PLANNING FOR INTEGRATED DEVELOPMENT OF PUDUCHERRY REGION, INDIA

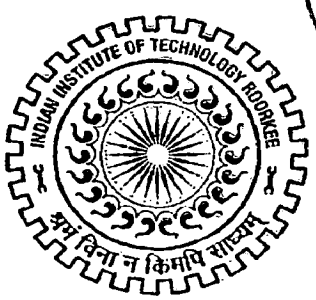
A DISSERTATION

Submitted in partial fulfillment of the requirements for the award of the degree of

MASTER OF URBAN AND RURAL PLANNING

By

R. ADINARAYANANE @ SADISH KUMAR



DEPARTMENT OF ARCHITECTURE AND PLANNING
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
ROORKEE -247 667 (INDIA)
JUNE, 2010

CERTIFICATE

Certified that this report entitled **"PLANNING FOR INTEGRATED DEVELOPMENT OF PUDUCHERRY REGION, INDIA"**, which has been submitted by **Mr. R. ADINARAYANANE @ SADISH KUMAR**, in partial fulfillment of the requirements for the award of the degree of **MASTER OF URBAN AND RURAL PLANNING**, submitted in the Department of Architecture and Planning, **INDIAN INSTITUTE OF TECHNOLOGY- ROORKEE**, is the student's own work carried out by him under my supervision and guidance. The matter embodied in this dissertation has not been submitted by him for the award of any other degree of this or any other institute.

Date: 10-06-2010

Place: ROORKEE

V. Devadas

(Dr. V. DEVADAS)
Department of Architecture and Planning
Indian Institute of Technology- Roorkee
Roorkee, Uttarakhand State, India.

CANDIDATE'S DECLARATION

I hereby certify that this report entitled **"PLANNING FOR INTEGRATED DEVELOPMENT OF PUDUCHERRY REGION, INDIA"**, which has been submitted in partial fulfillment of the requirements for the award of the degree of **MASTER OF URBAN AND RURAL PLANNING**, submitted in the Department of Architecture and Planning, **INDIAN INSTITUTE OF TECHNOLOGY- ROORKEE**, is an authentic record of my own work carried out during the period from July 2009 to June 2010, under the supervision and guidance of **Dr. V. DEVADAS,** Department of Architecture and Planning, Indian Institute of Technology Roorkee, India.

The matter embodied in this thesis has not been submitted by me for the award of any other degree of this or any other institute.

Date: 10-06-2010
Place: ROORKEE

(R. Adinarayanane @ Sadish Kumar)

This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

V. Devadas

(Dr. V. DEVADAS)
Faculty of Planning,
Department of Architecture and Planning
Indian Institute of Technology- Roorkee

Date: 10-06-2010
Place: ROORKEE

ABSTRACT

Integrated development plan at micro level planning takes in to account the essential needs of the local people, and arrive at policies for judicious use of the locally available resources. A successful micro level plan relies upon the key-planning tool, such as, systems analysis, operation research, statistics, socio-economic evaluation and infrastructure system. An urban system comprises of several interacting subsystems, such as physical, social, economic, ecology, environment, infrastructure, and institutions. All these subsystems are interlinked and interdependent to each other functioning as a whole. All the subsystems, comprising the urban system are inextricably linked since they not only are interconnected but also are interdependent on each other.

The Investigator has made an attempt to understand the physical, socio-economic and environmental conditions, level of infrastructure facilities, which exists in the system at grassroots level. To understand the real functions of the study area at the grassroots level, survey research techniques have been employed to conduct the investigation. The most important infrastructure services, which decide the functions in a particular system, such as housing, health, education and power were considered along with population and population growth in the system. An attempt was made to identify the control parameters, which decide the functions of the system by employing correlation techniques. The functions of the system along with all the subsystem can be quantified, but because of shortage of time in Master's Thesis, the Investigator conceptualized the urban system model, and established the functions through diagram. Puducherry region, one of the industrially backward State Capitals of India, was selected for the purpose of this investigation. An attempt has been made to develop conceptualized urban system model by considering various subsystems and their controlling parameters obtained from the analysis to evolve plausible policy recommendations for integrated development of the study area. Further, System theory and Polarized Regional concept have been employed in this investigation. Projections are done for the year 2031 A.D by employing suitable statistical techniques for forecasting the demand and supply of infrastructure in the system. Finally, a set of plausible policies are evolved and recommendations are made for achieving integrated development in the study area.

ACKNOWLEDGEMENT

It is very difficult to put in few words the gratitude I feel for the assistance rendered by many individuals and have been source for completion of this thesis and course. However, I take this opportunity to acknowledge those who have given their valuable suggestions and support in shaping this study into a cogent form.

I wish to place on record my deep sense of gratitude and indebtedness to my respective guide **Dr. V. Devadas,** Faculty member, Department of Architecture and Planning, Indian Institute of Technology-Roorkee, for his ever willing nature to guide and explaining the concepts as well as untiring energies afford to review during the course of this research work. I consider myself a privilege to work under his guidance.

I would like to express my sincere thanks to **Prof. R. Shankar, Prof. R.K. Jain, Prof. R. Chandra** and **Prof. Nalini Singh,** faculty members, Department of Architecture and Planning, Indian Institute of Technology-Roorkee for their valuable lectures, encouragement and assistance extended to me during my term in Roorkee.

I would like to accord my deep sense of gratitude to my friend's father **Mr. K. Krishnamurthy** and my cousins **Dr. S. Ramadass** and **Mr. Sattianandane,** Puducherry, for their blessings, encouragement, support, and timely help rendered for improving my education career by joining this course in IIT-Roorkee.

I am very much thankful to the officials and staff members of concerned Authorities/ Departments functioning under the Government of Puducherry for sharing their important information and vital data required for this research work.

I am indebted to my wife **Mrs. A. Radjesvary,** and son **A. Vishnu Prasath,** I would like to give my special thanks to them whose patient love which enabled me to complete this work and this thesis is dedicated to them.

I am sincerely thankful to batch mate **Ankit Nagpal** for his valuable suggestion, love and support during the course of this work.

I would like to thank The Almighty for gifting me such a wonderful life with great friends around me, namely **K. Nakkiran, S. Murugesan, N. Balamurugan, M. Jaya Shankar, A. Anandha Krishnan, P. Nehrunesan, K.Ganavel, G. Shegar (PPA)**, and, **T. Ganapathy, D. Sathish Kumar** and **B. Ramesh,** PhD Research Scholars, IIT-Roorkee, for providing their support and encouragement.

Lastly, I am very much satisfied with my decision to join the Master of Urban and Rural Planning Programme at IIT-Roorkee because of the new perspective, it helped me to develop and the learning experiences from my stay in the campus.

Date: 10th June, 2010 **R. Adinarayanane @ Sadish Kumar**

Place: ROORKEE

CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter-01

INTRODUCTION

1.1 INTRODUCTION

Cities are the engines of economic growth. Cities in the developed counties and in the developing countries have more quantity of infrastructure services, which attracts more and more industrialization in the cities, as consequence, these cities having more economic prospects, higher standard of living, more avenues for further development, etc. It has been observed that in the developed countries, the urban system contributes 85 per cent of the GDP, where as in the middle income countries it is 73percent, and in the low income countries it is only 55 per cent [UN-HABITAT].

Urbanization is a continuing process, which takes place in a vibrant manner in the developed countries, where as the intensity of urbanization is lesser in developing countries and it is further lesser in under developed countries. Urbanization is influenced by different factors, which includes geographical location, natural growth of population, rural-urban migration, cross country migration, availability of infrastructure, national policies, conducive atmosphere in connection with socio, economic, political and environmental development, corporate strategies, peoples aspiration, attitudes, culture, etc.

Urbanization has both **spread** and **backwash effects** in the system. As indicated in UN-HABITAT's report, that the cities are engines of economic growth in any country, and it can be considered as spread effect, and simultaneously it has backwash effects too. In spread effect, the following points can be worth mentioned, which include, population growth, industrialization, generation of employment, creation of income earning opportunities, resources mobilization, strengthening of the existing infrastructure facilities, new addition of infrastructure facilities, strengthening of trade and commercial activities, and so on. The following activities emerged in the urban system, which can be considered as backwash effect of urbanization, including formation of slums, strengthening of the existing slums, squatter settlements, aggravating the problem of poverty, unemployment, under employment, disguised unemployment, and creation of all kinds of pollution, which lead to environmental

degradation, damaging the cultural values that exists in the system, increase in heinous crimes, scarcity of infrastructure, and so on. The proliferation and expansion of slums and informal settlements in the urban system, lead to socio-economic threat, which is the major challenge to the city administrators and also to the other community who lives in the urban system. Urbanization led to the following effects that are worth mentioning, to understand the backwash effect of urbanization. They are:

- Increasing population
- Increasing population in slums
- Increase in Energy consumption
- Solid Waste Management problems
- Scarcity in all kinds of infrastructure.
- Environmental problems.

The world population has increased considerably during the last four decades, with an increase of about 50 per cent and it has been observed that world population would increase to **9.10 billion** by the year **2050** [Reference -UN-HABITAT], of which two third of population will be living in the urban system. The population growth in high income countries, Latin America & Caribbean, Sub-Saharan Africa, East Asia & Pacific, Middle East & North Africa, and Europe & Central Asia and in South Asia is presented in Figure 1.01.

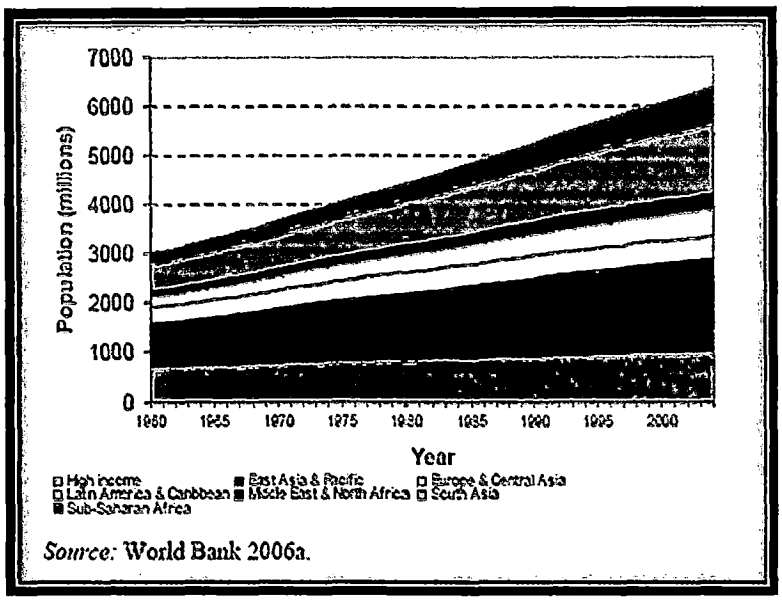


Figure no.1.01: World Population by Region, 1960 - 2005

1.2 POPULATION IN WORLD CITIES

Population controls the economic growth and development of any country. The problem which has been arisen in the developed countries, developing countries, underdeveloped countries are having direct bearing in population and its associated functions. The developed countries control the population growth and continued to be a developed country. It has been observed that even in cities of some of the developed countries, the population growth is negative, where as the population growth in the cities of developing countries and underdeveloped countries are considerably higher in size. The investigators analyzed the population growth in the cities of developed, developing and underdeveloped countries and are presented in Table 1.01 to 1.03 and Figure 1.02 to 1.07.

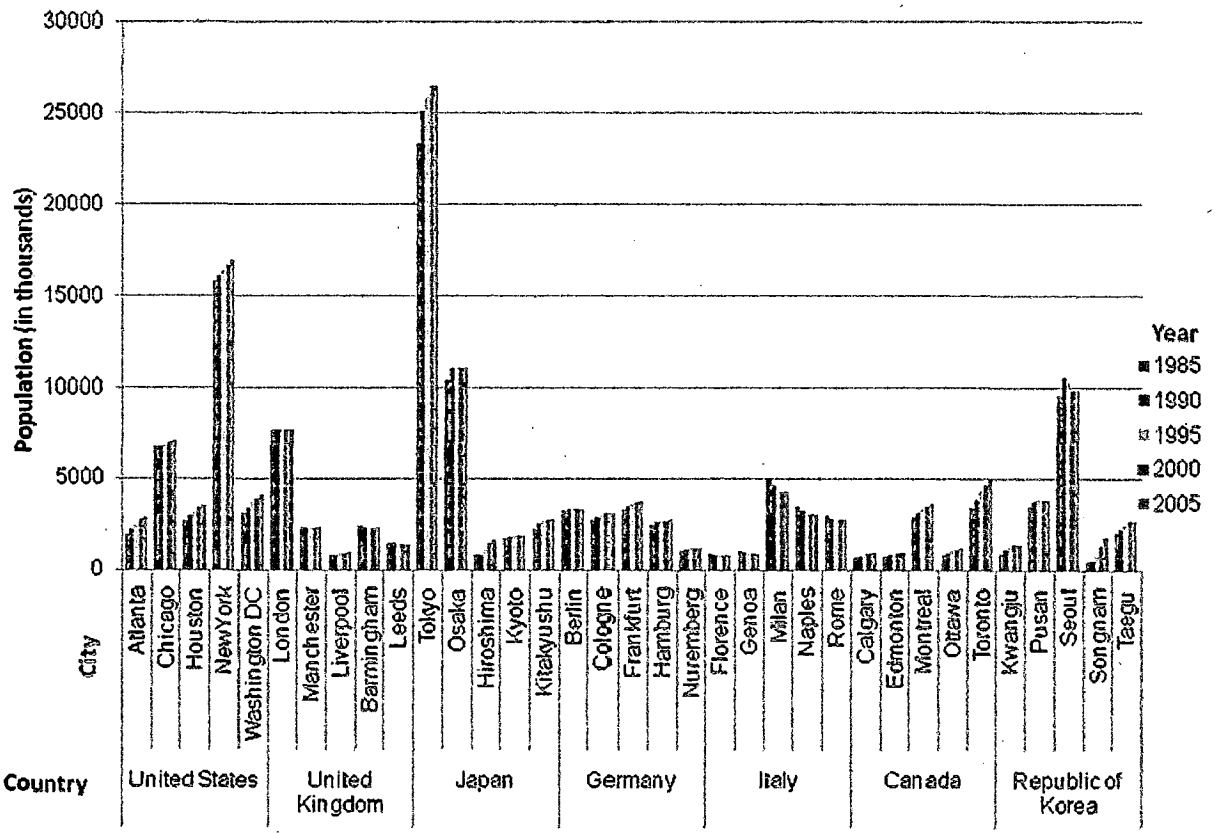


Figure no. 1.02: Population Size in selected cities of the Developed Countries

Table no. 1.01: Population Growth in selected cities of the Developed Countries

S.No.	Country	City	Population (in thousands)					Annual Growth Rate	
			1985	1990	1995	2000	2005	1985-1995	1995-2005
1	United States	Atlanta	1879	2174	2462	2691	2838	2.7	1.4
		Chicago	6786	6792	6844	6951	7089	0.1	0.4
		Houston	2658	2915	3164	3367	3511	1.7	1.0
		New York	15827	16056	16331	16640	16929	0.3	0.4
		Washington DC	3063	3380	3685	3931	4099	1.9	1.1
2	United Kingdom	London	7666	7653	7640	7640	7640	0.0	0.0
		Manchester	2313	2282	2252	2252	2252	-0.3	0.0
		Liverpool	788	831	876	914	937	1.1	0.7
		Birmingham	2330	2301	2272	2272	2272	-0.3	0.0
		Leeds	1465	1449	1433	1433	1433	-0.2	0.0
3	Japan	Tokyo	23322	25081	25785	26444	26444	1.0	0.3
		Osaka	10351	11035	11043	11013	11013	0.7	0.0
		Hiroshima	797	842	1094	1437	1640	3.2	4.1
		Kyoto	1714	1760	1804	1849	1849	0.5	0.3
		Kitakyushu	2217	2487	2619	2750	2750	1.7	0.5
4	Germany	Berlin	3268	3288	3317	3324	3327	0.2	0.0
		Cologne	2714	2855	2984	3054	3083	1.0	0.3
		Frankfurt	3293	3456	3606	3687	3720	0.9	0.3
		Hamburg	2451	2540	2625	2668	2685	0.7	0.2
		Nuremberg	1048	1106	1160	1192	1205	1.0	0.4
5	Italy	Florence	865	820	778	778	778	-1.1	0.0
		Genoa	1000	943	890	890	890	-1.2	0.0
		Milan	4984	4603	4251	4251	4251	-1.6	0.0
		Naples	3421	3210	3012	3012	3012	-1.3	0.0
		Rome	2930	2807	2688	2688	2688	-0.9	0.0
6	Canada	Calgary	656	738	833	899	956	2.4	1.4
		Edmonton	756	830	882	908	939	1.5	0.6
		Montreal	2904	3088	3324	3448	3567	1.4	0.7
		Ottawa	803	901	1025	1112	1187	2.4	1.5
		Toronto	3356	3802	4306	4651	4925	2.5	1.3
7	Republic of Korea	Kwangju	893	1122	1249	1379	1379	3.4	1.0
		Pusan	3490	3778	3813	3830	3830	0.9	0.0
		Seoul	9549	10544	10256	9888	9888	0.7	-0.4
		Songnam	443	534	842	1353	1785	6.4	7.5
		Taegu	1999	2215	2434	2675	2675	2.0	0.9

Source: Compiled by the Investigator based on the report of the United Nations Centre for Human Settlements (Habitat), 2001.

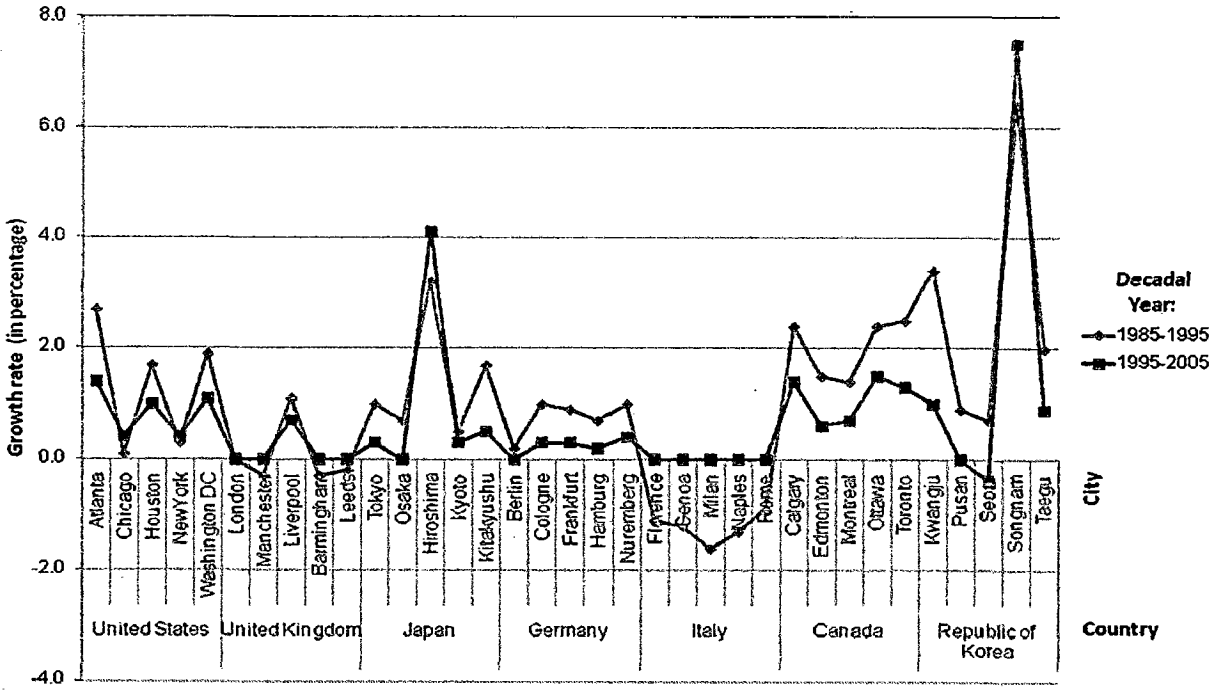


Figure no. 1.03: Population Growth rate in selected cities of the Developed Countries

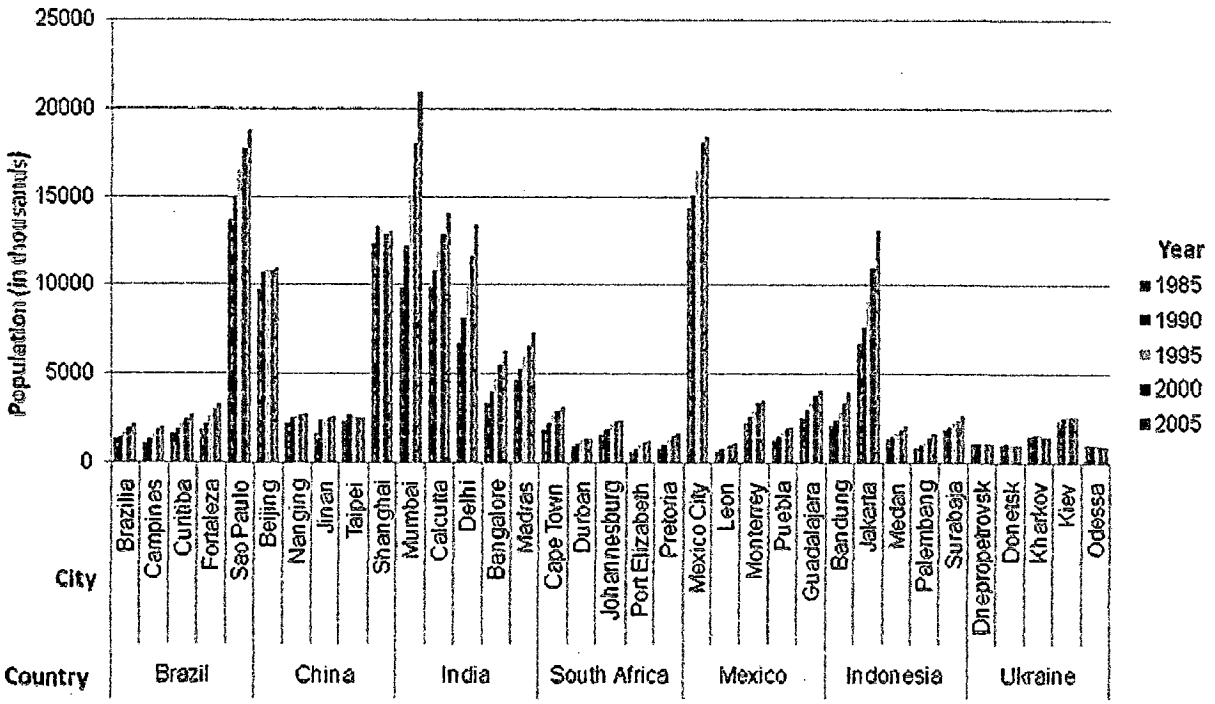


Figure no. 1.04: Population Size in selected cities of the Developing Countries

Table no.1.02: Population Growth in selected cities of the Developing Countries

S.No.	Country	City	Population (in thousands)					Annual Growth Rate	
			1985	1990	1995	2000	2005	1985-1995	1995-2005
1	Brazil	Brazilia	1346	1457	1778	1990	2176	2.8	2.0
		Campinas	1116	1339	1607	1862	2079	3.7	2.6
		Curitiba	1664	1930	2240	2525	2772	3.0	2.1
		Fortaleza	1865	2213	2627	3014	3342	3.4	2.4
		Sao Paulo	13758	15082	16533	17755	18823	1.8	1.3
2	China	Beijing	9797	10819	10829	10839	11035	1.0	0.2
		Nanging	2302	2611	2674	2740	2847	1.5	0.6
		Jinan	1667	2404	2484	2568	2687	4.0	0.8
		Taipei	2446	2711	2629	2550	2600	0.7	-0.1
		Shanghai	12396	13342	13112	12887	13106	0.6	0.0
3	India	Mumbai	9907	12246	15138	18066	20940	4.2	3.2
		Calcutta	9943	10890	11923	12918	14142	1.8	1.7
		Delhi	6770	8207	9948	11695	13451	3.9	3.0
		Bangalore	3395	4036	4799	5561	6354	3.5	2.8
		Madras	4748	5338	6002	6648	7390	2.3	2.1
4	South Africa	Cape Town	1933	2296	2727	2993	3164	3.4	1.5
		Durban	990	1119	1264	1335	1382	2.4	0.9
		Johannesburg	1625	1879	2172	2335	2438	2.9	1.2
		Port Elizabeth	662	828	1035	1186	1290	4.5	2.2
		Pretoria	835	1047	1314	1508	1640	4.5	2.2
5	Mexico	Mexico City	14474	15130	16562	18131	18452	1.4	1.1
		Leon	720	817	926	1050	1104	2.5	1.8
		Monterrey	2287	2624	2994	3416	3603	2.7	1.9
		Puebla	1289	1507	1722	1968	2079	2.9	1.9
		Guadalajara	2604	3011	3430	3908	4115	2.8	1.8
6	Indonesia	Bandung	2090	2460	2896	3409	4007	3.3	3.3
		Jakarta	6788	7650	9161	11018	13153	3.0	3.6
		Medan	1390	1537	1699	1879	2102	2.0	2.1
		Palembang	880	1033	1212	1422	1670	3.2	3.2
		Surabaja	1887	2062	2253	2461	2727	1.8	1.9
7	Ukraine	Dnepropetrovsk	1136	1169	1149	1129	1129	0.1	-0.2
		Donetsk	1076	1104	1089	1075	1075	0.1	-0.1
		Kharkov	1544	1591	1558	1526	1526	0.1	-0.2
		Kiev	2410	2582	2626	2670	2678	0.9	0.2
		Odessa	1081	1089	1050	1012	1012	-0.3	-0.4

Source: Compiled by the Investigator based on the report of the United Nations Centre for Human Settlements (Habitat), 2001.

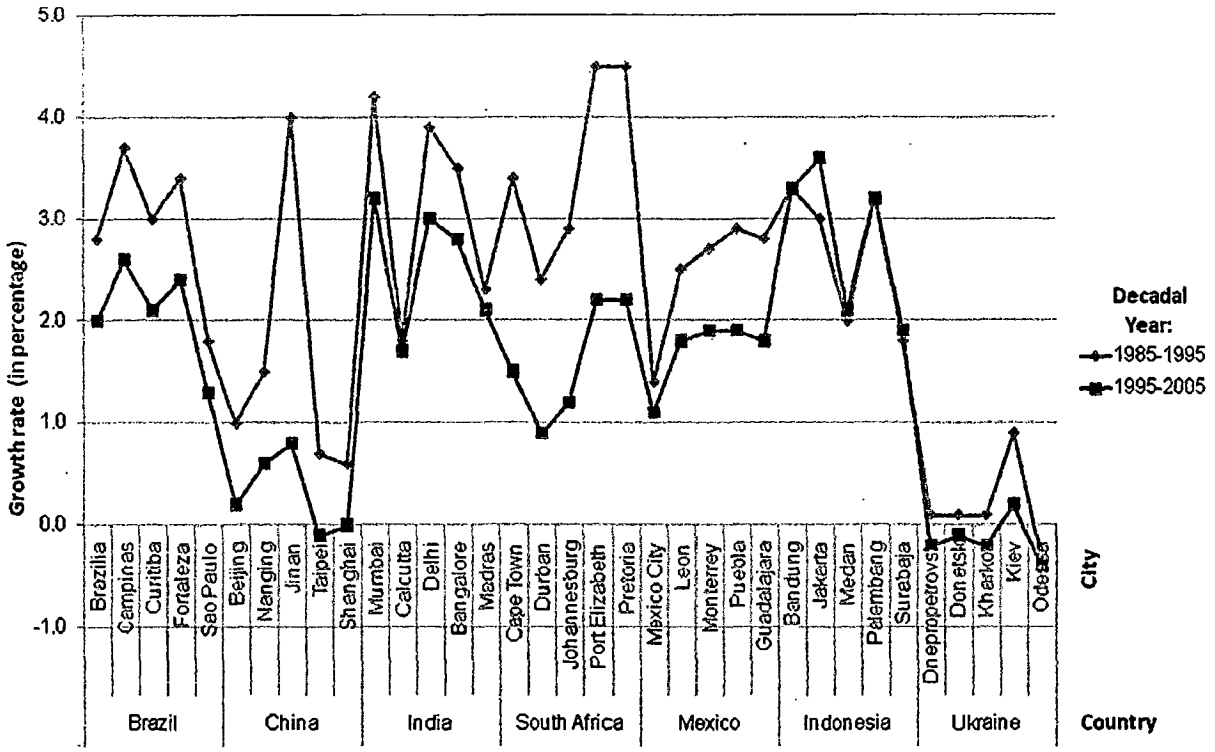


Figure no.1.05: Population Growth rate in selected cities of the Developing Countries

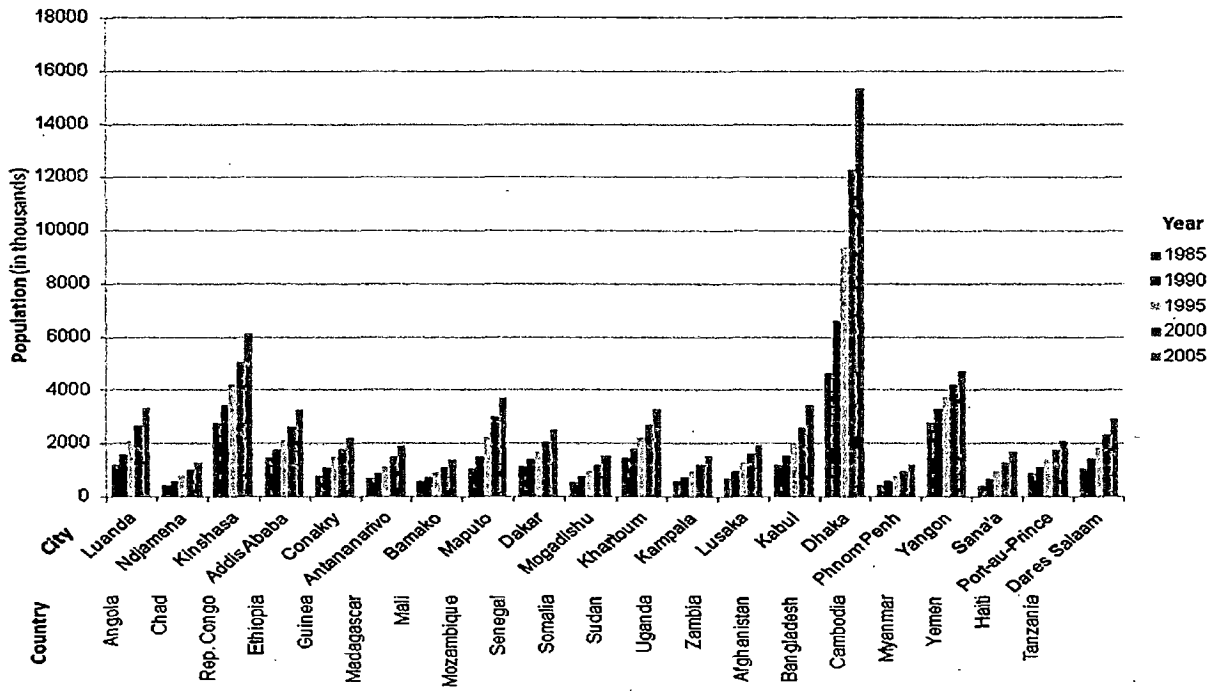


Figure no.1.06: Population Size in selected cities of the Underdeveloped Countries

Table no.1.03: Population Growth in selected cities of the Underdeveloped Countries

S.No.	Country	City	Population (in thousands)					Annual Growth Rate	
			1985	1990	1995	2000	2005	1985-1995	1995-2005
1	Angola	Luanda	1227	1606	2105	2677	3353	5.4	4.7
2	Chad	Ndjamena	455	613	826	1043	1289	6.0	4.5
3	Dem. Rep. of Congo	Kinshasa	2782	3444	4240	5064	6153	4.2	3.7
4	Ethiopia	Addis Ababa	1486	1793	2165	2639	3258	3.8	4.1
5	Guinea	Conakry	825	1123	1541	1824	2220	6.3	3.7
6	Madagascar	Antananarivo	690	896	1164	1507	1921	5.5	5.0
7	Mali	Bamako	599	738	912	1131	1404	4.2	4.3
8	Mozambique	Maputo	1067	1516	2218	3025	3713	7.3	5.2
9	Senegal	Dakar	1150	1401	1708	2079	2514	4.0	3.9
10	Somalia	Mogadishu	548	779	965	1219	1552	5.7	4.8
11	Sudan	Khartoum	1485	1828	2249	2731	3299	4.2	3.8
12	Uganda	Kampala	597	755	955	1212	1557	4.7	4.9
13	Zambia	Lusaka	721	974	1317	1640	1958	6.0	4.0
14	Afghanistan	Kabul	1237	1565	2029	2590	3468	5.0	5.4
15	Bangladesh	Dhaka	4652	6619	9416	12317	15366	7.1	4.9
16	Cambodia	Phnom Penh	461	594	765	984	1229	5.1	4.7
17	Myanmar	Yangon	2788	3299	3742	4196	4721	2.9	2.3
18	Yemen	Sana'a	402	678	965	1303	1697	8.8	6.5
19	Haiti	Port-au-Prince	881	1134	1427	1769	2121	4.8	4.0
20	United Rep. of Tanzania	Dar es Salaam	1096	1436	1873	2347	2936	5.4	4.5

Source: Compiled by the Investigator based on the report of the United Nations Centre for Human Settlements (Habitat), 2001.

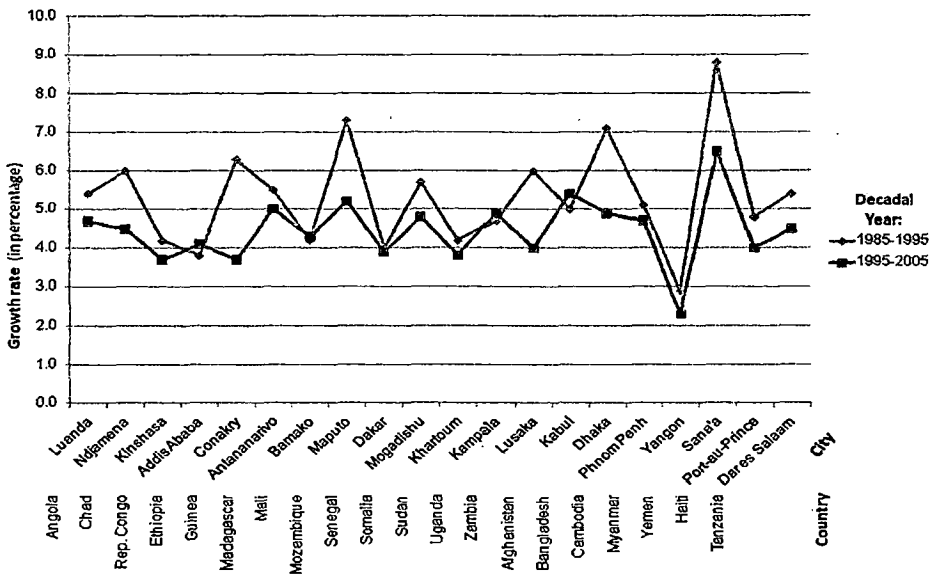


Figure no.1.07: Population Growth rate in selected cities of the Underdeveloped Countries

The above tables and figures show that the annual growth rate of population in selected cities in the developed countries are much negligible between 1985-1995 and 1995-2005, whereas, in selected cities of developing countries and in the underdeveloped countries, the population growth rate are higher in size during the corresponding period.

1.3 INCREASING POPULATION IN SLUMS

Population in the slum areas have been increasing in the second half of 20th century and it is continued to be increasing. It has been observed that the population living in the slums of the developing countries have been increasing at an alarming rate, due to several factors such as, unemployment, underemployment, disguised unemployment which prevails in the rural system of those developing countries; inefficient policies and planning systems prevails in the developing countries; inefficient administration that prevails in the developing countries; uneven distribution of wealth and infrastructure facilities; population explosion in developing countries; scarcity of resources, poor exploitation of resources, mismanagement of available resources and un-utilization of resources, in developing countries; poor technical knowhow among the people of the developing countries, concentration of resources and infrastructure facilities in few pockets and few hands, in the urban system of the developing countries, etc., are paving the way for the population growth in the urban system. It has been observed that the poorest among the poor people from the rural system of a developing country like India, migrate to the urban system, for searching job opportunities and live on the pavements and in the slums of the urban system. The population growth in slums in the world by developed and in the developing regions wise is presented in the Table1.04 and in the Figure1.08 and 1.09. This table reveals that the annual growth rate of population live in slums is very much negligible, in the developed regions, where as it is little higher in size, in the developing regions between the period 2001 and 2005. It is interesting to note that even negative growth rate has been observed in the developed regions, where as the highest growth rate, that is 4.53 per cent is observed in the developing region like sub-Saharan Africa, followed by Oceania, it is 3.24 per cent annual growth rates. It reveals that poverty in the developing countries is the root cause for the growth of population in slum areas of the developing countries.

Table no.1.04: Population growth of slums in the developed and developing regions of the world

Region	Slum Population (in thousands)			Slum Annual Growth rate (%)
	1990	2001	2005	
World	714972	912918	997767	2.22
Developed regions	41750	45191	46511	0.72
EURASIA (countries in CIS)	18929	18714	18637	-0.10
European countries in CIS	9208	8878	8761	-0.33
Asian countries in CIS	9721	9836	9879	0.11
Developing Regions	654294	849013	933376	2.37
Northern Africa	21719	21355	21224	-0.15
Sub-Saharan Africa	100973	166208	199231	4.53
Latin America and the Carribbean	110837	127566	134257	1.28
Eastern Asia	150761	193824	212368	2.28
Eastern Asia excluding China	12831	15568	16702	1.76
Southern Asia	198663	253122	276432	2.20
South-Eastern Asia	48986	56781	59913	1.34
Western Asia	22006	29658	33057	2.71
Oceania	350	499	568	3.24

Source: Compiled by the Investigator based on the report of United Nations Centre for Human Settlements (Habitat), 2006b, p.16.

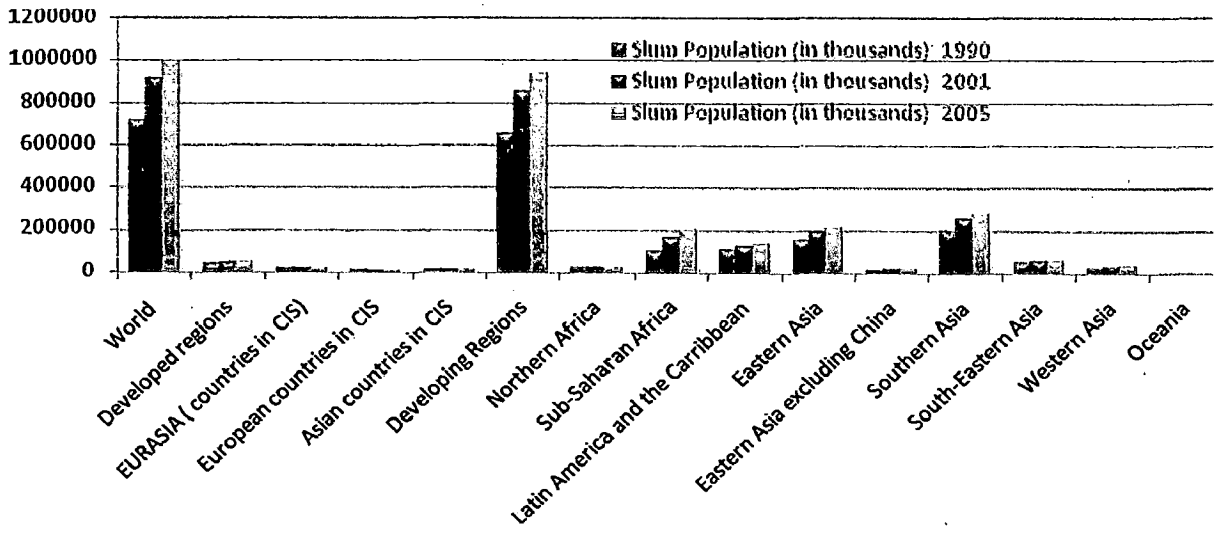


Figure no.1.08: Slum Population in the developed and developing regions of the world

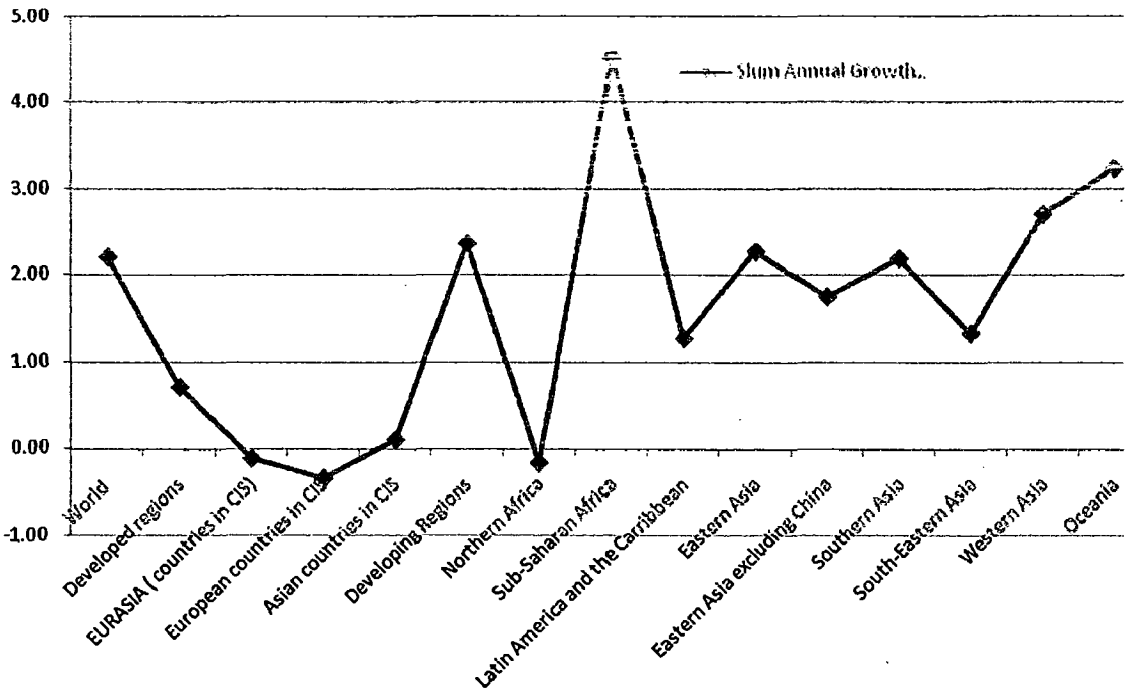


Figure no.1.09: Slum Annual Growth in the developed and developing regions of the world

1.4 ENERGY

Energy plays a major role in the world economy. Available energy resources in the world are not evenly distributed. Some countries are blessed with fossil fuel, where as some countries are blessed with other kinds of energy like solar, wind, hydro, biomass, etc. The countries which were having huge amount of fossil fuel deposit almost dictate the terms and conditions of the world economy, for example Organization of Petroleum Exporting Country [OPEC]. Energy consumption is the most important parameter, which decides the functions of the system. A Country's economic strength can be assessed based on the quantity of energy consumption, sources of energy consumption, types of energy consumption, energy conservation, technology adoption in energy consumption, demand and supply of energy, etc., and it has been observed that the developed countries consume more quantity of energy compared to the developing countries and underdeveloped countries, and their GDP growth is also observed as quiet high. The quantity of energy consumption and the GDP growth of the countries have positive correlation. The quantity of energy consumption, the per capita energy consumption and the energy consumption/GDP ratio of the selected developed and developing countries of the world are presented in the Table1.05 to 1.10 and in the Figure 1.10 to 1.15.

Table no.1.05: Energy consumption by selected developed countries of the world

Country	Primary energy consumption (million tonnes of oil equivalent)				
	1985	1990	1995	2000	2005
US	1763.1	1963.3	2116.7	2309.5	2342.7
United Kingdom	201.70	211	214	222.9	225.2
Japan	367.6	431	488.9	510.2	519.7
Germany	358.5	349.2	332.1	329.5	323.6
Italy	137.6	153.9	161.5	174.9	183
Canada	235.2	248.4	277.3	300.9	323.1
South Korea	52.7	90.3	148	190.7	224.6
France	195.4	218.2	235	253.9	261.8
Switzerland	26.1	26.8	27.8	29.1	27.5
Kuwait	11.8	9.3	14.8	19	26.2

Source: Compiled by the Investigator based on the bp statistics review of world energy report 2009

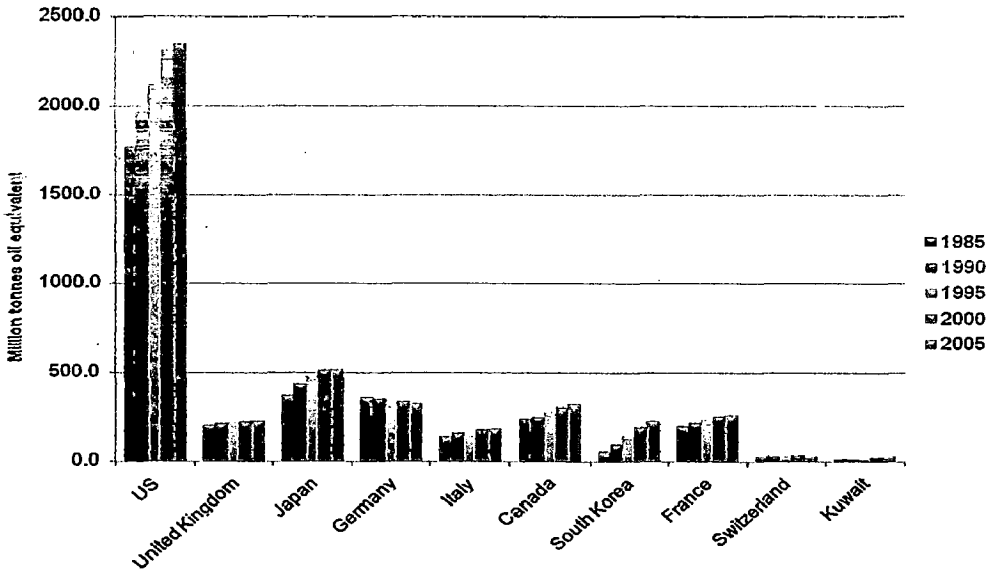


Figure no. 1.10: Energy consumption by selected developed countries of the world

Table no.1.06: Energy consumption by selected developing countries of the world

Country	Primary energy consumption (million tonnes of oil equivalent)				
	1985	1990	1995	2000	2005
Algeria	23.2	28.1	28	26.9	32.7
Brazil	109.2	123.8	149.5	182.9	198.8
China	533.1	685.1	916.7	967.3	1572.2
Colombia	18.4	22.9	26.4	25.4	27.6
Egypt	27.9	34.1	37.9	49	62.1
India	132.7	180.7	236	295.1	362.2
Malaysia	16.3	24.1	33.2	45.5	55.3
Indonesia	34.6	50.3	71.8	93.5	118.5
South Africa	81.7	90.2	100.3	107.9	119.7
Mexico	92.7	102	113.4	137.4	153.4

Source: Compiled by the Investigator based on the bp statistics review of world energy report 2009

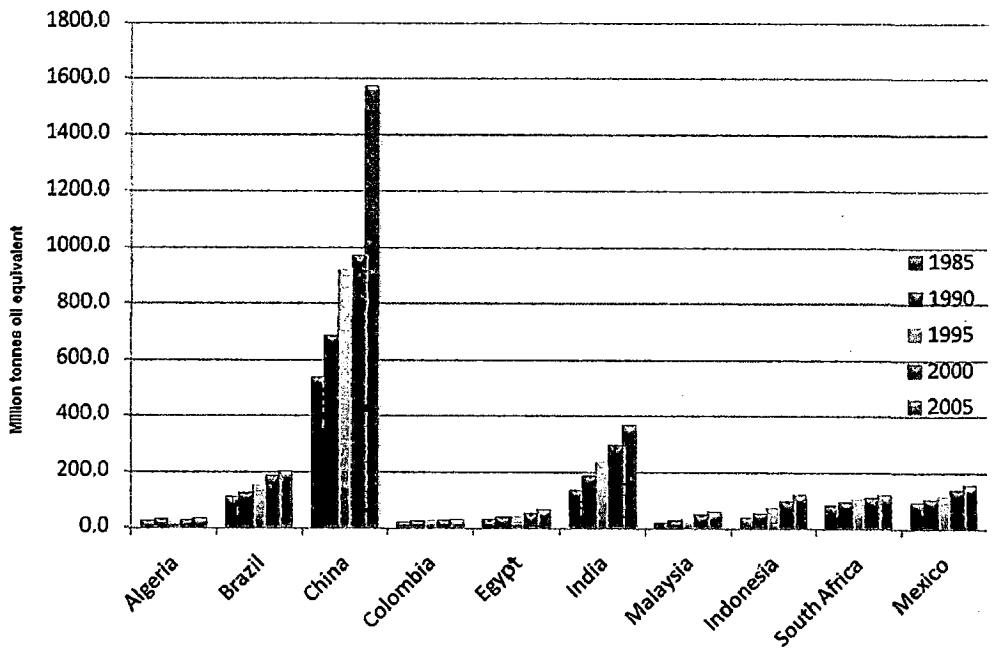


Figure no. 1.11: Energy consumption by selected developing countries of the world

Table no.1.07: Per capita Energy consumption by selected developed countries of the world

Country	Primary energy consumption (kg per capita)				
	1985	1990	1995	2000	2005
US	7410.35	7865.06	7949.21	8183.22	7903.57
United Kingdom	3558.26	3665.68	3673.82	3730.98	3739.22
Japan	3044.21	3488.83	3897.51	4021.44	4067.34
Germany	4614.02	4396.16	4067.76	4008.03	3923.88
Italy	2431.40	2713.38	2841.00	3071.19	3122.49
Canada	9066.38	8938.15	9446.75	9779.10	10003.41
South Korea	1291.48	2106.42	3282.11	4056.75	4650.67
France	3541.78	3845.95	4062.65	4311.02	4300.76
Switzerland	4034.00	3992.85	3948.30	4050.54	3697.68
Kuwait	6892.52	4376.47	8213.10	8675.80	10333.49

Source: Compiled by the Investigator based on the bp statistics review of world energy report 2009

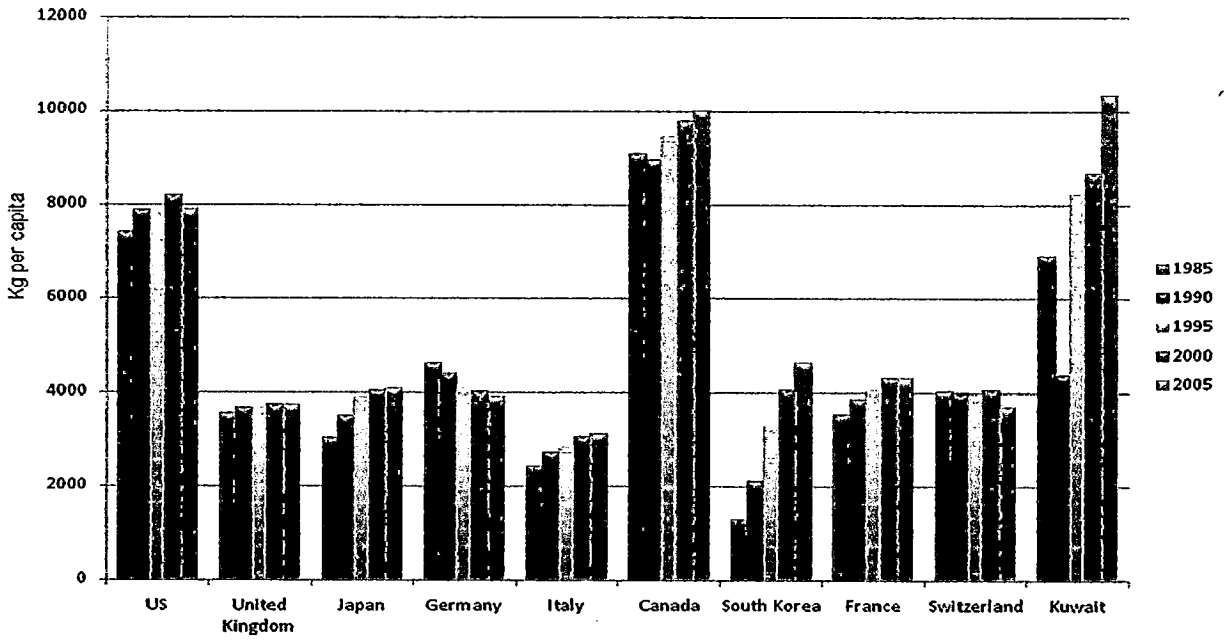


Figure no.1.12: Per capita Energy consumption by selected developed countries of the world

Table no.1.08: Per capita Energy consumption by selected developing countries of the world

Country	Primary energy consumption (kg per capita)				
	1985	1990	1995	2000	2005
Algeria	1049.90	1111.08	990.42	883.03	995.32
Brazil	802.57	828.68	926.41	1052.01	1066.50
China	507.21	603.51	760.84	766.09	1205.21
Colombia	582.94	656.64	690.04	609.37	614.07
Egypt	562.36	612.50	619.03	728.24	838.82
India	173.43	212.71	253.17	290.47	330.90
Malaysia	1039.73	1350.49	1630.46	1978.50	2181.69
Indonesia	212.22	282.22	372.50	453.30	537.27
South Africa	2609.57	2562.50	2563.91	2452.27	2552.88
Mexico	1228.38	1225.58	1244.17	1402.53	1488.03

Source: Compiled by the Investigator based on the bp statistics review of world energy report 2009

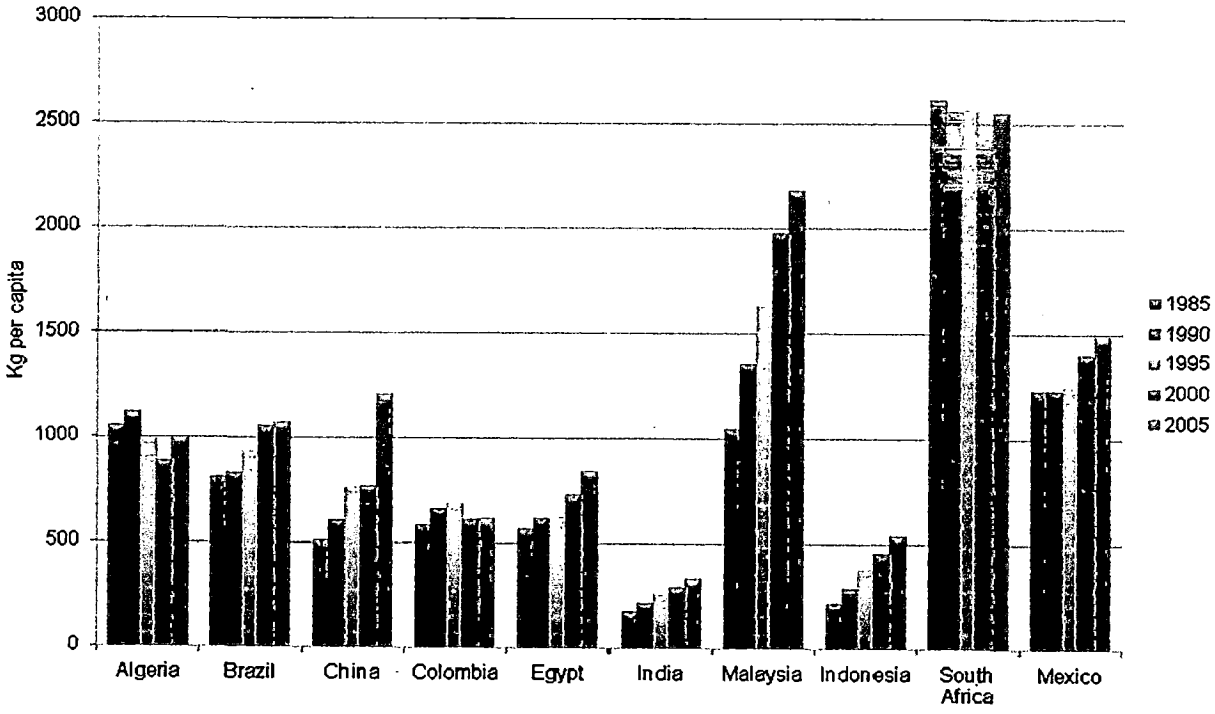


Figure no.1.13: Per capita Energy consumption by selected developing countries of the world

Table no.1.09: Energy consumption/GDP Ratio of selected developed countries of the world

Country	Energy consumption/GDP Ratio [Units 10^-10]				
	1985	1990	1995	2000	2005
US	18	14	11	8	6
United Kingdom	78	37	32	26	17
Japan	23	12	7	9	9
Germany	66	26	16	21	14
Italy	56	24	25	28	18
Canada	259	156	162	137	90
South Korea	134	80	63	79	59
France	65	31	26	32	20
Switzerland	410	169	125	165	101
Kuwait	3214	1375	3020	2300	1279

Source: Compiled by the Investigator based on the bp statistics review of world energy report 2009.

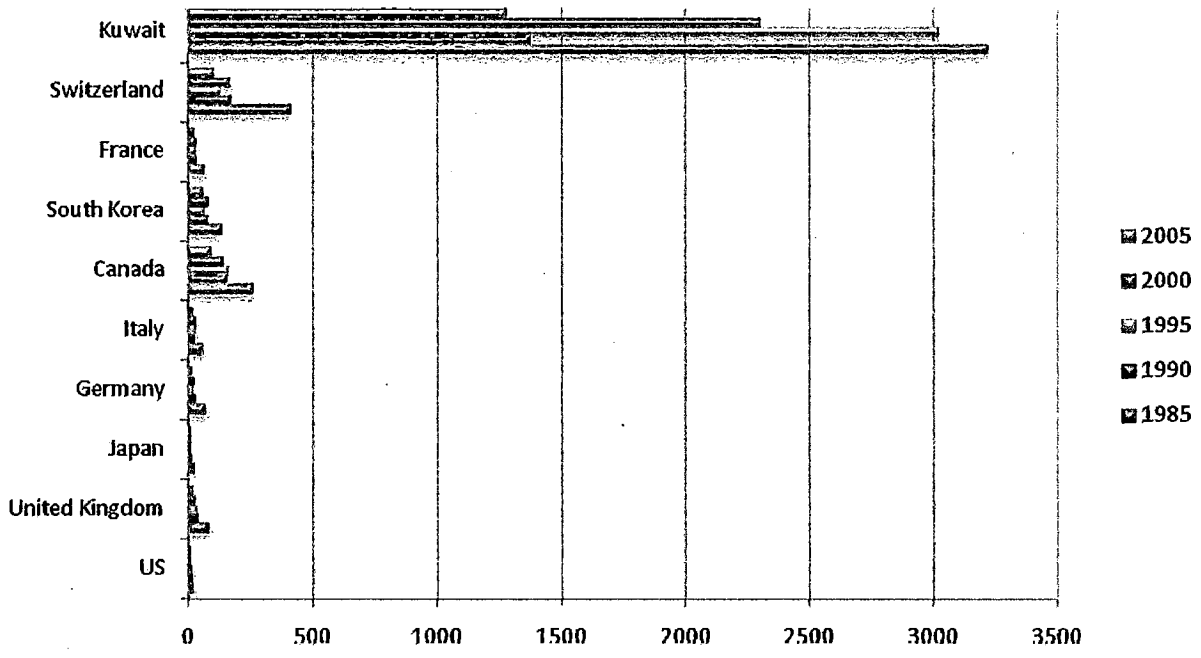


Figure no.1.14: Energy consumption/GDP Ratio of selected developed countries of the world

Table no. 1.10: Energy consumption/GDP Ratio of selected developing countries of the world

Country	Energy consumption/GDP Ratio [Units 10^-10]				
	1985	1990	1995	2000	2005
Algeria	181	179	237	161	98
Brazil	36	18	12	16	12
China	17	17	10	6	5
Colombia	167	163	75	73	50
Egypt	162	142	103	73	94
India	8	7	7	6	4
Malaysia	327	307	184	219	167
Indonesia	24	25	18	27	19
South Africa	389	229	170	185	105
Mexico	67	47	43	24	19

Source: Compiled by the Investigator based on the bp statistics review of world energy report 2009.

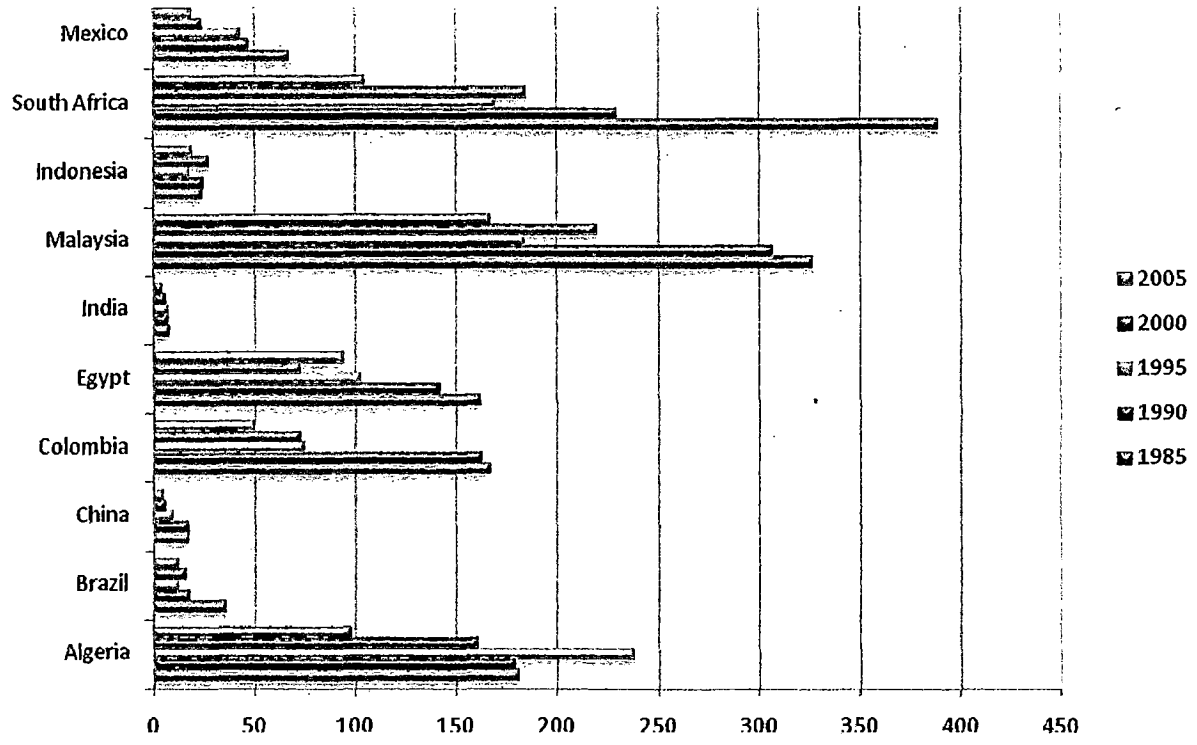


Figure no.1.15: Energy consumption/GDP Ratio of selected developing countries of the world

The per capita energy consumption among the selected developed countries, which includes South Korea, Italy, Japan, France, United Kingdom, Switzerland, Germany, Kuwait, United States of America and Canada were analyzed between the period 1985 and 2005, along with GDP growth of these countries, and are presented in the Table 1.05,1.07and 1.09, and in the Figure 1.10, 1.12 and1.14. It has been observed that the per capita energy consumption among these countries are changed quiet high, during these two decades and correspondingly the Energy/GDP ratio has also changed. During this period, further it has been observed that the per capita energy consumption in Kuwait had increased almost double in size between the same period, the per capita energy consumption is the highest in the world and GDP growth is also highest in the world among the selected developed countries. Similarly the per capita energy consumption of selected developing countries, which includes India, Indonesia, Egypt, Colombia, China, Brazil, Algeria, Mexico, Malaysia and South Africa were studied along with GDP growth of these countries between the period 1985 and 2005, and are presented in the Table 1.06, 1.08 and 1.10 and in the Figure 1.11, 1.13 and 1.15. These tables and figures illustrate that the per capita energy consumption in India among the studied countries is the least between 1985 and 2005, which establishes that there is a strong linkage between energy consumption and GDP growth in the country. The per capita energy consumption in Kuwait was 10333.49 kg in the year 2005, and its GDP growth is 1279X10^-10, where as in India, per capita consumption of energy is 330 kg per annum in the same period and its GDP growth was 4X10^-10.

1.5 WASTE MANAGEMENT

Waste management in the urban system is one of the most important parameters, and also it is a serious problem, which requires huge amount of money in almost all the developed and developing countries. The urban systems of the developing countries are already suffering from lack of financial resources for provision of urban amenities to the community. In these circumstances, waste management gives pressure to the administrators pertains to financial requirement and other material requirement for undertaking this task. Most of the urban systems of the developing countries suffers not only due to financial crunches, but also suffers from identification of landfill sites for dumping these wastes. In the developing countries, the

cities are growing much faster physically; as a result, the city administrators are forced to find out the landfill site far away from the city, which needs more and more amount of financial resource and material resources to dispose the waste. In these circumstances, the city administrators never make attempt to clean the entire city, but clean the city partially, as consequence, the cities in developing countries turn in to dirty cities, polluted cities and further which lead to total environmental deterioration. Efficient solid waste management system is very much essential for the development of the urban system of the developing countries, constructively. The unattended solid waste in the urban system accumulates in the urban system leads to air pollution and land pollution. During the monsoon season, the unattended and accumulated solid wastes in the urban system mingled with rain water, clock the drainage, which result in to water stagnation in the urban system. This water stagnation in the urban system, during the monsoon season, responsible for spreading deceases in the urban system. Further it also gives pressure to the city administrators to clear the drainage; otherwise, entire urban system's environment will be totally deteriorated, which will lead to adverse effects in the urban system.

The per capita waste generation in the developed countries is quite high compared to the developing and under developed countries. The per capita waste generation is positively correlate with the per capita GNP of the country. It has been observed that the per capita waste generation per day is 2 kg in United States of America, where as it is 0.50 kg per capita per day in a developing country like Bangladesh and it is 0.30 kg in Bhutan. The per capita waste generation and total waste generation in OECD countries are presented in Table 1.11. This table reveals that the people in the United States of America generate more quantity of waste among the OECD countries, i.e., 2kg per capita per day, followed by Australia 1.89 kg per capita per day, and it is 0.85 kg per capita per day in Greece, which account for the least per capita waste generated country among the OECD countries. This reveals that the country which has more economic strength generate more quantity of waste.

Table no. 1.11: OECD Municipal Solid Waste Generation Rates.

Country	Year	MSW Generation Rate[1]	Population[2]	Total Waste
		kg/capita/day		tonnes/day
USA	1992	2	263.1	526,200
Australia	1992	1.89	18.1	34,209
Canada	1992	1.8	29.6	53,280
Finland	1990	1.7	5.1	8,670
Iceland	1992	1.53	0.3*	459
Norway	1992	1.4	4.4	6,160
The Netherlands	1992	1.37	15.5	21,235
France	1992	1.29	58.1	74,949
Denmark	1992	1.26	5.2	6,552
Austria	1990	1.18	8.1	9,558
Japan	1992	1.12	125.2	140,224
Belgium	1992	1.1	10.1	11,110
Switzerland	1992	1.1	7	7,700
Turkey	1992	1.09	61.1	66,599
Hungary	1992	1.07	10.2	10,914
Sweden	1990	1.01	8.8	8,888
Germany	1990	0.99	81.9	81,081
Spain	1992	0.99	39.2	38,808
Italy	1992	0.96	57.2	54,912
Poland	1992	0.93	38.6	35,898
Portugal	1992	0.9	9.9	8,910
Mexico	1992	0.85	91.8	78,030
Greece	1992	0.85	10.5	8,925

Source: OECD, 1995; World Bank, 1997b; United Nations, 1995.

The composition of waste materials in the municipal solid waste generated among the OECD countries gives glaring example in people's day to day usage of materials, people's habits, people's attitudes etc. It is interesting to note that the most developed country, like United States of America consume more quantity of energy in the world by country wise, generate 2kg per capita waste per day has the composition of 23 per cent organic waste, 38 per cent paper waste, 9 per cent plastic waste, 7 per cent glass waste, 8 per cent metal waste and 16 per cent others, where as another OECD country like Turkey generates 64 per cent organic waste, 6 per cent paper waste, 3 per cent plastic waste, 2 per cent glass waste, 1 per cent metal waste and 24 per cent others of the total waste generation. The waste composition of the OECD countries is presented in the Table 1.12. This table clearly explains, not only composition of waste generated by the OECD countries, but also illustrates the economic strength of the OECD countries, indirectly. It has been observed from the literature that the

economically well developed country's peoples consume more quantity of metal and generate more quantity of metal waste, where as the economically less developed country's people use less quantity of metal and also generate less quantity of metal waste in their day to day living. The comparative analysis between United States of America and Turkey among the OECD countries pertains to waste generation and composition of waste generation is the glaring example for the same.

Table no.1.12: OECD Municipal Solid Waste Composition (percentage).

Country	Organic	Paper	Plastic	Glass	Metal	Other
Canada	34	28	11	7	8	13
Mexico	52	14	4	6	3	20
USA	23	38	9	7	8	16
Japan	26	46	9	7	8	12
Australia	50	22	7	9	5	8
Denmark	37	30	7	6	3	17
Finland	32	26	0	6	3	35
France	25	30	10	12	6	17
Greece	49	20	9	5	5	13
Luxembourg	44	20	8	7	3	17
Netherlands	43	27	9	4	5	8
Norway	18	31	6	4	5	36
Portugal	35	23	12	5	3	22
Spain	44	21	11	7	4	13
Switzerland	27	28	15	3	3	24
Turkey	64	6	3	2	1	24
Average	38	26	8	6	5	18

Source: OECD, 1995.

The people from the less developed countries generate lesser quantity of waste compared to their counter parts in the developing and developed countries. The per capita per day waste generation among the least developed countries is presented in the Table.1.13 and this table reveals that peoples from the listed countries in the table generate less than 1 kg waste per capita per day. It is interesting to note that Laos PDR produces slightly more quantity of waste, i.e., 0.75 kg per capita per day, whereas Bhutan is the least, i.e., is 0.30 kg per capita per day among the listed countries. The collection efficiency of waste in these countries is also very less. The waste collection efficiency of these less developed country's capital cities is presented in the Table 1.14 and this table reveals that the cities like Dhaka, Thimphu, Vientiane, Male', Yangon and Katmandu are having the collection efficiency of 50,

72, 25, 40, 55 and 70 per cent respectively. The unattended and accumulated waste in those cities creates adverse effect in the system.

Table no.1.13: Solid waste per capita generated among the least developed countries

Solid Waste per capita generated	
Country	**Solid waste (kg/day)**
Bangladesh	0.50
Bhutan	0.30
Laos PDR	0.75
Maldives	0.66
Myanmar	0.45
Nepal	0.50

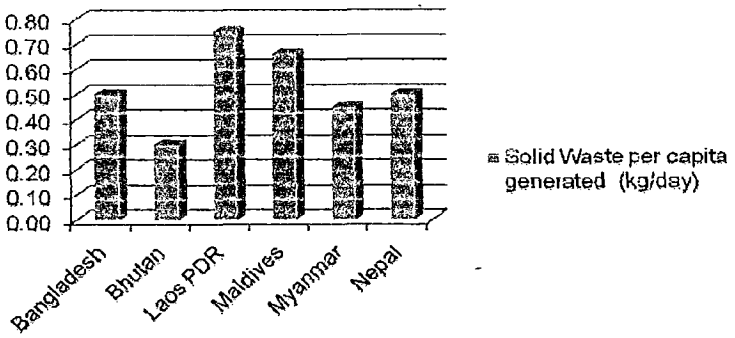
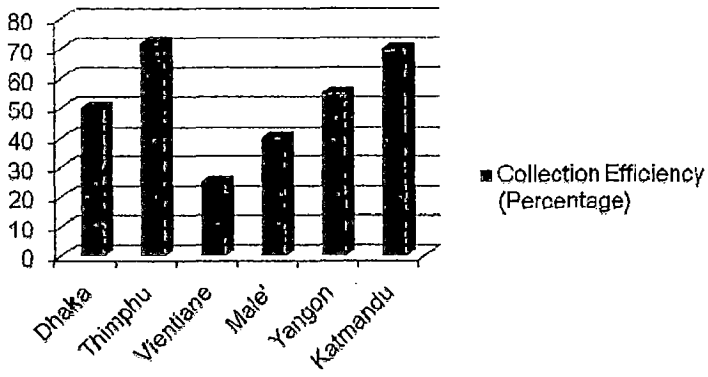


Table no.1.14: Waste collection efficiency among the less developed country's capital

Collection Efficiency	
Country	**Percentage**
Dhaka	50
Thimphu	72
Vientiane	25
Male'	40
Yangon	55
Katmandu	70



The developed countries not only collect the waste, which is generated in their cities but also dispose them in a proper manner and safeguard the interest of the people. The country like the United states of America dispose its generated waste scientifically and it has been observed that about 92 percentage of waste is disposed by sanitary landfill and the rest is recycled, where as in Asian countries more than 50 percentage of the collected waste is disposed by open dump method, which creates absolutely adverse effects in the system. Followed by Africa and Latin America, disposed the collected waste through open dump method by 47 and 34 per cent respectively and are presented in the Table1.15 and in the Figure 1.16.

Table no.1.15: Percentage of waste disposed by various methods among the selected regions of the world

Continent	Percentage of waste disposed by – Various methods					
	Recycling	Sanitary Landfill	Open Dump	Incineration	Open Burning	Others
Africa	3.9	29.3	47	1.4	9.2	8.4
Asia	8.5	30.9	50.9	4.7	1.7	4.5
Europe	10.7	27.6	33	13.8	11.8	4.4
North America	8.1	91.9	0	0	0	0
Latin America	3.2	60.5	34	2	5.5	2

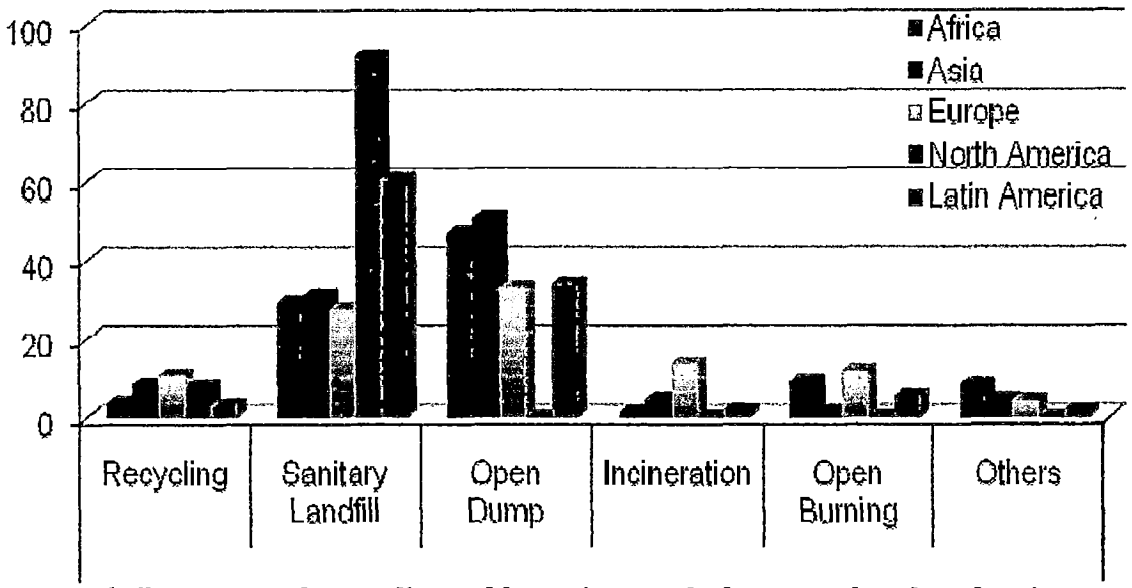


Fig. no.1.16: Percentage of waste disposed by various methods among the selected regions of the world

1.6 INFRSTRUCTURE FACILITIES

1.6.1 Sanitation: Sanitation is one of the most important parameters, which is responsible for human resources development. The developed countries give more emphasis towards sanitation, where as the less developed countries are unable to give much importance in this regard, due to huge finacial crunch and lack of other resources. In the less developed countries, people suffer from ill health and its associated problems,due to lack of sanitation

and also lack of minimum required amount of sanitation system. The United Nation's declared that the year 2008 is " the international year of sanitation". It has brought five key messages, in the international year of sanitation, which includes:

- ❖ Sanitation is vital for human health
- ❖ Sanitation generates economic benefits
- ❖ Sanitation contributes to diginity and social development
- ❖ Sanitation helps the environment
- ❖ Sanitation is achievable

It has been observed that more number of people at the world level, still do not have improved sanitation. The accessability of sanitation coverage is analysed at the world level by region wise and is presented the Table 1.16, 1.17 and 1.18 and in the figure1.17, 1.18 and 1.19 for the year 1990 and 2006 .

Table no.1.16: Proportion of world's population using Sanitation facilities,2006

Sanitation Farcicality	Coverage(%)
Improved	62
Shared	8
Unimproved	12
Open defectation	18

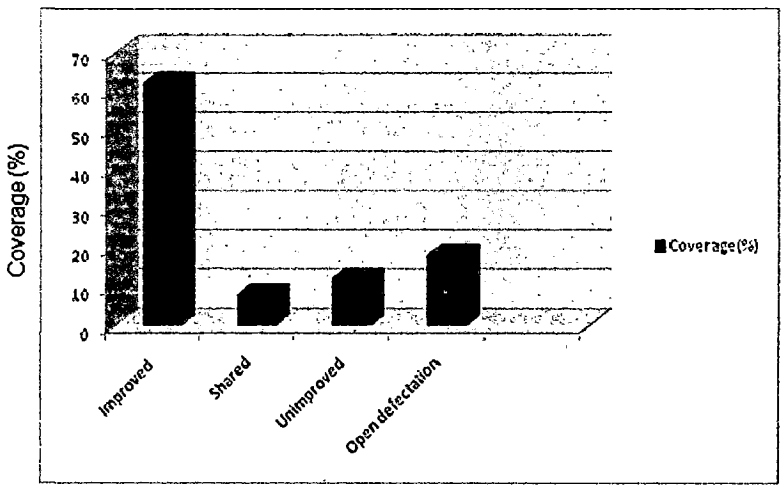


Figure no.1.17: Proportion of world's population using Sanitation facilities, 2006

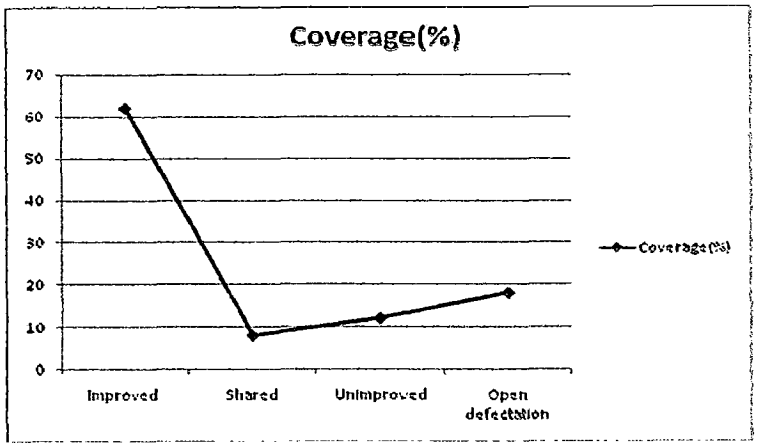


Figure no.1.18: Proportion of world's population using Sanitation facilities, 2006

Table no.1.17: Trends in Sanitation coverage of world regions -1990

Regions	Sanitation Coverage (%)			
	Improved	Shared	Unimproved	Open defectation
Southern Asia	21	6	8	65
Sub-Saharan Africa	26	14	24	36
South eastern Asia	50	5	17	28
Latin Amerina & Caribbian	68	5	10	17
Western Asia	79	4	10	7
Northern Africa	62	5	17	16
Eastern Asia	48	4	44	4
Developing Regions	41	6	22	31
World	54	5	17	24

Table no.1.18: Trends in Sanitation coverage of world regions-2006

Regions	Sanitation Coverage (%)			
	Improved	Shared	Unimproved	Open defectation
Southern Asia	21	6	8	65
Sub-Saharan Africa	26	14	24	36
South eastern Asia	50	5	17	28
Latin Amerina & Caribbian	68	5	10	17
Western Asia	79	4	10	7
Northern Africa	62	5	17	16
Eastern Asia	48	4	44	4
Developing Regions	41	6	22	31
World	54	5	17	24

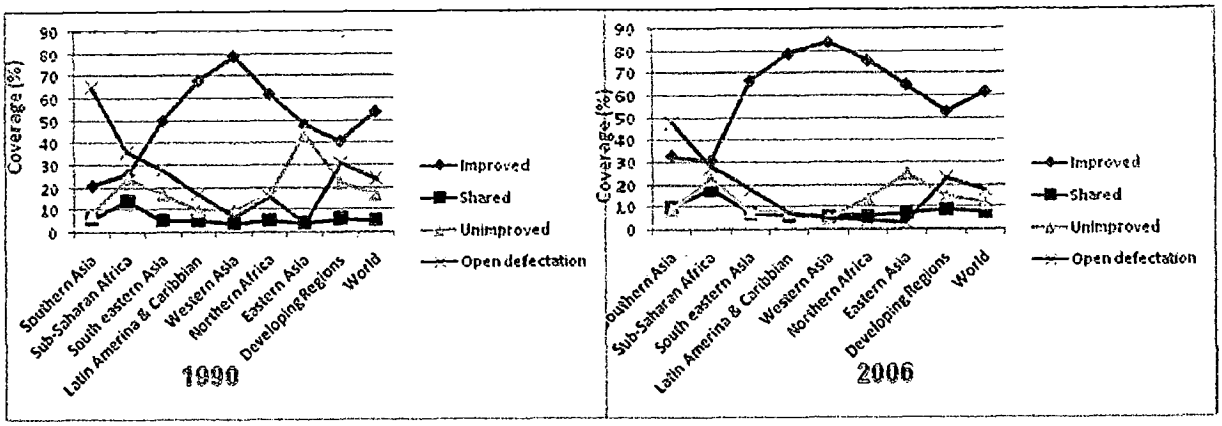


Figure no.1.19: Trends in Sanitation coverage of world regions-1990 and 2006

These tables and figures of year 1990 and 2006, revealed that the developed regions are having more accessbility of improved sanitation, where as the less developed regions do not have much accessability in improved sanitation but they are more prone to open defectation.The comparitive ananlysis between the rear 1990 and 2006 shows that all regions have improved their sanitation facilities and reduced the dependency of open defectation, which shows that even less developed regions are having awareness pertaining to sanitation and started to give more emphasis, in this particular field, as a part of human resources development.

The Investigator further analysed the sanitation coverage in the urban systems by region wise, for the year 2006 and presented in Table 1.19 and figure 1.20. These table and figure explains that the urban system of developed regions has 100 per cent coverage, where as urban system of less developed regions has less than 50 per cent of sanitation coverage, i.e., only 42 per cent. It has been observed from the table that the economically well off regions give more emphasis towards sanitation and less developed regions are also trying for giving much importance towards sanitation, that is why the least developed region also give sanitation coverage of 42 per cent of their population in the urban system.

Table no.1.19: Urban sanitation coverage,2006

Regions	Sanitation coverage (%)
CW of Independent States	94
Western Asia	94
Northern Africa	90
Latin America & Caribbean	86
Oceania	80
South -Eastern Asia	78
Eastern Asia	74
Southern Asia	57
Sub-Saharan Africa	**42**
Developing Regions	71
Developed Regions	**100**
World	79

Source: UNICEF and World Health Organization, 2008

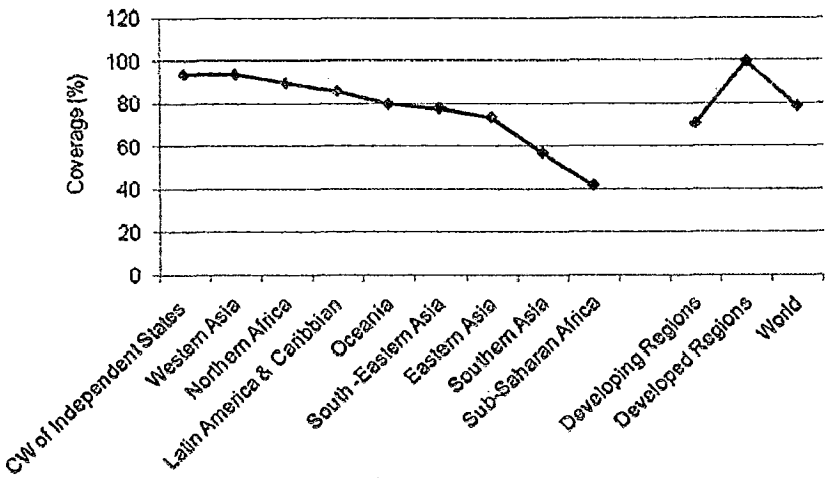


Figure no.1.20: Urban sanitation coverage,2006

1.6.2 Water supply

Water is lifeline that batches and feeds all human beings. Water is key component in determining the quality of human life. Water supply is one of the most important parameters, which is responsible for the survival of human resources in the system. The developed

countries give more emphasis towards drinking water supply, where as the less developed countries are unable to much emphasis in this regard, due to huge finacial crunch. In the less developed countries, people suffer from water borne deseases and it's associated problems,due to lack of water supply, poor quality of drinking waetr supply and lack of minimum required amount of drinking water supply system. The United Nation's categorized the drinking water supply coverage in to three steps, according to their source, supply safety and consumption, which includes:

- Unimproved drinking water sources
- Improved drinking water sources other than piped water supply
- Water piped in to a dwelling, plot or yard.

It has been observed that more number of people at the world level, still do not have piped water on their premises, in the less developed countries. The accessability to water supply coverage is analysed at the world level by region-wise and is presented in the Table 1.20 and 1.21 and in the figure 1.21 and 1.22 for the year 1990 and 2006.

Table no.1.20: Proportion population using a piped water supply connection in 1990

Regions	Piped water on premises	Other improved	Unimproved
CW of Independent States	71	22	7
Latin America & Caribbean	67	17	16
Northern Africa	58	30	12
Western Asia	69	17	14
Eastern Asia	51	17	32
Southern Asia	20	54	26
South-eastern Asia	16	57	27
Sub-Saharan Africa	16	33	51
Developing Regions	36	35	29
Developed Regions	91	7	2
World	48	29	23

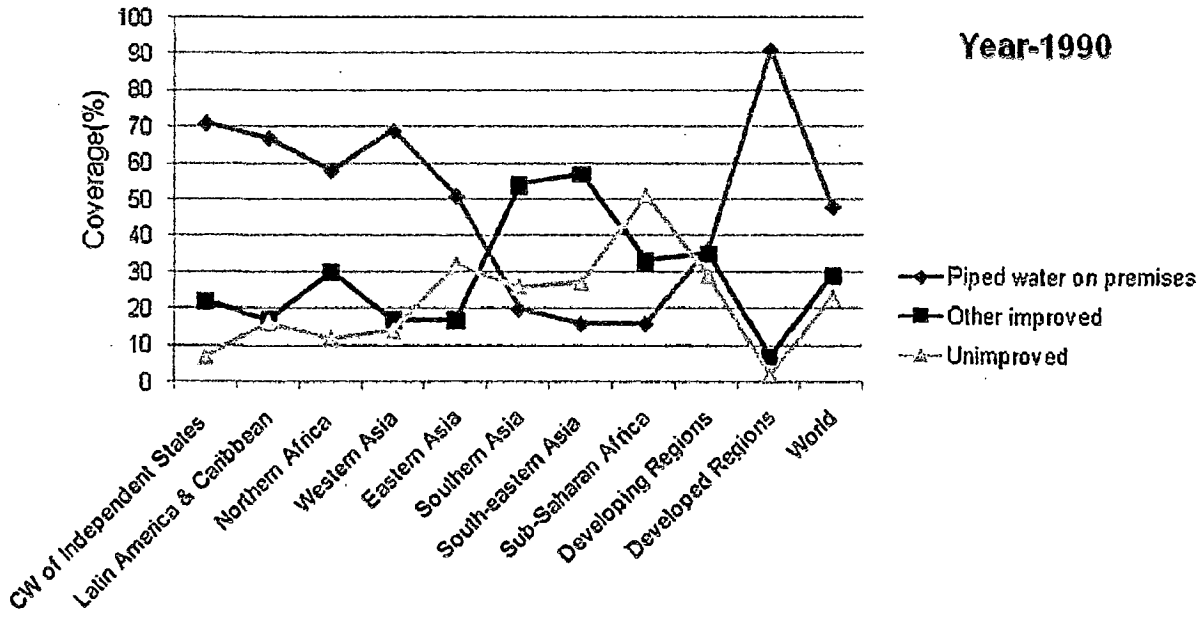


Figure no. 1.21: Proportion population using a piped water supply connection in 1990

Table no.1.21: Proportion population using a piped water supply connection in 2006

Regions	Piped water on premises	Other improved	Unimproved
CW of Independent States	73	21	6
Latin America & Caribbean	80	12	8
Northern Africa	78	14	8
Western Asia	80	10	10
Eastern Asia	73	15	12
Southern Asia	22	65	13
South-eastern Asia	32	54	14
Sub-Saharan Africa	16	42	42
Developing Regions	46	38	16
Developed Regions	93	6	1
World	54	33	13

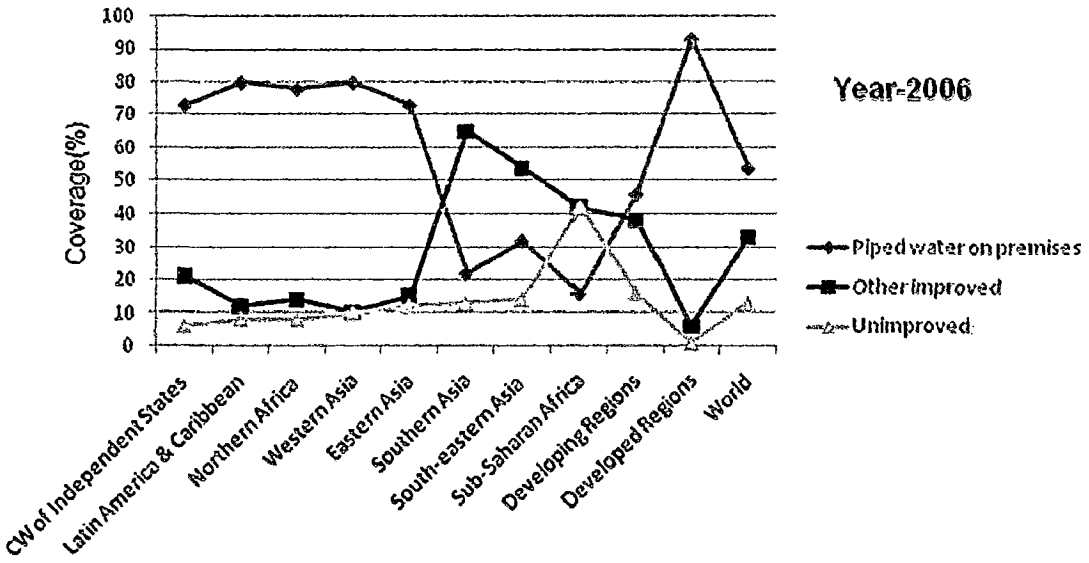


Figure no.1.22: Proportion population using a piped water supply connection in 2006

These tables and figures for the year 1990 and 2006, revealed that the developed regions are having more accessbility of piped water supply system, where as the less developed regions do not have much accessability in piped water supply system but they are more prone to other improved system.The comparitive ananlysis between the year 1990 and the year 2006 shows that all regions have improved their piped water supply facilities and reduced the dependency of other improved system, which shows that even the less developed regions are making attempt to provide safe drinking water supply and started to give more emphasis, in this particular field.The author further analysed the water supplycoverage in the urban systems of the region, for the year 2006 and presented in the Table1.22 and in the Figure 1.23. These table and figure explains that the urban system of developed regions has 100 per cent coverage, where as urban system of less developed regions has less than 50 per cent of water supply coverage, i.e., only 46 per cent. It has been observed from the table that the economically well off regions give more emphasis towards provision of drinking water supply and less developed regions also making an attempts for giving importance for safe drinking water supply, which resulted in to the least developed regions provide water supply coverage of 46 per cent of their population in the urban system.

Table no.1.22: Urban water supply coverage,2006

Region	Urban water supply coverage (%)
CW of Independent States	99
Eastern Asia	98
Latin America & Caribbean	97
Northern Africa	96
Western Asia	95
Southern Asia	95
South-eastern Asia	92
Oceania	91
Sub-Saharan Africa	**46**
Developing Regions	94
Developed Regions	**100**
World	**78**

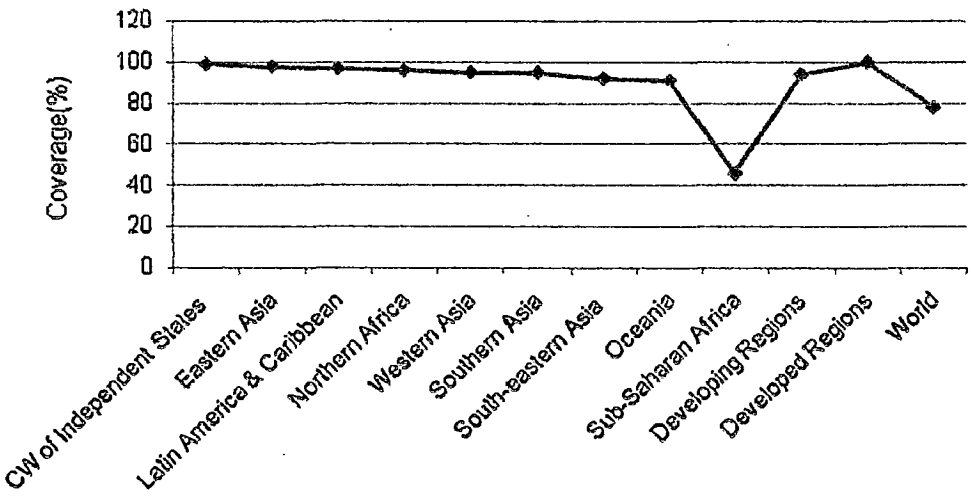


Figure no.1.23: Urban piped water supply coverage by region, 2006

1.7 ENVIRONMENTAL AND ASSOCIATED PROBLEMS

Man and his environment function through a mechanism of natural adjustment. If the forces are competitive, there will set in degradation and destruction; if complementary, human life will be enriched and the quality of life enhanced. Economic development does call for redistribution of populations and resettlement through continuous flows of migration which after results in demand for better infrastructure. Urbanization leads to heavier population concentrations which strain the physical and economic capacity of the geographical area beyond limits. It also may generate social tensions, rivalries and unrest in destination points. Development of infrastructure and migration are mutually and reversibly related as cause and effect and the environment is related independently to both – both as a cause and a consequence.

Indian cities today are the nodes of economic growth resource, mobilization and consumption. However, the sustainability of Indian cities is hampered by several factors, such as, inadequacy of the capital stock (land, water supply, mass transport, energy and housing), poverty and environment deterioration. Torrents of migrants, refugees and unemployed from the countryside inundate the cities. Unprecedented urbanization is posing the challenge of building in a decade equal to what was built in a hundred years. Slums and shanty towns, squatters and pavement dwellers are growing at twice the rate of planned housing. Per capita consumption of land and built space (including housing), water, power and the generation of wastes are all increasing at an alarming rate, when compared to population growth. As a result, the cities in India face the problems of overcrowding, sanitation and pollution and acute shortages of water, power, housing, transport, open space and public facilities.

India is undergoing rapid urbanization like the trend in world-wide. This means not only that more people than ever before will be living and working in cities, but also that more people and more goods will be making more trips in the urban areas, often over longer distances. Transport is a crucial infrastructure for development, and hence vehicular growth closely follows the trend of urbanization. The link between population and the number of vehicles observed in Indian cities that is likely to have far-reaching consequences for urban planning. Indian cities face a transport crisis characterized by levels of congestion, noise,

pollution, traffic fatalities and injuries, and inequity far exceeding those in most European and North American cities. India's transport crisis has been exacerbated by the extremely rapid growth of India's largest cities in a context of low incomes, limited and outdated transport infrastructure, rampant suburban sprawl, sharply rising motor vehicle ownership and use, deteriorating bus services, a wide range of motorized and non-motorized transport modes sharing roadways, and inadequate as well as uncoordinated land use and transport planning. Overall population growth and increasing urbanization have led to rapid growth of large cities, which have been overwhelmed by the sudden jump in travel demand. The supply of transport infrastructure and services, by comparison, has lagged far behind the demand. Most transport facilities are used far beyond their design capacity. Moreover, facilities for pedestrians and cyclists are virtually non-existent in most cities, thus forcing them to share crowded rights of way with rapidly moving motor vehicles.

India is an agricultural based country with a present population of approximately 1020 million (Union Health Ministry, 2004). There are 28 states and seven union territories in the country. The urban population is increasing rapidly, due to industrial growth. As a result, the 677 available Class I cities and Class II towns in 1991 have increased to more than 700 by 2001(CPCB, 2002). The quantity of Municipal solid waste generation had increased tremendously with improved life style and social status of the populations in urban centers. The annual waste generation has been observed to increase in proportion to the rise in population and urbanization, and issues related to waste disposal led to great challenge to the city administrators, as more land is needed for the ultimate disposal of solid wastes.

It is important to focus on certain disconcerting features of India's urban experience in order to highlight the implications of this growth in terms of sustainability. For instance, there are large imbalances and disparities in the spatial patterns of urbanization as measured by inter-regional and size–class distribution. The western states of Maharashtra, Goa, and Gujarat are having about 40 per cent urban; the eastern states of Orissa and Bihar are lagging far behind at 13 per cent. This has been both a cause and a consequence of inter-regional migration. The imbalance in size–class distribution is another factor contributing to the abnormal growth of bigger cities, while many of these are on the verge of collapse, many smaller cities lack adequate impetus for growth. Intra-city migration from smaller to bigger

cities is continuing along with the migration from rural to urban areas. The government's Integrated Development of Small and Medium Towns (IDSMT) scheme has not been able to reverse this trend. The different class of Indian cities based on the size of population is presented in the Table1.23. This table clearly indicates the growth pattern of cities in India.

Table no.1.23: Classes of Indian cities by size of population

Sl .no	year	Types of Cities\ Population						
		Class I 100,000 +	Class II 50,000-99,000	Class III 20,000-49,999	Class IV 10,000-19,999	Class V 5000-9999	Class VI Less than 5000	All classes
1	1951	27.5 million [44.60%]	6.1 million [10%]	9.7 million [15.7%]	8.4 million [13.6%]	8 million [13%]	1.9million [3.1%]	61.6million [100%]
2	1991	139.1 million [65.2%]	23.4 million [11%]	28.1 million [13.1%]	16.6 million [7.8%]	5.5 million [2.60%]	0.6million [0.3%]	213.3 million [100%]

Source : Census of India [1991].

The unplanned and uncontrolled growth of large cities has had negative effects on urban dwellers and their environment. The provision of infrastructure and services required for large and concentrated populations lags far behind the pace of urbanization. Consequently, the urban environment, particularly in large cities, is deteriorating rapidly. Cities and towns are facing serious shortages of power, water, sewerage, developed land, housing, transportation, communication, and other kind of basic infrastructure facilities.

"Urban governance is the sum of the many ways individuals and institutions, public and private, plan and manage the common affairs of the city. It is a continuing process through which conflicting or diverse interests may be accommodated and cooperative action can be taken. It includes formal institutions as well as informal arrangements and the social capital of citizens." UN-Habitat (2006).One interesting and particularly relevant element of this definition is that it acknowledges the existence of "conflicting or diverse interests" and puts the process of "accommodating" them at the core of urban governance. The normative agenda of good governance of international organizations like UN-Habitat is likely to remain utopian, without addressing the question of power, especially in a developing country like India, where strong inequalities prevail.

1.8 STUDY AREA PROBLEMS

The Puducherry region has been facing few problems like other State Capital of India and Indian cities, they are:

1.8.1 Impact on urban services

Urban services such as solid waste management, traffic and transport, and drainage facilities are not commensurate with the growing urban population. The deterioration of urban services in turn degrades the quality of the urban environment. Industries have also come up without proper systems for treatment and disposal of wastes, contributing to pollution of air, water and land.

1.8.2 Inadequate housing and slums

Migration from the surrounding rural areas both in Pondicherry and Tamil Nadu leads to urban congestion. Since the poor cannot afford good housing, slums tend to proliferate. Services in slums are even worse than that of the general population.

1.8.3 Urban governance

Puducherry region has special problems because some local services are provided by the Union Territory Government rather than the local bodies. Therefore it is necessary to delegate these functions to the local bodies and this point is also stressed by the 74th Constitutional Amendment Act. Property taxes and other local taxes / user charges would also have to be levied to ensure that the local bodies are financially sustainable and can carry out the functions delegated to them.

1.8.4 Solid Waste Management

The rapid growth of the Pondicherry region has resulted in increase in the generation of wastes both solid and liquid. Solid wastes generation consists of household garbage, industrial / commercial solid wastes, construction debris, and biomedical / hospital wastes and these wastes are not properly disposed; the quality of the environment is degraded.

1.8.5 Sewage and wastewater

The amount of sewage generated in Pondicherry is so great and an irrigation canal has been converted in to major sewer, and the local urban tanks and ponds are severely polluted. It has been observed that there is 30 per cent of the Pondicherry municipal area remains unsewered. The efficiency of the existing treatment plant is not satisfactory. Most of the sewage reaches the sea without treatment, affecting the coastal ecosystem. Stagnation of sewage and drainage has led to severe mosquito problems in Pondicherry. Drains, cess pits, and septic tanks are major locations for the breeding of mosquitoes. An integrated underground sewerage system is needed for the Pondicherry region.

1.8.6 Industrial Pollution

Rapid industrial growth has taken place during the nineties in Puducherry. The Union Territory has 57 large, 156 medium, and 6388 small-scale units. Most of these units are located in the Pondicherry region and particularly in four industrial estates. Since the estates are proximate to residential areas, pollution from these estates affects the quality of the environment in the surrounding region. Industrial pollution from these estates and other locations has begun to affect the quality of the air, water, and land which led to affect the quality of life in the surrounding region. The disposal of toxic wastes is also a matter of concern, following the surreptitious dumping of toxic wastes in Ousteri tank in 1993, which is one of the basic water resources of Puducherry region. Location of toxic waste industries needs to be surveyed and monitored to ensure that these wastes are disposed in an environmentally sound manner.

1.8.7 Roads, Traffic and Transport

At present 2,398 km of roads are maintained by the PWD, Municipalities and Commune Panchayats, of which 1,970 km (82.15 per cent) are surfaced and 428 km (17.85 per cent) are un surfaced. Rural roads in the Commune Panchayats account for nearly 50 per cent of the road length in the Union Territory. The quality of roads has deteriorated significantly in the recent past, becoming a hindering factor for further growth. The focus has to be, therefore, on overcoming existing deficiencies and improving the quality rather than extending the road network. The road and motor density of selected States and Union Territories are presented in the Table 24. It has been observed from this table that the road

density and motor vehicle density of Puducherry much less than in Delhi or Chandigarh, but higher than in Tamil Nadu or the all India average.Ambient air quality levels are deteriorating on account of the high density of vehicles, particularly two wheelers. Diesel driven vehicles and tempos are a major source of pollution. Licenses for new tempos have been stopped. Narrow roads and heavy increase in the two-wheeler population make it difficult for buses to ply through all the routes. The congested bus routes are also the cause for traffic accidents.

Table no.1.24: Road and motor vehicle density in Puducherry

Sl.No.	Union Territory/States	Road density Km/000 Sq.Km	Motor vehicle density per Sq.Km
1	Delhi	17,961	2017.50
2	Goa	2,314	71.60
3	Chandigarh	15,936	3948.90
4	**Pondicherry**	**4,908**	**259.10**
5	Tamil Nadu	1,588	27.52
6	**All India**	**750**	**12.31**

Source: CMIE, 2001

1.9 AIM OF STUDY: The study aims at:

"To evolve an Integrated Development Plan for Puducherry region with a view to narrow down the haphazard growth and to regulate/control the ongoing unplanned development of the region" To fulfill this aim, few important objectives are framed.

1.10 OBJECTIVE

The following objectives are framed to carry out the investigation. They are:

- To assess the existing conditions of the region, pertaining to all the subsystems of the system.
- To identify the control parameters that decides the functions of the system.
- To forecast the demand and supply of infrastructure requirement in 2031 A.D. for the development of the system.
- To evolve a set of policy guidelines for integrated development of Puducherry region.

1.11 SCOPE AND LIMITATION OF STUDY

The present investigation aims at to evolve an Integrated Development Plan for the development of Puducherry region, by considering the control parameters that are which decide the functions of the system. Theoretical functions of the urban systems would be studied properly to arrive at plausible policies for the development of the system. Finally a set of policy guidelines would be evolved and would be recommended for the development of the system. The investigator hopes that if the recommended policies are implemented in time, an integrated development would be anticipated in the city.

1.12 CONCEPT

In this present investigation, systems concept is employed. A system functions as a whole with the interaction of several sub systems. All the subsystems of the system are interlinked and interdependent on each other, and function as a whole. If one of the sub-systems of the system, functions with advancement,(takes lead role) or defunct its effects can be observed in the whole system. In this present investigation Puducherry region has been considered as system. Therefore, system concept is employed in this present investigation to assess the functions of the system, to evolve a set of plausible policy guidelines for integrated development of the region.

1.13 RESEARCH METHODOLOGY:

The research methodology, which is going to be followed in this investigation, is presented in Figure 24, and the methodology which would be used for data analysis is presented in Figure 25.

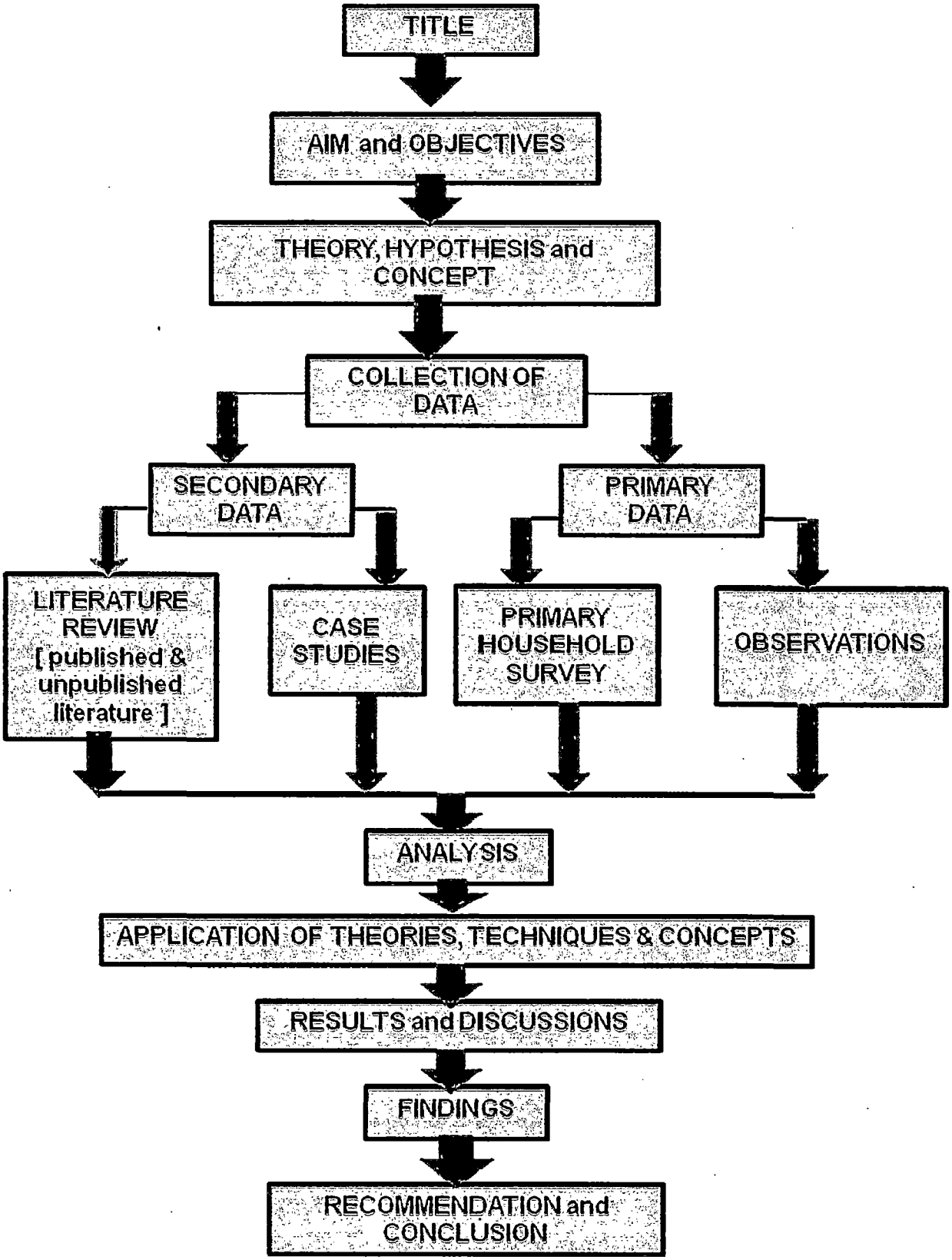


Figure no.24: Research Methodology

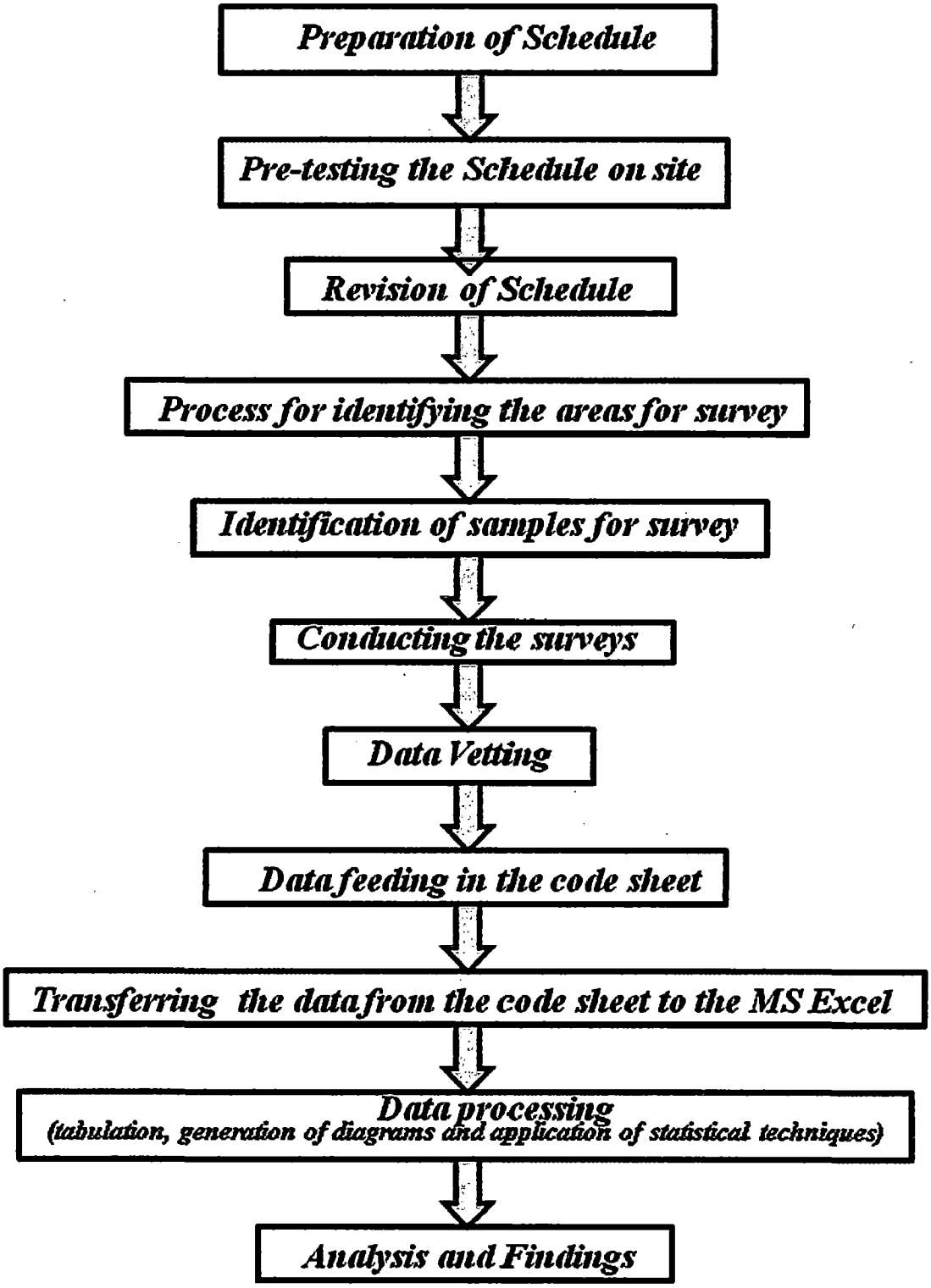


Figure no.25: Methodology of primary survey and analysis

Survey research methods have been employed in this present investigation. Secondary and primary sources of data pertaining to this present investigation are collected and employed.

1.14 SIGNIFICANCE OF THE PRIMARY DATA

Most of the secondary data was made available to the Investigator at the time of the investigation (2010) for the district based Census-2001. However, part of data, which is documented year-wise by the concerned agencies / departments and are compiled over a period of several years of publications. The secondary source of data have a set of data, which is commonly available, whereas certain data have more bearing at the micro level are not available in any form of secondary sources of data. Data pertaining to spatial qualities, environmental condition of the households, priorities of the households, details related garbage; drainage, income, expenditure and savings, accessibility to infrastructure services, household facilities, household appliances etc., at the micro level are not available in any form of secondary data. These data are also essential along with the available secondary sources of data to understand the functions of the system. Therefore, an extensive primary survey was attempted by using pre-tested household schedules in this investigation. This study was conducted in the current year 2010, which is considered as the base year for this study.

1.15 NEED FOR THE PRIMARY SURVEY

Integrated development plan aims at total development of the system, which requires in-depth understanding of various activities that prevail in the system, quantification resources and their potentialities, issues, etc., Primary survey is most popular device for obtaining desired data to understand the characteristic features in relations to landform, spatial, seasonal resources, population density, socio-economic activities, infrastructure facilities etc., pertaining to the study area. Development of the region is depending on changing several spatial and socio-economic factors. Therefore, the Investigator has decided to collect detailed investigation at the household level in the study area. The household survey brought lot of imminent to understand the system, the factors that influence the functions of the system pertaining to availability and consumption of natural and artificial resources, ecology, environment, etc.,

1.16 SURVEY TOOLS

Appropriate survey tool, such as pre-tested schedule is employed in the present investigation.

1.16.1 Household schedule

Household schedule is the most important one, which is used for conducting survey at the grassroots level. This schedule has several variables related to socio-economic and environmental quality of the households in the study area. Details, such as family size, Number of employed persons, Education, Number of technically qualified person, family income, housing detail, Details of household income and expenditure, Details of water supply, electricity, drainage /sewerage, waste disposal. Details of agriculture such as cropping pattern, irrigation, livestock, rural transportation etc., were included in this schedule. The household schedule used for this investigation is presented in Appendix.

1.17 ANALYTICAL TOOLS AND TECHNIQUES

1.17.1 Analytical Tools

Relevant analytical tools, such as code sheets and software (SPSS and EXCELL) were used in this investigation for data processing and analysis.

1.17.2 Analytical Techniques

Relevant Statistical techniques have been employed for doing tabulation in this present investigation.

1.18 CHAPTER SCHEME

Chapter one: Chapter one consists of introduction, statement of the problem, objectives, concepts, scope, and research methods.

Chapter two: Chapter two describes the case studies and review of literature pertaining to the research area.

Chapter three: Chapter three deals with study area profile (Puducherry region).

Chapter Four: Chapter four deals with the analysis of physical, socio-economic, infrastructure, environmental conditions and agriculture and allied activities of the study area. This chapter illustrates the dynamic functions of the study area.

Chapter five: Chapter five deals with application of statistical techniques employed for this present investigation, to forecast the demand and supply of infrastructure in the system.

Chapter Six: Chapter six describes the application of concepts and theories for this investigation.

Chapter seven: Chapter seven deals with results, discussions and findings

Chapter eight: Chapter eight concentrates on evolving planning policies, recommendation and conclusion.

Chapter-02

CASE STUDY AND LITERATURE REVIEW

2.1 CASE STUDY- 1

"PLANNING FOR INTEGRETED DEVELOPMENT OF THIRUVANANTHAPURAM CITY, INDIA", by Mr. SALIM. A (Ph.D. Thesis, 2004)

2.1.1 INTRODUCTION

The world is marching forward towards urbanization and about 50.00 per cent of the world population is living in the urban system. The investigator pointed out that the percentage of migration from the rural segment to the urban segment is increasing at an exorbitant rate for searching employment opportunities, and also for using the available other infrastructure services. As a consequence, the rate of increase in migration which gives negative impact over existing infrastructure services and ultimately bring down the available infrastructure facilities in the cities, which includes, housing, sanitation, drinking water supply, sewerage, drainage, power distribution, transportation, garbage collection and disposal, etc., and generate a demand of these services in the system. Almost all the cities in developed countries, developing countries and underdeveloped countries are being affected severely by these problem and greater task for the city administrators / planners for resolving solution to cater these infrastructure services. Further, it is observed that these problems are aggravating every year and even hopeless to solve these problems in near future. The right choice for handling these problems are promoting the strong economic growth and development, in the system.

The investigator explained the growth and development with few distinguished authors definitions. i.e., According to Schumpeter "Development is a discontinuous and spontaneous change in the stationery state which forever alter and displaces the equilibrium state, previously existing". Whereas growth is gradual and steady change in the long run which comes about by a gradual increase in the rate of savings and population (Schumpeter-1934) According to Friedman "Development is an innovative process leading to the structural

transformation of social system, whereas growth as an expansion of the system in one or more dimensions without any change in its structure. According to Kindle Berger, "Economic growth means more output, while economic development implies both more output and change in technical and institutional arrangements by which it is produced and distributed. Growth may involve not only more output derived from greater amounts of inputs but also greater efficiency, i.e., an increase in output by per unit of input. The aforesaid definitions of growth and development clearly explain that the growth leads to development, and for having growth strong input is very much essential. The investigator has made an attempt to understand the inputs, which decides the functions of the urban system leading to integrated development.

2.1.2 Objectives:

The following objectives were framed for the investigation. They are:

1. To assess the existing physical, socio-economic, and environmental conditions of the study area [urban system].
2. To assess the quantity and quality of infrastructure facilities available in the system.
3. To identify the control parameters, which decide the functions of the system in connection with physical, socio-economic, infrastructure and environmental condition of the system.
4. To study the functions of the systems in different alternative physical, socio-economic, infrastructure and environmental conditions.
5. To forecast the demand and supply of infrastructure facilities for 2031 A.D.
6. To evolve a set of policy guidelines, and to prepare a feasible integrated development plan for the development of the Thiruvananthapuram city.

2.1.3 Scope of the study:

The study area has been facing multidimensional problems in almost all aspects, such as, physical, socio-economic, infrastructure and environment. The investigator hopes that if the recommendations of the investigation are implemented systematically in time in the study area; steady integrated development can be anticipated in the system, definitely.

2.1.4 Concept:

The investigator employed the system concept. A system functions as a whole with the interaction of several sub systems. All the subsystems of the system are interlinked and interdependent on each other, and function as a whole. If one of the sub-systems of the system, functions with advancement, [take a lead role] or defunct its effects can be observed in the whole system. The investigator considered the Thiruvananthapuram city as a system. Therefore, system concept is employed in the investigation to assess the functions of the system at different alternative conditions to evolve a set of plausible policy guidelines for integrated development of the city.

2.1.5 Research Design:

Survey research methods have been employed in the investigation.

Data: Secondary and primary sources of data pertaining to the investigation were collected and employed. The methodology followed to conduct the investigation is presented in Figure 2.01.

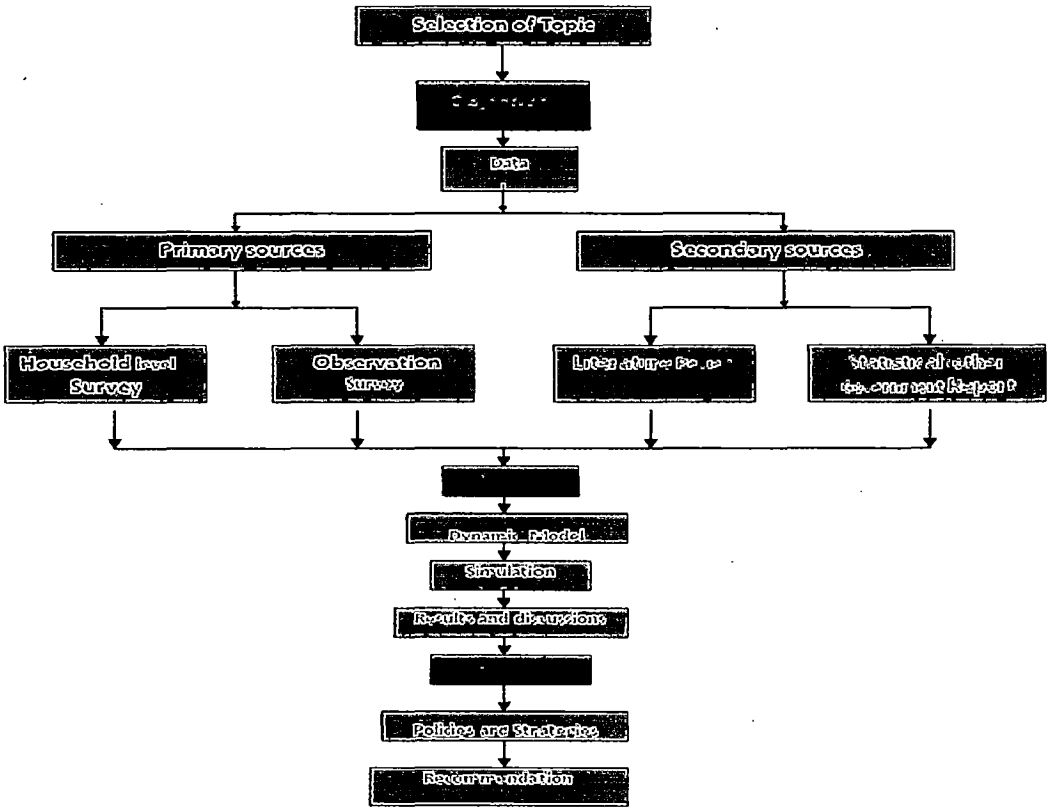


Figure no. 2.01 Methodology

Significance of the Primary Data:

The secondary data have a set of data, which is commonly available, whereas certain data have more bearing at the micro level are not available in any form of secondary sources of data. Data pertaining to spatial qualities, environmental condition of the households, priorities of the households, details related garbage and drainage, income, expenditure and savings, accessibility to infrastructure services, household facilities, household appliances etc., at the micro level are not available in any form of secondary data. Therefore, an extensive primary survey was carried out by the investigated by using pre-tested household schedules in this investigation.

Need for the Primary Survey:

Integrated Development Plan aims at total development of the system, which requires in- depth understanding of various activities that prevail in the system, quantification of available resources and their potentialities, issues, etc., The investigator observed and pointed out that the availability of resources vary from one area to another, season to season, household to household and so on. Therefore the investigator forced to collect detailed investigation at the household level in all the regions of Thiruvanthapuram city. The household survey brought lot of insight to understand the system, the factors that influence the functions of the system pertaining to availability and consumption of natural and artificial resources, ecology, environment etc.

Sampling Design:

The investigator chose the Thiruvananthapuram district, which is Southern most district of the Kerala State where the capital city of the state is confined. The block wise map of Thiruvananthapuram district is presented below in Figure 2.02.

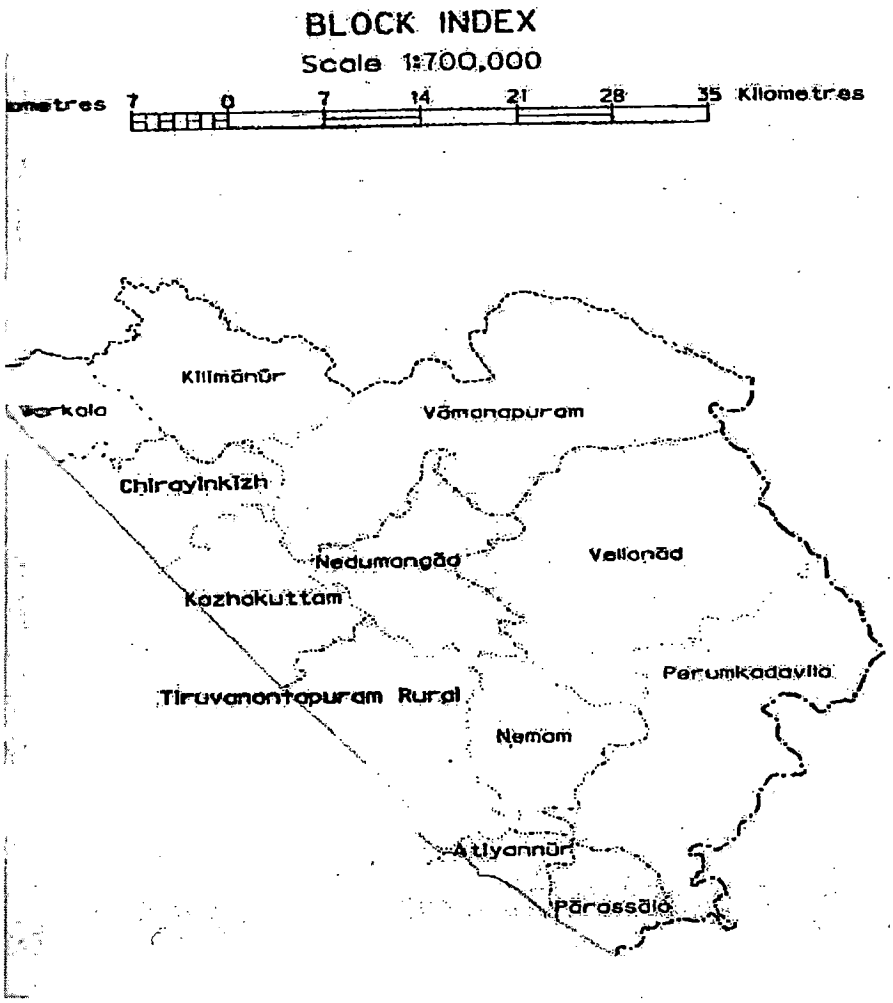


Figure no. 2.02: Block wise map of Thiruvananthapuram District

Selection of Sample households

The investigator selected total number of 260 households, based on the availability of households varying from 20 to 25 households in a community Development block by using systematic random sampling method. The sample size was chosen by having formula k=N/n, Where N and n represent the total number of households and sample size, respectively.

2.1.6 Survey Tools:

Appropriate survey tools, such as pre-tested schedule, questionnaires, etc., are employed by the investigator.

Schedule

The investigator employed three schedules, such as, District level, Community Development block level and household level.

District level: This schedule was developed and employed for conducting the survey concerning the development trend of the district. The officials directly involved in development administration at the district level were considered for this survey.

Community Development block level: The Community Development block level schedule was prepared and employed for collecting data based on population, land use pattern, land farm, cropping pattern, resources, availability of infrastructure services, housing, Central and State Governments development schemes and their status, etc.,

Household level: Household schedule is the most important one, which is used for conducting survey at the grassroots level and it has several variables related to socio-economic and environmental quality of the households in the study area.

2.1.7 ANALYTICAL TOOLS AND TECHNIQUES:

Analytical Tools

Relevant analytical tools, such as code sheets and software [SPSS and EXCELL] were used by the investigator for data processing and analysis.

Analytical Techniques

Relevant statistical techniques have been employed by the investigator for doing tabulation.

Modeling

Urban System dynamic model was developed and employed by the investigator to understand the dynamic functions of the system. STELLA software is employed to develop the urban system dynamic model.

Forecasting

STELLA software is also used for forecasting the demand and supply of certain important control parameters, which decide the functions of the system, such as population, housing, health, power and education are used in the model.

Simulation

Alternative plausible scenarios have been developed based on historical development, trend analysis, assumptions, etc. and the same have been tested in the model for arriving at different alternative decision by the investigator.

2.1.8 STUDY AREA PROFILE

Thiruvananthapuram city is the Capital city of the Kerala State and as well as the Headquarters of the Thiruvananthapuram District. The total area of the city is 142sq.km, which is not reflecting the actual area confined in this city, and is presented in Figure 2.03.

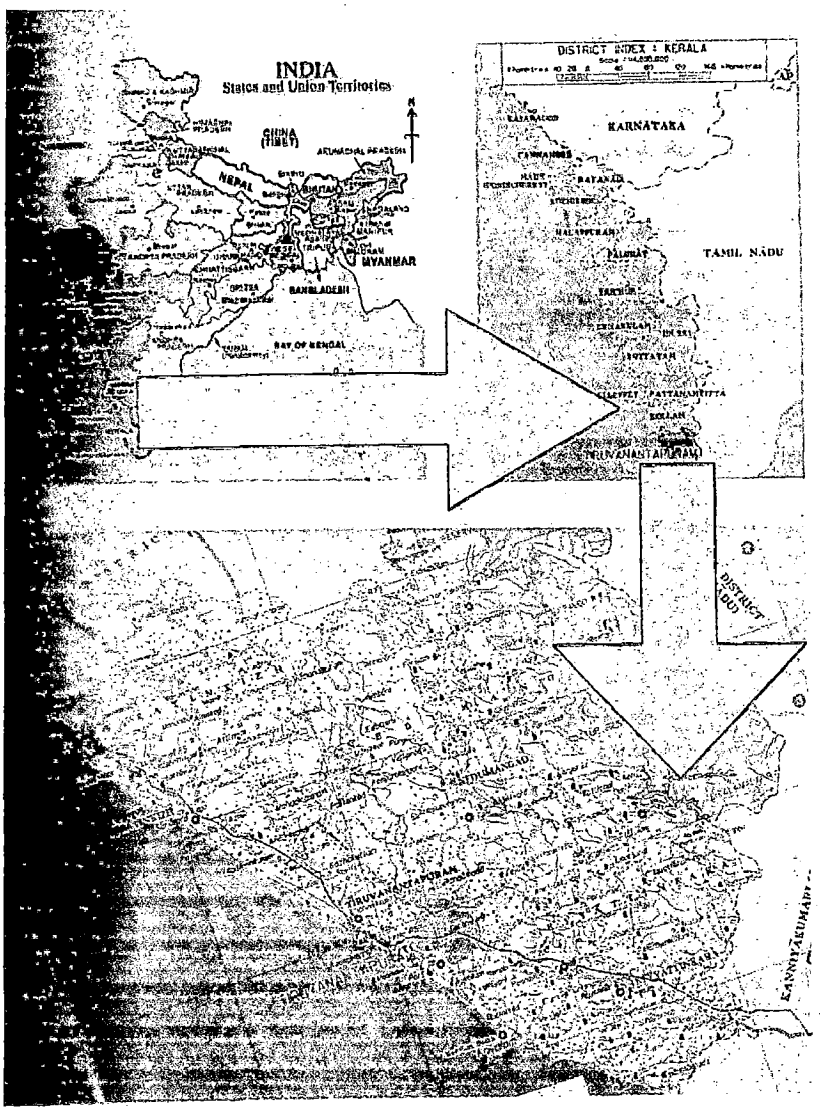


Figure no.2.03: Location of Thiuvananthapuram District

2.1.9 URBANIZATION IN THIRUVANANTHAPURAM CITY

The investigator considered the following control parameters, such as area, population, population density, area under crop, literacy rate, housing stock, water supply system, water consumption pattern, access to electricity and sanitation, transpiration, expenditure on education, occupational structure, per capita income etc., for analyzing the growth of the city.

2.1.10 DYNAMIC FUNCTIONS OF THE STUDY AREA

The following major variables considered by the investigator to understand the dynamic function. To analyze the data household income has been considered as the dependent variables and other variables are considered as independent variables.1) Household size, 2) Female and male members in the household, 3) Educational status, 4).Child population, 5).Employment 6) Residency status, 7).Tenure status of residence,8).Possession of residence, 9) Quality of residential site, 10).Access to residence, 11). Quality of access to residence, 12) Type of dwelling units, 13) Floors in dwelling units, 14) Habitable rooms in dwelling units, 15) Foundation material, 16) Wall material, 17) Roofing material, 18) Flooring material, 19) Drinking water, 20) Waste water disposal mean, 21) Drainage system,(22)Garbage disposal method, 23) Sewerage disposal, 24) Household facilities available, 25) Vehicle ownership, 26) Expenditure, 27) Savings, 28) Extent of residential land, 29) Priorities, 30) Household income, etc., The investigator himself conducted the survey by using the pre-tested schedules in 260 households at the grassroots level by employing survey research methodology.

2.1.11 APPLICATION OF THEORIES AND MODELS:

The priority of requirements based on the household survey were analyzed by the investigator and presented in Table 2.01.

The weighted index method is used to analyze their order of preference by various income groups. The formula used for weighted index method is X1+X2+X3.....Xn /N, Where X1, X2, X3 are the preference for a particular variable and 'N' the total number of response.

Table no.2.01 Priorities

Sl.No.	Parameter	Order of priorities
1	Education	1
2	Industries	2
3	Agriculture	3
4	Health	4
5	Trade and Commerce	5
6	Tourism	6
7	Fishing and Fish processing	7
8	Housing	8
9	Transport and Communication	9
10	Information Technology	10

Source: Primary Survey, 2003

Urban System Concept

Systems function as a whole with the interaction of several sub system. All the subsystems are interlinked and inter dependent to each other. The dynamic functions of the urban system along with its different subsystems is presented in Figure 2.40

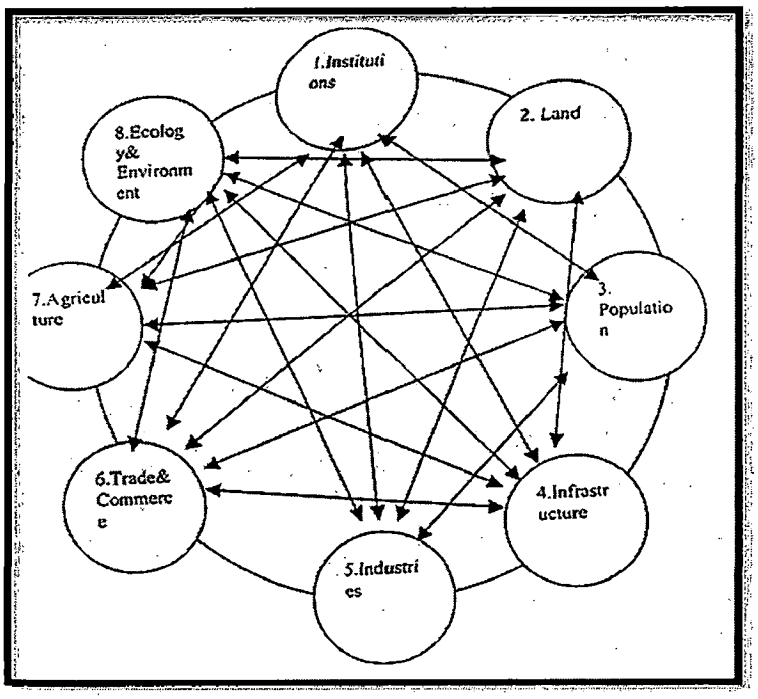


Figure no. 2.04: Functions of an urban system

ılization of the Urban System Model

ː investigator considered the five important sub systems, to undertake detailed ɔn pertaining to the functions of the system, which are, population, housing, health and power and is presented in Figure 2.05.

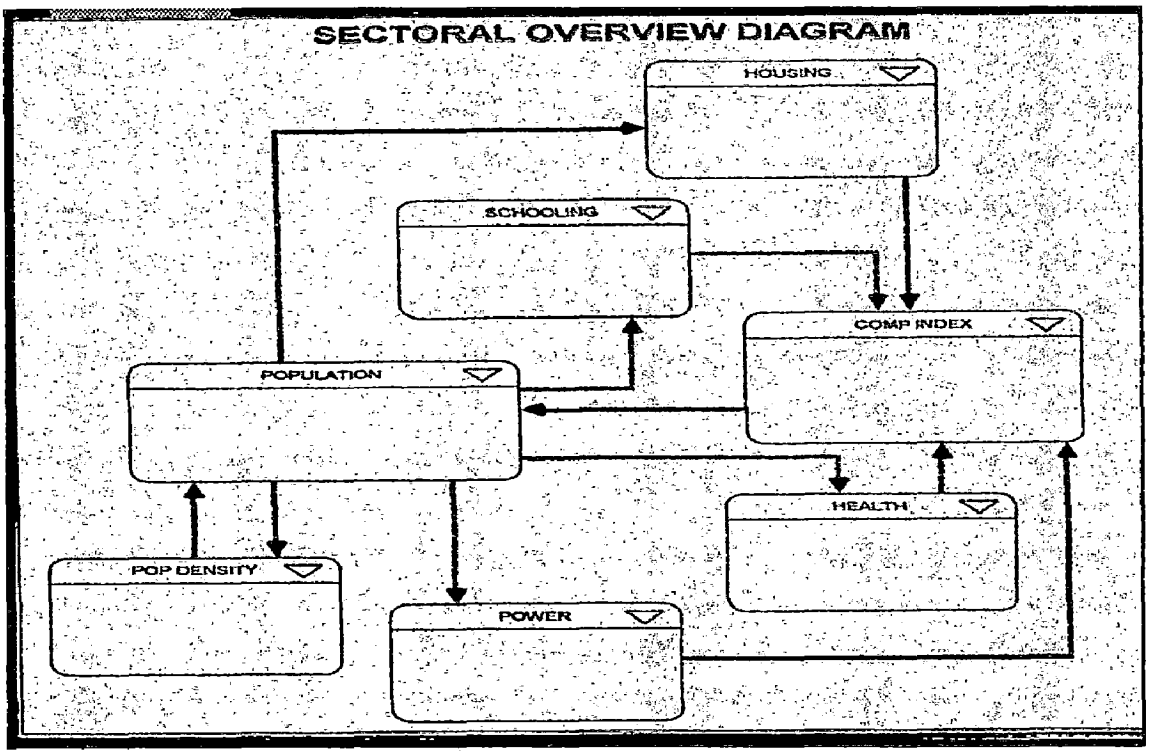


Figure no.2.05: Sectoral Overview Diagram

ın of System Dynamic Model

ː investigator chose five important sub systems, such as, population, housing, health and power for evolving a system dynamic model.

ı

calculate the quantity of population 11 variables such as, Birth rate, Death rate, ːth rate fraction, Normal death rate fraction, In migration, Normal in migration dex on in migration, Out migration, Out migration fraction, Effect on out migration ɔn out migration were considered along with the total quantity of population and a diagram is developed which is presented in Figure 2.06.

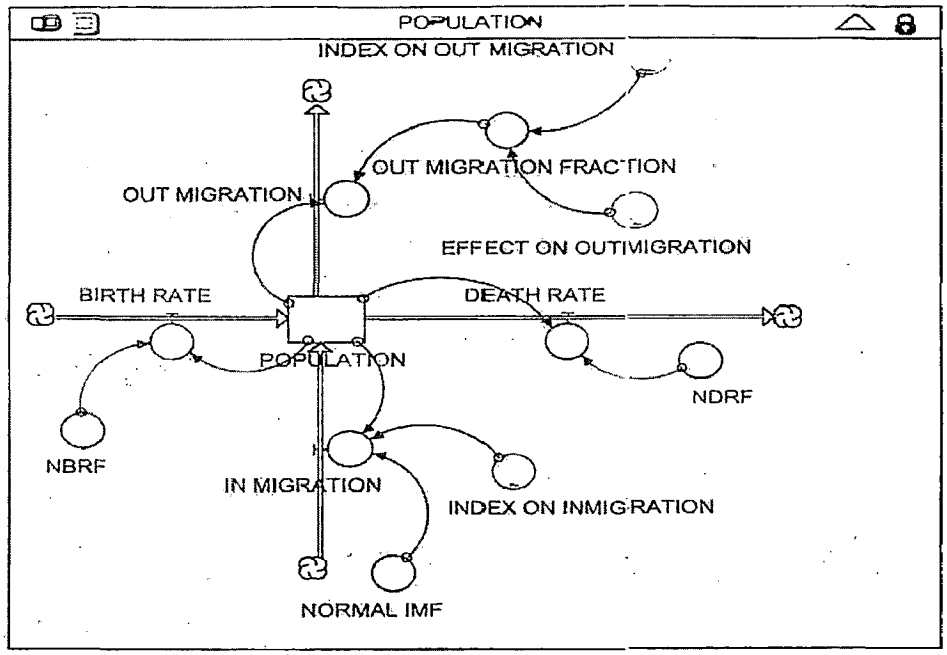


Figure no.2.06: Functional diagram for quantifying the population

Population density

The following variables were considered for the development of population density model. They are area, population, population density, planning standard, Density ratio and Effect on out migration. The functional diagram developed to quantify the population density is presented in Figure 2.07.

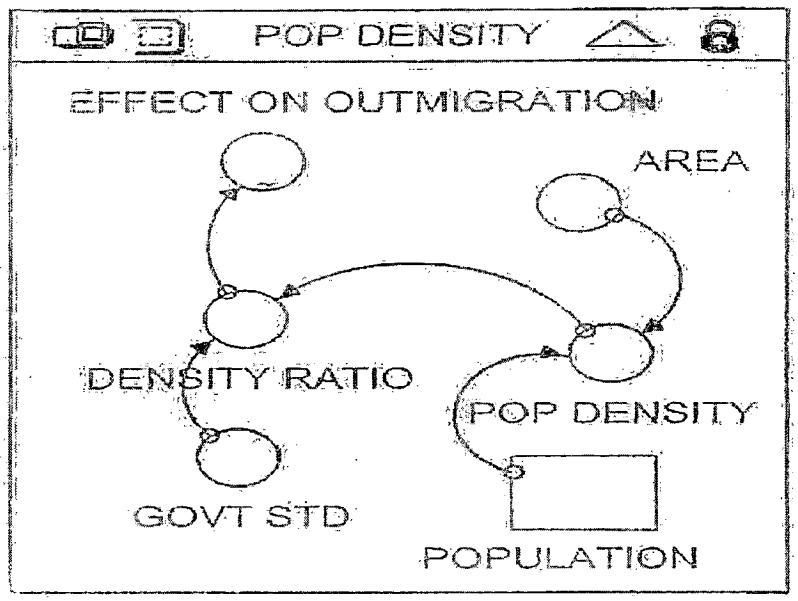


Figure no.2.07: Functional diagram for quantifying the population density

Housing

The following variables are controlling the housing stock of the study area. They are population, House of ratio, housing standard, Actual number of housing, housing built up rate, built up fraction, Total houses in construction, house completion rate, construction delays, deprecation and age of the buildings. The model diagram of housing is presented in Figure 2.08.

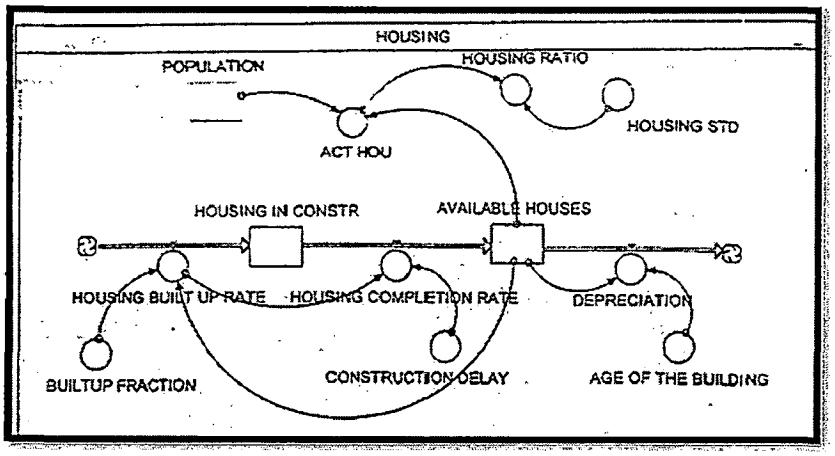


Figure no.2.08: Model diagram of housing

Education

The investigator selected the following variables to analyze the growth of schools in the system, such as, Population, Education ratio; Government standards of schools, School density ratio, Schools start up rate, School start up fraction, Schools in construction, School commencement rate, Time to complete and Number of school. A functional model has been developed by the investigator based on the above parameters to study the dynamic behavior of education facility in the system and is presented in Figure 2.09.

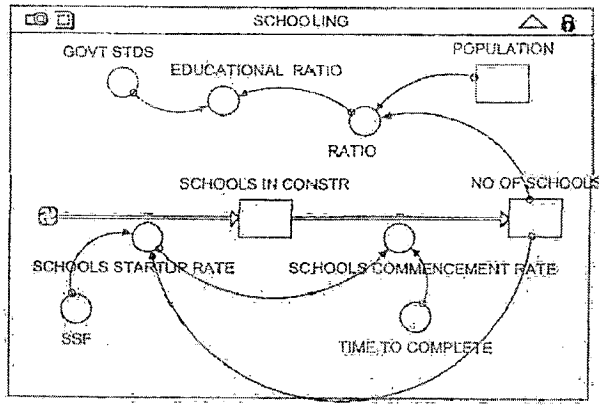


Figure no.2.09 Model diagram of education facility

Health

In order to identify the effects of health facility in the system, the following variables are considered for computation. They are, Population, Bed ratio, Ratio of beds, Effects of bed on in-migration, Bed addition fraction, Number of bed construction and Number of bed deletion and a diagram has been prepared for understanding the functions, which is presented in Figure 2.10.

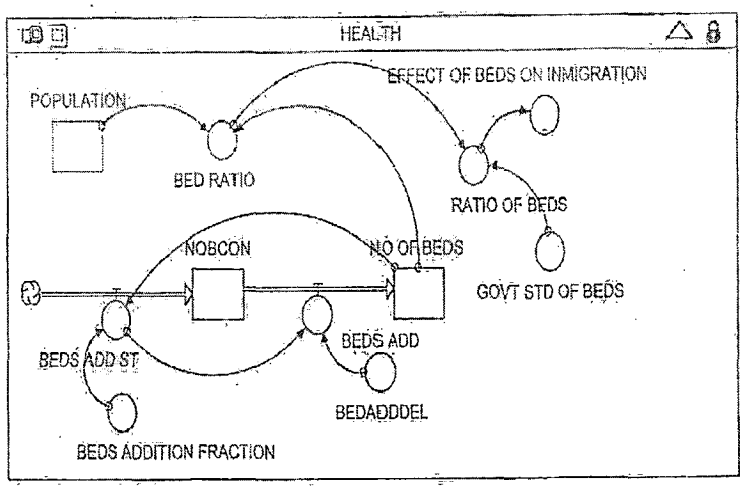


Figure no.2.10: Model diagram of health facility

Power

In order to develop the dynamic functional model, the following variables were considered by the investigator. They are, Population, Power demand, Power ratio, Requirement per person, Power supply capacity, Capacity in negotiation, Time to negotiate, Additional power completion rate, Capacity on negotiation and Capacity addition for developing a diagram and diagram is presented in Figure 2.11.

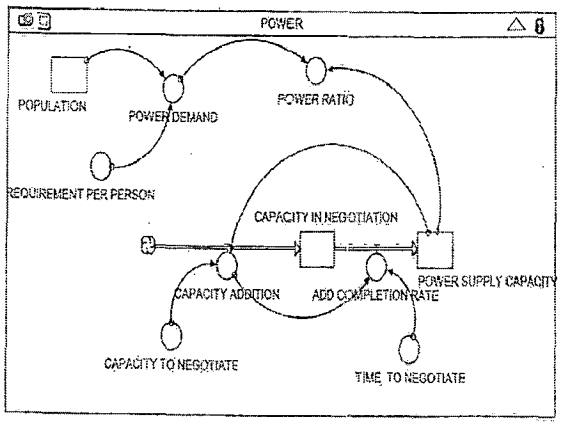


Figure no.2.11: Model diagram of power supply

Composite Index

An index of the set of combined variables is known as composite index. A composite index is prepared by summing of the index value of different subsystem. The formula used for calculating the composite index is as presented Figure 2.12 below:

Quality Of Life [QOL] = {(composite Index)

= (Infra 1, infra 2, infra 4)

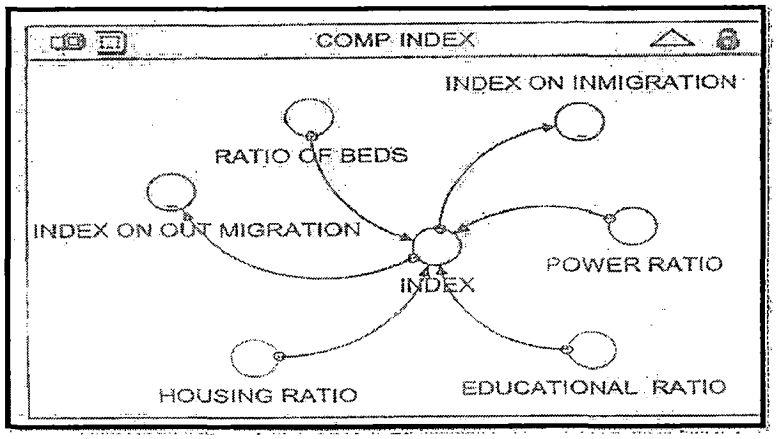


Figure no.2.12: Diagram for computing the Composite index [Quality of life]

Base Year Model Results (2001)

The developed system dynamic model is employed to understand the functions of the system. The model established the functions of the system by considering the functions of the system by considering all the incorporated subsystems together and observed that the Quality of life in the system is in decreasing trend from the year 1991 to 2001.

Model Validation

The developed model is employed to compute from a set of input for the year 2001, referred to as base year in this study, and the results are closely examined for model validation. It is observed that the model results are closely reflecting the real system.

Projection

The control parameters of the subsystem such as population, housing, education, health and power have been considered for projecting their value up to 2031AD for strategic planning. STELLA software used for doing projections by considering time series data of the said control parameters.

Projected Year Model Results

1. The projected year model results that the population of the study area would be 58 lakes in the year 2031 AD.
2. The requirement of houses would be 11.60 lakes as per the standards for the model results population of 58 lakes, but the available houses as per the present rates of construction would be 7.95 lakes.
3. In education, the number of schools required would be 1657 as per the standard of population of 58 lakes, but the model results for 2031 AD WOULD BE 2950.
4. In health segment, the number of beds in the hospital requirements would be 5800 as per the standard, but model results that the requirements would be 25000 in the year 2031AD.
5. In power supply, the quantity of power supply requirement would be 20880 Mw-h in 2031 AD, as per the standard, but the model results that the power supply would be 10700 Mw-h in 2031 AD.

Scenarios

A set of plausible scenarios are developed based on the present trend prevails in the system, Government policies, aspiration of the people, and also based on the experts opinion, to test the project year model 2031 AD to arrive at plausible decisions. The following control parameters are considered for developing the scenarios:

- ✓ Increase in number of houses
- ✓ Increase in number of schools
- ✓ Increase in number of beds in the hospitals
- ✓ Increase in power supply in the system
- ✓ Combination of increase in the number of all the aforesaid parameters.

The scenarios, which are tested with their values, are presented.

- ❖ The dynamic functions of the urban system are quantified by considering the most important control parameters, which decides the functions of the system:
- ❖ Projections were done to have a perspective look at the system for the year 2031 AD, and the projected year data were considered to develop a projected year model.
- ❖ Based on the model, several plausible scenarios were tested to have a look at the system under various alternative conditions to arrive at plausible decisions.

2.1.12 FINDINGS

Findings based on the Literature and Household survey

1. The study area has been characterized by different landforms, such as, highland, midland, and the lowland (coastal plain).
2. In the study area, the dwelling units are detached in nature and scattered throughout the geographical area. The residences confined besides the major transportation networks are having two or more floors and those in the interior and in the outskirts are having single storied.
3. About 15 per cent of population is migrated to the city from other parts of the country.
4. There are 1542 ponds, which are potential in nature scattered throughout the study area and are owned by private, community and local bodies.
5. The City Corporation and the neighboring Panchayats are having water supply system catering the population of 6 lakhs.
6. Three types of sewage disposal system prevail in the study area and their proportion, such as pit, septic tank and Municipal sewage system.
7. The existing road network is unable to cater the present requirement of the urban transportation system.
8. There is a marked variation of annual income among the families.
9. Social infrastructure facilities such as, schools, health centers, convenient shopping, markets, and recreation facilities are scattered throughout the study area, which are accessible to all sections of the community irrespective of income groups.
10. The study area is blessed with all types of health facilities, and are scattered throughout the Districts.
11. The literacy rate of the study area is about 90 per cent. The literacy rate in coastal parts of the study area is only 70 per cent.
12. Tertiary sector activities are dominated in the City center and Taluks head quarters.
13. Primary sector activities are dominated in the sub-urban, high land and in the coastal areas.
14. Secondary sector based activities are confined only in the selected pockets of the study area.

15. 93 per cent of the households are residing in owned houses and the rest are residing in rental houses.

Urban System Model based findings

To develop the urban system model, 2001-year data are considered. Therefore, year 2001, become the base year for the model. The model is validated and projections are made for 2031 AD and the projected year data are incorporated in this model.

The projected year model is used for simulation and the results are presented as below:

1. The study area will have about 58 lakes of population with an in-migration of 1.52 lakes and the density of population would be 4000 people per sq.km in the year 2031 AD, and the quality of living index would be 1.025.
2. A scenario, addition of school opening rate by 0.50 per cent in the system, resulted that the population would be 59.50 lakes, with in migration of 1.72 lakes, and population density would be 4103 persons per sq.km and quality of living index would be 0.9700.
3. A scenario, addition of school opening rate by 1.00 per cent in the system, resulted that the population would be 60.00 lakes, with in migration of 1.82 lakes, and population density would be 4137 persons per sq.km and quality of living index would be 1.055.
4. A scenario, no more addition of schools in the system, resulted that the population would be 55.00 lakes, with in migration of 1.28 lakes, and population density would be 3793 persons per sq.km and quality of living index would be 0.9600
5. A scenario, addition of 5.00 per cent of power in the system, resulted that the population would reach up to 59.00 lakes, with an in-migration of 1.64 lakes and density of population would be 4068 persons per sq.km and the quality of living index would be 1.025.
6. A scenario, addition of 10.00 per cent of power in the system, resulted that the population would reach up to 60.00 lakes, with an in-migration of 1.67 lakes and density of population would be 4137 persons per sq.km and the quality of living index would be 1.025.

7. A scenario, addition of house construction by 2.00 per cent in the system, resulted that the population would reach up to 62.00 lakes, with an in-migration of 2.00 lakes and density of population would be 4275 persons per sq.km and the quality of living index would be 1.075.
8. A scenario, addition of house construction by 3.00 per cent in the system, resulted that the population would reach up to 65.00 lakes, with an in-migration of 2.25 lakes and density of population would be 4482 persons per sq.km and the quality of living index would be 1.075.
9. A scenario, no more addition of house construction in the system, resulted that the population would reach up to 55.00 lakes, with an in-migration of 1.35 lakes and density of population would be 3793 persons per sq.km and the quality of living index would be 0.9800.
10. A scenario, addition of bed rate by 2.00 per cent in the system, resulted that the population would reach up to 65.00 lakes, with an in-migration of 2.35 lakes and density of population would be 4482 persons per sq.km and the quality of living index would be 1.125.
11. A scenario, addition of bed rate by 5.00 per cent in the system, resulted that the population would reach up to 77.50 lakes, with an in-migration of 3.75 lakes and density of population would be 5344 persons per sq.km and the quality of living index would be 1.216.
12. A scenario, no more addition in the system, resulted that the population would reach up to 53.00 lakes, with an in-migration of 1.125 lakes and density of population would be 3655 persons per sq.km and the quality of living index would be 0.9375.
13. A composite scenario, addition of 2.00 per cent beds, 2.00 per cent houses, 0.50 per cent schooling, and 5.00 percent power together in the system, resulted that the population would reach up to 70.75 lakes, with an in-migration of 2.50 lakes and density of population would be 4879 persons per sq.km and the quality of living index would be 1.160.
14. A composite scenario, addition of 5.00 per cent beds, 3.00 per cent houses, 0.50 per cent schools, and 10.00 percent power together in the system, resulted that the population would reach up to 91.50 lakes, with an in-migration of 4.10 lakes and

density of population would be 6310 persons per sq.km and the quality of living index would be 1.460.

15. A composite scenario, addition of 2.00 per cent beds, 2.00 per cent houses, 0.50 per cent schooling, and 10.00 percent power together in the system, resulted that the population would reach up to 70.75 lakes, with an in-migration of 2.50 lakes and density of population would be 4819 persons per sq.km and the quality of living index would be 1.1600.

    A composite scenario, addition of 2.00 per cent beds, 3.00 per cent houses, 0.50 per cent schools, and 10.00 percent power together in the system, resulted that the population would reach up to 72.50 lakes, with an in-migration of 3.10 lakes and density of population would be 5000 persons per sq.km and the quality of living index would be 1.1900.

2.1.13 POLICIES AND RECOMMENDATIONS

To develop a set of plausible recommendation, at the outset, existing planning standards are studied carefully, related to the control parameters that are studied in this investigation, such as housing power, health, schools, water supply and road length, and are presented in the Table 2.02

Table no.2.02: Planning Standards

Sl.No	Parameter	Standard requirement
1	Housing	One house for five persons
2	Water supply	150 lpcd
3	Power	400Kwh/person/year
4	Health	One bed/1000 people
5	Schools (primary, secondary and technical)	One school/3500 people
6	Road length	1000km/million population

Subsequently, the requirements of the major infrastructure services in the study area for the year 2031 AD is calculated based on the model results and scenario results are presented in the Table 2.03.

Table no.2.03: Model and Scenario results

SLNo	Projected year model and Scenarios	Population in lakhs	No of houses required (in lakhs)	No of beds in lakhs	No of schools	WaterDemand (LPCD) MLD	Power Demand (MW)	Road Length/Million population (Km)	Population Density (persons persq.km)	Quality of living Index
1	Projected year	58.0	11.6	.058	1657	870	580	5800	4000	1.025
2	Policy.1	59.0	11.8	.059	1685	885	590	5900	4068	1.025
3	Policy.2	60.0	12.0	.060	1714	900	600	6000	4137	1.025
4	Policy.3	62.0	12.4	.062	1771	930	620	6200	4275	1.075
5	Policy.4	65.0	13.0	.065	1857	975	650	6500	4482	1.075
6	Policy.5	55.0	11.0	.055	1571	825	550	5500	3793	0.98
7	Policy.6	65.0	13.0	.065	1857	975	650	6500	4482	1.125
8	Policy.7	77.5	15.5	.077	2214	1163	775	7750	5344	1.21665
9	Policy.8	53.0	10.6	.053	1514	795	530	5300	3655	0.9375
10	Policy.9	59.5	11.9	.059	1700	893	595	5950	4103	1.035
11	Policy.10	60.0	12.0	.060	1714	900	600	6000	4137	1.055
12	Policy11	55.0	11.0	.055	1571	825	550	5500	3793	0.96
13	Policy.12	70.7	14.15	.070	2021	1061	707	7070	4879	1.16
14	Policy.13	91.5	18.3	.091	2614	1373	915	9150	6310	1.46
15	Policy.14	70.7	14.15	.070	2021	1061	707	7070	4879	1.16
16	Policy.15	72.5	14.5	.072	2071	1088	725	7250	5000	1.19

This table illustrate that there would be huge demand of infrastructure services in the year 2031 in the system. The projected year model and the 15 policies, which are tested shoe a distinct demand of infrastructure services in the year 2031 in this system. The requirement of infrastructure services in the projected year model and each policy is calculated based on the Planning standards, cited in the above said table.

Projected Year Model

A good number of alternative policy scenarios have been evolved based on the scenarios developed in the projected year model [2031 AD] by considering the parameters those have direct bearings in the system. 15 polices have been developed, out of which the investigator observed one policy would be most suitable for development this system based detailed analysis of the policies and their results, the trend of development prevails in the City,

availability of land, population density, the availability of natural resources, etc., The selected policy is given below:

"A policy has been developed based on the composite addition of 2.00 per cent beds in the hospitals, 3.00 per cent houses, 0.50 per cent schools, and 10.00 per cent power in the projected year model and found that the population in the study area would be 72.50 lakhs [increased by 14.50 lakhs) in 2031 AD; the population density would be 5000 persons per Sq.km and the quality of index would be 1.190. When the policies operate the requirement of houses would be 14.50 lakhs, the requirement of schools would be 2071, the water demand would be 1088 MLD, power supply requirement would be 725 MW-hand the requirement of length of road would be 7250.00 km."

CONCLUSION

The study concluded by the investigator that if the recommended policies are considered and optimal, feasible, and viable schemes are developed based on the recommended policies and implemented in time, with statutory backing integrated development will be achieved in the system, along with steady socio-economic development, definitely.

2.2 CASE STUDY- 2

"PLANNING FOR INTEGRETED DEVELOPMENT OF THE INFORMATION TECHNOLOGY CITY-PUNE, INDIA", by Mr. SONAR SANJAYKUMAR GHANASHYAM, (Ph. D Thesis, 2006)

2.2.1 INTRODUCTION

Technological advancement has been shaping the socio-economic and spatial development of the cities of the world. Technological advancement in the form of Information Technology, which represents an outgrowth of developments in electronics and microelectronics, the technologies of which are central to both communications and computing bound to affect every aspect of human life and the city functions.

Emerging Information Technologies have started to transfer the economic role of cities, and their pattern of spatial development. In this process, many cities have lost their roles as corporate headquarters, and manufacturing centers, while some have attracted Information Technology based activities and emerged as Information Technology cities.

Advancement in information – communication technologies and subsequent reduction in the cost of information transfer has contributed towards the dispersal of Information Technology related economic activities. It has potential of both decentralization and centralization, which is observed that many cities across the globe are experiencing this phenomenon. The Indian cities are not exceptional one in this regard, since India has emerged as one of the favored Information Technology destinations by attracting major Information Technology related activates. Indian cities are having opportunities and challenges in this regard and the impact on urban infrastructure is being felt in several cities.

2.2.2 Objectives

The following objectives are framed in this investigation. They are:

1. To assess the existing socio-economic, physical, ecological, and environmental conditions of the study area (system).
2. To assess the potentiality of Information Technology in the system.
3. To identify the control parameters, which decide the functions of the system, and assess their functions.

4. To forecast the demand, and supply of infrastructure services for 2021 AD by different phase wise.
5. To evolve a set of plausible policy guideline and recommendations for integrated development of this Information Technology City.

2.2.3 Scope

The present investigation aims at to evolve a set of policy guideline for integrated development of this Information Technology city. The investigator hopes that if the present investigation's recommendations are implemented systematically in time, the city will have steady economic growth in the Information Technology industry by exploiting its own enriched resources, and infrastructure, and also will emerge as Information Technology capital of India in the 21st century, and total development can be anticipated in this city definitely.

2.2.4 Concept

System concept has been employed. A system functions as a whole with the interaction of several subsystems. In an urban system, all the subsystems, such as physical, social, economy, ecology, environment, infrastructure, and institutions together functions as whole. All these subsystems of the urban system are interconnected, and interdependent to each other, i.e., a subsystem's output is one or more other subsystem's input. In an urban system, if one of the subsystems defunct, or partially function or takes lead role in its function over a period of time its effects would be reflected in the whole system. In this investigation, the study area has been considered as 'system'. System concept has been employed to analyze the functions of the city for evolving a plausible set of policy guidelines for integrated development of this Information Technology city.

2.2.5 RESEARCH DESIGN

Survey research methods have been employed by the investigator and the methodology, followed to conduct this investigation, is presented in Figure 2.13.

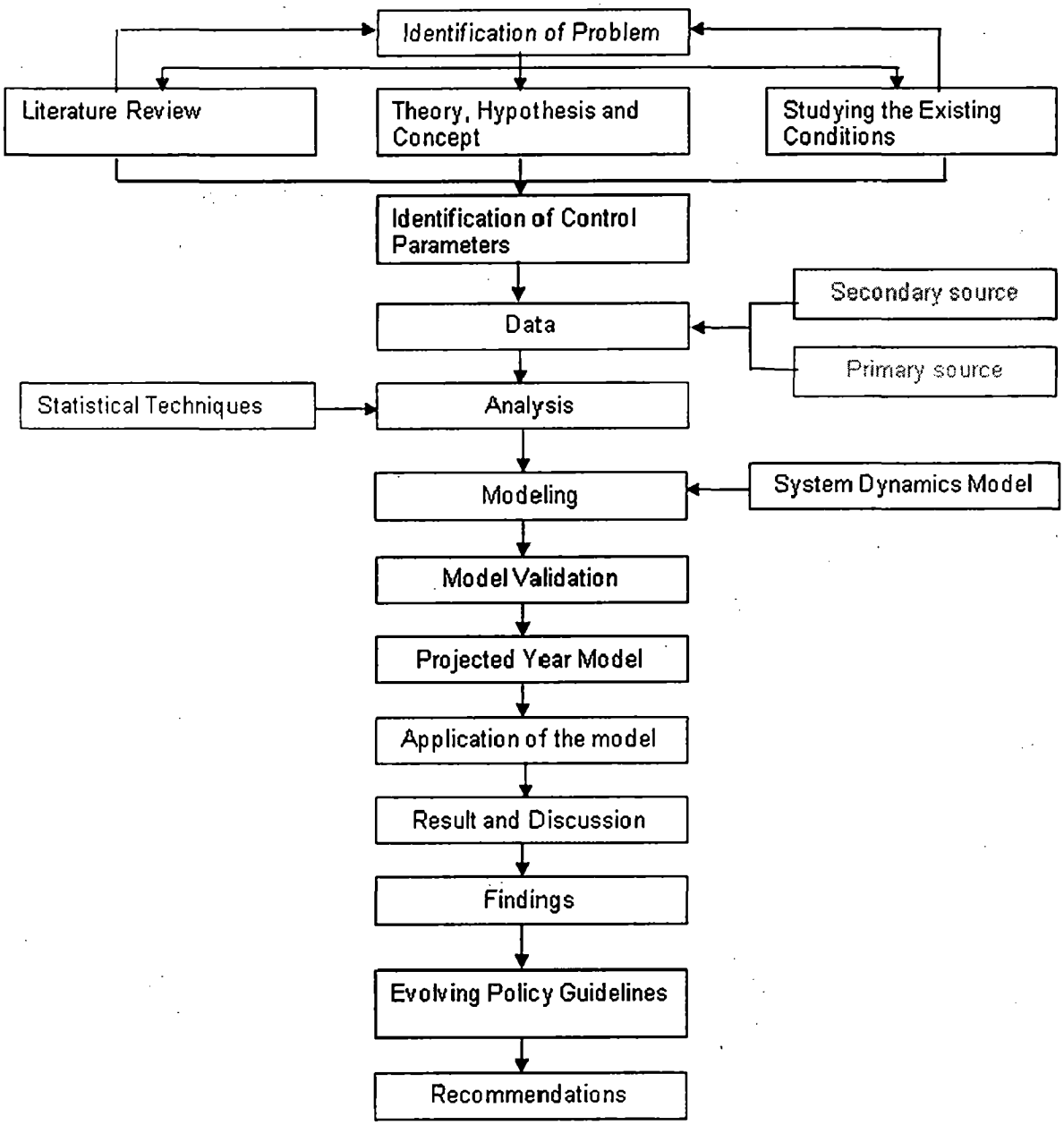


Figure no.2.13: Methodology

Data

Secondary and primary sources of data regarding state/study area, household and IT industry pertaining to the investigation were collected and employed.

Schedule

Household schedule is used for conducting survey at the grassroots level. The schedule has covered several aspects related to physical, socio-economic, and environmental quality of the households in the system. Details such as, household income from different sources, family size, education, employment, occupation, Information Technology related parameters, such as internet, telephone, mobile, computer, cable, ATM, E-mail, Credit cards, E-commerce, Video Conference etc., and infrastructure conditions, such as, transportation, water supply, sanitation and waste disposal parameters, housing positions etc., and expenditure pattern etc., were included in the schedule.

2.2.6 ANALYTICAL TOOLS AND TECHNIQUES

Analytical Tools:

Relevant analytical tools, such as code sheets, software [SPSS, EXCELL, POWERSIM) etc., were used for data processing, analysis and modeling.

Analytical Techniques:

Relevant statistical techniques, such as tabulation, correlation, multiple regression and system dynamic models, etc., were employed on the requirement of the investigation.

2.2.7 STUDY AREA PROFILE

Pune City and its Urban Agglomeration were considered for the investigation. The study area, Pune City and its Urban Agglomeration, is important city of Maharashtra State, which is one of the 30 provinces of the democratic republic of India. The location map of Pune agglomeration and Various regions in the study area of Pune city are presented in the Figure 2.14 and 2.15 respectively.

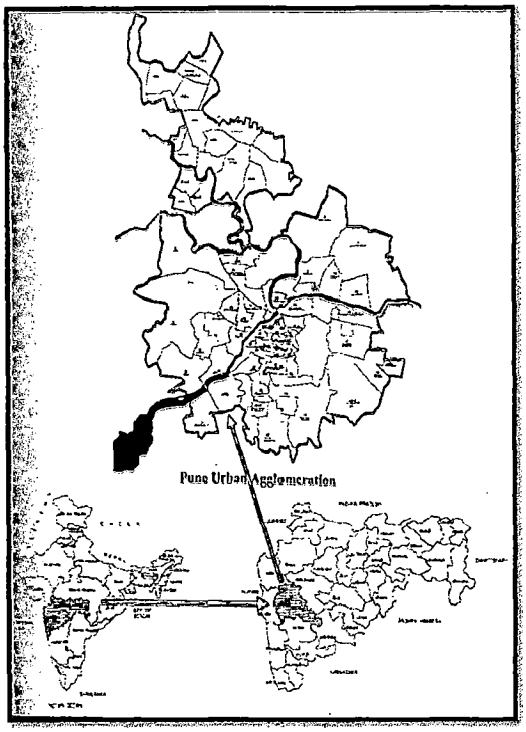


Figure no.2.14 Location map of Pune Urban Agglomeration

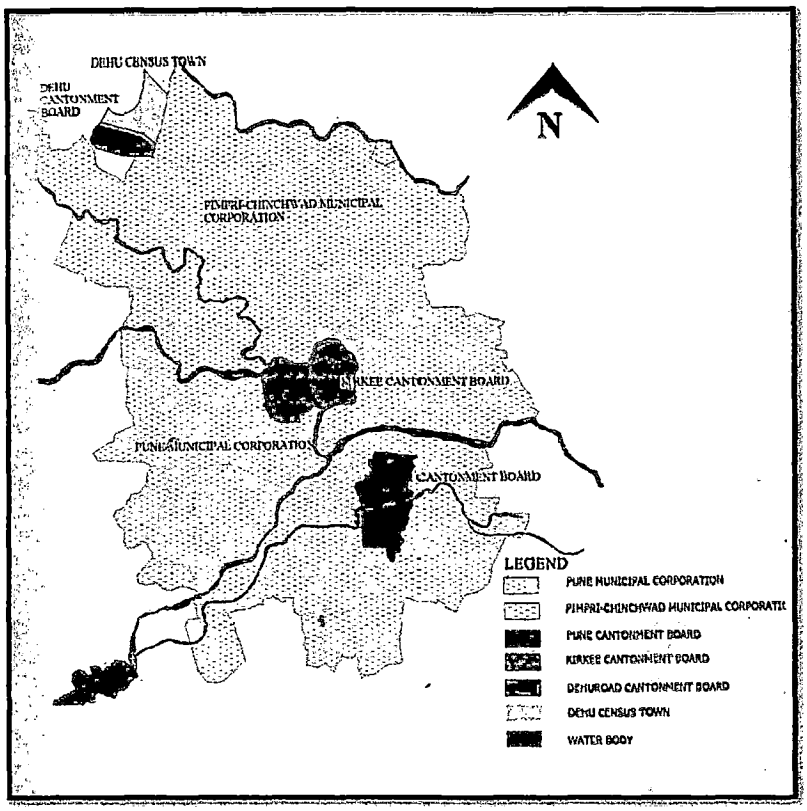


Figure no.2.15: Various Regions in the study area of Pune City

2.2.8 Information Technology Industry

The investigator has made an attempt to critically examine the potentiality for Information Technology industry in the study area and other respective levels as a whole. Further, the measures adopted by the Government Authorities at various levels in accordance with Information Technology industrial policy, Information Technology related infrastructure, and problems pertaining to Information Technology industry development at various levels are discussed to have a thorough insight on development of Information Technology industry in the study area.

2.2.9 PHYSICAL AND SOIO-ECONOMIC FEATURES OF THE STUDY AREA

The investigator conducted a detailed investigation to understand the functions of the system by considering a number of major variables. They are:

income, household size, population, family size, education, employment, occupation, male and female members in the households, expenditures etc., to understand the socio-economic conditions; to understand the availability of infrastructure services, the variable such as, Water supply, power supply, waste management, education, housing, transportation, recreation, health etc.,to understand the application of Information Technology, the variables such as internet, telephone, mobile, computer, cable network, online activities, TM, E-mail, Credit cards, E-commerce, Video Conference etc.,

2.2.10 APPLICATION OF THEORY, AND MODELS:

The investigator employed the Correlation techniques and Weighted Index method, to identify the control parameters that decide the functions of the system.

Correlation coefficient method:

The Correlation coefficient method is used to analyze the parameters of the various subsystems that highly influence the system. The household data collected for the investigation are utilized for the said purpose and correlation coefficient between the dependent variable and independent variable have been established. The parameters which

have higher correlation with the dependent variables are chosen as controlling parameters for further analysis.

Weighted Index method:

The Weighted index method is used to analyze the parameters to find the order of priorities on which they influence the various subsystems of the system. In this method, qualitative parameters and the parameters where it is not possible to find the correlation coefficient are investigated to decide the control parameters. The formula of the weighted index method used is as follows:

$$X = \frac{f1x1 + f2x2 \text{ ---------- } fd\ xn}{f1 + f2 \text{ ---------- } + fn}$$

Where x1, x2, xn are the preferences of respondent and f1, f2, fn are frequency of respondents.

Regression Analysis:

The multiple regressions is attempted to find out the tangible relationships of dependent variable, i.e. monthly income with multiple independent variables, such as economic parameters, demographic parameters, expenditure parameters, etc., based on the above control parameters. Multiple regression equations are attempted separately for the parameters, and it is observed that except expenditure parameters, other parameters do not provide tangible relationships in the system, thus a multiple regression analysis is done for expenditure parameters and the equation employed for **basic expenditure parameters** is as follows:

$$Y = f(x1, x2, x3 \ldots\ldots Xn)$$

For Non-basic expenditure parameters is given below

$$Y = f(z1, z2, z3 \ldots\ldots zn)$$

2.2.10.1 Application of System Dynamics theory:

The investigator employed Systems theory based on the system concept and System Dynamics models by considering the study area as system. The investigator observes that Information Technology industry and the city yet has not treated as one entity for evolving policies, plans, programs, etc., for the development of the system. In fact, the Government or Non-Government Organizations are taking whatever initiatives in Information Technology development are sporadic and isolated attempts. Therefore, the Investigator establishes that Information Technology industry is an integral part of the system and function as a catalyst for total development of the system.

System Dynamics Modeling:

System Dynamic modeling is one approach that can help the Planners and Managers to meet the challenges of decision-making and policy formulation for the development of the system. It represents the key feedback structures in the system. Simulating the model shows the effect of the system structures on policy interventions. It is a problem evaluation approach based on the premise that the structure of a system. The various steps for developing and employing the System Dynamic-models are:

- Define the problem
- Describe the system
- Develop the model
- Build confidence in the model [Validation]
- Use the model for policy analysis
- Use the model for public outreach.

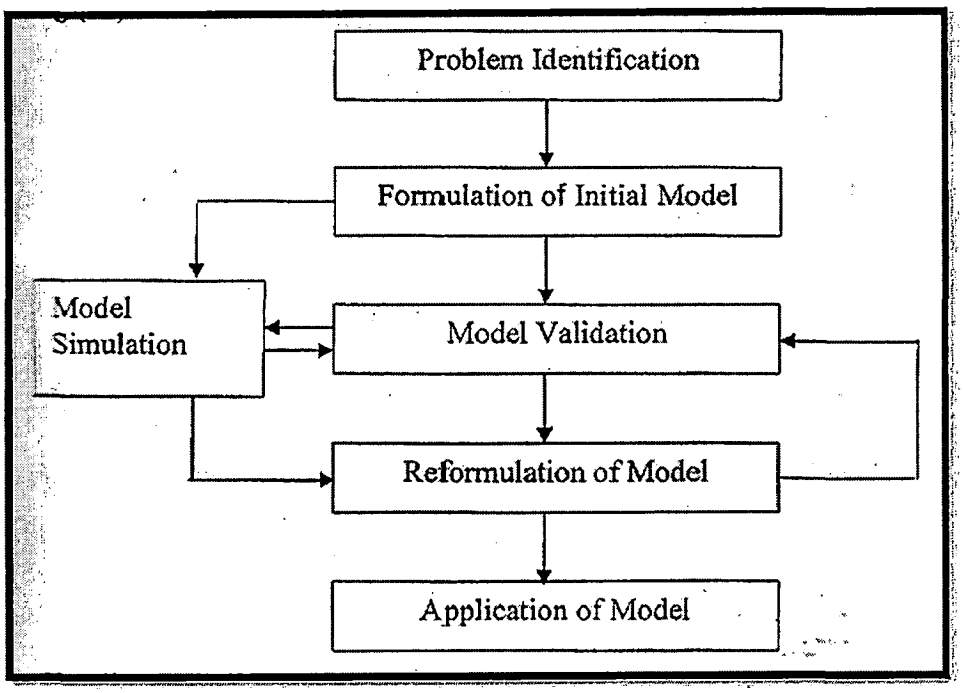


Figure no.2.16: Model development as an iterative process

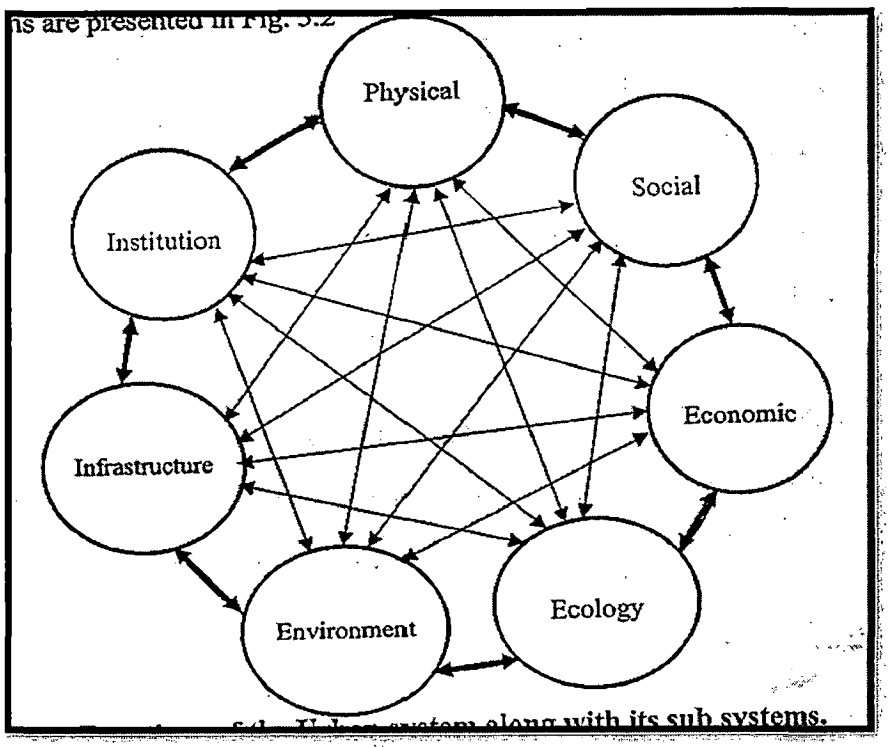


Figure no.2.17: Functions of the Urban system along with its sub systems

2.2.10.2 Conceptualization of Integrated Information Technology City [system] model

Information Technology industry is a function of several activities under various subsystems in the system. The functions of the various subsystems of the system contribute to the Information Technology industry development on one hand, and Information Technology contributes to the development of the system on the other. Then, after in depth analysis of collected data, various control parameters of Information Technology industry are identified and clubbed in to five subsystems, such as, Human Resource, Transportation and Communication, Local Level Infrastructures, Conducive Environment, and Institutional Support. A schematic diagram indicating various control parameters under different subsystems are presented in the Figure 2.18.

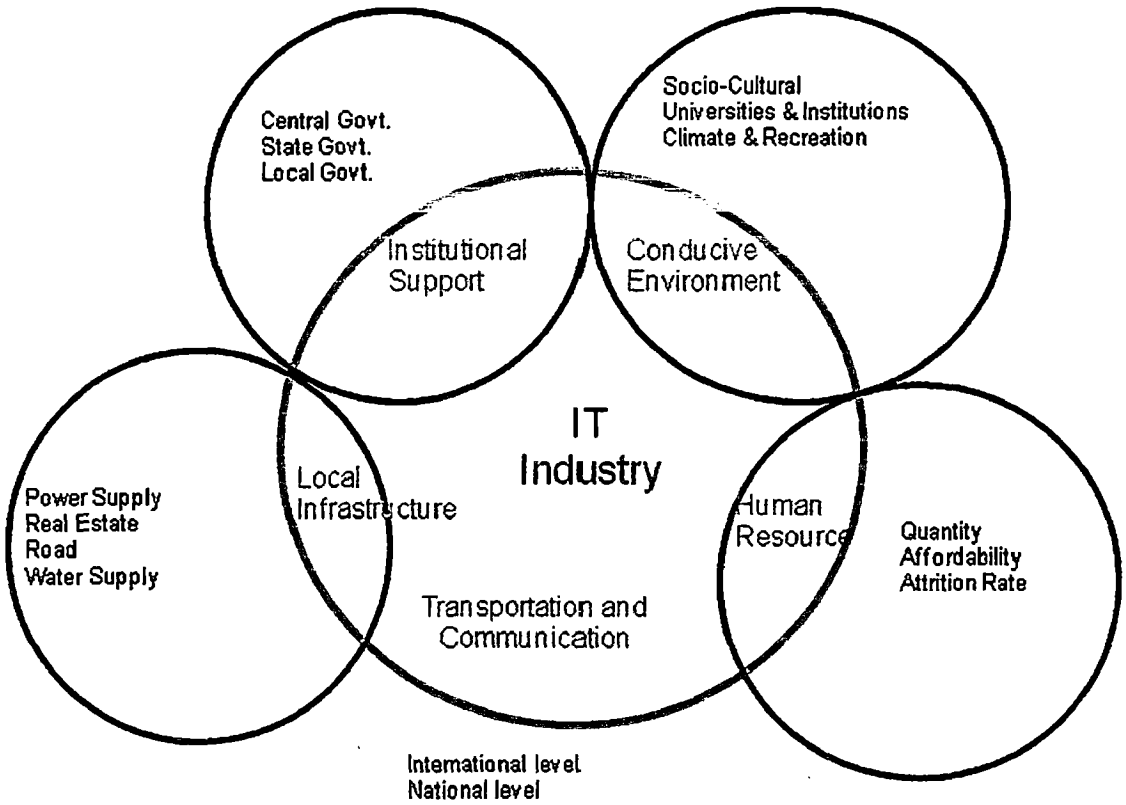


Figure no.2.18 Conceptualized integrated model for Information Technology

2.2.10.3 Application of System Dynamics Model

In this investigation, all the control parameters, such as, Human Resource, Transportation and Communication, Local Level Infrastructures, Conducive Environment, and Institutional Support are taken into consideration for integrated development of the system. Of these parameters, Transportation and Communication and Institutional Support are functioning as exogenous parameters, and where as Local Level Infrastructures, Conducive Environment and Human Resource are indigenous parameters. While building the System Dynamic model, indigenous parameters which are functioning within the system (the study area) are taken into considerations for integrated development of Information Technology City model. Then detailed System Dynamic models by subsystem wise has been developed by the investigator.

Model Validation:

The evolved integrated model has been employed to compute outputs from a set of inputs for the year 2001, which is referred as the base year for the model in this investigation. The data available for some important parameters up to year 2004 are considered for model validation. The model results are closely examined and compared to the data available in the real system and the results were obtained.

Projected Year [2021 AD] Model Results:

Period of projection is considered up to 2021 AD by keeping in mind the very dynamic and volatile nature if Information Technology industry. Projections were done in the validated integrated base year [2001 AD] model by employing **POWERSIM** software by considering the time series data available in then system.

The base year and projected year model results of various parameters, such as, population and, population density,(Figure 2.19)demand and supply in various infrastructure, such as, transportation[road length], power supply, real estate, and human resource, Information Technology industry, turnover per employee, per capita Gross Domestic Product Information Technology industry share in State Domestic Product, level of satisfaction of various control variables, overall satisfaction, environmental street, etc., were considered.

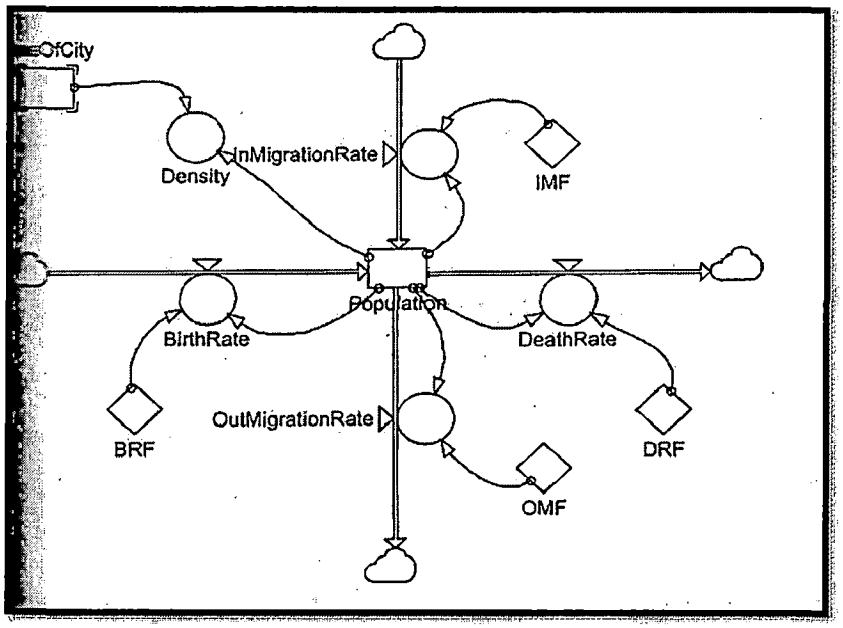


Figure no.2.19 System Dynamics Model for Population and Population Density

Scenarios

A set of plausible scenarios are generated based on the prevailing trend in the system, aspirations of the local people, requirements of Information Technology industry in the system, and expert's opinion in order to arrive at plausible decisions. The following control parameters are considered by the investigator for developing the scenarios. They are:

- Increase of road length [transportation]
- Increase of power supply
- Increase of human resource
- Increase of housing [real estate]
- Increase of commercial area [real estate].

The scenarios, which are tested with their values, are presented in Table 2.05 below

Table 2.04: Results of the Scenario

SL No.	Scenarios With growth rate of control parameters (in per cent)	IT industry Export (INR in billion)	Per Cent Variation	IT industry share to SGDP (per cent)	Per Cent Variation	IT industry employment (numbers)	Per Cent Variation	IT industry employment share to total employment (per cent)	Per Cent Variation
1	2 3	4	5	6	7	8	9	10	11
1	S_0 Projected year result	246.817	—	40.00	—	343515.75	—	13.18	—
2	S_1 PS 2%	251.027	1.70	40.41	1.03	349374.98	1.70	13.38	1.52
3	S_2 PS 2%+RL 2%	254.691	3.19	40.76	1.90	354473.59	3.19	13.53	2.81
4	S_3 PS 4%+RL 2%	268.883	8.94	42.08	5.20	374226.92	8.94	14.20	7.74
5	S_4 PS 6%+RL 4%	312.682	26.68	45.79	14.48	435185.23	26.68	16.13	22.82
6	S_5 PS 6%+RL 4%+HR 2%	325.885	32.03	46.82	17.05	453557.83	32.03	16.70	26.71
7	S_6 PS 6%+RL 4%+HR 4%	369.353	49.65	49.95	24.86	514058.67	49.65	18.52	40.52
8	S_7 PS 8%+RL 6%+HR 4%+HS 2%	427.854	73.35	53.61	34.03	595478.50	73.35	20.84	58.12
9	S_8 PS 8%+RL 6%+HR 4%+HS 2%+CA 2%	573.100	132.20	60.76	51.90	797629.01	132.20	26.07	97.80
10	S_9 PS 8%+RL 8%+HR 6%+HS 2%+CA 4%	618.034	150.40	62.54	57.35	860167.95	150.40	27.55	109.03
11	S_{10} PS 8%+RL 8%+HR 8%+HS 4%+CA 4%	646.105	161.77	63.58	58.95	899236.27	161.77	28.45	115.86
12	S_{11} PS 2%+RL 2%+HR 2%+HS 2%+CA 2%	364.110	47.52	49.59	23.98	506761.11	47.52	18.30	38.85
13	S_{12} PS 4%+RL 4%+HR 4%+HS 4%+CA 4%	472.062	91.26	56.05	40.13	657007.16	91.26	22.51	70.79
14	S_{13} PS 6%+RL 6%+HR 6%+HS 6%+CA 6%	616.373	149.73	62.48	56.20	857855.23	149.73	27.50	108.65
15	S_{14} PS 8%+RL 8%+HR 8%+HS 8%+CA 8%	713.372	189.02	65.84	64.60	992857.15	189.02	30.50	131.41
16	S_{15} PS 10%+RL 10%+HR 10%+HS 10%+CA 10%	780.998	216.43	67.84	69.60	1086976.47	216.43	32.46	146.28

SL No.	Scenarios With growth rate of control parameters (in per cent)	Total SGDP (INR in billion)	Per cent variation	Per capita SGDP (in INR)	Per cent variation	Environmental stress	Per cent variation	Overall satisfaction	Per cent variation
1	2 3	12	13	14	15	16	17	18	19
1	S_0 Projected year result	616.978	—	100258.70	—	0.47	—	0.53	—
2	S_1 PS 2%	621.188	0.68	100942.81	0.68	0.47	—	0.53	—
3	S_2 PS 2%+RL 2%	624.851	1.28	101538.11	1.28	0.47	—	0.53	—
4	S_3 PS 4%+RL 2%	639.044	3.58	103844.44	3.58	0.47	—	0.53	—
5	S_4 PS 6%+RL 4%	682.843	10.68	110961.73	10.68	0.47	—	0.53	—
6	S_5 PS 6%+RL 4%+HR 2%	696.044	12.81	113106.85	12.81	0.47	—	0.53	—
7	S_6 PS 6%+RL 4%+HR 4%	739.514	19.86	120170.73	19.86	0.473	0.64	0.527	-0.56
8	S_7 PS 8%+RL 6%+HR 4%+HS 2%	798.015	29.34	129677.04	29.34	0.473	0.64	0.527	-0.56
9	S_8 PS 8%+RL 6%+HR 4%+HS 2%+CA 2%	943.261	52.88	153279.47	52.88	0.482	2.55	0.518	-2.26
10	S_9 PS 8%+RL 8%+HR 6%+HS 2%+CA 4%	988.195	60.17	160581.31	60.17	0.486	3.40	0.514	-3.02
11	S_{10} PS 8%+RL 8%+HR 8%+HS 4%+CA 4%	1016.266	64.72	165142.80	64.72	0.489	4.02	0.511	-3.58
12	S_{11} PS 2%+RL 2%+HR 2%+HS 2%+CA 2%	734.271	19.01	119318.69	19.01	0.479	1.91	0.521	-1.70
13	S_{12} PS 4%+RL 4%+HR 4%+HS 4%+CA 4%	842.223	36.50	136860.93	36.50	0.482	2.55	0.518	-2.26
14	S_{13} PS 6%+RL 6%+HR 6%+HS 6%+CA 6%	986.534	59.90	160311.29	59.90	0.486	3.40	0.514	-3.02
15	S_{14} PS 8%+RL 8%+HR 8%+HS 8%+CA 8%	1083.533	75.62	176073.67	75.62	0.489	4.04	0.511	-3.58
16	S_{15} PS 10%+RL 10%+HR 10%+HS 10%+CA 10%	1151.158	86.58	187062.73	86.58	0.490	4.26	0.510	-3.77

2.2.11 RESULTS AND FINDINGS:

The following are some of the very important inferences based on the extensive literature survey and the intensive primary survey conducted.

Finding based on the literature:

1. The Pune City has grown about 100 times in its 184 years of history from a mere 5.00sq.km area to 483.73 sq.km, and has the fastest urban growth rate.
2. The decadal growth rate of population in the study area has experienced fluctuation and it has obtained a higher growth rate during 1961 to 1971, and the lowest in 1951 to 1961.
3. The population density found to vary among the various settlement of the study area. It ranges from 943.46 persons per Sq.km to more than 1000.00 persons per Sq.km.
4. Pune City and the Pune Urban Agglomeration have an average household size of 4.82.
5. Maharashtra State stands first amongst the major States of the country in terms of State Gross Domestic Product and accounts for about 15.00 per cent of the National Income.
6. It is one of the leading industrial States in the country accounting for 20.00 per cent of the country's investment.
7. Tertiary sector is the highest contributor to the Net State Domestic Product followed by the Secondary Sector.
8. The secondary, i.e., the manufacturing sector and the tertiary sector provide the largest employment opportunities, in the study area.
9. There is a high percentage of two wheelers and three wheelers in the city, which indicates inadequacy, and poor performance of public transport system in the study area.
10. The share of the Pune City to that of India's Information Technology industry export has increased from 3.52 per cent to 7.00 per cent during the same period, which clearly indicates growth potential of Information Technology industry in Pune City.

Findings based on the primary survey:

1. It is found that the total of 244 surveyed households is having population of 977 persons with an average household size of 4.00 persons per households. The maximum household size is 5.00 and the minimum household size is 3.82 in the study area.

2. More than two- third of the population surveyed households is confined to the three lower income groups, more than one-fourth of the population belongs to the three middle income groups and only 4.00 per cent of population are confined to the two highest income groups.
3. More than half [51.07 per cent] of population are males and the rest [48.93 per cent] are females.
4. It is manifested from the survey of households that more than one-third[37.67 per cent] of surveyed population is employed in the study area.
5. Occupation in tertiary sector dominates among the surveyed households with just a little less than three-fifth [58.70 per cent] of them confined to this sector.
6. The survey reveals that the level of services of water supply is good in the system. It has been observed that 84.00 per cent of the respondents rate the water supply services is as good and the rest [15.37 per cent] of them rate it as average in the system.
7. According to the opinion of respondents, the level of services of power supply in the system is average to poor.

Regression Model based Findings:

1. The household survey revealed that the monthly income from various occupations in many households is mutually exclusive, and some households have more than one occupation.
2. It is ascertained from the correlation between the monthly income of households and various occupations that tertiary sector is the prime occupation, followed by the secondary sector and primary sector.
3. The higher correlation coefficient suggests between monthly income and male population suggests that the male employment is dominating in the system
4. In expenditure, it is found that food and clothing together from expenditure and it consumes major share of total income. The expenditure on housing and loan are considered as least priority.
5. It is observed that there are presence of very high level of health and education infrastructure, followed by water supply in the system.

6. It is revealed from the Weighted Index method that computer, cable network, telephone/mobile and ATM are regularly used gadgets in the system.

System Dynamic Model based Findings:

1. The model results revealed that the population in the study area would be increased from 3755525.00 in 2001 to 6153865.00 in the rear 2021 AD and the area would be increased from its present area of 483.73 Sq.km to 700.01 Sq.km. The population density in the study area would be increased from 7764.00 persons per Sq.km in 2001 to 8791.00 persons per Sq.km.
2. The model results manifests that the demand of road length in the study area would be increased from 3023.31 Km in 2001 to 4318.78 Km in the year 2021 AD.
3. It is observed from the model that the power supply would be increased by more than 232.00 per cent from its present supply position by the year 2021 AD.
4. The supply of commercial area would be increased by about 43.00 per cent between 2001 and 2021 AD.
5. It is observed from the model results that housing supply would be decreased from 615484.00 numbers in 2001 to 505136.98 numbers in year 2021 AD and the demand of housing would be increased from 715338.10 numbers in 2001 to 1145833.31 numbers in 2021 AD.
6. The State Gross Domestic Product would be increased from INR 172.75 billion in 2001 to INR 510.18 billion in 2021 AD.
7. The employment generation opportunities through Information Technology industry would be increased from 34794.47 numbers in 2001 to 231757.15 numbers in the year 2021AD.
8. The model results manifest that enhancement of individual parameters alone would not influence the Information Technology Industry and the system to a larger extent. The composite scenarios with a combination of parameters that influence the development of Information Technology Industry and the system as a whole both economically and socially only can be considered for the development of the system.

2.2.12 POLICIES AND RECOMMENDATIONS

Development concept:

- In order to develop a set of policy guidelines and plausible recommendations, the following strategies have been considered. They are:
- Gradual increase of total power supply growth rate from minimum of 2.0 per cent to maximum 10.00 per cent by the year 2021 AD in the study area.
- Gradual increase of road length growth rate from minimum of 2.00 per cent to maximum of 10.00 per cent by the year 2021 AD in the study area.
- Gradual increase of human resource growth rate from minimum of 2.00 per cent to maximum of 10.00 per cent by the year 2021 AD in the study area.
- Gradual increase of housing growth rate from minimum of 2.00 per cent to maximum of 10.00 per cent by the year 2021 AD in the study area.
- Gradual increase of road commercial area growth rate from minimum of 2.00 per cent to maximum of 10.00 per cent by the year 2021 AD in the study area.
- Composite scenarios are tried with the combination of two or more than two control parameters to develop alternative policies.
- Gradual increase of growth rate of various control parameters in combination are tried to develop a set of policy guidelines and plausible recommendations.

Alternative Policy Scenarios:

A good number of alternative policy scenarios have been evolved based on the scenarios developed in the projected year model [2021 AD] by considering the parameters those have direct bearings in the system. 15 polices have been developed, out of which the investigator observed one policy would be most suitable for Information Technology industrial development and overall development of the system based on the detailed analysis of the policies and their results. The selected policy is given below:

"A policy has been developed by adding 8.00 per cent in power supply growth rate, 8.00 per cent road length growth rate, 8.00 per cent human resource growth rate, 4.00 per cent in housing supply growth rate, and 4.00 per cent commercial area growth rate in the projected year model [2021 AD]".

2.2.13 Conclusion:

Finally, a set of policy guidelines was prepared by phase wise requirements and achievements and requirements in alternative conditions for Information Technology industry development along with total of the system. The study concluded by the investigator that if the recommended policies are considered and optimal, feasible, and viable schemes are developed based on the recommended policies and implemented in time, with statutory backing integrated development will be achieved in the system, along with steady socio-economic development, definitely.

2.3 LITERATURE REVIEW

2.3.1. An integrated planning tool for sustainable cities

Jan Rotmans, Marjolein van Asselt, Pier Vellinga [2000] made an attempt to evolve an integrated planning tool for sustainable development of cities. The authors proposed the city planning frame with the combination of an information system and dynamic model. Good amount of literature review pertaining to dynamic functions of cities have been done with careful analytical work. In the integrated city planning model (Figure 2.20) the authors have established organization function, policy function, monitory function and evaluative function. Further, three sub-systems such as economic stocks, socio-cultural stocks and ecological stocks and put together the theatrical function of these three sub-systems were established by employing diagrammatic model. In an interceptive form, i.e., these sub-systems are interconnected and interdependent to each other. Maastricht City was chosen and the investigators have employed this model for preparing perspective plan for a sustainable city to the projected year 2030 AD. Dynamic functional planning concepts have been employed in this investigation. However, the authors never attempted for quantifying the functions and concluded with theoretical conceptualization.

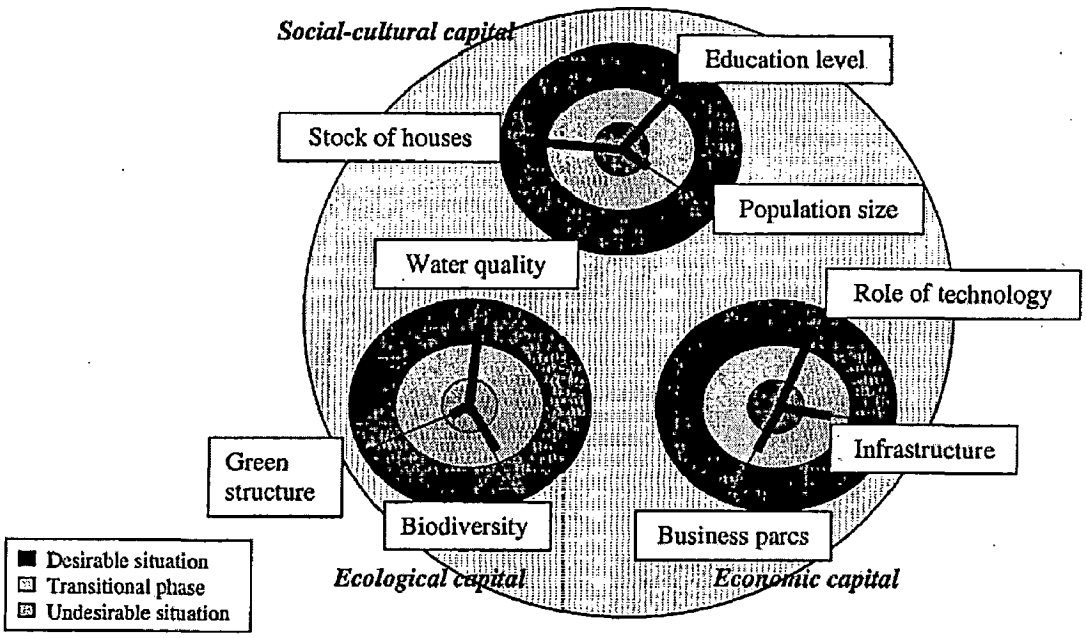


Figure no.2.20: Cockpit for Maastricht

2.3.2. Employment creation through participatory urban planning and slum upgrading

Michael Majale [2008], made an attempt to improve the living conditions of urban poor communities in slums and evolve coordinated policies and action on employment creation through participatory urban planning and slum upgrading. The author had studied the slum population and their intensity of problem with slum dwellers across the globe. The authors were identified three key societal sectors such as public, private and civil society, can all play a role, at various levels, global, regional, national and local, in addressing the urgent challenge of slums. Further, the author pointed out the difficulty to deal with the accelerating urban population growth, and the expansion of cities and towns is outstripping the capacity and resources of governments and local authorities to plan and manage development, and provide infrastructure, housing and employment opportunities.

It has been observed that slum upgrading typically involves physical, social, economic, organizational and environmental improvements to existing slums. Infrastructure, in particular, is key to improve the living conditions and livelihood opportunities of slum dwellers. The author stressed the importance of local resource-based employment-intensive approaches which can be adopted for a wide range of infrastructure works, including water supply, sanitation services, sewerage and drainage networks, roads and pathways, low-level bridges, and electrification. The author established the Local Economic Development [LED] approach, which involves the actors of the stakeholder groups, such as public sector, private institutions and civil society. Kitale, a town in Kenya was chosen by the investigator, where pro-poor and pro employment urban development strategy has been employed through participatory urban planning project. The project established and developed constructive partnerships between key stakeholders to identify employment creation and LED opportunities through slum upgrading and translate these into action. Further the author discussed in detail about key achievements through this project, at various locations of selected town Kitale, in terms of pro-poor participatory slum upgrading interventions, employments creation and LED. Finally the concluded with recommendations for coordinated policies and action on employment creation through participatory urban planning, partnership building and working, and slum upgrading under national level, Municipal level and community level.

2.3.3. Forecasting municipal solid waste generation in a fast-growing urban region with system dynamics modeling

Brian Dyson, Ni-Bin Chang [2004], the authors made an attempt to predict the accuracy of solid waste generation by forecasting municipal solid waste generation in a fast-rowing urban region with system dynamics modeling. Good amount of literature review pertaining to estimation of the solid waste generations in urban areas and after detailed analysis, the authors have pointed out that the anticipated prediction accuracy waste generation is the great challenge through all traditional forecasting methods, till today. The dynamic properties in the process of solid waste generation cannot be fully characterized in those model formulations. It has been observed by the authors from most of the traditional statistical forecasting models, such as the geometry average method, saturation curve method, least-squares regression method, and the curve extension method, are designed based on the configuration of semi-empirical mathematical models. The structure of these models is simply a cause-effect and purely related to observed data base. It is particularly designed for handling situations in which only limited data are available for forecasting practice and system environments are not well-defined or fully understood.

The investigators have studies carefully and found there is a need to integrate those separate dynamic efforts as a whole that may be able to account for the interrelationships among relevant dynamic features influential for municipal solid waste generation. Such concatenation enables us to explore the interactions among a variety of socio-economic, environmental, and managerial factors when we still have to handle the data scarcity issue. The investigator introduced a new approach through system dynamic modeling for the prediction of municipal solid waste generation in an urban area. City of San Antonio, Texas, North America was chosen for employing System Dynamic Model (Figure 2.21and 2.22) and generalized model were developed by considering the influenced variables such as income per service center, people per house hold, historical amount generated, income per household, population to simulate the waste generation

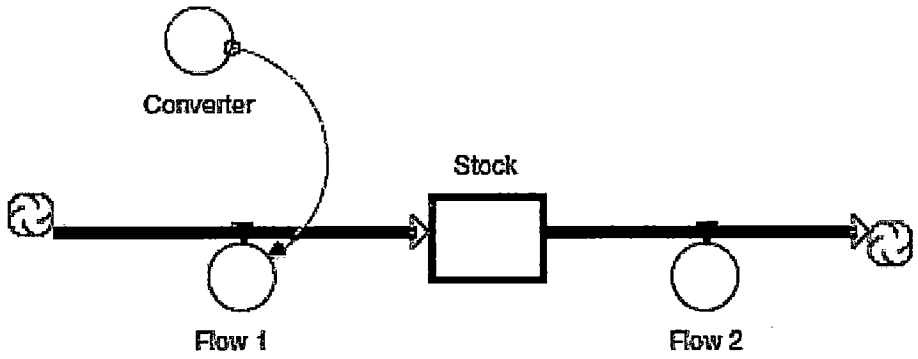


Figure no.2.21: Stella diagram showing stocks, flows and converter

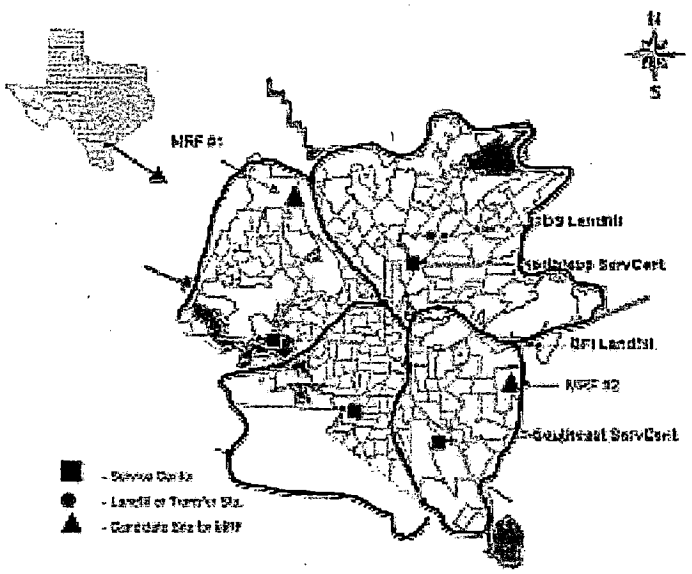


Figure no.2.22: City of San Antonio service centers, landfills, and transfer station

The software Stella was used in this investigation to perform the simulations, which is iconographic software using basic building blocks such as stocks, flows, and converters that are intuitively assembled to simulate the dynamic processes of a system. The investigators had analyzed the simulation results carefully and selected one model has been selected as most appropriate model to reflect System Dynamic in solid waste generation. Based on the historical records and predictive results of San Antonio population, income, and waste generation, the study concluded that the increasing trend is phenomenal in all aspects.

2.3.4. Integrating land use and transport planning to reduce work-related travel: a case study of Tampines Regional Centre in Singapore

Loo Lee Sim, Lai Choo Malone-Lee, Kein Hoong Lawrence Chin[2000], the authors made an attempt to understand the urban transport problem by way of alleviate traffic congestion by decentralizing commercial activities from the CBD of Singapore to the regional centres, through integrating land use and transport planning to reduce work-related travel. The authors discussed in detail about the urban transport problems of Asian cities and the Singapore found to be an exceptional one in this aspect. The key to Singapore's success lies in its comprehensive and highly coordinated land transport policy, which combines the integration of land use and transport planning with demand management measures. The authors have studied the good numbers of literature regarding the improvement of efficiency of public transport system, effective travel demand management and improving traffic management measures. The location map of Tampines Regional centre is presented in Figure 2.23.

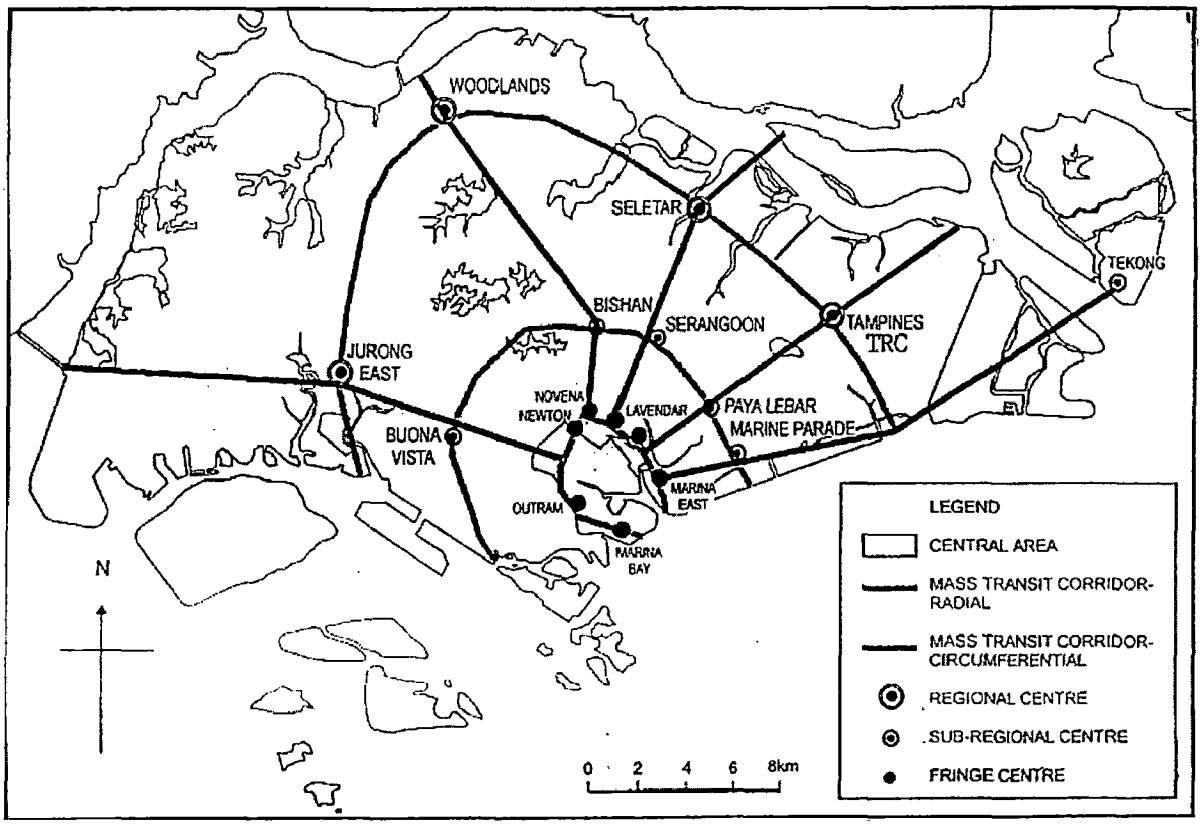


Figure no. 2.23: Location of Tampines Regional Centre.

A detailed three separate survey had been conducted by authors o assess the employment and work travel pattern in the study area. Further, the investigators have made through analysis about the mode of travel to work by residents, resident's work place by travel time to work, mode employees travel to work, distribution of travel time to work by residence. The results indicates that commercial firm were mostly attracted, due to its good location and accessibility to public transport at Regional centres, which will provide more employment opportunities residents in that region.

The study of the authors concluded that the integration of land use and transport planning through the development of regional centres can be an elective way of reducing the amount of work-travel and reliance on the car in order to alleviate traffic congestion in cities, the Singapore experience may not be readily applicable to other cities. The regional centres as planned are intense commercial centres surrounded by high-density housing and integrated with an efficient public transport system. Cities with similar compact, high-density urban areas may be able to adopt a similar strategy, but such an integration of land use and transport planning will not be possible for cities suffering urban sprawl with low-density suburbs. For such cities, it will be necessary to first address the fundamental problems of urban sprawl and the efficiency of transportation networks. Where the urban population can be concentrated and serviced by high-capacity and efficient public transportation systems, decentralization strategies are likely to enjoy a greater likelihood of success.

2.3.5. PLANECO - planning in ecological networks:

Piergiorgio BELLAGAMBA [2000], PLANECO is a research project founded by the Italian Ministry of University and Scientific Research in the years 1998–2000. The author chosen Italy and made attempt to understand the national ecological network. In Italy the interconnection between the natural and cultural systems, together with the overlay of a national ecological network, interacts at all levels of planning and land use transformation. The author studied the Planeco Project and suggested some possible solutions for this problem in three ways:

1. In the first case, 'dynamic indicators' will be used to determine the present situation and possible scenarios. Among these indicators are settlement dispersion, infrastructure density and permeability, and spatial and quantitative relationship between natural and urban land use.
2. In the second, the new consideration of a ramified zone structure of protected areas takes the place of the old consideration of a centralized zone structure. This allows a better environmental continuity between the inside and the outside of the parks, and supports an eco-centric planning process to be tested in areas of special environmental protection.
3. In the third, town-planning principles like linear urban development are reviewed because they fragment environmental continuity and threaten the quality of nature.

The investigator considered the important parameters such as bio-permeability, the major units of environmental continuity, Environmental systems and landscape units, Environmental fragmentation of infrastructural and urban barriers, Potential zoological diversity and Geography of social morphologies and carefully analyzed. It has been observed by the author that the development of ecological networks in Europe and, particularly, in Italy should be carried out incorporating cultural aspects into the features of an ecological network and, in turn, considering the interaction between its natural and cultural components. Socio-economic trends and functions of the site should be taken into account, linking ecology to environmental economics. Then, the integration of ecological networks into the planning system becomes imperative.

The author concluded that wider landscape context should be used in the development of ecological networks, including human processes that have shaped the landscape and its natural and cultural components. The wider public policy context can be addressed in parallel, with the goal of balancing nature conservation with sustainable development. Further, this assumption emphasizes how ecological networks, in areas of ancient human occupation like Italy, are located between nature and culture. Finally the author stressed this reason the planning of future landscapes in these areas should imply not only ecological and natural aspects, but also cultural, social, economic and political considerations.

2.3.6. Strengthening urban governance in the South through city-to-city cooperation: Towards an analytical framework

Marike C. Bontenbal [2009], the author made attempt to Strengthening urban governance in the South through city-to-city cooperation. First, the body of knowledge on urban governance, in particular the relationships between local institutions and civic society is explored.(Figure 2.24). Based on four case study partnerships linking cities in Nicaragua, Peru, South Africa, Germany and the Netherlands, a number of C2C interventions will provide empirical evidence are observed and presented in this investigation. Good numbers of literature have been studied by the author with regard to strengthening urban governance. The investigator developed a theoretical model for assessing C2C contributions to urban governance, by considering three important aspects such as local government strengthening, Reinforcing-civic society relation and civic society capacity building, which is presented below.

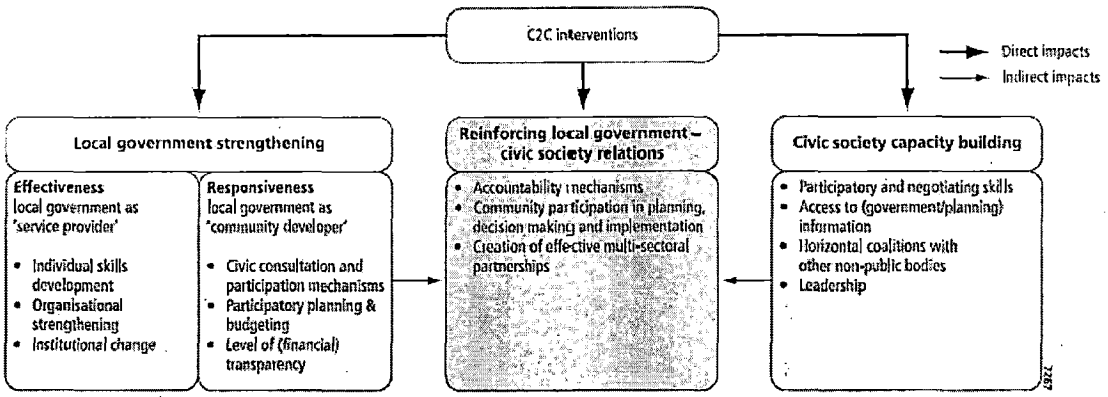


Figure no.2.24: Assessing C2C contributions to urban governance strengthening in the South: the optimal scenario

The investigation concludes with the link between urban governance strengthening and city-to-city cooperation has been identified as multifarious and complex. The potential impact that city partnerships can have on urban governance has been presented in an analytical framework. It takes various dimensions, targeting a range of urban actors, including local governments and citizens. In order to fully understand the impact of C2C on urban governance, a critical assessment should be made of existing governance structures in the cities in the South, including the legal and institutional frameworks of local governments and participation, traditions and cultures of citizenship and existing mechanisms and instruments for municipal planning.

2.3.7. Integrated Urban Infrastructure Development in Asia

KULWANT SINGH and FLORIAN STEINBERG [1996], the authors made an attempt to understand the important elements of experience of integrated urban infrastructure development in Asia. The investigator intention was to discuss the present challenges, shortcomings, and impact of urban infrastructure programs / projects. The authors carefully studied the Seminar, which was co-sponsored by Economic and Social Commission for Asia and the Pacific (ESCAP), Bangkok and the Regional Housing and Urban Development Office (RHUDO) of US AID, New Delhi delegates from 10 countries. The Seminar focused on the integration of 'urban infrastructure' rather than 'urban development' in general, as it was felt that integration in the urban infrastructure field is a tangible objective while integration of all urban development activities is far too ambitious. The investigator have reviewed various experiences and hopes that institutions concerned may feel encouraged to promote a convergence and re-enforcement of the elements applicable for their own integrated urban infrastructure projects/programmes. However, a long time horizon, in order of 10 to 25 years, may be required to imbed innovative programmes which follow this approach of integration, and to incorporate these programmes/projects into the routine operations of local governments. Finally conclude with some plausible recommendations for the integrated approach to infrastructure planning and development for the Asian Region.

2.3.8. Ten Steps to Sustainable Infrastructure

CHARLES L. CHOGUILL [1996], the author made an attempt to achieve the sustainable infrastructure, particularly water supply, sanitation, drainage and solid waste management. Good number of literature had been reviewed by the author with respect to water supply, sanitation facilities, drainage, urban roads, solid-waste disposal facilities, land management on the basis of existing situations of various cities. The author developed a model for the progressive improvement to a conventional standard of urban infrastructure in a sustainable manner, paying particular attention. The investigator opined that the development of an adequate infrastructural base in urban areas is a prerequisite to the achievement of urban sustainability. Simplistically, infrastructure can be divided into two components. The first of these is social infrastructure, including educational and health care facilities. The second

category, which forms the core of this research study, is physical infrastructure, including water supply, sanitation facilities, drainage, urban roads, solid-waste disposal facilities and land management. These include what the World Bank refers to as "the long lived engineered structures, equipment and facilities, and the services they provide which are used in economic production and by households".

The author had developed a sustainable model for the progressive improvement of infrastructure with ten guiding principles. They are:

1. *It must be recognized that within all cities in the developing world, two inter-dependent circuits exist, the formal and the informal*

3. *It must be recognized that the town system of infrastructure, that which is based on conventional technology, should be operated by either a municipal authority or a private firm nominated by that municipality, on a full cost-plus recovery* basis.

4. *Irregular land tenure issues should be resolved within the informal residential sectors of the city*

5. *Informal infrastructure should be designed and built using external technical assistance as required, to be upgradable from a basic standard to that which can be incorporated, with time, into the town system*

6. *Informal infrastructure built by the local community should be under its control*

7. *The technology adopted for informal-sector infrastructure must be maintainable by the community*

8. *The informal structure must be affordable by its low-income users*

9. *Informal-sector infrastructure must be socially acceptable to the community involved*

10. *In order to achieve city-wide coverage of infrastructure, including within the informal residential sector, it is necessary that government adopt the role of facilitator and enabler rather than merely as provider*

11. *Non-governmental organizations can play a key role in assisting communities to develop infrastructure systems.*

The overall conclusion of the study is that a shift is taking place in the way that the role of the local community must be seen with respect to infrastructure. Increasingly, multilateral organizations are shifting priority from the neighborhood to higher levels. Till

today the environmental concerns and sustainability arguments are great challenge to city administrators. As a result, governments, non-governmental organizations and communities must all work together to design systems that can be built locally and operated and maintained by the community, and yet which can be upgraded from on-site and community standard to the generally accepted conventional town standard. Further the study concludes that the sustainability can be achieved overnight, yet should constitute a target for future development. In order to achieve this, local communities will require considerable assistance and support from agencies and organizations at all levels. Yet without this, environmental standards will continue to deteriorate, mortality rates will continue at a high level and acceptable standards of living will continue to remain elusive for low-income groups.

2.3.9. How to assess the quality dimension of urban infrastructure: the case of water supply in Delhi

Marie-He´le`ne Ze´rah [1998], The author made an attempt to understand the realty water supply for households with access to piped water supply in Delhi City. The author had reviewed good number of literature to assess the status of nation's water supply and also impact of water supply unreliability. It has been observed by the author based on the literature that problem of water supply unreliability in Delhi lies more in an inefficient management of the supply network rather than in a scarcity of water resources. Further, the author had analyzed annual cost of water supply unreliability borne by households in Delhi and comparative analysis between Delhi Municipal Corporation and private house expenditure was also compiled by the author. It has been observed by the author after thorough analysis, If providing water round the clock is not an easy task, marginally improving the level of supply is certainly a feasible option as an increase in the water tariff is likely to be accepted by households, at least to a certain extent. Also, a reliable supply would have a positive impact on health and on the environment. In fact, the only argument in favor of an unreliable supply is that unreliability can be used as a tool to regulate demand. Besides, this is an argument often given by the authorities in Delhi. They affirm that, as the water tariff is too low to control the demand, unreliability plays this role effectively. To verify this assumption is of major importance for the definition of public policy.

Finally, concluded that the measure the quality of a service provided by taking only into consideration the number of hours of supply is not enough. The introduction of data on pressure provides us with a more appropriate picture of the reality. It also gives a better understanding of the demand while underlining the importance of the concept of service which is differentiated according to users and usage. Mostly, it raises the question of the social cost of deficient infrastructure for the community. Hence, to comprehend the multidimensional aspects of infrastructure is undoubtedly a major step for a better definition of public policies.

2.4 OBSERVATIONS

1. Thiruvananthapuram City is the State capital; similarly the city which I have chosen for this investigation is also a State capital.
2. All these cities are having almost similar socio-economic and physical settings; however the Pune City is located not nearer to the sea front.
3. All these three cities are having knowledge based industries (IT industry).
4. Thiruvananthapuram City and Pune City are having knowledge based industries such as Techno park and Information Technology industries. The study area [Puducherry City] is also thriving for knowledge based industries.
5. All these three cities are having good numbers of qualitative health and education institutions, as a result, not only pupil from India, but also from across the globe are studying in all these three cities.
6. All these three cities are having very conducive climate for socio-economic growth.
7. All these three cities are well connected by road and rail network, however, the study area [Puducherry City] has little difficult in Air connectivity.
8. Thiruvananthapuram City and Puducherry City are having water logging problems, though Puducherry City is confined in the seashore and Thiruvananthapuram City located for about 8 km away from the seashore.
9. All these three cities are having the problem of Solid Waste Management.

10. All the three cities are having good domestic water supply system; where as drainage and sewerage related problems prevail in all these three cities.
11. The land value is shooting up in skyrocketing speed in all these three cities, due to (i) non availability of much land and (ii) Availability of knowledge based industries [Information Technology industries], within the urban system.
12. Change in land use is also observed in all these three cities, however, the intensity of land use change in Thiruvananthapuram City is comparatively lesser.

STUDY AREA PROFILE

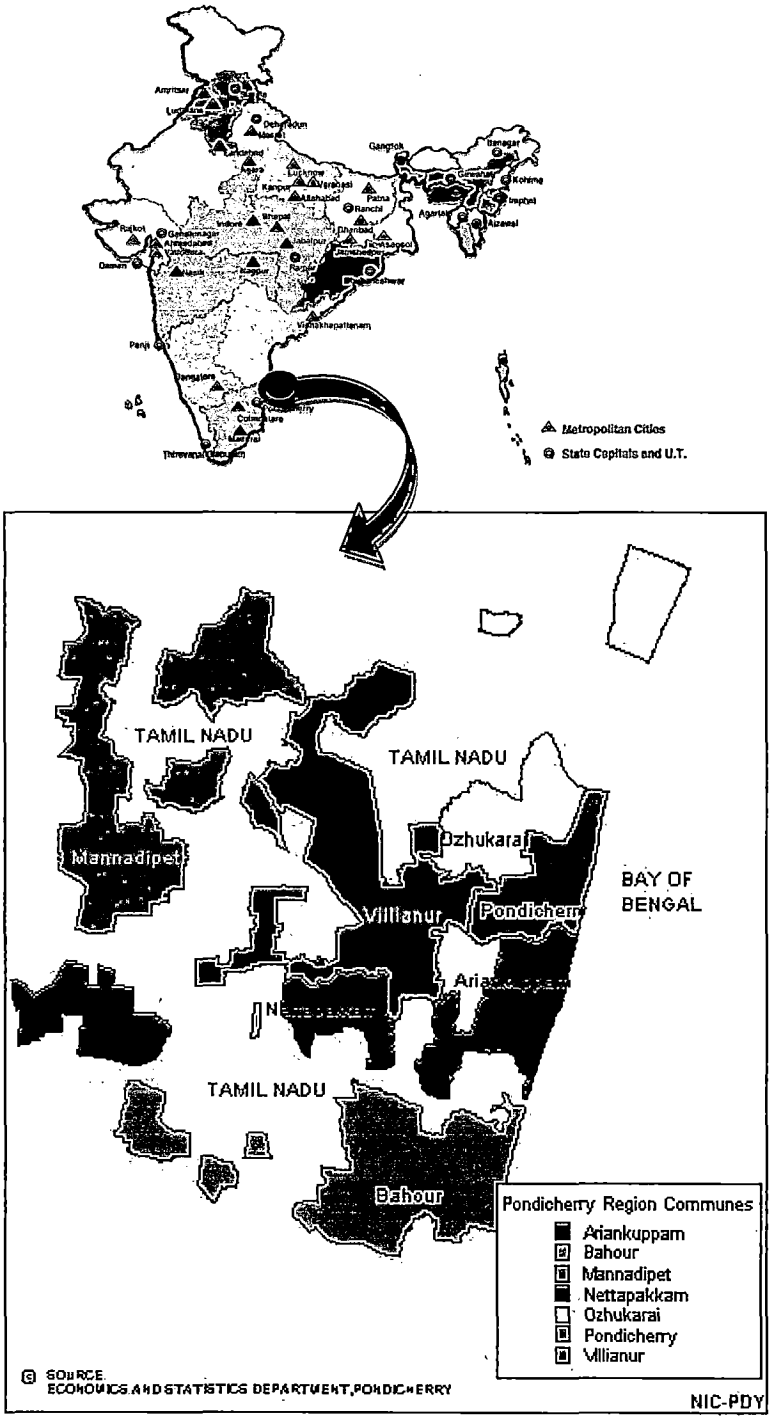
3.1 INTRODUCTION

Puducherry is a city, an urban agglomeration and a municipality in Puducherry District in the Indian union territory of Puducherry. Both the Union Territory and the city were previously known as 'Pondicherry', i.e., before September 2006. Puducherry is one among the seven Union Territories of India. The Union Territory of Puducherry was constituted out of the four erstwhile French establishments of Pondicherry, Karaikal, Mahe and Yanam. Puducherry and Karaikal are embedded with Tamil Nadu. The bulk of Puducherry region is an irregular stretch of land consisting, the municipalities of Puducherry & Oulgaret, and commune panchayats of Ariankuppam, Villianur, Nettapakkam, Mannadipet and Bahour respectively.

3.1.1 LOCATION

Puducherry city is a flat terrain of average elevation of about 15 metres above the mean sea-level, intersected by the deltaic channels of River Gingee, Ponnaiyar and other streams forming the two main drainage basins, interspersed with lagoons, lakes and tanks. River Gingee crosses the region diagonally from northwest to southeast. Ponnaiyar forms the southern border. The alluvial delta of Ponnaiyar is only a few metres above the sea. To the northwest of these hills are a section of fossiliferous limestone formations of the Cretacian age. To the south of this area is situated in the alluvial tract of Varahanadi (Gingee) and to the north is the recent alluvium. Besides the main area, the region's eleven enclaves lie scattered within Villupuram, Tindivanam and Cuddalore Taluks. The three isolated enclaves of Mannadipet Commune lie on the North West. One peculiar feature of Mannadipet Commune is that the area surrounding Vadhanur village in Mannadipet main enclave is a mixed territory. Some of the plots in the area belong to Puducherry and the others to Tamilnadu. Nettappakkam Commune has one isolated enclave towards the southeast. Villianur has a very small enclave, viz., and the Manakuppam enclave close to the limits of Nettappakkam Commune forming part of the bulk. Thus, from north to south these eleven enclaves skirt the

main entity of Puducherry almost in a semi-circle between 11° 45' and 12° 0' Northern latitude and between 79° 37' and 79° 50'of Eastern longitude. The Bay of Bengal bound the region as a whole on the East and by Villupuram & Cuddalore District on all the other sides. The total area of the this city is 293 Sq.km, and is presented in Figure 3.01



Figureno.3.01: Location of Puducherry Region, India

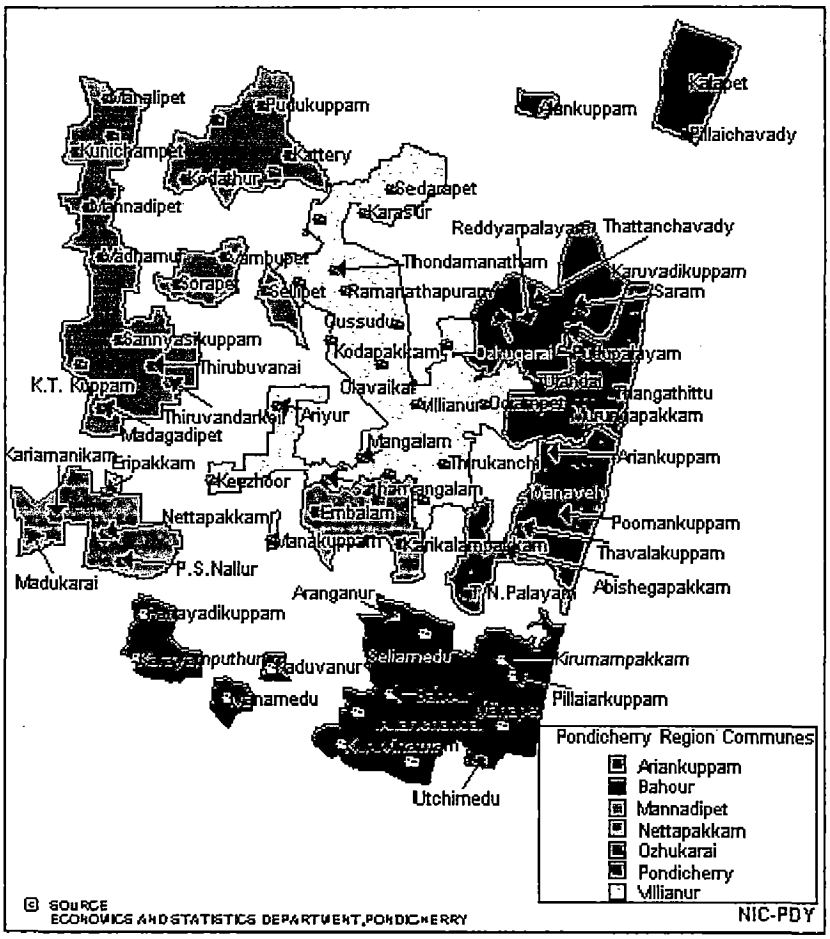
3.1.2 HISTORICAL BACKROUND

Puducherry called as 'Poduke' in olden days has a very old history that dates back to first century AD. According to legend Puducherry was once an abode of scholars well versed in Vedas, and hence called Vedapuri. During the 14th Century, Puducherry was under Vijayanagar Empire and was ruled by Naiks of Thanjavur and Bijapur Sultan. During this period, Portuguese and Danish merchants used the place as a trading center.The French East India Company established their trading centre at Puducherry in 1674. Dutch and British trading companies also interested in trade with India and Dutch captured Pondicherry in 1693, but returned it to France by the Treaty of Ryswick in 1699. In 1703, Francois Martin obtained the village of Kalapet from Nawab Dawood khan, the representative of Aurangzeb, in order to obtain timber from the forests surrounding it for construction of houses in Puducherry town. The same Nawab ceded the village group of Ozhukarai in 1706, as well as the village groups of Murungappakkam, Olandai, Pakkamudiyanpet and Karuvadikkuppam. Nawab Safdar Ali gave the villages of Theduvantham and Archivak (Abhishekapakkam), Odiyambattu and Tirukkanji as gift to Dumas in September 1740. The French acquired Mahe in 1720s, Yanam in 1731, and Karaikal in 1738.Duplex became the Governor of French Territory in India on 15th January 1742 and brought Madras also under French control in September 1746. Madras was under French regime for 30 years. The attack of Pondicherry by the British in 1748 failed. Dupleix's help to Chanda Sahib and Musafer jung in 1750 added Villianur and Bahour, a group of 36 villages, to the French rule. In 1750, following the victory of Ambur, Musafar Jung confirmed the grant of Villianur and added 36 villages of Bahour so that the advance posts were brought up to the Ponnaiyar. Since then, the French territories were besieged four times second in 1761, resulted in the capture of the town. Following the Treaty of Paris signed on 10 February 1763; Puducherry and its dependencies which included Ozhukarai, Ariankuppam,Virampattinam, Murungappakkam, Pakkamudiyanpet, Olandai, Abhishekapakkam,Kommapakkam and Kalapet, and were restored to the French. It was again besieged and captured in 1778 and restored in 1785. It was captured a third time in 1793. Following the Treaty of Peace of 30th May 1814 the establishments were finally restored in 1816.The Treaty of 1814 provided for the restitution of all the settlements and factories which France had possessed in India as on 1 January 1792. These possessions were determined by the Convention concluded at Versailles on 31st August 1787 and by the Treaties of Peace

(Versailles) signed on 3 September 1783 and previously on 10 February 1763. Thus by the Treaty of 1814, the French were allowed to retain only those areas which were in their possession in 1763.There was internal disturbance in Pondicherry and the British utilized this opportunity in August 1793 to gain Pondicherry under their control and it was administered as part of Madras till 1815. However, after the Treaty of Paris in 1814, the British restored the possession of the settlements, which the French possessed on 1.1.1792 back to the French in 1816. Since then the French rule continued till 31-10-1954.Pondicherry helped in the freedom movement in British India since 1910. Sri Aurobindo of Bengal came to Pondicherry in 1910 followed by patriots like Poet Subramanya Bharathi, V.V.C. Iyer and others. In 1918, the British demanded the extradition of Sri Aurobindo and other freedom fighters. The French government did not comply with this. Mahatma Gandhi visited Pondicherry in 1934 and Jawaharlal Nehru in 1939.Pondicherry still retains much evidence of its history as a French colony. The design of the city was based on the French grid pattern, features neat sectors and perpendicular streets. The entire town is divided into two sections, the French Quarter ('Ville Blanche' or 'White town') and the Indian quarter ('Ville Noire' or 'Black Town'). The history of French India is led by Joseph Francois Dupleix, governor general of the French establishment in India, and the rival Robert Clive. There is also French influence in the layout of the city. The numbering of the houses is unique compared to other cities in Tamil Nadu, in which all with the even numbers are on one side and the odd number are on the opposite side of the road.

3.1.3 PHYSICAL ASPECTS

Area: The territory has a total area of 492 km²: Puducherry 293 Sq.km, Karaikal 160 Sq.km, Mahe 9 Sq.km and Yanam 30 Sq.km .The total area of Puducherry region and its eleven enclaves is 293 Sq. km, comprising of 81 revenue villages with the total population of 735,332 which 75.47 per cent of the total U.T. population of 9, 74,345 according to the census 2001.The study area comprising of 293.00 Sq.km, and is presented in Figure 3.02. The urban agglomeration of Puducherry District is 71.90 Sq.km, and is presented in Table 3.01.



Figgure no.3.02: Puducherry Region – Commune wise

Table no.3.01: Puducherry Urban Agglomeration

S.No.	Local Bodies	Area	Population
1	Pondicherry Municipality	19.54 Sq.km	2,20,865
2	Oulgaret Municipality	36.70 Sq.km	2,17,707
3	Villianur Commune Panchayat [Urban]	10.89 Sq.km	44,194
4	Ariankuppam Commune Panchayat [Urban]	4.77 Sq.km	23,193
Total		**71.90 Sq.km**	**5,07,960**

Source: Town & Country Planning Department, Puducherry

Topography: The Pudycherry region is flat terrain of average elevation of about 15 meters above the mean sea level, intersected by the deltaic channels of River Gingee and Ponnaiyar and other streams forming the two main drainage basins, interspersed with lakes and tanks. To the North-West of Pondicherry town, a girdle of low hills (or an elevated

ground of about 30 meters high) is noticed to extend in a E.N.E.–W.S.W direction. This high ground suddenly emerges from the low alluvial plain country. Known as "Les Montagnes Rouges" or the "Red Hills of Pondicherry", or Gorimedu, probably so named after the memorials put up during the first siege of Pondicherry (1760). This forms the most prominent feature in the landscape. River Gingee crosses the region diagonally from north-west to south-east. Ponnaiyar forms the southern border. Actually the alluvial delta of Ponnaiyar is almost on dead level ground, only a few meters above the sea. To the north-west of this hills is a section of fossiliferous limestone formations of the Cretacian age. To the south of this area is situated the alluvial tract of Varahanadi (Gingee) and to the north is the recent alluvium. Pondicherry area is said to mark the northern limit of sediments laid down during the great Cenomanian marine transgression along the east coast of South India. According to geologists the high ground might have been formed due to faulting and upliftment along a plane extending in a general E.N.E–W.S.W. direction. The Muthirapalayam water wells with plentiful of water may be lying along the plane postulated fault. According to them, the lateralized scrap of the Cuddalore rocks west of Kalapet may also be representing a fault which, when extended, joins the Red Hills. Black clays and simulating marine clays have been observed in well cuttings to the west and south west of Pondicherry with local intercalation of peaty materials and sands. The persistence of the horizon over a considerable area is said to be suggestive that the area at one time must have been a lagoon. There are evidences to show a gentle submergence along the east coast perhaps during the Pleistocene times. During the period several changes seem to have been taken place including the changes of course of certain rivers. According to the geomorphologists, the straight shore line is also suggestive of some structural dislocation. Shallow bays were formed during the submergence, the limits of which may be traced from the presence of black sticky clays recorded in the area. The unusual thickness of alluvium near Pondicherry (which is stated to exceed 167 meters) is said to indicate that it was part of an extensive lagoon, which has since been silted up and uplifted. Beds of peat at various levels below the surface of the ground have been recorded near Pondicherry. The coastal border has a length of 22 Km. and a breadth ranging from four to six hundred meters. Superficially the coast is flat and sandy. The coastal zone of Pondicherry comprises newer and older dunes including saline areas of clayey texture. The other zone is made up of the two plateaux called Podicherry plateau and the Thiruvakkarai plateau

composed of geological formation called the "Cuddalore sandstone". The upper layers are made up of red transported ferralitic soil. The Valudavur plain lies between these Plateaus. Marshy depressions are also frequently encountered in the plains of Valudavur. The flat alluvial zone occupies the rest of the Pondicherry region.

Weather: Puducherry experiences a hot and tropical maritime type of climate characterized by small daily range of temperature, humid weather and moderate rainfall. The summer season prevails from March to June, followed by the period of the southwest monsoon, which lasts up to September. The months of October and November constitute the main northeast monsoon season. The winter season prevails from December to February.

Rainfall: The average annual rainfall is of the order of 127 cm/year. Of this about 50 per cent is recorded during October – November. November is the rainiest month contributing about 30 per cent of the annual rainfall. The variability of annual rainfall is fairly large and that of seasonal rainfall still larger. In a year, there are on an average of about 55 rainy days.

Temperatures: The mean daily temperature ranges from 25^0 C to 32^0 C and will rise to 37^0 C during hot summer months of May and the early parts of June. December and January form the coolest part of the year with the mean daily maximum temperature at about 28 ^{0}C and the mean daily minimum temperature at about 21^0 C.

Humidity: In view of the coastal location, the relative humidity is generally high. It ranges from 50 to 75 percent.

Wind Directions: Winds are generally light to moderate in velocity during summer and early southwest monsoon season. During southwest monsoon, winds are mostly from south to west. During the summer season, winds are southwesterly or westerly in the morning and southerly or southwesterly in the afternoons. In October and January winds are varied in directions.

Ground Water Table: Ground water in the project area is generally found at the shallow depths of five to ten feet in the coastal areas and 30-40 m in the western parts. The ground water drops by few meters in the lean months.

Linkages and Connectivity: Puducherry Town is situated on the eastern side of Puducherry district and is the district headquarters. This town has first-class connectivity with Tamil Nadu state. The East Coast Road connects Puducherry with Chennai. Apart from this the other important roads are NH45A and NH66, which are also passing through this city.

Railways: Puducherry is connected by broad gauge railway line. Recently, a new train has started from Puducherry connecting Bhuvaneswar City via Chennai.

Port: Puducherry has an old port located near the lighthouse and a new port near Ariankuppam, in Puducherry.

Airport: Puducherry has a medium sized airport, but is not functional. The airport in Puducherry is not economically viable due to the presence of Chennai airport, which is close to Puducherry and airport expansion work is now under progress.

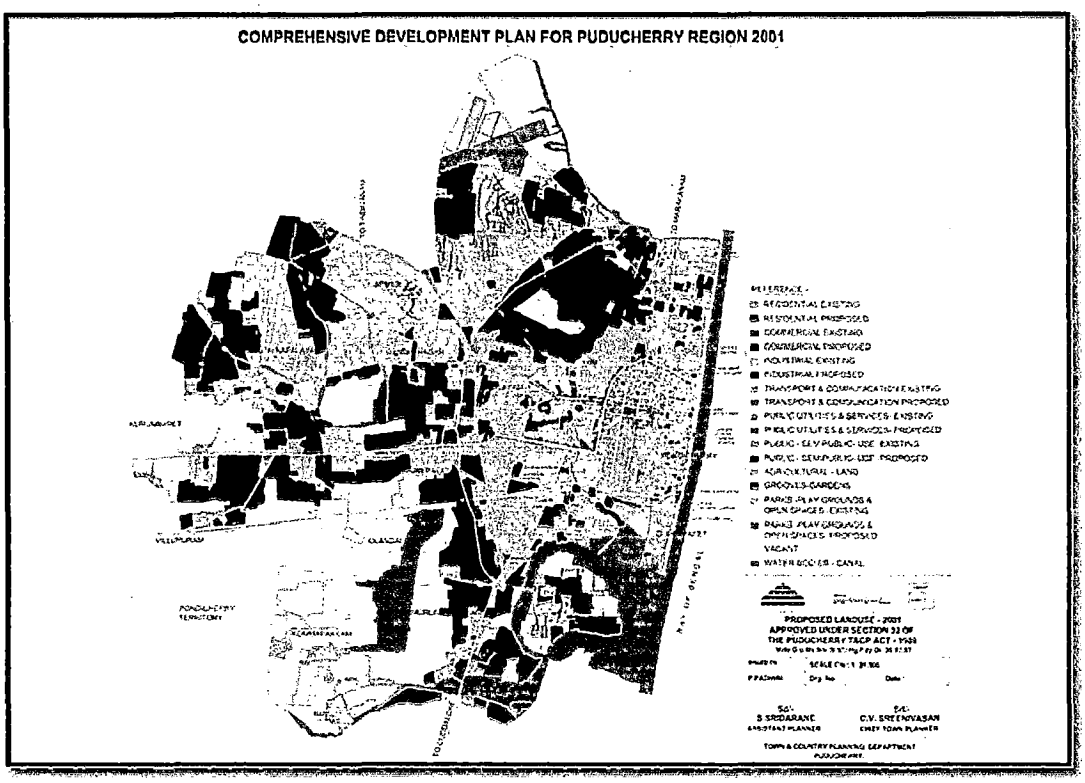
3.1.4 LAND USE IN PUDUCHERRY REGION

The Comprehensive Development Plan of 1982 for Puducherry & Oulgaret municipalities was evolved to provide for the physical growth and balanced evelopment of the notified planning area through a series of intergraded land use zones specifying the uses. The Comphrehensive Development Plan (CDP) was made statutory on 9 March 1982. The planning area covering an extent of 41.91 sq. km includes the municipal areas of Puducherry and Oulgaret, excluding the revenue villages of Kalapet, Pillaichavady and Alankuppam. The CDP was framed for projected population of 3.25 lakhs within the planning area by the year 1994. However, the population as per 1991 census for the said area is 3.48 lakhs, and further bound to rise to 4.82 lakhs by the year 2001. Subsequently, the urban agglomeration was extended from 41.91 Sq.km to 71.90 Sq.km. The Comprehensive Development Plan is mainly delineated into six Planning Divisions and seven villages. The land use analysis as per the revised CDP is presented in Figure 3.03 and in Table 3.02.

Table no. 3.02: Land use Analysis of Puducherry City

Sl.No.	Land Use	Existing-1997(in Ha)	Proposed-2002 (in Ha)	% to Total area
1	Residential	952.79	1325.40	31.62
2	Commercial	55.00	72.02	1.72
3	Industrial	142.00	210.87	5.04
4	Transport and Communication	506.14	750.30	17.90
5	Public utilities and Services	11.13	38.33	0.91
6	Public and Semi Public	285.00	267.86	6.39
7	Parks and Playgrounds	161.82	195.98	4.68
8	Major recreation	40.47	30.24	0.72
9	**Total Developed area**	**2154.35**	**2891.00**	68.98
10	Canals and Water Bodies	75.69	308.09	7.35
11	Grooves and Garden	25.60	102.65	2.45
12	Green Belt	192.40	-	-
13	Agriculture	1742.50	888.80	21.21
	Total	**4190.54**	**4190.54**	**100.00**

Source: Town & Country Planning Department, Puducherry



Source: Town & Country Planning Department, Puducherry

Figure no.3.03 Comprehensive Development Plan of Puducherry City

3.2 DEMOGRAPHIC CHARACTERISTICS

Puducherry region has witnessed a rapid growth of population in the past three decades. Especially during the decade 1981-91, the State has grown at a rate of 33.6 per cent and Puducherry district at a rate 36.8 per cent per annum. The population details of Puducherry urban area (comprising of Puducherry & Oulgaret Municipalities and Ariankuppam & Villianur Commune Panchayats) is presented in Table 3.05. This rapid growth is attributed to the industrialization and urbanization of adjacent towns, such as, Oulgaret, Ariankuppam and Villianur. In 2001, the urban area of Puducherry was increased with the addition of Ariankuppam and Villianur. In terms of absolute numbers, Puducherry and Oulgaret towns of the State constitute around 50 percent population of the State and 60 per cent of the Census District. The Population and growth trends are presented in Table 3.06.

Table no.3.05: Details of population in Puducherry urban area

Sl.No.	Area	Population			Growth Rate (%)	
		1981	1991	2001	1981-91	1991-01
1	Puducherry U.T.	6,04,471	807785.00	9,74,345	33.64	20.62
2	Puducherry region	4,44,417	6,08,338	7,35,332	36.88	20.88
	Urban area					
3	Puducherry Municipality	1,62,639	2,03,065	2,20,865	24.86	8.77
4	Oulgaret Municipality	95491.00	1,59,951	2,17,707	67.50	36.11
5	Ariankuppam (Urban)	9409.00	13498.00	23193.00	43.46	71.80
6	Villianur (Urban)	18178.00	22730.00	44194.00	25.04	87.47
	Total	**2,85,717**	**3,99,244**	**5,05,959**	**39.73**	**26.33**

Source: Compiled by the Investigator based on Census of India, 2001

Table no.3.06: Decadal Growth of population

S.No.	Decadal Growth of Population					Decadal Growth (%)		
1	Region	1971	1981	1991	2001	1971-81	1981-91	1991-2001
2	Pondicherry	340240	444417	608338	735332	30.62	36.88	20.87

Source: Compiled by the Investigator based on Census of India, 2001

3.2.1 Population Density

Puducherry has one of the highest densities in the country. The gross density in the urban areas has increased from 5,553 persons per sq km in 1991 to 7,037 persons per sq km in 2001. The increase in density is mostly due to natural increase and also due to migration from nearby villages. The population density in Puducherry municipal limits is 11,303 persons per sq km, which has reached the saturation level. The population is expected to grow more in the outer areas. The population density in Puducherry urban area is presented in Table 3.07.

Table no.3.07: Population Density in Puducherry urban area

Sl.No.	Town	Area (in Sq.km)	Population		Density	
			1991	2001	1991	2001
1	Puducherry Municipality	19.54	203,065	2,20,865	10,392	11,303
2	Oulgaret Municipality	36.7	1,59,951	2,17,707	4,358	5,932
3	Ariankuppam (Urban)	4.77	13,498	23,193	9,059	4,862
4	Villianur (Urban)	10.89	22,730	44,194	2,087	4,058
Total		**71.90**	**3,99,244**	**5,07,960**	**5,553**	**7,037**

Source: Compiled by the Investigator based on Census of India, 2001

3.2.2 Household Size

The household size in Puducherry urban area has reduced from 5.04 in 1991 to 4.39 in 2001. The reduction in the household size is due to migration and increase in nuclear families. The household size in Puducherry urban area presented in Table 3.08.

Table no.3.08: Household size in Puducherry urban area

Sl.No.	Town	Area (in Sq.km)	Households		Household Size	
			1991	2001	1991	2001
1	Puducherry Municipality	19.54	40376	49423	5.03	4.47
2	Oulgaret Municipality	36.70	31906	48830	5.01	4.46
3	Ariankuppam (Urban)	4.77	2524	5041	5.35	4.61
4	Villianur (Urban)	10.89	4357	9500	5.22	4.48
Total		**71.90**	**79163**	**114795**	**5.04**	**4.39**

Source: Compiled by the Investigator based on Census of India, 2001

3.2.3 LIVESTOCK

Rearing of livestock has plays a significant role in the development of rural economy and it has become a way of life. Bulk of the livestock products come from small and non-commercial farmers. These farmers are mostly poor and have limited capacity in knowing the Government Programmes. No livestock improvements programme can make headway unless the implementation of strategy developed among all people a sense of active involvement.

The Livestock population of Puducherry region, as per the livestock census, 2003 is presented in the Table 3.08(a). This table reveals that the study area is having total livestock population and Total numbers of poultry of 1, 05,562 and 2, 01,667 respectively, as per the census year, 2003. Further, it has been observed from the table that total livestock comprising of crossbred cow, N.D. cow, buffalos, sheep, goat, pigs, horses and ponies, donkeys, dogs and rabbits in the system. Normally, the livestock census has been carried out for every five years and the livestock population of Puducherry Union Territory from the year 1961 to 2003 is presented in the Table 3.08(b). This table reveals that the total livestock population total numbers of poultry has been increased from 1, 36,046 to 1, 58,305 and 1, 01,614 to 2, 44,475 respectively from the year 1961 to 2003.

To safeguard the health of domestic animals and to sustain and improve the productivity of farm animals, in the study area have been taken care of Animal Husbandry and Animal Welfare Department, Puducherry. The efficient strategies for the development of required infrastructure throughout the study area for extending Veterinary health coverage and breeding facilities are very much essential to cater the needs of meat and milk productivity in the system. There is another aspect which is equally important to make available the adequate quantity of animal protein for the growing population and to improve the income of the rural poor in non-plant production activities on priority basis, which in turn helps in strengthening the economy of the rural areas.

Table no.3.08 (a): Livestock population in Puducherry region

Sl.No.	Region/Commune	Crossbred Cow			N.D. Cow			Buffalo			Sheep	Goat	Pigs	Horses and Ponies	Donkeys	Dogs	Rabbit	Total Live stock	Total Poultry
		Male	Female	Total	Male	Female	Total	Male	Female	Total									
1	Puducherry	376	1948	2324	42	169	211	72	466	538	40	1627	146	2	1	4362	346	9597	11830
2	Oulgaret	533	3451	3984	259	871	1130	14	92	106	75	1683	141	11	6	4867	291	12294	33607
3	Bahour	1447	7407	8854	369	1740	2109	65	204	269	468	3989	80	6	-	2596	96	18467	15422
4	Ariankuppam	461	3095	3556	206	1213	1419	4	59	63	2	2799	-	1	7	1262	124	9233	24966
5	Mannadipet	1249	8235	9484	465	1507	1972	13	93	106	908	4346	86	19	-	2067	75	19063	50496
6	Nettapakkam	961	6899	7860	162	1020	1182	7	48	55	313	3967	32	-	-	1660	176	15245	28364
7	Villianur	1159	8565	9724	261	1761	2022	89	327	416	408	5796	44	12	3	3022	216	21663	36983
I	Puducherry Region	6186	39600	45786	1764	8281	10045	264	1289	1553	2214	24207	529	51	17	19836	1324	105562	201667
II	Karaikal Region	2454	13419	15873	1389	3803	5192	158	737	895	218	22690	248	24	1	3137	365	48643	28549
III	Mahe	81	503	584	1	15	16	1	0	1	-	136	-	1	-	429	14	1181	6370
IV	Yanam	84	185	269	40	290	330	88	1350	1438	157	506	54	4	-	161	-	2919	7889
V	Union Territory of Puducherry	8805	53707	62512	3194	12389	15583	511	3376	3887	2589	47539	831	80	18	23563	1703	158305	244475

Source: compiled by the Investigator based on livestock census 2003, Animal Husbandry and Animal Welfare Department, Puducherry

Table no.3.08 (b): Livestock Census Population during 1961- 2003

Sl. No.	Category	Number of Livestock from 1961 to 2003								
		1961	1966	1972	1977	1982	1987	1992	1997	2003
1	Cattle	79590	80110	89602	91600	93526	88717	92720	72769	78095
2	Buffalo	11365	11668	12110	9986	9042	10072	7152	4042	3887
3	Sheep	8050	7946	7056	4603	9030	5449	3994	1923	2589
4	Goat	35501	34163	41731	39258	52531	32707	44016	40719	47539
5	Pig	1161	2003	1891	2362	2537	700	849	1256	831
6	Others	379	285	256	304	10159	11754	9030	13975	25364
7	**Total Livestock**	**136046**	**136175**	**152646**	**148113**	**176825**	**149399**	**157761**	**134684**	**158305**
8	**Poultry**	**101614**	**117661**	**180343**	**148229**	**165126**	**107367**	**123198**	**121276**	**244475**

Source: Animal Husbandry and Animal Welfare Department, Puducherry

3.2.4 LITERACY

Literacy rate is considered as one of the major indicators, which is highly responsible for urbanization process. The national literacy rate is 65.38 per cent, whereas Puducherry city has 80.66 per cent, and enjoys the higher literacy rate. This shows that the Puducherry city has higher literacy rate than the national average and the literacy rate in Puducherry urban area is presented in Table 3.09.

Table no.3.09: Literacy rate in Puducherry urban area

Sl.No.	Area	1991			2001		
		Total	Male	Female	Total	Male	Female
1	Puducherry Municipality	70.70	77.38	63.90	72.36	81.52	70.55
2	Oulgaret Municipality	68.37	76.10	60.28	75.88	81.63	70.01
3	Ariankuppam (Urban)	66.82	74.73	58.76	71.55	78.54	64.58
4	Villianur (Urban)	62.66	71.23	53.57	69.54	76.27	62.64

Source: Compiled by the Investigator based on Census of India, 2001

3.3 ECONOMY

In general, the primary and the secondary sector of the economy dominates developing countries, whereas, the tertiary sector dominate in the developed countries economy. The Indian economy is considered as developing one. The details of State income and sector wise distribution of GSDP are presented in Table 3.10 and in Figure 3.04 respectively. It has been observed from this table and the figure that the secondary and tertiary sectors are having almost equal contribution i.e., 47 per cent and 48 per cent respectively. These two sectors of the economy are almost equally dominate in this State, and whereas the primary sector has considerably less contribution which is about 5.00 per only in the study area.

The status of the economy of the state reveals that the contribution of tertiary and secondary sectors (net domestic product at current prices) is increased from Rupees 623077 in 2006.07 to Rupees 700228 in 2007-08, whereas the contribution of primary sector towards the total economy is very less for the corresponding period. It is evident that both secondary and tertiary sector of the economy dominates the economic structure of the study area.

3.1.5 VEGETATION

The most important occupation in this Pondicherry Union Territory is Agriculture, which provides livelihood to about 35 per cent of the rural population. The Union Territory of Pondicherry is characterized with large portion of small holdings of less than 1 ha. The land holding pattern and land use pattern are presented in Table 3.03.

Table no.3.03: Land Holding Pattern of Puducherry

S.No.	Land Area	No. of Holdings	Area in Ha.
1	Less than 1 Ha.	26096	9299
2	In between 1 and 2	5011	7105
3	Above 2 Ha.	3468	16874
	Total	**33278**	**34575**

Source: Department of Agriculture, Pondicherry

The Union Territory of Puducherry receives rainfall both from "South – West monsoon" and "North–East monsoon." The monsoon period (June to May) is divided into four seasons; i) South–West monsoon, ii) North–East monsoon, iii) Winter period and iv) Hot weather period respectively. The total geographical area of the Union Territory of Puducherry is 480.58 Sq. Km according to the Survey of India, whereas it is reported as 48,651 hectares according to village paper, which is classified into nine categories .The nine fold classification of land utilization and the area under each category with its respective percentage to the total geographical area are presented in Table 3.04.

Table no.3.04: Land use pattern of Puducherry

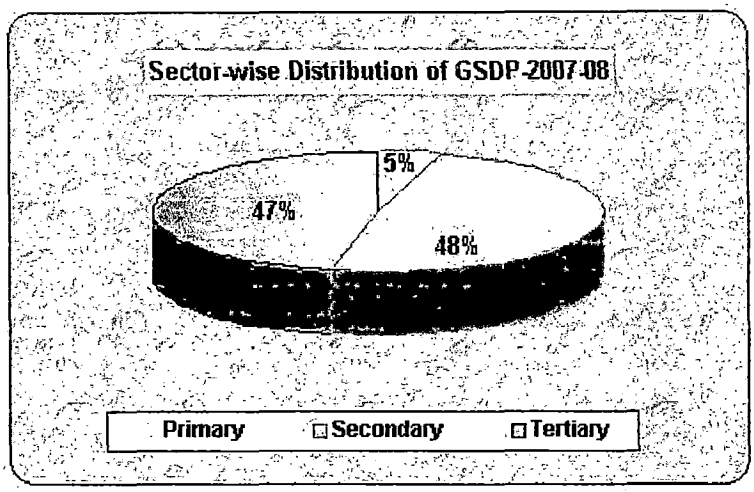
S.No.	Category	2007-2008	
		Area in Hectare	**Percentage to the total Geographical area**
1	Forest	0	0.00
2	Land put to non-agricultural use	18141	37.29
3	Barren and un cultivable land	72	0.15
4	Permanent pastures and other grazing land	0	0.00
5	Land under misc.tree crops and groves	1239	2.54
6	Cultivable waste	4276	8.79
7	Other fallow land	2482	5.10
8	Current fallow	2572	5.29
9	Net area sown	19869	40.84
	Total	**48651**	**100.00**

Source: Season and Crop Report 2007-08, Directorate of Economics and Statistics, Government of Puducherry.

Table no.3.10: Details of State Income

S. No.	Item / Details	Unit	2006-07	2007-08
1	2	3	4	5
	NSDP			
1	At current prices(NSDP)	Rs. in lakh	623077	700228
2	At constant prices(NSDP)	"	351410	393896
3	**Share of G S.D.P. by sectors (at current prices)**			
3.1	Share of Primary Sector	Rs. in lakh	34707	37178
3.2	Share of Secondary Sector	"	347921	396916
3.3	Share of Tertiary Sector	"	336737	378790
	Total		**719365**	**812884**
4	**Per Capita Income**			
	(a)At Current Prices	Rs.	57596	63524
	(b) At Constant Prices	Rs.	32484	35734

Source: Directorate of Economics and Statistics, Puducherry, 2008-09.



Source: Directorate of Economics and Statistics, Puducherry, 2008-09.

Figure no. 3.04: Sector wise Distribution of GSDP for the year 2007-08

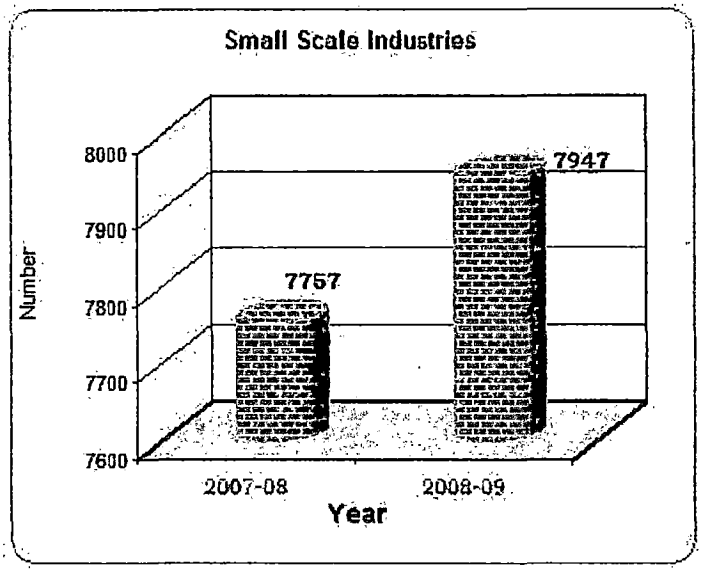
3.3.1 INDUSTRY

Industrial activities are very much essential for the development of the economy. As already discussed that tertiary sector has much dominance in the system, which shows that the study area is having more industrial activities. The details of various categories of industry

and growth of industries in Puducherry Region are presented in Table 3.11 and in Figure 3.05 respectively.

Table no.3.11: Details of Industries in Puducherry Region

INDUSTRIES							
Sl. No.	Item	Unit	2008-09 (Cumulative)				
			Pudu cherry	Karaikal	Mahe	Yanam	State
1	2	3	4	5	6	7	8
1	No. Of Small Scale Industries	No.	**6414**	988	247	298	7947
2	No. of Medium Scale Industries	"	**164**	4	-	8	176
3	No. of Large Scale Industries	"	**59**	10	1	3	73
4	Investment	Rs. in Lakh	**177217**	43153	781	9637	230788
5	Sugar Factories	No.	**2**	-	-	-	2
6	Textile Mills	"	**5**	2	1	-	8
Source: Directorate of Industries & Commerce, Puducherry, 2009							



Source: Directorate of Industries & Commerce, Puducherry, 2009

Figure no.3.05: Growth of small scale industries in Puducherry.

3.3.2 EMPLOYMENT

Employment is considered as one of the most important parameters and considered as the 'back bone' of the economy in the system. The employment opportunities in the primary, secondary, and tertiary sectors of the economy have been considered in this investigation, and have been observed that the secondary and tertiary sectors of the economy are functioning well in the system. It has been observed that there are 43,002 working population in various organizations, which include State government service, central government service and Autonomous bodies in the state during the year 2005-06. The available workers in the State government service, central government service and private sector services are presented in Table 3.12.

Table no.3.12: Details of employment

Details of Employment						
S.No.	Unit	State Government	Central Government	Autonomous bodies	Local Bodies	Total
1	State	28229	4200	7982	2591	43002
2	Percentage	65.65	9.77	18.56	6.03	100.00

Compiled by the Investigator based on Directorate of Economics and Statistics, 2007, Puducherry

3.3.3 ANIMAL HUSBANDRY

The Puducherry District has about 3654 numbers of livestock, including cow, buffalos, goats, which accounts almost one-third (66.06 per cent) of the total livestock in the region, The District also holds more than one-third (68.36 per cent) of total poultry population of the region. The details of the available livestock and poultry in this District are presented in Table 3.13 and in Figure 3.06 respectively.

Milk Production: Milk is one of the major components in the food system of Puducherry Region. More number of people consumes milk and milk based products as food, which create a high demand of milk and milk based products in the system. The above table reveals that the milk production in the State is about 45510 tonnes of this Puducherry district alone accounts for 33857 tonnes, i.e., for about three-forth of (74.39 per cent) of the total milk production in the Region.

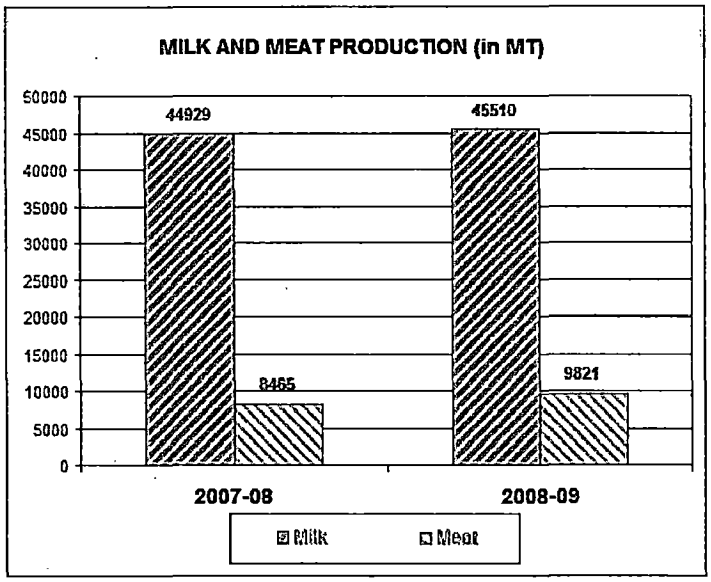


Figure no.3.06: Details of Milk and Meat production for the year 2007 and 2008

Table no.3.13: Livestock population in the Puducherry Region

ANIMAL HUSBANDRY							
Sl. No.	Item / Details	Unit	2008-09				
			Pudu cherry	Karaikal	Mahe	Yanam	State
1	2	3	4	5	6	7	8
1	Milk Production	Tonnes	**33857**	10292	352	1009	45510
2	Egg production	Lakh.No	**77.93**	29.70	1.57	2.64	111.84
3	Meat Production						
	I) Livestock	MTs	**3654**	1440	116	322	5532
	II) Poultry	"	**2932**	1194	43	120	4289
4	Veterinary Hospital	Nos.	**1**	1	-	-	2
5	Veterinary Dispensaries	"	**8**	5	1	1	15
6	Key village Units	"	**44**	15	1	1	61
7	Veterinary Assistant Surgeon	"	**23**	8	1	1	33
8	Assistant Veterinarian	"	**78**	24	3	4	109
9	Field man	"	**9**	4	2	2	17

Source: Department of Animal Husbandry and Animal Welfare, Puducherry, 2009.

3.3.4 FISHERIES

The coastal length of the Puducherry Region is 22 Kilometers and fishery type of this district are marine nature and inland fishing respectively. The marine fishing of this Puducherry city is 19755 Metric Tonnes for the year 2008-09 and Inland fishing accounts for 3538 Metric Tonnes respectively. The details of fishing activities are presented in Table 3.14 and Figure 3.07 respectively.

Table no. 3.14: Details of fishing activities

FISHERIES							
Sl. No.	Item	Unit	2008-09				
			Pudu cherry	Karaikal	Mahe	Yanam	State
1	2	3	4	5	6	7	8
1	Length of coastal line	Kms.	**24**	20	1	-	45
2	Marine Fish catch	M. Tonnes	**19755**	9299	2667	913	32634
3	Inland fish catch	„	**3538**	832	-	1121	5491
4	Prawn catch						
	Marine	„	**1245**	203	371	97	1916
	Inland	„	**174**	7	-	78	259

Source: Department of Fisheries & Fishermen Welfare , Puducherry

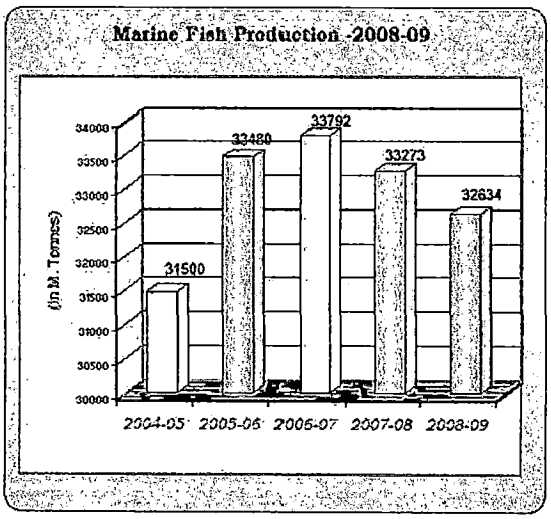


Figure no.3.07: Marine Fish Production in Puducherry, 2009.

3.3.5 CO-OPERATIVE INSTITUTIONS

The Puducherry region has good number of Co-operative institutions for proving better services to their community and details of co-operative societies in the study area is presented in Table 3.15. This table reveals that there are 47 primary agriculture co-operative societies available in this District with a working capital of 1, 20,600 lakhs.

Table no.3.15: Co-operative Institutions in Puducherry

CO-OPERATION							
Sl. No.	Item / Details	Unit	2008-09				
			Pudu cherry	Karaikal	Mahe	Yanam	State
1	2	3	4	5	6	7	8
1	Societies	No.	**361**	88	27	38	514
2	Membership	'000 Nos	**394.40**	96.00	40.00	18.60	549.00
3	Working Capital	Rs. lakhs	**1,20,600**	7,800	3000	415	1,31,815
4	Primary Agricultural Credit Societies	Nos.	**47**	6	1	-	54
5	Membership (PACS)	Nos.	**84,060**	6960	180	-	91,200

Source: Registrar of Co-operative Societies, Puducherry

3.3.6 BANKING AND FINANCIAL INSTITUTIONS

Banking and other financial institutions play a vital role in the development of a particular system. The details of Banking and other financial institutions of Puducherry district is presented in Table 3.16. This table reveals that there are 86 scheduled commercial banks, one State co-operative bank and Co-operative Urban bank available in the District. It has been observed that the total amount of savings and deposit has reached to Rupees 4435 crores. Of which, 55.46 per cent of the total amount is issued under various credits. Puducherry district alone contributes more than three-fourth (81.04 per cent) of the total deposit of the State, i.e., 5472 crores. The Credit Deposit Ratio of the State and District are 51.90 and 55.47 respectively. The table reveals that the Credit Deposit Ratio of the District is higher than the State, and this shows that the people have deposited larger amount of money.

Table no.3.16: Banking and Financial Institutions in Puducherry

BANKING							
Sl. No.	Item / Details	Unit	2008-09				
			Pudu cherry	Karaikal	Mahe	Yanam	State
1	2	3	4	5	6	7	8
I	**Scheduled Commercial Banks**						
	Offices	Nos	**86**	26	5	5	122
	Deposit	(Rs.in Crore)	**4435**	728	245	64	5472
	Credit	"	**2460**	298	54	28	2840
	Credit Deposit Ratio		**55.47**	40.93	22.04	43.75	51.9
II	**State Co-operative Bank**						
	Liability	in '000 Rs	**3894988**	189259	10567	45263	4140077
	Assets	"	**3894988**	189259	10567	45263	4140077
III	**Co-operative Urban Bank**						
	Liability	in '000' Rs	**1263599**	-	-	-	1263599
	Assets	"	**1267665**	-	-	-	1267665

Source: Reserve Bank of India, Various Issues

3.4 HOUSING

The basic requirements of human being are food, cloth and shelter. The demand of housing is increasing year by year. The rural-urban migration is shooting up every year for searching better employment and infrastructure facilities in the urban system. These migrants are forced to live in the urban system with insufficient housing condition and infrastructure. The native population growth and migrations are highly responsible for the shortage of housing facilities in the system. Housing details of the study area are presented in Table 3.17 and 3.18 respectively. The table reveals that 267206 houses available, of this almost one – third (66.30 per cent) of total houses lies in the urban area and the rest of them (33.70 per cent) accounts for rural area.

The table 18 reveals the physical condition of the houses in the study area. It has been observed that about one-tenth (91.30 & 90.60 per cent) of the total houses in both urban and rural areas are good conditions, less than one -tenth of them (8.00 & 8.80 per cent) are livable conditions, and the rest of them less than one per cent are under dilapidated conditions in the system.

Table no.3.17: Details of Housing in Puducherry region

Sl.No.	Description	Total	Percent(%)	Rural	Percent(%)	Urban	Percent(%)
1	Number of census houses	2,67,206	100.00	89,979	33.70	1,77,227	66.30
2	Vacant census houses	20,057	7.50	5,695	6.30	14,362	8.10
3	Occupied census houses	2,47,149	92.50	84,284	93.70	1,62,865	91.90
	Uses of occupied census houses						
4	Residence	2,02,001	81.70	69,746	82.80	1,32,255	81.20
5	Residence-cum-other use	3,017	1.20	1,037	1.20	1,980	1.20
6	Shop, Office	21,114	8.50	4,360	5.20	16,754	10.30
7	School, College, etc.	1,617	0.70	632	0.70	985	0.60
8	Hotel, Lodge, Guest House, etc.	830	0.30	183	0.20	647	0.40
9	Hospital, Dispensary, etc.	750	0.30	171	0.20	579	0.40
10	Factory, Workshop, Work shed, etc.	3,643	1.50	1,120	1.30	2,523	1.50
11	Place of worship	2,146	0.90	1,044	1.20	1,102	0.70
12	Other non-residential use	12,031	4.90	5,991	7.10	6,040	3.70

Source: Compiled by the Investigator based on Census of India, 2001

Table no.3.18: Condition of houses in Puducherry region

Sl.No.	Condition of census houses	Total	Percent(%)	Rural	Percent(%)	Urban	Percent(%)
1	Total	204,806	100.00	70,766	100.00	134,040	100.00
2	Good	186,584	91.10	64,148	90.60	122,436	91.30
3	Livable	16,987	8.30	6,197	8.80	10,790	8.00
4	Dilapidated	1,235	0.60	421	0.60	814	0.60
	Distribution of Households by condition of census houses occupied by them						
5	Total	208,655	100.00	72,199	100.00	136,456	100.00
6	Good	190,130	91.10	65,495	90.70	124,635	91.30
7	Livable	17,274	8.30	6,279	8.70	10,995	8.10
8	Dilapidated	1,251	0.60	425	0.60	826	0.60

Source: Compiled by the Investigator based on Census of India, 2001

3.5 ENVIRONMENT

Environment character is one of the most important parameters which decide the functions of the system. The environmental characteristics, such as, water quality, air quality, land quality, noise pollution and their quality are playing major role, in providing healthy living environment to the masses in the system. Growth of population, increase in number of vehicles, burning of solid waste in the open spaces and dumping of raw wastes in the open spaces unscientifically, excess fertilizers and pesticides use in agricultural lands, etc., are one of the major reasons for environmental degradation in the city. As a result, the city is experiencing several kinds of diseases. The water-bodies in the study area are polluted mainly due to effluent discharged from the available industries. The details pertain to industries and industrial growth in the study area is presented in Table 3.19 and 3.20.respectively. This table reveals that the industrial growth have achieved two fold increase in the study area from the year 1990 to 2004. Normal air pollution caused due to vehicular movement on the road leads to generation of dust including suspended particulate matter (SPM) from the roads and emission of gaseous pollutants such as Sulphur Dioxide (SO_2), Oxides of Nitrogen (NOx), Carbon Monoxide(CO) and Lead (Pb), from the exhaust of the vehicles. Apart from this, pollution also results due to spillage of diesel, petrol, lubricants, etc., on the roads. The recommended national ambient air quality standards should be maintained in the city for suspended particulate matter.

Clogging and overflow of drains is observed in Puducherry, now and then which cause overflow, due to the dumping of garbage, plastics, etc., into the gutter. The clogging of drain leads to foul smell and also provides conditions inevitable for breeding of vectors. Many diseases like malaria, dengue fever, viral fever, brain fever are reported because of this reason. The French Government had constructed an optimal drainage system, by employing appropriate technology and techniques to safe guard the interest of the core city area (within boulevard town) during the regime and it had been functioning well up to the Government of Puducherry initiated project pertaining to beach beautification in the city. During the course of construction of this project, the city administration sealed the drainage outlets, which were existing in the sea front. During the monsoon season, whatever, accumulated dirt, filth, garbage, etc., were washed away by the rain water, the city used to become clean naturally; It

has been observed that the beach beautification project sealed the drainage outlet, as a result, water accumulated and stagnated in the city, during the monsoon season, which mingle with the unattended waste in the system, decompose, and totally spoil the city's environment. It is recommended to open these drainage outlets, which were functioning well earlier by employing appropriate technology to safeguard the interest of the city. Unplanned development of Pondicherry has created serious environmental problems, leading to lowering of living standards. Scarcities of basic requirements like drinking water, proper drainage facilities for waste water, inadequate sewage treatment and disposal facilities which lead to Puducherry environmentally in tight spot.

Table no.3.19: Different Types of Industries in Puducherry region

Sl.No.	Categories	LSI	MSI	SSI	Total
1	Food Products	6	12	870	888
2	Cotton Products	7	7	829	843
3	Wood Products	Nil	Nil	465	465
4	Paper Products	4	7	419	430
5	Leather, Rubber, Plastic Products	9	36	729	775
6	Chemicals	20	29	1571	1620
7	Non Metallic Mineral Products	8	5	299	312
8	Metal Products	3	20	853	876
9	Machinery Products	11	31	629	672
10	Miscellaneous Products	Nil	Nil	196	196
11	Personal Services	2	10	200	212
12	Repairing/Servicing	Nil	Nil	248	248
	Total	70	159	7308	7537

Note: SSI- Small Scale Industries, MSI- Medium Scale Industries LSI- Large Scale Industries

Source: Industries Department, Govt. of Puducherry, 2005.

Table no.3.20: Growth of Industries in Puducherry region

Cumulative No.	1990-91	1997-'98	1998-'99	1999-00	2002-03	2003-04	2004-05
No. of SSIs	3883	5726	6014	6199	6876	7126	7308
No. of MSIs	53	93	111	115	139	149	159
No. of LSIs	17	28	38	42	55	65	70
Total	3953	5847	6163	6356	7070	7340	7537

Source: Industries Department, Govt. of Puducherry, 2005.

3.6 ECOLOGY

The ecological subsystem consists of many bio-subsystems. The communities (human and animal) and non-living environment function together and form an ecological system or ecosystem. Urban ecological subsystem consists of human population, animal population, birds, lakes and ponds, so they do have a autotrophic components or green belt.

Though Pondicherry State is neither having reserve forest nor scrub jungle to support wild animals, it has wetlands such as Ousteri and Bahour Tank (fresh water), which attract huge number of migratory water birds, both migrants and residents. They mainly include ducks, teals, pochards, waders, which are mainly coming from very far off places mostly from North and central Siberia. These water fowls arrive here in late August and early September and depart in mid April after spending their winter in India. The endangered marine reptiles like olive ridley turtle and leather backed turtle have been breeding along the shores of Puducherry. Among the birds, the rare birds like pelican, white necked stork and glossy ibis are recorded in good numbers in Ousteri tank. The crested pochard, which is considered to be rare species in South India, is found in thousands in Kaliveli Tank of nearby Tamil Nadu State and in hundreds in Ousteri Tank in Puducherry.

The flora of Pondicherry has a remarkable diversity which may be attributed to the diverse soil types comprising the hydromorph soil (rich in clay), the halomorphic soils (terrains more or less saltish), the sand dunes and the very dry soils developed on the red sand stones of Kalapet, Dhanvantrinagar (Gorimedu) and Ousteri. Added to this, a large number of

exotic varieties were introduced by the Europeans in the course of last three centuries. This ecological diversity is reflected in the land use. The flora is listed under six categories, viz., hydrophytes, halophytes, plants of sandstones, avenue tree, hedge plants and ornamental plants. Species diversity of mangroves is very much limited in Pondicherry region and it is present in the estuaries and the riverine sides of Ariyankuppam river and Malattar. Puducherry does not have forest resources in abundance and in fact there is no recorded forest area in Pondicherry. Social forestry can aptly be defined as forestry of the people, by the people and for the people. Since September 1986, social forestry programmes have been implemented by the Department of Agriculture, Local Administration Department, Animal Husbandry Department and the Public Works Department in Pondicherry. The Local Administration Department planted trees on their own land, while the Animal Husbandry Department planted trees in Ossudu and Bahour regions and Public Works Department planted the trees along the road sides and the banks of the tanks.

The Puducherry region has six major water bodies, they are of Olandai Tank, Murungapakkam Tank, Ayeekulam at Muthirapalyam, Kanakaneri, Osuteri and Bahour tank respectively. Ousteri (or Oussudu) Lake is the largest lake in Pondicherry, among all the water bodies of around 800 acres of water located approximately 6km. west of the town. For over a decade, environmentalists have tried to get the lake protected as a sanctuary. A panoramic view of the Lake is presented in Figure 3.08.

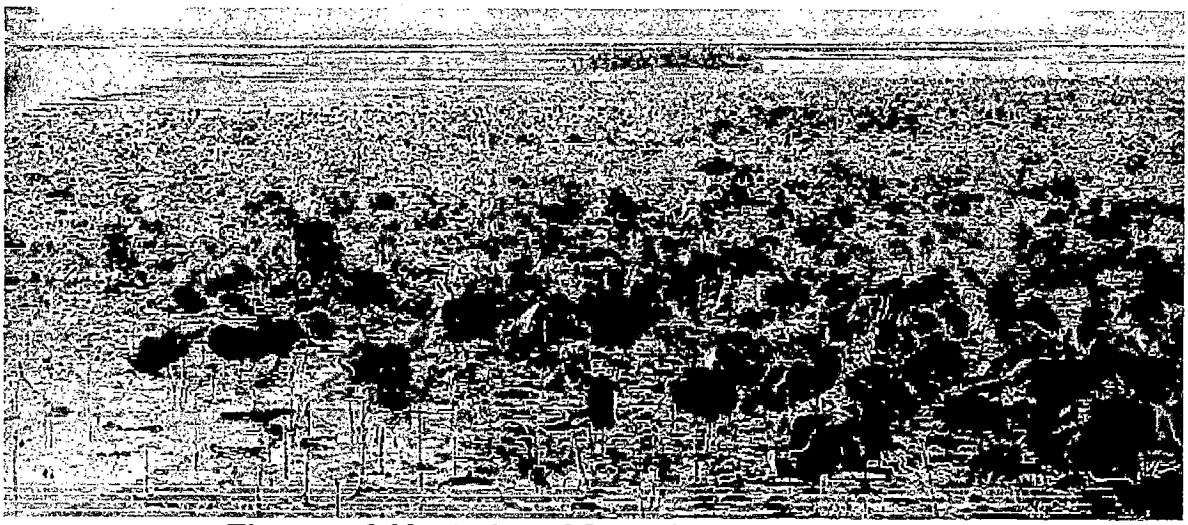


Figure no.3.08: A view of Ousteri Lake in Puducherry.

The lake was created during the Vijaynagar rule and was reconstructed by Anandarangapillai during the French regime to irrigate the nearby lands leased to him and provide drinking water to the city. The eastern and northern foreshore of the lake lies in Tamil Nadu and the rest in Pondicherry. "In the French rule a filtering water station was constructed in Muttrapalayam " the water reached Pondicherry by gravity and was known as Muttrapalayam water." As Pondicherry has developed into a more industrial city not much agriculture is carried out, and therefore, the lake has abundant water during all the seasons. This natural water resource should be prevented from all kinds of pollution and also much attention must be given for maintain its ecological balance in the system

3.7 PHYSICAL INFRASTRUCTURE

3.7.1 POWER

The consumption of power shows the growth and development of a particular system. It has been observed that there is strong correlation between per capita energy consumption and the gross domestic product in the system. This clearly indicates that energy is one of the most important factors, which is responsible for the development of the system. The power consumption of different activities and per capita electricity consumption in Puducherry city is presented in Table 3.21 and in Figure 3.09 respectively.

The present electricity demand of the Union Territory including that of the four regions of Puducherry, Karaikal, Mahe and Yanam is 382.9 MW during peak period. There is no power generation in the Union Territory except that a 32.0 MW Gas based Power Plant operated by the Pondicherry Power Corporation Limited. The demand is normally being met from the power allocation from Central Generating Stations (CGS), drawl of power from neighbouring state Electricity Boards and the Gas Power Plant of Pondicherry Power Corporation Limited. At present there is no shortage in meeting the requirements of the present demand in any of the four regions. .

Table no.3.21: Activity-wise power consumption of Puducherry region

ELECTRICITY							
Sl. No.	Item	Unit	2008-09				
			Pudu cherry	Karaikal	Mahe	Yanam	State
1	2	3	4	5	6	7	8
1	Towns Electrified	Nos	**3**	1	1	1	6
2	Revenue Villages Electrified	"	**63**	29	-	-	92
3	Electricity Consumed	Lakh KWH	**14575.86**	4491.36	206.14	712.39	19985.75
4	Per capita Consumption	KWH	**1704.74**	2319.57	518.36	1676.09	1767.21
5	Agricultural Connections	No.	**8276**	636	3	28	8943
6	H.T Industrial Connections	"	**332**	60	2	31	425
7	L.T Industrial Connections	"	**4661**	776	154	178	5769
8	Domestic Connections	"	**190944**	47468	8172	9251	255835
9	Commercial Connections	"	**28220**	6300	2692	1215	38427
10	Length of H.T. lines	Kms	**818.677**	291.878	31.596	31.047	1173.198
11	Length of L.T. lines	"	**3155.683**	771.732	248.412	109.726	4285.553
12	No. of Power Transformers	No.	**1494**	272	67	62	1895
13	Street lights	"	**31221**	9645	2755	1996	45617

Source: Electricity Department, Puducherry, based on Projected Populatin 2009.

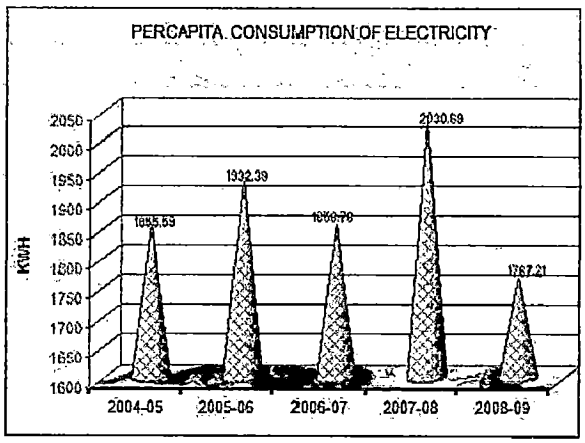


Figure no.3.09: Per capita consumption electricity in Puducherry region

The entire power requirement of Puducherry is met from the power allocated from the Central Generating Stations, Tamil Nadu Electricity Board, Kerala State Electricity Board and from the Puducherry Power Corporation Limited. The entire power for the Puducherry region is availed through two major 230 / 110 KV interconnected Sub-stations located at Villianur and Bahour and 10 numbers of 110 KV Sub-stations located at load centers. Besides, the power from TNEB is availed at 110 KV Sub-station located at Bahour. The power supply from these sub-stations is distributed to the HT consumers through HT feeders and to the LT consumers after stepping down to LT level by means of Distribution Transformers.

3.7.2 WATER SUPPLY

Water supply and quality of water supply are also considered as important factor to assess the development of any system. About 90.00 per cent of the population of the study area has access to safe drinking water. The Puducherry public works Department and two municipal agencies in the District are trying their level best to supply good quality of drinking water in the system. Pondicherry was originally under French Regime had protected water supply system even during 1902. The water is supplied 3 times daily and total duration of supply is 10 hours per day.

The Public Health Division of Public Works Department, Pondicherry is in charge of water supply and sewerage system in the urban and suburban areas of Pondicherry. In the rural areas, water supply system are created by the Public Health Division and handed over to the respective commune panchayats for operation and Maintenance. The water supply needs for the population of 5.05 lakhs (Census of India, 2001) in the entire urban and sub urban areas are met by about 180 deep bore well sunk in and around Pondicherry. Two head works, one at Muthirapalayam and the other at Thirukanchi share about 2.5 per cent of the total supply. The total quantity of water Supplied is 80 Million liters per day (MLD) and the per capita water supply for the Population in urban and sub urban areas is 135 liters approximately per capita per day (LPCD) and in rural areas the per capita water supply is 70 LPCD. The climatic condition in this region is moderate. The normal annual rainfall is 1205 mm. The region receives rainfall from both during southwest monsoon (June to September) and

northeast monsoon (October to December). Of the total annual rainfall, 63 per cent occurs during northeast monsoon and 27 per cent during southwest monsoon. The remaining rainfall is received during hot weather and winter periods. The climate is tropical with a maximum temperature of about 40^{O} C. The average annual rainfall would be sufficient to recharge the ground water sources and to cater the water supply needs of Pondicherry and sub-urban areas. The salient features of urban water supply are presented in Table 3.22 and 3.23 respectively.

Table no.3.22: Salient Features of Pondicherry Urban Water Supply System

Area	:	293 Sq km.
Urban area	:	24.33 Sq km.
Average annual rainfall	:	1200 mm
Present urban population (2001)	:	5,00,000
Projected urban population(2031)	:	8,59,000
Source	:	Ground water
Per capita water supply	:	135 lpcd
Present Demand (2001)	:	67.5 MLD
Ultimate Demand (2031)	:	116 MLD
Quantity supplied	:	80 MLD
Head works	:	Muthirapalayam & Thirukanji
No. of Bore wells	:	160 Nos.
Yield of Bore wells	:	600 - 1800 lpm
Bore well depth	:	45 m - 120 m
Mode of supply	:	OHT & Direct pumping
No. of OHTs	:	41 Nos
No. of Zones	:	9 Nos.
Completed zones	:	5 (Zone-I, Zone-II, Zone-IV, Zone-V, Zone IX)
On going zones	:	2 (Zone-III, Zone- VI)
To be taken zones	:	2 (Zone-VII, Zone-VIII)
Length of Pumping main	:	31.60 KM
Length of Distribution lines	:	215 KM
Sea water intrusion	:	More than 4 KM land wards

Source: Public Works Department, Puducherry

Table no.3.23: Future proposal for treatment of Surface water from Oussudu

Capacity of Oussudu tank	:	15.29 MCM
Expected quantum of water	:	30 MLD for 5 Months up to 2011. After 2011, 30 MLD throught the year.
Components/treatment contemplated	:	1) Raw water pumping main 2) Chemical dosing system 3) Flash mixer 4) Clariflocculator 5) Slow sand filter 6) Chlorination
Scheme Cost	:	23.18 Crores

Source: Public Works Department, Puducherry

The entire area of the Pondicherry region is covered by alluvial and other sedimentary formations. The shallow alluvial aquifers, the deep Cuddalore sandstone and Vanur-Ramanathapuram aquifers constitute the three major potential aquifer systems of this region. The depth of these aquifers vary from 10 m to 55 m. Ground water from the above aquifer systems is developed by means of shallow and deep tube wells. The drinking water needs of urban Pondicherry are met from a cluster of 10 bore wells at Muthirapalayam. Head works established during the French regime, about 7 Km west of Pondicherry town, a group of 4 bore wells at Thirukanji, about 4 Km South West of Pondicherry and remaining 146 tube wells at other locations both within and outside of the urban area. These wells are 45 m to 120 m deep and reported to be yielding about 600 to 2,000 lpm. The ground water extracted is potable and directly pumped into the OHT/distribution system local disinfection using bleaching powder/sodium hypochlorite. Totally 160 bore wells are under the control of Public Health Division, from which nearly 80 MLD of water is drawn and supplied to the public. The entire domestic demand for drinking water in Pondicherry region is met from ground water sources through a series of tube wells constructed under comprehensive urban water supply and rural water supply schemes depending upon the disposition of the population. The urban and sub-urban population of 5 lakhs (2001) is provided with about 160 tube wells. The total water requirement is supplied through these tube wells. Domestic needs share 16 per cent of total ground water consumption.

While the urban population is served with drinking water from 160 bore wells in and around Pondicherry, the rural areas of Pondicherry are served with water supply from deep bore wells but with great difficulty. The difficulties are of various natures as given below:

- Depleting ground water level due to drought and other reasons.
- Saline water intrusion in the coastal villages of the region.
- Quality affected bore well water due to excess iron in the interior villages.
- Brackishness presence in certain villages.
- Bore wells getting defunct due to long use.
- Insufficient source and supply due to growth in population

Under the rural water supply sector in Pondicherry Region five Commune Panchayats and one Municipality segment are covered and is presented in Table 3.24.

Table no.3.24 Coverage of Rural water supply

Ariankuppam	-	20 Villages/hamlets/habitations
Bahour	-	42 Villages/hamlets/habitations
Nettapakkam	-	27 Villages/hamlets/habitations
Mannadipet	-	40 Villages/hamlets/habitations
Villianur	-	44 Villages/hamlets/habitations
Oulgaret Municipality	-	9 Villages/hamlets/habitations
Total		182 Villages/hamlets/habitations

Source: Public Works Department, Puducherry

3.7.3 SEWERAGE

The sewerage system in Puducherry covers the core area (about 30 per cent of the urban area). The system was commissioned in 1980 under the Integrated Urban Development Project (IUDP), while the other areas are dependent on septic tanks for wastewater disposal. The wastewater from these septic tanks is disposed either into soak pits or into natural drains in the city, resulting in unhygienic conditions in the surrounding areas. The over review of existing sewerage system in Puducherry city is presented in Table 3.25. This table reveals that the total coverage area covered under sewerage system is 20.00 Sq.km and population serving a population of only 30.00 per cent in the study area.

Table no.3.25: Overview of Puducherry Sewerage System

Sl.No.	Item	Deatails
1	Area Coverage	20 Sq.Km
2	Population Covered	30 percent
3	Sewer System	98 Km
4	Pipe material	Stone ware/Cast Iron/RCC Hume pipes/ Ductile Iron
5	Number of Pumping stations	9
6	Length of Pumping Main	14 Km
7	Location of STP	Lawspet (7 Km North of City) Duprayapet (2 Km West of City)
8	Capacity of STP	12.5 MLD at Lawspet - Oxidation Ponds 2.5 MLD at Duprayapet -USAB
9	Treatment Process	Oxidation Ponds and Up flow Anaerobic Sludge Blanket(USAB) at Lawspet

Source: Public Works Department, Puducherry.

3.7.4 DRAINAGE

Drainage is one of the important factors, which decides the functions of the system. Availability of adequate drainage in the urban system leads to healthy creates the healthy living environment. Having this in mind the Investigator studied the available drainage system in the study area. The total network length of storm water drains in the Puducherry urban agglomeration area is 1065.61 km. This is approximately 133 percent of the total road length in the Puducherry urban agglomeration area. The predominant network in the Puducherry urban agglomeration area is of pucca open type.

All the storm water drains discharge wastewaters into the low-lying areas, sea and water bodies. The coverage of drains in Puducherry urban area is presented in Table 3.26. The table reveals that of four local bodies Ariankuppam is having low percentage of drains and the same should be increased to at least 150 per cent of road length for effective drainage in the system. The drains constructed in the study area, were in consideration for a population 3 decades ago. The study reveals that the current drains are incapable of carrying the surface water especially in the monsoon seasons. The system has to be redesigned to meet the future requirements for increasing population. The areas uncovered with drains should also be provided with storm water drainage facilities and the coverage area of existing system should be extended, especially in the urban area.

Table no.3.26: Drainage details of Puducherry urban area

Sl.No.	Item	Puducherry Municipality	Oulgaret Municipality	Ariankuppam Panchayat	Villianur Panchayat	Puducherry Urban Agglomeration	
		Length of drains in Km					%
1	Open drains-Pucca	268.56	324.74	44.36	323.72	961.38	90.20
2	Open drains-Kutcha	-	20.36	5.93	-	26.29	2.50
3	Closed Drains	50.93	10.20	-	16.82	77.95	7.30
4	**Total**	**319.49**	**355.30**	**50.28**	**340.54**	**1065.61**	**100.00**
5	**% to road length**	**132.37**	**159.74**	**57.97**	**135.60**	**133.47**	

Source: Puducherry, Oulgaret Municipalities, Ariankuppam & Villianur Panchayat, Puducherry.

3.7.5 SOLID WASTE MANAGEMENT

Management of municipal solid waste is another important task now days and the municipal administration face a severe threat due to accumulation of wastes and generation of its associated problems in the urban system. Analyses across countries over time reveal that the generation of municipal solid waste is positively related to variations in per capita income and that the generation of municipal solid waste per capita does not vary with population size among countries but vary with comparable per capita income. Most of the solid waste is dumped in the open grounds. Irregular collection of solid waste from the households has to be regularized.

Participation of private agencies should be encouraged for collection, storage, transportation, and finally recycling and dumping of waste. At present, the total waste generated is this city about 198 tons/day accounting for 85 per cent of waste collection. Sources of waste generation in Puducherry city is presented in Table 3.27. This table reveal that the generation domestic waste in the study area is more than one- third (40.00 per cent) of total waste generation, followed by road & construction waste for about one third (30.00 per cent).

Table no.3.27: Waste generation sources in Puducherry City

Sl.No.	Sources of Waste Generation	Distribution (in %)
1	Domestic Waste	40.00
2	Market Waste	10.00
3	Hospital Waste	2.00
4	Sweeping & Sanitary Waste	10.00
5	Garden & Agriculture Waste	8.00
6	Road & Construction Waste	30.00
	Total	**100.00**

Source: Puducherry Municipality, Puducherry

3.8 SOCIAL INFRASTRUCTURE

The Investigator considered social infrastructure, such as, education, health, transportation, communication, and tourism for the present investigation since they play a vital role in the system, and are presented in the following sequel:

3.8.1 EDUCATION

Education is one of the most important parameters, which decides the functions of the system. The study area is blessed with more number of schools, technical institutions, research institutions, etc., which provide education to the community. The details of Government schools and the students available in this study area are presented in Table 3.28. This table reveal that the study area comprising of 395 pre-primary schools, 208 primary schools, 81 middle schools, 113 high schools and 74 higher secondary schools and are having students strength of 29992, 25810, 19768, 49996, 90999 respectively in the system.

The Puducherry region is having good number higher and technical institutions, and is presented in Table 3.29. This table reveals that the study area has 104 colleges belongs to Central, State Government, Societies and private which consists of Arts & Science, medical , Engineering & Technology, Nursing , Vertinary, Agriculture, Dental, Law, Catering . Polytechnic, B.Ed , Nursing etc., It has been observed that the study are has student-teacher ratio for Primary, middle, and High/higher secondary schools of 1:20, 1:20 and 1:26 respectively. This clearly indicates that Puducherry city is having strong educational infrastructure for providing better quality of education to the masses.

Table no.3.28: Number of Schools in the Puducherry Region

Sl. No.	Item / Details	Unit	2007-08				
			Pudu cherry	Karaikal	Mahe	Yanam	State
1	2	3	4	5	6	7	8
I	INSTITUTIONS						
	Pre-primary Schools	Nos.	**395**	102	21	15	533
	Primary Schools	"	**208**	74	15	12	309
	Middle Schools	"	**81**	24	5	2	112
	High Schools	"	**113**	33	6	11	163
	Higher Sec. Schools	"	**74**	15	5	1	95
	Junior College	"	**0**	0	0	3	3
II	ENROLMENT (by stage)						
	Pre-primary Schools	"	**29992**	4975	1643	1607	38217
	Primary Schools	"	**25810**	5694	2253	2948	36705
	Middle Schools	"	**19678**	6896	1594	908	29076
	High Schools	"	**49996**	14069	2469	5706	72240
	Higher Sec. Schools	"	**90999**	12671	4646	348	108664
	Junior College	"				650	650
III	ENROLMENT (by Class)						
	Pre-Primary Schools		**29992**	**4975**	**1643**	**1607**	**38217**
	Boys	"	**15568**	2657	844	883	19952
	Girls	"	**14424**	2318	799	724	18265
	Primary Schools I - V		**83695**	**16954**	**5242**	**5283**	**111174**
	Boys	"	**43162**	8632	2784	2677	57255
	Girls	"	**40533**	8322	2458	2606	53919
	Middle Schools VI-VIII		**51942**	**11540**	**2901**	**3040**	**69423**
	Boys	"	**27150**	6003	1517	1514	36184
	Girls	"	**24792**	5537	1384	1526	33239
	High Schools		**31133**	**6958**	**1613**	**1547**	**41251**
	Boys	"	**15797**	3531	823	754	20905
	Girls	"	**15336**	3427	790	793	20346
	Higher Sec. Schools		**19713**	**3878**	**1206**	**690**	**25487**
	Boys	"	**9372**	1679	587	306	11944
	Girls	"	**10341**	2199	619	384	13543

Source: Directorate of Economics and Statistics, Puducherry.

Table no. 3.29: Abstract of Higher and Technical Education Institutions 2008-2009

Sl.No	Type of College	Puducherry	Karaikal	Mahe	Yanam	Total
	I. ALL COLLEGES (GOVT./CENTRAL/SOCIETY/ PRIVATE)					
1	Arts, Science & Commerce Institutions	**14**	3	2	2	21
2	Research Institutions	**1**	0	0	0	1
3	Medical Institutions	**8**	0	0	0	8
	(a) Dental	**2**	0	1	0	3
	(b) Nursing	**6**	1	0	0	7
	© Para-Medical	**2**	0	0	0	2
4	Veterinary Institutions	**1**	0	0	0	1
5	Agriculture Institutions	**0**	1	0	0	1
6	Law College	**2**	0	0	0	2
7	Engineering & Technology	**9**	5	0	1	15
8	Education (a) B.Ed.	**20**	4	2	1	27
	(b) D.T.Ed.	**35**	13	1	2	51
9	Polytechnic	**2**	1	1	1	5
10	Catering	**2**	0	0	0	2
	TOTAL	**104**	**28**	**7**	**7**	**146**
	II. STATE GOVT. COLLEGES					
1	Arts, Science & Commerce	**3**	2	1	1	7
2	Law College	**1**	0	0	0	1
3	Education (b) D.T.Ed.	**1**	0	0	0	1
4	Polytechnic	**1**	0	0	0	1
5	Catering	**1**	0	0	0	1
	TOTAL	**7**	**2**	**1**	**1**	**11**

(Cont.,)

	IV. SOCIETY COLLEGES					
1	Arts, Science, Commerce & Fine Arts	**5**	0	0	0	5
2	Medical Institutions	**0**	0	0	0	0
	(a) Dental College	**1**	0	0	0	1
	(b) Nursing	**0**	0	0	0	0
	(c) Para Medical	**1**	0	0	0	1
3	Veterinary Institutions	**1**	0	0	0	1
4	Agriculture Institutions	**0**	1	0	0	1
5	Engineering & Technology	**1**	1	0	0	2
6	Education (a) B.Ed.	**0**	1	0	0	1
	(b) D.T.Ed.	**0**	1	0	0	1
7	Polytechnic	**1**	1	1	1	4
	TOTAL	**10**	**5**	**1**	**1**	**17**
	V. PRIVATE COLLEGES(UN-AIDED)					
1	Arts, Science, Commerce	**6**	1	1	1	9
2	Medical Institutions	**6**	1	0	0	7
	(a) Dental College	**1**	0	1	0	2
	(b) Nursing	**6**	1	0	0	7
	(c) Para Medical	**1**	0	0	0	1
3	Law College	**1**	0	0	0	1
4	Engineering & Technology	**8**	4	0	1	13
5	Education (a) B.Ed.	**20**	3	2	1	26
	(b) D.T.Ed	**34**	12	1	2	49
6	Catering	**1**	0	0	0	1
	TOTAL	**84**	**22**	**5**	**5**	**116**

Source: Directorate Higher and Technical Education, Puducherry

3.8.2 HEALTH

Health is also one of the most important parameters since it plays major role in human resources development of a particular system. Puducherry Government trying its level best to have a good health system even at the grassroots level in the system. The study area is also blessed with good Government and private health institutions, clinics, etc. It has been observed that the study area has 8 medical colleges and JIPMER hospital & medical research

Table no.3.30: Details of health institutions in Puducherry

HEALTH AND FAMILY WELFARE							
Sl. No.	Item / Details	Unit	2007-08				
			Puducherry	Karaikal	Mahe	Yanam	State
1	2	3	4	5	6	7	8
1	Hospitals	Nos.	**5**	1	1	1	8
2	Dental College and Hospital	"	**1**	-	-	-	1
3	Chest Clinic	"	**1**	-	-	-	1
4	Physical Medicine and Rehabilitation Centre (PMRC)	"	**1**	-	-	-	1
5	Community Health Centres	"	**2**	1	1	-	4
6	Primary Health Centres	"	**27**	11	1	-	39
7	Sub-Centres	"	**52**	17	4	4	77
8	E.S.I. Dispensaries	"	**11**	1	1	1	14
9	Hospital Beds (including PMRC Beds)	"	**1386**	506	171	100	2163
10	Dental College and Hospital Beds	"	**50**	-	-	-	50
11	Community Health Centre Beds	"	**60**	30	30	-	120
12	Primary Health Centre Beds	"	**129**	92	2	-	223
13	Sub-Centres Beds	"	**32**	17	4	2	55
14	Jipmer Beds	"	**1098**	-	-	-	1098
15	Birth Rate *	Per '000 Population					16.4
16	Death Rate *	"					7.5
17	Infant Mortality Rate *	"					25
18	Eligible couples protected by Family Welfare Methods	%	**65.2**	58.6	59.4	71.3	63.6
19	Per capita expenditure on Medical and Health services (excluding JIPMER)	Rs.	**1158**	2205	1517	797	1337

Source: Department of Health &Family Welfare , Puducherry.

Institute' which belongs to the central Government are available in the system. Details of hospitals, clinics, health Centers, Hospital beds and other health facilities available in the

study area are presented in the Table 3.30. This table reveals that Puducherry has 1386 hospital beds; JIPMER has 1098beds, 50 Dental college hospital beds, 189 Health centre's bed and 32 Sub-enter bed respectively. The per capita expenditure on medical and health services (excluding JIPMER) is Rs.1158. The District has total of 2755 beds in all hospital together.

3.8.3 TRANSPORTATION

Transportation is another of the parameters, which decides the function of the system.

Table no.3.31: Details of Roads and Transport in Puducherry.

ROADS AND TRANSPORT							
Sl. No.	**Item / Details**	**Unit**	**2008-09**				
			Pudu cherry	Karaikal	Mahe	Yanam	State
1	2	3	4	5	6	7	8
I	**Roads**						
1	Length of Roads(P.W.D.)	Kms.					
	(a) National Highways	"	**38.058**	21.400	1.988	-	61.446
	(b) State Highways	"	**36.277**	0.525	1.478	-	38.280
	(c) Major District Roads & Other District Roads	"	**179.871**	67.736	22.229	26.445	296.281
	(d) Rural Roads	"	**183.276**	98.756	-	-	282.032
	Total	"	**437.482**	188.417	25.695	26.445	678.039
2	Length of Roads (Municipalities)	"	**523.205**	145.018	105.230	48.500	821.953
3	Length of Roads (Commune Panchayats)	"	**1094.980**	278.590	-	-	1373.570
II	**Motor Vehicles**						
	No. of Motor Vehicles Registered	Nos.	**46218**	4744	579	232	51773

Source: Public Works Department, Puducherry and Transport Department, Puducherry

In fact, efficient transportation system works as a catalyst for the development of the system. The study area is well connected by road, but rail and air connectivity is not lacking in the study area. Road-based mode transportation is mostly preferred for intra-city transportation. The details of roads and transport about the study area are presented in Table 3.31. This table reveals that District has total 437.48 km, of this the length of National Highways 38.05 km, State Highways 36.27 km, District roads 179.81 km and rural roads 183.27 km respectively. Further, it explains that length of municipalities and commune panchayat roads accounts for 523.20 km and 1094.98 km respectively. It has also observed that number of motor vehicles registered are 46218, which is increasing every year.

3.8.4 TELECOMMUNICATION

Telecommunication system is one of the most important networks for the efficient functioning of the city. Puducherry region is a part of the Global Information Highway. Good telecom infrastructure including cellular, pager, ISDN, and Internet services are available. Puducherry has 64 lines per 1000 persons which is highest tele density in the county. The details of post office and telephone connections pertaining to study are are presented in Table 3.32. This table reveals that the study area is having 68 post offices (both urban and rural) and 80630 telephone connections followed by 1039 STD PCO and 2451 local PCO respectively in the system. Data in respect of Private companies are not included.

Table no.3.32: Details of Telecommunication in Puducherry

POSTS -TELEGRAPH & TELECOMMUNICATIONS							
Sl. No.	Item / Details	Unit	2008				
			Pudu cherry	Karaikal	Mahe	Yanam	State
1	2	3	4	5	6	7	8
1	Rural Post Offices	"	**37**	21	-	-	58
2	Urban Post Offices	"	**31**	6	4	1	42
3	Telephone Connections	"	**80630**	17640	5292	2072	105634
4	STD PCO	"	**1039**	309	84	47	1479
5	Local PCO	"	**2451**	368	251	282	3352

Source: Postal Department & B.S.N.L, Puducherry

3.8.5 FIRE STATIONS

The Puducherry District has six Fire Stations, which are located Puducherry towm (3numbers),Shanmugapuram, Madukarai and Thirukkanur. These Fire Stations are functioning effectively for the fire exigency of the study area.

3.8.6 CREMATION YARD AND BURIAL GROUNDS

The city has two cremation grounds, one at Karauvadikuppam and the other at Pavazhakaranchavady. Recently, both burial grounds are facilitated for the electric cremation process. Further, the city has several burial grounds, which are confined to particular Religious Institutions and some of them are located even within the core city area.

3.8.7 TOURISM

Tourism is considered as one of the important activities of the city for economic development in the study area. The entire stretch of coastal line of the District is in the process of development of tourism related activities. A detail of tourism activities in the study area is presented in Table 3.33

Table no.3.33: Tourism activities of Puducherry

TOURISM						
Sl. No.	Item / Details	Unit	2007 January - December		2008 January - December	
			Puducherry	Karaikal	Puducherry	Karaikal
1	2	3	4	5	6	7
I	**Tourist Arrivals**					
	Foreign	Nos.	**57,265**	417	**59,952**	357
	Indian (Domestic Tourist)	"	**655,056**	143,472	**6,85,483**	1,42,316
II	**Accommodation**					
	(a) Rooms (A/c & Non A/c)	"	**2,892**	449	**3,114**	466
	(b) Dormitory	"	**54**	7	**44**	1
	(c) Beds(A/c& Non A/c)	"	**5,893**	928	**6,341**	947
	(d) Dormitory Beds	"	**355**	43	**349**	16

Source: Tourism Department, Puducherry

This table reveals that number of Foreign and Indian tourists arrived in the study area is considerably increasing for the calendar year 2007 to 2008. It has been observed that

accommodation facilities are also increased for the corresponding years. This clearly indicates that these tourism activities definitely have contribution for economic development of the city.

3.9 INSTITUTIONS

The State Government's line departments continue to play a crucial role in urban basic service delivery. Sectors and agency involvement include:

Water Supply & Sewerage

The Public Works Department (PWD), Puducherry, an apex body of the State, is the responsible agency for creation of water and sewerage infrastructure in the state.

Master Plan/Comprehensive Development Plan

The Town and Country Planning Department (TCPD) prepares the Master Plan for the town, and the mandate of implementing the Master Plan lies with the Urban Local Bodies, growth is generally haphazard and unplanned, the Master Plan is rarely referred to. However, with a vision to achieve planned growth, revision of Master Plan is in progress.

Roads and Highways

Public Works Department maintains the National and State Highways that pass through the town/city. The major district roads and other major roads are also maintained by the PWD. However, the internal roads are created and maintained by the ULBs in their respective jurisdiction.

Environmental Protection

The Puducherry Pollution Control Board (PPCB) is responsible for environmental protection and enforcement of rulings related to the same, passed by the competent authorities.

Slum up gradation

The Puducherry Slum Clearance Board (PSCB) develops improvement schemes for notified/regularized slum settlements in the city/town. Infrastructure provision is financed partly through loans from the Housing and Development Corporation (HUDCO), and partly through grants from Government of Puducherry and Government of India.

Electricity Department

The Electricity Department provides the new service connection to domestic, commercial, industrial and agriculture services etc., according to their needs of the people in study area.

Puducherry Planning Authority

The main functions of the Pondicherry Planning Authority is to control and regulate the development and use of land in the notified Planning Area through the provisions of the Town and Country Planning Act, 1969, the Town and Country Planning Rules, 1974 and the Pondicherry Building Bye-laws and Zoning Regulations, 1972 as per Development plan. The Authority issues permits for all developmental works within the Puducherry region, collects development charges and initiates action against violations of provisions of the Town and Country Planning Rules, Buildings Bye-laws and Zoning Regulations.

Puducherry Housing Board

The aims and objectives of the Pondicherry Housing Board are in Consonance with the National Housing & Habitat Policy, 1998 announced by Ministry of Urban Affairs and Employment, Government of India. The Pondicherry Housing Board implements the following housing schemes for Economically Weaker Sections (EWS), Low Income Group (LIG), Middle Income Group (MIG) and Higher Income Group (HIG). Further, the board has also promoting housing layouts in the study area.

Planning and Research Department

The subjects dealt with in the Planning and Research Department are Formulation of Five Year Plan, Annual Plan, Plan Co-ordination and Plan Monitoring, Training on

Development Planning, Development Banking, National Small Savings Conduct of Evaluation studies and Cadre Control Authority for Planning and IT personnel.

Department of Science, Technology and Environment

The mains functions of this department are popularization of Science and Scientific technologies, promotion of technology transfer from lab to land, facilitation of scientific research by way of grants for better applied research, bringing awareness among the public regarding environmental issues by celebrating days of environmental importance and to advise the State Government on any matter concerning with the prevention and control of pollution.

In addition to above good numbers of Government Departments /Agencies are involved for providing better services to the masses in the study area.

Chapter-04

DYNAMIC FEATURES OF THE STUDY AREA

4.1 INTRODUCTION

The investigator has made an attempt to understand the physical, socio-economic and environmental conditions, level of infrastructure facilities, which exists in the system, at the grassroots level, and is presented in this chapter. To realize the real functions of the study area at the grassroots level, survey research techniques have been employed to conduct the investigation.

A detailed investigation has been conducted to understand the dynamic functions of the system by considering the following major variables. They are: household size, male and female members in the household, married and unmarried members in the household, educational status, house ownership, type of dwelling unit, number of rooms, household appliances, population, religion, primary and secondary occupation, household income, source of income, expenditure, savings, water supply, power supply, waste management, education, vehicle ownership, transportation, recreation, health, distance to various social infrastructure, energy consumption, type of crop, agricultural input and output, area under irrigation, season wise cropping pattern, livestock, human and animal power consumption, rural transportation, land, water, and air quality, noise pollution, quality of living, etc., The Investigator himself conducted the detailed survey by using the pre-tested schedules in 106 households at the grassroots level to understand the functions of the system. All the schedules were thoroughly examined for consistency and followed by data vetting. Out of 106 schedules 6 schedules were discarded and remaining 100 schedules were chosen for the data analysis. Subsequently, the data were transferred into code sheets, and thereafter into computer to avoid errors and used EXCEL software for statistical analysis. To analyze the data, household income has been considered as the dependent variable, and the remaining major variables are considered as independent variables for analysis. By considering these variables, the tabulation process has been carried out and 103 tables were prepared. Out of these 103 tables, 47 most important tables were chosen for the analysis and results are presented in the sequel.

4.2 INCOME

Income is one of the most important parameters, which decides the functions of the system. Income has the positive correlation with status of the family; the income is increased simultaneously the family's status in the society will also be increased. Moreover, household income decides the purchasing power of the family in particular, and the system in general. The growth of income leads to increase in standard of living, increase in using infrastructure services, followed by increase in investment, which further leads to increase in production, which in turn stimulate the trade and commercial activities, creation of lots of employment opportunities, which ultimately tends to increase in income, saving, etc. As a consequence, there is increase in capital formation, and subsequently, increase in reinvestment in the system. In this cyclic process, a dynamic functions takes place in the system, this puts the wheel of economy into motion. Further, these dynamic functions encourage the vibrant economy, which is very much essential for the development of any system. Having these in mind, the Investigator analyzed the economic strength of the households by considering income as a parameter. To analyze the income of the households, the collected data have been classified into six income groups. They are monthly income below Rs.10, 000; 10,001-20,000; 20,001-30,000; 30,001-40,000; 40,001-50,000 and above 50,000, analyzed carefully, and presented in Table 4.01 and in Figure 4.01. This table and the figure clearly indicate that availability of households increase along with increase in income up to the monthly income of Rs.30,000, and then observed the reverse trend. If one considers these two middle income groups in the Table, i.e., the groups having monthly income

Table no. 4.01: Income-wise distribution of households

S. No.	Income – group	No. of Households	Percentage
1	<10000	8	8.00
2	10000-20000	29	29.00
3	20000-30000	33	33.00
4	30000-40000	15	15.00
5	40000-50000	8	8.00
6	>50000	7	7.00
	Total	**100**	**100.00**

Source: Primary Household Survey- 2010.

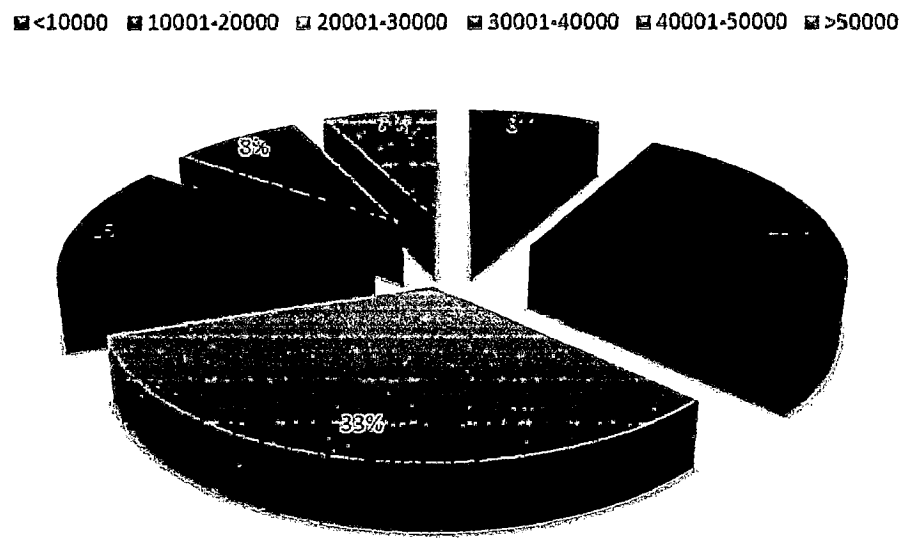


Figure no.4.01: Income-wise distribution of households

of Rs.20,000-30,000 and Rs.30,000-40,000, together, then they share about half of the households (48.00 per cent), and if one consider the second and third group in the Table, i.e., monthly income group of Rs.10,000-20,000 and Rs.20,000-30,000 together, then it would together form about two-third (62.00 per cent) of the total households. Further, this table reveals that the less than one tenth (8.00 per cent) of the total households are having monthly income below Rs.10, 000; little below one third (29.00 per cent) of the households having income between Rs.10, 000-20, 000, followed by one third of the households (33.00 per cent) are having income between Rs. 20,000 -30,000; little below one seventh (15.00 per cent) of the households having Rs.30, 000-40,000. Further, it is observed that less than one tenth of the total households are having income range between Rs.40, 000-50,000 and above Rs.50, 000 respectively. It could be deduced from the table, based on the above, that majority of the surveyed households are living in the middle income category only in the study area. The Investigator observe that the first two income groups, i.e., < Rs.10,000 to up to Rs.20,000 as lower income group; groups having monthly income from Rs.20,000 to Rs.40,000 as middle income group; and the other segment consist of monthly income above Rs.40,000 are considered as higher income group for further analysis. The investigator further reexamined these last two income groups (monthly income group of Rs.40,000-50,000, and above

Rs.50,000) and observed that households are having either double income or involved in commercial activities or working in financial institutions and banking sectors.

4.3 RELIGION

Religion is an important parameter, which decides the behavior of the individuals, family, groups, etc., in the society. The cultural attitudes, customs and traditions, people's habit, religious belief, etc., are the highly influential factors which are responsible for the social behavior of a particular religion and the system in general. Religion is an integral part of the society. Therefore, the investigator made an attempt understand the religious pattern of the people in the study area, and is presented in Table 4.02 and Figure 4.02. This Table and the Figure reveal that about nine-tenth of the households (88.00 per cent) belongs to Hindu community, followed by the Christian community has a share of about one-tenth (8.00 per cent), and the rest (4.00 per cent) belongs to Muslim community respectively. It has been observed that the available Christian and Muslim households are almost evenly distributed in all segments of income groups, and the Hindu households are increasing along with increase in income group up to the monthly income group of Rs.20, 000-30,000, and then observed the reverse trend. This table concludes that the city is much dominated by the households belonging to the Hindu community.

Table no.4.02: Income-group and Religion

S. No.	Income-group	Religion						Total	
		Hindu		Christian		Muslim			
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	8	9.09	0	0.00	0	0.00	8	8.00
2	10000-20000	26	29.55	2	25.00	1	25.00	29	29.00
3	20000-30000	29	32.95	3	37.50	1	25.00	33	33.00
4	30000-40000	13	14.77	2	25.00	0	0.00	15	15.00
5	40000-50000	7	7.95	0	0.00	1	25.00	8	8.00
6	>50000	5	5.68	1	12.50	1	25.00	7	7.00
	Total	**88**	**100.00**	**8**	**100.00**	**4**	**100.00**	**100**	**100.00**

Source: Primary Household Survey- 2010.

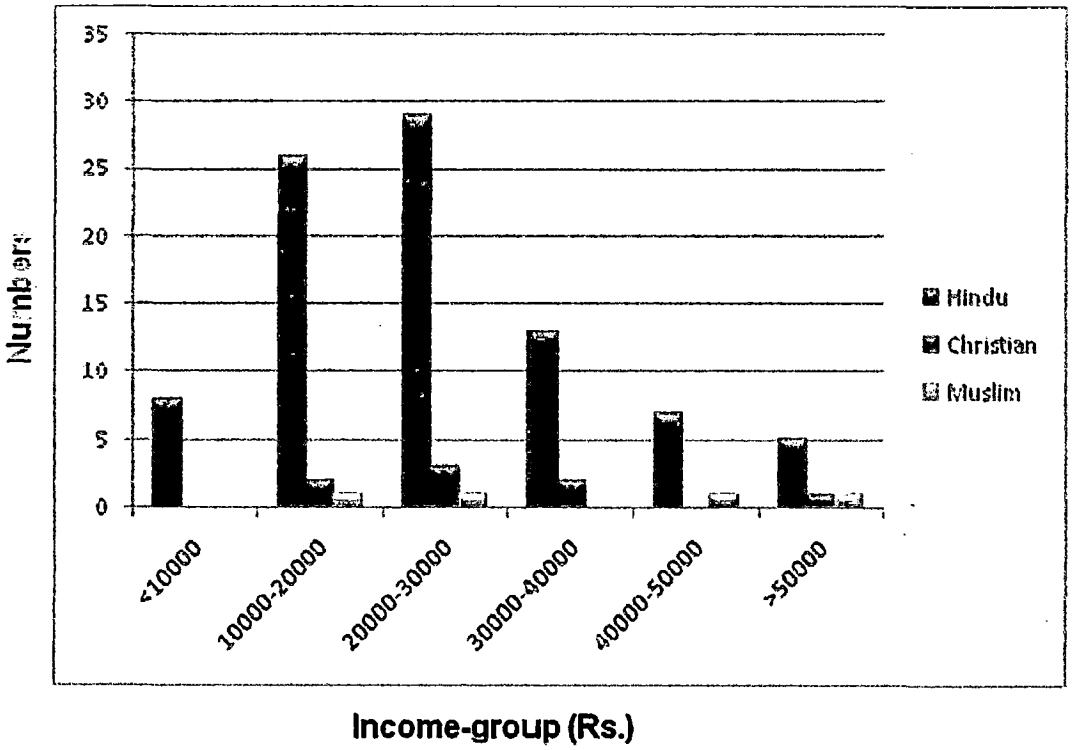


Figure no.4.02: Income-group and Religion

4.4 POPULATION AND HOUSEHOLD SIZE

Population is the major parameter, which decides the functions of the system. In India, the higher rate of acceleration in population growth leads to low per capita availability of land, low per capita Gross Domestic Product, low per capita income, low per capita consumption on infrastructure services, etc. These factors lead to crisis in the family in particular, and in the system in general. Since the population is the prime and key parameter, number of population at the household is considered in the survey schedule, which is used for conducting the primary household survey, and classified into male and female categories for analysis. Further, understanding the population growth trend in different income groups is indispensable to decide the function of the particular system.

Household size is also one of the most important parameters, which make a decision for the functions of the system. If a household has higher size of population with lower annual income, one can conclude that the household not only suffers socially but also economically in

the society. Whereas, the household has a small size of population with marginal annual income, it flourishes and possess better standard of living compared to the earlier one. Having the above in mind, the Investigator analyzed total number of population in different income groups by male and females, household size, etc., and the results are presented in Table 4.03 and in Figure 4.03.

Table no.4.03: Population distribution

S. No.	Income-group (Rs.)	Population Distribution						Average Household size
		Male		Female		Total		
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.
1	<10000	18	8.82	12	6.25	30	7.58	3.75
2	10000-20000	59	28.92	48	25.00	107	27.02	3.70
3	20000-30000	64	31.37	66	34.38	130	32.83	3.93
4	30000-40000	37	18.14	31	16.15	68	17.17	4.53
5	40000-50000	16	7.84	20	10.42	36	9.09	4.50
6	>50000	10	4.90	15	7.81	25	6.31	3.57
		204	**100.00**	**192**	**100.00**	**396**	**100.00**	**3.99**

Source: Primary Household Survey- 2010

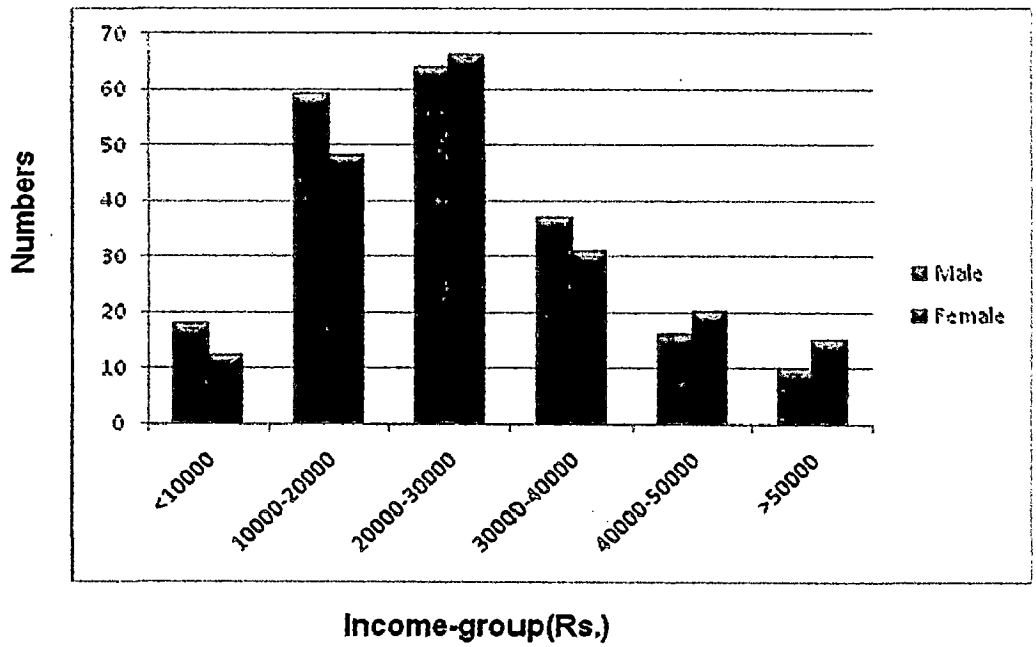


Figure no.4.03: Population distribution

This table and figure reveals that the available population (male and female population) is increasing along with increase in income up to the monthly income group of Rs.20, 000-30,000 and then observed the reverse trend. Out of the total population, almost two third of population (67.42 per cent) are grouped under lower income and middle income categories, i.e., income up to group of Rs.40, 000/- per month, and the remaining (32.58 per cent) lies under the higher income group category, having monthly income above Rs.40, 000 which is almost evenly distributed among fifth and sixth income groups. Similarly the pattern of distribution also observed among the male and female population classification. Further, it is also observed from the table that the average household size is increasing from the monthly income group of Rs.10, 000-20,000 to Rs.30,000-40,000, and then observed the reverse trend. Further, it has been observed that out of the total population, about half (48.48 per cent) of the population are female, and rest of them (51.52 per cent) are male population, and then overall average size of population is four in the system. It is concluded from the table and the figure that the population with sound economic background produce less number of children and their standard of living also higher compared to the lower and middle income group categories.

4.5 LITERACY AND EDUCATION

Literacy and Education are the two eyes of socio-economic development of any system. The study area has 80.66 per cent of literacy rate as per Census of India, 2001. To understand the status of education among the households, the qualified persons are classified into the following category, they are Up to metric, High school, Graduation, Post graduation, Illiterate for making analysis and are presented in Table 4.04 and 4.05 and Figure 4.04. This table and the figure explain that there are 367 educated persons available among the surveyed households. It has been observed from the table that out of the total literate population, one-third (33.51 per cent) of the educated personnel confined in the lower income group and more than half of (50.95 per cent) lies in the middle income group , and the rest (15.54 per cent) of them are confined in the higher income group category.

Further, it has been observed that among the qualified persons in different income groups, the persons qualified up to metric is much higher in the first three income groups (income groups up to Rs.10,000, Rs.10,000-20,000 & Rs.20,000-30,000). These three groups together accounts for three-fourth (74.85 per cent) of the total up to metric qualified persons, and the rest (25.15 per cent) of them are evenly distributed in all other income group categories. The table also reveals that the available number of qualified personnel increasing along with increase in income up to first three income groups having monthly income up to Rs.30,000 and then observe reverse trend. It clearly indicates that households have higher income with higher qualification on one hand, and the middle income group also has equal contribution on the other hand. Therefore one can easily conclude that higher income work as a catalyst for higher education in the system.

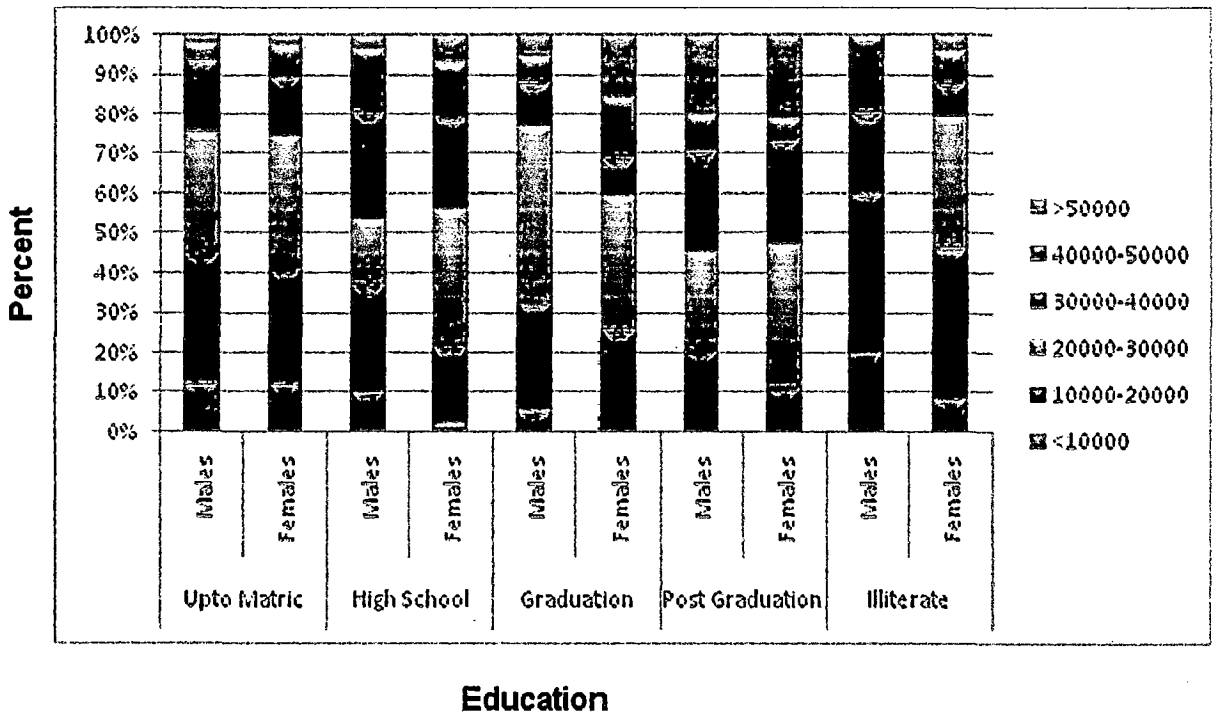


Figure no.4.04: Income wise education among Males and Females

Table no.4.04: Education among males

S. No.	Income-group (Rs.)	Education (Males)										Total	
		Up to Metric		High School		Graduation		Post Graduation		Illiterate			
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	11	11.83	3	10.00	3	5.36	0	0.00	1	20.00	18	8.82
2	10000-20000	30	32.26	8	26.67	15	26.79	4	20.00	2	40.00	59	28.92
3	20000-30000	29	31.18	5	16.67	25	44.64	5	25.00	0	0.00	64	31.37
4	30000-40000	17	18.28	8	26.67	6	10.71	5	25.00	1	20.00	37	18.14
5	40000-50000	4	4.30	5	16.67	4	7.14	2	10.00	1	20.00	16	7.84
6	>50000	2	2.15	1	3.33	3	5.36	4	20.00	0	0.00	10	4.90
	Total	**93**	**100.00**	30	**100.00**	56	**100.00**	20	**100.00**	5	**100.00**	**204**	**100.00**

Source: Primary Household Survey- 2010.

Table no.4.05: Education among females

S. No.	Income-group (Rs.)	Education (Females)										Total	
		Up to Metric		High School		Graduation		Post Graduation		Illiterate			
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	9	12.16	1	2.33	0	0.00	0	0.00	2	8.33	12	6.25
2	10000-20000	21	28.38	8	18.60	8	25.00	2	10.53	9	37.50	48	25.00
3	20000-30000	25	33.78	15	34.88	11	34.38	7	36.84	8	33.33	66	34.38
4	30000-40000	11	14.86	10	23.26	3	9.38	5	26.32	2	8.33	31	16.15
5	40000-50000	6	8.11	6	13.95	5	15.63	1	5.26	2	8.33	20	10.42
6	>50000	2	2.70	3	6.98	5	15.63	4	21.05	1	4.17	15	7.81
	Total	**74**	**100.00**	43	**100.00**	32	**100.00**	19	**100.00**	24	**100.00**	**192**	**100.00**

Source: Primary Household Survey- 2010.

4.6 EMPLOYMENT

Employment is considered as one of the most important parameters and considered as the 'back bone' of the economy in the system. The employment opportunities in the primary, secondary, and tertiary sectors of the economy have been considered in this investigation, and have been observed that the secondary and tertiary sectors of the economy are functioning well in the system. The employed persons confined in various income groups are analyzed and income group wise contribution of employment to total employment and share of employment to total population are presented in Table 4.06 and Figure 4.05. This table and the figure reveals that there are 146 employed persons available in the surveyed households, which accounts for more than one-third (36.86 per cent) of the total population. It has been observed that numbers of employed persons are increasing along with increase in income in the first three income segments i.e., monthly income up to Rs.30,000 and then observed the reverse trend. Further, It has been observed that the share of employment is almost evenly distributed among all the income groups except the highest income group, i.e., monthly income of above Rs.50,000. It has also been observed that more than one third (36.87 per cent) of the total available populations are working,

Table no.4.06: Employment Characteristics

S. No.	Income-group (Rs.)	Employment Status			
		No of Persons employed		Share of Employment	Population
		Nos.	Per cent	Percent	
1	<10000	11	7.53	36.67	30
2	10000-20000	40	27.40	37.38	107
3	20000-30000	43	29.45	33.08	130
4	30000-40000	25	17.12	36.76	68
5	40000-50000	14	9.59	38.89	36
6	>50000	13	8.90	52.00	25
	Total	**146**	**100.00**	**36.87**	**396.00**

Source: Primary Household Survey- 2010.

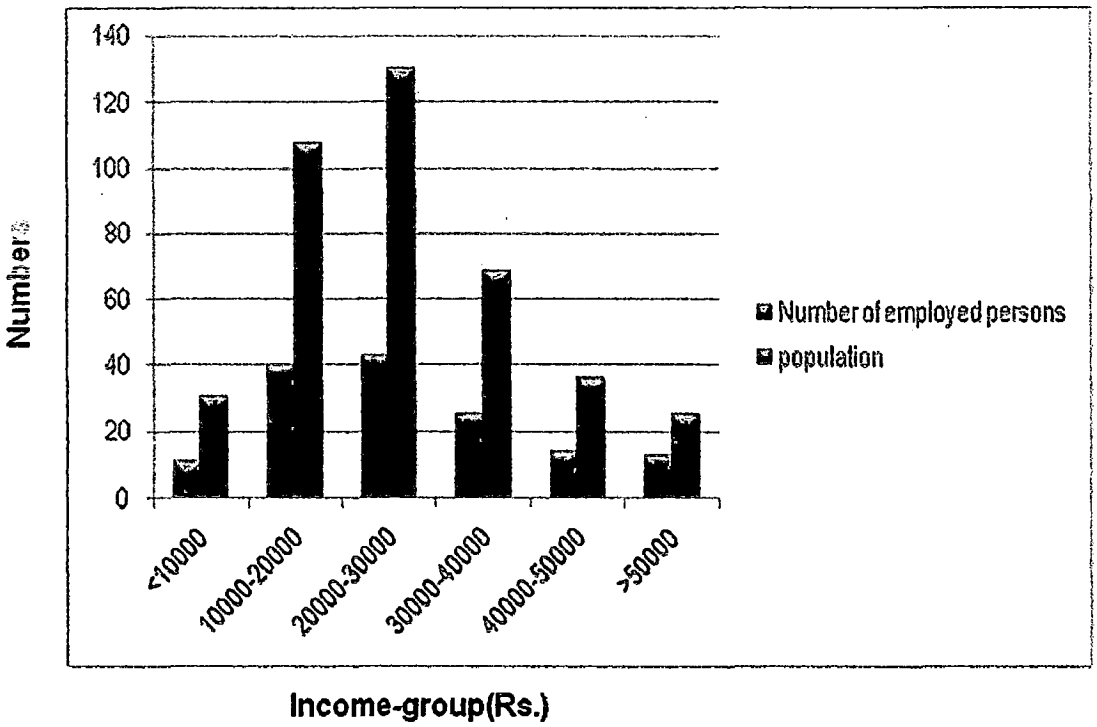


Figure no. 4.05: Employment Characteristics

and almost one third of the population qualified graduation and post graduation. It clearly indicates that education plays a major role in occupation and occupation more or less decides the income and the standard of living in the system.

4.7 TYPE OF OCCUPATION

The investigator further analyzed the occupational pattern of the people, among various income groups and the results are presented in Table 4.07 and 4.08 respectively. The Table 07 reveals that the Government job, private job business and agriculture are increasing along with increase in come from monthly income less than Rs.10,000 to Rs.30,000 and thereafter decreasing with increase in income, in the remaining income groups up to monthly income above Rs.50,000. Further it has been observed that in case of primary occupation, one-third (33.00 per cent) of the total surveyed households are employed in government, followed by Agriculture, private service, own business with 32.00, 21.00 and 14.00 per cent respectively.

Table 4.07: Employment pattern for primary occupation

Sr. No.	Income-group(Rs.)	Primary Occupation							
		Govt. Job		Private Job		Business		Agriculture	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	2	6.06	0	0	0	0	6	18.75
2	10000-20000	4	12.12	8	38.10	2	14.29	15	46.88
3	20000-30000	17	51.52	5	23.81	5	35.71	5	15.63
4	30000-40000	4	12.12	2	9.52	4	28.57	4	12.50
5	40000-50000	4	12.12	2	9.52	2	14.29	2	6.25
6	>50000	2	6.06	4	19.05	1	7.14	0	0
		33	**100.00**	**21**	**100.00**	**14**	**100.00**	**32**	**100.00**

Source: Primary Household Survey- 2010.

The Table 08 illustrates that the status of secondary occupation, and one-fourth (25.00 percent) of households are engaged with some kind of secondary occupation. This table reveals that Government job, private job and agriculture are increasing along with increase in income in the first two income groups having monthly income up to Rs.20,000 and the rest of them are evenly distributed up to the monthly income of above Rs.50,000. Further, the table explains that of the total surveyed households the government job and private service has equal contribution, and are observed as 9 per cent respectively and 7.00 per cent in agriculture, and the remaining 75 per cent does not have any kind of secondary occupation at all.

Table 4.08: Employment pattern for secondary occupation

Sr. No.	Income-group (Rs.)	Secondary Occupation							
		Govt. Job		Private Job		Agriculture		None	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	1	11.11	0	0	0	0	7	9.33
2	10000-20000	2	22.22	2	22.22	2	28.57	23	30.67
3	20000-30000	1	11.11	3	33.33	2	28.57	26	34.67
4	30000-40000	1	11.11	1	11.11	0	0	13	17.33
5	40000-50000	1	11.11	2	22.22	3	42.86	3	4.00
6	>50000	3	33.33	1	11.11	0	0	3	4.00
		9	**100.00**	**9**	**100.00**	**7**	**100.00**	**75**	**100.00**

Source: Primary Household Survey- 2010

4.8 SOURCE OF INCOME

Source of income of the households is one of the most important parameters, which decides functions of the system, since activities of all the primary, secondary and tertiary sectors of the economy is highlighted to understand the real economic pattern. To understand the status of economy among the households, the source of income is classified as Business, Salary, Agriculture, and combination of these three are further classified as Business & Agriculture and Salary & Agriculture respectively and are presented in Table 4.09 and in Figure 4.06 respectively.

The table and the figure reveals that all the sources of income are increasing along with increase in income up to first two income groups having monthly income up to Rs.20,000 and the rest observed the reverse trend in the system. Further, it has been observed that of the total surveyed households almost half (48.00 per cent) of the households are falls under the source of salary income category, followed by agriculture income of 22.00 per cent respectively. Further, the table reveals that two income combinations, i.e., Salary & Agriculture is 15.00 per cent and Business & Agriculture is only 2.00 per cent of total households. Salary is the most dominant source of income followed by agriculture and so on in the system.

Table no.4.09: Employment pattern for secondary occupation

S. No.	Income-group (Rs.)	SOURCE OF INCOME									
		Business		Salary		Agriculture		Business & Agriculture		Salary & Agriculture	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	0	0	2	4.17	5	22.73	0	0	1	6.67
2	10000-20000	2	15.38	10	20.83	11	50.00	0	0	6	40.00
3	20000-30000	5	38.46	20	41.67	2	9.09	2	100.00	4	26.67
4	30000-40000	5	38.46	6	12.50	3	13.64	0	0	1	6.67
5	40000-50000	0	0	4	8.33	1	4.55	0	0	3	20.00
6	>50000	1	7.69	6	12.50	0	0	0	0	0	0
		13	**100.00**	**48**	**100.00**	**22**	**100.00**	**2**	**100.00**	**15**	**100.00**

Source: Primary Household Survey- 2010

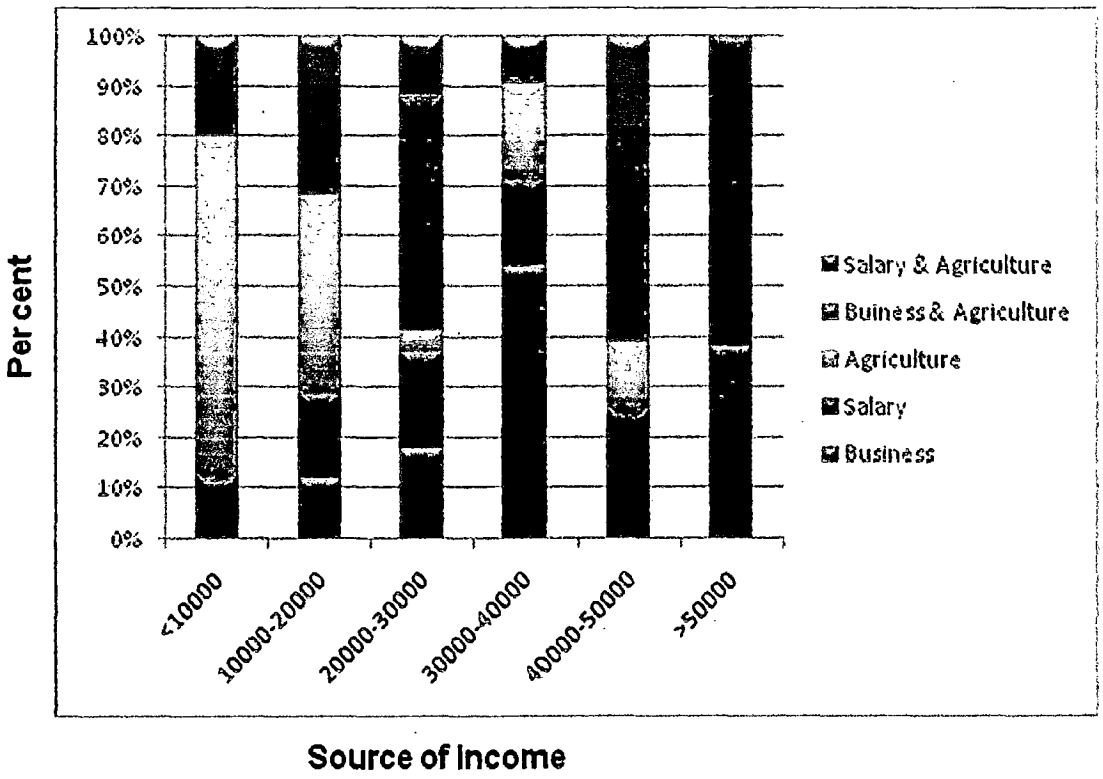


Figure no.4.06: Source of Income among different income groups

4.9 HOUSEHOLD EXPENDITURE

The Investigator studied the expenditure pattern of the surveyed households in terms of actual monthly expenditure, as percentage to monthly income, and average, and per capita expenditure for each income category. Income and expenditure are having direct relation, and income decides the purchasing power of the people in a particular system. Normally, the higher income group people spend more amount of money than the lower income group people, since the higher income group have strong purchasing power. The lower income group normally spends more amounts of money towards their food for their survival, whereas the higher income group spends a very meager per cent of their income for food. The higher income group generally spends more money to take pleasure in the infrastructure facilities, whereas it almost absence in case of the lower income group, since they have only very little capacity of purchasing power. Expenditure among various income groups towards other kinds of expenses, which include power consumption, domestic water, cooking gas, petrol/diesel, health, cloths, education, recreation, transport, telephone and other expenses are varying

Table no.4.10: Household Average Expenditure among different income groups

S. No.	Income Group (Rs.)	Household Average Expenditure									
		Food	Education	Cloths	Health	Transport	Telephone	LPG/Kerosene	Petrol/Diesel	Electricity	Water
		Household Average	Household Average	Household Average	Household Average	Household Average	Household Average	Household Average	Household Average	Household Average	Household Average
1	<10000	2031.25	250.00	450.00	343.75	218.75	208.75	327.50	400.00	116.87	33.75
2	10000-20000	3500.00	925.86	686.20	551.72	474.13	586.20	365.00	577.58	164.65	35.86
3	20000-30000	4121.20	1622.72	1046.96	906.06	692.42	898.48	365.45	1295.45	310.45	49.39
4	30000-40000	5300.00	3433.33	1333.33	726.67	886.67	863.33	368.00	1686.67	329.67	73.33
5	40000-50000	5812.50	3500.00	1437.50	887.50	506.25	1312.50	410.00	2343.75	656.25	70.00
6	>50000	7142.85	3642.85	1642.85	642.85	1142.85	1521.42	328.57	1785.71	514.28	71.42

Source: Primary Household Survey- 2010

Table no. 4.11: Per Capita Expenditure among different income groups

S. No.	Income Group (Rs.)	Per Capita Expenditure									
		Food	Education	Cloths	Health	Transport	Telephone	LPG/Kerosene	Petrol/Diesel	Electricity	Water
		Per Capita	Per Capita	Per Capita	Per Capita	Per Capita	Per Capita	Per Capita	Per Capita	Per Capita	Per Capita
1	<10000	541.67	66.67	120.00	91.66	58.33	55.67	87.33	106.67	31.67	9.00
2	10000-20000	948.59	250.93	185.98	149.53	128.50	158.87	98.92	156.54	44.62	9.72
3	20000-30000	1046.15	411.92	265.77	230.00	175.76	228.07	92.76	328.84	78.80	12.53
4	30000-40000	1169.11	757.35	294.12	160.29	195.58	190.44	81.17	372.05	72.72	16.17
5	4000-50000	1291.67	777.78	319.44	197.22	112.50	291.67	91.11	520.83	145.83	15.55
6	>50000	2000.00	1020.00	460.00	180.00	320.00	426.00	92.00	500.00	144.00	20.00

Source: Primary Household Survey- 2010

4.9.2 Per Capita Expenditure

The Per Capita expenditure for all the activities has also been considered by the investigator to understand, the economic status of the different income groups in the study area. The Per Capita expenditure towards the expenses, such as food, education, cloths, health, transport, telephone, LPG/Kerosene, petrol/diesel, electricity and drinking water have been analyzed and presented in Table 4.11 and Figure 4.08. The table and the figure reveals that all the household expenses are increasing along with increasing income from lower income group to higher income group having monthly income from less than Rs.10,000 to above Rs.50,000. Further, it has been observed that income group wise expenditure towards the above activities indicates a clear idea about their spending in different activities. It has been observed that of the total expenditure in all the income groups spent more money for food and further it explains that the lowest income groups are spending more money towards food (50 per cent of their income) and almost half of their total income is spent for food. Further, It is also observed from the table that the per capita expenditure in the lowest income category is Rs.541.67 where as in the highest income category it is Rs. 2000 per month. Households in the highest income category spend almost four times more on food than the households in the lowest income category, which shows that the highest income category people consume good quality of food.

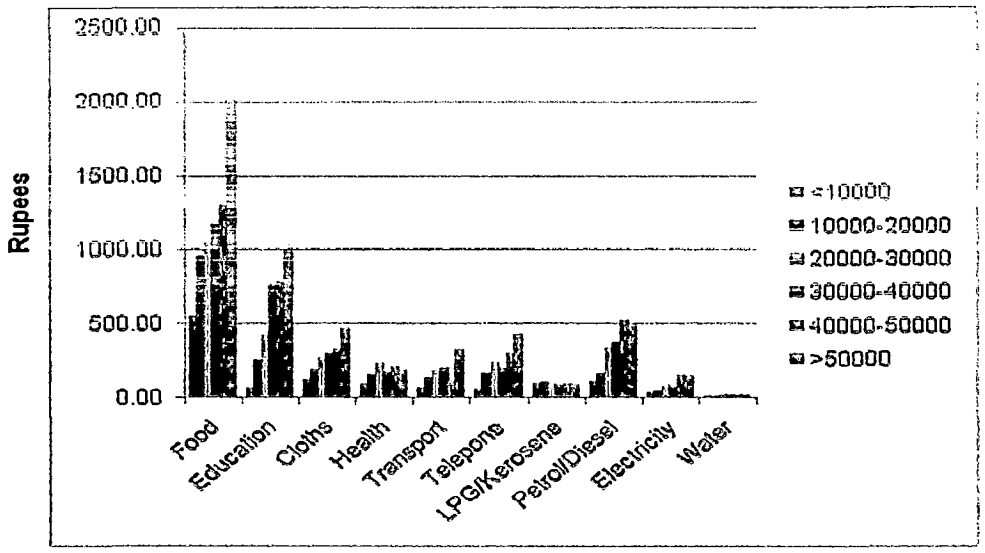


Figure no.4.08: Per Capita Expenditure among different income groups

4.9.3 Expenditure on Food

Food is considered as one of the basic necessities of life for survival. A substantial share of household income is spent to cater this basic necessity of life. The investigator studied the expenditure pattern of the surveyed households in terms of actual monthly expenditure, as percentage of monthly income, for each income category and the results are presented in Table 4.12 and in Figure 4.09 respectively. This Table and Figure explains that food expenditure is increasing along with increase in income for the first two income groups which are having monthly income up to Rs.20,000, and then observed the reverse trend. Further, It has been observed from the table that almost half (50.00 per cent) of the total number of surveyed households spend between 11-20 per cent of their monthly income on food and one-fifth (20.00 per cent) spends up to 30 per cent of their monthly income on food. The table also reveals that while in the highest income category, all households spend less than one-tenth of their monthly income on food, in the lowest income category almost all spend (more than 50.00 per cent) more than of their monthly income towards the food alone, which shows that the lowest income group does not have life at all.

Table 4.12: Expenditure on food as percentage of monthly income

Sr. No.	Income-group (Rs.)	Expenditure on Food (%)									
		Up to 10		11--20		21 - 30		31-50		41-50	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	0	0	1	2.08	4	20.00	2	20.00	1	33.33
2	10000-20000	3	15.79	11	22.92	7	35.00	6	60.00	2	66.67
3	20000-30000	7	36.84	19	39.58	5	25.00	2	20.00	0	0.00
4	30000-40000	4	21.05	9	18.75	2	10.00	0	0	0	0.00
5	40000-50000	2	10.53	4	8.33	2	10.00	0	0	0	0.00
6	>50000	3	15.79	4	8.33	0	0	0	0	0	0.00
		19	**100.00**	**48**	**100.00**	**20**	**100.00**	**10**	**100.00**	**3**	**100.00**

Source: Primary Household Survey- 2010

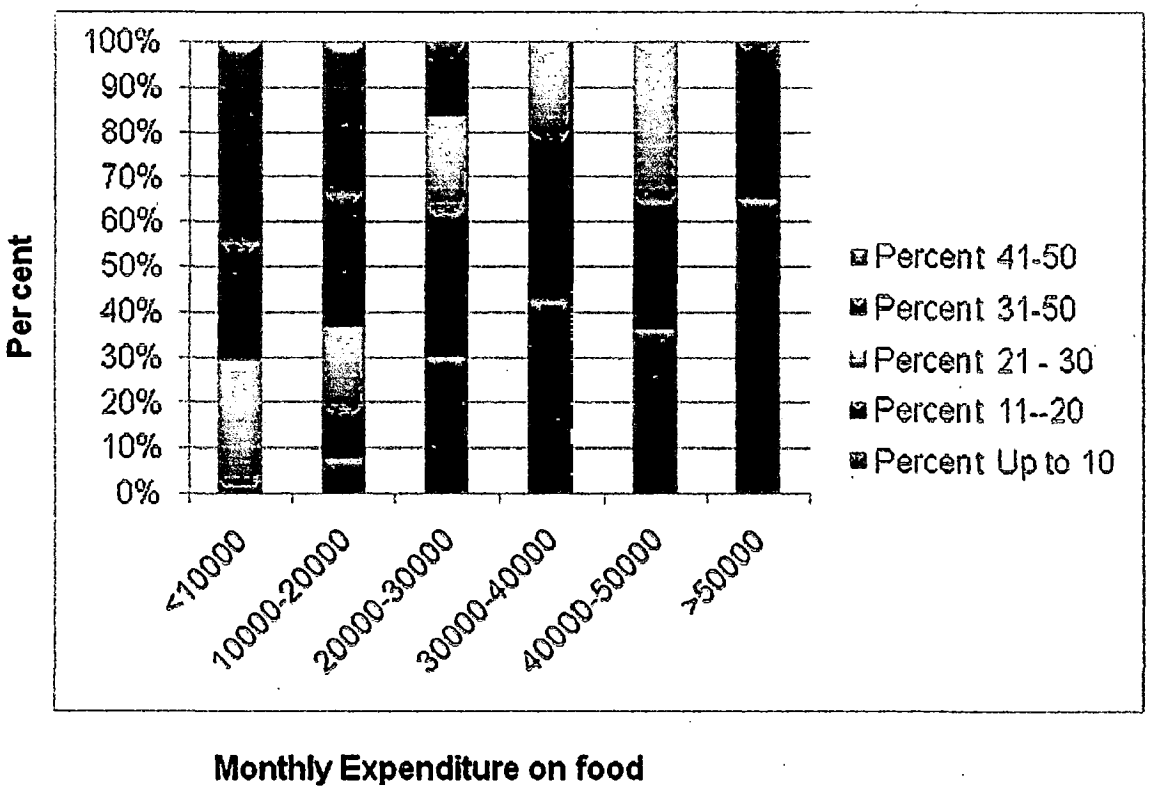


Figure no.4.09: Expenditure on food as percentage of monthly income

4.9.4 Expenditure on Education

Education is one of the important parameters for the socio-economic development of any system. The share of expenditure towards the education indicates awareness in the society. Further, education decides the income earning opportunity of the households in the system. Having the above knowledge in mind, the Investigator studied the expenditure for education. The expenditure pattern of the surveyed households is studied in terms of actual monthly expenditure, as percentage of monthly income, for each income category and the results are presented in Table 4.13 and figure 4.10. This Table and Figure explains that expenditure on education is increasing along with increase in income for first two income groups are having monthly income up to Rs.20,000 and then observed the reverse trend. Further, the table illustrates that more one-fourth (29.00 per cent) of the households do not spend on education. It has been observed that almost one-fourth (24.00 per cent) of the total

depending upon their level of income. Having the above in mind, the Investigator made an attempt to analyze the expenditure pattern of different income categories, pertaining to some major selected activities, and the results are presented as below:

4.9.1 Household Average Expenditure

The household average expenditure towards the expenses, such as food, education, cloths, health, transport, telephone, LPG/Kerosene, petrol/diesel, electricity and domestic water have been analyzed and presented in Table 4.10 and Figure 4.07. This table and the figure reveals that all the household expenses are increasing along with increasing income from lower income group to the highest income group having monthly income of less than Rs.10,000 to above Rs.50,000. It has been observed that in all the income groups spent more money for food, and further it explains that the lowest income group is spending more money towards food , i.e., almost half of the total income is spent for food, in this particular group. As a consequence, this particular income group spend very meager amount of money for education, cloths, health, transportation, communication, energy, etc., which shows that they really live with less standard of living.

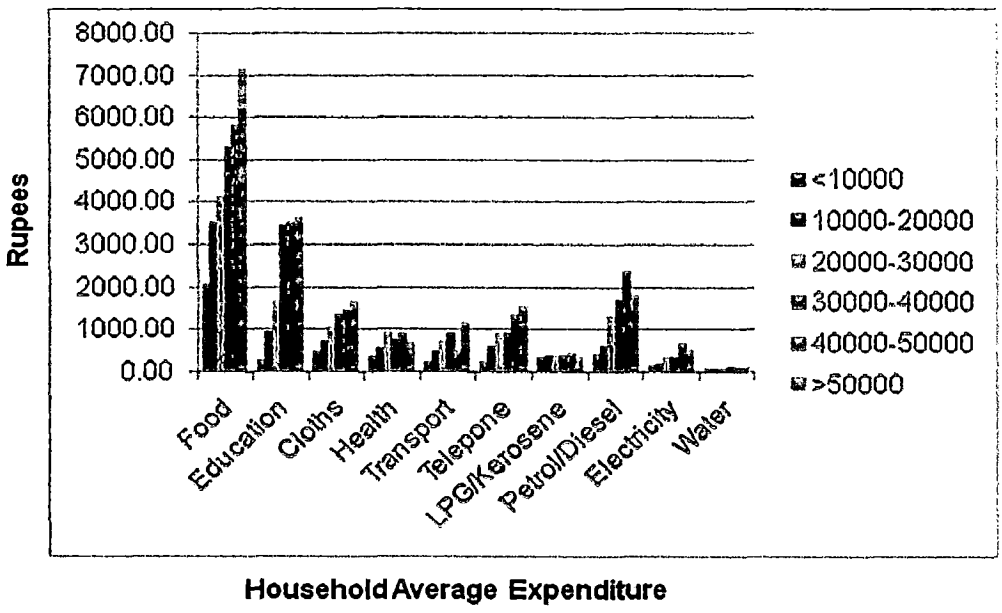


Figure no.4.07: Household Average Expenditure among different income groups

Table no.4.13: Expenditure on education as percentage of monthly income

Sr. No.	Income-group (Rs.)	Expenditure on Education (%)											
		Up to 5		6--10		11--15		16--20		Above 21		None	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	0	0	0	0	1	8.33	1	7.14	0	0	6	20.69
2	10000-20000	3	12.50	6	40.00	5	41.67	2	14.29	1	16.67	12	41.38
3	20000-30000	16	66.67	4	26.67	3	25.00	2	14.29	1	16.67	7	24.14
4	30000-40000	2	8.33	3	20.00	1	8.33	5	35.71	2	33.33	2	6.90
5	40000-50000	0	0	1	6.67	2	16.67	3	21.43	2	33.33	0	0
6	>50000	3	12.50	1	6.67	0	0	1	7.14	0	0	2	6.90
		24	**100.00**	**15**	**100.00**	**12**	**100.00**	**14**	**100.00**	**6**	**100.00**	**29**	**100.00**

Source: Primary Household Survey- 2010

number of surveyed households spend between up to 5 per cent of their monthly income on education. Further, the table reveals that the second, third and fourth income category spends more than one tenth (15.00, 12.00 and 14 per cent) spend 6-10 per cent, 11-15 and 16-20 per cent of their monthly income on education. The lowest income category almost one -fifth (18.00 per cent) do not spend at all on education purpose and middle-income categories spend the larger share (43.00 per cent of surveyed households) of their monthly income to cater their required education.

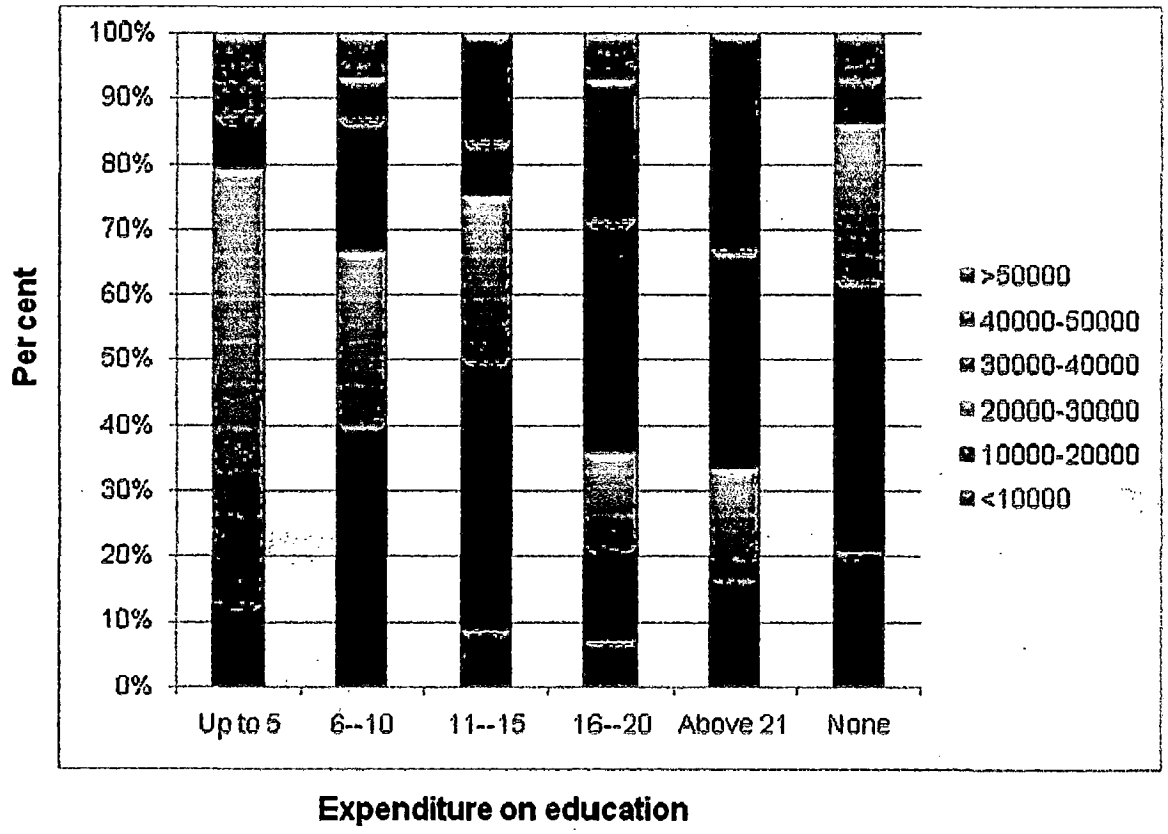


Figure no.4.10: Expenditure on education as percentage of monthly income

4.9.5 Expenditure on Cloth

Clothing is one of the basic needs of community in life. The expenditure pattern of the surveyed households is studied in terms of actual monthly expenditure, as percentage of monthly income for each income category and the results are presented in Table 4.14 and figure 4.11. This Table and the Figure reveals that the expenditure on cloths is increasing along with increase in income for first three income groups are having monthly income up to Rs.30,000 and then observed the reverse trend in the system. Further, It has been observed from Table that almost half (48.00 per cent) of the total number of surveyed households spend between 2.51-5.0 per cent of their monthly income on cloths. While less one third (28.00 per cent) spend up to 2.5 per cent of their monthly income. It has been further observed that almost one-fourth (24.00 per cent) spend more than 5 per cent of their monthly income on cloths. It is also observed that second and third category contributes larger share i.e., middle income groups are about half (48.00 per cent) the total number households and where as the lowest income category and highest income categories' contribution less than one tenth (8.00 and 7.00 per cent) of surveyed households. This clearly shows that middle income groups are spends more amounts towards cloths.

Table no.4.14: Expenditure on cloths as percentage of monthly income

Sr. No.	Income-group (Rs.)	Expenditure on Cloths (%)					
		Up to 2.5		2.51 - 5.00		Above 5	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	1	3.57	4	8.33	3	12.50
2	10000-20000	9	32.14	13	27.08	7	29.17
3	20000-30000	9	32.14	17	35.42	7	29.17
4	30000-40000	4	14.29	6	12.50	5	20.83
5	40000>50000	2	7.14	4	8.33	2	8.33
6	>50000	3	10.71	4	8.33	0	0
	Total	**28**	**100.00**	**48**	**100.00**	**24**	**100.00**

Source: Primary Household Survey- 2010

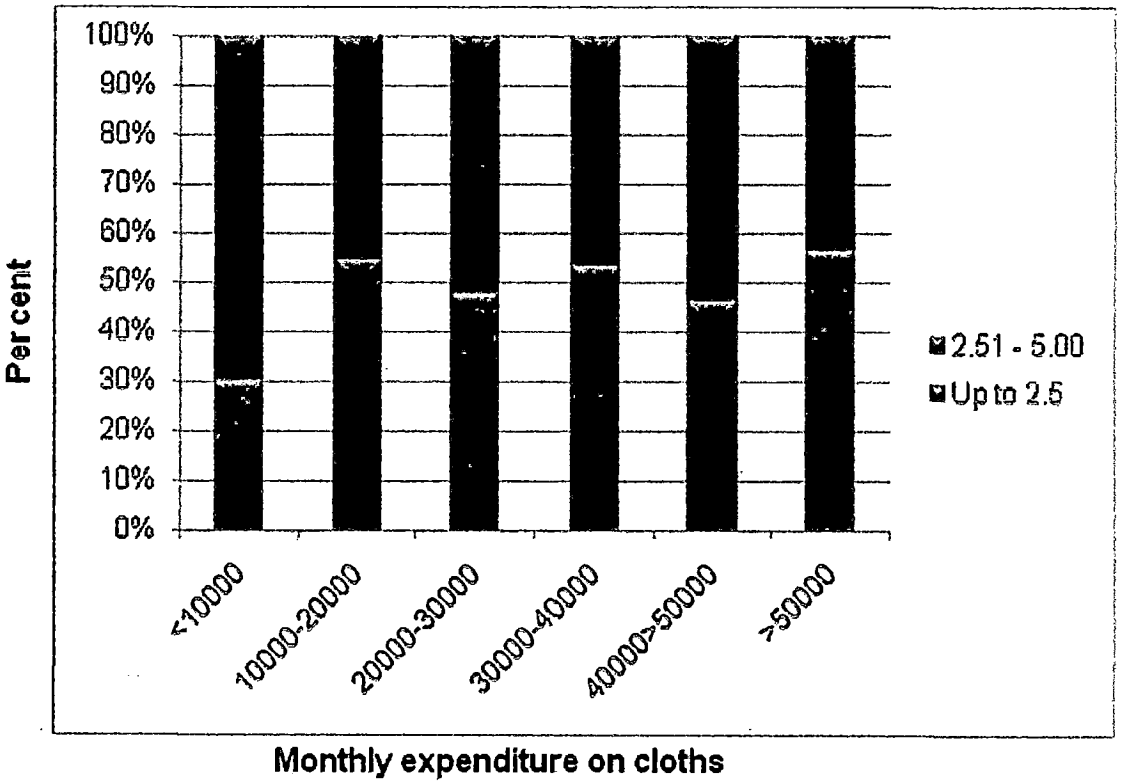


Figure no.4.11: Expenditure on cloths as percentage of monthly income

4.9.6 Expenditure on Health

Health is another one of the most important needs of human being in the system. Expenditure on health indicates awareness of people about health in the system, and the quality of life prevailing in the system. It also points towards availability of health care facilities in the system and people's paying ability on health facilities. The investigator realized the importance of the health facilities and its expenditure, are studied the data carefully. The expenditure pattern of the surveyed households is examined in terms of actual monthly expenditure, as percentage of monthly income, for each income category and the results are presented in Table 4.15 and figure 4.12 respectively. This Table and the Figure reveals that the expenditure on health is increasing along with increase in income for first three income groups are having monthly income up to Rs.30,000 and then observed the reverse trend in the system. It has been observed that middle income contributes major share (48.00 per cent) having monthly income Rs.20,000 to Rs.40,000 respectively and followed by the other higher and lower income groups.

Table no.4.15: Expenditure on health as percentage of monthly income

S. No.	Income-group (Rs.)	Expenditure on Health (%)							
		<2.5		2.51- 5		5.1-7.50		> 7.6-10	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	1	2.50	4	8.89	2	20.00	1	20.00
2	10000-20000	7	17.50	18	40.00	3	30.00	1	20.00
3	2000-30000	13	32.50	14	31.11	3	30.00	3	60.00
4	30000-40000	10	25.00	4	8.89	1	10.00	0	0
5	40000-50000	3	7.50	4	8.89	1	10.00	0	0
6	>50000	6	15.00	1	2.22	0	0	0	0
	Total	**40**	**100.00**	**45**	**100.00**	**10**	**100.00**	**5**	**100.00**

Source: Primary Household Survey- 2010

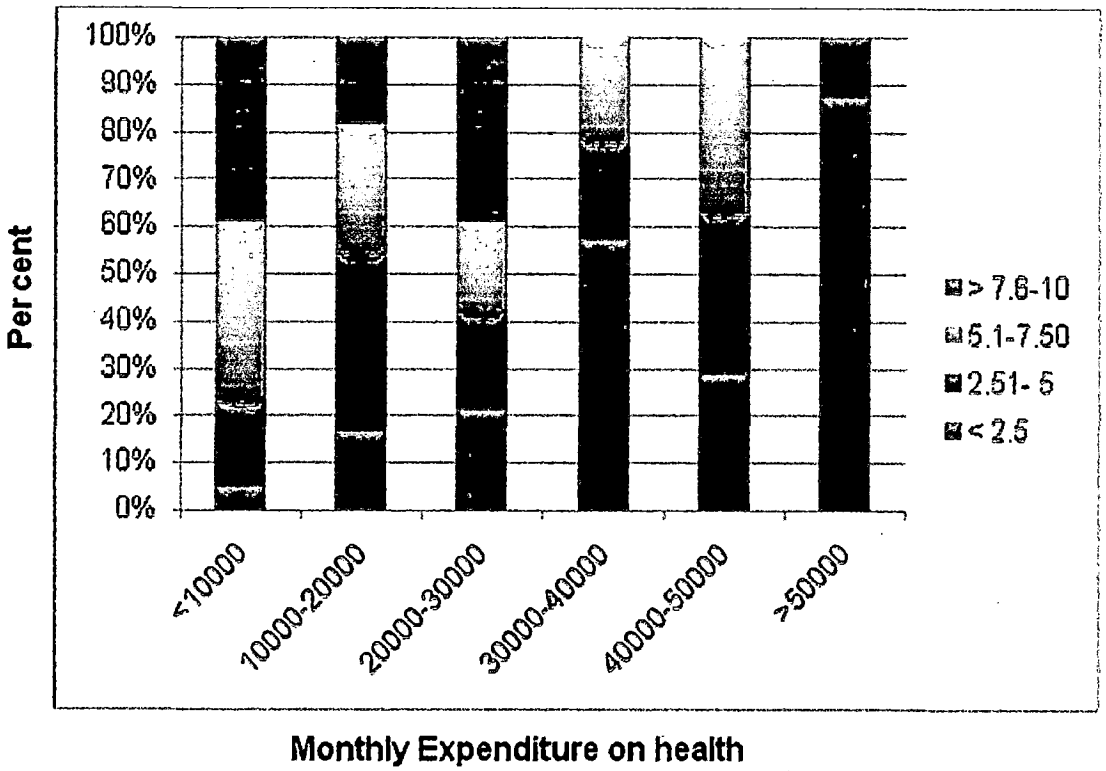


Figure no.4.12: Expenditure on health as percentage of monthly income

Further, It has been observed that less than half (45.00 per cent) of the total number of surveyed households spend between 2.51-5 per cent of their monthly income on health and almost two-fifth (40.00 per cent) spend up to 2.5 per cent of their monthly income on health. It

has been observed one-tenth (10.00 per cent) of the total number of surveyed households spends between 5.1-7.5 per cent of their monthly income on health and almost two-fifth (39.87 per cent) and less than one tenth (5.00 per cent) is spending more than 10.00 per cent.

4.9.7 Expenditure on Transportation

The transportation is one of the important parameters, which decides the functions of the systems. An efficient transportation system leads to more dynamic functions of a particular system. A transportation activity in the system shows the extent of mobility prevails in the system and dependence of people on the transportation activities for various purposes. Expenditure for transportation indicates the economic status of the people in the system and it is directly or indirectly related with quality of transportation available in the system. Having this knowledge, the Investigator studied the expenditure for transportation. The expenditure pattern of the surveyed households is studied in terms of actual monthly expenditure, and as percentage of monthly income, for each income category, and the results are presented in Table 4.16 and figure 4.13 respectively.

Table no.4.16: Expenditure on transportation as percentage of monthly income

S. No.	Income-group (Rs.)	Expenditure on Transportation (%)							
		Up to 3		3.1 - 6.00		6.1 - 9.00		None	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	4	8.00	1	4.17	1	14.29	2	10.53
2	10000-20000	13	26.00	9	37.50	2	28.57	5	26.32
3	20000-30000	16	32.00	9	37.50	3	42.86	5	26.32
4	30000-40000	9	18.00	3	12.50	1	14.29	2	10.53
5	40000-50000	3	6.00	0	0	0	0	5	26.32
6	>50000	5	10.00	2	8.33	0	0	0	0
		50	**100.00**	**24**	**100.00**	**7**	**100.00**	**19**	**100.00**

Source: Primary Household Survey- 2010

This Table and the figure reveals that the expenditure on transportation is increasing along with increase in income for first three income groups are having monthly income up to Rs.30,000 and then observed the reverse trend in the system. Further, It has been observed from Table and figure that half (50.00 per cent) of the total number of surveyed

expenditure, as percentage of monthly income, for each income category, and the results are presented in sequel.

4.9.9 Expenditure on petrol / diesel

Consumption of fuels for travelling purpose depends on availability and extent of use of vehicles in the system. More use of personal vehicles and more expenditure on energy show the economic strength of the people as well as compulsion of the people living in the system. In addition, expenditure for fuel shows commuting requirement of the people for various purposes, such as, working, office, education, social, leisure, etc., The Investigator studied the expenditure on fuel in the system and the results are presented in Table 4.17 and figure 4.14 respectively.

Table no 4.17: Expenditure on petrol / diesel to monthly income

S. No.	Income-group (Rs.)	Expenditure on Petrol / Diesel (Rs.)									
		Up to 500		501-1000		1001-3000		3001-5000		None	
		Nos.	Percent	Nos.	Percent	Nos.	Percent	Nos.	Percent	Nos.	Percent
1	<10000	1	10.00	5	11.36	0	0	0	0	2	22.22
2	10000-20000	5	50.00	11	25.00	6	19.35	0	0	7	77.78
3	20000-30000	3	30.00	18	40.91	11	35.48	1	16.67	0	0
4	30000-40000	1	10.00	7	15.91	5	16.13	2	33.33	0	0
5	40000-50000	0	0	1	2.27	5	16.13	2	33.33	0	0
6	>50000	0	0	2	4.55	4	12.90	1	16.67	0	0
	Total	**10**	**100.00**	**44**	**100.00**	**31**	**100.00**	**6**	**100.00**	**9**	**100.00**

Source: Primary Household Survey- 2010

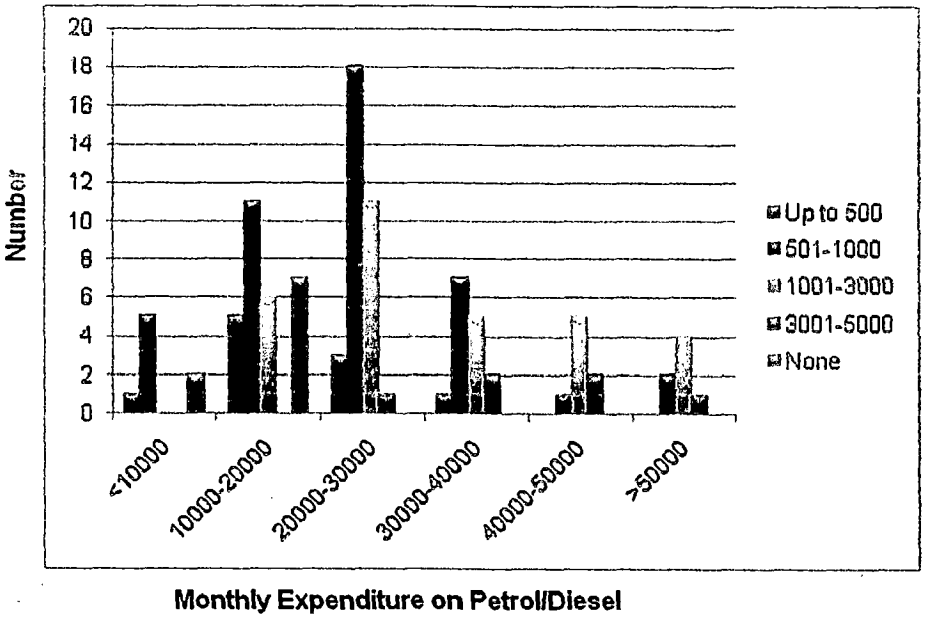


Figure no.4.14: Expenditure on petrol / diesel of monthly income

This Table and Figure reveal that the expenditure on fuel is increasing along with increase in income for the first three income groups, which are having monthly income up to Rs.30,000 and then observed the reverse trend in the system. Further, the table and figure illustrate that almost half (44.00 per cent) of the surveyed households spends Rs.501-1000, and less than one third (31.00 per cent) of households spends Rs.1001-3000. It has been observed that one tenth of surveyed households is spending up to Rs.500 and almost one tenth (9.00 per cent) of households do no spend at all for this purpose, and are confined among the lower income group category.

4.9.10 Expenditure on Electricity

Power supply is one of the important controlling parameters, which decide the functions of the system. The scarcity of power supply leads the entrepreneurs to move out of the state for setting up of industries and residents.Energy consumption at the household level commensurate with income of the households. Domestic electricity consumption depends on use of appliances for various purposes in the households. Availability and use of appliances at the household level show economic prosperity, and the quality of life prevailing in the system.

Expenditure for power supply gives an idea about consumption of electricity and the purchasing power of the people for the same in the system. Having this knowledge in mind, the Investigator conducted the survey thoroughly to understand the expenditure pattern in the study area. Thereafter the expenditure pattern of the surveyed households is studied in terms of actual monthly expenditure, percentage to monthly income, and the results are presented in Table 4.18 and in Figure 4.15 respectively. This Table and Figure reveals that the expenditure on electricity is increasing along with increase in income for first three income groups, are having monthly income up to Rs.30,000 and then observed the reverse trend in the system. Further, it has been observed from Table and Figure that more than one-third (79 per cent) of the total number of surveyed households spend up to Rs.500 of their monthly income on electricity. While less than one-eighth (17.00 per cent) spends between Rs.501-1000 of their monthly income on electricity, remaining households (4.00 per cent) spends between Rs.1001-3000 of their monthly income towards consumption on electricity. Households in the highest income category spend more than fifteen times as compared to households in the lowest income category for this purpose. This clearly indicates that there is a strong association between energy consumption and income level of the households in the system.

Table no.4.18: Expenditure on electricity of monthly income

S. No.	Income-group (Rs.)	Expenditure on Electricity (Rs.)					
		Up to 500		501-1000		1001-3000	
		Nos.	Percent	Nos.	Percent	Nos.	Percent
1	<10000	8	10.13	0	0	0	0
2	10000-20000	24	30.38	3	17.65	2	50.00
3	20000-30000	29	36.71	2	11.76	2	50.00
4	30000-40000	10	12.66	5	29.41	0	0
5	40000-50000	5	6.33	3	17.65	0	0
6	>50000	3	3.80	4	23.53	0	0
	Total	**79**	**100.00**	**17**	**100.00**	**4**	**100.00**

Source: Primary Household Survey- 2010

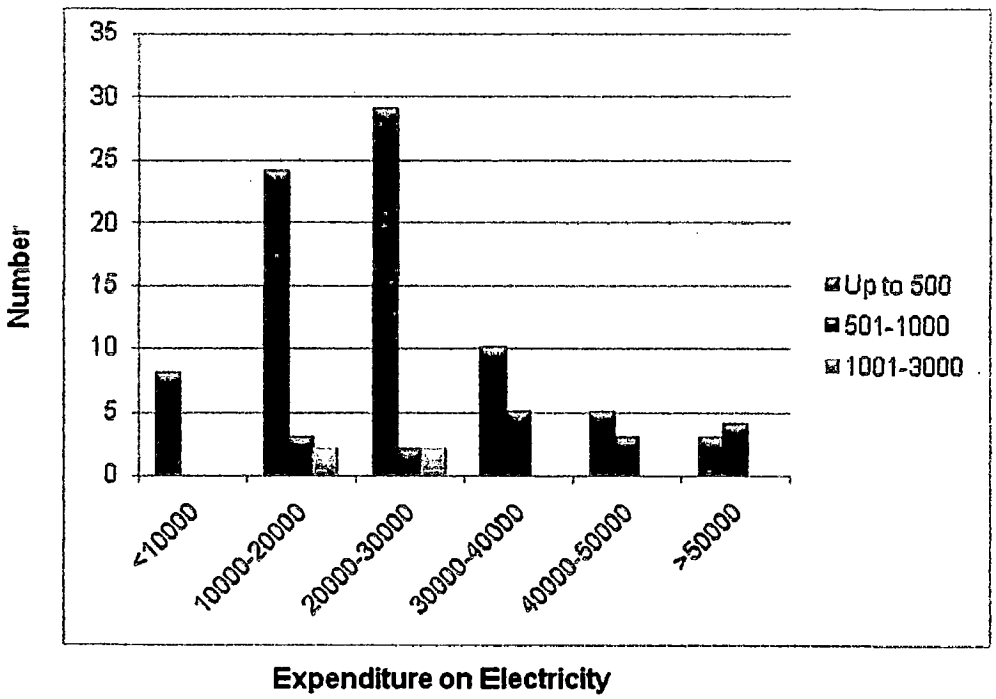


Figure no.4.15: Expenditure on electricity of monthly income

4.9.11 Expenditure on LPG/ Kerosene

Energy consumption for cooking gives an idea about cooking activities in the system. Amount of money spent towards energy for cooking shows the economic standard of the people and the quality of living available in the system. Generally, the economically well off people use liquefied petroleum gas (LPG) for cooking, which is the clean and costly energy, where as the economically poor prefer the use of fuel-wood, charcoal, etc., which create more smoke and soot in the kitchen that harm the health. Keeping this in mind, the Investigator studied the expenditure pattern for cooking gas. The expenditure pattern of the surveyed households is studied in terms of actual monthly expenditure, for each income category, and the results are presented in Figure 4.16 and Table 4.19 respectively. This Table and Figure reveal that the expenditure on LPG/Kerosene is increasing along with increase in income for first three income groups are having monthly income up to Rs.30,000 and then observed the reverse trend in the system. Further, the table and the Figure illustrate that nine-tenth (88.00 per cent) of the households spend between Rs.201-400 on LPG, and more than one-fifth (22.88 per cent) spend up to Rs.500. It has been observed that more than one tenth (12.00 per cent) households spend between Rs.501-1000 per month on LPG. It clearly shows that the

households confined among the highest income category spend twice as much household in the lowest income category. It is interesting to note that all the households are having LPG even in the households confined in the rural system. However, in some households are having kerosene stove as substitute for LPG, in the system for exigency.

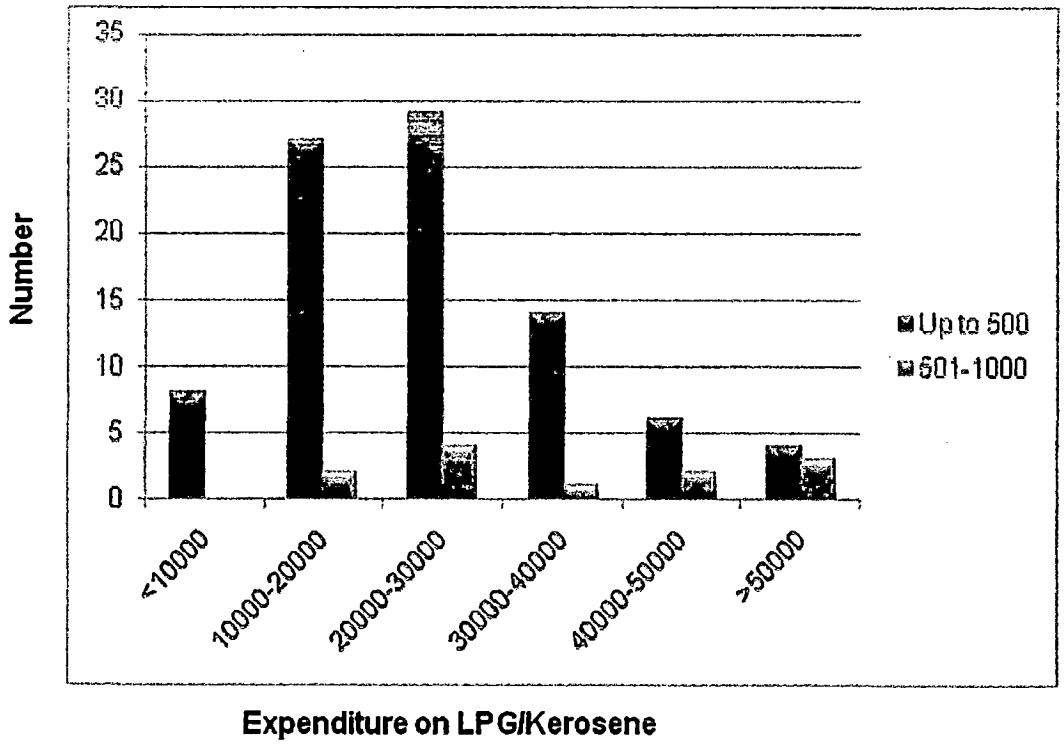


Figure no.4.16: Expenditure on LPG/Kerosene of monthly income

Table no.4.19: Expenditure on LPG/ Kerosene of monthly income

S. No.	Income-group (Rs.)	Expenditure on LPG / Kerosene (Rs.)			
		Up to 500		501-1000	
		Nos.	Percent	Nos.	Percent
1	<10000	8	9.09	0	0
2	10000-20000	27	30.68	2	16.67
3	20000-30000	29	32.95	4	33.33
4	30000-40000	14	15.91	1	8.33
5	40000-50000	6	6.82	2	16.67
6	>50000	4	4.55	3	25.00
	Total	**88**	**100.00**	**12**	**100.00**

Source: Primary Household Survey- 2010

4.9.12 Expenditure on Telephone

Telephone and internet services have made rapid development in the Indian society in the recent years. Telecommunication is considered as one of the important input to enhance the economic productivity in an urban system. People invariably, provided the affordability; opt for telephone and internet to stay connected with family members and to improve their income earning opportunities. Having this knowledge in mine the investigator studied the expenditure pattern of the surveyed households in terms of actual monthly expenditure, as percentage of monthly income, for each income category, for telephone, and the results are presented in Figure 4.17 and Table 4.20 respectively. This Table and Figure reveals that the expenditure on telephone is increasing along with increase in income for first two income groups are having monthly income up to Rs.20,000 and then observed the reverse trend in the system The Table 4.31 illustrates that one-third (33.00 per cent) of the households spend up to Rs.500 on telephone, and more than one-third (35.00 per cent) spend between Rs.501-1000. While less than one-third (30.00 per cent) spend up to Rs.1001-3000. It is interesting to note that all the households are utilizing telephone services. The table clearly indicates that expenditure on telephone increases with income.

Table no.4.20: Expenditure on telephone of monthly income

S. No.	Income-group (Rs.)	Expenditure on Telephone (Rs.)							
		Up to 500		501-1000		1001-3000		3001-5000	
		Nos.	Percent	Nos.	Percent	Nos.	Percent	Nos.	Percent
1	<10000	8	24.24	0	0	0	0	0	0
2	10000-20000	15	45.45	9	25.71	4	13.33	1	50.00
3	20000-30000	7	21.21	12	34.29	14	46.67	0	0
4	30000-40000	2	6.06	9	25.71	4	13.33	0	0
5	40000-50000	0	0	3	8.57	5	16.67	0	0
6	>50000	1	3.03	2	5.71	3	10.00	1	50.00
		33	**100.00**	**35**	**100.00**	**30**	**100.00**	**2**	**100.00**

Source: Primary Household Survey- 2010

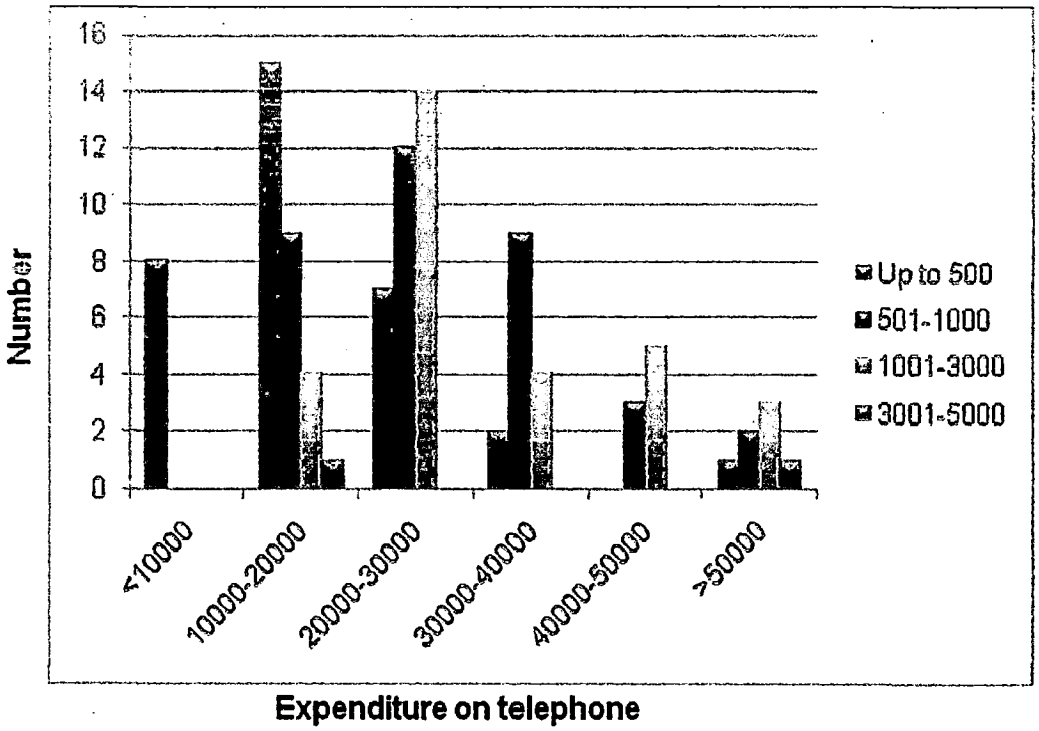


Figure no.4.17: Expenditure on telephone of monthly income

4.9.13 Expenditure on Water

Water is essence of human life. The Puducherry region relies totally on ground water resource and is providing portable water supply to all the villages and the towns. It has been observed that people in the study area pay very less for piped water as compared to surrounding sates of Tamil Nadu, where there is great water scarcity like Chennai metro city. Having this knowledge in mind, the Investigator conducted the survey thoroughly to understand the expenditure pattern in the study area. The expenditure pattern of the surveyed households is studied in terms of actual monthly expenditure for each income category, and the results are presented in Table 4.21.

Table no.4.21: Expenditure on drinking water of monthly income

S. No.	Income-group (Rs.)	Expenditure on Drinking water (Rs.)			
		Up to 100		101-300	
		Nos.	Percent	Nos.	Percent
1	<10000	8	8.60	0	0
2	10000-20000	28	30.11	1	14.29
3	20000-30000	31	33.33	2	28.57
4	30000-40000	13	13.98	2	28.57
5	40000-50000	7	7.53	1	14.29
6	>50000	6	6.45	1	14.29
	Total	**93**	**100.00**	7	**100.00**

Source: Primary Household Survey- 2010

This Table reveals that the expenditure on water is increasing along with increase in income for first three income groups are having monthly income up to Rs.30,000 and then observed the reverse trend in the system. Further, the table illustrates more than three-fourth (93.00 per cent) of the households spend up to Rs.100 on water, and less than one-tenth (7.00 per cent) spend between Rs.101-300. While more than half of (65.00 per cent) spend only up to Rs.50 toward water supply bill.

4.10 SAVINGS

Saving is one of the most important parameters, which decides the functions of the economy of a particular system. Increase in savings lead to more capital formation, which tends to invest more in the system. Generally, system which has more investment will lead to more production, more production will stimulate the more trade and commercial activities, higher trade & commercial activities lead to increase in income and more income ultimately leads to more savings. This function in cycle of economic activities, which lead to better economic growth and development in the system. Having this in mind, the investigator has made an attempt to understand the saving behavior of household for different income group categories and results are presented in Table 4.22 and Figure 4.18 respectively.

This Table and Figure reveals that the percentage of savings is increasing along with increase in income for the first three income groups which are having monthly income up to Rs.30,000 and then observed the reverse trend in the system. It is also evident that the savings money in the higher income household is much higher compared to low income category households. It has been observed from the above Table and Figure that one-fourth of the households (25.00 per cent) save more than half of the monthly income. Followed by about one-seventh (7.14 per cent) of them save 40 to50 per cent of monthly income, one-fifth save 31 to 40 per cent, and another a set of one fifth saved 20 -30 per cent, which shows that people are having the tendency of savings, which lead to capital formation in the country.

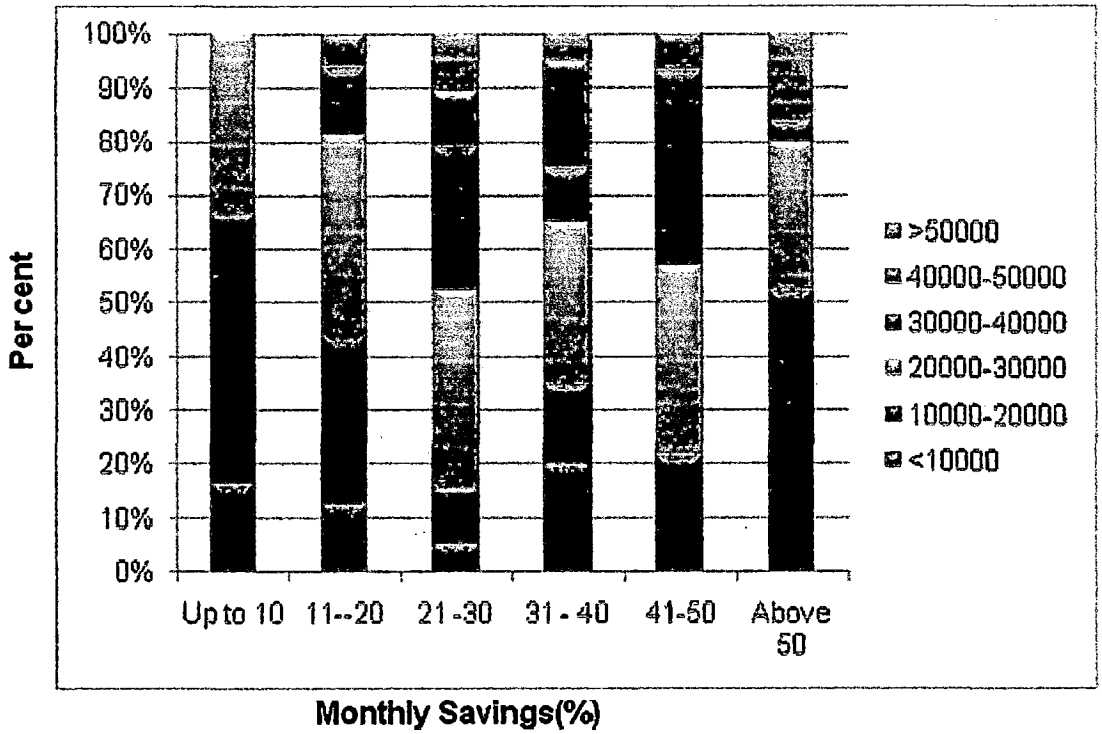


Figure no.4.18: Savings as percentage to monthly income

Table no.4.22: Savings as percentage to monthly income

S. No.	Income-group (Rs.)	Savings (%)											
		Up to 10		11--20		21 -30		31 - 40		41-50		Above 50	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	1	16.67	2	12.50	1	5.26	4	20.00	0	0	0	0
2	10000-20000	3	50.00	5	31.25	2	10.53	3	15.00	3	21.43	13	52.00
3	20000-30000	2	33.33	6	37.50	7	36.84	6	30.00	5	35.71	7	28.00
4	30000-40000	0	0	2	12.50	5	26.32	2	10.00	5	35.71	1	4.00
5	40000-50000	0	0	1	6.25	2	10.53	4	20.00	1	7.14	0	0
6	>50000	0	0	0	0	2	10.53	1	5.00	0	0	4	16.00
	Total	**6**	**100.00**	**16**	**100.00**	**19**	**100.00**	**20**	**100.00**	**14**	**100.00**	**25**	**100.00**

Source: Primary Household Survey- 2010

4.11 HOUSING

Housing is one of the most important parameters, which decides the functions of the system. Housing is the basic human need, it is not a merely amenity, but essential necessity. A major portion of one's life is spent in the house. Housing constitutes a very important part of the social environment where an individual is natured and where he grows and matures as a citizen. Housing plays a very significant role in improving the national economy, in maintaining the social health and stability and in ensuring the people for a decent life. Having these in mind, an attempt has been made to study various housing characteristics of the surveyed households such as: Tenure, Type of dwelling, Physical conditions, and are presented in Table 4.23 and Figure 4.19 respectively, in the following sequence.

Table no.4.23: Type of dwelling unit

S. No.	Income-group (Rs.)	Type of House					
		Detached		Semi-detached		Apartment	
		Nos.	Percent	Nos.	Percent	Nos.	Percent
1	<10000	8	9.20	0	0	8	57.14
2	10000-20000	24	27.59	3	33.33	2	14.29
3	20000-30000	27	31.03	6	66.67	2	14.29
4	30000-40000	13	14.94	0	0	2	14.29
5	40000-50000	8	9.20	0	0	0	0
6	>50000	7	8.05	0	0	0	0
	Total	**87**	**100.00**	**9**	**100.00**	**14**	**100.00**

Source: Primary Household Survey- 2010

The type of dwelling among various income groups are examined through this table and the figure. The table and the Figure reveals that the detached and semi-detached dwellings are increasing along with increase in income for first three income groups are having monthly income up to Rs.30,000 and then observed the reverse trend in the system. Further, it has been observed that more than one-fourth (87.00 per cent) of the total surveyed household live in detached housing and more than one-tenth (14.00 per cent) households lives apartment. While less than one-tenth (9.00 per cent) live in semi-detached houses. This clearly indicates that people have much preferred living in detached houses in the system.

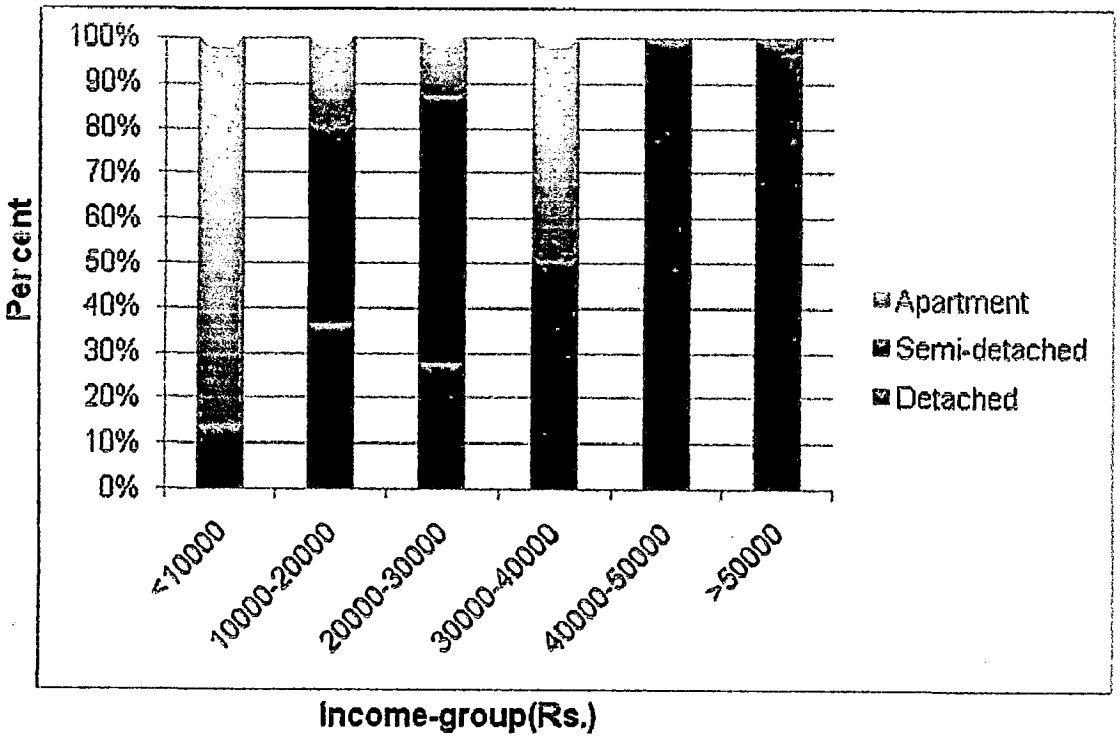


Figure no.4.19: Type of dwelling unit

4.11.1 Housing Tenure

The status of the housing tenure has been examined and the results are presented in Table 4.24 and the Figure 4.20 respectively. This table and figure illustrates that both rental housing tenure is increasing along with increase in income for first three and second income groups are having monthly income up to Rs.30,000 and then observed the reverse trend in the system. Further, it has been observed that more than three-fourth (per cent) of the total surveyed households own the house and about one-fifth (18.00 per cent) live in a rented house. Further, it is evident that ownership increases with increase in the income. It is also observed that number of rented accommodation is highest (13.00 per cent) in the two middle-income categories i.e. income group Rs.10001-20000 and Rs. 20001-30000, which indicates their higher mobility of the people in the system.

Table no.4.24: Tenure status of houses

S. No.	Income-group (Rs.)	House Ownership			
		Rented		Owned	
		Nos.	Percent	Nos.	Percent
1	<10000	0	0	8	9.76
2	10000-20000	2	11.11	27	32.93
3	20000-30000	11	61.11	22	26.83
4	30000-40000	3	16.67	12	14.63
5	40000-50000	0	0	8	9.76
6	>50000	2	11.11	5	6.10
	Total	**18**	**100.00**	**82**	**100.00**

Source: Primary Household Survey- 2010

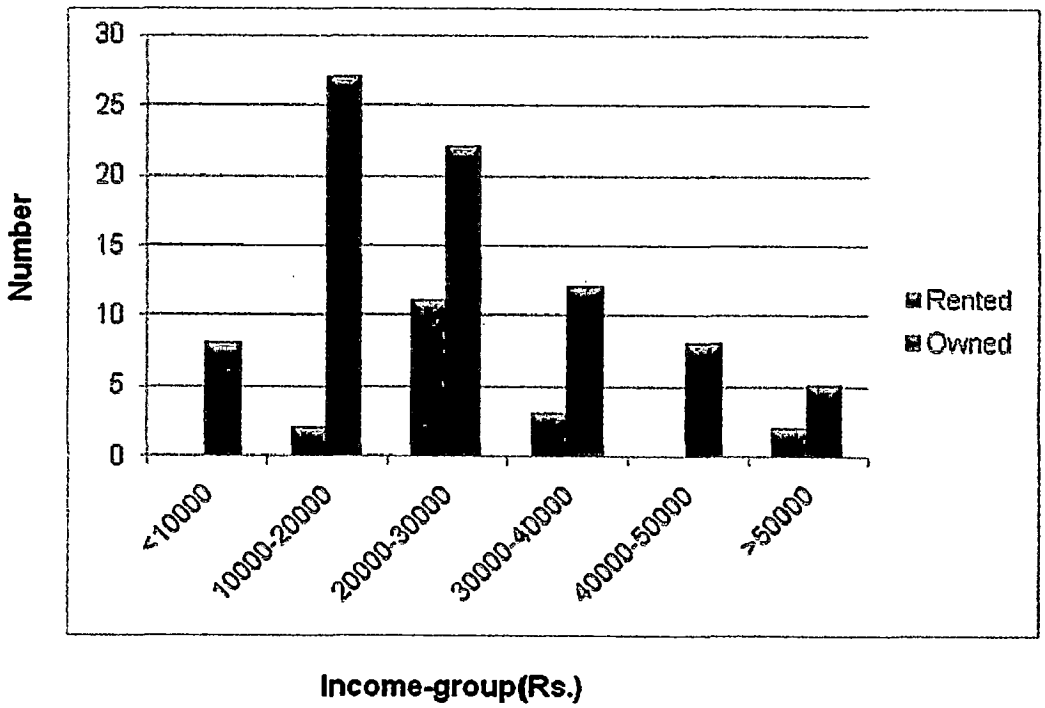


Figure no.4.20: Tenure status of houses.

4.11.2 Physical condition of Houses

The habitable condition of houses among the surveyed households is presented through Table 4.25 and Figure 4.21 respectively. This Table and Figure reveals that good living condition is increasing along with increase in income among all the income groups and observed the reverse trend for liveable condition of house in the system.

Further, it has also observed from the table that more three-fourth (78.00 per cent) of the households have good habitable condition in their houses and about one-fifth (22.00 per cent) have satisfactory habitable condition. It evident that there is no poor habitable housing conditions among surveyed households in the system.

Table no.4.25: Physical condition of houses

S. No.	Income-group (Rs.)	Physical condition of House			
		Good		Livable	
		Nos.	Percent	Nos.	Percent
1	<10000	2	2.56	6	27.27
2	10000-20000	25	32.05	4	18.18
3	20000-30000	26	33.33	7	31.82
4	30000-40000	11	14.10	4	18.18
5	40000-50000	8	10.26	0	0
6	>50000	6	7.69	1	4.55
	Total	**78**	**100.00**	**22**	**100.00**

Source: Primary Household Survey- 2010

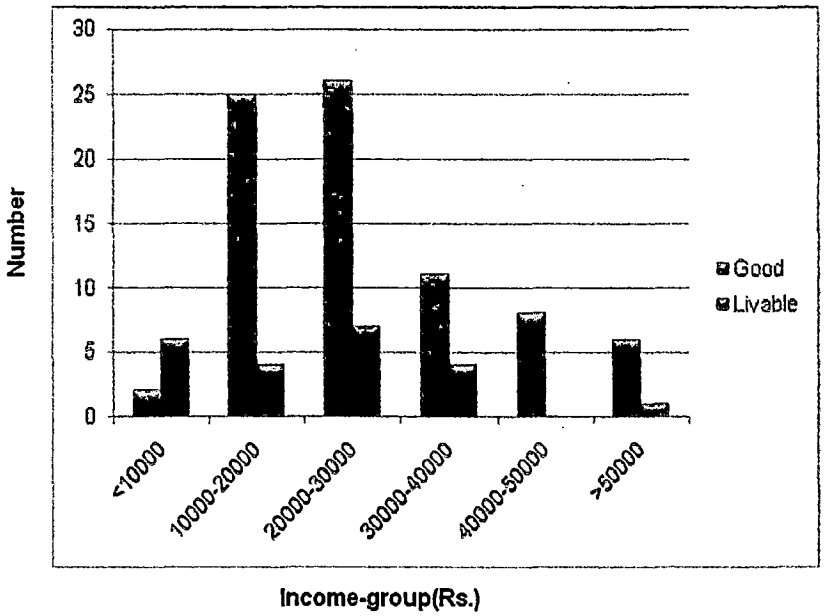


Figure no.4.21: Physical condition of houses

4.12 INFRASTRUCTURE

Cities, towns, and urban agglomerations are expanding faster in most of the regions of the world than the overall growth of the population, due to availability of infrastructure services in the particular system. Infrastructure is divided in to three types, which include physical, economic and social infrastructure. All these three infrastructure are very much essential for the development of the urban system. In India, the urban system which has more infrastructure services developed further, and continuously growing with higher intensity, whereas the urban system has less infrastructure services grows with less intensity. Having the above in mind, the investigator studied the physical infrastructure among the survey households which include transportation, water supply, electricity, drainage/sewerage, waste management and are presented in the following sequence.

4.12.1 Transportation

Transportation is one of the important parameters, which decides the functions of the systems. In the study area different kinds of mode of transportation is available. Even though different kinds of mode of transportation are available, people used to have their own vehicles for their mobility since the present public transportation system, which exists in the system is inadequate. Having these in mind the investigator studied the availability of transportation among survey households with different income groups and are presented in the table 4.26.

Table 4.26: Availability public Transport

.S. No.	Income-group (Rs.)	Availability of Public Transport			
		No		Yes	
		Nos.	Percent	Nos.	Percent
1	<10000	4	7	4	9.09
2	10000-20000	21	37.50	8	18.18
3	20000-30000	24	42.86	9	20.45
4	30000-40000	7	13	8	18.18
5	40000-50000	0	0	8	18.18
6	>50000	0	0	7	15.91
	Total	**56**	**100.00**	**44**	**100.00**

Source: Primary Household Survey- 2010

This table reveals that more than half (56.00 per cent) of the surveyed households are not satisfied with existing available mode of public transportation and remaining less than half

(44.00 per cent) are using the present public transportation system. It clearly shows that present mode of public transportation system is not at satisfactory level and the same is inadequate.

4.12.2 Water Supply System

Water is a valuable resource, which is very much essential for human nourishment, and a minimum quantity of water is essential to maintain health and hygiene in an urban system. In selected regions of Indian subcontinent, the available water sources are inadequate to cater the demand of the urban population. For example, the metro city like Chennai, some parts of Tamil Nadu & Andra Predesh states and Rajasthan states huge water scarcity exists in the system. Having this knowledge, the investigator studied the drinking water supply among survey households for different income groups, which include water supply system use of water equipments, and daily supply hours are examined and presented in the following sequence.

Table no.4.27: Water supply system

S. No.	Income-group (Rs.)	Water Supply System			
		Public supply		Public/Own source	
		Nos.	Per cent	Nos.	Per cent
1	<10000	8	12.70	0	0
2	10000-20000	22	34.92	7	18.92
3	20000-30000	21	33.33	12	32.43
4	30000-40000	9	14.29	6	16.22
5	40000-50000	3	4.76	5	13.51
6	>50000	0	0	7	18.92
		63	**100.00**	**37**	**100.00**

Source: Primary Household Survey- 2010

The Investigator studied the present water supply system in the study area and the results are presented in the Table 4.27 and Figure 4.22 respectively. This table and figure reveals that public supply /own source is increasing along with increase in income almost for all the income groups in the system.

Further, it has been observed that almost two-third (63.00 per cent) of surveyed households having access to public water supply and whereas for about one-third are having both public and own sources of water supply to cater their needs in the system.

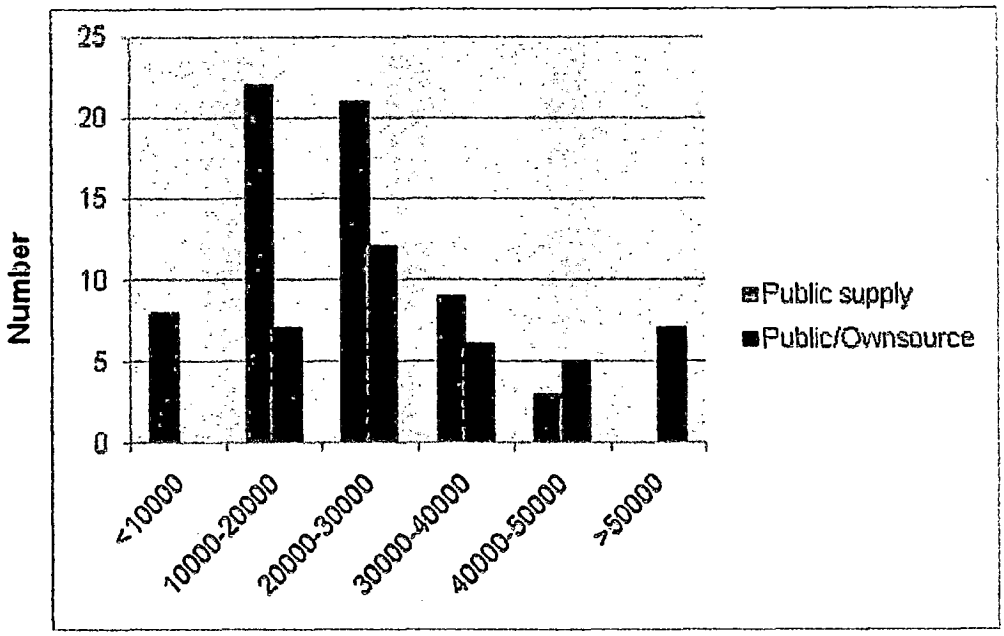


Figure no.4.22: Water supply system

The investigator has also examined the water supply hours per day exists in the system and results are presented in the Table 4.28 and Figure 4.23 respectively. This table and figure reveals that more than three-fourth (86.00 per cent) of surveyed households having supply hours between 5-12 hours per day and whereas about one-tenth (13.00 per cent) are having water supply hours between 2-5 hours per day. It clearly shows that all the households are having access daily to drinking water and even though the intermittent water supply system exists in the system.

Table no.4.28: Water supply hours per day

S. No.	Income-group (Rs.)	Water Supply Hours					
		< 2 Hrs		2-5 Hrs		5-12Hrs	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	0	0	1	7.69	7	8.14
2	10000-20000	0	0	4	30.77	25	29.07
3	20000-30000	1	100.00	4	30.77	28	32.56
4	30000-40000	0	0	2	15.38	13	15.12
5	40000-50000	0	0	2	15.38	6	6.98
6	>50000	0	0	0	0	7	8.14
		1	**100.00**	**13**	**100.00**	**86**	**100.00**

Source: Primary Household Survey- 2010.

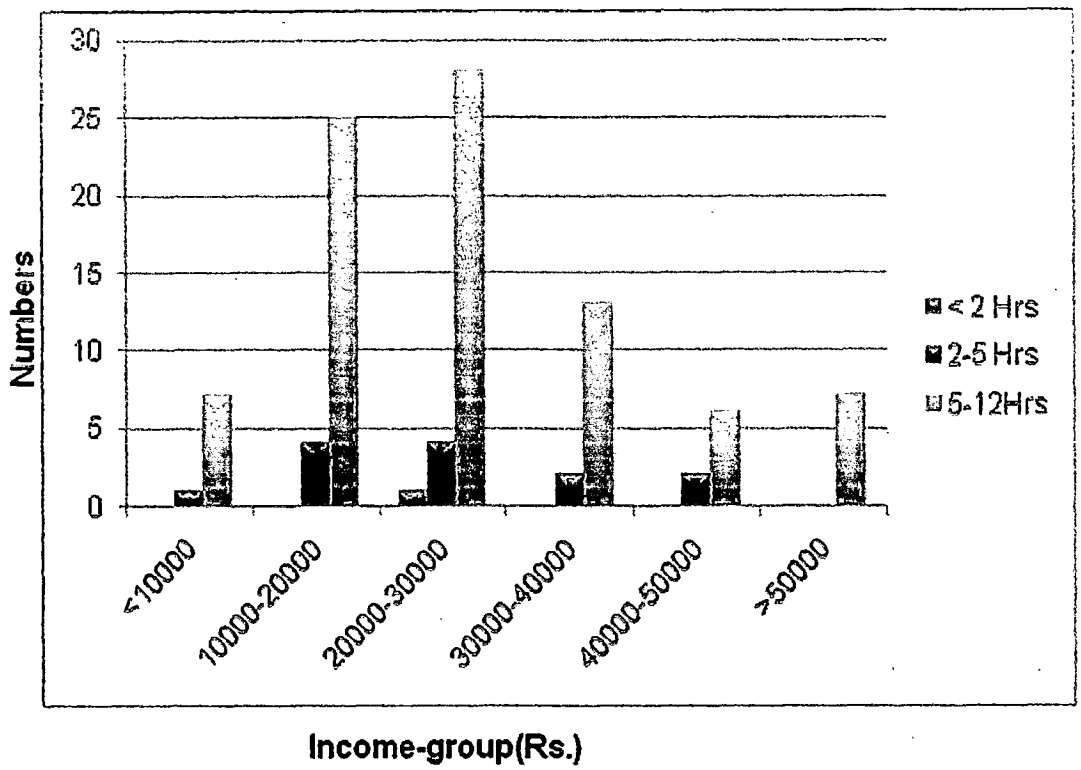


Figure no.4.23: Water supply hours per day

4.12.3 Use of water equipments

The investigator studied the use of water equipments in the study area and the results are presented in the Table 4.29 and Figure 4.24 respectively. This table and figure reveals that the use of water equipments are increasing along with increase in income for first three income groups are having monthly income up to Rs.30,000 and then evenly distributed among the other income groups in the system. Further, it has been observed that one-third (33.00 per cent) of surveyed households using water equipment as aqua guard and whereas more than one-tenth (14.00 per cent) uses water filter. It has been further observed from the table that more than half of surveyed household are not using any water equipments in the system. It clearly shows that people are much more health conscious in the system and they are not satisfied with the quality of water in existing public water supply system.

Table no.4.29: Use of water equipments

S. No.	Income-group (Rs.)	Use of Water Equipments					
		Filter		Aqua guard		None	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	1	7.14	0	0	7	13.21
2	10000-20000	2	14.29	5	15.15	22	41.51
3	20000-30000	9	64.29	11	33.33	13	24.53
4	30000-40000	1	7.14	7	21.21	7	13.21
5	40000-50000	0	0	5	15.15	3	5.66
6	>50000	1	7.14	5	15.15	1	1.89
		14	**100.00**	**33**	**100.00**	**53**	**100.00**

Source: Primary Household Survey- 2010

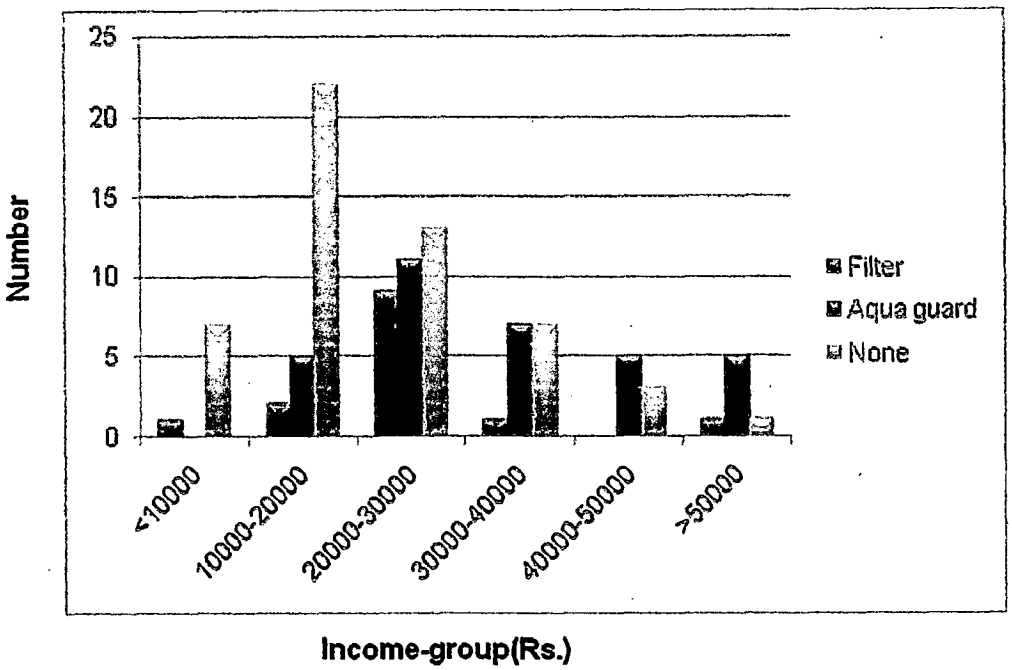


Figure no.4.24: Use of water equipments

4.12.4 Electricity

The critical role of power in spurring economic growth is undisputed. The per capita energy consumption rate of a country is an indicator of economic development of a country. This clearly shows that power is one of the most important factors, which control the functions of the system. Further, the regular power supply of desired quality is also indicator of quality of life a city. Keeping this knowledge in mind, an attempt has therefore been made

to analyse the type of service, voltage fluctuations and the results are presented in Table 4.30. This table reveals that overhead service is increasing along with increase in income up the monthly income group Rs.30,000 and then the observed the reverse trend. Further the table reveals that more than three-fourth of surveyed households are having overhead service connections and for about one-tenth of households have underground cable service. Further, it has been observed from the Table that almost one-fifth (19.00 per cent) of households face the problem of voltage fluctuations in the system. It is evident that the study area has the continuous power supply in the system.

Table no.4.30: Type of service and voltage fluctuations

S. No.	Income-group (Rs.)	Electricity					
		Type of service					
		Overhead		Underground		Voltage Fluctuations	
		Nos.	Per cent	Nos.	Per cent	Yes	No
1	<10000	8	8.99	0	0	3	5
2	10000-20000	29	32.58	0	0	2	27
3	20000-30000	27	30.34	6	54.55	7	26
4	30000-40000	11	12.36	4	36.36	4	11
5	40000-50000	7	7.87	1	9.09	0	8
6	>50000	7	7.87	0	0	3	4
		89	**100.00**	**11**	**100.00**	**19**	**81**

Source: Primary Household Survey- 2010

4.12.5 Surface Drainage

Surface drainage is one of the important parameters, which decides the functions of the system. The problems pertaining to storm water drainage system are presented in Table 4.31 and Figure 4.25. This table reveals that more than half (51.00 per cent) of the households report the problem of overflow during rainy season in surface drainage and about half (49.00 per cent) households do not have the overflow problem. It shows that much attention is needed for the development of proper surface drainage in the system.

Table no.4.31: Status of surface drainage

S. No.	Income-group (Rs.)	Status of Surface Drainage			
		Overflow of drains during Rainy season			
		Yes		No	
		Nos.	Per cent	Nos.	Per cent
1	<10000	2	3.92	6	12.24
2	10000-20000	15	29.41	14	28.57
3	20000-30000	15	29.41	18	36.73
4	30000-40000	7	13.73	8	16.33
5	40000>50000	5	9.80	3	6.12
6	>50000	7	13.73	0	0
		51	**100.00**	**49**	**100.00**

Source: Primary Household Survey- 2010

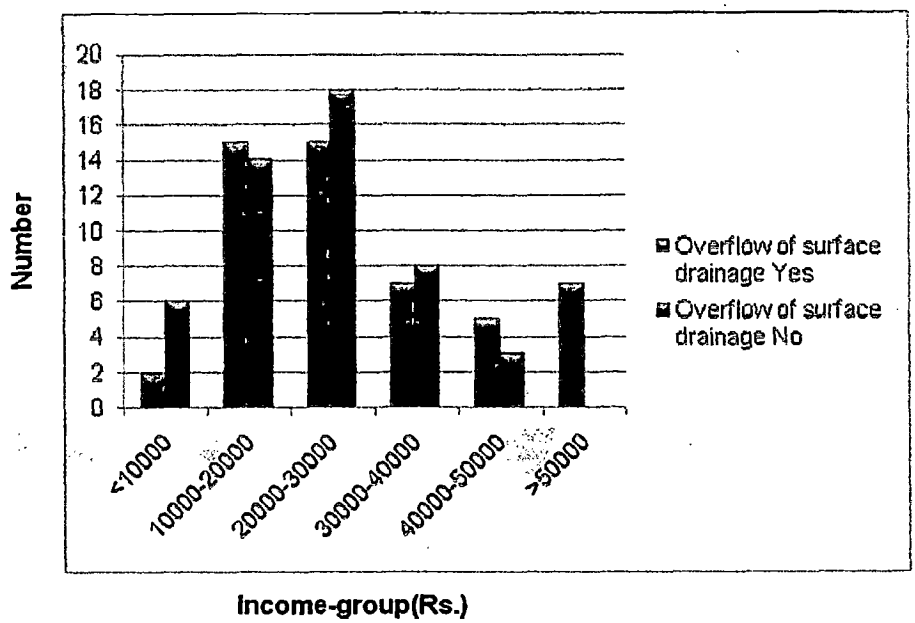


Figure no.4.25: Status of surface drainage

4.12.6 Waste management

Waste management is another one of the important parameter, which decides the functions of the system. Municipal solid waste management is an important task now days and the municipal administration face severe threat due to accumulation of wastes, in the urban system. Analyses across the globe over the years reveal that the generation of municipal solid waste is positively related to variations in per capita income, and generation of municipal solid waste per capita does not vary with population size, but comparably vary with per capita

income. Having these in mind, the investigator examined the waste management among survey households for different income groups and is presented in the following sequence.

The investigator studied the method of waste disposal in the study area and the results are presented in the Table 4.32.This table reveals that reveals that usage of storage container for waste collection is increasing up to monthly income of Rs.20, 000 and then observed the reverse trend. Further, It has been observed that more than half (59.00 per cent) of the household disposal of wastes practiced through storage container and whereas less than half of household disposing the wastes by using dustbin/PVC bags in the system.

Further, frequency of waste collection in the system was analyzed and results are presented in the Table 4.33 and Figure 4.26 respectively. This table and figure illustrates that frequency of waste collection in the study area. It has been observed that almost half (49.00 per cent) of the household wastes have been collected everyday and whereas more than one-third of household have weekly waste collection in the system. Further, it is also observed that less than one-tenth of household wastes are collected in alternate day in the study area. It gives clear idea about the existing waste collection system in the study area and gives stress for the improvement of everyday collection to maintain the cleanness and proper living environment in the system.

Table no.4.32: Method of waste disposal

S. No.	Income-group (Rs.)	Waste Disposal			
		Storage container		Dustbin/PVC bag	
		Nos.	Per cent	Nos.	Per cent
1	<10000	7	11.86	1	2.44
2	10000-20000	27	45.76	2	4.88
3	20000-30000	10	16.95	23	56.10
4	30000-40000	7	11.86	8	19.51
5	40000-50000	7	11.86	1	2.44
6	>50000	1	1.69	6	14.63
		59	**100.00**	**41**	**100.00**

Source: Primary Household Survey- 2010

Table no.4.33: Frequency of waste collection

S. No.	Income-group (Rs.)	Frequency of Waste Collection					
		Everyday		Alternate day		Weekly	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	3	6.12	0	0	5	11.63
2	10000-20000	10	20.41	2	25.00	17	39.53
3	20000-30000	17	34.69	3	37.50	13	30.23
4	30000-40000	8	16.33	1	12.50	6	13.95
5	40000-50000	8	16.33	0	0	0	0
6	>50000	3	6.12	2	25.00	2	4.65
		49	**100.00**	**8**	**100.00**	**43**	**100.00**

Source: Primary Household Survey- 2010

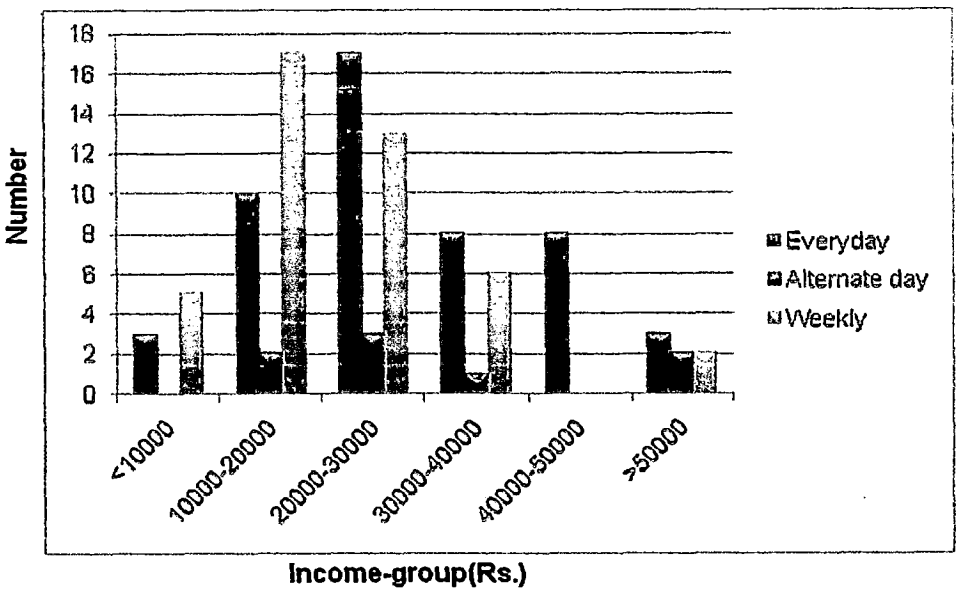


Figure no.4.26: Frequency waste collection

The following table 4.34 reveals that share of agencies involved for waste collection in the process of waste management in the system. It has been observed that more than half (40.00 per cent) of the household enjoying the service of Government agencies for waste collection and whereas the almost one-fourth (24.00 per cent) of household depending the services of private agencies, in the system. Further, it has been observed that some Non-Governmental Organization is contributing their share (6.00 per cent) among household in the system. It is interesting to note from the table that almost one-third (30.00 per cent) of surveyed household contributes their share for own waste collection/ disposal by themselves, in to their farm, in the rural system.

Table no.4.34: Agency for waste collection

S. No.	Income-group (Rs.)	Agency for Waste Collection							
		Nagar Nigam		Private Agency		NGO		Own disposal	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	1	2.50	2	8.33	0	0	5	16.67
2	10000-20000	10	25.00	4	16.67	1	16.67	14	46.67
3	20000-30000	11	27.50	12	50.00	3	50.00	7	23.33
4	30000-40000	7	17.50	2	8.33	2	33.33	4	13.33
5	40000-50000	8	20.00	0	0	0	0	0	0
6	>50000	3	7.50	4	16.67	0	0	0	0
		40	**100.00**	**24**	**100.00**	**6**	**100.00**	**30**	**100.00**

Source: Primary Household Survey- 2010

4.13 ENVIRONMENTAL CHRACTERISTICS

Environmental character of the city is important control parameters which decide the functions of the system. The investigator studied the environmental characteristics among the surveyed households which include water quality, air quality, land quality, noise pollution and finally the quality of living in the system, for various income groups and results are presented in the Table 4.35, 4.36, 4.37, 4.38 and 4.39 respectively, in the following sequence.

The table 4.35 reveals that more than three-fourth (76.00 per cent) of surveyed households are satisfied with water quality available in the system and whereas one-tenth (10.00 per cent) of the households are not satisfied. Further, more than one-tenth (14.00 per cent) of the surveyed households more comfortable with the quality of water in the study area.

Table no.4.35: Water quality

S. No.	Income-group (Rs.)	Water Quality					
		Very Good		Good		Moderate	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	2	14.29	5	6.58	1	10.00
2	10000-20000	3	21.43	26	34.21	0	0
3	20000-30000	5	35.71	23	30.26	5	50.00
4	30000-40000	2	14.29	11	14.47	2	20.00
5	40000-50000	1	7.14	6	7.89	1	10.00
6	>50000	1	7.14	5	6.58	1	10.00
		14	**100.00**	**76**	**100.00**	**10**	**100.00**

Source: Primary Household Survey- 2010

Table no.4.36: Air quality

S. No.	Income-group (Rs.)	Air Quality					
		Very Good		Good		Moderate	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	1	10.00	7	8.97	0	0
2	10000-20000	2	20.00	26	33.33	1	8.33
3	20000-30000	3	30.00	24	30.77	6	50.00
4	30000-40000	2	20.00	10	12.82	3	25.00
5	40000-50000	1	10.00	7	8.97	0	0
6	>50000	1	10.00	4	5.13	2	16.67
		10	**100.00**	**78**	**100.00**	**12**	**100.00**

Source: Primary Household Survey- 2010

The table 4.36 indicates present air environmental conditions of surveyed households in the study area. It has been observed from the Table that more than three-fourth (78.00 per cent) of surveyed households are satisfied with pollution level in the air environment available in the system and whereas more than one-tenth (12.00 per cent) of the households are not satisfied. Further, one-tenth (10.00 per cent) of the surveyed households more comfortable with present air environmental conditions in the study area.

Table no.4.37: Land quality

S. No.	Income-group (Rs.)	Land Quality					
		Very Good		Good		Moderate	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	1	10.00	6	7.32	1	12.50
2	10000-20000	2	20.00	26	31.71	1	12.50
3	20000-30000	4	40.00	26	31.71	3	37.50
4	30000-40000	1	10.00	12	14.63	2	25.00
5	40000-50000	1	10.00	7	8.54	0	0
6	>50000	1	10.00	5	6.10	1	12.50
		10	**100.00**	**82**	**100.00**	**8**	**100.00**

Source: Primary Household Survey- 2010

The table 4.37 indicates present land quality of surveyed households in the study area. It has been observed from the Table that more than three-fourth (82.00 per cent) of surveyed households are satisfied with the available land quality in the system and whereas less than one-tenth (8.00 per cent) of the households are not satisfied. Further, one-tenth (10.00 per cent) of the surveyed households more comfortable with existing land quality in the study area.

Table no.4.38: Noise pollution

S. No.	Income-group (Rs.)	Noise Pollution							
		Very High		High		Moderate		Low	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	0	0	1	8.33	4	11.43	3	5.77
2	10000-20000	1	100.00	2	16.67	10	28.57	16	30.77
3	20000-30000	0	0	5	41.67	11	31.43	17	32.69
4	30000-40000	0	0	3	25.00	3	8.57	9	17.31
5	40000-50000	0	0	0	0	3	8.57	5	9.62
6	>50000	0	0	1	8.33	4	11.43	2	3.85
		1	**100.00**	**12**	**100.00**	**35**	**100.00**	**52**	**100.00**

Source: Primary Household Survey- 2010

The table 4.38 explains present noise pollution level among the surveyed households in the study area. It has been observed from the Table that more than half (52.00 per cent) of surveyed households experiencing absence of noise pollution in the system and whereas more than one-third (8.00 per cent) of the households are disturbed with the noise pollution Further, it has been observed that more than one-tenth (12.00 per cent) of the surveyed households are much affected by noise pollution in the study area.

Quality of Life is the product of the interaction among social, health, economic and environmental conditions which affect human and social development and system in general. The term quality of life is used to evaluate the general well-being of individuals and societies. Standard indicators of the quality of life include not only wealth and employment, but also the built environment, physical and mental health, education, social belonging, recreation and leisure time. Having this knowledge the investigator made an attempt to understand the quality of living among the surveyed households for various income groups in the study area and results are presented in Table 4.39.

Table no.4.39: Quality of living

S. No.	Income-group (Rs.)	Quality of Living					
		Excellent		Good		Moderate	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	0	0	6	7.50	2	15.38
2	10000-20000	1	14.29	25	31.25	3	23.08
3	20000-30000	3	42.86	26	32.50	4	30.77
4	30000-40000	2	28.57	10	12.50	3	23.08
5	40000-50000	1	14.29	6	7.50	1	7.69
6	>50000	0	0	7	8.75	0	0
		7	**100.00**	**80**	**100.00**	**13**	**100.00**

Source: Primary Household Survey- 2010

The table 4.39 explains about the living quality conditions among surveyed households in the study area. It has been observed from the Table that more than three-fourth (80.00 per cent) of surveyed households are comfortable with living environment in the system and whereas more than one-tenth (13.00 per cent) of the households are not satisfied. Further, less than one-tenth (7.00 per cent) of the surveyed households much more comfortable with existing quality of living environment.

4.14 AGRICULTURE

Agriculture is the one of the most important parameters, which decides the functions of the system. India is an agrarian country and almost two-third of population of India lives in the rural system. Agriculture is the primary source of income in the rural segments, which lead to the development of primary sector of the economy of a particular system. Agriculture output (Production of crops, seeds and vegetables etc,) of the rural system is the input for the survival of urban system. The study area has 293 Sq.km area, of which 71.90 Sq.km is confined in the urban segments and the rest of the area is confined in the rural system, but the people among these system(both urban and the rural) depend on each other for their survival, since the area is very less. Further, the commutation time is also very less from the rural to urban and back. As a consequence, not much difference is obtained in the rural system compared to the urban system in the study area. Hence, the rural system must be studied along with the urban system, for arriving at plausible decisions. The study area is most urbanized and it has two-third (68.80 per cent) urban population and less than one-third (31.20 per cent) of them are confined in the rural population.

Paddy is the principle crop amongst the all the crops followed by sugarcane in the study area. The paddy and the sugarcane cultivation in the study area which accounts for 58.93 per cent and 6.70 per cent of the total cropped area, during the year 2007-08. Having this knowledge, the investigator studied the cropping pattern among the surveyed household and results are presented in the following sequence. The table 4.40 and figure 4.27 gives clear idea about cultivation of Paddy and Sugarcane in the study area among surveyed households. It has been observed that more than one-fourth (83.00 per cent) household cultivating Paddy

and whereas less than one-fifth (17.00 per cent) of household cultivate Sugarcane crop in the system. It clearly indicates that Paddy is most dominant cultivation crop in the study area. Therefore, the Investigator considered to examine the cultivation of paddy and followed by sugarcane for the analysis. Having this mind, the Investigator studied the surveyed households in the rural system along with urban system for various income categories and the results are presented in the Table 4.41 4.42 in the following sequel.

Table no.4.40: Type of crop

S. No.	Income-group (Rs.)	Type of Crop			
		Paddy		Sugarcane	
		Nos.	Per cent	Nos.	Per cent
1	<10000	5	15.15	1	14.29
2	10000-20000	14	42.42	3	42.86
3	20000-30000	6	18.18	2	28.57
4	30000-40000	4	12.12	0	0.00
5	40000-50000	4	12.12	1	14.29
6	>50000	0	0.00	0	0.00
	Total	33	100.00	7	100.00

Source: Primary Household Survey- 2010

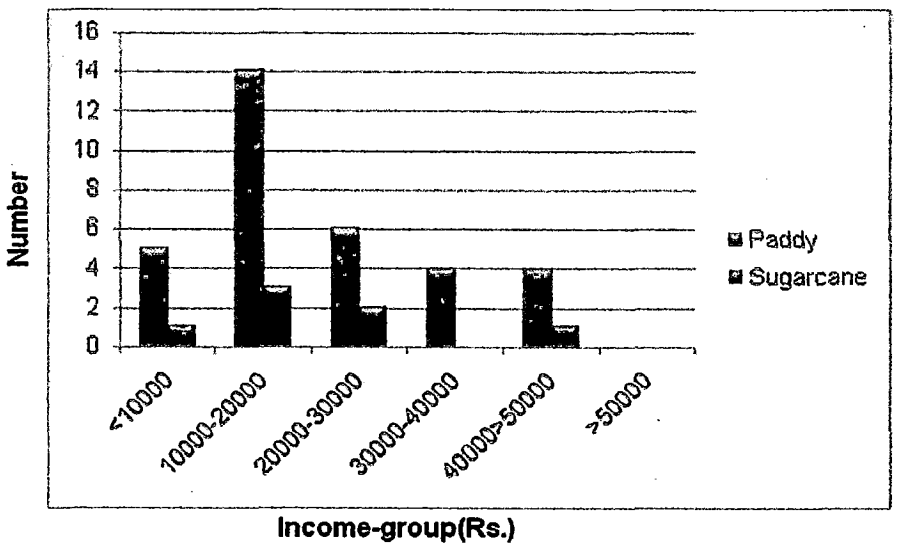


Figure no.4.27: Type of crop

Table no.4.41: Area of land under paddy

S. No.	Income-group (Rs.)	Total Area of Land under Paddy										Actual Land
		less than 1 acre		1 - 3 acre		3 - 5 acre		5 - 10 acre		10 - 15 acre		
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Area
1	<10000	1	100.00	4	21.05	0	0.00	0	0.00	0	0.00	9
2	10000-20000	0	0.00	10	52.63	2	25.00	1	33.33	1	50.00	42
3	20000-30000	0	0.00	5	26.32	0	0.00	0	0.00	1	50.00	22
4	30000-40000	0	0.00	0	0.00	4	50.00	0	0.00	0	0.00	16
5	40000-50000	0	0.00	0	0.00	2	25.00	2	66.67	0	0.00	22
6	>50000	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
	Total	**1**	100.00	**19**	100.00	**8**	100.00	**3**	100.00	**2**	100.00	**111.00**

Source: Primary Household Survey- 2010

Table no.4.42: Area of land under sugarcane

S. No.	Income-group (Rs.)	Total Area of Land under Sugarcane						Actual Land
		1 - 3 acre		3 - 5 acre		5 - 10 acre		
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Area
1	<10000	1	20.00	0	0.00	0	0.00	2
2	10000-20000	2	40.00	0	0.00	1	100.00	11
3	20000-30000	2	40.00	0	0.00	0	0.00	4
4	30000-40000	0	0.00	1	100.00	0	0.00	0
5	40000-50000	0	0.00	0	0.00	0	0.00	4
6	>50000	0	0.00	0	0.00	0	0.00	0
	Total	**5**	100.00	**1**	100.00	**1**	100.00	**21.00**

Source: Primary Household Survey- 2010

The table 4.41 reveals that area under paddy cultivation among the surveyed households for various income categories. It has been observed that less than half (48.00 per cent) of total household are cultivates paddy between 1-3 acres and almost one-fourth (20.00 per cent) of households have 3-5 acres. Further, it has been observed that one-tenth (7.50 per cent & 5.00 per cent) of household have 5-10 acres & 10-15 acres of paddy cultivation in the system.

The table 4.42 explains that area under sugarcane cultivation among the surveyed households for various income categories. It has been observed that more than one-third (72.00 per cent) of total household are cultivates Sugarcane between 1-3 acres and whereas more than one-tenth (14.00 per cent) of household households have 3-5 acres and 5-10 acres of paddy cultivation in the system.

The Investigator studied the area under irrigation and results are presented in the Table 4.43 and Figure 4.28 respectively. This table and figure reveal that area under irrigation among the surveyed households for various income categories. It has been observed that almost more than half (60.00 per cent) of total household are having irrigated land between 1-3 acres and almost one-fourth (23.00 per cent) of households have 3-5 acres. Further, it has been observed that one-tenth (10.00 per cent) of household have 5-10 acres and remaining (7.00 per cent) have 10-15 acres of land under irrigation in the system.

Table no.4.43: Area under irrigation

S. No.	Income-group (Rs.)	Area under Irrigation									
		less than 1 acre		1 - 3 acre		3 - 5 acre		5 - 10 acre		10 - 15 acre	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	1	100.00	5	20.83	0	0.00	0	0.00	0	0.00
2	10000-20000	0	0.00	12	50.00	2	22.22	2	50.00	1	50.00
3	20000-30000	0	0.00	7	29.17	0	0.00	0	0.00	1	50.00
4	30000-40000	0	0.00	0	0.00	5	55.56	0	0.00	0	0.00
5	40000-50000	0	0.00	0	0.00	2	22.22	2	50.00	0	0.00
6	>50000	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	Total	**1**	100.00	**24**	100.00	**9**	100.00	**4**	100.00	**2**	100.00

Source: Primary Household Survey- 2010

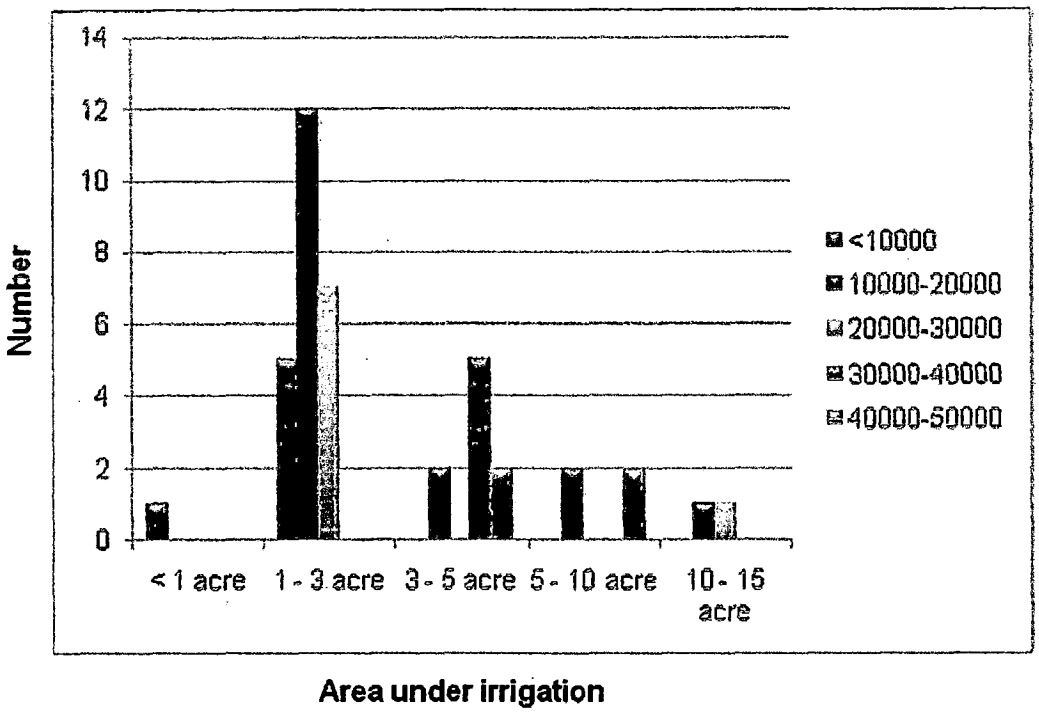


Figure no.4.28: Area under irrigation

The actual input required for the cultivation of crops must be studied to increase the yield and for introducing improved techniques to achieve the goal of higher productivity in the system. Having this in mind, the investigator examined the actual input required for paddy and sugarcane cultivation among the surveyed households for various income categories, in the study area and results are presented in Table 4.44 and Table 4.45 respectively.

Table no.4.44: Input to Paddy

S. No.	Income-group (Rs.)	Input to Paddy per Acre (Kharif season)				
		Nitrogen ,Potassium and Phosphorous(NPK)				
		N(kg)	P(kg)	K(kg)	Total	Total crop area
1	<10000	66.67	113.88	66.67	247.22	9
2	10000-20000	67.85	104.16	66.67	238.68	42
3	20000-30000	59.09	93.18	59.09	211.36	22
4	30000-40000	62.50	93.75	62.50	218.75	16
5	40000-50000	54.54	86.36	54.54	195.44	22
6	>50000	0	0	0	0.00	0
	Total	**310.65**	**491.33**	**309.47**	**1111.45**	**111**

Source: Primary Household Survey- 2010

The table 4.44 reveals that the actual input required for the cultivation of paddy crop among surveyed household for various income groups. It has been observed that Nitrogen, Potassium and Phosphorous (NPK) consumption in the farm of the lowest income category is 66.67kg, 113.88 & 66.67kg per acre paddy cultivation respectively, whereas among the higher income category it is 54.54kg,86.36kg & 54.54kg per acre respectively. Further, it has been observed from table that NPK input consumption goes on decreasing along with increasing in income group from first to the fifth income group category. The lowest income groups with lesser land holding size use more quantity of NPK input, whereas the higher income group with larger land holding size, the usage of input quantity is less, when compared to the lower income groups.

Table no.4.45: Input to Sugarcane

S. No.	Income-group (Rs.)	Input to Sugarcane per year				
		Nitrogen ,Potassium and Phosphorous(NPK) per Acre				
		N(kg)	P(kg)	K(kg)	Total	Total crop area
1	<10000	175.00	175.00	175.00	525.00	2
2	10000-20000	184.54	184.54	184.54	553.62	11
3	20000-30000	200.00	200.00	200.00	600.00	4
4	30000-40000	0.00	0.00	0.00	0.00	0
5	40000-50000	225.00	225.00	225.00	675.00	4
6	>50000	0.00	0.00	0.00	0.00	0
	Total	**784.54**	**784.54**	**784.54**	**2353.62**	**21**

Source: Primary Household Survey- 2010

The table 4.45 indicates that the actual input required for the cultivation of sugarcane crop among the surveyed household for various income groups. It has been observed that Nitrogen, Potassium and Phosphorous (NPK) consumption among the lowest income category consumes as input 175kg, 175kg & 175kg per acre for paddy cultivation in a year, whereas higher income category input consumption is 225kg, 225kg & 225kg per acre. Further, it has been observed from Table that input consumption goes on increasing along with increasing land area from first income to fifth income category.

The major product as an output of agriculture sector contributes larger share of rice production, followed by Sugarcane compared to overall agriculture production, in the study

area. The investigator examined the actual output of major products among the surveyed household for various income categories and results are presented in the Table 4.46.

Table no.4.46: Output as major product

S. No.	Income-group (Rs.)	Output - Major Product	
		Rice	Sugarcane
		Qt.(Kg/acre)	Qty(T/acre)
1	<10000	677.78	45.00
2	10000-20000	667.85	50.00
3	20000-30000	647.72	56.00
4	30000-40000	681.25	0.00
5	40000-50000	681.81	54.00
6	>50000	0.00	0.00
	Total	**3356.41**	**205.00**

Source: Primary Household Survey- 2010

The Table 4.46 reveals that the actual production as output of major products among survey households for different income groups. It has been observed that lowest income groups produce 667.78 Kg rice per Acre and whereas higher income groups produce 681.81 Kg rice per acre in the system. It clearly indicates that the average rice production in the study area can be quantified as 675Kg or 13.50 bags per acre of land in the study area. Further, it has been from the Table that lowest income group produce 45 Tones of Sugarcane per Acre and whereas higher income groups produce 54 Tones per acre in the system. It also clearly indicates that the average production of Sugarcane in the study area can be quantified as 51 Tones per acre of land in the study area.

4.15 Rural Transport

Rural transportation system is another one parameters which decides functions of the system. Rural transport plays a vital role in agriculture activities in the rural system, it not only help the farmers in cultivation process, for saving the considerable amount of time and labours on one hand and also it decides price of agricultural commodities by adding transportation freight charges while carrying to the market , in addition to production cost, on the other. Having this in mind the investigator studied the actual rural transport available in the study area among the surveyed households in the system and presented in Table 4.47 and 4.48 respectively.

The Table 4.47 reveals that actual usage of tractor among the surveyed household for various income categories. It has been observed that one-fourth (25.00 per cent) of surveyed household are using tractor less than 1 hour per day and whereas more than one -fourth (32.00 per cent) of the household use 1-3 hours per day in the system. Further, it has been observed that less than one-tenth (5.00 per cent) of household uses the tractor 3-5 hours per day and more than one-third (38.00 per cent) of household are not using at all in the system.

Table no.4.47: Rural Transportation system

S. No.	Income-group (Rs.)	Usage of Rural Transport per day							
		Tractor							
		less than 1 hr		1-3 hr		3-5 hr		Total	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	4	40.00	0	0.00	0	0.00	4	0.00
2	10000-20000	2	20.00	4	30.77	1	50.00	7	30.77
3	20000-30000	4	40.00	2	15.38	1	50.00	7	15.38
4	30000-40000	0	0.00	2	15.38	0	0.00	2	15.38
5	40000-50000	0	0.00	5	38.46	0	0.00	5	38.46
6	>50000	0	0.00	0	0.00	0	0.00	0	0.00
	Total	**10**	100.00	**13**	100.00	**2**	100.00	**25**	**100.00**

Source: Primary Household Survey- 2010

The Table 4.48 reveals that actual usage of bullock cart among the surveyed household for various income categories. It has been observed that one-tenth (7.50 per cent) of surveyed household are using bullock cart less than 1 hour per day and whereas more than one -tenth (12.50 per cent) of the household use 1-3 hours per day in the system. Further, it has been observed that more than three-fourth (80.00 per cent) of household are not using at all in the system.

Table 4.48: Rural Transportation system

S. No.	Income-group (Rs.)	Usage of Rural Transport per day					
		Bullock cart					
		less than 1 hr		1-3 hr		Total	
		Nos.	Per cent	Nos.	Per cent	Nos.	Per cent
1	<10000	1	33.33	0	0.00	1	0.00
2	10000-20000	1	33.33	3	60.00	4	60.00
3	20000-30000	0	0.00	0	0.00	0	0.00
4	30000-40000	0	0.00	2	40.00	2	40.00
5	40000-50000	1	33.33	0	0.00	1	0.00
6	>50000	0	0.00	0	0.00	0	0.00
	Total	**3**	100.00	**5**	100.00	**8**	**100.00**

Source: Primary Household Survey- 2010

4.16 FINDINGS BASED ON HOUSEHOLD SURVEY

In this present investigation, different kinds of analysis are made based on the primary household survey and the following very important findings are observed from the survey. They are:

1. The number of households are increasing along with increase in income up to monthly income group of Rs.20, 000 to 30,000 and then observed the reverse trend.

2. About half of the household are confined in the middle income group among the surveyed households.

3. The study area has three religious characters, which include Hindu, Christian, and Muslim, but almost nine-tenth of surveyed households (88.00 per cent) belongs to Hindu community which is predominant community in the system. The people belongs to other community are very meager.

4. The male and female population among the surveyed households are almost identical, that the male population is just above half (51.51 per cent) of the total population and the rest of them are females.

5. The average size of the family is below four i.e., 3.99, which shows that people are practicing family planning measures at higher rate. This is the very good symptom for the development.

6. Education is one of the most important parameters, which is the backbone for the development of country.

7. Literacy status of the male and female population shows that literacy is penetrated in almost all the segments of the population, i.e., from the lowest income group to highest income group. However, literacy rate is little higher among the male population than the female population, since the more numbers of female population are literate, which is the healthy symptom for national development. This is the reason for population reduction in the system.

8. Graduation and Post Graduation qualification is common among the both male and female population in the study area.

9. Employment is also not bad in the system, and also it is evenly distributed in almost all the segments of population (income groups).

10. More than one-third (36.86 per cent) of the population is employed either in Government or private or business.

11. There are 100 persons having the primary occupation and 25 persons are having secondary occupation. Of the total primary occupational persons, one-third (33.00 per cent) belong to government personal and equally another one-third belong to agriculture, followed by about one-fourth (21.00 per cent) are having private job and the rest are engaged in business.

12. In sources of income, about half (48.00 per cent) of them are accrued from salary, about one-fourth (22.00 per cent) accrued from agriculture, about one-seventh (15.00 per cent) accrued through salary plus agriculture and rest of them through business. It is interesting to note that salary is the most dominant source of income, followed by agriculture in the system.

13. In expenditure, the per capita expenditure is increasing along with increase in income from lowest income group to highest income group, pertaining to food, education, cloths, health, transport, telephone, petrol/diesel, electricity, water and so on. However, the middle income group is more health conscious and spending more money than the other groups in this regard.

14. Savings is very common phenomenon in Southern India, most of the people save good amount of money for future requirements. It has been observed that one-fourth of surveyed households save more than 50.00 per cent of their income, followed by just above one-seventh (14.00 per cent) save 40-50 per cent of their income and one-fifth of the population save 20-30 per cent and 30-40 per cent of their monthly income respectively. Further, rest of the households are saves considerable amount of money, which shows that the people in the study area contribute more in capital formation through savings. This is one of the most important parameters which decide the functions of the economic growth in our country.

15. More than four-fifth (82.00 per cent) of the surveyed households are living in their residences and rest of them living in the rented houses. Of the rented houses about two-third (66.66 per cent) of households confined among the monthly income group of Rs.20, 000-30,000, which is confined among the middle income group category, the rest of them are scattered over almost all income groups.

16. All the respondents of the survey are living in the either good houses or in the livable condition of houses. Majority of the houses (75.00 per cent) are observed as good conditions and the rest are in the livable conditions.

17. In transport infrastructure more than half of respondents (56.00 per cent) observed as facilities not available and rest of them observed as these facilities are available. The facilities observed as not available are middle income group and low income group category.

18. In water supply system about two-third (63.00 per cent) are having public water supply system and rest (37.00 per cent) are having either public or own supply source of system.

19. The water supply system is observed as very good in the city. Majority of the households (86.00 per cent) observed as water supply is available from 5-12 hours and the rest observed as 2-5 hours per day. It shows that water supply system is good in the system.

20. More than half (53.00 per cent) never use any water related equipments, whereas, one-third of households use Aqua guard and rest of them use filter in their houses. It shows the Government supplies good quality water and the people are also quite aware about using water related equipments in their houses.

21. Electricity supply is also good in the city. It has been observed that about one-fifth (19.00 per cent) observed as there are voltage fluctuation, in the system.

22. In surface drainage, half of the people opined that there are overflows in the drains during the rainy season. Therefore, it needs adequate attention, otherwise there will be problem pertain to physical environment and deterioration in the system.

23. In waste management, about two-fifth (59.00 per cent) are having storage container and the rest (41.00 per cent) are using dust bin / PVC bags, in the system.

24. Waste collection is also not up to the mark in the municipal area, and it has been observed that about half (49.00 per cent) opined that every day they collect the waste, whereas more than two-fifth (43.00 per cent) opined that they collect the waste once in a week and rest of them opined that they collect waste in alternate day. It shows that the waste management system is not healthy in this city.

25.In environment, quality of water is good, more than three-fourth of the people (76.00 per cent) observed that Government supplies good quality of water and rest of them opined as very good, and moderate, and none of them opined that quality is bad, it shows that Government supplies the good quality of water.

26. Majority of the households which are having agriculture operation and are confined among the lower income group.

27. In agriculture operation, the total area under cultivation is observed as 132 acres among all the surveyed households. Of this, majority of the households (84.09 per cent) cultivating paddy and rest of them (15.91 per cent) cultivate sugarcane crop in their farm. This shows that Paddy is the dominant crop, and followed by sugarcane in the study area.

28. In area under irrigation, It has been observed that about one-fifth (24.00 per cent) of surveyed households are having land holding size of 1-3 acres, about one-tenth (9.00 per cent) have 3-5 acres, and rest of them are less than one-tenth (4.00 and 3.00 per cent) are having 5-10 acres and 10-15 acres respectively in the system.

29. In paddy cultivation, application of fertilizers (NPK) are decreasing along with increase in income in the study area, which shows that the lowest income group with less land holding size, use more quantity of input in the system.

30. Whereas in the cultivation of sugarcane crop, the trend is reversed. It has been observed that the application of NPK is increasing along with increase in income. This observation is true that the middle income group used to cultivate cash crops, which needs huge amount of money for cultivation, compared to shrill crop the middle income people can afford it.

31. It has been further observed that in paddy crop output is almost evenly distributed among all income groups i.e., 678 kg to 682 kg per acre. It shows that the variation in output is very negligible. Similar observation is also observed in sugarcane cultivation.

32. In rural transportation system, it has been observed that the tractor and bullock cart are major modes of transport for agriculture activities in the system.

33. It has been further observed that the most of the households for about two-third (62.50 per cent) of households in agriculture operation are using tractor for their transportation purpose and whereas one-fifth (20.00 per cent) of them use bullock cart, for this purpose.

Chapter-05

FORECASTING THE DEMAND AND SUPPLY OF INFRASTRUCTURE IN THE SYSTEM

5.1 INTRODUCTION

In this present investigation, the Investigator has conducted thorough investigation at the grassroots level to understand the functions of the system. The parameters that influence highly in deciding the functions of the system is termed as control parameters. In this chapter, an attempt was made to identify the control parameters that decide the functions of the system by employing correlation techniques. The most important parameters, which decide the functions of the system are considered for analysis and are presented in chapter 4.

The Investigator observes that integrated development of the study area is very much essential for holistic development of the system, and therefore an attempt has been made to develop conceptualized urban system model by considering various subsystems and their controlling parameters obtained from the analysis to evolve plausible policy recommendations for integrated development of the study area (System). Further, the Systems theory and Polarized Regional concept have been employed in this investigation. Projections are done for the year 2031 A.D. by employing suitable statistical techniques. Subsequently, plausible policies are evolved and recommendations are made to have integrated development of the system.

5.2 CORRELATION COEFFICIENT METHOD

In practice, one comes across a large number of problems involving the use of two or more than two variables. If two quantities vary in such a way that movements on one are accompanied by movements on the other, these quantities are correlated. The degree of relationship between the variables under consideration is measured through the correlation analysis. The measure of correlation called the correlation coefficient or correlation index summarizes in one figure the direction and degree of correlation. The correlation analysis

refers to the techniques used in measuring the closeness of the relationship between the variables. "Correlation analysis deals with the association between two or more variables".

The Correlation coefficient method is used to analyze the parameters of the various subsystems that highly influence the system. The household data collected for the investigation are utilized for the said purpose, and correlated coefficients between the dependent variable and the independent variables have been established. The parameters, which have higher correlation with the dependent variables, are chosen as the controlling parameters for further analysis. A detailed examination of the data points of the household survey revealed that the monthly income from various occupations in some households is mutually exclusive and others have more than one occupation. Therefore, monthly income of the households is considered as the dependent variables (y) and all other parameters are considered as independent variables (x) for analysis.

The degree of correlation between independent variables and income variables of different subsystems of the system are presented in Table 5.01. This table reveals that monthly savings, monthly expenditure are having high correlation with dependent variable monthly income with Correlation Coefficient 0.8597 and 0.8281 respectively. It has been observed from the table that variable between Expenditure on recreation and Education among females - High school are having moderate correlation with income and their Correlation Coefficients are varying between 0.7631 and 0.3031 respectively. Further, it has been observed that some of the variables from Number of Two-Wheelers owned to the Expenditure on health are having less correlation with income, with their Correlation Coefficients varies between 0.2887 and 01910 respectively. Rest of them is having negative correlation with income and can be concluded that they do not have correlation with income at all.

Table no.5.01: Degree of correlation between independent variables and income variables

S.No.	Variables	Correlation Coefficient
1	Monthly Savings	0.8597
2	Monthly Expenditure	0.8281
3	Expenditure on recreation	0.7631
4	Expenditure on petrol/diesel	0.6561
5	Expenditure on food	0.6084
6	Expenditure on loan repayment	0.5712
7	Expenditure on drinking water	0.5455
8	Expenditure on education	0.4915
9	Expenditure on Telephone	0.4271
10	Number of Four-Wheelers owned	0.4238
11	Expenditure on cloths	0.4140
12	Expenditure on LPG /kerosene	0.4102
13	Education among females - Post graduation	0.3876
14	Expenditure on Transportation	0.3874
15	Expenditure on electricity	0.3502
16	Number of Vehicles owned	0.3460
17	Education among females - Graduation	0.3146
18	Education among females - High school	0.3031
19	Number of Two-Wheelers owned	0.2887
20	Education among males - Post graduation	0.2676
21	Number of females	0.2496
22	Persons having age between 5 to 15 years	0.2187
23	Number of floors of the House	0.2147
24	Persons having age between 40 to 60 years	0.2116
25	Number of rooms in the House	0.1948
26	Expenditure on health	0.1910
27	Total number of persons	0.0875
28	Number of persons unmarried	0.0587
29	Number of persons married	0.0487
30	Education among males - High school	0.0316
31	Education among males - Graduation	-0.0032
32	Number of Bi-cycles owned	-0.0342
33	Persons having age more than 60 years	-0.0524
34	Illiterate population among males	-0.0842
35	Number of males	-0.1234
36	Persons having age less than 5 years	-0.1256
37	Education among females - Up to Matric	-0.1788
38	Persons having age between 15 to 40 years	-0.1837
39	Illiterate population among females	-0.1885
40	Education among males - Up to Matric	-0.3725

Source: Compiled by the Investigator based on the Primary Household Survey, 2010.

5.3 FORECASTING THE DEMAND AND SUPPLY OF INFRASTRUCTURE REQUIREMENT FOR THE YEAR 2031 A.D

This section deals with forecasting of the infrastructure required for the year 2031. At the outset, population is projected for the year 2031 A.D by using suitable statistical methods. Depending on increase in population, extra facilities, which requires are calculated by using suitable planning standards. The real value of the analysis that was done in chapter 4 with a better understanding of past behavior, one can often make good projections or forecasting for the future. By using the knowledge, one can understand the trend, cyclical and seasonal components of the time series, develop forecasts that will provide helpful planning and decision-making information.

Forecasts for one year or less are considered as short term or short-range forecasts. Forecasts of 5 years, 10 years or more are considered as long-term or long-range forecasts. One cannot assure that the trend will continue in the future exactly as it was in the past. If major technological breakthroughs or competitor actions significantly differ from past conditions, then the forecasts may need to be modified. However, if no major changes occur, projections of past trend patterns can prove extremely helpful in forecasting future values of the time series.

The following important control parameters, which decide functions of the system, are considered for projections: They are:

a) Population

b) Housing

c) Drinking water supply

d) Power

e) Health and Sanitation

f) Education

g) Financial Institutions

h) Solid waste

i) Police Station

j) Fire Service Station

k) Agriculture

l) Livestock

5.4 METHODS OF FORECASTING

Forecasting is one of the most important aspects in undertaking planning studies. There are few methods available for forecasting such as, geometric increment method, regression method, arithmetic increment method, incremental increase method, logistic curve method, etc. In this present investigation, population is considered as the focal point. Considering population as focal point, other requirements are calculated by employing relevant standards, which have been set for different variables by different concerned organizations. To project the population availability for the year 2031 A.D, geometric increment method was employed by considering the population increment from 1991 census to 2001 census. The method, which is followed, for population projection for this study is as follows:

5.4.1 Population

Population projections for Puducherry region have been made by the Investigator by employing Mathematical method, which includes Arithmetic method, Geometric method and the Exponential method. The projections are made for the year 2011, 2021 and 2031 A.D., based on population of the year 1991 and 2001 as per census of India. Different results are observed by employing different projection methods. During the course of investigation, it has been observed that due to the changing growth rate and the exponential growth of population of the city, the Exponential method best suits for the projection of population for the study area.

a.) Arithmetic Method-

$$P_n = P_o + n\,(P_o - P_m)/\,m$$

Where, P_n = Projected population for n years

P_o = Present known population

P_m = Population m years earlier than present

n = Number of years hence from now

m = Number of years earlier than present

b.) Geometric Method-

$$P_n = P_o (1+r)^n$$

and $(1+r) = (P_o/P_m)^{1/m}$

Where, P_n = Projected population for n years

P_o = Present known population

P_m = Population m years earlier than present

r = Growth rate of population

n = Number of years hence from now

m = Number of years earlier than present

c.) Exponential Method-

$$P_n = P_o . e^{rn}$$

Where, P_n = Projected population for n years

P_o = Present known population

r = Growth rate of population

n = Number of years hence from now

e = exponential (2.72)

a.) Arithmetic Method-

$$\mathbf{P_n = P_o + n (P_o - P_m)/ m}$$

Total population in the year 1991 = 6, 08,338

Total population in the year 2001 = 7, 35,332

Using Arithmetic Method:

$$P_{2031} = P_{2001} + 30 (P_{2001} - P_{1991}) / 10$$

$$P_{2031} = 735332 + 30 (735332 - 608338) / 10$$

$$P_{2031} = 11, 16,314$$

b.) Geometric Method-

Total population in the year 1991 = 6, 08,338

Total population in the year 2001 = 7, 35,332

Using Geometric Increment Method:

$$P_n = P_0 (1+ r)^n$$

To find r, $P_{2001} = P_{1991} (1+ r)^{10}$

$$735332 = 608338 (1+ r)^{10}$$

$$(1 + r) = (735332 / 608338)^{1/10}$$

Therefore $r = 1.019 - 1$

$$r = 0.019$$

Therefore population in the projected year 2031 is

$$P_{2031} = P_{2001} (1 + 0.019)^{30}$$

$$= 735332 (1 + 0.019)^{30}$$

$$P_{2031} = 12, 93,329$$

c.) Exponential Method-

$$P_n = P_o . e^{rn}$$

To find r, $P_{2001} = P_{1991} . e^{rn}$

$P_n = 735332$

$P_0 = 608338$

$e = 2.72$

$n = 10$ years

$$735332 = 608338 (2.72)^{r\,10}$$

$$1.2087 = 2.72^{10r}$$

Taking log on both sides one arrives at

$$\log 1.2087 = 10r \log 2.72$$

Therefore r = 0.0823 / 4.3456

$$\mathbf{r = 0.0189}$$

Therefore population in the projected year 2031 is

$$P_{2031} = P_{2001}. e^{rn}$$

$$P_{2031} = 735332 . (2.72)^{0.0189*30}$$

$$\mathbf{P_{2031} = 12, 96, 833}$$

The population projection for the Puducherry Region by employing various mathematical methods and are presented in Table 5.02

Table no.5.02: Population projection of Puducherry Region

S.No.	Year	Population (in lakhs)	Population projection (in lakhs)		
			Arithmetic method	Geometric method	Exponential method
1	1991	6.08	-	-	-
2	2001	7.35	-	-	-
3	**2011**	-	**8.62**	**8.87**	**8.88**
4	**2021**	-	**9.89**	**10.71**	**10.73**
5	**2031**	-	**11.16**	**12.93**	**12.96**

Source: Compiled by the Investigator

It has been observed from the projection that the population of Puducherry Region will be about 11.16 lakh, 12.93 lakh and 12.96 lakh by the year 2031 A.D. by employing Arithmetic method, Geometric method and the Exponential method respectively. Considering the exponential method as best suited for the study area, the projected population of Puducherry region would be 8.88 lakhs, 10.73 lakhs and 12.96 lakhs in the year 2011, 2021 and 2031 A.D., respectively.

5.4.2 Population density

Puducherry region has one of the highest densities in the country. The gross density in the urban areas has increased from 5,553 persons per sq km in 1991 to 7,037 persons per sq km in 2001. The population is expected to grow more in the outer areas. The population density in Puducherry urban & rural area and overall density of region are presented in Table 5.03. This table reveals that the decadal growth of population density in the urban area has expected to increase from 7,037 persons per sq km in 2001 to 12,460 by the projected year 2031 and whereas the rural area it is expected the increase from 1028 persons per sq km in 2001 to 1814 respectively. Further, it has also observed from the table that overall density of the region is 2510 persons per sq km in 2001 and this would be increased to 4426 by the year 2031 A.D.

5.4.3 Housing

Requirement of housing for the year 2031 in the study area is calculated as follows:

Population to be considered for construction of houses = 1296833 - 735332 = **5, 61,501**

Considering a general family size of 5,

Number of houses required = 561501 / 5 = **1, 12,300**

To this total number of houses, number of kutcha and semi-pucca houses can be added to find out the total number of houses required, since they are not the permanent in nature. As per the Census of India, 2001 the livable and dilapidated condition of census houses accounts for **17,274** and **1,251** respectively.

Therefore, the total number of houses required = 112300 + 17274 + 1251

= **1, 30,825**

Table no.5.03: Details of Population Density in Puducherry Region

Sl.No.	Area (in Sq.Km)	Population (In lakhs)					Density				
		1991	2001	2011	2021	2031	1991	2001	2011	2021	2031
1	71.9 (Urban)	399244	507960	613710	741475	**895839**	5553	7037	8536	10313	**12460**
2	221.1(Rural)	209094	227372	274707	331898	**400994**	946	1028	1242	1051	**1814**
3	293 (overall)	608338	735332	888417	1073373	**1296833**	2076	2510	3032	3663	**4426**

Source: Compiled by the Investigator based on Census of India, 2001

5.4.4 Drinking Water Supply

Drinking water supply is one of the most important parameters, which needs adequate attention nowadays, since ecological imbalances and environmental crisis are very much phenomenal in our country. Though these problems are very much aggravated mostly in the urban system, it has been started to penetrate in the rural system too. The Central Public Health and Environmental Engineering Organization (CPHEEO), created in 1953, is the technical wing of the Ministry of Urban Development (MoUD), Government of India plays central role in setting design standards and norm setting for urban water supply and sanitation. In India piped water systems, mostly designed according to standards set by the Bureau of Indian Standards (BIS) and the per capita norms set by the BIS are as follows:

- metro cities with sewerage system : 150 lpcd;
- towns and cities with sewerage system: **135 lpcd;**
- towns and cities without sewerage system: 70 lpcd
- population covered by public standpipes: **40 lpcd**

In the investigation 135 lpcd has been considered for per bovine urban population

Quantity of water required for urban population = 135 * 892310

= 120461850 liters

= **120.4618 MLD**

For the rural masses, to calculate the demand of the quantity of drinking water, the ministry of Rural Development, Government of India's norms have been followed: They are:

- There are 40 liters of safe drinking water per capita per day (lpcd) for human beings.
- There are 30 lpcd additionally for cattle in the Desert prone areas.
- One hand pump or stand post for every 250 persons.
- The water source should exist within the habitation within a distance of 1.60 km in plains and within 100 meters elevation difference in the hills.
- Drinking water is defined as safe if it is free from biological contamination and chemical contamination.

In the investigation the same 40 lpcd for man has been considered for per bovine population.

Quantity of drinking water required for population = 40 * 404523

= 16180920 liters

= **16.1809 MLD.**

Quantity of water required for livestock = 40 *1,05,562

= 4,222,480 liters

= **4.2224 ML**

Total quantity of water required = (120.4618 + 16.1809 + 4.2224)

= **140.86 ML**

(or)

The total number of hand pumps required in the study area = 561501 / 250

= 2,246

In addition to the above quantity, water requirement for various non residential purposes, such as Hospital, Hotels, Hostels, Nursing homes, boarding schools / colleges, restaurants, Airport & Seaports, Railways & bus terminals stations, Day schools/ colleges, Offices, Factories, cinema, concrete halls and theatres. Industrial unit's sewerage and drainage systems etc., have to be considered for their better functioning in the study area. The investigator assumed that 25 per cent of total quantity of water requirement for the masses has been considered to cater the needs of these non-residential purposes.

Therefore overall quantity of water requirement for better survival and functioning of the study area are as follows:

= 140.86 + 25 per cent of the total quantity of water required

= 140.86 + 35.21 = **176.07 ML**

5.4.5 Health and Sanitation

As per the Urban Development Plans Formulation and Implementation guidelines, 1996, and the standards of Government of India the following health facilities are required:

- General hospital - for 2.50 lakh population with capacity of 500 beds.
- Community Health Center – for a population of 80,000 to 120 lakh
- Primary Health Center – for a population of 30,000 in plains and 20,000 in tribal and difficult terrain areas.
- Sub-Center – for a population of 5,000 in plains and 3,000 in hilly and tribal areas.

The total population by the year 2031 = 12, 96,833 in the study area.

Number of General Hospital required = 1296833 / 250000 = 5

(5 General Hospital exists in the study area)

Number of Community Health Centers required = 1296833/120000 = 11

Number of Primary Health Centers required = 1296833/30000 = 43

Number of Sub-centers required =1296833/5000 = 260.

Number of hospital available at present are 1657, excluding the JIPMER central Government medical institute bedding capacity of 1098.

The number of hospital beds required by the year 2031 = 2594

(As per the norms and standards given in the UDPFI guidelines, 1996 by the Ministry of Urban Affairs & Employment, Government of India)

Therefore number of hospital beds required = 2594 – 1657 = 937 Hospital beds.

The health facilities required to be provided by considering the existing facilities are as follows

Number of Community Health Centers required = 11-2 = **9**

Number of Primary Health Centers required = 43 -27 = **16**

Number of Sub-centers required = 260 -52 = **208.**

Number of Hospital beds required = **937.**

5.4.6 Power

The power demand during the financial year 2008-09 was around 380 MW. During the financial year 2009-10, the power demand is expected to be around 410 MW and by the end of the eleventh five year plan, i.e., FY 2011-12, the anticipated demand is estimated to be around 475 MW. Till the year 2007-08, the availability from the Central Generating Stations was comfortable and adequate to meet the power requirements of Puducherry. However, from April 2008, the availability of the Central Generating Stations have got reduced due to shortage of coal, nuclear fuel, etc. Due to this, the availability of power has got drastically reduced forcing Puducherry to curtail its unrestricted power requirement. For instance, the availability of power from the Neyveli Lignite Corporation Limited has become almost zero during the end of November 2008. The HT consumers have been subjected to load shedding frequently, to cope up with the situation.

During the months of June & July during in the financial year of 2009-10, Puducherry faced huge quantity of power shortages. On request of Government of Puducherry, Ministry of Power has allocated additional power of 50 MW from the Central Generating Station to Puducherry, till the time this power situation improves. If the generation of the Central Generating Stations picks up and the total availability of power from Central Generating Stations and from other sources of supply is available to the UT, then power is expected to be adequate to meet the normal requirement of power of this UT until FY 2011-12. The progress of Electrification in Puducherry has been commendable and the details of electrification achieved till 31.03.2009 is presented in Table 5.04.

Table no.5.04: Details of Electrification in Puducherry region

Sr. No.	Description		Unit	Total
1	Distribution Transformers		Nos.	1957
2	HT Lines		Kms.	1173
3	LT Lines		Kms.	4286
4	HT/ EHT Industrial Services		Nos.	418
5	LT Industrial Services		Nos.	5770
6	Agricultural Services		Nos.	8960
7	Domestic Services		Nos.	217672
8	Commercial Services		Nos.	38609
9	One Hut One Bulb Services	OC	Nos.	22353
		SC	Nos.	16885
		Total	Nos.	39238
10	Street Lights		Nos.	46297
11	HT Under Ground Cables		Kms.	63
12	LT Under Ground Cables		Kms.	754

Source: Aggregate Revenue Requirement & Tariff Proposal, 2009-10, by the Electricity Department, Puducherry

As per the norms and standards given in the UDPFI guidelines, 1996, by the Ministry of Urban Affairs & Employment, Government of India, based on the estimated requirements of power supply for Master plan of Delhi, the consumption works out to be about 2 KW per household at the city level and includes domestic, commercial, industrial and other requirements.

Therefore, the power requirement of projected year 2031 A.D has been estimated as follows

The total population by the year 2031 = 12, 96,833

Considering a general Household size of 5 as per the census of India, 2001.

Total number of households by the year 2031 = 1296833 / 5

= 2,59,367

Therefore, Total power required by the year 2031 would be = 259367 * 2 KW

= 518734 KW

= **518.73 MW**

The Activity-wise power consumption by the year 2031 has been forecasted and presented in the sequel. Considering 20 per cent increase for every five year to all the non residential activities have been worked out for assessing the future requirement and for agriculture services, based on the assumption of 10 per cent increase, in the study area.

1. Number of HT/ EHT Industrial Services required = **901**
2. Number of LT Industrial Services required = **12,444**
3. Number of Agriculture Services required = **13,380**
4. Number of Domestic Services required = 324208 – 217672 = **1,06,536**
5. Number of Commercial Services required = **81,660**
6. Number of Street Lights required = **81,052**

5.4.7 Education

Education is one of the most important parameters, which decides the functions of the system. Education plays a vital role in the economic, social and cultural development of a country. Besides molding character and values of the citizen, the overall growth of the country depends on educational growth. Education is the basic prerequisite to build a just, equitable society and a tool for the development of the individual and the nation. As per Census, 2001, the literacy rate of Union Territory of Puducherry is 81.23 per cent as against the National average of 65.38 per cent. The Union Territory of Puducherry has been placed under category-IV having literacy rate of 75 per cent and above and is in the 7th place in ranking of literacy rate among all the States/Union Territories in India. The study area is blessed with more number of schools, technical institutions, research institutions, etc., which provide education to the masses.

As per the norms and standards given in the UDPFI guidelines, 1996, by the Ministry of Urban Affairs & Employment, Government of India, Investigator analyzed the status of existing educational facilities, the same has also been forecasted for the projected year 2031 A.D. and are presented in the Table 5.05.

Table no.5.05: Education Facilities in Puducherry Region

S.No.	Description	Norms & Standards as per UDPFI guidelines	Facilities required for year 2031 Nos.	Facilities provided, 2007-08 Nos.
I	**Pre-primary to Secondary Education**			
	Pre-primary Schools	1 for 2500	**519**	395
	Primary Schools (Class I to V)	1 for 5000	**259**	208
	Senior secondary schools (VI to XII)	1 for 7500	**173**	187
II	**Higher Education- General**			
	College	1 for 1.25 lakh population	**11**	76
	University	1	**1**	1
	Technical Education center	One such center for every 10 lakh population (1 ITI and 1 polytechnic)	**2 numbers each**	2 numbers each
III	**Professional Education**			
	Engineering College	New Engineering Colleges 2 Nos	**2**	9
	Medical College	2 sites	**2**	8

Source: Compiled by the Investigator based on the norms of UDPFI guide lines, 1996

This table reveals that the study area is having good numbers education institutions at all the level, starting from Pre-primary schools, Higher education and professional institutions. It has been observed that the study area has exorbitant education facilities as against the minimum requirement as prescribed by the norms and Standards of UDPFI guide lines, 1996, Government of India. This clearly indicates that Puducherry Region has strong educational background to provide better education to the masses.

5.4.8 Municipal Solid waste

The rapid growth of the Pondicherry region has resulted in increase in generation of both solid and liquid wastes. Solid wastes generation consists of household waste, industrial/ commercial wastes, construction debris, and biomedical/hospital wastes, and these wastes are

not properly disposed; as a consequence, the quality of the environment is degraded. Most of the solid waste is dumped in open grounds. This city has produced 265 tons per day during the year 2003, which increased to 370 tons per day in the year 2008, with a waste generation capacity of 0.59 Kg per capita per day, which comprises of 65 per cent of biodegradable waste, and the rest (35 per cent) are non-biodegradable waste. These wastes has the composition of yard waste, paper waste, plastic waste, and other wastes, and their corresponding values are 38.40, 30.00, 10.40, and 21.20 per cent respectively (Swati Patnaik, M. Vikram Reddy, 2009).

Quantity of waste generated in Puducherry Region (2008) = 370 tons per day

Quantity of waste projected for the year 2031 = 1296833 * 0.59

= 765131.47 Kg

= 765.13 **tons per day**

5.4.9 Police

The mission of the Puducherry police is to uphold the rule of law without fear or favor and to provide safety and security to the people without violating their Human Rights. The Police shall strive to maintain law and order and harmony in the society by performing duties in a non-partisan and unbiased manner and shall also focus on crime control in order to be able to instill confidence among the citizens. As per the norms and standards given in the UDPFI guidelines, 1996 by the Ministry of Urban Affairs & Employment, Government of India, the requirement of Police Station and Police post are as follows:

Number of Police Station required by the year 2031 (1 for 90000 population) = 15

Number of existing police stations in the study area = 19

Number of Police post required by the year 2031 (1 for 50000 population) = 8

Number of existing police post in the study area = 7

In addition to the above 2 Traffic police stations and 2 Women police stations, 1 P.C.R Cell, 1 Food Cell and 1 Vigilance police stations are available in the study area.

5.4.10 Agriculture

Assuming the food requirement of 300 kg, a person a year,

Total food grains required for the population = 300 * 1296833

= 38,90,49,900 kg per year

Present output from the crops = 53,32,4000 kg per year

Shortage of food grains =38,90,49,900 – 5, 33, 24,000

= 33,57,25,900 kg per year

5.4.11 Livestock

By considering an amount of 250 ml of milk per capita for a healthy family,

The quantity of milk required would be = 0.25 * 1296833

= 3,24,208 liters per day

= 3,24,208 * 365 liters per year

= 11,83,35,920 liters per year.

= **118.33 ML / year.**

The quantity of milk available at present = 3, 28, 70,874 liters/ year

Shortage of milk = 11,83,35,920 – 3, 28, 70,874

= 8,54,65,046 liters/year

= **85.46 ML / year**

5.5 CONCLUSION

The investigator identified the most important control parameters which decide the functions of the system and projections are made for the year 2031 A.D, for the demand and supply of infrastructure requirement, based on the population growth.

Chapter-06

APPLICATION OF CONCEPTS AND THEORIES

6.1 INTRODUCTION

The investigator observes that the study area has been witnessed with haphazard growth and unplanned development in the system. The integrated development is very much essential to regulate/control the ongoing unplanned development of the region. In this present investigation, the investigator has conducted a thorough investigation at the grassroots level to understand the functions of the system. The parameters that influence highly in deciding the functions of the system are termed as control parameters. System's concept and Polarized regional concept are employed in this investigation to integrate most important control parameters of various subsystems of the system to achieve integrated development in the system. Attempts has been made to develop a conceptualized urban system model, and established the functions through diagram and are presented in the sequel.

6.1.1 INTEGRATED DEVELOPMENT PLAN

Development plan is a systematically and scientifically evolved work schedule to achieve the specific objectives within the specific period of time by employing the specific amount of resources. Integrated development aims at total development comprising all aspects of development, which include physical, social, economic, ecology, environment, infrastructure, institution, and so on. A workable Integrated Urban Development Plan relies upon the combined application of the following techniques, such as, Information system, Statistics, Operations Research, System Dynamics, and Socio-Econometrics. Conventionally, most of the Scholars employ statistics and few location based techniques to prepare the Master Plan (development plan) and wind up. These plans never yield the desired objectives of the plan rather it creates schism and unrest in the system. These kinds of plans never minimized the problems that exist in the system rather it aggravates the problems in the system

6.1.2 SYSTEM

A system functions as whole with the interaction of several sub-systems. All the subsystems of the system are interlinked and interdependent to each other, and forming a system. If one of the subsystems defunct, or partly functions or functions with higher degree (taking a lead role) during its function, its effects can be visualized in the entire system over a period of time. Sometimes, the system may not function at all in some cases, while in some cases the system may function, but with lot of disturbances or the smooth functioning of the system may be paralyzed.

6.2 URBAN SYSTEM CONCEPT

The following sub-systems are linked together and form an urban system. They are physical, social, economic, ecology, environment, infrastructure, and institutions. All these subsystems are interlinked and interdependent to each other functioning as a whole. Urban system is purely a dynamic system since it is always functioning. "A system functions as a whole with the interaction of several sub system. All the subsystems of the systems are inter linked and inter dependent on each other. If one of the sub systems of the system defunct its effect can be seen in the whole system. Similarly, if one of the subsystems takes a lead role or has advanced functions in the system, its effects can also be observed in the whole system". In this present investigation the whole region is considered as system, since it has several subsystems and all the sub-systems are interlinked and interdependent to each other, and function as a whole. Urban system has different subsystems, such as, physical, social, economic, ecology, environment, infrastructure, and institutions. These all subsystems are interlinked and interdependent on each other and functions as a whole.

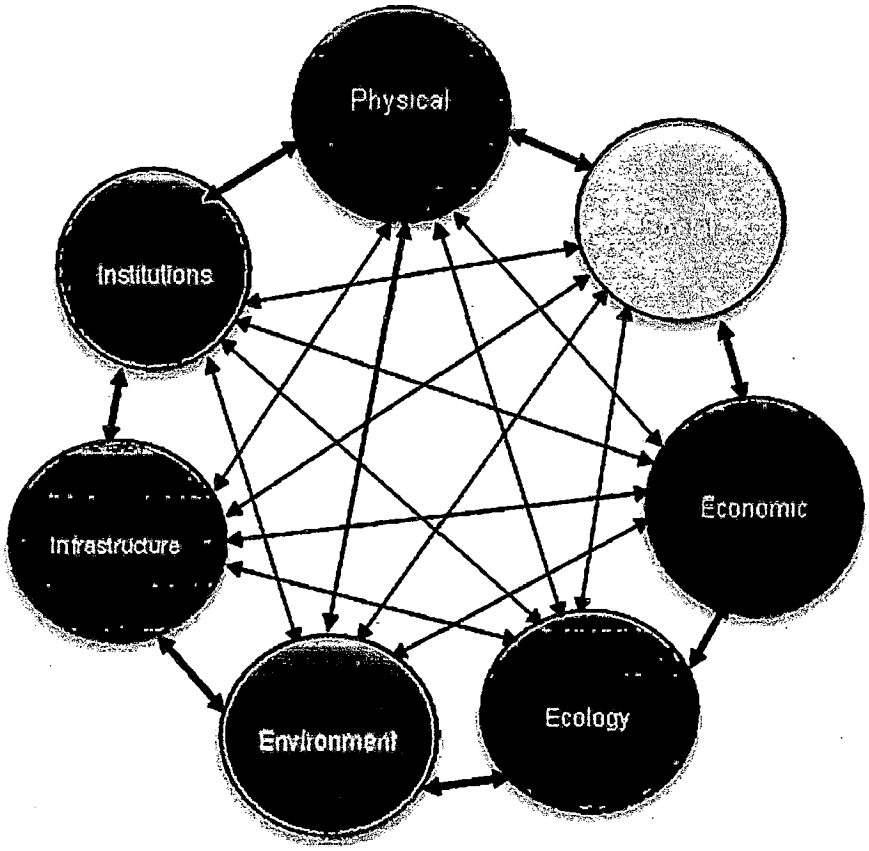


Figure no.6.01: Functions of Urban system along with its subsystems

In an urban system, the following sub-systems are interlinked together and form an urban system. They are:

1. Physical
2. Social
3. Economic
4. Ecology
5. Environment
6. Infrastructure, and
7. Institutions.

The functions of the urban system along with its various sub systems and are presented in Figure 6.01. This figure reveals that the all the sub-systems are interlinked and interdependent to each other, forming a system and function as a whole. The functions of the system along with all the subsystems can be quantified, but because of the shortage of time in Master's Thesis, the Investigator conceptualized the urban system model, and establishes its function through diagram no.6.01.

6.2.1 POPULATION FUNCTION

The population function is the one of the subsystem of the urban system. If population increases at an exorbitant rate, its effects can be visualized in the entire system. Population growth will have adverse effects and upset the ecosystem of the city. The excessive rate of consumption of the natural and artificial resources will affect the Physical and Environmental subsystem. The accumulation or concentration of people at one place will result in to social transformation on one hand, and this will create new economic activities on the other. All the subsystems of the system are functioning based on population.

6.3 Interrelation of Subsystems

The interrelation and interaction of all the subsystems has been discussed below in the sequel.

6.3.1 Physical subsystem

Physical subsystem consists of the land, topography, availability of water resources, vegetation, minerals and climatic conditions. The growth of any settlement can be controlled by these factors on one hand, and the physical subsystem consists of the danger of fire and flood, extreme climatic conditions, storms, the possibility of natural disasters such as earthquakes, Tsunami and volcanic eruption on the other. These are the factors which are highly influence the people and also determining factors in deciding whether to settle or move to different sites. The study area is located on the sea front and features of the coastal area are unique, compared to other cities in India. In view of the coastal location, the relative humidity is generally high, i.e., it ranges from 50 to 75 per cent and moderate temperature 21^0C creates comfortable living environment to settle down in the study area. The study area is facing the

problems of seawater intrusion and some parts of it affected by the disaster of Tsunami during the year 2005.

In olden days, many villages were located on the sites that offered some natural protection, site such as elevated terrain, islands and peninsulas; otherwise they would have to build some artificial protection around their settlement. The larger early urban areas, with some exception, are found where the climate is relatively moderate. Geographic studies reveal that the most of the urban settlements are located on relatively flat terrain. Physical conditions derive the type of settlement, architecture, food, clothing, culture and civilization. For example in hilly regions of North-East of India , prefer sloping roofs of their houses, so that in heavy rains the water could drain out of the roof. The people wear thick cloths for prevention from cold. Abundant water resource and fertile land encourage people to cultivate rice and hence rice has become the bread basket of this region. Similarly, in Rajasthan State, where the terrain is relatively flat, and rainfall and vegetation are less because of water scarcity, people go for flat roof, stone jails in their buildings and preferred to wear colorful cloths. The study area has been blessed with good ground water resources and the entire domestic demand for drinking water in Pondicherry region is met from ground water sources through a series of tube wells constructed in the study area.

Physical subsystem decides the boundaries of a particular settlement. Riverside cities are linear and somewhere hills and ponds define the boundaries of the city. City's physical subsystem consists of housing, public buildings, market and offices, parks and playgrounds, roads, flyovers and bridges etc. Man's intervention converts natural environment into built environment. Urbanism brings about many changes in surrounding environment. Building occupying formerly open land, pavements on streets, smoke from vehicles and factories, can alter the climate. Solid and liquid wastes from housing, industries, market can destroy the natural environment. Environment and health are important for the masses and need to be preserved and conserved. This conservation requires health facilities and can be taken in use with the capital investment. Important thing is that all the functioning of subsystems of the city, i.e., physical, social, and economic, ecology, environment, infrastructure and institutions are interlinked with each other.

6.3.2 Social Subsystem

Social subsystem can be observed in the behavior pattern of the people, religion, caste-system, tradition, culture and civilization. Man is a social animal and society has been built by the hands of natural forces. The fear from animals, and natural calamities, inspired people to live in groups and hence they formed society. Communities are the part of nature and people have suffered from many evils they have inflicted on the environment. They have faced the necessity to improve economic security, correct social maladjustments, discard mass superstition, or resist seizure of power by autocrats bent upon personal glory and self-aggrandizement. The study area is much influenced by the French culture, since the Pondicherry region still retains much evidence of its history as a French colony. The design of the city was based on the French grid pattern, features neat sectors and perpendicular streets. The entire town is divided into two sections, the French Quarter ('Ville Blanche' or 'White town') and the Indian quarter ('Ville Noire' or 'Black Town').The history of French India is led by Joseph Francois Dupleix, Governor General of the French establishment in India, and the rival Robert Clive. There is also French influence in the layout of the city. The numbering of the houses is unique compared to other cities in Tamil Nadu, in which all with the even numbers are on one side and the odd number are on the opposite side of the road. The Auroville (Universal city of South India) is situated in Tamil Nadu State which is 8 km away from northern side of Puducherry City. This universal city accommodates the people almost all parts of the world and this township influence much in the study area one of the prime reason for lot of cultural changes and also brings international exposure.

The main distinguisher of urban and rural system is the social and political organization. Social advancement lies in the people but can make permanent aesthetic changes. For example, the Romans built their cities complete with temple, theatre, stadium, great bath, and villas, etc. The built environment of Rome indicates the strong social, political and administrative structure of the city. The built environment of Orissa indicates the religious and architectural development of society, as there are so many temples built in stone and with a special style of architecture. Social advancement promotes education, administration and economy. Ancient times there were Religious schools, like Madarsa of Islam, Buddhist school

and Ashrams of Hindus and these were there for religious education. However, in Gurukuls and Ashrams the lessons of physical training, meditation (Yoga), war, music, dance and drama were also taught. Rest of the culture was being transferred by old generation to next generation in the houses only. This education was restricted to a special caste of the society and boys only. Girls were taught in houses only. Nowadays with the consequence of social transformation the educational parameters are expanded, and education has become open to all the sectors of the society, and for both the genders. Field of education is also expanded from religion, war and arts to technology, marketing, advertisement, industrial training and several other sciences. Social gatherings, religious functions, sports conventions, fashion shows, theatre, cinema, marriages, etc., are such parts of social subsystem which have major role in economic subsystem. The study reveals that the Puducherry region has blessed with exorbitant number of education facilities to serve better education to their masses, which not only increase status of the individual, it also improve economic condition of study area on one hand, and the economy of the nation on the other.

6.3.3 Economic Subsystem

People are engaged in economic activities to lead a comfortable life. The whole emphasis of activities is given on gaining and spending wealth. People want to upgrade their lifestyle, and this greed results in the multidimensional growth, in terms of economic activities. Money is required first to fulfill the basic needs (physical), and then to fulfill the demands (luxury and comfort). Economic development is dependent over availability of natural resources, human capital, education, technological advancement, public health, healthy social conditions and availability of market and customers. As the economic conditions are improved, more and more people are shifted from primary sector of economy (agriculture, forestry, fishery, horticulture and allied activities) to secondary sector (manufacturing units), and tertiary sectors (service, administration and education) and as the economy is developed, the GNP in primary sector would be decreased. The status of the economy of the region reveals that the contribution of tertiary and secondary sectors (net domestic product at current prices) is increased from Rupees 623077 in 2006-07 to Rupees 700228 in 2007-08, whereas the contribution of primary sector towards the total economy is very less for the corresponding

period. It is evident from the analysis that both secondary and tertiary sector of the economy dominates the economic structure of the study area.

A high average level of real income per head is always associated with high proportion with working population engaged in tertiary sector. Primary sector of economy lies in the rural settlements and urban economy lies in secondary and tertiary sectors. Manufacturing sector, i.e., industries is associated with the production of processed materials and goods. More the number of industries require more number of skilled and unskilled manpower. This gives rise to housing requirement, market, health services, schools, and safety and security measures and in this way the tertiary sector of economy is naturally developed. The physical subsystem is affected by the economic subsystem in order to develop the industries and the other requirement of industries, i.e., housing, amenities and other infrastructural services. Secondary sector of economy requires a well developed infrastructure, i.e., water, electricity, sewerage system, roads, transportation, and market (commercial area; economic subsystem). This means that economic subsystem must be well supported by physical subsystem for its proper functioning. Industrial activities are very much essential for the development of the economy. As already discussed that tertiary sector has much dominance in the system, which shows that the study area is having more industrial activities. The study area has 6414 small scale industries, 164 medium scale industries and 59 large scale industries during the year 2008-09 respectively. In addition to this 2 sugar factories and 5 textile mills are functioning in the study area. The Puducherry Government has also announced to bring Information Technology Park (IT Park) in the study area and this may lead to create lots of employment opportunities and also stimulate better economic development in the region.

The consequences of proper functioning of economic subsystem are the increase in the income and saving and improvement of lifestyle on one hand, and environmental degradation on the other. Industries produce smoke, dust, solid waste, waste water, chemicals, etc, which cause environment pollution. In this way the environmental subsystem is disturbed. If the balance between industrial production and environment is to be maintained, it also requires technological advancement to control pollution and also the assets to afford the applied the applied technologies. Economic growth then becomes necessary to sustainability, as it alone

can provide the necessary financial resources and technological capacity required to deal with environmental problems. There is a strong relationship between economic, institutional, and social subsystem too. Whenever there is commercial, industrial or educational development, it attracts the people from different areas for employment opportunities. As the people from different places accumulate at a place, they bring different culture and this amalgamation of different cultures brings an altogether different culture. The social stratification which was done according to religion, cast and community is done over the basis of occupation and economic status. People from the others states attracted by better education facilities in the study area. In migration to Puducherry region increases every year due to education and employment opportunities. This process leads to better economic development and social transformation in the system. One can conclude that the study area there is strong nexus between the economic subsystem and social and infrastructure subsystems.

6.3.4 Ecological Subsystem

Ecology and economics both the words are derived from a same root, which deals with "housekeeping" in the sense of management of man's works. Extending economic cost-accounting to include the natural environment, as well as manmade structures and developments is an important step in redressing dangerous imbalances between these two necessary components of man's total environment. The Puducherry region has six major water bodies; they are of Olandai Tank, Murungapakkam Tank, Ayeekulam at Muthirapalyam, Kanakaneri, Osuteri and Bahour tank respectively. Ousteri (or Oussudu) Lake is the largest lake in Puducherry, among all the water bodies of around 800 acres of water located approximately 6km. west of the town. Though Pondicherry State is neither having reserve forest nor scrub jungle to support wild animals, it has wetlands such as Ousteri and Bahour Tank (fresh water), which attract huge number of migratory water birds, both migrants and residents. The flora of Puducherry has a remarkable diversity which may be attributed to the diverse soil types comprising the hydro morph soil.

The ecological subsystem consists of many bio-systems. System is a regularly interacting of interdependent group of items forming a unified whole. The communities (human and animal) and non-living environment function together as an ecological system or

ecosystem. Urban subsystem contain human population, birds and animal population, large number of trees substantial area of grass and shrubs, and in many cases, lakes and ponds-so they do have a autotrophic components or green belt. This large system can be compared with a large, mature forest, like a large elephant which have a tremendous metabolism and requires a large flow of energy to sustain it. There is no such thing as steady thing as a large stone, but the circulation of energies within the body, be it a city, forest or body of an elephant. Sometimes elephant may not get food, or forest may not get rains, but they have ability to sustain for some time, even without fulfillment of all the needs. Natural ecosystem has this ability. Whatever the hazards occur, nature has ability to come back into its own, original and healthy state, but this ability is rarely found in the urban system, as the urban system is the fuel-powered ecosystem, or industrial system. Here, highly concentrated potential energy of fuel replaces, rather than merely supplements, sun energy. The other sources of energy are non-renewable and hence non-sustainable.

The organic production (energy) of the city's green belt does not contribute appreciably to the support of people and machines that so densely populate the urban-industrial area. Puducherry does not have forest resources in abundance and in fact there is no recorded forest area in Pondicherry. The urban forests and grasslands do have an enormous aesthetic value and they do contribute indirectly to pollution abatement by reducing noise, carbon dioxide, and other waster products of fuel consumption, but fuel and labor expanded in watering, fertilizing, pruning, removing wood and leaves, and other work required to maintain the city's private and public green belts, adds to the energy cost (money) of living in the city. The natural water resources available in the study area should be prevented from all kinds of pollution and also much attention must be given for maintain its ecological balance in the system.

6.3.5 Environmental Subsystem

Natural environment cannot provide the comfortable living conditions to mankind; it has to be molded in such a way that the resultant built environment can give safety from harsh natural conditions and animals. Built environment consists of buildings, barricades, roads, parks, playgrounds, etc. Cities themselves a unique from of natural, built and cultural

environment. As a natural environment, cities have their own distinctive properties, such as the urban heat island, wind tunnels created by large buildings, and air intervention effects, etc. Yet the natural environment is molded into artificial environment, but in the absence of favorable built environment human health may suffer a lot. The functions of natural environmental subsystem are:

- There are natural resources for production and consumption, principally raw materials and energy.
- The natural environment operates as a sink for society's waste products, and
- It provides a series of free services; like fresh air, water and vegetation.

The relation between physical, and economic subsystem can be understood. If the physical subsystem is not built properly then the human physical and mental health is badly affected and to get rid of this difficulty, the support of social and institutional subsystem (health services) and economic subsystem (funds for availing the health services) is required. Urban environmental subsystem is not just the built environment, but the social, economic and political environment. Social, economic, and political environment determine the quality and growth of the physical environment. Environment means physical conditions, not psychological. The total environment of the city consists of this entire environment. Urban sprawl can pose particular problems by eating into valuable natural habitats, whilst cities also pass on some of their impacts, making intensive demands on the natural resources of their hinterlands, such as quarries for building materials. Estimation of economic value of the natural resources is never ever done before its over-exploitation, however the commodities which are made out of these natural resources, or with the help of these resources have their own market price. One can conclude based on the above that there is a strong relationship and interdependency among the environmental, physical, economic and ecological subsystems

6.3.6 Infrastructural Subsystem

Urbanization and the phase of its acceleration is the foremost important aspect in deciding the level of the kinds of infrastructure requirement in the urban system, for its development. The features of urban population are changing not only as a result of its dynamism, but also the national development in which it belongs. Cities, towns, and urban agglomerations are expanding faster in most of the regions of the world than the overall growth of the population, due to availability of infrastructure services in the particular system. Infrastructure is divided in to three types, which include physical, economic and social infrastructure.

- **Physical**: water, drainage, sewerage, solid waste management system, roads, rails, gas, airways, and waterways, etc.
- **Economic**: All kinds of work centres, workshops, industries, trade and commercial centres, banks and financial institutions, advertisement institutions, legal firms, broker office, online transaction centres etc.
- **Social**: parks, nurseries, water bodies, accessibility to internet connection, e-governance, education and health institutions, Police and defense services, Economic back-up and institutional framework readily available at the time of floods, earthquakes, or any other natural calamity, etc.

These entire three infrastructures are very much essential for the development of any urban system. In India, the urban system which has more infrastructure services developed further, and continuously growing with higher intensity, whereas the urban system has less infrastructure services grows with less intensity. Provision of required amount of infrastructure services to the Indian urban system becomes a mirage, due to the functions of population explosion in the urban system on one hand, and the Government of India and the respective State Governments attitudes on the other. Further, it has been also observed from various studies that whatever infrastructure is made available in the urban system by the Government of India and by the respective State Governments, turning into a drop in the ocean, due to the functions of population explosion, in the urban system. Various studies

proved that there is strong nexus between infrastructure services and economic development in the urban systems. According to United Nations, "Cities are the engines of economic development "but, according to the investigator's view, without required amount of infrastructure services in the urban system, the cities cannot be the engines of economic development.

The population of the Indian cities is growing and there is rapid growth in demand. Indeed, there is a wide gap between demand and supply as because of migration large number of people is coming towards city, the demand for infrastructure is more and supply is less. There is lack of resources, and even the financial resources are less. Institutional parameters show that there is lack of public and private partnership for the development of infrastructure. The use of ineffective and obsolete technologies is also the governing factor for poor infrastructure development. Even if the physical infrastructure is built, the lack of maintenance pulls it behind and leaves in unusable state.

6.3.7 Institutional Subsystem

Integrated functioning local governing bodies, working for planning, development and maintenance of the region are required for the holistic development of the city or region.

6.4 GROWTH POLES THEORY

Francois Perroux introduced the concept of economic *Growth Poles* in 1949. The core idea of the growth poles theory is economic development, or growth, which is not uniform over an entire region, but instead takes place around a specific pole. The concept of growth pole is presented in the Figure no.6.02. This pole is often characterized by a key industry around which linked industries develop, mainly through direct and indirect effects. The expansion of this key industry implies the expansion of output, employment, related investments, as well as new technologies and new industrial sectors. The regional development is imbalanced, because of agglomeration economies taken place near the growth pole. Transportation, especially transport terminals, can play a significant role in such a process. Transportation plays a very significant role in developing growth poles, since it is the only mean, which is used for resource mobilization, commutation, recreation, day to day

activities and other purposes. The more dependent or related an activity is to transportation, the more likely and strong this relationship. At a later stage, the emergence of a **secondary growth pole** is possible, mainly if a secondary industrial sector emerges with its own linked industries.

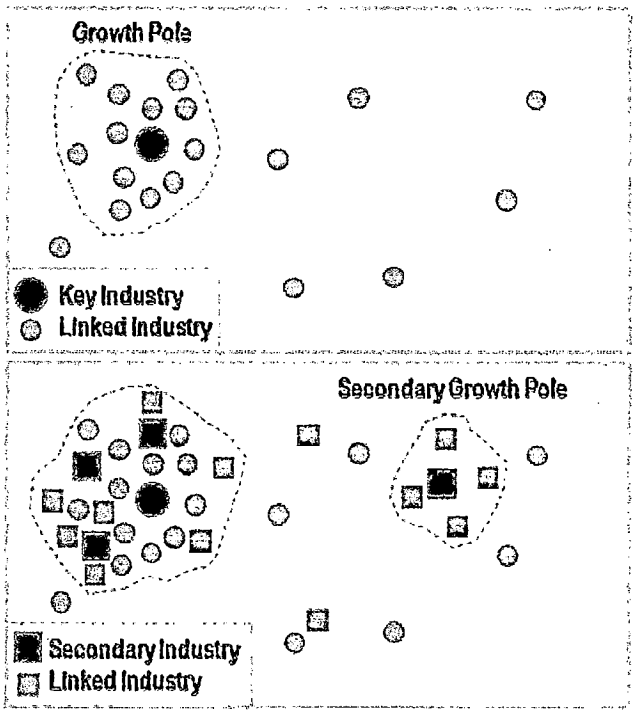


Figure no.6.02: Concept of Growth Pole

6.4.1 Growth Pole Theory: origins and definition

Growth pole theory, as originally formulated, assumes that growth does not appear everywhere at the same time, but it manifests itself in "points" or "poles" of growth (Perroux, 1950; 1955). With variable intensities, the growth spreads by different channels and eventually affects the economy as a whole (Vanneste, 1971). It is widely argued that Perroux's initial concept of growth pole denoted an individual plant; one that occupied an abstract economic space, rather than a specific geographical space such as a city or region (Vanneste, 1971; Monsted, 1974; Mitchell-Weaver, 1991).

In his latter writings, as Vanneste (1971) points out, Perroux refined his concept of growth pole as a dynamic unity in a defined environment. The unit is simple or complex: (a) a

firm, or (b) group of firms not institutionalized, or (c) group of firms institutionalized, such as private and semi-public undertakings. Based on these features of the growth pole concept, other authors (Davin, et. al, 1950) associated a functional attribute to the concept. They postulated that a growth pole is formed when an industry, through the flow of goods and incomes which it is able to generate, stimulates the development and growth of other industries related to it (technical polarization); or determines the prosperity of the tertiary sector by means of the incomes it generates (income polarization); or stimulates an increase of the regional economy by causing a progressive concentration of new activities (psychological and geographical polarization). To the extent that the growth pole concept has a functional character, Vanneste (1971) argues that it would be wrong to neglect the spatial aspect and the geographical implications of the concept. If the growth pole has a local geographical base, then it is safe to assume that it can induce external economies in local firms. This means that growth is induced not only through direct trading between firms located in the same geographic area, but also through a structural change in the region. In that sense, Monsted (1974) asserts that local trade and business, which are not even directly associated with the growth pole will experience high demand induced by better resources and wages in the region. Bhandari (2006) thinks that the geographical aspects of growth poles are now considered to be the most important facet of growth pole theory. As already pointed out, the growth pole concept involves an enormous confusion of ideas, which makes it extremely difficult to put forward a clear definition of it.

The Geography Dictionary (2004) defines growth poles as follows:

"A point of economic growth. Growth poles are usually urban locations, benefiting from agglomeration economies, and should interact with surrounding areas, spreading prosperity from the core to the periphery". This definition presupposes a linkage between growth poles, economic growth and urbanization, as well as potential interaction effects. The linkage is so crucial that it deserves further discussion.

6.4.2 Linkage between Cities as Growth Poles and Urbanization

To better understand the linkage between cities as growth poles and urbanization, it is important that we define the salient terms such as: urban area, urbanization, and urban growth. By an *urban area*, we mean a settlement or a locality defined as "urban" by national statistical agencies, generally on the basis of population concentration. An urban area may also be defined in terms of land use types and industrial categories. Thus, an urban area may be defined as an area characterized by social, economic and institutional activities which are predominantly based on the manufacture, production, distribution, or provision of goods and services other than agricultural uses, or the extraction of natural resources in unprocessed form, or low density residential development.

Urbanization is defined as: (a) the social process whereby cities grow and societies become more urban; (b) the process of the formation and growth of cities; or (c) a historical transition from being mostly rural to predominantly urban. In statistical terms, urbanization reflects an increase in the percentage of a country's total population that lives in towns and cities. This number represents the level of urbanization of a country. The *rate of urbanization* is the speed at which the percentage of the total population living in towns and cities is growing. The urban population trend among the selected regions of the world is presented in the Table 6.01. This table reveals that although urbanization is a global phenomenon, yet the level and rate of urbanization vary significantly across geographical areas, regions and countries. On one hand, Africa has the lowest level of urbanization, approximately 39 percent in 2007, compared to 48 percent in Asia, 72 percent in Europe, 78 percent in Latin American, and 81 percent in North America on one hand, the rate of urbanization in Africa since 1950 is the highest among all the continents in the world, on the other.

Table no.6.01: Urban Population Trend 1950-2030, selected Periods & Regions

Sl.No.	Region	Percent of Total Urban population					Rate of Urban Growth(%)				
		1950	1980	2000	2010	2030	1950-55	1980-85	2000-05	2010-15	2025-30
1	World (Total)	29.10	39.10	46.60	50.60	59.60	3.00	2.70	2.10	1.90	1.50
2	More Developed	52.50	68.80	73.10	75.00	80.60	2.30	0.90	0.60	0.50	0.40
3	Less Developed	18.00	29.60	40.20	45.30	56.00	3.80	3.70	2.70	2.40	1.80
4	Africa	14.50	27.90	35.90	39.90	50.00	4.70	4.30	3.90	3.20	2.90
5	Asia	16.80	26.30	37.10	42.50	54.10	3.50	3.60	2.50	2.30	1.80
6	Europe	51.20	68.00	71.40	72.60	77.80	2.00	0.79	0.21	0.17	0.14
7	Latin America/ The Caribbean	41.40	64.90	75.30	79.40	84.60	4.40	3.00	2.00	1.50	0.98
8	North America	63.90	73.90	79.10	82.10	86.70	2.70	1.20	1.40	1.20	0.86
9	South America	42.70	68.30	79.50	83.70	88.30	4.60	3.10	2.00	1.50	0.91
10	Australia/New Zealand	76.20	85.40	86.90	88.70	88.30	2.80	1.20	1.40	1.00	0.82

Source: Compiled by the Investigator based on the United Nations (2008), Population Division, the Department of Economic and Social Affairs, 2008-09

One of the important indices of population concentration is the density of population. It is defined as the number of persons per square kilometer. Details of population density of India are presented in Table 6.02. This table reveals that population density of India in 2001 was 324 persons per square kilometer, which shows that now 57 more people live in a square kilometer area in the country than the number that lived a decade ago.

Table no.6.02: Density of population, India: 1901-2001

Sl.no.	Year	Density (per Sq.Km)
1	1901	77
2	1911	82
3	1921	81
4	1931	90
5	1941	103
6	1951	117
7	1961	142
8	1971	177
9	1981	216
10	1991	267
11	2001	324

Source: Compiled by the Investigator based on Census of India, 2001

The population density of India from 1901 to 2001 is presented in Table 6.02. This table reveals that at the beginning of the twentieth century i.e. in 1901 the density of India was as low as 77 and this steadily increased from one decade to another to reach 324 in 2001. The persons living in per sq. km. has increased by 21.3 per cent in 2001 as compared to 1991.High increase in the density of population is a matter of great concern as it puts immense pressure on our natural resources and also it may adversely affect the quality of life. Due to difference in climatic conditions, availability of resources etc., the states and Union territories of our country largely varied in terms of density. It is, therefore, essential to analyze the variations across the States and Union territories. Ranking of States and Union territories by density between the year 1991 and 2001 is presented in Table 6.03. This table reveals that the population density within the country widely varies across the States and Union territories. It varied from 13 persons per sq. km. in Arunachal Pradesh to 9294 in Delhi. Further, it has been observed from the table that density of population has been increased in all States and Union territories of India between 1991 and 2001, but one can understand the huge variations in the rate of increase in density.

Further, this table indicates that among major states, West Bengal is still the most thickly populated, where population density has gone up from 767 in 1991 to 904 in 2001. However, among major states, Bihar is now the second highest densely populated State pushing Kerala to the third spot in terms of ranking. Similarly, Punjab and Tamil Nadu have now interchanged their relative position of tenth and eleventh ranks respectively in 1991. It has been observed that the Puducherry Union Territory holds the third position among all the states / Union Territories of India.

An attempt has been made by the Investigator to understand the differentials in population densities across the six regions in the country. The variation of population, distribution of States and Union territories by density in different regions between the year 1991 and 2001 is presented in the Table 6.04, 6.05 and 6.06 respectively. These tables reveal that the Eastern region has by far the highest density and the North Eastern region the lowest. Eastern region has recorded the highest increase in density from 431 in 1991 to 525 in 2001 followed by Central region and Western region respectively.

Table no.6.03: Variation of Population Puducherry Union Territory: 1901 to 2001

Sl.No.	Year	Total Population (Persons)	Variations in No. Persons	Increase(+)/ Decrease(-) in %	Density (per Sq.Km)
1	1901	2,46,354	-	-	500.72
2	1911	2,57,179	(+) 10,825	(+) 4.39	522.72
3	1921	2,44,156	(-) 13,023	(-) 5.06	496.25
4	1931	2,58,628	(+) 14,472	(+) 5.93	525.67
5	1941	2,85,011	(+) 26,383	(+)10.20	579.30
6	1951	3,17,253	(+) 32,242	(+) 11.31	644.82
7	1961	3,69,079	(+) 51,826	(+) 16.34	750.16
8	1971	4,71,707	(+) 1,02,628	(+) 27.81	958.75
9	1981	6,04,471	(+) 1,32,764	(+) 28.15	1228.60
10	1991	8,07,785	(+) 2,03,314	(+) 33.64	1641.84
11	2001	9,74,345	(+)1,66,560	(+) 20.62	1980.37

Source: Directorate of Census Operations, Puducherry

Table no. 6.04: Ranking of States and Union Territories by density

Sl.No.	Rank in 2001	States/Union Territories	Density (per Sq. Km) 2001	1991	Rank in 1991
1	1	Delhi *	9,294	6,352	1
2	2	Chandigarh *	7903	5632	2
3	3	Pondicherry *	2029	1683	3
4	4	Lakshadweep *	1894	1616	4
5	5	Daman & Diu *	1411	907	5
6	6	West Bengal	904	767	6
7	7	Bihar	880	685	8
8	8	Kerala	819	749	7
9	9	Uttar Pradesh	689	548	9
10	10	Punjab	482	403	11
11	11	Tamil Nadu	478	429	10
12	12	Haryana	477	372	12
13	13	Dadra & Nagar Haveli *	449	282	15
14	14	Goa	363	316	13
15	15	Assam	340	286	14
16	16	Jharkhand	338	274	16
17	17	Maharashtra	314	257	18
18	18	Tripura	304	263	17
19	19	Andhra Pradesh	275	242	19
20	20	Karnataka	275	235	20
21	21	Gujarat	258	211	21
22	22	Orissa	236	203	22
23	23	Madhya Pradesh	196	158	23
24	24	Rajasthan	165	129	26
25	25	Uttaranchal	159	133	24
26	26	Chhatisgarh	154	130	25
27	27	Nagaland	120	73	31
28	28	Himachal Pradesh	109	93	27
29	29	Manipur	107	82	28
30	30	Meghalaya	103	79	29
31	31	Jammu and Kashmir	99	77	30
32	32	Sikkim	76	57	32
33	33	Andaman & Nicobar Islands *	43	34	33
34	34	Mizoram	42	33	34
35	35	Arunachal Pradesh	13	10	35

Source: Compiled by the Investigator based on Census of India, 2001

Table no.6.05: Distribution of States and U.T. by density in different regions

Sl.No.	Region	States/Union Territories*	Number of States/Union Territories*	Density (per Sq.Km)	
				1991	2001
1	**Northern**	Jammu & Kashmir			
		Himachal Pradesh			
		Punjab			
		Chandigarh*			
		Haryana			
		Delhi*			
		Rajasthan	**7**	**174**	**223**
2	**Central**	Uttaranchal			
		Uttar Pradesh			
		Chhatisgarh			
		Madhya Pradesh	**4**	**278**	**347**
3	**Eastern**	Bihar			
		Sikkim			
		West Bengal			
		Jharkhand			
		Orissa			
		Andaman & Nicobar Islands*	**6**	**431**	**525**
4	**North East**	Arunachal Pradesh			
		Nagaland			
		Manipur			
		Mizoram			
		Tripura			
		Meghalaya			
		Assam	**7**	**124**	**151**
5	**Western**	Gujarat			
		Daman & Diu*			
		Dadra & Nagar Haveli*			
		Maharashtra	**4**	**239**	**293**
6	**Southern**	Andhra Pradesh			
		Karnataka			
		Goa			
		Lakshadweep*			
		Kerala			
		Tamil Nadu			
		Pondicherry*	**7**	**310**	**351**

Source: Compiled by the Investigator based on Census of India, 2001(Note * denotes the Union Territories)

The growth pole concept was originally conceived within "economic space", but later transposed into "geographical space". By conceptualizing growth pole in spatial terms, economists sought for a link between growth pole theory and urban accumulation and concentration (Monsted, 1974; Parr, 1999; Bertenelli and Strobl, 2003). The assumption was that cities with their accumulation and concentration of population and capital resources (agglomeration economies) could become growth poles. That being the case, Penouli (1972) and Friedman (1966) have treated growth poles as centers from which innovations and progress are diffused. A historical trend has been documented from the developed, industrialized countries suggesting that growth and development start from points of accumulation and concentration within a geographic area (growth poles). The argument is that these growth poles have the potential of giving birth to other centers of accumulation and concentration. The process is seen as a natural progression in the urbanization process, where relative growth in a country's urban population is accompanied by an even faster increase in the economic, political, and cultural importance of cities (World Bank, 2000).The conclusion is that the level of urbanization is highest in the most developed, high-income countries and lowest in the least developed, low-income countries.

The growth pole approach to economic development in developing countries was formulated on the presumption that by deliberately focusing of investment at a limited number of centers, a necessary condition for development would be satisfied (Parr, 1998). As a result, the growth pole concept generated considerable intuitive appeal among policy makers. The role of economists, urban and regional planners, and allied social scientists became important in providing insights to governments and national leaders in their efforts to unravel the complexities of the growth pole strategy, as they grappled with high levels of urbanization. As Thayer Watkins (Darwent, 1969) put it, *"The policy makers presumed that economists could supply the technical analysis needed to make sense of the policies based upon the concept of growth poles"*. The conception of cities as growth poles in the urbanization process sparked a momentum to jumpstart economic growth in developing and industrializing countries in the 1960s and 1970s, mostly countries in Latin America and Southeast Asia, by pursing a growth pole strategy. Planners and development economists set about identifying locations, which they believed, could act as growth poles or growth centers in the national urban system.

Naturally established cities were activated as growth poles and strategically located points in a region were artificially induced as growth poles. These poles tended to be secondary cities within the national urban hierarchy places that could grow to fill the gap between the primary city and smaller places (Mitchell-Weaver, 1991).

When the economic concept of growth pole was linked specifically to that of geographical poles of investment, it gave rise to dialectical relationship between the concepts of *growth* and *development* (Mitchell-Weaver, 1991; Monsted, 1974). Based on the writings of Perroux in the late 1960s, Mitchell- Weaver (1991) offers an important distinction between growth in a region and development in a region. Growth is defined as *"a steady rise of the indicator of a dimension of the total economy in the region or a nation"*, while development is defined as *"a combination of mental and social changes in population, which enables total production to grow, both cumulatively and permanently"*. In other words, economic growth can be stimulated through cities as growth poles without being accompanied by development.

Francois Perroux's original work focuses on the development of growth poles in economic spaces. He developed a typology of economic spaces, the most important being that of economic space as a field of forces, from which he derived the notion of a pole as a vector of economic forces "as a field of forces, economic space consists of centres (poles or foci) from which centrifugal forces emanate and to which centripetal forces are attracted " Perroux did acknowledge that growth poles would also exist in geographical space, but it was Bourdville who extended the original theory to include more comprehensively the geographical dimension. To keep the distinctions clear and in perspective, the term growth pole can be taken to refer to the original concept of Perroux without any specific geographical dimension, while the term growth centre or growth point refers to a spatial location. The following basic economic concept and their geographical developments can be identified through growth poles and growth centres.

6.4.3 The concept of leading industries

The concept of leading industries and propulsive firms, states that at the centre of growth poles are large propulsive firms belonging to leading industries which dominate other economic units. There may be just one single dominant propulsive firm or a core of them forming an industrial complex. The original geographical location of such industries in certain

focal points in a region may be due to several factors i.e., the localization of natural resources (water/ shelter/fuel), the localization of more man-made advantages (communications or existing service-based central places with advantages of infrastructure and labour supply), or possibly just chance. In reality, the growth points are often grafted on to the existing framework of central places.

6.4.4 The concept of polarization

The concept of polarization states that the rapid growth of the leading industries (propulsive growth) induces the polarization of other economic units into the pole of growth. Implicit in this process of polarization are the various agglomeration economies (internal and external economies of scale). This economic polarization will inevitably lead to geographical polarization with the floe of resources to and the concentration of economic activity at a limited number of centres within a region. Even when the original raison the centre of such locations disappears, they will often continue to prosper due to the presence of the agglomeration economies.

6.4.5 The concept of spread effects

The concept of spread effects states that in time the dynamic propulsive qualities of the growth pole radiate outwards into the surrounding space, These 'trickling down' or 'spread' effects are particularly attractive to the regional planner and have contributed much to the recent popularity of the theory as a policy tool.

6.5 INDUSTRIAL PROFILE OF PUDUCHERRY REGION

6.5.1 INDUSTRIAL ESTATES

The Govt. of Puducherry had initially started three industrial estates in the Territory in order to motivate the industrial development. Later a Corporation for industrial development has been established in the year 1974 viz. Pondicherry Industrial Promotion, Development and Investment Corporation (PIPDIC). Then the corporation has taken over the infrastructure development for industrial promotion. Four industrial estates were developed and allotted to the entrepreneurs based on the request in the study area. All the industrial estates are provided with all necessary basic infrastructure facilities. They are:

Thattanchavady

Thattanchavady Industrial Estate was established in the year 1962 over an area of 51 acres of the land. There are 60 sheds of various sizes, 39 plots of 11,200 Sq.Ft and 10 plots of 7,500 Sq.Ft. 110 units are functioning in the estate. In order to encourage the industries the sheds/plots are sold under Hire-purchase Scheme and Conditional Assignment scheme.

Kattukuppam

The Rural Industrial Estate, Kattukuppam, Manapet was estabilished in the year 1969 over an area of 15.58 acres of the land. There are 13 sheds and 38 plots of 11,200 Sq.Ft. There are 19 units functioning in this estate.

Mettupalayam

The Industrial Estate, at Mettupalayam was established in the year 1976 over an area of 167.00 acres by PIPDIC. There are 367 plots and 89 sheds of various sizes. 257 units are functioning in this Industrial Estate.

Sedarapet

The Industrial Estate, at Sedarapet was established in the year 1982 over an area of 62.19 acres by PIPDIC. There are 191 plots of various sizes. 83 units are functioning in this PIPDIC Industrial Estate.

Kirumampakkam

The Industrial Estate, at Kirumampakkam was established by PIPDIC over an area of 25.00 acres. 19 units are functioning in this PIPDIC Industrial Estate.

Thirubuvanai

An exclusive Industrial Estate for Electronic industries was established by PIPDIC over an area of 50 acres.

The details of industrial estates exists in the study area is presented in Table 6.07.

Table no.6.06: Details of Industrial Estates in Puducherry Region

Sl.No.	Name	Area in acres	No. of Units
1	Thattanchavady	51.22	110
2	Mettupalayam	167.00	257
3	Sedarapet	62.19	83
4	Kattukuppam	15.58	27
5	Kirumampakkam	25.00	19
6	Thirubuvanai	50.00	-

Source: Compiled by the Investigator based on the Directorate of Industries & Commerce, 2009-10

With a small industrial inheritance of three textile mills Puducherry has come a long way. Details of existing industries in the region are presented in the Table 6.08. This table reveals that the study area has 8367 industries representing a cross section of industries. Seven well established industrial estates with comprehensive infrastructure facilities propelling the Industrial growth of Puducherry. Spectacular performance at export front and the principal export items are Leather, Chemicals, Textiles and Metallic products in the study area.

Table no.6.07: Details of Industries in Puducherry Region (As on 31-12-2009)

Sl.No.	Categories	LSI	MSI	SSI	Total
1	Food Products	6	12	914	932
2	Cotton Products	7	10	1016	1033
3	Wood Products	Nil	Nil	486	486
4	Paper Products	4	7	456	467
5	Leather, Rubber, Plastic Products	11	41	836	888
6	Chemical & Chemical Products	22	34	1639	1695
7	Non-Metallic Mineral Products	8	5	315	326
8	Metal Products	3	21	918	942
9	Machinery Products	11	39	661	711
10	Miscellaneous Products	Nil	Nil	361	361
11	Personal Service	3	13	250	266
12	Repairing Servicing	Nil	Nil	258	258
	Total	**73**	**182**	**8110**	**8367**

Note: SSI- Small Scale Industries, MSI- Medium Scale Industries LSI- Large Scale Industries
Source: Directorate of Industries &commerce, 2009-10 Puducherry

Chapter-07

RESULTS, DISCUSSIONS AND FINDINGS

In this present investigation, different kinds of analysis are made at various stages, which include review of literature, study area analysis, and analysis of primary household survey. The findings of the analysis are grouped in to two categories and are presented as below:

7.1 FINDINGS BASED ON LITERATURE AND STUDY AREA

1. The study area is characterized by different landforms, such as highland, midland, and the lowland (coastal plains).

2. In the study area, certain pockets are confined in the low lying area; and also affected by water logging and flooding, during the monsoon season, which affects the day – today life of the households by flooding on roads, residential areas, work places, which block the traffic movement.

3. In the study area, the dwelling units are detached in nature and scattered throughout out the geographical area. The residences confined besides the major transportation networks are having two or more floors, and those live in interior and in the outskirts are having single storied.

4. The existing road network is unable to cater the present requirement of the urban transportation system. The existing public transportation facilities are poor that forced the people to procure their own vehicle for their mobility.

5. Social infrastructure facilities, such as, schools, health centers, convenient shopping, markets and recreation facilities are scattered throughout the study area, which are accessible to all sections of the community irrespective of income groups.

6. The study area has good number of education facilities to cater the needs of its masses. Setting up of professional educational institutions; including engineering and medical

colleges is an ongoing process in the study area, which attracts more number of in migrants in the region.

7. It has been observed that there is high demand for serviced residential land, which are lying besides the transportation routes, core area of the city, residential colonies, near to the urban agglomeration, in suburban centers, and the land value varies in accordance with the availability of services in various locations of the city.

8. In the study area, the people of the coastal location belong to fishermen community. Fishing and its allied activities are the major source and income earning opportunities to this community and their economic condition is very poor. They are prone to all kinds of natural hazards, during the monsoon season, due to having poor quality of housing.

9. The study area has six major water bodies, and are Olandai Tank, Murungapakkam Tank, Ayeekulam at Muthirapalyam, Kanakaneri, Osuteri and Bahour tank. Ousteri (or Oussudu) Lake is the largest lake in Puducherry region, among all the water bodies, around 800 acres of water located approximately 6 km west of the town. It can be retrieved from all kinds of pollution and can be used as water base tourism by maintaining its ecological balance in the system.

10. Trained, educated human resources are abundant in the study area. Unemployment is rampant and majority of them are migrating to Middle East, European, and other countries for employment.

7.2 INFERENCES BASED ON THE LITERATURE REVIEW

The following more important points are observed based on the literature reviewed and are presented in the sequel. They are

1. Integrated planning technique for sustainable development of cities is advised. Dynamic functional planning concepts have been employed, but never attempted for quantifying the functions and concluded with theoretical conceptualization.

2. An attempt was made to improve the living conditions of urban poor, especially people live in slums and evolved coordinated policies, by creating employment opportunity through participatory urban planning and slum upgrading. Partnership building and working, and slum upgrading under national level, Municipal level and community level has been stressed.

3. An attempt was made to forecast the municipal solid waste generation in a fast-growing urban region by employing system dynamics modeling. City of San Antonio, Texas, North America was chosen for the said purpose. The following variables were considered for the said purpose, which include income per service center, people per house hold, historical amount generated, and income per household, population to simulate the waste generation, and it has been observed that income has more bearing in waste generation.

4. An attempt was made to understand the urban transport problem by way of alleviate traffic congestion by decentralizing commercial activities from the CBD of Singapore to the regional centers, through integrating land use and transport planning aiming at to reduce work-related travel. Further, it is observed that regional centers can be developed wherever intense commercial centers are available with good transport network system.

5. An attempt was made to understand the national ecological network in Italy, and observed that landscape planning, in all areas, such as, ecology, natural, cultural, social, economic and political considered.

6. An attempt was made to strengthening urban governance in the South through city-to-city cooperation. Efficient institutional mechanism for urban governance is established to establish the relationships between local institutions and civic society. It is further stressed for understanding the impact of C2C on urban governance, the following measures which include a critical assessment of existing governance structures in the

cities in the South, including the legal and institutional frameworks of local governments and participation, traditions and cultures of citizenship and existing mechanisms and instruments for municipal planning.

7. An attempt was made to understand the important elements of experience of integrated urban infrastructure development in Asia and conclude with some plausible recommendations for the integrated approach to infrastructure planning and development for the Asian Region.

8. An attempt was made to achieve sustainable infrastructure, particularly water supply, sanitation, drainage and solid waste management for the development of the urban system. The study concludes with good amount of plausible recommendations for achieving sustainable development.

9. An attempt was made to understand the realty water supply for households with access to piped water supply in Delhi City, and observed that the number of hours of water supply is not enough. Further, it has been observed that comprehensive infrastructure development policies are essential for the development system, which should be cost effective.

7.3 FINDINGS BASED ON HOUSEHOLD SURVEY

In this present investigation, different kinds of analysis are made based on the primary household survey and the following important findings are observed, they are:

1. The number of households is increasing along with increase in income up to the monthly income group of Rs.20, 000 to 30,000 and then observed the reverse trend.

2. About half of the household are confined in the middle income group among the surveyed households.

3. The study area has three religious characters, which include Hindu, Christian, and Muslim, but almost nine-tenth of surveyed households (88.00 per cent) belongs to

Hindu community, which is the predominant one in the system. The people belong to other community are very meager.

4. The male and female population among the surveyed households are almost identical, but the male population is just above half (51.51 per cent) of the total population and the rest of them are females.

5. The average size of the family is below four, i.e., 3.99, which shows that people are practicing family planning measures at higher rate. This is the very good symptom for development.

6. Education is one of the most important parameters, which is the backbone for the development of the country. This parameter is highly activated in this system.

7. Literacy status of the male and female population shows that literacy is penetrated in almost all the segments of the population, i.e., from the lowest income group to the highest income group. However, literacy rate is little higher among the male population than the female population. The study area has more numbers of literate female population, which is the healthy symptom for national development. This is the only reason population reduction takes place in the system.

8. Graduation and Post Graduation qualification is common among both male and female population in the study area.

9. Employment is also not bad in the system, and also it is evenly distributed in almost all the segments of population (income groups).

10. More than one-third (36.86 per cent) of the population is employed either in Government or in private or in business.

11. There are 100 persons having the primary occupation and 25 persons are having secondary occupation. Of the total primary occupational persons, one-third (33.00 per cent) belong to government personal and equally another one-third engaged in agriculture, followed by about one-fourth (21.00 per cent) are having private job and the rest are engaged in business.

12. In sources of income, about half (48.00 per cent) of them are accrued from salary, about one-fourth (22.00 per cent) accrued from agriculture, about one-seventh (15.00 per cent) accrued through salary plus agriculture and rest of them through business. It is interesting to note that salary is the most dominant source of income, followed by agriculture in the system.

13. In expenditure, the per capita expenditure is increasing along with increase in income from the lowest income group to the highest income group, pertaining to food, education, cloths, health, transport, telephone, petrol/diesel, electricity, water and so on. However, the middle income group has more health conscious, and spending more money than the other groups in this regard.

14. Savings is one of the most important parameters, which decide the functions of the economic growth in our country. Savings is a common phenomenon in Southern India and most of the people save good amount of money for future requirements. It has been observed that one-fourth of surveyed households save more than 50.00 per cent of their income, followed by just above one-seventh (14.00 per cent) save 40-50 per cent of their income and one-fifth of the population save 20-30 per cent and 30-40 per cent of their monthly income respectively. Further, rest of the households save considerable amount of money, which shows that the people in the study area contribute more in capital formation through savings, which in turn lead the country's steady economic growth.

15. More than four-fifth (82.00 per cent) of the surveyed households are living in their residences and rest of them living in the rented houses. Of the rented houses, about two-third (66.66 per cent) of the households confined among the monthly income group of Rs.20, 000-30,000, which is confined among the middle income group category, the rest of them are scattered over almost all income groups.

16. All the respondents of the survey are living either in good houses or in livable condition of houses. Majority of the houses (75.00 per cent) are observed as good conditions and the rest are in the livable conditions.

17. In transport infrastructure, more than half of respondents (56.00 per cent) observed as facilities not available, while rest of them observed as these facilities are available. The facilities observed as not available are belonging to middle income group and the low income group categories.

18. In water supply system, about two-third (63.00 per cent) of them are having public water supply system and rest (37.00 per cent) are having either public or own source of supply system.

19. The water supply system is observed as very good in the city. Majority of the households (86.00 per cent) observed as water supply is available from 5-12 hours, and the rest of them observed as 2-5 hours per day. It shows that water supply system is good in the system.

20. More than half (53.00 per cent) of the respondents never use any water related equipments, whereas, one-third of households use Aqua guard, and rest of them use filter in their houses. It shows that the Government supplies good quality water and the people are also quite aware about using water related equipments in their houses.

21. Electricity supply is also good in the city. It has been observed that about one-fifth (19.00 per cent) of them observed as there are voltage fluctuation in the system.

22. In surface drainage, half of the people opined that there are overflows in the drains during the monsoon season. Therefore, it needs adequate attention, otherwise there will be problem pertain to deterioration of physical and environmental subsystem of the system.

23. In waste management, about two-fifth (59.00 per cent) are having storage container and the rest (41.00 per cent) are using dust bin / PVC bags, in the system.

24. Waste collection is also not up to the mark in the municipal area, and it has been observed that about half (49.00 per cent) of them opined that every day they collect the waste, whereas more than two-fifth (43.00 per cent) opined that they collect the waste

once in a week, and rest of them opined that they collect waste in an alternate day. It shows that the waste management system is not much healthier in this city.

25. In environment, quality of water is good, more than three-fourth of the people (76.00 per cent) observed that Government supplies good quality of water and rest of them opined as very good, and moderate, and none of them opined that quality is bad, it shows that the Government supplies good quality of water.

26. Majority of the households, which are having agriculture operation are confined among the lower income groups.

27. In agriculture operation, the total area under cultivation is observed as 132 acres among the surveyed households. Of this, majority of the households (84.09 per cent) cultivating paddy and rest of them (15.91 per cent) cultivate sugarcane crop in their farm. This shows that Paddy is the dominant crop, and followed by sugarcane in the study area.

28. In area under irrigation, It has been observed that about one-fifth (24.00 per cent) of surveyed households are having land holding size of 1-3 acres, about one-tenth (9.00 per cent) have 3-5 acres, and rest of them are less than one-tenth (4.00 and 3.00 per cent) are having 5-10 acres and 10-15 acres in the system, respectively.

29. In paddy cultivation, application of fertilizers (NPK) are decreasing along with increase in income in the study area, which shows that the lowest income group with less land holding size, use more quantity of input in the system. Whereas in the cultivation of sugarcane crop, the trend is reversed. It has been observed that the application of NPK is increasing along with increase in income. This observation is true that the middle income group used to cultivate cash crops, which needs huge amount of money for cultivation, compared to cereal crop, which the middle income people can afford it.

30. It has been further observed that in paddy crop, output is almost same among all income groups, i.e., 678 kg to 682 kg per acre. It shows that the variation in output is much negligible. Similar observation is also observed in sugarcane cultivation.

31. In rural transportation system, it has been observed that the tractor and bullock cart are major modes of transportation for agriculture activities in the system.

32. It has been observed that about two-third (62.50 per cent) of the households use tractor for transporting their agro products, whereas one-fifth (20.00 per cent) of them use bullock cart, for the said purpose.

7.4 CONCLUSION

The investigator observed the above findings based on the primary analysis and exploration of literatures. The inferences of the same will be incorporated to evolve plausible policy guide lines for the integrated development of the system (Puducherry Region).

Chapter-08

RECOMMENDATIONS AND CONCLUSION

In fact, in almost all Indian cities, the existing eco-system has been fading away from the system due to the contemporary process of urbanization. In this study area, though the process of urbanization took place in a moderate form, the features of the region were not spoiled much, but few setbacks were observed in this system, such as, (1) most of the water bodies are connected with either drainage canal, or used them as waste dumping yard or used as slum area, etc., (2) wetland area (Paddy crops area) were converted into residential areas, (3) drinking water and sanitation problems were aggravated, (4) dilapidated housing conditions are observed, (5) through traffic is halted and traffic jams are observed in few important junctions, (6) power supply related problems are aggravated, (7) more in-migration in the system, etc.

At this juncture, it is an inevitable requirement to safeguard the interest of the system. Keeping the requirement in mind, a set of plausible recommendations are made based on the investigation and analysis, i.e., survey findings, having discussion with experts, and other administrators, to develop the system at the grassroots level.

8.1 RECOMMENDATIONS

The following recommendations are evolved based on the surveys, discussion with experts and the policies of the Government. They are:

1. Convert the present Puducherry Planning Authority in to a Puducherry Regional Planning and Development Authority by adding the neighboring urban agglomerations, towns and Commune Panchayats along with Puducherry Municipal limits since the total area is just 293 Sq. Km.

2. Heritage is an integral part of the urban fabric of Puducherry, and the heritage site may be preserved. Specific building byelaws by considering conservation have to be evolved

and implemented by considering the historical importance, heritage and future development options of the city.

3. Commercial activities from core area should be relocated to the well planed areas to reduce congestion.

4. Mixed traffic and heavy vehicles should be banned in the core area of the study area to avoid traffic congestion.

5. Use of self-finance methods, such as, Transferable Development Rights (TDR), Additional Floor Space Index (FSI), Acquisition and Reservation (A & R), etc., should be used only to decongest the core area where land value is very high.

6. Plausible slum improvement and rehabilitation programs should be evolved and implemented on priority basis to improve the housing conditions.

7. It is an inevitable requirement for strong legislative measures to regularise the unauthorised development with requisite provisions of amenities and infrastructure services with imposition of fine and measures should be taken to control the same in future.

8. Housing scheme should be implemented for slum dwellers, economically weaker section, and low-income group peoples, etc., on priority basis.

9. Measures should be taken for the functioning of present Domestic Airport with wide range of flight operation for 24 hours. Development of Airport should be done on priority basis to enhance national level and international level connectivity.

10. Dedicated rail line should be provided for Puducherry –Chennai train service to improve the physical connectivity between Puducherry –Chennai Metropolitan city, for achieving better mobility of people and freight in the study area.

11. Measures should be adopted for the protection and conservation of natural water bodies, historical sites, architectural sites, etc., in the study area.

12. The study area is blessed with high rainfall, and the water supply requirement of this entire region is met through ground water source. Even though, the study area has Ground Water Regulation Act and set up for monitoring the extraction and use of ground water, there is a need of Hydrological Data Center for maintaining and or analyzing the water resources data, which in turn help to assess the potential source for future requirement.

13. An effective water management strategy is essential to overcome the limitations posed by increased salinity of ground water near the coast line and fast depleting ground water resource. The replacement of worn-out machinery in the pumping stations and check on unaccounted water is also essential to improve the production efficiency and per capita availability of water.

14. There is an urgent need for improvement in the sanitation network coverage of the city as it poses the serious threat to the environment and marine ecosystem near the coast line. Further, it is essential to take necessary steps for recycling of waste water.

15. Most of the solid waste in Puducherry region is dumped unscientifically, in the open ground. Further, there is irregular collection is observed at the household level. It is suggested that private participation should be encouraged at all stages of solid waste management, i.e., for collection, storage, transportation, and finally recycling and dumping of waste.

16. Suitable Landfill site must be identified in the study area, for the scientific disposal of solid waste on land without creating nuisance or hazards to public health or safety and the same should be engineered construction.

17. Burning of solid waste in an open dumping ground at Karuvadikuppam near oxidation pond should be avoided. The present solid waste open dumping place should be shifted in the appropriate site, since it is not only located within four to five Kilometers distance from the core area of the city, but also hindering the Airport development activities, deteriorating the city's environment, and paving the ways for spreading diseases.

18. Puducherry region lacks in effective drainage system, most of the existing drains need repairs and there is an urgent need to increase the network coverage for effective drainage of the city. The drainage system of the city should be integrated with existing surface water bodies in order to harness the rain water.

19. The French Government had constructed an optimal drainage system, by employing appropriate technology and techniques to safe guard the interest of the core city area (within boulevard town) during its regime and it had been functioning well up to the Government of Puducherry initiated beach beautification project in the city. During the course of construction of this project, the city administration sealed the drainage outlets, which were existing in the sea front. During the monsoon season, whatever, accumulated dirt, filth, garbage, etc., were washed away by the rain water, and thereby the city used to become clean naturally. It has been observed that the beach beautification project sealed the drainage outlet, as a result, water accumulated and stagnated in the city, during the monsoon season, which mingle with the unattended waste in the system, decompose, and totally spoil the city's environment. It is recommended to open these drainage outlets, which were functioning well earlier by employing appropriate technology to safeguard the interest of the city.

20. To improve the traffic and transportation condition in Puducherry city it is necessary to decongest the city core area. Public transportation should be encouraged through introduction of rapid transit system in the city.

21. The knowledge based sunrise industry (Information Technology Park) growing stronger with time. A large pool of Information Technology professionals and state-of-the-art communications facilities available at Puducherry region. Most comprehensive and futuristic Information Technology policy and incentives for the development of the Information Technology industry in the system. Information Technology industry should be treated as an integrated part of the study area while developing policies, plans, etc.

22. Recreational and leisure activities should be developed to ease out mental stress of employees working in Information Technology industry on 24x7 working pattern.

23. Steps should be taken to encourage the interaction among industry, educational institutions, Research and Development institutions, etc., to have feedback mechanism for mutual growth of Information Technology industries and the system as a whole.

24. Creation of Special Economic Zone in the Puducherry region and it will have more effect pertaining to the socio economic growth and development of the system.

25. Textiles are the traditional business of Puducherry, and specialized skilled manpower is also available in this regard. Fabric produced is of the highest quality with promising demand in the overseas market, till today.

26. Skilled craftsman engaged in manufacturing world class leather products, and good amount of leather products are exports from this region.

27. There is a good scope for establishing ancillary units of automobile industry, which can produce auto components, with the coming up of auto giants like Ford and Hyundai in the neighboring State.

28. The Puducherry region has good amount of marine catch amounting to 40,000 tonnes a year. It has been observed that huge quantities of marine food products are untapped, and infrastructure related to this particular product is also not available in this region. There is an ample scope for strengthening this industry in the region.

29. Agro Food processing, floriculture ventures like cut flowers and for cultivating medicinal and aromatic plants have huge amount of potential in this region. Feasibility studies have to be undertaken to strengthening this industry and the unemployed youths may be given adequate training and employ them in the same, which in turn, not only strengthen the agro industry, but also considerably reduce the unemployment problems in the region.

30. To achieve a balanced development in the system, the compact city and high-rise development concept would be encouraged in urban fringes through amendment of existing Building Bye-Laws and Zoning regulations pertaining to the region.

31. Increasing phase of in migration for search of better education and employment opportunities has been observed and hence there should be some check measures for in migration, which would be helpful to understand the population function in the study area.

32. Promoting integrated townships in the suburbs for decongesting the accumulated population in the urban core, this in turn helps to achieve a balanced development in the study area.

33. Ousteri (or Oussudu) Lake is the largest one in Puducherry among all the water bodies, and it is spread around 800 acres of land and is located approximately 6 km West of the town. It can be retrieved from all kinds of pollution, and can be used as water base tourism by maintaining its ecological balance in the system.

34. To achieve a balanced ecosystem, feasible development plan pertaining to ecology and environment of the study area shall be evolved and implemented by considering the existing features in the system along with total development of the system.

35. The study area is blessed with huge amount of potentiality for the development of tourism, in the coastal area of the region. It is an inevitable requirement to evolve a feasible development plan pertaining to tourism development and shall be implemented in the system.

36. There is no major power generation plant in the Union Territory of Puducherry, except a 32.5 MW combined cycle gas power plant in Karaikal owned by the Puducherry Power Corporation Limited. The entire power requirement of Puducherry is met from the power allocated from the Central Generating Stations, Tamil Nadu Electricity Board, and Kerala State Electricity Board and from the Puducherry Power Corporation Limited. Captive power generation in the study area, with surplus charges to improve power supply situation to cater needs of future development. There is an urgent need to curtail the growing inefficiencies in power sector or else the inadequacy of power would turn into a major constraint for economic development of this region.

37. There is an inevitable requirement for strong institutional mechanism for integrated development of the region. The Town and Country Planning Department has to initiate serious measures for evolving realistic regional development plan to achieve integrated development of the system.

38. Puducherry is having close proximity to several ports like Chennai, Nagapattinam, Tuticorin, Kakinada, Vishakapatnam and Cochin. Necessary steps should be taken to modernize the existing Puducherry port with container handling facilities and storing infrastructure.

39. The Investigator made an attempt for location analysis of various existing nodal points in the study area and growth poles has been proposed (presented in Figure Nos. 8.01 to 8.07 respectively), which are to be strengthen with respect to all kinds of infrastructure facilities, since the geographical area of Puducherry Region is very less, (i.e., 293 Sq.Km) to achieve integrated development in the system.

8.2 CONCLUSION

The prime objective of a realistic urban development plan is achieving integrated development in a particular system, for which the plan is evolved. This requires plausible policy guidelines and feasible plan for which thorough grassroots level investigation is essential. The available literature in the field of urban development reveals that several studies were attempted to develop plan at sectoral level, but not at integrated level, without understanding the interactions and interrelationships amongst various components of the urban system.

In this present investigation, an attempt was made to evolve plausible policy recommendations for the integrated development in a system (Puducherry Region) by considering the most important control parameters, which decides the functions of the system. It is observed that although steps are being taken by the Government for the development of the same in the system, lack of comprehensive plan and integrated approach becomes a deterrent in the development process. Therefore, the investigator conducted primary household survey at the grassroots level and exploration of available literature, to understand the physical, socio-economic and environmental conditions, level of infrastructure facilities, which influence the total development of the system. An attempt has been made to develop conceptualized urban system model by considering various subsystems and their controlling parameters obtained from the analysis to evolve plausible policy recommendations for integrated development of the study area.

Further, System theory and Polarized Regional concept have been employed in this investigation. Projections are done for the year 2031 A.D by employing suitable statistical techniques for forecasting the demand and supply of infrastructure in the system. Finally, a set of plausible policy recommendations are evolved for achieving integrated development of the system. The study concludes that if the recommended policies are considered and optimal, feasible, and viable schemes are developed based on the recommended policies and implemented in time, with statutory backing integrated development will be achieved in the system, along with steady socio-economic development, definitely.

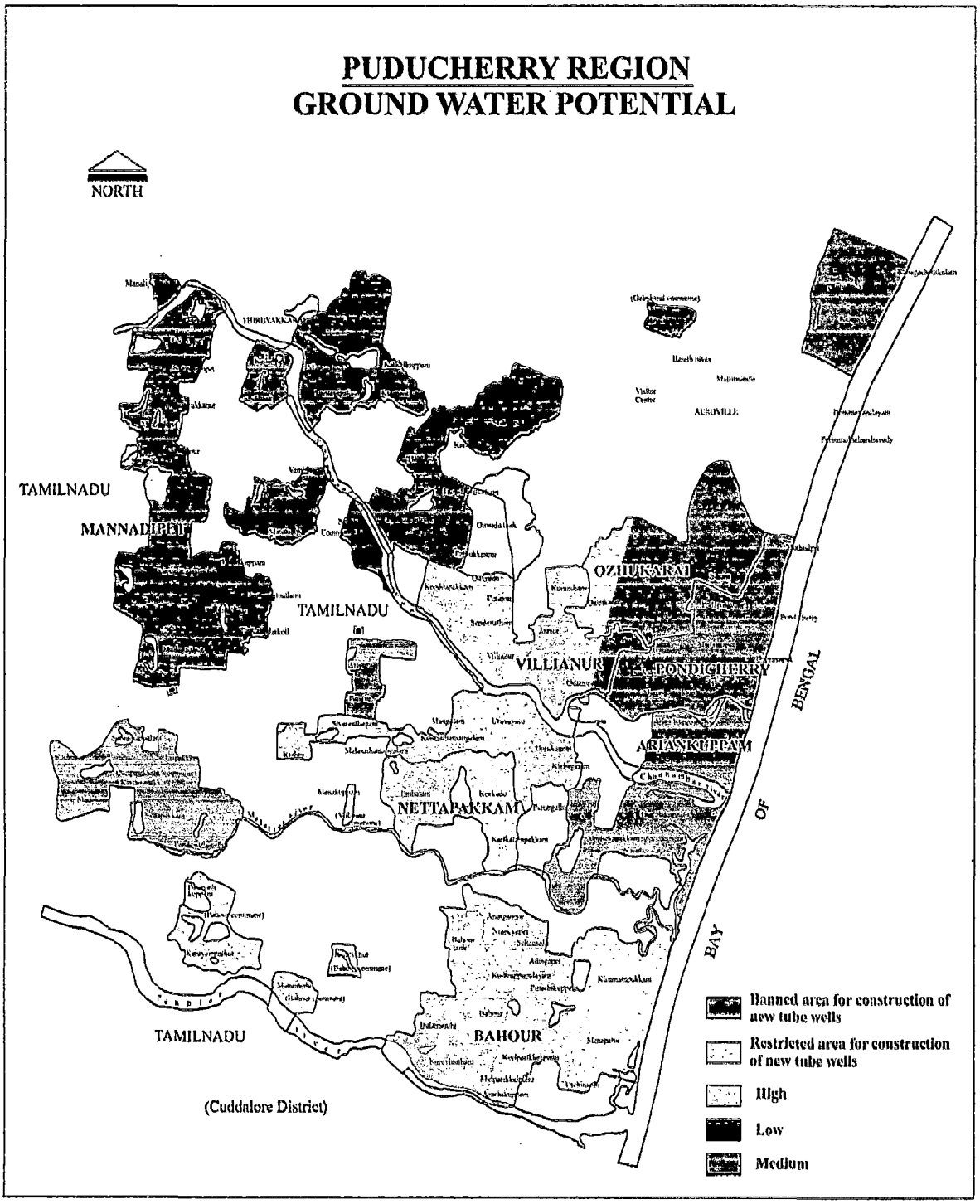


Figure no. 8.01: Ground water potential of Puducherry Region

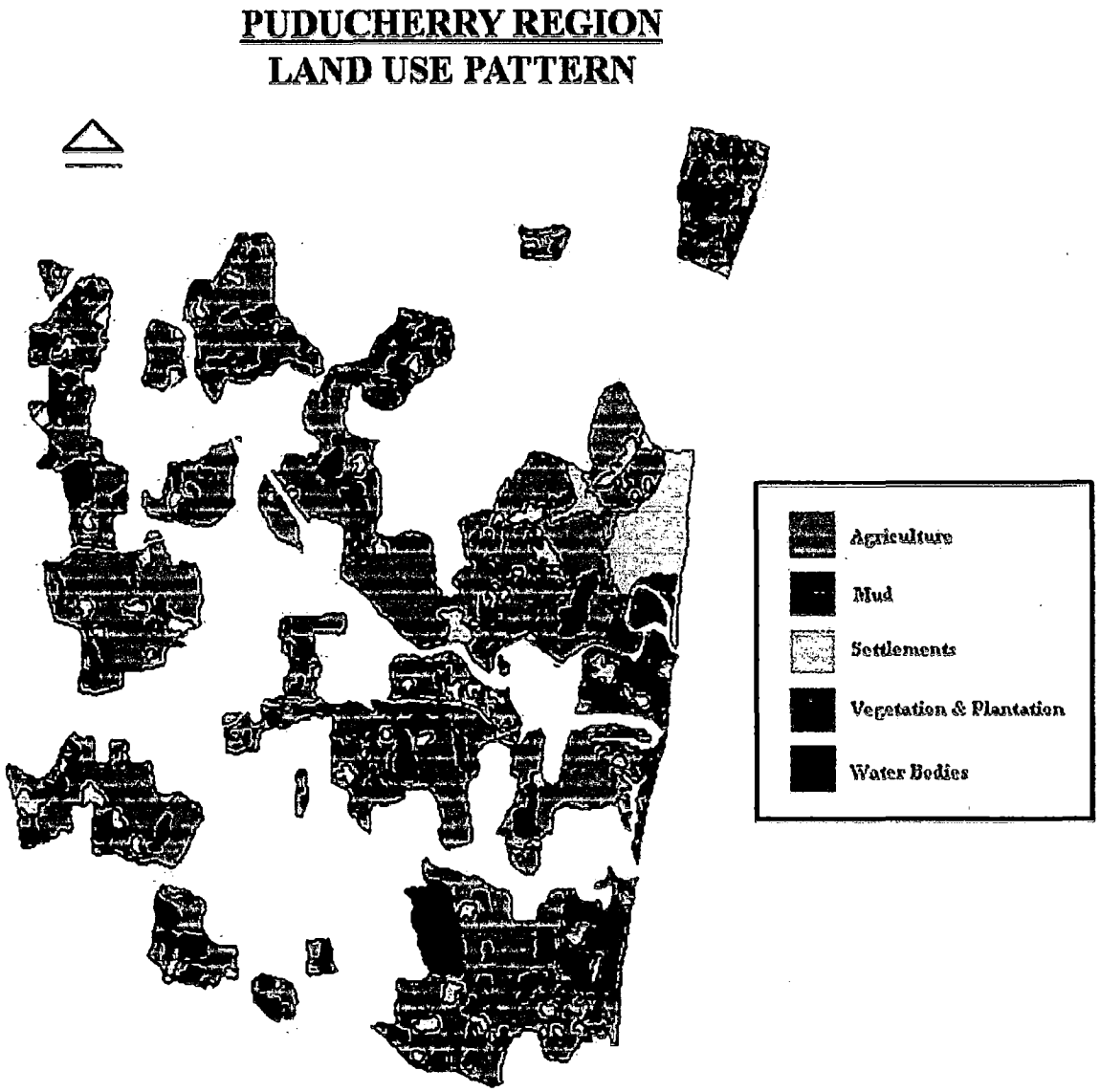


Figure no.8.02: Land use Pattern of Puducherry Region

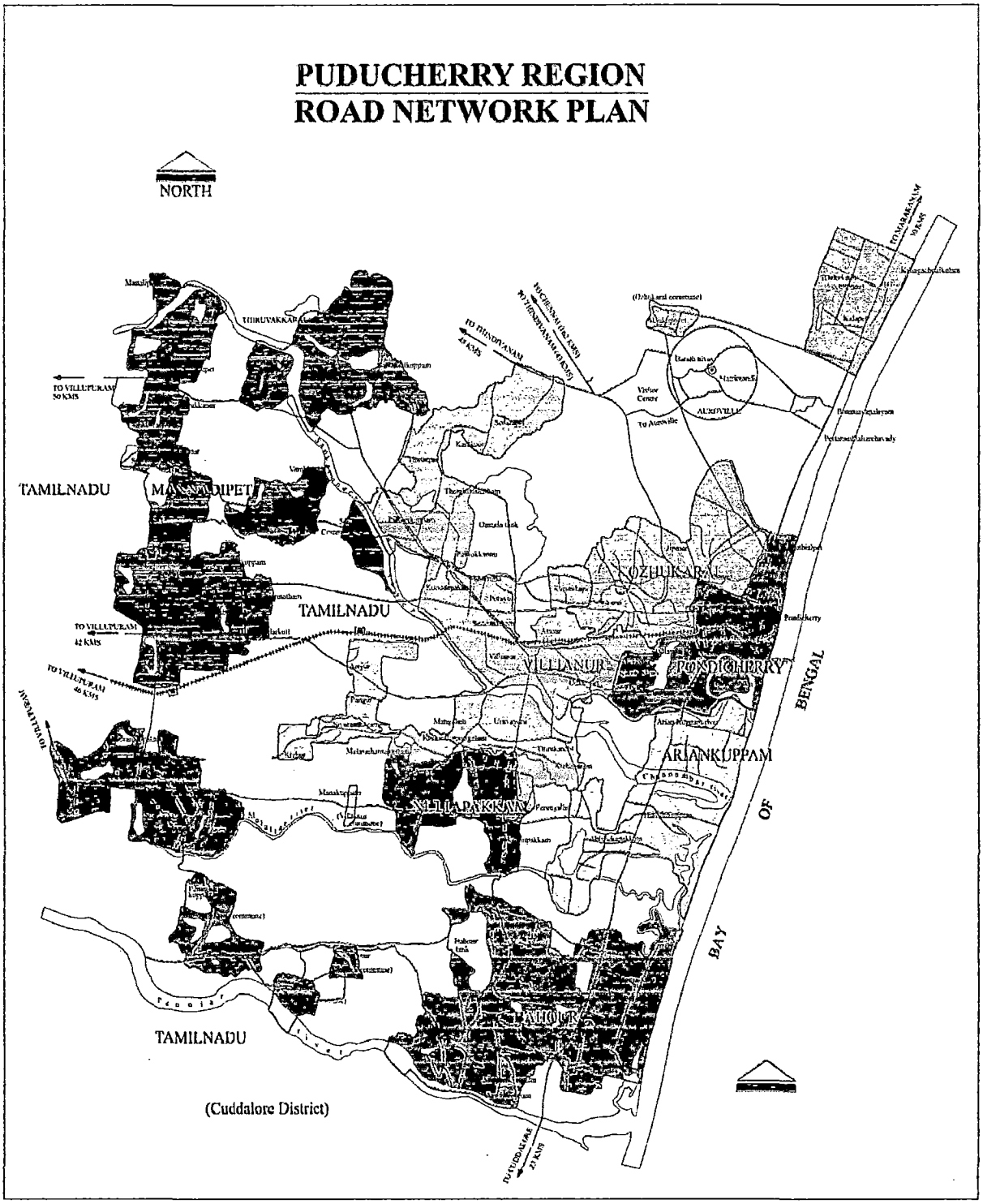


Figure no.8.03: Road Network Plan of Puducherry Region

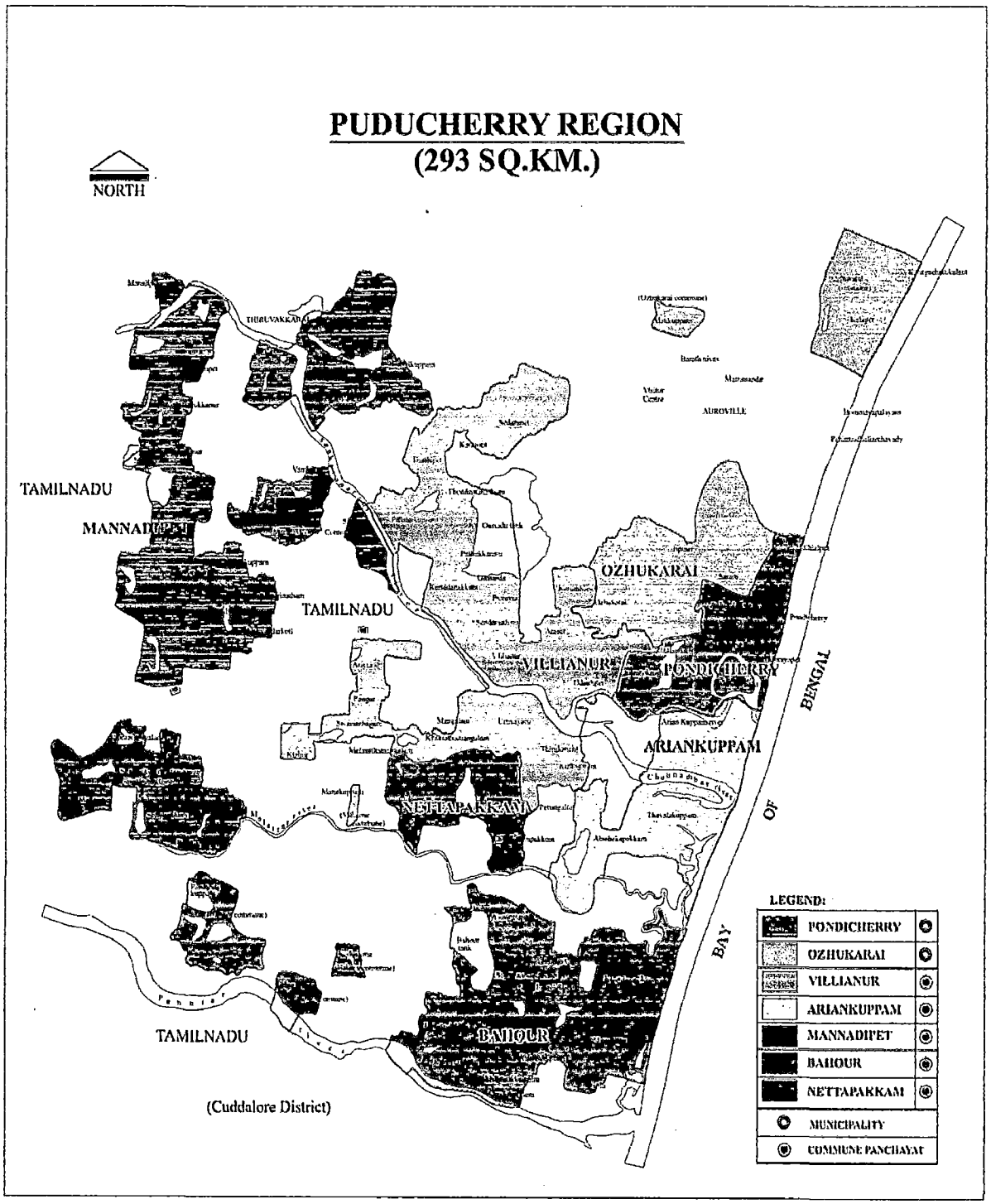


Figure no. 8.04: Administrative boundaries of Local Self Government in Puducherry Region

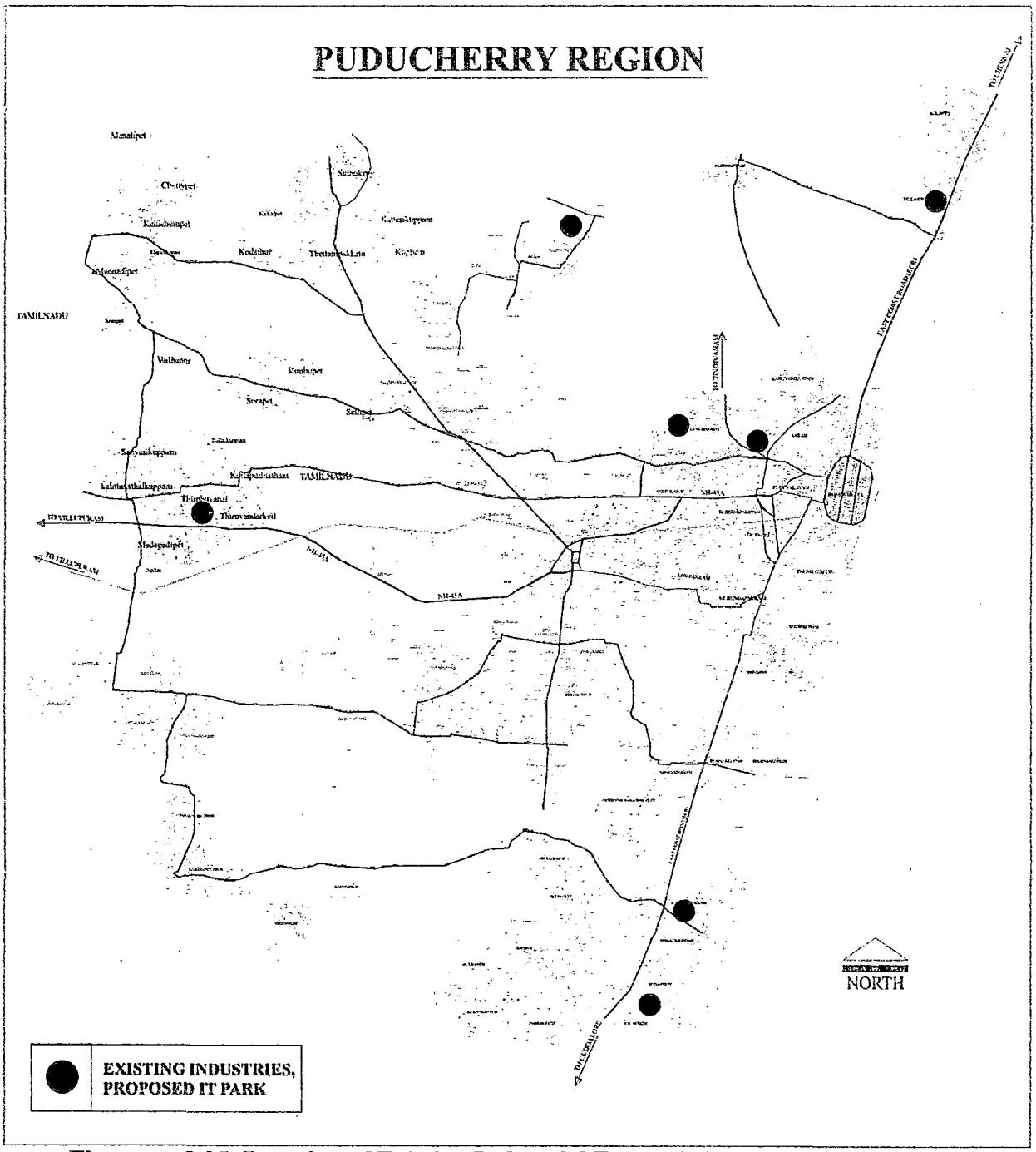


Figure no.8.05: Location of Existing Industrial Estates in Puducherry Region

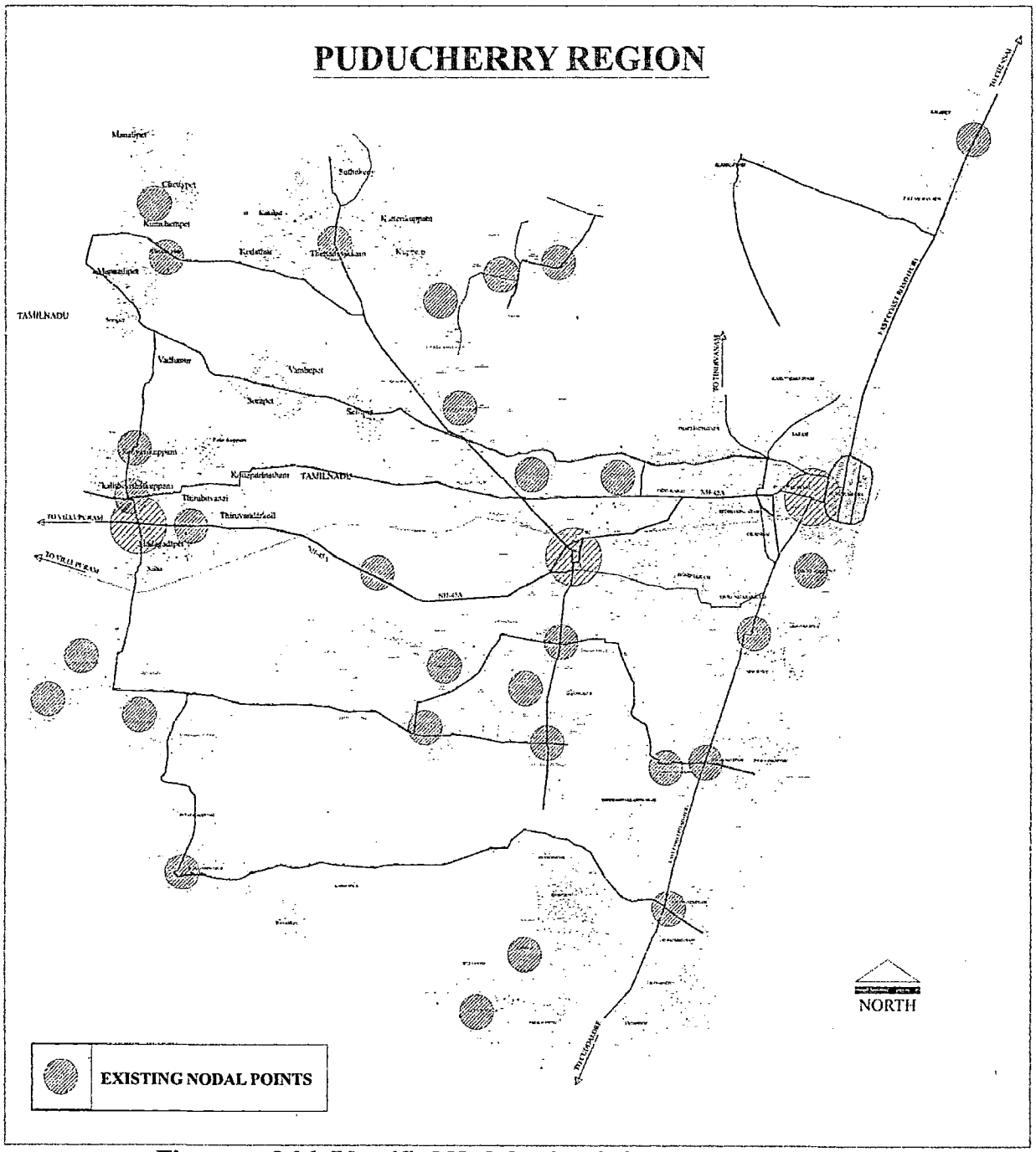


Figure no.8.06: Identified Nodal points in Puducherry Region

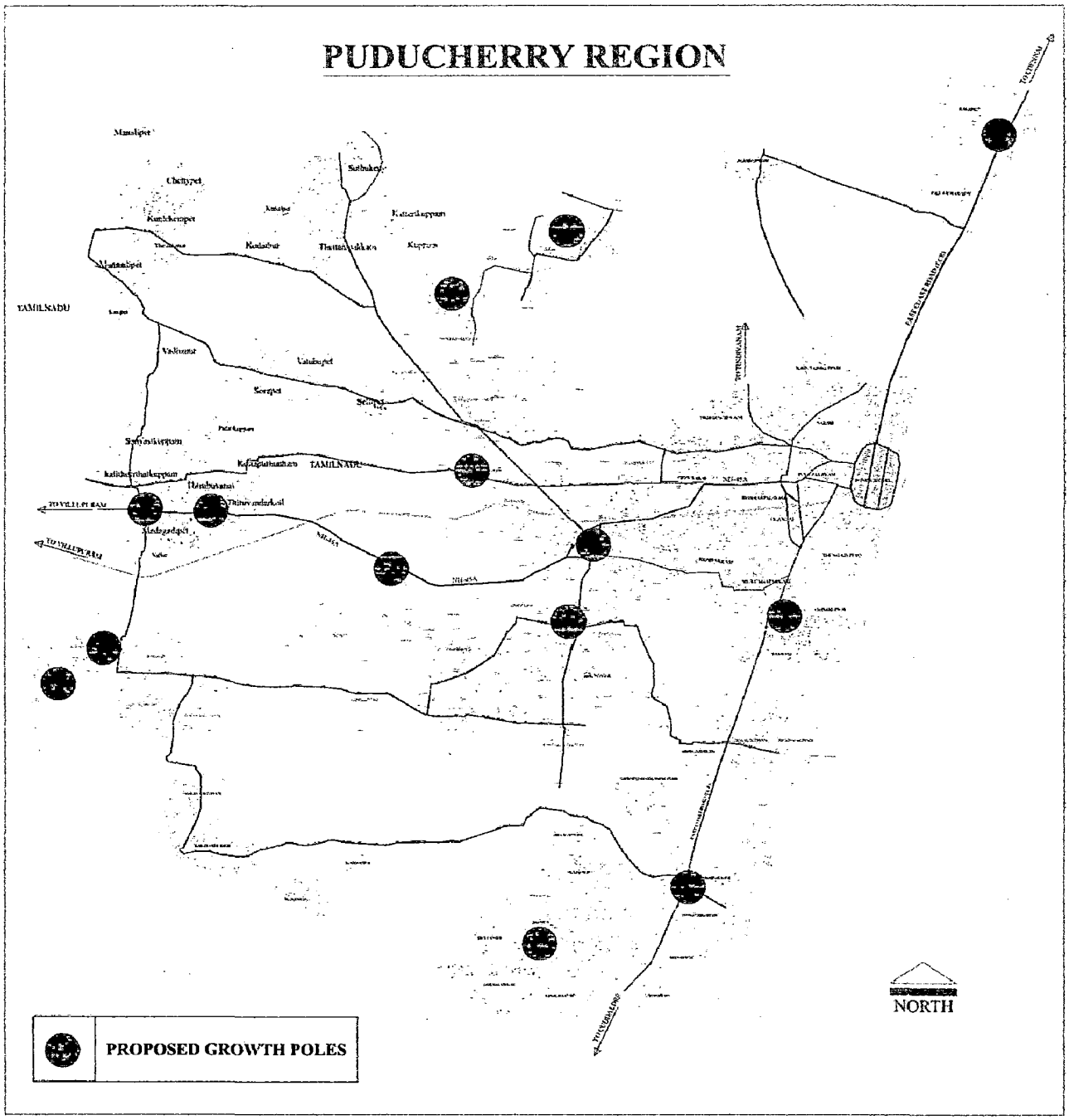


Figure no.8.07: Proposed Growth Poles in Puducherry Region

BIBLIOGRAPHY

1. Arvind K. Jha, C, et.al (2008), Greenhouse gas emissions from municipal solid waste management in Indian mega-cities: A case study of Chennai landfill sites, Chemosphere 71, 750–758.
2. Brian Dyson, Ni-Bin Chang (2004), "Forecasting municipal solid waste generation in a fast-growing urban region with system dynamics modeling" Elsevier publishers.
3. Census of India, (2001), " Provisional Population Totals of Puducherry "
4. Census of India, (2001), "Summary, Housing Tables of 2001 Census Puducherry.
5. Central Public Health and Environmental Engineering Organization (CPHEEO), SWM Manual, (2000).
6. CHARLES L. CHOGUILL (1996), "Ten Steps to Sustainable Infrastructure" Pergamon publishers.
7. Confederation of Indian Industry, 2008, Puducherry Vision 2025, report published by the Sriram Charitable Educational Trust.
8. CPCB, Management of municipal solid waste, Delhi: Central Pollution Control Board; 2000.
9. CPCB, Publication. Manual for municipal solid waste, Delhi: Central Pollution Control Board, 2003.
10. Devadas. V, Nand Kumar, (2007), Integrated Urban Development Plan: A scientific approach, Journal of Indian Building Congress, New Delhi, India, Vol-14, pp 35-42.
11. Devadas.V, (1997), Technologies for Recycling Urban Wastes, Proceedings of the International Conference on Planning for 21st Century (Concepts and Systems), University of Roorkee, Volume-II, pp 325-331.
12. Devadas.V, (1997), Waste Resources Assessment in Thiruvananthapuram city, Proceedings of the International Conference on Planning for 21st Century (Concepts and Systems), University of Roorkee, Volume-II, pp 125-133.
13. Devadas.V, R. Adinarayanane @ Sadish Kumar, (2010), Strategies for Infrastructure Provision in Puducherry City, Proceedings of Conference on Inclusive Planning for

Empowering the Urban Poor, National Town and Country Planners Congress, Nagpur, India, pp 371-378.

14. Directorate Economics & Statistics Department, (2009) Puducherry at a glance, 2009.
15. Dr. Kopardekar H. D and Diwan G.R, (1974), "Urban and Regional Planning.
16. Forrester. J. (1993), "Critical Theory, Public Policy and Planning Practice.
17. George Chadwick (1971), "A Systems View Planning", published by Pergamon Press, New York.
18. Government of India, (2006), HUDCO, Indian Best Practices on Sustainable Development and Living Environment.
19. Government of Puducherry (2008), Directorate of Economics and Statistics, Puducherry at a glance statistical report.
20. Government of Puducherry, (2003-04), Department of Fisheries and Human welfare, Annual Administration Report.
21. Government of Puducherry, (2006), Local Administration Secretariat, the Gazette of Pondicherry- population wards wise.
22. Government of Puducherry, (2007), Town and Country Planning Department, City development plan report.
23. Government of Puducherry, (2007-08), Department of Agriculture, Season and Crop report.
24. Government of Puducherry, (2008), Industries Department, List of industries and performance report.
25. Government of Puducherry, (2008-09), Planning and Research Department, Annual Plan Report.
26. Government of Puducherry,(2008-09), DistrictIndustriesCentre,Schemes/Programmes.
27. Haiqing Li (2003), "Management of coastal mega-cities—a new challenge in the 21st century", by Pergamon.
28. Hilda Blanco, Marina Alberti, (2009),"Hot, congested, crowded and diverse: Emerging research agendas in planning" by Elsevier.
29. Hina Zia, Devadas .V, (2008), Urban Solid Waste Management in Kanpur, India: Opportunities and perspectives, Habitat International 32, 58–73.

30. J.Brian McLoughlin (1969), "Urban and Regional Planning, A Systems Approach", published by Faber and Faber, London.
31. Jan Rotmans, Marjolein van Asselt, Pier Vellinga (2000) "An integrated planning tool for sustainable cities", Elsevier publishers.
32. John Glasson, (1974), "An introduction to Regional Planning" Concepts, Theories and Practice, by Hutchinson and Co (Publishers) Limited.
33. John Pucher,(2005), Nisha Korattyswaropam, Neha Mittal, Neenu Ittyerah "Urban transport crisis in India" by Elsevier.
34. John Ratcliffe, (1974), "An Introduction to Town and Country Planning" by Hutchinson of London.
35. Khalid Nasralden Mandeli (2008), "The realities of integrating physical planning and local management into urban development: A case study of Jeddah, Saudi Arabia" by Elsevier
36. KULWANT SINGH and FLORIAN STEINBERG (1996), "Integrated Urban Infrastructure Development in Asia" Pergamon publishers.
37. Lewis Keeble, (1969), "Principles and Practice of Town and Country Planning" by the Estate Gazette Limited, London.
38. Loo Lee Sim, Lai Choo Malone-Lee, Kein Hoong Lawrence Chin(2000), "Integrating land use and transport planning to reduce work-related travel: a case study of Tampines Regional Centre in Singapore" Pergamon publishers.
39. Mahesh Chand and Vinay Kumar Puri,(1983), " Regional Planning in India" by Allied Publishers Private Limited.
40. Marie-He´le`ne Ze´rah (1998), "How to assess the quality dimension of urban infrastructure: the case of water supply in Delhi" Pergamon publishers.
41. Marike C. Bontenbal (2009), "Strengthening urban governance in the South through city-to-city cooperation: Towards an analytical framework" Elsevier publishers.
42. Michael Majale (2008), "Employment creation through participatory urban planning and slum upgrading", Elsevier publishers.
43. Mufeed Sharholy, et. al, (2007), Municipal solid waste characteristics and management in Allahabad, India, Waste Management 27, 490–496.

44. Mufeed Sharholy, et. al., (2008), Municipal solid waste management in Indian cities – A review, Waste Management 28, 459–467.
45. NEERI Report (2005), Assessment of status of municipal solid waste management in metro cities, state capitals, class I cities and class II towns, 2005.
46. P.K. Srivastava , et. al, (2005), Stakeholder-based SWOT analysis for successful municipal solid waste management in Lucknow, India, Waste Management 25, 531–537.
47. Piergiorgio BELLAGAMBA (2000),"PLANECO- planning in ecological networks" Ascoli Piceno,ITALY.
48. Pondicherry Pollution Control Committee, (2005), State of Environmental Report, 2005.
49. Pratap KJ Mohapatra, Purnendu Mandal and Madhab C Bora, (1994), "Introduction to System Dynamics Modelling", published by University (I) Limited.
50. R Ramanathan ,(2000), "Link between population and number of vehicles-Evidence from Indian cities" by Pergamon.
51. Report of Tata Energy Research Institute (TERI), 1998.
52. Report of United Nations, 1995.
53. Report on Organization for Economic Co-operation and Development (OECD) countries1995.
54. Rosemary D.F. Bromley a, David L. Matthews b and Colin J. Thomas, (2007), "City centre accessibility for wheelchair users: The consumer perspective and the planning implications", by Elsevier.
55. S.P. Guptha, (1969), "Statistical Methods", published by Sultan Chand & Sons.
56. Salim. A.,(2004)," Planning for Integrated Development of Thiruvananthapuram City, India", Doctoral Thesis, Indian Institute of Technology, Roorkee, India.
57. Sarika Rathi, (2006), Alternative approaches for better municipal solid waste management in Mumbai, India, Waste Management 26, 1192–1200.
58. Sonar Sanjaykumar Ghanashyam, (2006), " Planning for Integrated Development of the Information Technology City-Pune, India, Doctoral Thesis, Indian Institute of Technology, Roorkee, India.

59. Subhasish Chattopadhyay, Amit Dutta, Subhabrata Ray, (2009), Municipal solid waste management in Kolkata, India – A review, Waste Management 29, 1449–1458.
60. Sumeeta Srinivasan , Peter Rogers,(2005), "Travel behavior of low-income residents: studying two contrasting locations in the city of Chennai, India" by Elsevier.
61. Sunil Kumar, et. al, (2009), Assessment of the status of municipal solid waste management in metro cities, state capitals, class I cities, and class II towns in India: An insight Waste Management 29, 883–895.
62. Susanna Myllyl¨, Kristiina Kuvajab "Societal premises for sustainable development in large southern cities" by Elsevier.
63. Swati Pattnaik, M., Vikram Reddy, (2009), Assessment of Municipal Solid Waste management in Puducherry (Pondicherry), India, Resources, Conservation and Recycling xxx(2009) xxx–xxx.
64. The World Bank report, 2006.
65. UN-HABITAT, (2008-09), State of the world's cities -Harmonious cities.
66. UN-Habitat, World Urban Forum,(2004), "Dialogue on the urban poor: improving the lives of slum-dwellers."
67. Unpublished report, (2008) Puducherry Municipality and Oulgaret Municipality Puducherry, Vikash Talyan, et. al, (2008), State of municipal solid waste management in Delhi, the capital of India, Waste Management 28, 1276–1287.
68. Unpublished report, (2009),Town and Country Planning Department, Puducherry,
69. Ve´ronique Dupont (2006), "Conflicting stakes and governance in the peripheries of large Indian metropolises – An introduction" by Elsevier
70. W.J. Forester, (1969), Urban Dynamics, MIT press USA.
71. World Bank report, 1997b.
72. World Development report (2009)" Spatial Disparities and Development Policy"

APPENDIX

Schedule

1.Demographic Characteristics :

1.1. Name of the Family head :..... 1.2. Religion :.....
1.3. Address : ..... 1.4. Caste :.....
1.5. Family Details :

S. No.	Name of the person	Relation with family head	Age in years	Married Y/ N	Maximum education attained	Monthly income	Primary occupation	Secondary occupation
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
11.								
12.								
13								
14.								
15.								

1.6 Sources of Income:

1.7 Monthly Expenditure (in Rs./month):

a. Food
b. Education
c. Recreation
d. Drinking
e. Transportation
f. Loan repayment
f. Cloths
h. Health
i. Any other
j. Telephone
k. Saving

Energy:

a. LPG
b. Petrol
c. Diesel
d. Electricity
e. Kerosene
f. Charcoal
g. Fuel wood

1.8 Household Appliances:

Refrigerator....., T.V....., A.C....., Stove....., Mixer/ Grinder....., Computer....., Washing Machine....., pressure cooker....., cooler....., geyser....., microwave....., solar cooker....., tape recorder/ DVD player....., any other.....

2. Physical characteristics:

2.1 Housing:

- Type of house: Detached/ Semi Detached/ Apartment/ Row/ Flat
- Age of the House (in yrs).....
- Physical condition: Good/ Liveable/ Dilapidated
- Ownership: Rented/ Owned/ Other.....
- No. of rooms..... No. of Floors.....
- Finance: Bank/ Self/ Ancestral/ Any Other

3. Physical Infrastructure:

3.1 Transportation:

- Condition of the Road: Kutcha/ Pucca
- Maintenance of the road: Good/ Bad/ Worse/ Not Any
- Vehicles owned (No.): Cycle.....; 2-wheeler....., 4-wheeler....., Any Other.....
- Movement Chart:

Activity	Mode of transportation (public/ private)	Distance in Km.	Frequency in a week
Shopping			
Recreation			
Work			
School/ College			
Railway Station			
Public Transport			

3.2 Water Supply:

- Supply System: Public supply system/ Own Source/ both.
- Time of Supply (in hrs):.....
- Use of equipments: Filter/ Zeero B/ Aqua guard.

3.3 Electricity:

- Available/ Unavailable — Metered/ Non-Metered
- Overhead Poles/ Under Ground Cables — Voltage Fluctuations
- Tariff: Monthly/ Flat Rate.....

3.4 Drainage/ Sewerage:

- Availability of: Septic Tank/ Soak Pit/ Sewer/ No Facility.
- Drains: Open/ Covered/ No Drains.
- Problems: Overflow/ Clogging/ Bad Odour/ No Problem
- Over Flow of Drains during rainy seasons (Yes/ No)

3.5 Waste Disposal:

- Method of collection at house:

a.) Storage container b.) Dustbin/ PVC bag c.) throwing out

- Frequency of collection from the area:

a.) Everyday b.) Alternate days c.) 3 days d.) 4 days e.) weekly

- Agency for collection:

a.) Nagar Nigam b.) Private agency c.) NGO

4. Environmental characteristics:

Water Quality : Very Good/ Good/ Moderate/ Poor
Air Quality : Very Good/ Good/ Moderate/ Poor
Land Quality : Very Good/ Good/ Moderate/ Poor
Noise Pollution : Very High/ High/ Moderate/ Low
Quality of Living : Excellent/ Good/ Moderate/ Bad

5. Remarks:

Cropping Pattern:

Sl.no	Type of Crop	Area (in ha.)	Input***					Production item	Output	
			N	P	K	H.P.	A.P.		Major product(kg)	By-product (kg)

***N=Nitrogen, P=Phosphorus, K= Potassium, H.P=Human power, A.P=Animal power

Area under Irrigation:

Sl.no.	Area (in ha.)	Kharif Crop-I	Rabi Crop-II	Summer Crop-III

Livestock:

Sl.no.	Type	Nos	Variety	Input	Output	
					Major product	By-product
	Cow					
	Buffalo					
	Goat					
	Sheep					
	Chicken					

Biogas:

Sl.no.	Type of plant	Nos	Time of operation per day	Whether subsidy was utilized	Remarks
1.	Dome plant				
2.	Floating plant				

Labour :

Sl.no.	Agriculture	Human power		Animal power	Remarks
		male	female		
1.	Seed bed preparation				
2.	Weeding				
3.	Irrigation [watering]				
4.	Harvesting				
5.	Winnowing				
6.	Transportation				
7.	Marketing				

Rural Transportation:

Sl.no.	Type of transport	Time duration (hours per day)	Remarks
1.	Bullock cart		
2.	others		

Horticulture:

Sl.no	Types	Labour		Irrigation type	Energy			Input cost	Output cost
		Male	Female		Human power	Animal power	Electricity consumption		
1.	Mango								
2.	Jack fruit								
3.	coconut								
4	Vegetables								

Rural Industries:

Sl.no	Type	Labour		Energy input			Input cost	Output cost
		Male	Female	Human power	Animal power	Electricity		