*	0.29	0.29	0.29		*
108	0.12	0.12	*	*	*	3.60	3.60	*	*	*	0.13	0.13	*	*	*	0.38	0.38	*	*	*
109	0.23	0.23	0.85	*	*	7.36	7.36	2.15	*	*	0.56	0.56	2.17	*	*	2.17	2.17	0.93	*	*
110	-	-	1.42			4.01	4.01	2.85			0.16	0.16	0.20			0.54	0.54	0.29		
111	1.40	1.40	1.00		*	2.51	2.51	1.03		*	0.09	0.09	0.20		*	0.34	0.34	0.50		*
112	0.13	0.13	0.20			1.53	1.53	1.50			0.23	0.23	0.21			0.07	0.07	0.07		
113	0.11	0.11	0.10			3.24	3.24	3.27			0.28	0.28	-			0.27	0.27	0.57		
114	0.50	0.50	0.15			5.45	5.45	6.39			0.07	0.07	0.33			0.84	0.84	0.08		
115	10.93	10.93	0.14			4.21	4.21	16.21			1.06	1.06	1.07			1.21	1.21	0.19		
116	0.09	0.09	0.95			4.10	4.10	3.28			0.22	0.22	0.60			0.52	0.52	0.16		
117	0.06	0.06	*	*	*	2.33	2.33	*	*	*	0.09	0.09	*	*	*	0.26	0.26	*	*	*
118	0.85	0.85	0.57		*	1.60	1.60	1.90		*	0.32	0.32	0.32		*	0.12	0.12	0.13		*
119	0.41	0.41	0.22			9.25	9.25	9.76			0.45	0.45	0.46			0.68	0.68	0.48		
120	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
121	0.02	0.02	0.32			3.38	3.38	3.11			0.36	0.36	0.37			0.12	0.12	0.12		
122																				
	117.34	112.06	102.86			408.85	404.60	387.98			55.42	54.37	45.07			76.85	72.24	52.46		

SOURCE : Census of India, Baroda District (1961, 1971 & 1981)
A = 1961, B = 1971, C = 1981, D = 1991, E = 2001

to overcome the problems of haphazard, uncontrolled development, deteriorating environmental processes and problems that must be understood if living conditions and standards are to be improved or maintained at current levels.

One of the prime prerequisites for better use of land is information on existing land-use patterns and changes in land-use through time. Clawson and Stewart [1965] have stated : "In this dynamic situation, accurate, meaningful, current data on land use are essential. If public agencies and private organizations are to know what is happening, and are to make sound plans for their own future action, then reliable information is critical".

The variety of land use and land cover data needs are exceedingly broad. Current land-use and land cover data are used to prepare environmental impact statements and assess future impacts on environmental quality.

For many years, agencies at the various governmental levels have been collecting data about land, but for the most part they have worked independently and without co-ordination. Too often this has meant duplication of effort, or it has been found that data collected for a specific purpose were of little or no value for a similar purpose only a short time later. Thus, land use classification system has been standardized to assess, and manage areas of critical concern for environmental control.

Remote sensing techniques, including the use of conventional aerial photography, can be used effectively to complement surveys based on ground observation and enumeration, so the potential of timely and accurate inventory of the current use of the nation's land resources now exists. At the same time, data processing techniques permit the storage of large quantities of detailed data that can be organised in a variety of ways to meet specific needs.

For the demarcation of the land-use pattern for the first two mentioned years viz. 1876-78 and 1959-60, the task was relatively simple, as Survey of India Toposheet Nos. 46.F/3, 4 and 7 for the respective years, as at all bottom of the toposheets the symbols are given. The scale used was 1:63,000. The presentation scale is 1:1,81,818.

For the visual interpretation of SPOT HRV_2 MLA satellite imagery, band $B_1G_2R_3$ dated 15th January, 1988 was used. SPOT collects the data in two modes viz. Panchromatic mode [0.51-0.73 µm] with a geometric resoluation of 10 m, and Multispectral mode. In the multispectral mode, it collects the data in three spectral bands viz. two in the visible and one in the near infrared regions. The geometric resolution of this data is 20, which is better than LANDSAT TM and MSS. Each scene covers an area of about 60 x 60 km. The analysis of this data was carried out using a false colour composite made with the help of band 1 [0.5 - 0.59 µm], band 2 [0.61 - 0.68 µm] and band 3 [0.79 - 0.89 µm]. As the shapes and sizes of most of the structures in the urban region are visible, it has been attempted to use this data for urban land-use mapping of the region. The boundaries of various urban land-use categories are very sharp and was found easy to delineate.

The interpretation key for use with SPOT multispectral data was prepared on the basis of the image characteristics as well as the associated elements. They are [a] size, [b] pattern, [c] tone, [d] texture, and [e] remarks, which help in identifying different objects present in the urban scene and judging their significance in the urban area analysis. The interpretation key for use with SPOT data in identifying different land-use classes is given in Table : 11.

The original scale of the SPOT satellite imagery used was 1:400,000. For interpretation purposes, the enhancement was done to 1:25,000. The present land-use map [Fig. 14] is on 1:1,81,818.

TABLE : 11

IDENTIFICATION KEY FOR LAND-USE AND LAND COVER CLASSIFICATION SYSTEM FROM [SPOT-I] SATELITE DATA

SR. NO.	LAND COVER CATEGORY			IMAGE CHARACTERISTICS				REMARKS
	LEVEL I	LEVEL II	LEVEL III	TONE	TEXTURE	SIZE	PATTERN	
1	Urban or built up land	1.1 Residential	1.1.1 Dense	White-dark blue	Coarse	Variable	Regular streets	Areas with specific geometrical boundaries
			1.1.2 Moderate	Blue	Medium	Variable	Regular streets	
			1.1.3 Sparse	Light blue	Coarse	Variable	Regular streets	
		1.2 Mixed built up		Light blue-bluish white	Coarse	Variable	Unorganised	Areas with vague boundary on the periphery of the main city & usually coalesing with suburbs.
		1.3 Industrial		Light blue-bluish white	Medium	Variable	Rectangular	Areas with specific geometrical boundary and interspaced with vegetation and open land.
		1.4 Transportation	1.4.1 Roads	Dark grey	Medium	Variable	Linear	Interspread with pink tone.
			1.4.2 Railways	Light grey	Medium	Fixed	Linear	
			1.4.3 Airport	Light blue to white	Smooth	Fixed	Linear	
		1.5 Recreational		Reddish to pinkish	Medium	Variable	Dispered	
2	Agricultural land			Shades of red and brown	Coarse	Variable	Rectangular	Occuring in rectangular patches.
3	Waste/Barren land			Light yellow to light grey	Coarse	Variable	Irregular	Devoid of vegetation and showing steep, narrow and wide gullies.
		3.1 Transitional area		Light brown to light greyish white	Coarse to mottled	Variable	Irregular	Showing scrubby vegetation & change in land-use.

CLASSIFICATION CRITERIA :

A land use and land cover classification system which can effectively employ orbital and high-altitude criteria [Anderson, 1971].

1. The minimum level of interpretation accuracy in the identification of land-use and land cover categories from remote sensor data should be at least 85 percent.

2. The accuracy of interpretation for the several categories should be about equal.

3. Repetable or repetitive results should be obtainable from one interpreter to another and from one time of sensing to another.

4. The classification system should be applicable over extensive areas.

5. The categorisation should permit vegetation and other types of land cover to be used as surrogates for activity.

6. The classification system should be suitable for use with remote sensor data obtained at different times of the year.

7. Effective use of sub-categories that can be obtained from ground surveys or from the use of larger scale or enhanced remote sensor data should be possible.

8. Aggregation of categories must be possible.

9. Comparison with future land use data should be possible.

10. Multiple uses of land should be recognized when possible.

Some of these criteria should apply to land use and land cover classification in general, but some of the criteria apply primarily to land use and land cover data interpreted from remote sensor data.

It is hoped that, at the more generalized first and second levels, an accuracy in interpretation can be attained that will make the land use and land cover data comparable in quality to those obtained in other ways. For land use and land cover data needed for planning and management purposes, the accuracy of interpretation at the generalized first and second levels is satisfactory.

As per Anderson et al. [1976] the land classification system includes only the more generalized first, second and third levels. The classification system is capable of further refinement on the basis of more extended and varied use. Land use and land cover classification of the study area is given in Table : 12.

DEFINITIONS :

An attempt has been made to include sufficient detail in the definitions presented here to provide a general understanding of what is included in each category at Level I, II and III.

1. Urban or built-up land :

Urban or built-up land comprises of areas of intensive use with much of the land covered by structures. Included in this category are cities, towns, villages, strip developments along highways, transportation, power and communications facilities, and areas such as those occupied by mills, shopping centres, industrial and commercial complexes, and institutions that may, in some instances be isolated from urban areas.

TABLE : 12

LAND-USE AND LAND COVER CLASSIFICATION SYSTEM AS APPLICABLE FOR THE STUDY AREA FOR USE WITH REMOTE SENSOR DATA

[after Anderson et al 1976]

Level I	Level II	Level III
1. Urban or built-up land	1.1 Residential	1.1.1 Dense
		1.1.2 Moderate
		1.1.3 Sparse
	1.2 Mixed built-up Land	
	1.3 Industrial Area	
	1.4 Transportation	1.4.1 Roads
		1.4.2 Railways
		1.4.3 Airport
	1.5 Recreational	
2. Agricultural Land		
3. Waste/Barren Land	3.1 Transitional Area	
4. Water	4.1 Rivers	
	4.2 Streams	
	4.3 Lakes	

2. Residential :

Residential land uses range from high density, represented by the multiple-unit structures of urban cores, to low density, where houses are on lots of more than one acre, on the periphery of urban expansion. Linear residential developments along transportation routes extending outward from urban areas are included as residential

appendages to urban centres. The residential strips generally have a uniform size and spacing of structures, linear driveways, and lawn areas; the commercial strips are more likely to have buildings of different sizes and spacing, large driveways, and parking areas.

Areas of sparse residential land use, such as farmsteads are included in categories to which they are related. Rural residential and recreational subdivisions, however, are included in this category, since the land is almost totally committed to residential use, even though it may have range type of cover. In some places, the boundary is clear where new housing developments abut against intensively used agricultural areas, but the boundary is vague and difficult to discern when residential development occurs in small isolated units over an area of mixed or less intensive use.

3. Industrial :

Industrial areas include a wide array of land uses from light manufacturing to heavy manufacturing plants viz. chemical, refinery, fertilizer, petrochemicals etc.

4. Mixed urban or built-up land :

The mixed urban or built-up category is used for a mixture of Level II urban or built-up areas where individual uses cannot be separated at mapping scales; where more than one-third inter-mixture of another use or uses occurs in a specific area, it is classified as "mixed urban built-up land".

This category typically, includes developments along transportation routes and in cities, towns and built-up areas where separate land uses cannot be mapped individually viz. residential, commercial, industrial and occasionally other land uses.

5. Agricultural land :

Agricultural land may be defined broadly as land used primarily for production of food. On high-altitude imagery, the chief indications of agricultural activity are in the form of distinctive geometric fields and road patterns on the landscape and the traces produced by livestock or mechanized equipment. However, pasture and other lands where such equipments are used infrequently, do not show such well defined shapes as in other areas. These distinctive geometric patterns are also characteristic of urban or built-up lands because of street lay-outs and development by blocks. Distinguishing between agricultural and urban or built-up lands ordinarily, is possible on the basis of urban activity indicators and the associated concentration of population. The number of building complexes is smaller and the density of the road and highway network is much lower in agricultural lands than in urban or built-up land.

The interface of agricultural land with other categories of land use, may sometimes be a transition zone in which there is an inter-mixture of land uses at first and second levels of categorization, where farming activity is limited by degradation of land. The exact boundary is difficult to locate, and agricultural land may grade into transitional or barren land.

6. Waste/Barren Land :

Barren land is a land with limited activity to support life and in which less than one-third of the area has vegetation or other cover. In general, it is an area of thin soil, sand or rocks. Vegetation, if present, is more widely spaced and scrubby than that in the shrub and bush category of rangeland. Unusual conditions such as a heavy rainfall, occasionally result in growth of a short-lived, more luxuriant plant cover. Land may appear barren

TABLE : 13

U.S.G.S. LEVEL I LAND USE COLOUR CODE

SR. NO.	LEVEL I CATEGORY	COLOUR
1.	Urban or built-up land	Red [Munsell 5R 6/12]
2.	Agricultural Land	Light Brown [Munsell 5 YR 7/4]
3.	Rangeland	Light Orange [Munsell 10 YR 9/4]
4.	Barren Land	Grey [Munsell N 8/10]
5.	Water	Black

TABLE : 14

LEVEL II AND III LAND USE COLOUR CODE

SR. NO.	CATEGORY		COLOUR
	LEVEL II	LEVEL III	
1.	Residential	Densely	light red
2.		Moderately	purple
3.		Sparsely	pink
4.	Mixed built up land		blue
5.	Industrial Area		Dark red
6.	Recreational		parrot green
7.	Transitional area		yellow

because of man's activities.

7. Transitional Areas :

The transitional areas category is intended for those areas which are in transition from one land use activity to another. They are characterized by the lack of any remote sensor information which would enable the land use interpreter to predict reliably the future use, or discern the past use. All that actually can be determined in these situations is that a transition is in progress, and interference about past or future use in should be avoided. This transitional phase occurs when, any type of land use ceases, as areas become temporarily bare as construction is planned for such future uses as residences, shopping centres, industries, agriculture etc.

MAP PRESENTATION :

In order to provide a systematic and uniform approach to the presentation of land use and land cover information in map format, a scheme of color coding has been employed [Table : 13]. In this scheme, level I land uses have been color coded using a modified version of the World Land Use Survey [International Geographical Union, 1952] Colour Scheme.

The level II and III colour coding as used in this research is given in Table : 14 and Fig. 14.

OBSERVATIONS :

From the study of the Survey of India Toposheet Nos. 46 F/3, 4 and 7 [1876-79 and 1959-60], and SPOT HRV_2 satellite imagery, 1988, three land-use maps have been prepared [Fig. 12, 13 and 14], the area occupied by respective land-use categories computed and tabulated [Table 15]. The following observations have been made from the three maps mentioned above.

FIG:- 12. URBAN LAND USE / LAND COVER MAP OF THE BARODA CITY AND ITS SURROUNDINGS
(BASED ON SURVEY OF INDIA TOPOSHEET NOs. 46 F/3, 4 & 7. YEAR 1876-78)

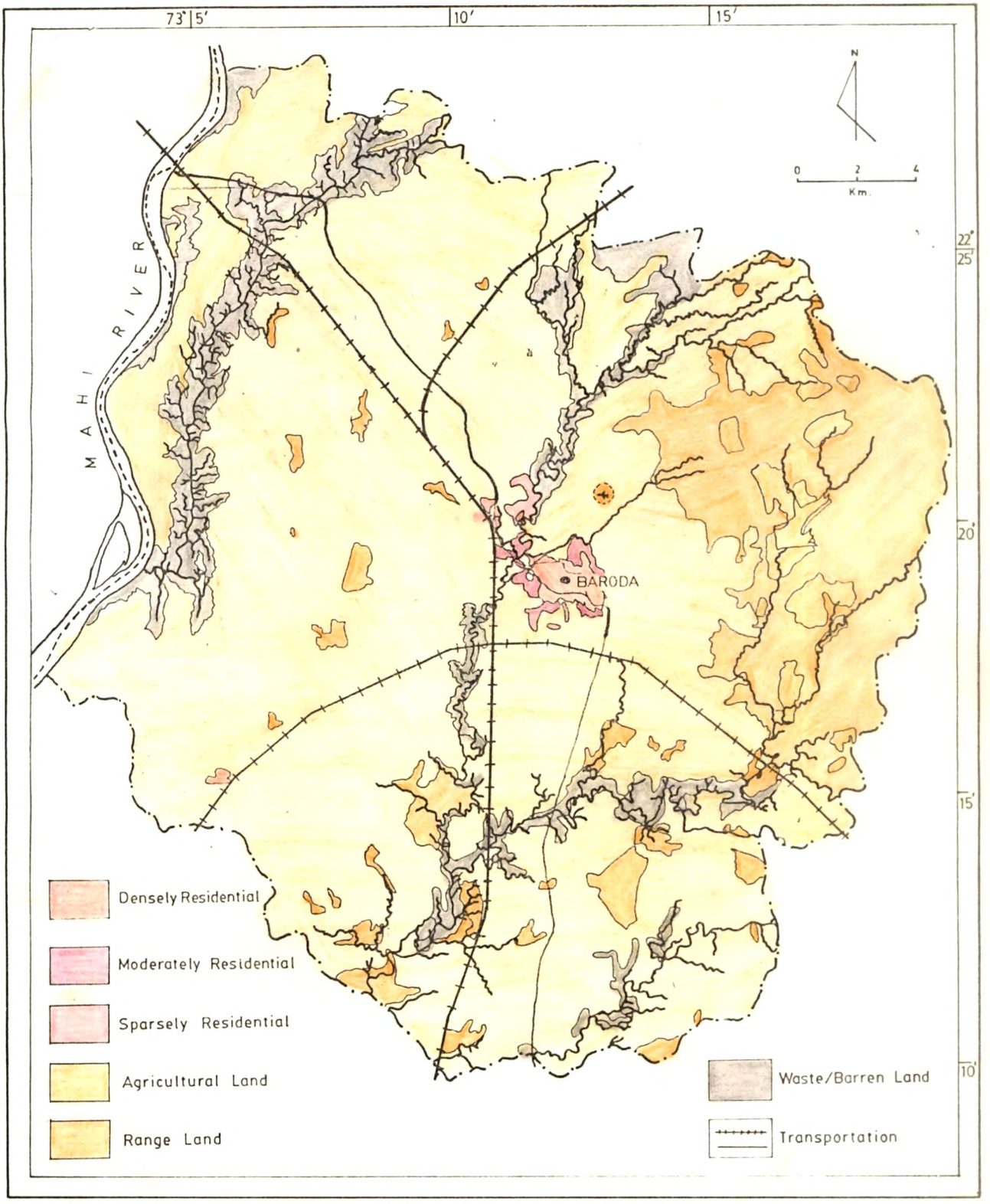


FIG:-13. URBAN LAND USE / LAND COVER MAP OF THE BARODA CITY AND ITS SURROUNDINGS
(BASED ON SURVEY OF INDIA TOPOSHEET NOs. 46 F/3, 4 & 7 YEAR 1959-60)

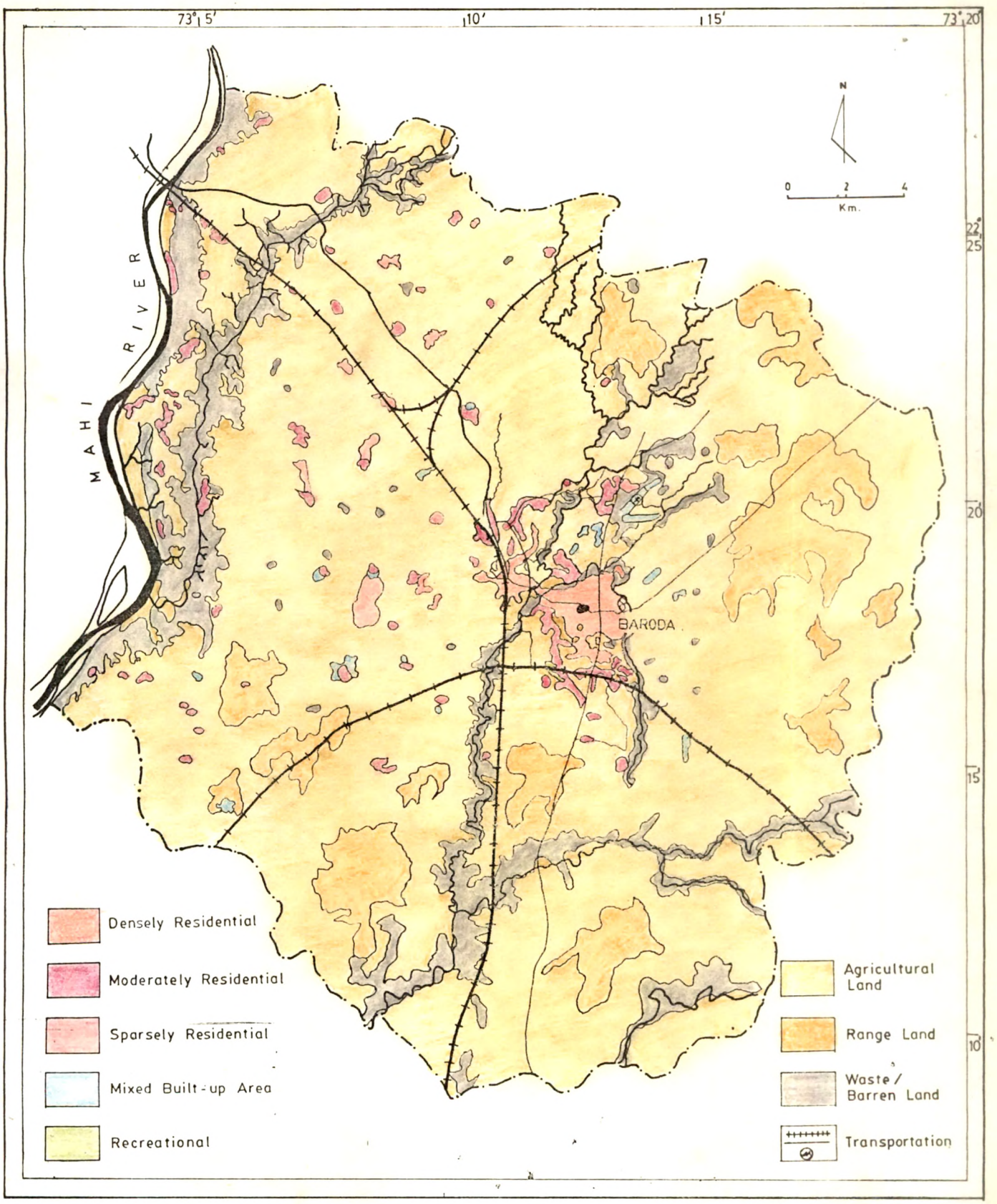


FIG. 14. URBAN LAND USE / LAND COVER MAP OF THE BARODA CITY AND ITS SURROUNDINGS
(BASED ON SPOT SATELLITE IMAGERY YEAR 1988)

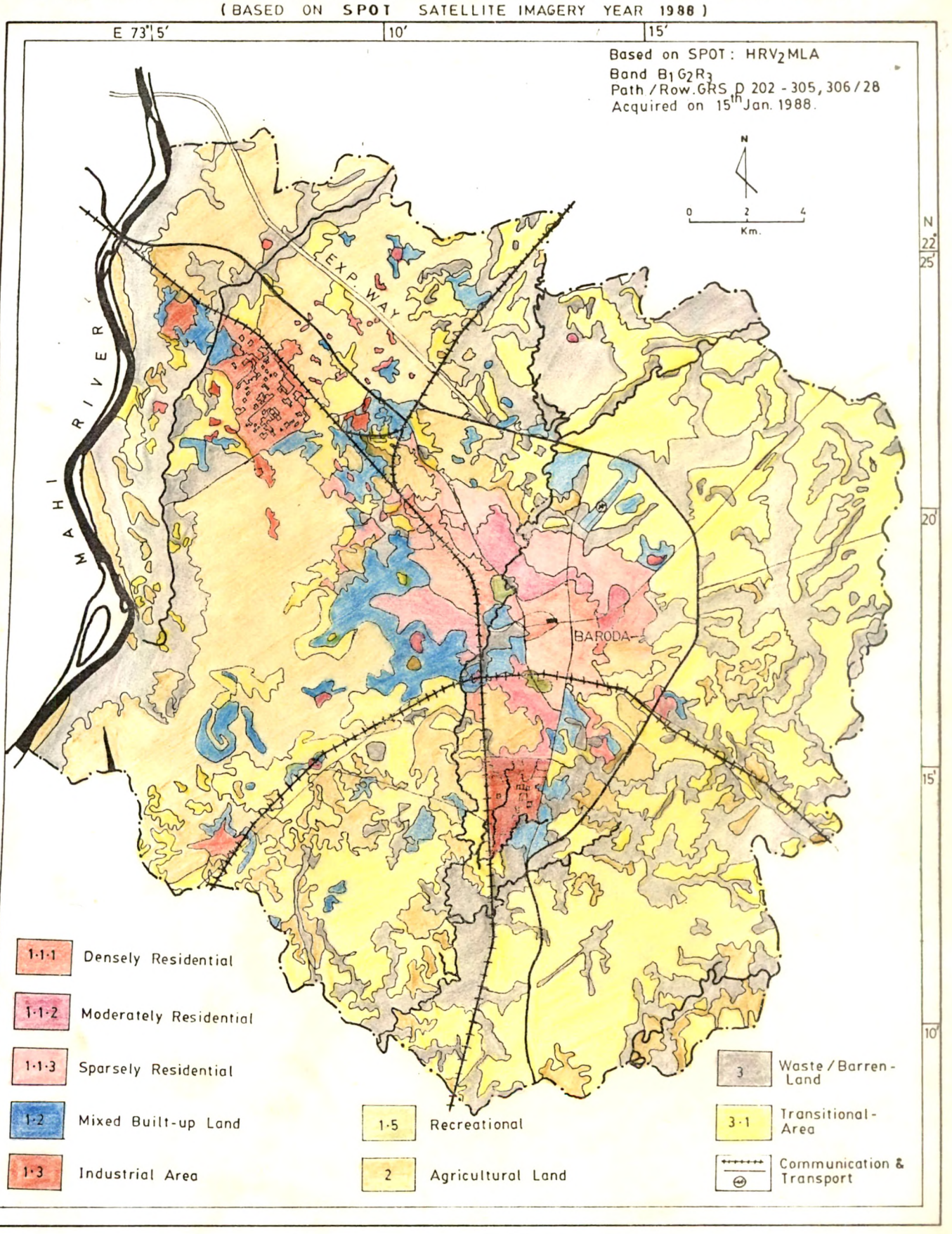


TABLE : 15

LAND-USE PATTERN IN THE STUDY AREA

[in sq. km]

SR. NO.	CATEGORY	YEAR			VARIATION INCREASE(+) OR DECREASE(-) in sq.km		RATE OF INCREASE(+) OR DECREASE(-) in sq.km/year	
		1876-78 +	1959-60 +	1988 *	1876-88 TO 1959-60 [82 YEARS]	1959-60 TO 1988 [28 YEARS]	1876-78 TO 1959-60	1959-60 TO 1988
1	2	3	4	5	6	7	8	9
1	RESIDENTIAL AREA							
	DENSELY	5.63	13.06	16.50	+7.43	+3.44	+0.09	+0.12
	MODERATELY	4.07	12.42	14.00	+8.35	+1.58	+0.10	+0.05
	SPARSELY	3.00	6.06	11.02	+3.06	+4.96	+0.03	+0.17
2	MIXED BUILT-UP AREA	-	2.18	24.08	+2.18	-21.90	+0.02	+0.78
3	INDUSTRIAL AREA	-	-	21.56	-	-21.56	-	+0.77
4	RECREATIONAL AREA	-	1.60	1.55	+1.60	-0.05	+0.01	-0.001
5	AGRICULTURAL LAND	537.57	515.00	197.13	-21.21	-318.55	-0.26	-11.37
6	RANGE LAND	103.23	74.63	-	-28.60	-	-0.34	-
7	WASTE/BARREN LAND	60.50	89.05	119.62	+28.55	-30.56	+0.36	+1.09
8	TRANSITIONAL AREA	-	-	308.52	-	+233.89	-	+8.39
	TOTAL STUDY AREA IN SQ.KM	714	714	714				

\+ Based on Survey of India Toposheet Nos. 46 F/3, 4, 7 - Years 1876-78 and 1959-60.

* Based on SPOT-I HRV_2 MLA band $B_1G_2R_3$ dated 15th January 1988.

[A] 1876-78 [Based on Survey of India Toposheet Nos. 46 F/3, 4 and 7]

With the accession of Sayajirao III in 1875, a new chapter in the history of Baroda began. A visitor, after coming out of the two-storeyed, large and comfortable railway station, during that time, found before him a panorama of parks, palatial buildings and well laid out asphalt roads [Mehta, 1971].

Baroda city occupied a total area of 12.70 sq.km [1.7%) out of the total study area of 714 sq.km. This area was mostly comprised of residential and educational buildings. The population during that time was around one lakh, with a density of nearly 9,000/sq.km. Apart from the city area mentioned above, the other major land-use categories around Baroda city were, agricultural land [75.3%] range land [14.45%], and about 8.47% of waste or barren land [Fig. 12 and Table : 15].

Industrialization was negligible. The main urban area was located on order inceptisol and I_2 soil series [sandy loam]. The water supply must have been through localised ponds and the Sursagar lake, located in the centre of present day Baroda. Mention of a few dug wells are there in past literature.

[B] 1959-60 [Based on Survey of India Toposheet Nos. 46 F/3, 4 and 7]

Negligible industrial growth was seen upto 1960. The area occupied by Baroda city, which was having its own municipality during this time, was 46.19 sq.km [Table : 10], which constituted nearly 6.4% of the total study area of 714 sq.km. This showed a nearly four-times increase in size, as compared to the 12.70 sq.km. Baroda city occupied during 1876-79. Out of the 46.19 sq.km area occupied by Baroda Municipality area, a total of 23.66 sq.km area [Table : 17 and Fig. 13] was occupied by built-up area, while the balance was made up of waste/barren land. The total

built-up area of 23.66 sq.km comprised of 13.06 sq.km, 7.32 sq.km, 0.5 sq.km and 1.18 sq.km densely, moderately, and sparsely populated residential and mixed built-up areas respectively.

During 1961, the population in the city area was 309,718, while in the surrounding rural area comprising the total study area, the population was 1,68,056 [Census of India, 1961; Table : 10].

In 1981, the area of Baroda city [108.26 sq.km] doubled in comparison to the area occupied in 1971 [57.5 sq.km], while the population increased to 7,34,473 [1981] from 4,66,696 [1971]. The rural population increased to 10,20,575 [1981] from 6,93,657 [1971]. There can be two possibilities for this bimodal urban and rural growth rate. One could be the migration of rural population to the urban area, and the second could be a natural slow growth.

During 1960, the main urban centre was located on I_2 soil series of the Inceptisol order, and consequently, spread in a north direction to encompass I_1 soil series of the Inceptisol order.

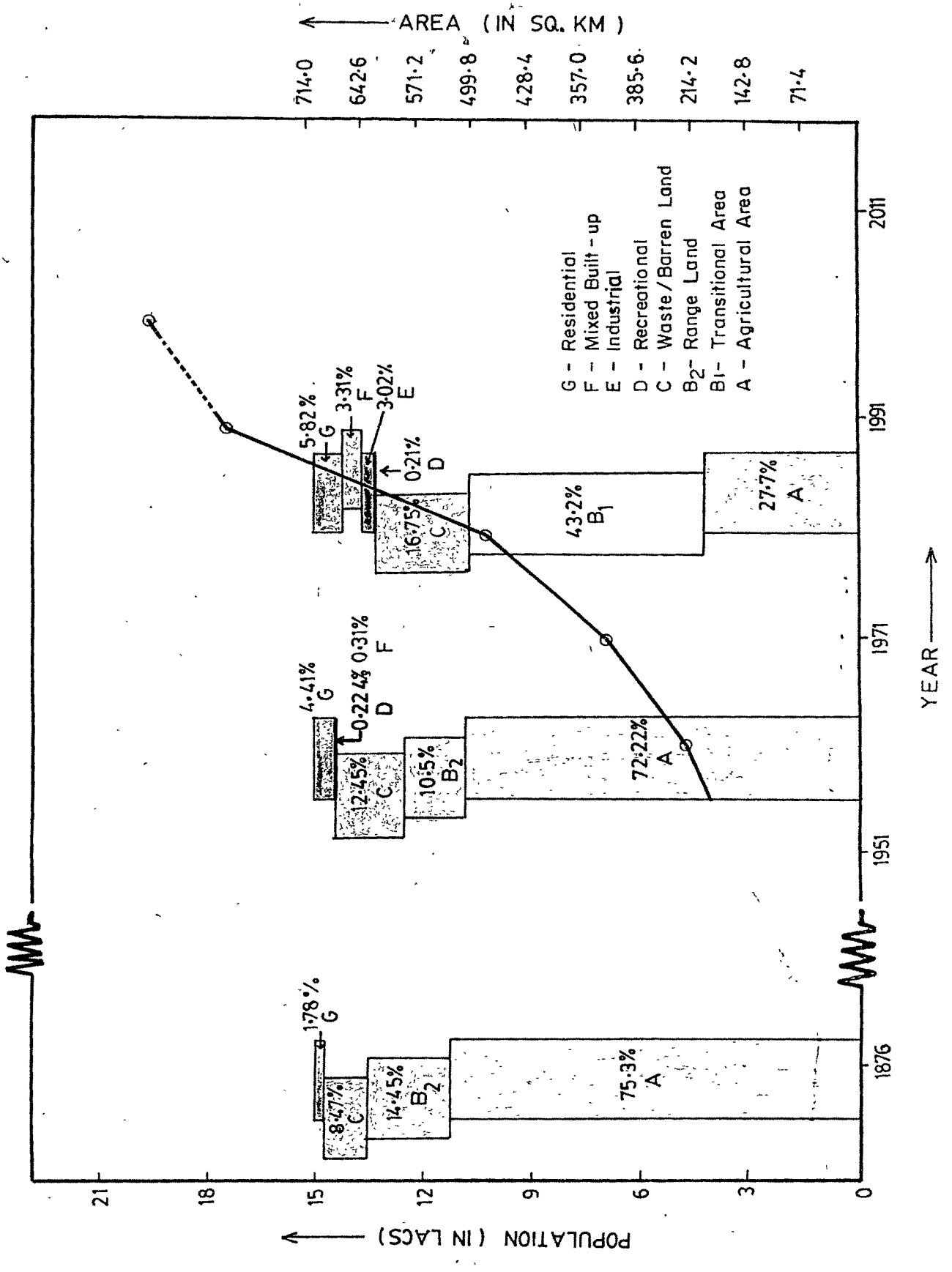
In a span of 82 years between the periods 1876-78 to 1959-60, the following land-use variation can be seen [Table : 15 and Fig. 15].

The residential area increased by 18.84 sq.km, the mixed built-up area increased by 2.18 sq.km and the agricultural land decreased by 21.21 sq.km. It can be deduced safely that a majority of the decrease in agricultural land must have contributed to the increases in the residential and mixed built-up areas. The 28.60 sq.km decrease in rangeland can be directly related to the increase in waste/barren land [29.55 sq.km].

[C] 1988 [Based on SPOT-1 HRV_2 MLA band $B_1G_2R_3$ satellite imagery dated 15.1.1988]

The past-sixties period saw an exponential increase in public

FIG.15. TEMPORAL AND SPATIAL DISTRIBUTION OF LAND-USE CATEGORIES AND POPULATION GROWTH IN THE STUDY AREA



and private-sector industrialisation with concurrent urbanization. Within a span of 28 years from 1959-60 onwards, the land-use pattern changed from a semi-urban and semi-agranian one, to a highly industrialised and urban area. This increase in urban/ industrial area [Plate : 10, 11 and 12] took place at the expense of previously existing agricultural/range land. The area occupied by Baroda city in 1988, was 82.33 sq.km, which shows an increase of nearly 3½ times as compared to the area occupied in 1959-60. This is evident from Table 17 and Fig. 14. The total urban sprawl of the study area including residential, mixed built-up, recreational and industrial areas during 1959-60 was 35.32 sq.km, while that in 1988, it was 88.79 sq.km [Table : 15]. The most striking feature is that while there was a nearly three-fold increase in urban sprawl between 1876-78 to 1959-60 [+ 22.82 sq.km in 82 years], the increase between 1959-60 to 1988 was more than two-fold [+ 53.47 sq.km in 28 years].

The loss of agricultural land [Plate : 13] is both exponential and striking, with a decrease of 21.21 sq.km in 82 years between 1876-78 to 1959-60 and a gargantuan 318.55 sq.km between 1959-60 to 1988 [28 years].

Another striking feature is the increase in transitional areas [Plate : 14, 15 and 16] which have increased to 308.52 sq.km in 1988 from negligible areas during 1876-78 and 1959-60. This indicates that activities in previously existing rangelands [Table : 15] and agricultural lands had stopped, prior to a change over to another land-use category. This has resulted in a degradation of land, resulting in top-soil erosion, gullying and an overall increase in waste/barren lands [Plate : 17 and 18].

Projections of population with time for the study area, [based on Census of India, 1961, 1971, 1981] and assuming the same growth rate [Table : 10 and Fig. 15], show that the total population in 1991 would be

RESIDENTIAL BUILDINGS COMING UP IN AND AROUND AGRICULTURAL LAND. THE PORTION IN THE LAND IN THE FOREGROUND IS STILL BEING UTILIZED FOR FARMING.

PLATE 10

PLATE 11

PLATE 12 : INDUSTRIAL ACTIVITY COMING UP IN AGRICULTURAL FIELDS.

PLATE 13 : AGRICULTURAL LAND IN THE STUDY AREA.

PLATE : 14 TYPICAL TRANSITIONAL AREA WHICH HAVE BEEN LEFT IDLE AND HAVE DEVELOPED BARREN LAND

PLATE : 15 TYPICAL TRANSITIONAL AREA WHICH HAVE BEEN LEFT IDLE AND HAVE DEVELOPED THORNY VEGETATION

PLATE : 16 TYPICAL TRANSITIONAL AREA WHICH HAVE BEEN LEFT IDLE AND HAVE DEVELOPED GULLYING

RAVINE FORMATION IN TRANSITIONAL AREAS DUE TO STOPPAGE OF NORMAL AGRICULTURAL PRACTICES.

PLATE 17 :

PLATE 18 :

17,05,523. Out of this, 11,55,340 would be located in the urban area, and the balance 5,50,183 in the rural area. Projections for 2001 AD show that the total population would be 19,47,438, out of which 18,26,030 would be in the urban area, and 1,21,608 in the rural zone. This is indicative of an increasing rate of migration from the rural to urban areas, along with a spread of urban sprawl to include existing villages, agricultural and range lands.