PLANNING FOR INTEGRATED DEVELOPMENT OF THIRUVANANTHAPURAM CITY, INDIA

A THESIS

Submitted in fulfilment of the requirements for the award of the degree of

DOCTOR OF PHILOSOPHY

in

ARCHITECTURE AND PLANNING

By

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August, 2004

CANDIDATE'S DECLARATION

I, hereby, certify that the work which is being presented in the thesis entitled **"PLANNING FOR INTEGRATED DEVELOPMENT OF THIRUVANANTHAPURAM CITY- INDIA"** in fulfillment of the requirement for the award of the Degree of **Doctor of Philosophy,** and submitted in the Department of Architecture and Planning of the Indian Institute of Technology (**IIT**), Roorkee is an authentic record of my own work carried out during a period from July 2002 to August 2004 under the supervision of Dr. V. Devadas.

The matter presented in this thesis has not been submitted by me for the award of any other degree of this or any other Institute/University.

Date: 25.8.2004

Salim.A

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

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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 several interacting subsystems, such as, Institutions, land, population, infrastructure, industries, trade and commerce, agriculture, and ecology and environment and function as integral whole. All subsystems, comprising the urban system are inextricably linked since they not only are interconnected but also are interdependent on each other.

The present investigation attempt to take a close look at the micro level development in an urban system, and undertake an in-depth study in each of its various subsystems, and finally making use of the multiple, complex linkages within the system, projects the future scenarios and arrive at a set of policy directions for promoting a steady growth of the urban economy.

An extensive field survey was conducted to collect relevant data and suitable analytical and quantitative techniques were employed for quantifying the available resources, infrastructure services, and for estimating the demand and supply for infrastructure for 2031 A.D in the closed system.

A system dynamic model was developed, and employed to take in to account the functions of different subsysterns under various alternative

conditions. The most important infrastructure services, which decide the functions in the particular urban system, such as, housing, health, education, and power were considered along with population and population growth in the system. The study enables a close examination of the overall implication of several alternative policy options characterized by various combinations of the relevant control parameters. Thiruvananthapuram city, one of the industrially backward State Capitals of India, was selected for the purpose of this investigation. The study confines attention to the microstructure of the demand and supply of infrastructure services, socio-economic conditions, agro climatic factors, physical barriers, etc., that influence the evolution of plausible, integrated development plan in accordance with the needs and aspirations of the population. Finally, a set of policy guidelines and recommendations has been developed for achieving integrated development in the study area.

ACKNOWLEDGEMENT

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

I am indebted to **Prof. R. Shankar**, Head, **Prof. Najamuddin**, former head, **Prof.S.Y.Kulkarni**, PGS&R committee chairman, and all other faculty members of Department of Architecture and Planning, Dean of Student Welfare, Post Graduate Dean of Academic and Registrar and Assistant Registrar (Academic) IIT, Roorkee, for their valuable suggestions and moral support which I received throughout my stay in the institute.

I am grateful to **Prof. (Dr) S.C. Handa**, Coordinator of Quality improvement program (Q.I.P) centre, IIT Roorkee, All India Council for Technical Education (AICTE) and Ministry of Human Resources Development Government of India, for extending financial assistance in the form of Research fellowship to complete this research work.

I am grateful to **Dr R.P. Saini**, Department of AHEC, IIT, Roorkee, for his valuable criticism and suggestions during the stages of this research.

I am grateful to **Dr. Gunashekharan,** Registrar, Indian Institute of Technology, Kharagpur, for extending his timely help for arraigning the laboratory facilities for the analytical work of this thesis.

I am grateful to **Dr. Mahanthy**, Professor, and shri. Bagodia Research scholar, Department of Industrial Engineering and Management, Indian Institute of Technology Kharagpur, for extending their full support and timely help for the analytical and modeling work of this thesis.

Thanks are due to shri. **Kutty Ahmed Kutty**, Shri. **K.Mohankumar** and Shri.**M.A. Vahid**, Members of Kerala Legislative Assembly, who helped in many ways for carrying out this research.

Thanks are due to Prof. K.K. George, former Director, Technical Education, Government of kerala, Prof. S.K. Mohan, Principal, Prof. K.P. Geetha, Prof. P.S. Abraham, (Department of Architecture), Prof. K.Madhusoodhanannair (Department of Electronics and Communication), College of Engineering Thiruvananthapuram for extending their support to complete this research in time.

Thanks are due to shri. Jayakumar, Scientist, National Informatics Centre, Thiruvananthapuram, shri. Hafeesul Rehuman, Kerala State Electricity Board, Thiruvananthapuram, shri.Lukman, Kerala Water Authority, Thiruvananthapuram, Ar.Saijumohammed, Ar.Sreelal, shri.Cibi chakraborthi and shri. Anoop for extending their help for the data collection of this research.

Thanks are also due to Dr. Ruchita Garg, shri. Tony Xavier and shri. Sunil Edward (Ph.D. Scholars), Department of Architecture & Planning, Indian Institute of Technology, Roorkee, for their useful suggestions and timely help rendered during different stages of this research work.

Thanks are due to the officials of Thiruvananthapuram Development Authority, State Town Planning Department, Thiruvananthapuram, Centre for Earth Science Studies, Thiruvananthapuram, Urban local bodies and Gram Panchayats of Thiruvananthapuram district, Department of Architecture, College

of Engineering, Trivandrum for providing necessary information and data pertaining to my thesis.

I am grateful to the Director, Technical Education, Government of Kerala, for sponsoring me to this course and giving an opportunity to further my studies. I am thankful to all faculty members, Department of Architecture, College of Engineering, Trivandrum, who spared me irrespective of their heavy teaching load in the Department.

I would like to accord my deep sense of gratitude to the residents of Thiruvananthapuram district, who extended the full cooperation for carrying out the primary studies of this research work.

At last, but not the least, I am indebted to my parents, wife, children and all family members and friends for their encouragement and moral support without which it would not have been possible to complete this thesis work.

Dated: 25 August 2004. (SALIM A.)

Place: Roorkee

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CHAPTER 1

INTRODUCTION

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 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. This alarming rate of migration into the cities straining the available infrastructure facilities in the cities, such as, housing, sanitation, drinking water supply, sewerage, drainage, power distribution, transportation, garbage collection and disposal, etc., and create a short fall of the above in the system. Most of the cities in the world are facing these serious issues, and are struggling to tackle these issues in some way or other. Every year, these problems are aggravating further into deeper level and unable to give even a glimpse of hope to tackle these problems in near future. Strong economic growth and development is the only option to tackle these problems.

Few distinguished Authors have defined economic growth and development. According to Schumpeter "Development is a discontinuous and spontaneous change in the stationary state which forever alter and displaces the equilibrium state, previously existing". Whereas growth is a 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(107). According to Kindle Berger, "economic growth means more output, while economic development implies both more output and change in the technical and institutional arrangements by which it is produced and distributed(107). 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. In this present investigation, an attempt is made to understand the inputs, which decide the functions of the urban system leading to integrated development.

1.2 URBAN AREA:

The area where there is an opportunity for diversified living environment along with diverse life styles. People live, work and enjoy the social and cultural relationship provided by the proximities of an urban area.

According to Arthur B Galion, "City is a concentration of people in a given geographic area who support themselves on a fairly permanent basis from the economic activities of that area." It can be a centre of industry, trade, education, government or mixture of all these with diversity, which attract people towards it(15).

1.3 URBANIZATION

Urbanization is a continuous process, which is not merely a concomitant of industrialization, but a concomitant of the whole gamut of factors underlying the process of economic growth and social change(15). Today, about 50 per cent of world population live in the urban system, where better infrastructure facilities are

available compared to the rural system. The urban system has been classified based on the size of the population. It has been observed that there are 19 cities having more than 10 million plus population, 22 cities with 5 to 10 million, 370 cities with 1 to 5 million and 433 cities with 0.5 to 1 million population in the world. It has been also calculated that by the year 2030 AD, about 60 per cent of the total population may live in the cities. The cities may become supermarket for employment, incubators of technology, suppliers of physical and social infrastructure, and portals to the rest of the world. Cities are also turn in to the centers of trade and commerce, processing, real estate, learning, health and recreation. These cities attract the poor and unemployed people from the rest of the urban system. It has been observed that the urban population growth is only 0.9 per cent in the developed countries, whereas in the developing countries it is 3.8 per cent (192). The selected information pertaining to the percentage of urban population to the total population, and annual growth rate of urban population are presented in Table 1.1 by different group of countries, such as, least developed, all developing, industrialized, low human development index, medium human development index and high human development index.

Table1.1 Urban population growth

SL No	Classification of countries	Urban population to Total population by per cent			Annual growth rate of urban population	
		1970	1995	2015	1970-95	1995-2015
1	Least developed	12.7	22.9	34.9	5.1	4.6
2	All developing	24.7	37.4	49.3	3.8	2.9
3	Industrialized	67.1	73.7	78.7	1.1	0.6
4	Low HDI	18.2	27.4	38.6	4.1	3.7
5	Medium HDI	23.0	37.1	52.7	3.9	2.8
6	High HDI	52.8	70.9	78.5	3.3	1.7

Source: UNDP human development report -2000
Note : HDI - Human development index

The table reveals that the countries having high value of human development index are having more percent of urban population, i.e., in 1975, the urban population was more than half of the total population (52.8 per cent) and it had been increased up to above two third of the total population in 1995 (70.90 per cent), whereas in the least developed countries it is meager (12.70 per cent) in 1970, and it was about one fourth in 1995. These clearly indicate that the countries having high human development index have more percent of urban population than the least developed countries. The analysis of the annual urban population growth rate reveals that the least developed countries are having higher rate of growth (5.1 per cent) in 1970-1995, whereas it is very meager (1.1 per cent) in the industrialized countries, and the industrialized countries have more per cent of population in the urban system (192).

It has been observed that urbanization and human development index (HDI) are interlinked. High value of human development index represent higher rate of urbanization. It has been observed that a slow down pace in the rate of growth of mega cities in the world wide; but in Asian context, the rate of growth is 4 times higher than that of the rest of the continents. Among the Middle East countries, urban population is the highest in Kuwait, i.e., 97 per cent, followed by the Gaza strip has 95 per cent, Bahrain and Qatar have 92 per cent and Saudi Arabia has 86 per cent respectively.

In India, the population in the urban area is increasing at a rapid speed. The total population in the urban area was at the rate of 21.30 per cent in the year 1975, and 27.70 per cent in the year 2000, and it is expected to reach 35.00 per cent by the year 2015. The estimated population in the year 2015 is about 1250

million, of which 400 million people would be forced to live in the urban areas (192). There is an ongoing trend of concentration of urban population from smaller urban areas to the Metropolitan cities, which is also observed in the last 2 decades, and this trend is expected to continue in future as well. In India, the planned economic era lead to strengthen the existing cities, towns, etc., and also paved the way for developing new towns, which stimulate the population to migrate from the rural segment to the urban segment and most of the urban segment face severe problems due to the sudden influx of population. Most of the State capitals of Indian subcontinent are facing this concentration issue, and attempts are made to reduce the intensity of the problems in few pockets. The general problems face in the urban segments is discussed briefly and are presented as follows:

1.4 HOUSING

The available housing stocks in the Indian cities are absolutely insufficient to cater the growing demand of the new entrants. As a consequence, the growing new entrants find some space wherever it is available in the urban system, like in the neglected portion or waterlogged areas of public land or besides the transportation networks with limited protection from natural hazards and settle. They are forced to live in the unhygienic and insanitary conditions without having link with the existing urban population. Generally, they engage in tertiary sector activities, which have more avenues for unskilled labour. The daily income may not be even sufficient for feeding their own family members and they find very difficult to meet the other essential items as well. This situation forces them not even to think about one of the foremost necessity of men **'a home'** for laying their head, and longing for the same. Similarly, other physical and social infrastructure

facilities are also not accessible to these neglected groups. Therefore, they are forced to live in the areas, which are prevailed by dilapidated, congested and unhealthy conditions.

1.5 ROAD NETWORK

Road network is considered as the vein and artery of the urban system. Traffic and transportation can also play a vital role in national development by transferring food grains, fuel, construction materials, and commutation and so on. The quality and quantity of road in India is very less. India is having only 893 km road for a million populations, whereas, in Australia it is 25695 km. This shows that the percentage of road is very less in India compared to the developed nations. In India, the available roads are also facing many problems, such as, absence of good alignment, sidewalk, surfacing, signal system, drainage, guardrails, etc. It has been observed that only 20.00 per cent of the available Indian roads are of good condition, which shows that greater attention is very much essential to safeguard this precious network, and also develop new networks to meet the growing demand (192).

1.6 DRINKING WATER

Water is a precious resource, which is very much essential for each and every activity of human development. Though India has 380 cubic km of water resources (192), the available quantity of water is not managed properly, which lead to various water related issues in both urban and rural system. Shortage of drinking water in Indian cities, create unhealthy condition in the system. During the summer season, the people struggle to get adequate quantity of water for fulfilling their basic needs. In selected regions of Indian subcontinent, the available water

which affects the health condition of the urban population. It has been observed that almost all Indian cities are facing this issue at varying magnitude.

1.9 SEWERAGE AND DRAINAGE

Sewerage and drainage system is another essential component for the development of the urban system. Absence of proper sewerage and drainage system in the urban system leads to various adverse effects in the system. It has been observed that the sewerage and drainage system in almost all Indian cities are very bad compared to the developed nations. In India, the percentage of area covered in the urban system by these services is very less and the efficiency of operation is also very poor. It has been observed that in most of the cities, the sewerage lines were laid centuries back, which were aimed at to serve a limited number of populations. Unfortunately, the same (sewer lines) system is functioning till today with out any addition or modification, and is allowed to accommodate to serve the huge chunk of population, which leads to environmental decay.

1.10 SOLID WASTE

Solid waste management in the urban system is also an important aspect, which is almost neglected in several Indian cities. In few Indian cities, solid waste management is attempted but not fully done. New Delhi, the capital city of India, is also not an exceptional one in this regard. This leads to accumulation of solid waste in the residential areas, commercial streets, central business districts, service centers, and often open spaces besides roads. This affects the pedestrian and vehicular movement and finally polluting the environment. During the monsoon season, the entire solid waste spread into the roads, mixing with

sources are also not in a position to cater the demand of the urban population. The average per capita consumption of water per day in the Indian cities is less than 100 litres, which is far behind the standard 165 litres as well as with the consumption rate of advanced countries like Norway @ 300 litres per day. About 15.00 per cent of the Indian urban population has no access to safe drinking water (192). These show the need for efficient water management along with development of water resources, in the urban system.

1.7 POWER

Energy is one of the most important parameters, which is very much essential for any kind of development. It has been observed that the per capita energy consumption rate of a country is clearly reflecting its economic condition (200). Higher quantity of power consumption reflects the countries economic development. In India, about 46.00 per cent of the population does not possesses domestic electric connection at all. The average per capita power consumption in India is only at the rate of 379 KW-hr per year, whereas in Norway, it is 25000 KW/hr per capita /year (192). This reveals the grave situation of power sector in the country.

1.8 SANITATION

Sanitation is another area, which reflects the environmental and health condition of the people of the nation. In India, about 31.00 per cent of the population has access to safe sanitation facilities, whereas it is 100 per cent in the developed nations. In India, in the urban system, it becomes a very essential item, since the available facility is very meager to a segment of the community. Formation of unhygienic condition in urban areas leads to environmental decay,

rainwater, blocking the drainage movement, and leads to flood in the urban system. A cursory glance of problems, which are presented above stimulate the Investigator to have a detailed investigation pertaining to this field of learning and also to prepare an integrated development plan for an urban system

Plausible urban development plan aims at having integrated development in the urban system, along with reducing the prevailing socio-economic, physical and environmental conflict in the system. A realistic integrated urban development plan considers total development of the system, which includes, Physical, socio-economic and environmental development, judicious use of scarce resources, development of infrastructure and preservation of aesthetic, and scenic beauty of the system.

Having the aforesaid in mind, which hinter the development of the system, it is of interest to collect the available literature in this particular field and are reviewed, carefully.

1.11 LITERATURE REVIEW

It has been observed that number of distinguished Authors have done research, and published in the field of urban development. The publications which are very much relevant in this present investigation are collected and reviewed (1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 33, 34, 35, 36, 38, 39, 40, 41, 42, 43, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 71, 72, 73, 74, 75, 76, 77, 79, 81, 83, 85, 86, 87, 88, 89, 91, 92, 94, 95, 98, 99, 100, 101, 102, 104, 105, 106, 107, 109, 110, 111, 112, 113, 114, 116, 117, 118, 119, 120, 122, 123, 124, 125, 126, 127, 128, 131, 132, 133, 134, 136, 138, 140, 141, 142, 143, 145,

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At the outset, the collected literatures are scrutinized very carefully to understand their relevance and observed that almost all studies are done based on different segments, such as, either physical development or few components of infrastructure or economic development and so on. Therefore, the Investigator has segregated the collected literature in to different sections, and are presented briefly as below:

(1) Population
(2) Housing
(3) Water supply
(4) Sewerage and drainage
(5) Garbage
(6) Power
(7) Transportation
(8) Education
(9) Health
(10) Financial institutions
(11) Institutions involved in infrastructure sector
(12) Peoples participation
(13) Urban development

The literature grouped under the aforesaid segments is presented in the sequel. They are:

1.11.1 Population

In India, the population in the urban system is increasing at an alarming rate, but the available infrastructure services in the system are not increasing proportionate to the population growth. This leads to straining of available infrastructure facilities in the system. It has been observed that the population growth in the urban system is quite high during the last four decades and is presented in Table 1.2

Table1.2 Urban population to the total population (per cent)

Sl. No	Year	Total population (million)	Urban population (million)	Per cent
1	1961	439.20	79.10	18.01
2	1971	548.20	108.90	19.87
3	1981	685.20	159.70	23.30
4	1991	838.60	215.80	25.73
5	2001	1025.25	284.99	27.79

Source: 10th five year plan report 2002-2007, Government of India, New Delhi.

The table illustrate that the urban population is increasing and the trend of urbanization is also increasing in a slow pace. The urban population increases from 18.01 per cent in 1961 to 27.79 percent in 2001, which shows urban planning requires more attention in terms of quality and quantity of essential infrastructure facilities. The available literature pertaining to population is analyzed thoroughly and the following observations were made (5, 7, 23, 28, 34, 35, 36, 49, 53, 59, 71, 75, 77, 100, 101, 138, 145, 165, 191, 193, 199, 200, 201, and 202).

1. Large-scale economic activity is taking place in the urban system, such as trade and commerce, industries, transportation, tourism, education and health.

2. Concentration of social infrastructure, such as, health, education, transportation, recreation, tourism, communication and banking is present.
3. All types of services are available in the urban system.
4. Large-scale public and private investment take place for satisfying the requirements of the urban population.
5. Employment in the unskilled service sector, such as, construction, maintenance, transportation, trade and commerce, etc., attracts further more population in the urban system.
6. The per capita income of the urban population is higher than the rural population.
7. The urban poor spend more amount of money for urban services than the higher income group people.
8. Higher size of population concentration in the urban area leads to reduction of open spaces, vegetation and overall quality of the environment.
9. High density of population creates the reduction of quality of services in the system, which leads to formation of slums and unemployment.
10. Unemployment in the urban system creates antisocial activities such as, robbery, theft, criminals, prostitution etc leading to insecurity in the urban life.
11. Higher land value in the urban areas pushes out the urban poor to the outskirts of the city where land value is affordable.

1.11.2 Housing

Housing is one of the basic necessities of human life, and it is a major economic activity, which form part of the total construction industry accounts

more than 50.00 per cent of the development outlays. The working group on housing for the tenth plan observed that 90.00 per cent of the total housing shortage is pertaining to the weaker sections of the society only (145). As per the Reserve Bank of India's direction, housing becomes a priority sector of lending, and the institutional credit dispersal have grown up from Rs. 5767 crores in 1997 to Rs 12626 crores in 2001- 2002(145). In India, Housing and Urban Development Corporation (HUDCO) is the premier institution in the housing and infrastructure development sector, earmark 55.00 per cent of the total activities towards the housing of the economically weaker sections (EWS) and lower income groups. Housing and urban development corporation (Hudco), is targeting 30 lakhs housing units by the end of the 10^{th} plan and so far it supported to 33.82 lakhs units. The Working Group on Housing estimates that, there would be a deficiency of 22.44 million housing units in the urban area during the tenth plan period. The collected literature pertaining to housing is analyzed thoroughly and the following observations are made. (1, 4, 5, 7, 19, 21, 23, 24, 32, 36, 51, 52, 53, 54, 59, 65, 66, 71, 73, 75, 77, 84, 85, 97, 101, 103, 108, 109, 123, 128, 137, 165, 168, 177, 184, 189, 190, 192, 193, 195, 196, 197, and 200)

1. Housing plays a major role in the quality of living and human development index.
2. In Indian cities, the housing production is not commensurate with the housing demand, which leads to congestion, poor quality of living, slum and squatter settlement formation and even lead to form a group of the pavement dwellers.

3. The social housing schemes of the public agencies, conventional construction practices are being followed which incur higher cost.
4. A wide variety of natural and local construction materials are abundantly available in different regions of the country, but are not used properly.
5. Construction cost of the houses are increased in recent years due to various factors, such as, increase in land values, material production cost and labour cost.
6. The availability of serviced land for residential development is decreasing in the urban system.
7. In some pockets of the urban system, people use un-serviced and undeveloped areas for residential developments that lead to flooding and traffic blockage, destruction of infrastructure facilities and destruction of the environmental quality of the system.
8. The available housing stock consists of good, livable and dilapidated houses. Of which, the share of the dilapidated houses is about 15.00 per cent, i.e., in addition to the numerical shortage of houses another 15.00 per cent houses has to be constructed to tackle the problem.
9. The number of agencies working in the social housing schemes for the disadvantaged sections is very meager compared to the other sections of the society.
10. The role of NGOs in the housing sector is also very meager to assist the people, to carry out the schemes with people's participation.

1.11.3 Urban Transport

Transportation plays a major role in the urbanization process, and it is considered as the vein and artery of urban life. The public transportation system

available in most of the Indian cities are not satisfying the travel requirements of the population for various activities, such as, employment, education, health, recreation, etc., which force them to procure their own vehicles for movement. The liberalized policy of the Government coupled with the lending schemes of the financial institutions boost this activity of procuring own vehicles in recent years, which lead to increase in use of private owned vehicles at an alarming rate in recent years, whereas the length and width of roads remains almost constant. This, ultimately, hampers the traffic movement that leads to traffic jams and traffic delays in the system. The available literature pertaining to traffic and transportation of the Indian cities are analyzed thoroughly and the following observations were made (2, 3, 4, 6, 11, 13, 18, 20, 21, 26, 29, 33, 38, 49, 58, 60, 64, 68, 72, 80, 83, 85, 86, 92, 94, 102, 105, 106, 110, 111, 116, 118, 122, 126, 128, 131, 140, 143, 145, 147, 151, 156, 169, 170, 176, 178 and 199).

1. The road capacity is inadequate to hold the traffic flow.
2. Poorly planned traffic, and transportation system in cities.
3. Deficiency of parking facilities
4. On street loading and unloading activities are common in the core areas of the cities.
5. Heavy through traffic in the core areas of the city.
6. Lack of pedestrian facilities.
7. Inter model mixing of traffic movements.
8. Unauthorized occupation of pedestrian facilities, like encroachment of footpaths, foot -over bridges and subways.

9. The liberalized policy of the government to facilitate private investment in the urban transportation sector especially road construction and management.
10. Foreign direct investment and multilateral agencies like Asian Development Bank and World Bank supported for the development of transportation in some pockets of the country.

1.11.4 Power

Electric power is considered as the backbone of the quality of living and the economy of an urban system. Uninterrupted power supply creates confidence in the residential sector for carrying out their activities irrespective of time and space, which leads to healthy environment for development. The per capita power consumption in the country is only 400 KWh, which is far less than the consumption rate of selected developed countries. In India, about 30.00 per cent of the total population has no access to power. In industrial and commercial sector, power is an inevitable requirement. The power demand in industrial and commercial sectors is increasing day by day, and the gap between the demand and the supply is widening, which create adverse effects in the economy. The literature available, pertaining to the power supply is analyzed thoroughly and the following observations were made (3, 7, 11, 13, 18, 22, 28, 29, 32, 34, 35, 36, 49, 61, 63, 65, 68, 75, 77, 79, 83, 86, 92, 94, 100, 105, 107, 117, 126, 131, 132, 134, 140, 143, 145, 157, 161, 170, 171, 175, 178, 179, 192, 193, 199, 200 and 201)

1. A wide variety of energy resources are available in the country, which are not identified, developed properly for meeting the demand.

2. Efficient power supply is highly essential in an urban system to carryout the urban activities including the safety and security of the people.

3. Wide disparity is observed among the States in relation to power consumption.
4. A sizable population is not having access to power supply.
5. Power generation, transmission and distribution sectors are not managed properly.
6. Industrial production and the economy are linked with the quantity and quality of power supply available in the system.
7. Efficient power supply attracts more industries in to the system and enhances economic growth.
8. Power tariffs are not revised properly.
9. Private agencies show more efficiency in power distribution management than the public agencies.
10. Private finance investment is increasing in the power sector.

1.11.5 Water Supply

Drinking water supply is one of the most important parameters, which directly linked with the life of the people of a system. Good quality of water supply is considered as one of the components of the development index to analyze the strength of the urban system. The increase in population in the urban areas leads to shortfall of water supply, and the available supply is not in a position to satisfy the need of the growing population that create unhygienic condition, health problems and waterborne decease in the system. The available literature pertaining to water Problems in Indian cities are analyzed thoroughly and the

following observations were made (2, 5, 6, 7, 9, 13, 16, 18, 23, 27, 32, 34, 35, 36, 40, 41, 47, 48, 49, 50, 54, 61, 62, 63, 70, 71, 73, 75, 77, 78, 81, 82, 92, 98, 100, 107, 108, 110, 115, 126, 129, 130, 133, 134, 144, 145, 155, 159, 161, 165, 171, 172, 178, 180, 181, 185, 186, 188, 192, 193, 194, 199, and 200).

1. Most of the Indian cities do not have good water supply distribution system.
2. The quantity of water supply distribution is not commensurate with the growing demand.
3. The available quality of water is also very poor especially during the summer and rainy season.
4. In selected cities, certain pockets of the city, water is not at all available due to the peculiar terrain of the city.
5. The outdated water distribution system in many cities leading to the loss of sizable percentage of water through water leakage and breaking down of supply lines.
6. In some cases, the broken water supply line mixed with sewer lines and sewer water is mixed with drinking water, which leads to spreading of diseases.
7. The water charge collection and fixing of water tariff are not properly done, which do not matching with the project cost and overhead charges.
8. Water harvesting techniques and methods are not popularized in many of the cities.

1.11.6 Sewerage and Drainage

It has been observed that 80-85 per cent of the used water at the domestic sector drained out from the houses as wastewater. Most of the Indian cities don't

have well-developed sewerage and drainage network. Lack of funds in the Municipal bodies lead to poor maintenance of the existing drainage lines, and form obstacles to development. The capacity of the available drainage lines are not meeting the required demand, it is mixed with storm water and creates dangerous situation during the rainy season. It has been observed that many of the Indian cities do not treat the sewerage properly before disposing them into the natural courses, which creates environmental problems and finally affect the quality of ground water table in the system. Similarly, most of the Indian cities never attempted to treat the wastewater and use the same for industrial and agriculture purposes. The available literature pertaining to sewerage and drainage were analyzed thoroughly, and the following observations were made (2, 4, 5, 7, 13, 14, 16, 18, 20, 21, 23, 27, 28, 31, 32, 34, 36, 38, 41, 43, 45, 47, 48, 50, 54, 59, 62, 63, 65, 70, 73, 81, 82, 85, 88, 90, 92, 95, 100, 108, 110, 113, 114, 116, 124, 125, 126, 129, ,132 ,133 ,138, 143, 145, 155, 159, 168, 172, 178, 181, 186, 188, 191, 193, 194, and 200).

1. The access to sanitation facilities is increased over the years i.e., it was 63.90 per cent in 1991, and it was 68.00 per cent in 2001.
2. The sanitary facilities available in the slums are not maintained properly (community toilets), and the hygienic conditions are found in the worst condition.
3. The quality of water available in the slums (through stand posts) is not meeting the bare minimum needs of the people.
4. One stand post is being served by an average of 300-350 people, which leads to accumulation of wastewater around the post resulting in to unhygienic condition in the system.

5. Higher income group people have better access to sewerage and sanitation facilities due to the fact that they generally reside in the areas have good infrastructure facilities.
6. Most of the urban local bodies are not collecting sewerage and drainage service charge from the beneficiaries, which ultimately leads to weakening of the institutional set up.

1.11.7 Garbage

The garbage production varies from country to country and the developed countries produce more quantity than the under developed countries. Garbage collection, treatment and disposal became one of the major parameters of city development index (CDI). Available literature pertaining to garbage management is analyzed thoroughly, and the following observations are made (7, 8, 11, 12, 13, 16, 18, 20, 23, 25, 28, 30, 37, 43, 46, 48, 49, 50, 54, 55, 56, 59, 63, 64, 65, 79, 81, 82, 83, 86, 88, 92, 95, 98, 100, 107, 110, 113, 118, 124, 126, 133, 134, 138, 140, 141, 142, 145, 149, 155, 157, 161, 164, 167, 170, 178, 192, 194, 196, and 200):

1. The major share of Municipal solid waste is generated from the residential, commercial and institutional establishments.
2. About 50.00 per cent of the solid waste is not collected, unattended, and are leftover in the system, which create unhealthy condition in the urban system.
3. The higher income group people avails better facilities than the lower income group, since the higher income group either reside in the posh areas where better service is available or they hire private personnel's to meet their requirement.

4. Most of the cases, the Municipal Corporation never attended garbage collection where lower income group reside since they do not have voice in the administration.
5. The financial condition of the urban local bodies is also weak, which leads to improper and inefficient management.
6. Unscientific dumping of garbage occurs in different cities, which leads to deterioration of environmental quality, fertility of the soil, reduction in water percolation capacity, deterioration of ground water- table, etc.

1.11.8 Education

Education is one of the key factors for development of any nation. In India, a sizable quantity of money is spending over the years, through the 5-year plans to improve the quality of basic education in the country. Even though, a sizable amount of money is spent for education over the years continuously, the results are not so enterprising. Provision of primary education becomes mandatory in the 74th Constitution Amendment Act-1992. Though basic education is made mandatory requirement in the constitution, it is not growing at the expected level. The literacy rate is increasing at nominal rate only due to various administrative reasons. The literacy rate of the country is only 65.38 per cent in 2001, whereas it was 16.67 per cent in 1951. The 93rd Constitution Amendment Act of 2001 envisages free and compulsory education to children between the ages of 6 and 14.

Table 1.3 Literacy rate

Sl.No	Year	Total population (in millions)	Total literate (in millions)	Per cent
1	1951	360.90	60.16	16.67
2	1961	439.20	105.49	24.02
3	1971	548.20	161.44	29.45
4	1981	685.20	299.22	43.67
5	1991	838.60	437.83	52.21
6	2001	1025.25	670.20	65.37

Source : Census of India 2001

The available literature pertaining to education in India is analyzed thoroughly, and the following observations were made (34, 35, 36, 77, 138, 139, 145, 191, 192, 193, 199, 200, 201, and202).

1. Education is a tool to measure the quality of human development of a system.
2. Central and State Government are spending sizable amount of money to improve the quality and quantity of education system.
3. A number of agencies rendering services to this sector, including Government, Community Based Organizations, Co-operatives, Philanthropists, Missionaries, Private and Non-governmental Organizations.
4. The share of private investment in education also is an increasing trend.
5. During the last 5 decades, infrastructure facilities of the educational institutions have improved quite a lot, like building, accessibility, drinking water supply and sanitation, playfield, library and other recreation facilities.
6. Government programs, such as, Operation black board, District primary education program (DPEP) and Sarvashiksha Abiyan (universal education) have made slight improvement in the education scene of the country.

7. A remarkable shift is visible from general education to technical education in view of the potential job opportunities in the market.
8. Considerable quantity of educated unemployed youths is migrating to other countries for employment opportunities.

1.11.9 Health

Health is considered as one of the most important parameters, which decides the functions of a system. Life expectancy in the country has been increased over the years due to the advancement in health sector. The infant mortality rate has reduced over the year's from146 per thousand in1951 to 70 per thousand in 2001. The life expectancy is also increased from 36.70 years in 1951 to 64.6 years in 2001. The available number of hospitals and beds are also increased to the greater extend, which intern improved the health condition of the people. The available literature pertaining to health is analyzed thoroughly, and the following observations were made (77, 138, 139, 145, 191, 192, 193, 199, 200, and 201).

1. Health condition of the people of a system is directly linked with their income and their living environment.
2. Over the years, the health sector in the country has been improved quite a lot, but not par with the developed nations.
3. Health related awareness is higher among the educated people and they give more attention to good health.
4. Lack of awareness on socio-economic condition among the weaker sections; produce more children, with multiple deficiencies related to nutrition, health and productivity (output).

5. The haves spent more amount of money towards heath related activities and they try to live in a good and healthy environment.
6. The available health based infrastructure facilities are more or less enjoyed by the higher income personnel's and the elite sections of the society.
7. The availability of health facilities are more confined in the urban area compare to the rural areas, which create a tendency to move towards the urban areas for better health facilities.

1.11.10 Institutional Provisions in Infrastructure

Good institutions are highly essential for any system for efficient operation and management of certain activities in the system. Generally, in India, public institutions work for providing of infrastructure services. These institutions suffer in different angles due to the shortage of fund to carryout their schemes, activities, etc., People have a wrong notion that these services are the part of the Government administration, and generally blame the Government without making their own contribution to improve or to help the system for better services. Deficiency of operation in the system leading to environmental problems, which resulted in to health related issues among the people. The available literature pertaining to institutions and their contribution to infrastructure services are analyzed thoroughly and the following observations are made (2, 3, 4, 6, 9, 11, 13, 14, 16, 18, 20, 21, 23, 24, 25, 26, 28, 28, 40, 41, 44, 49, 58, 60, 63, 65, 66, 67, 70, 77, 81, 83, 85, 88, 89, 98, 100, 102, 107, 110, 114, 118, 124, 125, 126, 132, 134, 139, 140, 143, 145, 149, 157, 159, 161, 170, 186, 187, 190, 191, 192, 193, 199, 200, and201).

1. Different types of institutions are working in provision of infrastructure services to the masses, such as, Government, private and non-government organizations with distinct operational characteristics.
2. In certain cities, the private institutions are working very satisfactorily and are collecting a sizable amount from the Municipal budget as service charge for the same.
3. Generally, these private institutions are managed with lesser number of service personals with minimum wages.
4. The non-government institutions are mainly concentrating in the less serviced, and in the areas where the depressed sections of the society reside.
5. Proper long term policies, planning and program related to infrastructure services are almost absent in most of the cities.
6. In certain cities, some kinds of private initiatives are made for managing these kinds of services.

1.11.11 Private Institutions

As explained earlier, the financial condition of the urban local bodies are very weak to carry out the development of infrastructure services in the system. The private institutions started to engage in this sector since it is a lucrative one in recent years. The available literature pertaining to private institutions and their contributions in infrastructure services are analyzed thoroughly and the following observations are made (30, 31, 32, 46, 49, 62, 65, 66, 67, 69, 83, 85, 86, 88, 89, 94, 96, 98, 100, 102, 107, 110, 115, 118, 124, 126, 132, 134, 139, 140, 143, 145, 149, 151, 157, 159, 162, 167, 170, 171, 178, 185, 186, 187, 189, 191, 192, 193, 199, 200 and 201).

1. Private institutions are very much essential in areas where Government institutions are weak.
2. The private institutions function with less operational cost, by giving lesser wages, and extracting more work from the service personnel's.
3. The employments in the private institutions are generally made based on contract, which make accountability in each and every activity. Therefore, the service performances of the private institutions are comparatively better than the Government institutions, since the government institutions accountability is absolutely absent.
4. The management setup in the private institutions is better than the Government institutions.
5. The private institutions generally operate their activities on profit basis rather than service bases.

1.11.12 Non-Government Agencies

The non-government organizations are working at the grassroots level with the objective of improvement or development of the system based on no profit and no loss. They generally work along with the people; educate them to impart awareness among them in the particular aspect in which they concentrate. They work as a interface between the Government, and the beneficiaries carrying out the development activities.

1. It has been observed that the State and the Central Government institutions are giving more importance to the non government organizations in developmental activities at different levels, and even financial allocations are made to them to carryout development activities in the last three five year plans.

2. It has been also observed that the Government institutions fail to understand the real problems of the people of an urban area because the officials generally fail to make good rapport with the beneficiaries.

1.11.13 Financing of Infrastructure

At present, most of the countries are spending sizable portion of their annual budget towards the development of infrastructure. It has been proved that availability of better infrastructure services provide good quality of life, which create better ambience in the system. The available literature pertaining to financing of infrastructure was analyzed thoroughly and the following observations were made (2, 3, 4, 6, 9, 11, 13, 14, 16, 18, 20, 21, 23, 24, 25, 26, 28, 28, 40, 41, 44, 49, 58, 60, 63, 65, 66, 67, 70, 77, 81, 83, 85, 88, 89, 98, 100, 102, 107, 110, 114, 118, 124, 125, 126, 132, 134, 139, 140, 143, 145, 149, 157, 159, 161, 170, 186, 187, 190, 191, 192, 193, 199, 200, and201).

(1) Formerly, the Central Government or the State Government had done all the infrastructure related services.

(2) The amount of money required to meet the demand of infrastructure services is very high in recent years, and the respective Governments are not in a position to meet this amount from their own source.

(3) The Governments (both Central and State) started to borrow money either from internal or from external financial agencies to meet the requirement.

(4) The Government started to encourage private partnership to make investments in infrastructure services. Recently, the private and the Government together are carrying out larger infrastructure investments like development of Golden Quadrilateral, connecting all the four metropolitan

cities of the country, such as, Delhi, Mumbai, Chennai and Kolkota, and also development of airports like Cochin and Bangalore.

(5) The Government is entrusting some of the viable projects to private institutions under Build Operate and Transfer scheme.

(6) Many of the private institutions are investing in housing sector especially in the Metropolitan and Mega cities, and they found that the investment in this sector is a viable option.

(7) Most of the Nationalized Banks, Cooperative banks and other housing development and financial institutions lend loans for individual and group housing activities at reasonable interest rates.

1.11.14 People's Participation in Infrastructure Services

People's participation is one of the major factors, which decides the success or failure of any project. In people's participation, the beneficiaries rather than the administrators evaluate the projects. The views and suggestions of the beneficiaries are highly essential even during the formulation stage of a project, implementation stage, and also managing of schemes. The beneficiaries can easily identify the strength and weakness of any project at the particular location. The contributions of the beneficiaries to the projects may be listed in several aspects, which include financing, providing local technology and work force to carry out the projects. The available literature pertaining to people's participation in infrastructure services are analyzed thoroughly, and the following observations were made (96, 101, 132, 134, 143, 144, 145, 149, 157, 159, 161, 164, 168, 178, 191, 192, 193, 199, 200, and 201).

(1) In most of the successful schemes the people's participation played much major role.

(2) The program like mass literacy, family planning, environmental awareness programs, construction of local roads, cleaning of local water-bodies, social forestry, finance mobilization for local development programs, construction of local nursery schools, construction of health centers, construction of recreational centers, operation and maintenance of public open spaces, etc., become more successful with peoples participation.

(3) In social housing schemes, the people's participation in various activities, which include identification of the beneficiaries at local level, is tremendous, by providing their skills, valuable time and even management of the scheme.

(4) The people's participation increases the efficiency and assures good quality of the schemes.

(5) Some of the schemes launched by the Government of India under food for work envisage people's participation in the developmental process, which have shown tremendous amount of success.

(6) In certain schemes in which people are affected temporarily needs more peoples participation, otherwise the scheme never be even implemented, such as, improvement of slums, development of roads through the congested areas of the city. In such projects people's participation is highly essential; to educate, and motivate the people relating to the benefit of such development schemes, and muster their support for the same.

(7) In certain areas some of the schemes were reviewed and some are abandoned due to mass agitation of the public. Noted among them are

silent valley power project in Kerala State, sand mining in coastal area of the Allappuzha district of the kerala state, etc.

1.11.15 Urban Development

The 74 th Constitution Amendment Act of 1992 envisages the creation of urban local bodies with democratic governance. The 12th schedule of the 74th Constitution Amendment Act 1992 mainly focuses towards the major responsibilities to fulfill the needs and aspirations of the community. Article 243 W emphasis of preparation of plan for economic development and social justice. Similarly, urban poverty alleviation is another aspect, which needs more attention. The urban population is increasing at a higher rate than the population growth rate. This leads to straining of available infrastructure facilities in the system. The available literature pertaining to urban development analyzed thoroughly, and the following observations were made (1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 33, 34, 35, 36, 38, 39, 40, 41, 42, 43, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 71, 72, 73, 74, 75, 76, 77, 79, 81, 83, 85, 86, 87, 88, 89, 91, 92, 94, 95, 98, 99, 100, 101, 102, 104, 105, 106, 107, 109, 110, 111, 112, 113, 114, 116, 117, 118, 119, 120, 122, 123, 124, 125, 126, 127, 128, 131, 132, 133, 134, 136, 138, 140, 141, 142, 143, 145, 146, 147, 148, 149, 150, 152, 154, 156, 158, 159, 160, 161, 165, 166, 168, 169, 170, 171, 173, 176, 178, 179, 180, 182, 184, 185, 187, 190, 191, 192, 193, 196, 197, 200, 201, and 202):

(1) So far the Development Authorities never attempted an integrated approach of total development of the system; they concentrated the development of a particular aspect, without considering the

development of the remaining aspects. Over the years, lack of co-ordination between different agencies leads to widening the gap between the demand and supply of infrastructure services in the system.

(2) The major sources of income for the urban local bodies are from their own sources, such as, taxes, rent from their assets and the share from the state fund.

(3) Most of the urban local bodies are facing severe financial crisis for carrying out development programs.

(4) It has been also observed that the State Governments are receiving a sizable amount of money is getting from the Central assistance for various schemes, and other agencies like, National housing bank and Housing and urban development corporation, etc.

(5) Under the Accelerated urban water supply scheme (AUWSP), which was launched in 1993-94, sanctioned 654 schemes in the year 2001-2002 with the central assistance of 337 crores.

(6) Through Integrated development of small and medium towns scheme (IDSMT), which was launched in 1979-80, it has sanctioned 1172 schemes only with a worth of 531.00 crores.

(7) Through Mega city development scheme, which was started in 1993-94 covers the city like Mumbai, Kolkota, Chennai, Hyderabad, and Bangalore with the central assistance of 714.75 crores.

(8) Tax-free bond scheme, which was introduced in 2001, envisages the local bodies to collect money from the public for the development of the

city. Ahmedabad and Hyderabad Municipalities collected 82.5 crores and 100.00 crores respectively through this scheme.

(9) Development activities are initiated by taking loans from international lending agencies, like Asian Development Bank (ADB), World Bank, etc., in several pockets of the country.

(10) Repel of urban land ceiling and regulation act 1976 became a boost in the urban land market.

(11) Tenth five year plan envisages to ease more land for development, with flexible zoning regulation, change of land use and easier subdivision regulation, extension of services to new areas to reduce the congestion in cities, etc,

(12) Tenth five-year plan also envisages 100 per cent foreign direct investment (FDI) for integrated development of townships.

Having analyzed the aforesaid literature, the Investigator comes to the conclusion that the available literature concentrate only segment basis, i.e., part by part the system is covered, but not the system as a whole with quantifying the functions of the urban system. This observation gave more impetus to the Investigator to take up this present investigation, i.e., preparing an integrated development plan for an urban system. To prepare an integrated development plan, Thiruvananthapuram city, a southernmost capital city of the state in India is chosen.

Thiruvananthapuram city, the capital city of Kerala State has been facing various issues related to physical, socio-economic, ecology and environmental aspects. Since the Investigator has been engaged in urban planning related activities for more than a decade, living in this city for more than three decades,

and has more knowledge about the problems and prospects of this city, the Investigator has chosen this city for conducting a detailed investigation and also for preparing an integrated development plan for the development of this city as his area of research.

Thiruvananthapuram city has lot of problems like other State Capital of India. The major problems of the city are presented as below:

1. High density of population.
2. Shortage of dwelling units.
3. High land value in the core areas.
4. Drinking water supply management.
5. Acute shortage of power supply.
6. Insufficient drainage system.
7. Outdated sewerage system.
8. Inefficient flood management system in certain pockets.
9. Inefficient solid waste management system in certain pockets.
10. Lack of pedestrian facilities.
11. High volume of traffic.
12. Insufficient off street parking.
13. Absence of bus bays and bus shelters.
14. Improper location of bus terminals.
15. Poor geometry and intersections of roads.
16. Absence of road signs and markings.
17. Intermixing of slow and fast moving vehicles.
18. Intermixing of through and local traffics, and so on.

Having the above knowledge in mind, a set of objectives has been framed to evolve a feasible integrated development plan for the development of Thiruvananthapuram city of Kerala State.

1.12 Objectives

The following objectives are framed for this present 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.

1.13 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 this present investigation are implemented systematically in time in the study area; steady integrated development can be anticipated in the system, definitely.

1.14 CONCEPT

In this present investigation, systems concept is employed. A system functions as a whole with the interaction of several sub systems. All the sub systems 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, Thiruvananthapuram city has been considered as a system. Therefore, system concept is employed in this present 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.

1.15 RESEARCH DESIGN

Survey research methods have been employed in this present investigation.

DATA

Secondary and primary sources of data pertaining to this present investigation are collected and employed. The methodology followed to conduct this investigation is presented in Fig 1.1 and Table 1.4

Table 1.4 Details of Data collected

Sl.No	Levels	Source of information/ person concerned	Type of information
1	District	District level officers	Secondary and primary
2	Taluk	Taluk level officers	Secondary and primary
3	Community Development block	Block level officers	Secondary and primary
4	Local bodies (urban &rural	Local body officials and experts	Secondary and primary
5	Households	Household persons	Primary

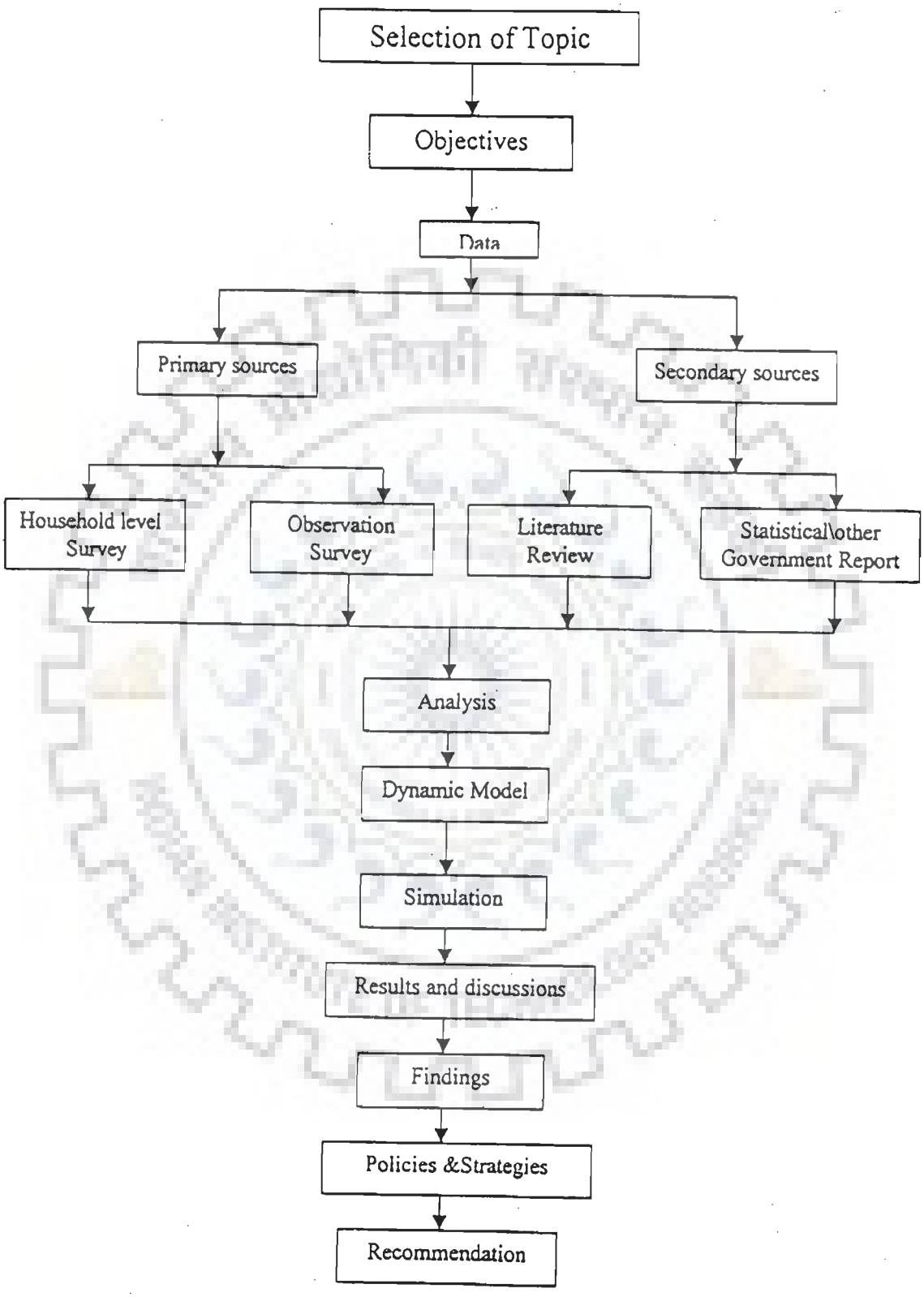


Fig 1.1 METHODOLOGY

1.15.1 Significance of the Primary Data

Most of the secondary data was made available to the Investigator at the time of the investigation (2003) for the district based on the Census- 2001. However, part of data, which is documented year-wise by the concerned agencies and is 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 to 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. 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 survey was conducted in the year 2003, which is considered as the base year for this study.

1.15.2 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. As mentioned earlier, the study area is divided in to three natural divisions, such as, highland, midland, and coastal plains; and each has distinct characteristic features in relations to landform, spatial, seasonal resources, population density,

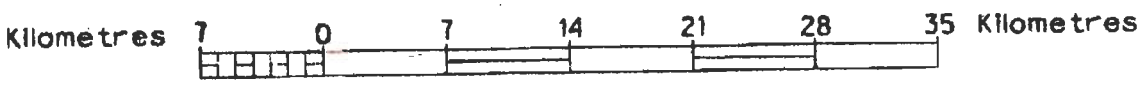
socio-economic activities, infrastructure facilities, etc. Development in all these regions is depending on changing several spatial, seasonal, socio-economic factors. It is interesting to observe that the availability of resources vary from one area to another, season to season, household to household and so on in these three regions. In the coastal region, the housing problems are aggravated during the monsoon season, and the drinking water problems are aggravated during the summer season. In the coastal region, most of the houses are in a dilapidated condition, and during the monsoon season water (rainwater and surface water) enter in their houses and the people face tremendous amount of pressure during this season. Similarly, the other two regions are facing several kinds of problems in accordance with seasonal and economic variations, etc., which are varying from the coastal region. These aforesaid aspects forced the Investigator to collect detailed investigation at the household level in all the regions. 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.

1.15.3 Sampling Design

Thiruvananthapuram district (figure.1.2), the Southern most district of the Kerala State where the capital city of the state is confined is chosen for this present Investigation. Relevant data were collected through an extensive field survey for supplementing the data available from census and other sources. As already said, Thiruvananthapuram district has three distinct natural divisions (coastal plains, midland and highland) and it is divided in to four Taluks and all the four Taluks are further divided in to twelve Community Development blocks

BLOCK INDEX

Scale 1:700,000



REFERENCES

State Boundary

District Boundary

Tāluk Boundary

Block boundary

as shown in figure 1.2. Of the total twelve Community Development blocks, six-Community Development block have sea front, one Community Development block is confined purely in midland, and the rest are confined either in the hill area or in the midland area.

1.15.4 Selection of Sample Households

At the outset, The Investigator has collected the list of households by Community Development block-wise and analyzed the number of households. A total number of 260 households were selected 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 the formula k=N/n, where N and n represent the total number of households and the sample size, respectively. The households selected by Community Development block-wise were shown in Table 1.5.

Table1.5. Details of selected samples

Sl no:	Name of the Taluks	Name of the Community Development block.	Block no:	No. of selected samples.
01	Chirayinkil.	*Chirayinkil.	1	25
		*Varkala.	2	20
		**Kilimannoor.	3	20
02	Nedumangad	***Vamanapuram.	4	20
		**Nedumangad	5	20
		*** Vellanad.	6	20
03	Thiruvananthapuram	*KazhaKuttom.	7	25
		*Thiruvananthapuram.(rural)	8	25
		**. Nemom.	9	25
04	Neyyattinkara	*Adhiyannoor.	10	20
		***Perumkadavila.	11	20
		*Parassala.	12	20
	Total	-	-	260

* Community development block (sea facing)
** Community development block (midland)
***Community development block (highland)

1.16 SURVEY TOOLS

Appropriate survey tools, such as pre-tested schedule, questionnaires, etc., are employed in the present investigation. They are

1.16.1 Schedule

Three different level schedules, such as, District level, Community Development block level, and household level schedules were employed in this investigation, and are presented in the sequel. They are:

1.16.1.1 The district level schedule

The District level 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. Thus, the officials of the district planning office, Urban development department, Rural development agency, departments like Industry, Agriculture, Fishery, Forestry, Khadi and village industries, Tourism, Housing Board, Employment exchanges, Traffic and transportation planning and Research centre, etc, were considered for conducting this survey.

1.16.1.2 The community development block level schedule

The Community Development Block level schedule was prepared and employed for collecting data based on population, land use pattern, land form, cropping pattern, resources, availability of infrastructure services, housing, Central and State Governments development schemes and their status, etc. Different offices that are connected with the development activities at the Community Development bock level were considered for conducting the survey.

1.16.1.3 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 details, Details of household income and expenditure, etc, were included in this schedule. The household schedule used for this investigation is presented in Appendix-I

1.16.2 Method of Administrating the Survey at the Household Level

The household survey was conducted in the year 2003. To conduct the household survey, at the outset, the Investigator contacted the District Planning officials at the district level and explained the objectives of the survey. The officials extended their full support to carry out the survey. Subsequently, the Investigator had detailed discussion with the officials at the Community Development Blocks level relating to specific issues, which gave valuable insight in organizing the schedule. Once the schedule is organized, the Investigator conducted a pre- testing survey in some of the identified households for finalizing the schedule with the help of the Community Development Block officials. The collected data by using the pre-tested schedules were analyzed thoroughly, and develop the final schedule for conducting the investigation.

The Investigator approached the households directly, and has a detailed discussion with the members of the households, after obtaining prior appointment

from the respondents for conducting the final survey at the household level. The non-working hours of the households were preferred for conducting the survey. The heads of the households were considered as respondents for the purpose of this survey. The Investigator himself carried out this household survey. Since the Investigator himself conducted the survey, he gained lot of insight about the overall functioning of the system, and was also able to draw some conclusion based on the observation.

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 MODELLING

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

1.19 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 and the same are used in the model.

1.20 SIMULATION

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

1.21 RESULT AND DISCUSSIONS

Results of all types of analysis, such as, (i) literature survey (ii) primary household survey, (iii) model results, and (IV). Simulation results have been discussed in detailed to arrive at plausible recommendations.

1.22 RECOMMENDATION

A set of policy guidelines is prepared based on the results, discussions and findings of this investigation for integrated development of the study area.

1.23 JUSTIFICATION OF THE STUDY AREA

The study area (Thiruvananthapuram city) is divided in to three natural divisions, such as, highland, midland, and coastal plains; each has distinct characteristic features in relations to landform, resources, population density, socio-economic activities, infrastructure facilities, etc. This city has a higher density of population, i.e., 5245 persons per square kilometer in the city, 1480 persons per square kilometer in district as a whole in 2001. The present investigation aims at to prepare a perspective plan, i.e., for 2031 A.D. Since the city has the aforesaid distinct characteristic features, it is not possible to accommodate more number of populations in the system. At the same time, the Government has changed its policies to liberalize its economy by encouraging privatization in education, health, knowledge based industries, etc. As a result,

more number of institutions (based on education, health, information technology, etc.,) came up in the system, which attract more number of populations. These institutions need more quantity of land (bulk quantity of land) with supporting infrastructure facilities. Bulk quantity of land is not available in the core area of the city, and the available small size of land costs also very high compared to the land available in the hinterland. Therefore, the entrepreneurs started to setup institutions in the periphery of the city, and even faraway from the present city limit, which pave the way for spreading the city in to the whole district. The Investigator felt, by looking at the present trend, that in the year 2031A.D, Thiruvananthapuram city would be spread in the entire Thiruvananthapuram district if the present trend continues. Moreover, the present city limit does not have the bearing capacity of additional population as above-mentioned. Therefore, the entire district is considered for this present investigation.

The existing condition of the Thiruvananthapuram district is presented in detail in the second chapter where the study area profile is presented since the Thiruvananthapuram district as a whole is considered for perspective planning.

CHAPTER SCHEME

The thesis is organized in the following chapters:

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

Chapter two: Chapter two deals with study area profile (Thiruvananthapuram district).

Chapter three: Chapter three describes the urbanization trend of the Thiruvananthapuram city.

Chapter four: Chapter four deals with the analysis of physical, socio-economic, infrastructure and environmental condition of the study area.

Chapter five: Chapter five illustrates the dynamic functions of the study area under various alternative conditions.

Chapter six: Chapter six deals with results, discussions and findings.

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

CHAPTER 2

STUDY AREA PROFILE

2.0 THIRUVANANTHAPURAM CITY

2.1 LOCATION

Thiruvananthapuram city is confined within the Thiruvananthapuram District, is located at 8^0 17' and 8^0 51' N latitude and 76^0 41'and$77^0$17'E longitudes, and it lies in the Southern part of the Kerala State. It is surrounded by the Kanya Kumari District of Tamil Nadu in the South, Thirunnelveli District of Tamil Nadu in the East, Kollam District of Kerala State in the North and the silvery coast of Arabian Sea in the West. Thiruvananthapuram city is the Capital city of the Kerala State as well as the Headquarters of Thiruvananthapuram District. The total area of the city is 142 sq. km, which is not reflecting the actual area confined in this city, and is presented in Figure, 2.1

2.2 HISTORICAL BACKGROUND

History of the Thiruvananthapuram city is interlinked with the History of the Princely State of Travancore (Venad). Thiruvananthapuram city has been developed around the Sree Padmanabha Swamy Temple, which was patronized by the royal family of Travancore. The King Ravi Varma Kulasekharan renovated the temple in 1314 AD. The name Thiruvananthapuram is the Anglicised form of Thiru Anantha Puram, which means the town of "Thiru Anantha". The existence of Thiruvananthapuram was observed in early literature, which was written in 13 century AD. "Ananthapuravarnana" that an area lied in between Neyyar and Vamanapuram rivers, and the existence of a University named "Kanthalloor sala"

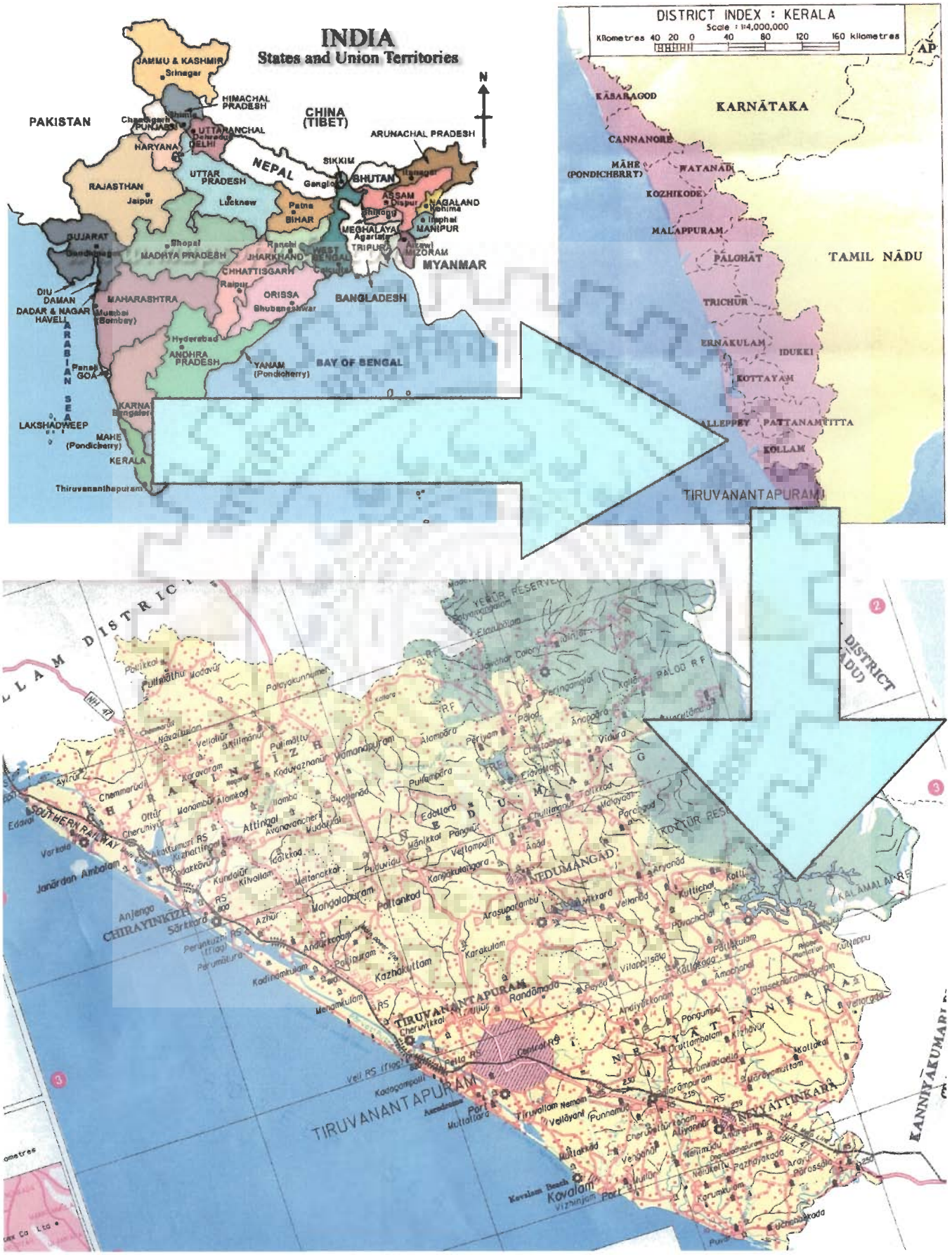


FIG. 2. LOCATION OF THIRUVANANTHAPURAM DISTRICT

was also mentioned in the same literature, which reveals that Thiruvananthapuram might have developed before 1200AD. Another early literature known as "Unnineelisandesam" was written in 14 century AD, which not only confirmed about the existence of Thiruvananthapuram but also establish the land route known as "Kollappervazhi" connecting Thiruvananthapuram and Kollam, the Capital of the then Venad Kings. The Capital of the State was shifted to Padmanabhapuram, 55 kilometer away towards the south of Thiruvananthapuram after the destruction of Kollam by the "Cholas". MarthandaVarma Maharaja (1729-1758 AD) is considered as the founder of the modern Travancore state, where Padmanabhapuram was the Capital of the Princely State of Venad till the first half of 18th century. King Dhrama Raja (1758-1798AD) shifted his Capital from Padmanabhapuram to Thiruvananthapuram during the second half of the 18th century. Raja Kesavadasan, the Divan of Dharma Raja constructed ports at Vizhinjam, Kulachal, Poonthura, a Shipyard at Vizhinjam, developed the Chalai Market, constructed the Gopuram (Tower) of the Padmanabha Swamy Temple, etc., during the same period. Thiruvananthapuram enjoyed many privileges, being the seat of family deity of the Venad kings. In 1824 AD, Col Munro developed an inland water transportation route from Thiruvananthapuram to Kollam by connecting Paravoor Backwater and Kadinamkulam Backwater. Ramavarma Ayilliam Thirunnal made two tunnels in the Varkala cliff in the year 1880 AD, and made the route as a thoroughfare. In the year 1860 AD, the construction of Anantha Victoria Marthanda Varma Canal connecting Thiruvananthapuram and KanyaKumari was started and completed in a later period. During the period of Ramayyan Dalawa, Public works Department was started and appointed Mr. Barton as the Chief Engineer (1863 AD), which

paved the way for the development of Thiruvananthapuram-Chencottah road and was completed in 1875 AD. The concept of National Highways was introduced, after Independence and the road connecting from KanyaKumari to Salem was notified as National Highway –47, which passes through this city and major towns in the District. In the year 1949 AD, Travancore and Cochin States were merged together and formed Travancore-Cochin State, and the status of the District was continued till the year 1956 AD. Thiruvananthapuram District of the erstwhile Travancore-Cochin State had eight Taluks such as, Thovala, Agasteeswaram, Vilavancode, Kalkulam, Neyyattinkara, Thiruvananthapuram, Nedumangad and Chirayinkil. In the year 1956 AD, when the state was reorganized based on linguistics, four Taluks such as, Thovala, Vilavancode, Agasteeswaram and Kalkulam were Tamil language speaking people confined were bifurcated from the Thiruvananthapuram District and formed the present KanyaKumari District and was merged along with the Tamil Nadu State. The remaining four Taluks form the present Thiruvananthapuram District. The present Thiruvananthapuram city covers more than 80 per cent inhabited area of the Thiruvananthapuram District of the Kerala State.

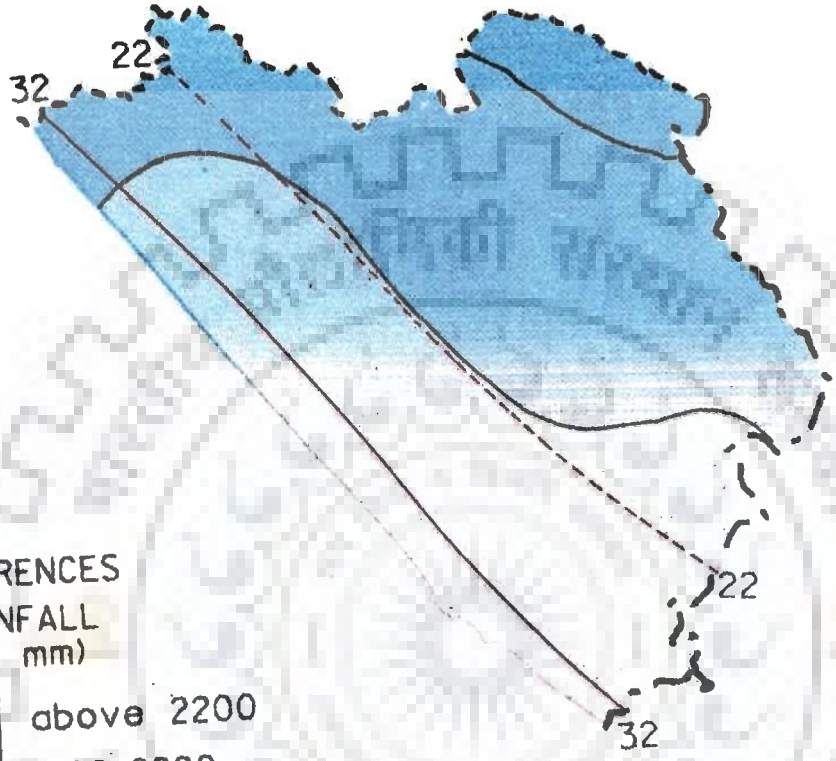
2.3 PHYSICAL ASPECTS

Thiruvananthapuram city enjoys heavy rainfall, high humidity, and a fairly uniform temperature through out the year. The city experiences a bright clear sky and the average temperature is noted between 23.3^{0}C and 30.6^{0}C even during the winter season, i.e. from December to February. The average rainfall of the city is 2112 mm/year, which is much lesser than the States average of 3232 mm/year. The details of annual and monthly rainfall of the district are presented in Figure 2.2

CLIMATIC CONDITION

Scale 1:1,000,000

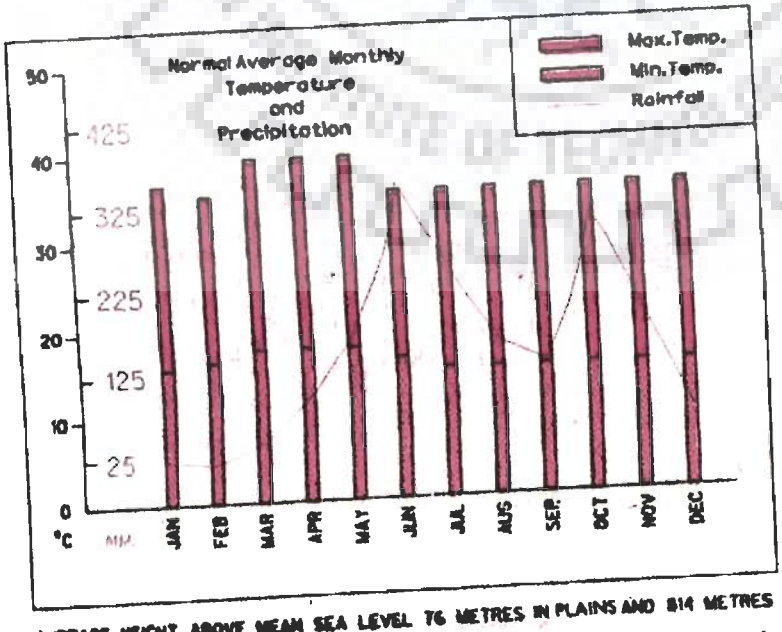
Kilometres 10 0 10 20 30 40 50 Kilometres



REFERENCES

RAINFALL (in mm)

- above 2200
- 1800-2200
- below 1800



TEMPERATURE (in 0°C)

Summer maximum

Winter minimum

AVERAGE HEIGHT ABOVE MEAN SEA LEVEL 76 METRES IN PLAINS AND 814 METRES IN GHATS/HILLS.

Sources: 1) National Atlas. 2) Meteorological Dept.

Number of Hillocks and Valleys are confined in the city and are controlling the temperature of the city, and it has slopes from East to West. There are three natural divisions emerged in the State, which are low land, mid land and high land, and are also seen in this District explicitly. The low land and the mid land are densely populated, whereas in the high land it is not so, since the area is characterized by the Reserve Forest. The major rivers, such as, Karamana, Neyyar and Vamanapuram are originating from the highland and flows towards the Arabian Sea, which is confined in the Western side. There are six water lagoons available in the District, such as, Akkulam Kayal, Anchutengu Kayal, Kadinamkulam Kayal, Veli Akkulam Kayal, Edayar Lake and Vellayani Kayal. There are 1542 perennial ponds confined all over the study area. The physical characteristic features of the study area is presented in Figures 2.3, 2.4 & 2.5.

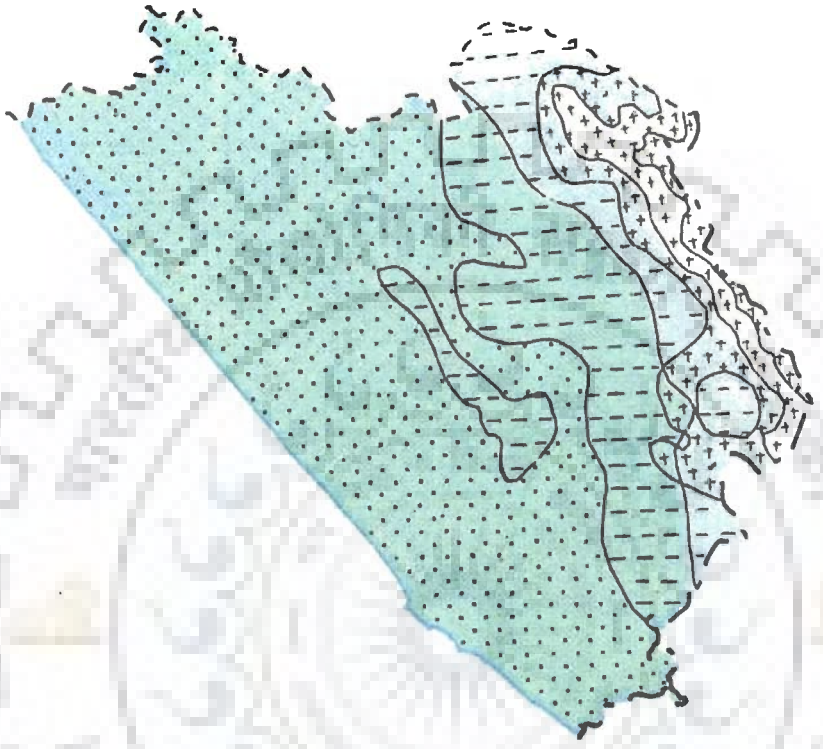
2.4 PHYSICAL DEVELOPMENT OF THE CITY

Thiruvananthapuram District has been divided into four Taluks (Figure 2.6) such as Chirayinkil, Nedumangad, Thiruvananthapuram and Neyyattinkara. The District has been further divided into 12 Community development blocks for the purpose of development administration. They are (1) Varkala, (2) Kilimannoor, (3) Chirayinkil, (4) Vamanapuram, (5) Nedumangad, (6) Vellanad, (7) KazhaKuttom, (8) Nemom, (9) Adhiyannoor, (10) Thiruvananthapuram rural, (11) Perumkadavila and (12) Parassala. There are four Municipalities (Figure 2.7) such as (1) Varkala, (2) Attingal, (3) Nedumangad, (4) Neyyattinkara and a Municipal Corporation known as Thiruvananthapuram are confined in this District. In addition to the above, there are 88 Gram Panchayats also confined in this District and are presented in Taluk wise in Table 2.1

RELIEF AND SLOPE

Scale 1:1,000,000

Kilometres 10 0 10 20 30 40 50 Kilometres



REFERENCES

ELEVATION
(In metres)

- Above 1000
- 500-1000
- 100-500
- 0-100

SLOPE (In metres per km)

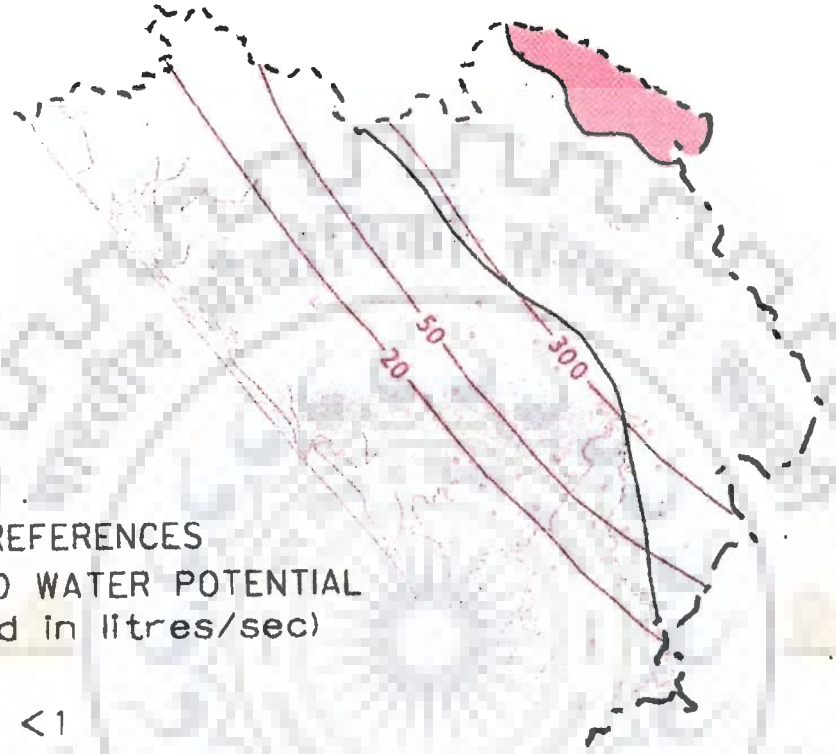
- 300-600
- 10-300
- less than 10

Source: Survey of India.

IRRIGATION AND HYDROGEOLOGY

Scale 1:1,000,000

Kilometres 10 0 10 20 30 40 50 Kilometres



REFERENCES

GROUND WATER POTENTIAL
(Yield in litres/sec)

- < 1
- 1-5
- 10-25

GROUND WATER HYDROLOGY

- 50 — Water Table Contour (m.a.msl.)
- Direction of ground water flow

IRRIGATION

- Tube-well
- Canal
- Well

Source: Central Ground Water Board.

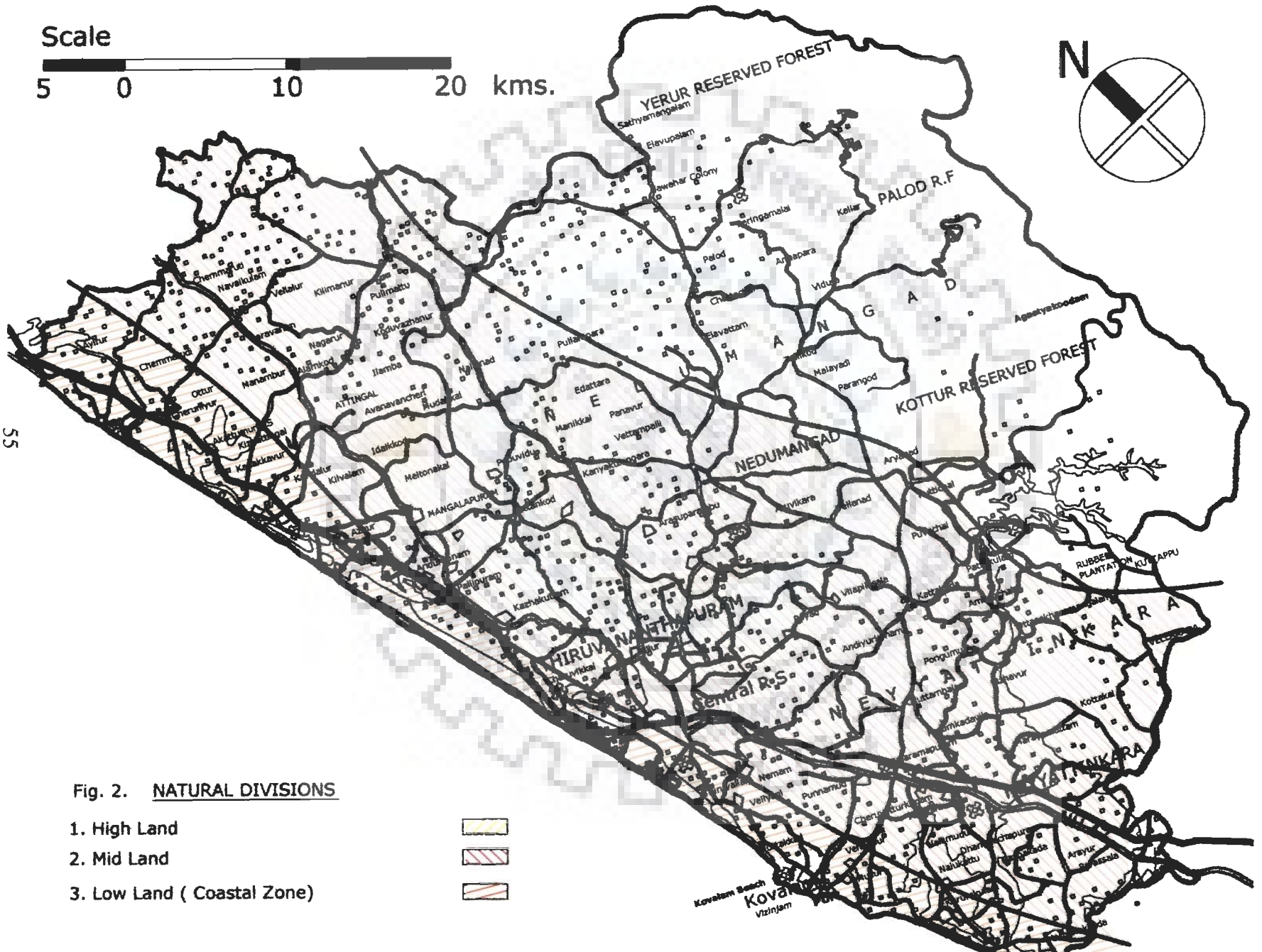


Fig. 2. NATURAL DIVISIONS

1. High Land
2. Mid Land
3. Low Land (Coastal Zone)

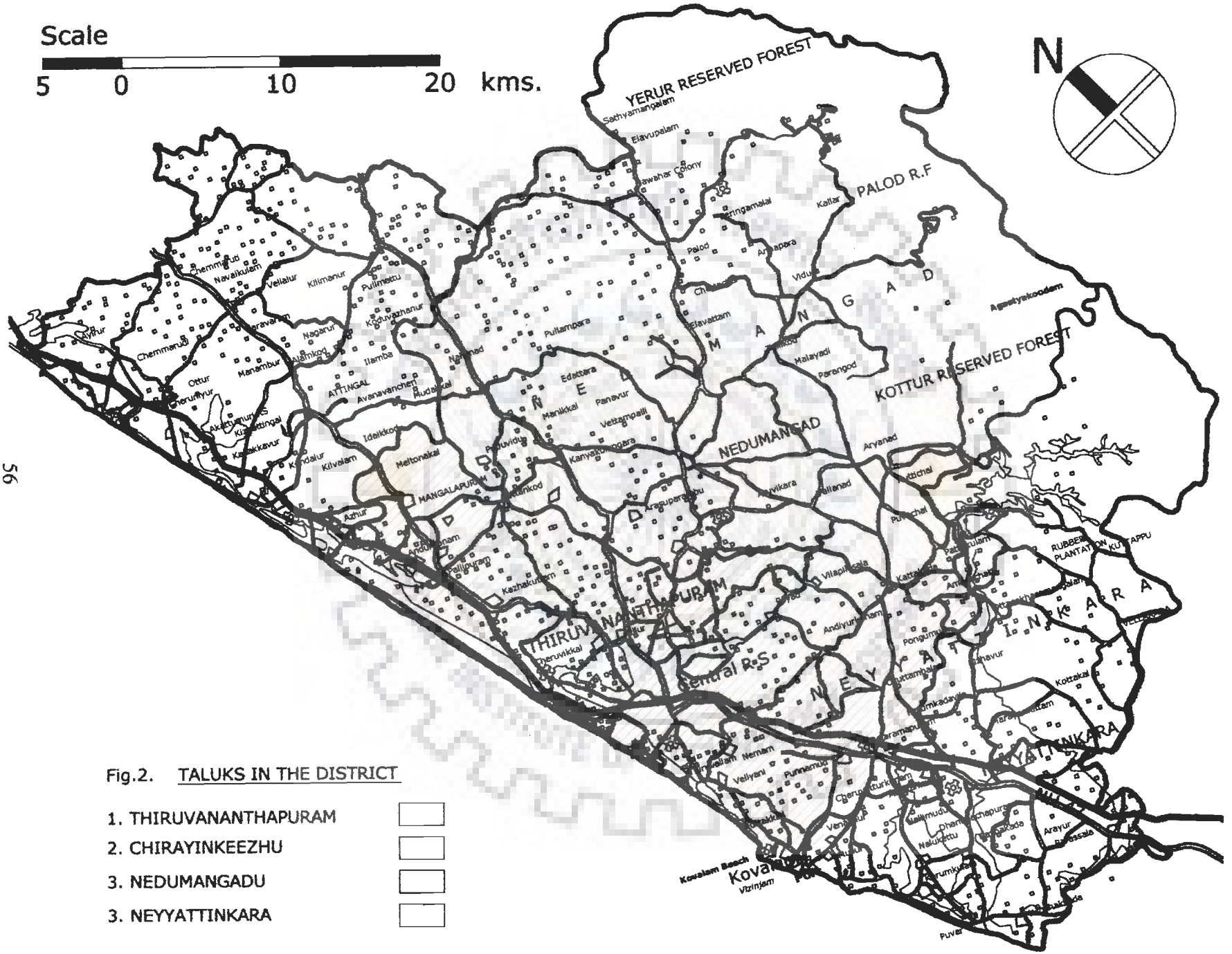


Fig.2. TALUKS IN THE DISTRICT

1. THIRUVANANTHAPURAM
2. CHIRAYINKEEZHU
3. NEDUMANGADU
3. NEYYATTINKARA

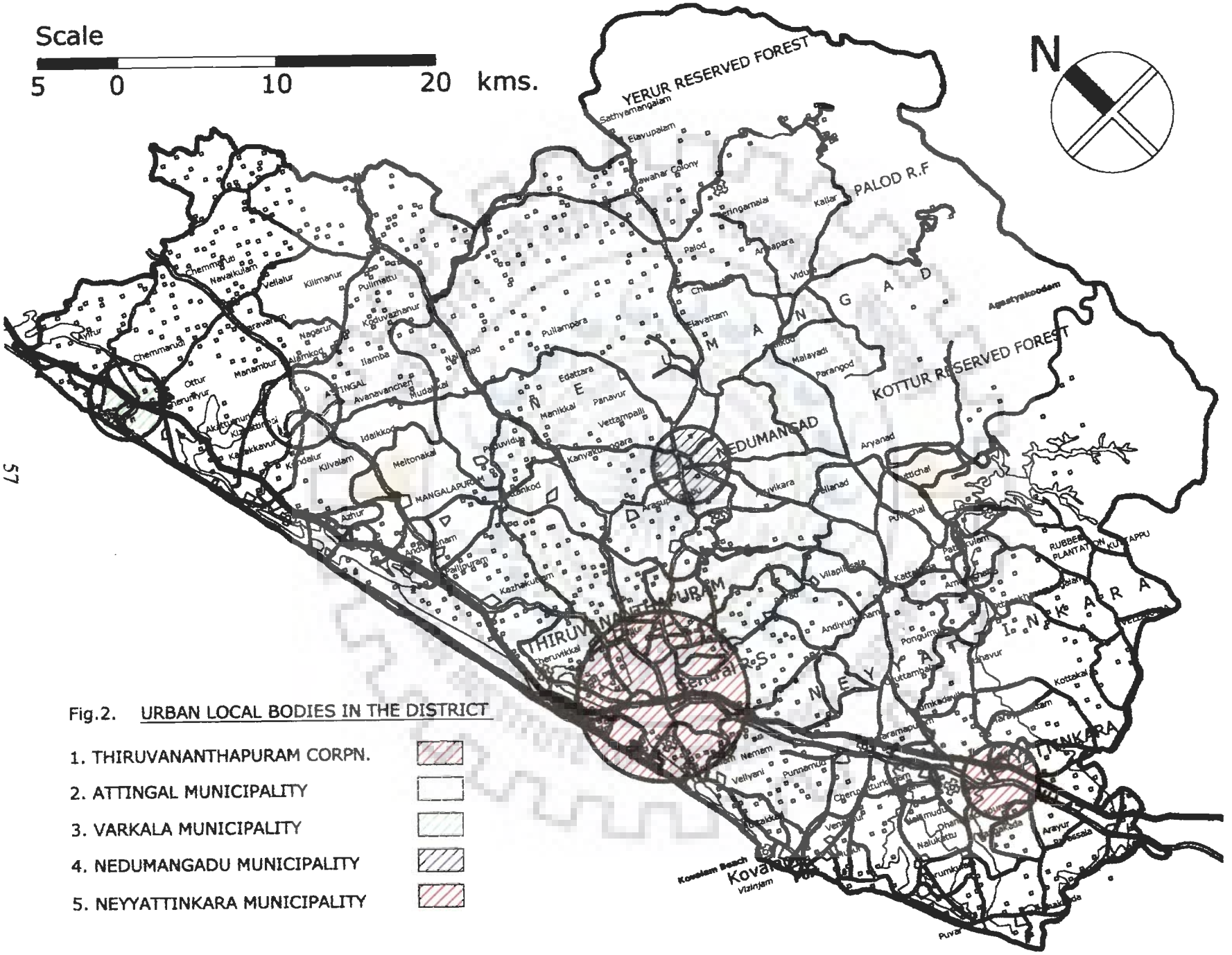


Fig.2. URBAN LOCAL BODIES IN THE DISTRICT

1. THIRUVANANTHAPURAM CORPN.
2. ATTINGAL MUNICIPALITY
3. VARKALA MUNICIPALITY
4. NEDUMANGADU MUNICIPALITY
5. NEYYATTINKARA MUNICIPALITY

Table 2.1 Details of administrative functionaries in the study area

SL NO	Name of Taluks	No of corporations	No of Municipalities	No of Community development Blocks	No of Gram Panchayats
1	Thiruvananthapuram	1	0	3	10
2	Nedumangad	0	1	3	20
3	Chirayinkil	0	2	3	22
4	Neyyattinkara	0	1	3	26
5	Total	1	4	12	88

Source: District Administration, government of Kerala-2001

The table explains that the Thiruvananthapuram Corporation is confined in the Thiruvananthapuram Taluk of the study area. The Municipalities are almost uniformly spead over the entire district. The number of Gram Panchayats also almost uniformly spread across the District except in the Thiruvananthapuram Taluk since Thiruvananthapuram Taluk is more urbanized than the rest of the Taluks of the District. Thiruvananthapuram city is the Administrative Capital of the State, and it has many specialized Institutions, which are serving for the entire State and also function as one of the major destination centres of Health, Higher Education and Tourism in the Southern part of the country.

Physical development of this city lies along with the major transportation corridors, as in the case of other cities of Kerala State. The Government Secretariat, are most of the major Institutions, etc are located in the city centre since this city is being the administrative capital of Kerala State. Major commercial centres of the city are located at Chalai (wholesale market), Palayam, and also

besides the Mahatma Gandhi road, a portion of the National Highway-47. Recreational centres, such as, Stadiums, Zoo, Museum, Parks, Theatres and other Cultural centres are also scattered over at various parts of the city. Though the city was emerged few centuries ago, a vast development is witnessed in the recent years, and the city has been spreading towards the suburban areas, such as, Veli, Sangumugham, Papanamcode, KazhaKuttom, Nedumangad, Balaramapuram, Venjaramood and Attingal. This city is blessed with several kinds of specialized institutions, and noted among them are Space Research Center - Thumba and Valiyamala, Tropical Botanical Garden research Institute - Palode, Central Tuber Crops Research Institute- Sreekariyam, Central Power Research Institute-Sreekariyam, Rajiv Gandhi Institute of Biotechnology-Thiruvananthapuram, Sree Chitra Institute of Medical science and Technology-Medical College Campus, Video park -KazhaKuttom, several Engineering Colleges, University Campus - Kariavattom, Techno Park - KazhaKuttom, Equatorial Rocket Launching Station (TERLS)- Thumba, Lakshmibai National Institute of Physical Education-KazhaKuttom, and number of other specialized Medical Institutions.

2.5 DEMOGRAPHIC CHARACTERISTICS

According to the Census of India 2001, the total population of the Kerala State is 31838619, which is spread over an area of 38855 square kilometer. The population density of the State is 820 persons per square kilometer. This is far higher than that of the National population density 324 persons per square kilometer. Thiruvananthapuram District is having a population of 3234707 spreads over an area of 2186 square kilometer bearing a density of 1480 persons

per square kilometer. The details of the population of the Country, State and District are presented in Table 2.2.

Table 2. 2. Population - 2001

S. No.	State	Population (Numbers)	Decadal growth rate (%)	Sex ratio	Population density (2001)	Literacy rate (%)
1	India	1027015247	21.34	933	324	65.38
2	Kerala	31838619	9.42	1058	819	90.92
3	Thiruvananthapuram	3234707	9.78	1058	1480	89.35

Source: Census of India -2001

The table illustrates that India has the population growth of 21.34 per cent in a decade (1991-2001) and the state (in which the study area lies) has only 9.42 per cent growth rate, which is very low compared to the national growth rate. It is very interesting to note that the study area is also almost having the same trend of population growth i.e., 9.78 per cent in the same period. In fact, the State (Kerala State) gives more importance towards Human Resource Development, and the annual budget allocation towards Human Resource Development is also phenomenal, which leads to higher literacy rate in the State. As a consequence, the population of the State is well aware of the problems of over population growth that checks the population growth. Further, the table also reveals that the study area has a population density of 1480 persons per square kilometers, which is much higher than the State density of population, whereas the study area has 89.35 per cent literacy rate which is similar (90.92 per cent) to the literacy rate of the State. These show that the literacy is spread over the State uniformly.

2.6 POPULATION DENSITY

The population density of the District is 1480 persons per square kilometer. This varies among the four Taluks. Of the four Taluks, Thiruvananthapuram Taluk enjoys the highest density of population in the District. It has been observed that very thick population density is found in the city centre and the coastal belts, i.e. up to 10,000 persons per sq. km, whereas, it is ranging from 2500-5000 persons per square kilometer in the neighboring Panchayat areas. The details of the population density of the District by Taluks wise is presented in Table 2.3 & (Figure 2.8).

Table 2.3 Population density

Sl. No.	Name of the Taluks	Area in sq.km	Population 2001	Density
1	Chirayinkil	380.68	624379.00	1640.00
2	Nedumangad*	785.86-498.68=287.20	631909.00	2200.00
3	Thiruvananthapuram	307.55	1114049.00	3622.00
4	Neyyattinkara	570.91	864370.00	1514.00
5	Total	2045.00	3234707.00	1582.00

Source: Census of India 2001 Report

* This Taluk has 498.68-sq.km area of uninhabited area. Therefore the density of population is much lesser compared to the other Taluks.

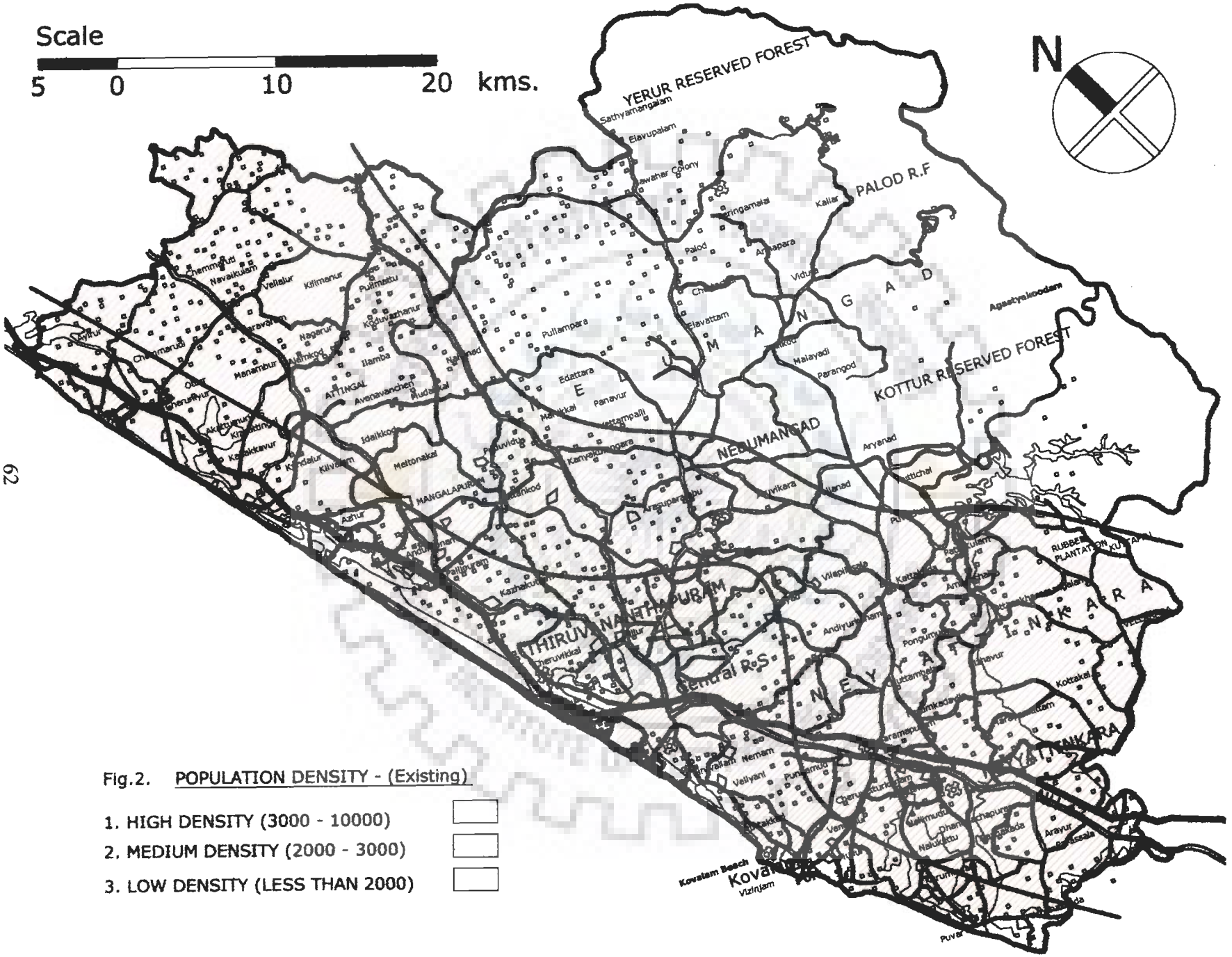


Fig.2. POPULATION DENSITY - (Existing)

1. HIGH DENSITY (3000 - 10000)
2. MEDIUM DENSITY (2000 - 3000)
3. LOW DENSITY (LESS THAN 2000)

2.7 LITERACY

The 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 Kerala state enjoys the highest literacy rate in the country with 90.92 per cent. It has been observed that the Thiruvananthapuram city has 95 per cent, but in some coastal pockets where fishermen folk live have only about 60 per cent literacy. It clearly indicates that these fishermen folks never given much attention to education. The details of the literacy rate in the four Taluks of the District is presented in Table 2,4

Table 2.4: Literacy Rates by Taluk wise, 2001

Sl.No	State/ District/ Taluk	Population Taluk wise	Literacy rate								
			Total			Rural			Urban		
			Person	Male	Female	Person	Male	Female	Person	Male	Female
1	Thiruvananthapuram	3234707	89.36	92.68	86.26	88.04	91.84	84.53	91.90	94.27	89.65
2	Chirayinkil Taluk	624379	88.61	92.54	85.22	88.27	92.73	84.46	90.93	91.21	90.67
3	Nedumangad Taluk	631909	87.85	92.19	83.86	87.68	92.04	83.66	89.65	93.73	85.85
4	Thiruvananthapuram	1114049	91.95	94.64	89.40	89.31	92.91	85.91	92.71	95.13	90.41
5	Neyyattinkara Taluk	864370	87.61	90.59	84.71	87.72	90.75	84.78	86.73	89.35	84.17

Source: Census of India -2001

The table illustrate that the Thiruvananthapuram district has higher literacy rate i.e., about nine tenth of the population is literate (89.36 per cent). It has been observed that the literacy is almost uniformly distributed all over the study area

irrespective of urban or rural segment, and by sex (either male or female). It is interesting to note that though the intensity of urbanization is much higher in Thiruvananthapuram Taluk, compared to other Taluks, the difference of literacy rate observed is very negligible. This shows that education facilities are spread all over the study area, and the people are also more concern towards education.

2.8 EMPLOYMENT

As mentioned in the Physiography, there are three distinct natural divisions such as, high- land; mid- land and coastal area are confined in this District. The Chirayinkil Taluk falls both in coastal and mid- land, while the Nedumangad Taluk lies in the mid land and high- land, Thiruvananthapuram Taluk covers the coastal areas, and the mid- land, and Neyyattinkara Taluk spread over in all the three divisions. The employment opportunities in this District spread over all the three sectors of the economy. The majority of employment opportunities available in the coastal as well as in the high- land are of primary sector in nature, whereas in the mid land region mainly caters the secondary and tertiary sector activities, which includes manufacturing and services. The coastal area of Chirayinkil Taluk is famous for coir industry, and Industrial estates are also located at Pappanamcode of Neyyattinkara Taluk and Veli of Thiruvananthapuram Taluks. Balaramapuram of Neyyattinkara Taluk is famous for handloom industry. In the Thiruvananthapuram Corporation area, more than 75 per cent of the people engaged in non-agricultural activities, except the fishermen folks. In most of the Gram Panchayats, more than 75 per cent of the population engages non-agricultural activities except Kalliyoor, Pallichal, Vilappil and Vilavoorkal. The Fishermen community predominantly occupies the

coastal area of the District. There are 50950 active fishermen (marine) live in this District. The details of the workers in the four Taluks are presented in Table 2. 5.

Table 2.5: Working population in Thiruvananthapuram District

(Population in numbers)

Sl. No.	Name of Taluk	Working population		
		Total	Male	Female
1	Chirayinkil	204093 (100.00)	142319 (69.73)	61774 (30.27)
2	Nedumangad	201459 (100.00)	162386 (80.60)	39073 (19.40)
3	Thiruvananthapuram	369862 (100.00)	280652 (75.88)	89210 (24.12)
4	Neyyattinkara	273037 (100.00)	224016 (82.04)	49021 (17.96)
5	Total	1048442	809364	239078

Source: Directorate of Economic and statistics, Government of Kerala Thiruvananthapuram -2001

The table shows that the District has more number of working populations. The detail classification of working population reveals that Thiruvananthapuram Taluk has more number of working populations compared to the other Taluks since it lays core area of the city. It has been also observed that availability of female population is much higher. The female work force represent almost one quarter of the working population of this District The Taluk wise classification of female working force explains that about one third of work force is female (30.27 per cent) in Chirayinkil Taluk, where the coir based industrial activities are confined. Followed by Thiruvananthapuram Taluk, where female workforce represents one- forth of the total workforce (24.12 per cent). The rest of the Taluks are also having considerable amount of female working

force. These show that females are given due importance in the system, and becoming decision makers in various capacities. These trends lead to multidimensional development in the system.

It has also been observed that there are 1323947 employees working in various organizations, which include State government service, Central government service and private sector in the State. The available workers in the State and the district are presented by State government service, Central government service and private sector services in Table 2. 6.

Table 2.6 Employment in Public and Private sectors in the State and District - 1999

Sl. No.	Unit	State Government	Private	Central Government	Total
1	State	639350 (48.29)	581605 (43.92)	10299 (7.90)	1323947 (100.00)
2	District	132136 (63.86)	43326 (20.94)	31442 (15.20)	206904 (100.00)
3	Percentage	20.66	7.44	30.52	15.62

Source: Directorate of Employment and Training, Government of Kerala, Thiruvananthapuram-2001

The table illustrate that at the State level, about half of the working population (48.29 per cent) are working in the State Government services, a considerable amount of working population (43.92 per cent) work in private sector, and a very meager amount of population (7.90 per cent) work in the Central Government organizations, which are confined in the state. Whereas, the district level employment data reveals an interesting trend i.e., of the total District workforce, about two third of them (63.86 per cent) work in the State Government organizations, one fifth of them (20.94 per cent) work in the private sector, and a very meager (15.20 per cent) work in the Central Government organizations. The

above trend clearly explains that, the available State Government, and Central Government organizations are more or less largely confined in this District since the administrative capital of the State is also confined in this District.

2.9 LAND USE

Characteristic features of the land are also the most important parameters, which decide the functions of the urban system. If the urban system has more quantity of undulated terrain, possibility of physical development at larger scale is very meager since large-scale industrial development needs lot of resource movement and that can be possible only in the plain areas. To have steady development in an urban system, more industrial activities have to be developed in the process of urbanization. Therefore, analysis of the characteristic features of land and land use pattern of the urban system, etc., occupy a major area of interest in planning.

As already pointed out, the District has three distinct characteristic features of land. They are lowland, mid-land and highland and the land use pattern also showing little differences in these divisions within the District. The land use pattern of the District is presented in 2.7

Table 2.7 Land use pattern of the District-2001

Sl No	Land use	2001	
		Area (in hectors)	Per cent
1	Residential with cash crops	60809.00	27.81
2	Industrial	533.70	0.25
3	Trade and Commercial	1047.80	0.50
4	Public semipublic	8153.78	3.73
5	Roads and streets Transportation)	8175.64	3.74
6	Paddy fields& wetlands	78477.40	35.90
7	Forest area	51152.40	23.40
8	Parks & open spaces	4612.46	2.11
9	Water bodies	5596.16	2.56
10	Total	218600.00	100.00

Source: Statistics for planning, Directorate of economics and Statistics, Government of Kerala-2001

Of the total area, more than one –third of the area is (35.90 per cent) is covered under agricultural operations. Followed by residential area occupies more than one –fourth of the area (27.81per cent). It is interesting to note that the plantation crops, such as, coconut and pepper, predominantly cover the residential areas. This district has considerable amount of forest cover, which is also about one –fourth of the total area (23.40 per cent). Other activities, such as, transportation, public and semipublic, water courses, recreation, trade and commerce and industries covered the areas 3.74 per cent, 3.73per cent, 2.56 per cent, 2.11per cent, 0.502 per cent and 0.256 per cent respectively, which shows that industrial activities are almost negligible. Since about three-fifth area (59.30 per cent) of the District is covered under agriculture and forest, plantation crops are thickly covered in the residential areas, which is also accounted for more than one –fourth of the total area (27.81 per cent) and water courses occupies about three per cent of the area. The District has a very good living environment. The Government of kerala is also protecting this conducive environment to certain extend by suitable rules and regulations. Since industrial activities are absolutely negligible (only 0.256 per cent of the area) the district is environmentally well protected.

In fact the District has several peculiar characteristic features of land uses. It has a cover of water bodies (which include six lagoons, 1542 ponds, and three rivers and ecologically sensitive areas. The high land is dominated by forest and tea plantation. The total forest cover of the District is 22.40 per cent of the total area. This District has about 965 hectares of Tea Plantation, which form 2.76 per cent of the total Tea Plantation in the State.

The mid land is dominated by the mixed land-uses, which include Tapioca, Cashew, Mango, Jackfruit, Banana and Coconut crops. A major portion of land in this region is used for residential, commercial and other Developmental activities.

The coastal area is characterized by high density of residential use mixed with water bodies and lagoons. Coconut plantation are very much dominant in this area.

2.10 LAND VALUE

The land value of the District is controlled by its potentiality within the existing city limit, accessibility, terrain, strata, etc., In addition to the location factors, such as nearer to the work place, educational institutions, recreation centres, etc, also occupy prime important in deciding the land value. Thiruvananthapuram District has an undulating terrain beneath, which is a hard stratum, suitable for any type of construction activities. Land values in the midland (within the city corporation limit) have drastically increased in the recent years, and it has been doubled at present compared to the year 1993. The highest land value is observed in the core area of the city, central business district (CBD) areas, developed residential areas, within the urban limit of theTaluk Head Quarters, etc. In addition to the above, certain pockets that lie within the District, such as Kallambalam, Venjaramood, Pothencode, Vembayam and Balaramapuram also have high land value equivalent to the city centre. This ranges from Rs 20000 to Rs 25000 per square meter of land. It has been observed that the cost of land is ranging between Rs 5000 to Rs 10000 per square meter in the outskirts of the CBD area. In the coastal area, the land value ranges from Rs. 600 to Rs 5000 per square meter of land.

A shift in land value is observed from the midland to highland. The value in highland is Rs 250 to Rs 500 per square meter, which is considerably very low compared to the midland value. The plantation area, which lies in the highland, has very lesser value, and it is ranging from Rs 100 to Rs 150 per square meter.

Land being a scarce commodity, the open spaces available nearer to the C.B.D areas, which are presently used for agricultural operations, are being converted into residential purposes due to the peculiar landform of the city. Formerly, most of the valleys were retained as paddy fields, which acted as storage places of excess water during the rainy seasons and avoided flooding in other areas of the city. Recently, there has been a trend of filling up the paddy fields, and converted into use as residential plots. Though the existing paddy fields have been zoned as green belts, residential construction is allowed in violation to the development plan of the city.

In the recent years, the Government's new educational policy again boosted the land value in this District. The Investors in education and its allied activities are occupying bulk quantity of agricultural land and establish education and allied institutions. The new policy of establishing of new Educational Institutions in the Co-operative and Private sectors also pave the way of opening up of new institutions in this District.

2.11 ECONOMY

Generally, the primary or the secondary sector of the economy dominates developing countries, whereas, the tertiary sector dominate in the developed countries economy. Though the Indian economy is a developing one, the tertiary sector is more or less dominate in Kerala State in general, and the study area in

particular. Industrial pursuits (activities) covered only 0 .25 per cent of the total area of the District. This clearly shows that the industrial activities are negligible in the study area.

Tertiary sector of the economy is dominant in the Corporation area, the Municipality Head Quarters and the urban areas of this district. The Status of the economy of the District reveals that the contribution of tertiary sector (net domestic product at current prices) is increased from Rupees 1642476 in 1995-96 to Rupees 3168126 in 1999-2000, whereas the contribution of primary and secondary sector towards the total economy is decreased in the corresponding period. It is evident that tertiary sector of the economy dominates the economic structure of this District.

2.11.1 Industry

Industrial activities are very much essential for the development of the economy. As already pointed out the industrial activities are very much negligible in this district. However, the district has two major industries which are owned by the Government of India are presented in Table 2.8.

The table explains that only two Government owned industries are available in this District, where hardly 2566 persons are employed, and their transactions are also very limited, ie, Rs 9169 lakhs (sales data). Besides these two major industries, there are several public and private institutions, trade and commercial centers, etc are confined in this district. In addition to the above, few industrial institutions are come up very recently in this district, which draw more attention. They are the Techno Park (software industrial park), Video Park, Kerala State Electronics Development Corporation, and two industrial Estates The

location of the aforesaid all available industrial institutions are presented in Figure 2. 4.

Table 2.8: Government of India companies limited – Manufactures in the District

Sl. No.	Name of unit	Persons Employed	Value of production in lakhs	Sales in lakhs
1	Hindustan latex	2122	8183	8179
2	Vijaya Mohini Mill	444	1086	990
3	Total	2566	9269	9169

Source: Directorate of Economics and Statistics, Kerala State, 2002.

2.11.2 Forest

The forest coverage particularly in this district has special characteristic features. They are: (1) located in high altitude (2) evergreen, (3) Ponmudi hill station is located, (4) Agastiarmala bio diversity reserve forest is located, (5) two rivers such as, Karamana and Neyyar are originated from this land, (6) three reservoirs such as, Neyyardam, Pepparadam and Aruvikaradam are situated in the foothills of Ponmudi hill station, which give water supply to the Thiruvananthapuram Corporation, Municipalities and for irrigation activities. The forest products are varying in kinds. The details of the forest area, Natural Park and sanctuaries and the income accrued from the forest area are presented in Table 2.9,2.10,2.11 respectively.

Table 2.9: Details of Forest area in the State and District,(Sq.Km)

Sl. No.	Item	State	Per cent	District	Per cent
1	Forest area	10815.00	27.83	498.60	23.40
2	Total area	38855.00	100.00	2186.00	100.00

Source: Forest Department, Government of Kerala, 2001

The table explains that the total area of forest covered in the State and the District are 10815.00 and498.60sq.km respectively. Further, it illustrates that district forest coverage is slightly lesser than the State level coverage, i.e., in the state more than one –fourth of the total area is covered under forest (27.83 per cent), whereas in the District it is less than one –fourth of the total area (23.40per cent)

Table 2.10: Natural Park and Sanctuaries in the State and District

Sl. No.	Jurisdiction	Area in sq km	Natural park & sanctuaries	Per cent
1	State	10815.00	2325.00	21.49
2	District	498.60.	181.00	36.30

Source: state Forest Department, Government of Kerala- 2001

The table depicts the total area under Natural Park and sanctuaries available in the forest coverage of the State and the District are 2325 and 181 sq.km respectively. It is interesting to note that the District has more than one – third of area under natural park and sanctuaries in the available forest area ie, 36.30per cent, whereas in the State, it is much lesser, ie, 21.49 per cent.

Table 2.11: Details of Forest produce

Sl. No.	Year	District			
		Timber in round log (m3)	Timber in round pole (m3)	Sawn and square timber (m3)	Fuel wood (m ton)
1	1992-93	313	94	7	357
2	1993-94	2548	29	13	2683
3	1994-95	1025	1399	1.4	16117
4	1995-96	577	399	10	284
5	1996-97	138	6224	.5	1260
6	1997-98	50	-	-	70
7	1998-99	52	28	1.6	5487

Source: state Forest Department, Government of Kerala-2001

This table illustrates that the different types of goods produced in the forest. It has been observed that the products from the forest except fuelwood are decreasing from the year 1993-94 to 1998-99. The Investigator further had discussion with the officials of the forest department, and found that the forest coverage of the District is kept under reserve forest category, and woodcutting for timber is not permitted except extracting fuel wood. Therefore, the forest produce is very less in this District.

2.11.3 Animal Husbandry

The District has about 468052 numbers of livestock, including cow, buffalos, and goats, sheep, which forms 8.3 per cent of the total livestock of the State. The District also holds 7.6 per cent of the total poultry population of the State. The details of the available livestock and poultry are presented in Table 2.12.

Table 2.12: Livestock Population in the State and District in 1996

Sl. No.	Item	State	Per cent	District	Percentage
1	Cattle	3396355	54.60	255516	54.59
2	Buffalos	165125	3.23	15304	3.27
3	Goats	1860501	41.05	192017	41.02
4	Sheep	6058	0.09	378	0.08
5	Pigs	142784	1.00	4683	1.00
6	Others	6114	0.03	160	0.03
7	Livestock (Total)	5576917	100.00	468058	100.00
8	Poultry (Total)	26946091	100.00	2048252	7.60

Source: Animal Husbandry Department, Kerala State-2001

This table explains that the study area is almost covered by milk animals, which include cow, buffalos and goats, i.e., 98.88 per cent. Among the milk animal's buffalos amounted a very meager number (3.30 per cent), since this region people believe that the buffalo milk leads to arthritic deceases. The availability of other livestock is very much negligible in this system.

MILK PRODUCTION

Milk is one of the major components in the food system of Kerala State, Considerable number of people use milk and milk based products in food, which leads to a high demand of milk and milk based products in this state. It has been observed that the required milk production is not met in the State in general, and in this District in particular. Therefore, a huge quantity of milk is transported to this study area from the neighboring state of Tamilnadu.

The milk production of this District is about 7.7 per cent of the total production of milk of the State, i.e., 19205K litres per day. The quantity of milk produced in the state and the District in the year 2000AD is presented in Table 2.13.

Table 2.13: Milk production per day in the State and District

Sl. No.	Items	Milk production (KL)		Per cent in the District
		State	District	
1	Cow	17616	1325	7.52
2	Buffalos	564	52	9.21
3	Goats	1025	105	10.24
4	Total	19205	1482	7.71

Source: Animal Husbandry Department, Kerala State

The table denotes that the district produce very less quantity of milk, ie,.7.71per cent of the total milk production of the state. Of the total milk production of the District, nine-tenth of the total milk production, i.e., 84.40per cent from cows, followed by goat milk7.09 per cent and the buffalo milk production is very negligible i.e., 3.51per cent. These show that people of the study area prefer cow milk rather than any other milk.

2.11.4 Fisheries

The coastal length of the District is 78 kilometers, which constitute 13.22 per cent of the total coastal line of the State (590 km.). Fishery type of this District is marine nature. There are 50950 active marine fishermen available in the District. In addition to this, there are 1312 inland fishermen are also in the District

The fishing export is considered as one of the major sources of income of the State. In the year 1993-1994, the total export of marine products fetched to 251 crores. The export of marine products has increased to 1660 crores (660 per cent) during the year 1999-2000.

2.11.5 Cooperative Institutions

The district is blessed with larger number of cooperative institutions, through which handloom industry, coir based industries, etc., are functioning well. Chirayinkil Taluk of this District is blessed with vast area of backwaters. This facilitates to retting of coconut husks easily. Thus, this area is very much conducive for coir industry and coir industry dominates in this area. The entire available coconut raw husks of this District are processed in this area, which provide a sizable quantity of employment opportunities and income earning

opportunities. There are 58 coir co-operatives are functioning in this area, which constitute 11.57 per cent of the total coir co-operative institutions of the State. The details of the coir co-operative societies available in this District are presented in Table 2.14.

Table 2.14: Details of coir co-operatives in the State and District

Sl. No.	Year	State	District	Percentage
1	1997	552	56	10.14
2	1998	535	55	10.28
3	1999	559	55	9.83
4	2000	501	58	11.57

Source: Directorate of Industries and Commerce, Kerala State

The table reveals that the available coir based cooperative institutions are increasing in this District from the year 1997 to 2000, and it represent more than one-tenth (11.57per cent) of the total coir cooperative institutions of the state. The availability of the coir cooperatives also reflects the availability of coir-based activities in this district that leads to strengthening the economy further at the grassroots level in this system.

Neyyattinkara Taluk of this District is famous for Handloom industry. Balaramapuram handlooms, a handloom brand produced at Balaramapuram, which is confined in this area, is famous for its quality and fineness. This small-scale industry spread almost all over the District and providing employment opportunities to considerable amount of people.

2.11.6 Trade and Commerce

The contribution of trade and commercial activities at national level is very meager in export activities. At the grassroots level (in the study area), though the

study area does not have more industries or other manufacturing centers, considerable amount of service based trade and commercial activities are functioning, and it occupies a major place in its social and economic function. In fact, the study area is bestowed with good connectivity, which is the major requirement for better trade and commercial activities.

In this District, road, rail, air and water transportation system are available for easy movement of goods. The National Highway 47 passing through the District from North to South direction connecting the Taluk Head Quarters – Attingal, Thiruvananthapuram and Neyyattinkara. Apart from the National Highway, a state Highway –1, which connect Thiruvananthapuram and Shencotah through Nedumangad, the Taluk Head Quarter with Thiruvananthapuram. A major trade centre is located at Nedumangad, which is considered as one of the biggest trade centers for cash crops in the State. The State Government has a proposal to start two world markets (Export oriented) in this District, (1) at Nedumangad and (2) at Anayara in Thiruvananthapuram.

Commercial activities are spread across the District in varying magnitude. Attingal, Varkala, Kilimannoor, Chirayinkil, Venjaramood, Neyyattinkara are acting as counter magnets to the Chalai market, which is a famous commercial centre of the District (Figure 2.9). A sizable quantity of vegetable is exported to the Middle-East Countries through the International Airport Thiruvananthapuram. The other trading activities, which are prominent in this District are construction materials, including cement, steel, timber, hardware items, etc., food grains; food products, (fish, meat and others), vegetables; household appliances, textiles, Coir, furniture etc.

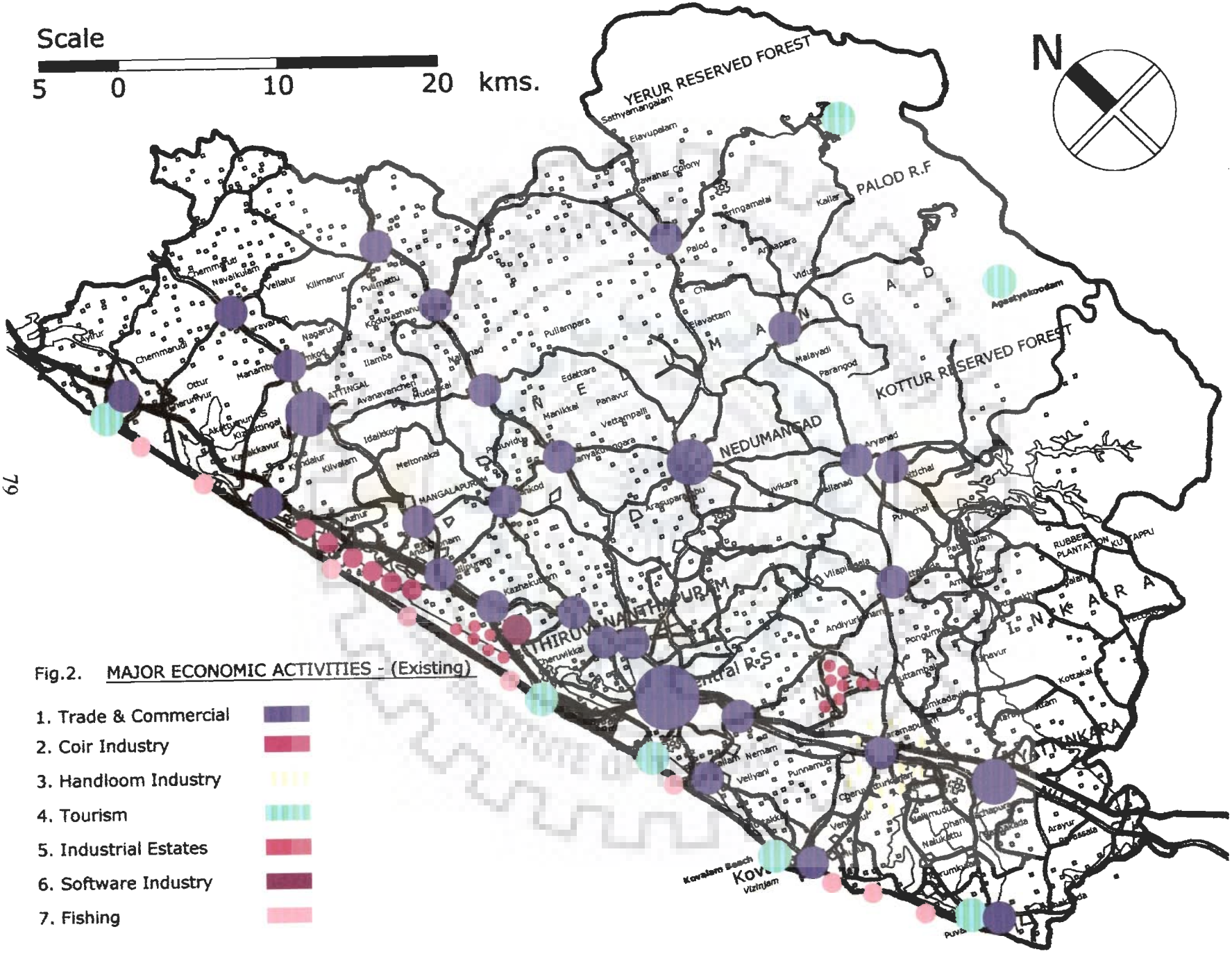


Fig.2. MAJOR ECONOMIC ACTIVITIES - (Existing)

2.11.7 Banking and Financial Institutions

Banking and other financial institutions play a vital role in the development of a region. In this regard, Kerala State is not an exceptional one. There are 1054 nationalized and scheduled bank branches spread over in the State having a deposit of 13541 crores. The Non Resident Indians working in abroad contribute the major share in this regard. It has been observed that about Rupees 696 crores of are accrued from their savings alone. The total amount of savings and deposit has reached rupees 3893263 crores. Of which, about 42.29 per cent of the total amount is issued under various loans. In Thiruvananthapuram District, the total deposit is accumulated Rupees 578 crores, which constitutes 15 per cent of the total deposit of the State. The credit-deposit (CD) ratio of the State and the District are 42.2 and 36.78. The details of the credit deposit ratio of the State and the District is presented in Table 2.15

Table 2.15: Details of Banking in the State and the District

Sl. No.	Unit	Total deposit in lakhs	NRI deposit in lakhs	CD ratio
1	State	3893263.00	696306.19	42.29
3	District	578514.00	-	36.78
4	Per cent	14.86	-	-

Source: Banking Statistics Quarterly Handout, Reserve Bank of India, Mumbai.

The table reveals that the credit- deposit ratio of the District is much lesser than that the State and it shows that huge amount of money is deposited by the people, but are not fully utilized in the system.

Apart from the banks (both nationalized and scheduled banks), the Government of Kerala has it own financial Corporation known as Kerala state Financial Corporation, which is also functioning in the state except for residential development.

The details of the amount sanction by this Kerala State Financial Corporation in different years at the State and District levels are presented in Table 2.16.

Table 2.16: Loan sanctioned by the Kerala State Financial Corporation in the State and District

Sl. No.	Year	State (in lakhs)	District (in lakhs)	Percentage
1	1991-92	49754	5444	10.94
2	1992-93	58842	6126	10.41
3	1993-94	67000	6786	10.12
4	1994-95	77341	8234	10.64
5	1995-96	101384	10574	10.42
6	1996-97	121221	12681	10.46
7	1997-98	146212	14943	10.22
8	1998-99	166242	16990	10.22
9	1999-2000	182448	18816	10.31

Source: Kerala State Financial Corporation, Government of kerala, Thiruvananthapuram-2001

The table illustrate that the financial corporation has been lending money to the people of Kerala since its inception in 1991-92, and the amount has been increased to 345 per cent from 1991-92 to 1999-2000 in this District. It is interesting to note that the percentage of amount distributed in terms of loans in this District is almost constant in every year since 19991-92 to 1999-2000,ie.,10.94per cent to10.31 per cent, which shows that the Government

would have fixed the percentage of amount distribution in terms of loan for maintaining balanced development in the state.

2.11.8 Net District Domestic Product

The net per capita State domestic product at factor cost by industry of origin at current price in the year 2000 was Rupees. 18262. At the same time the District showed a slightly higher net domestic product –Rupees 19293 i.e., 5.64 per cent higher than the net per capita State domestic product. The details of the net domestic product of the State and the District are presented in Table 2.17.

Table 2.17: Sector Distribution of net domestic product at current price

Sl. No.	Sector	Year									
		95-96	per cent	96-97	per cent	97-98	per cent	98-99	per cent	99-2000	per cent
1	Primary	1141913	32.32	1288631	31.66	1277977	28.47	1379800	26.97	1489749	25.38
2	Secondary	748642	21.19	848822	20.86	969420	21.60	1090303	21.31	1212605	20.66
3	Tertiary	1642476	46.49	1932415	47.48	2240950	49.93	2646680	51.72	3168126	53.96
4	Total	3533031	100.00	4069868	100.00	4488347	100.00	5116783	100.00	5870480	100.00

Source: Department of economics and statistics, Government of Kerala, Thiruvananthapuram-2001

The table shows that the share of the primary and secondary sector of the net domestic product of the District is observed in a downward direction; where as, the share of the tertiary sector moves upwards. In the year 1995-96, the share of the primary sector, to the net domestic product was 32.10 per cent, and the tertiary sector only 46.49 per cent. During the period 1999-2000, the primary sectors contribution was decreased to 25.38 per cent, 20.66 per cent respectively, whereas the tertiary sectors contribution was increased to 53.96 per cent. These figures show that the tertiary sector more or less control the economy of the District.

2.12 HOUSING

The basic necessities of human being are food, clothing and shelter. The demand of housing is increasing at an alarming rate every year. The developed countries addressed this particular issue to the certain extent, and the developing and the under developed countries search in dark to find out a solutions to "a dream of an individual" - 'a home of their own'. About forty million people are suffering from housing shortage in the world. Of which, 10 million are confined in the urban areas, and the rest are in the rural areas. Most of the countries of the world are trying to address this particular issue by using only the conventional method of construction through the social housing scheme. They could not succeed fully since the available resources are not matching with the demand. Today, certain countries tend to change their attitudes by adopting alternative technology, improving conventional construction practices and by employing low cost materials in construction activities.

The migrations from the rural to urban area have increased at an alarming rate in search of employment in the tertiary Sector. They forced to live in the un-serviced and waterlogged area of the urban system, that lead to the formation of slums and act as a magnet of all the unwanted activities of city life, including theft, robbery, prostitution, communal riot, etc. The dilapidated condition of homes in the slums leads to spreading of several kinds of diseases during the rainy season. These sections may not have proper residency cards, lands or identifications.

In the study area, there are 620000 residential houses and 6469414 households. Of which, 34.61 per cent of houses are dilapidated, 31.6 per cent are livable, and 28.54 per cent are good condition. Thiruvananthapuram city has more quantity of rental houses compared to the other two Metropolitan Cities of

Kerala, State, i.e. (16.30 per cent of the total houses). This may be due to the fact that this city is the capital of the state, and also sizable floating population coming to the city from within the State and also from the neighboring Districts of other States of India for enjoying the available better infrastructure facilities related to human resource development in this city.

Concentrated housing is seen in the core area of the city, while detached houses in individual plots with lesser density is seen in the newly developed residential sectors in the periphery of the city The adjoining Panchayats of the city are being urbanized to the greater extent, and this settlement features are found closer to the city. The existing housing stock available in Thiruvananthapuram District can be classified into the following groups, such as, Individual Housings, Group Housing and Institutional Housing.

2.12.1 Individual Housing

The major share of the houses in this study area is coming under this category. The people construct the houses on their own land with their own money or from the assistance from the financial Institutions or an interest free loan from the family members, relatives and even from the friends. Most of the public sector establishments offering housing loans for their employees either from their schemes or through other financial agencies.

2.12.2 Group Housing

The Government of India has been giving more thrust to provide housing to the needy communities by introducing centrally sponsored schemes. The Government of Kerala (State Government) implemented these schemes in various parts of the State by providing group houses through the local bodies.

These schemes mainly target the people those who are living below the poverty line, disadvantaged sections of the society, scheduled cast and scheduled tribes, etc,

2.12.3 Institutional Housing

As already pointed out, the study area is governed by good number of institutions, which include, administration, education, research, technical institutions and other service based institutions. These institution provide houses to their employees through either developing housing colonies in their premises or in nearby locations. These institutions are providing houses to their employees in subsidized rental rates. The employees prefers this scheme because they can stay near to their work places, interact with similar groups, and can enjoy the urban facility at lesser expense.

2.12 4 Housing Agencies

A number of housing agencies are working in Thiruvananthapuram district. They can be classified in to the following groups, such as, Public, Public sector Undertakings, Private sector and Non Governmental agencies.

2.12.4.1 Public agencies

2.12.4.1.1 Kerala State Housing Board

Kerala State Housing Board is the Nodal Government Agency in the State. They introduce different schemes targeting people of various income groups conforming to the policy of the Government.

2.12.4.1.2 Kerala State Nirmithi Kendra

Kerala State Nirmithi Kendra is another State Government owned Institution, which engage research in the field of cost effective and innovative materials, and construction practices in the field of housing. They are extending the output of the research to the needy and underprivileged sections of the society. This institution gives training to the technical persons who are working in this field, un- employed youths who are interested in construction activities and the masons for improving their skills.

2 12.4.2 Public Sector Undertakings

There are few institutions such as, Housing and Urban Development Corporation (HUDCO), State Housing Co-operative society, District Housing Co-operative society and Primary co-operative societies which are extending financial assistance for Individual as well as group housing schemes in the District.

2.12.4.3 Private Sector Undertakings

A number of private Developers are working in this District with many ongoing schemes. This includes development of housing plots, construction of individual houses, walk up apartments and multistory flats. These developers even arrange finances for the prospective customers. The leading private builder groups in the country are planning to set up their offices in this city for tapping the potential demand in housing. The new policy of the State Government to convert the city in to a destination centre for Health, Education, Software Industry and Tourism will also further boost this sector. The affluent section of the society considers that investment in housing and related sector is much safer and economical than doing investment in any other field.

2.12.4.4 Non Governmental Agencies

It is interesting to note that the state is blessed with number of community and charity based organizations, which render services at the grassroots level. Generally, they provide service in human resource development activities, but few institutions work for providing shelter to the needy communities, and noted among them are TSS and PCO, Thiruvananthapuram social service society (TSSS) and Program for Community Organization (PCO). These leading groups, especially work in the coastal areas, where the considerable amount of the fishermen community settled. These organizations are acting as interface between the government and beneficiaries to provide shelter to these communities.

2.13 INFRASTRUCTURE

Infrastructure is one of the most important parameters, which decides the functions of the system and development of any urban or rural system. The quality and quantity of infrastructure available in this study area clearly establish the urbanization level of the system.

At the outset, the Investigator classified the available infrastructure facilities in the study area, and grouped under physical and social infrastructure. The physical infrastructure services include water supply, drainage, sewerage, solid waste, power supply, transportation and communication and the rest are grouped into social infrastructure. Based on the aforesaid classification, the Investigator analyzed the available infrastructure services in the system and are presented as below:

2.13.1 Physical Infrastructure

2.13.1.1 Power

Consumption of power depicts the growth and development of any system. It has been observed that there is a strong correlation between per capita energy consumption and the gross domestic product in various countries. This clearly shows that power is one of the most important factors, which control the development of the system.

Kerala State Electricity Board (KSEB) is the sole institution, which does generation, transmission and distribution of electricity in the State and the District. The State is rich in water resources, and has ample potential of taping hydel power with economical. The installed capacity of Kerala State Electricity Board is 2031.6 MW as on 2001, which comprises of Hydel, Thermal and Wind farm power generation. The installed power capacity and power generation in the Kerala State is presented in by year wise from 1990-91 to1999-2000 in Table 2.18.

Table 2.18: Installed Power Capacity and Power generation in Kerala State

Sl. No.	Year	Installed power capacity (MW)	Unit generated (MU)	Purchased	Used (MU)
1	1990-91	1476.5	5491	-	5295
2	1991-92	1476.5	5326	270	5596
3	1992-93	1676.5	6193	-	5750
4	1993-94	1476.5	5822	463	6285
5	1994-95	1503.5	6573	507	7080
6	1995-96	1505.5	6663	752	7415
7	1996-97	1508.5	5501	1520	7021
8	1997-98	1775.8	5189	2528	7717
9	1998-99	2043.1	7842	1317	9159
10	1999-2000	2391.0	8901	892	9793

Source: Kerala State Electricity Board-2001, government of kerala, Thiruvananthapuram.

The table illustrate that the installed capacity of power generation in the state is constantly increased from 1990-91 to 1999-2000,ie., from 11.76 million units to23.91 million units and the production is also increased from 5491 to 8901 MU in the corresponding period. Besides these the State Electricity Board is also purchase power from the neighboring States to meet its requirements, and the power purchased figure also shows that considerable amount of power is purchased in every year to meet the acute power supply shortage resulting in to less industrial development.

The annual per capita power consumption of the state is recorded far below than the national average, i.e., 305 KWh against 360 KWh. In the year 2002-2003, the energy consumption of the State was 16392 million units, but the supply was only 15365 million units. The remaining quantity of power was purchased from the neighboring states. The annual growth rate of power consumption in the state is 10 per cent.

The power tariff in the State is one of the lowest tariff in the country due to the fact that the major quantity of power production is done through hydropower projects, and therefore, the unit cost of production is very less compared to the other source of power production, like thermal or nuclear sources. As a result, the Government also supplies power to the people at the lower rate. The details of power tariff in different activities, consumption and revenue accrued from them in the year 2000 is presented in Table 2.19

Table 2.19: Activity-wise power consumption and revenue collected in the Year 2000

Sl. No.	Activity	No. of consumers	Energy sold (MU)	Consumption in per cent	Tariff rate/ KW	Revenue collected Rs (in lakhs)	per cent to total collected
1	Domestic	4510865	4526	46.13	1.04	36672	22.58
2	Commercial light	954956	819	8.35	4.7	35741	22.0
3	Industrial LT	105524	622	6.34	2.55	14993	9.23
4	Industrial HT	1683	2825	28.76	2.95	62628	38.56
5	Irrigation	367919	375	3.82	0.55	2520	1.55
6	Public lighting	1398	178	1.81	0.50	2150	1.35
7	Water works	1837	257	2.62	2.55	4685	2.88
8	Bulk supply	7	173	1.76	1.75	2601	1.6
9	Misc.	85553	20	0.26	3.0	60	0.03
10	Railway traction	2	18	0.19	2.0	357	0.22
11	Total	6029744	9813	100		162407	100

Source: Kerala State Electricity Board, Government of kerala, Thiruvananthapuram-2001

The table explains that the domestic segment consumed about half of the total consumption (46.13 per cent) in the year 2000 AD, but the tariff collected from the same segment is only about one-fourth (22.58 per cent) of the total revenue collected through power distribution. Followed by domestic activity, industries (high tension occupies the second place) and it's consumption slightly crossed one –fourth of the total consumption, i.e., 28.76 per cent and fetched revenue about two-fifth (38.56 per cent) of the total revenue. The rest of the activities together consume very less quantity, and the tariff fetched from these also very meager. It has been observed that the tariff rate per unit of energy

(kilowatt) is very less compared to the neighboring States like Tamilnadu and Karnataka.

The State Government is allocating sizable amount money for power generation in the State. During the first 5year plan period, about 39.5 per cent of the State outlay was allotted for improving the energy sector of the State. In the successive five-year plan periods, it has been reduced to 20 per cent. The details of amount allocation in different plan periods for power generation and distribution are presented in Table 2.20

Table 2.20: Amount allocation during plan periods on energy development in the State (Rs in lakhs)

Sl. No.	Plan period	Allocation	per cent to total	Utilized	per cent of outlay
1	1951-56	1185	39.50	1060	89.50
2	1956-61	2345	26.90	2192	93.50
3	1961-66	4356	25.60	6084	139.70
4	1966-69	4691	32.90	4195	84.40
5	1964-74	7625	10.50	10740	140.90
6	1974-78	12990	22.80	11057	85.10
7	1978-80	8378	21.30	7060	84.30
8	1980-85	28007	18.80	32180	114.90
9	1985-90	44131	19.90	41912	95.00
10	1990-91	13542	21.30	12493	92.30
11	1991-92	15620	19.40	14642	93.70
12	1992-97	130000	23.80	179643	138.19
13	1997-2002	267100	-	-	-

Source: Kerala State Electricity Board, Government of Kerala-2001

The table illustrate that the allocation of money to this sector to total plan outlay is decreased from 39.50 per cent to23.80 per cent in the period between 1951-56 to 1992-97. In certain plan periods, the expenditure was little above the allocated amount since in those periods attempts have been made to install few power plants, which demanded more than the estimated cost. However, it has been also observed from the increase in allocation of power sector and its corresponding expenditure is very meager compared to the other developed neighboring States of the country, which also reflects the slow pace of industrial growth in this State.

The city has been experiencing deficiency in power supply and Electricity is available to only 76 per cent of the total households. This is higher than the figure of the other Metropolitan Cities of the State. Despite Governments policy of giving one light point connection at free of cost to low-income households, still the city is witnessing that 157 households out of every thousand have no electric connection.

2.13.1.2 Water Supply

Water supply and quality of drinking water supply are also considered as a major point to measure the development of any urban system. About 78 per cent of the population of the study area has access to safe drinking water. Thiruvananthapuram Corporation and the other four Municipalities in the District are trying their level best to supply good quality of water to their people. The dug wells are common in the Panchayat areas. The District is blessed with three rivers, such as, Karamana, Neyyar and Vamanapuram. In addition to the above, 34 irrigation tanks, 1542 ponds and 228 public water bodies are available in this District. The people abundantly use these recourses for their day-to-day needs

other than drinking and cooking purpose. Most of the ponds and water tanks are lying in the middle land and few are observed in the highland and in the coastal areas. The people residing in the coastal belt find it difficult to meet their daily water requirements, since the available ponds are facing salinity problem. During the summer months, i.e., from February to May, the coastal areas are prone to acute shortage of drinking water. The salinity of the seawater enters into the wells, which are confined nearer to seashores in summer and aggravating the issue further. Even though the District receives good rainfall, the peculiar terrain of the area that drains the whole water into the sea within an hour. Rainwater harvesting methods are also not common in this District, since considerable amount of rainfall is observed in this District

There are three reservoirs in the District, such as, Neyyar, Aruvikkara and Peppara. Water is collected from these reservoirs, treated and sends to the storage tank, which are located at Vellayambalam in the city. The water supply service is covered about 150 sq. km. Of the total quantity of water consumption, residential segment consumes about 54 per cent of the water.

2.13.1.3 Sewerage

Thiruvananthapuram Corporation is having an area of 142 Sq Km, and has 7.75 lakhs population. The total number of sewerage connections in different sectors, comprising of residential, commercial, institutional and industries are about 75000. The Authority collects one time tariff at the time of providing connections, and the Kerala State Water Authority spends the entire management service expenditure. The Corporation Authorities are collecting 5 per cent sewerage tax from the beneficiaries and the amount is not reaching the concerned Authority who provides the service. The concerned Authorities are

spending at the rate of Rs 4.5 crores annually for maintaining the scheme. Though a considerable amount of population live in the coastal areas, there is no sewerage scheme is implemented in the coastal areas, so far.

The existing sewage treatment plant, was developed during the Princely period, which is not capable of to handle the huge volume of the sewage in the city, today. As consequence, overflowing of sewage water is observed in certain parts of the city. The existing sewage farmyard is inadequate to hold the treated water. The population resides around the sewerage treatment plant as well as the sewerage farm are tremendously affected some kind of disease in the recent years. Moreover the available water bodies in the city, like, Karamana, Killiyar, Thekkanakarathodu, Parvathyputhanar are constantly polluted due to the direct out letting of drainage lines in these water bodies from the nearby residential areas.

2.13.1.4 Drainage

Drainage is one of the important factors, which decides the functions of the system. Availability of adequate drainage in an urban system leads to healthy environment. Having this in mind, the available drainage system in the study area is studied carefully, and observed that drainage facilities are covered only for about one-third (30 per cent) of the urban area in the city, and serving 43 per cent of the city people. The people of the city mainly depend on the piped water supply, which is supplied by the Kerala State Water Authority. It has been observed that 60 million litres, i.e., 80-85 per cent of the total consumed water per day drain out as wastewater through the drainage lines. There is no proper mechanism working is to drain the drainage water out properly. As a consequence, wastewater logging is observed in several parts of the low-lying

area of this study area. During the monsoon season, the rainwater is mixing along with the wastewater, which create havocs in the system by seriously affecting the health as well as the environmental condition of the system.

2.13.1.5 Solid Waste Disposal

Garbage, collection, treatment and disposal are considered as one of the prime urban activities, which is to be dealt with more care and vision. Solid waste is another parameter, which decide the smooth functions of any urban system, since it can create environmentally disorders. Availability of effective solid waste management system leads to good environmental condition, good health, etc. Having these in mind the status of the solid waste disposal in the system is studied and the present status presented.

It has been observed that most of the Indian cities are facing this problem at varying magnitude. The polluted urban waste causes serious environmental related issues in the urban system. Generally, bacteria's germinate from the garbage dumping sites; rats, snakes, etc., live in the sites, which seriously affect the public health, and lead to various kinds diseases. Plastic becomes one of the major components of garbage in the modern age. People use to keep the waste food, including fish, meat, chicken, kitchen waste etc., in the polythene bag tied it and throw into the public places. These bundles are allowed to lay on the road side without collection for more than a day, which decays in an anaerobic condition and worms germinate out of the bundle and contaminating the entire area.

Thiruvananthapuram Municipal Corporation had started a garbage recycling plant at Vilappilsala at a cost of Rs 9 crore. The Corporation personals

collect the garbage of the city daily and transported to Vilappilsala and convert it into farmyard manure (F.Y.M). In fact, the farmyard-processing center is facing serious problem since it is unable to sell the manure, and forced to dump in its store itself. So this center is not in a position to collect further more garbage from the city due to lack of stockyard facilities. The Corporation has temporary dumping yards at Chalai, Palayam and Manacaud. Once the garbage is dumped in the yard, the liquid percolate into the soil contaminating the drinking water and watercourses near the plant.

About 450 tones of garbage is being produced in the city every day, which include domestic waste, waste from commercial streets, fruit markets, meet markets; hospital; and drainage and the streets. These accumulated wastes are not collected fully, and about 50.00 per cent of them accumulated waste are left in the system without attending. These unattended wastes create havocs in the system during the rainy seasons. During the rainy seasons, these blocks the movement of water and water spread into the carriage way and destroying the road surface and traffic flow. The Authorities find it difficult to collect the garbage from each and every nook and corner of the city daily. These activities create serious health problem of the people of Vilappilsala

2.13.2 Social Infrastructure

The investigator considers the following social infrastructure, such as, education, health, transportation, communication, recreation, and tourism for analysis since they play a major role in the system and are presented as below:

2.13.2.1 Education

Education is one of the major factors, which decide the functions of the system. Education is used as a tool to measure the social development of a nation. In this study area, education plays really a major role in its development. Therefore, education is considered as one of the parameter in this investigation and analyzed.

The study area is blessed with number of schools, technical institutions, research centers etc., which provide education to the masses. It is also interesting to state that the study area is blessed with highly qualified people, qualitative institutions, which attract people from rest of the state for schooling and higher education (Figure 2.10). The details of Government schools, students and teachers ratio available in this District are presented by year wise in Table 2.21

Table 2.21 Number of Schools in the District

Sl. No.	Year	District			Teacher- student ratio
		No of schools	Students	Teachers	
1	1994-95	942	521046	17181	30.32
2	1995-96	951	513648	17074	30.08
3	1996-97	956	505315	16775	30.30
4	1997-98	956	496014	16874	29.39
5	1998-99	956	490175	16930	28.95

Source: Directorate of Public Instruction, government of Kerala , Thiruvananthapuram-2001

The table illustrates that from the year 1996-97 to 1998-99 the addition of school is standstill from the Government side since private people started to give more priority towards highly qualitative education at the school level. The availability of students in the Government school also shows a decreasing trend from the year 1994-95 to 1998-99. The teacher student ratio at school level is decreasing in the same correspcnding period, i.e., 30.32 to 28.95, and the ratio is

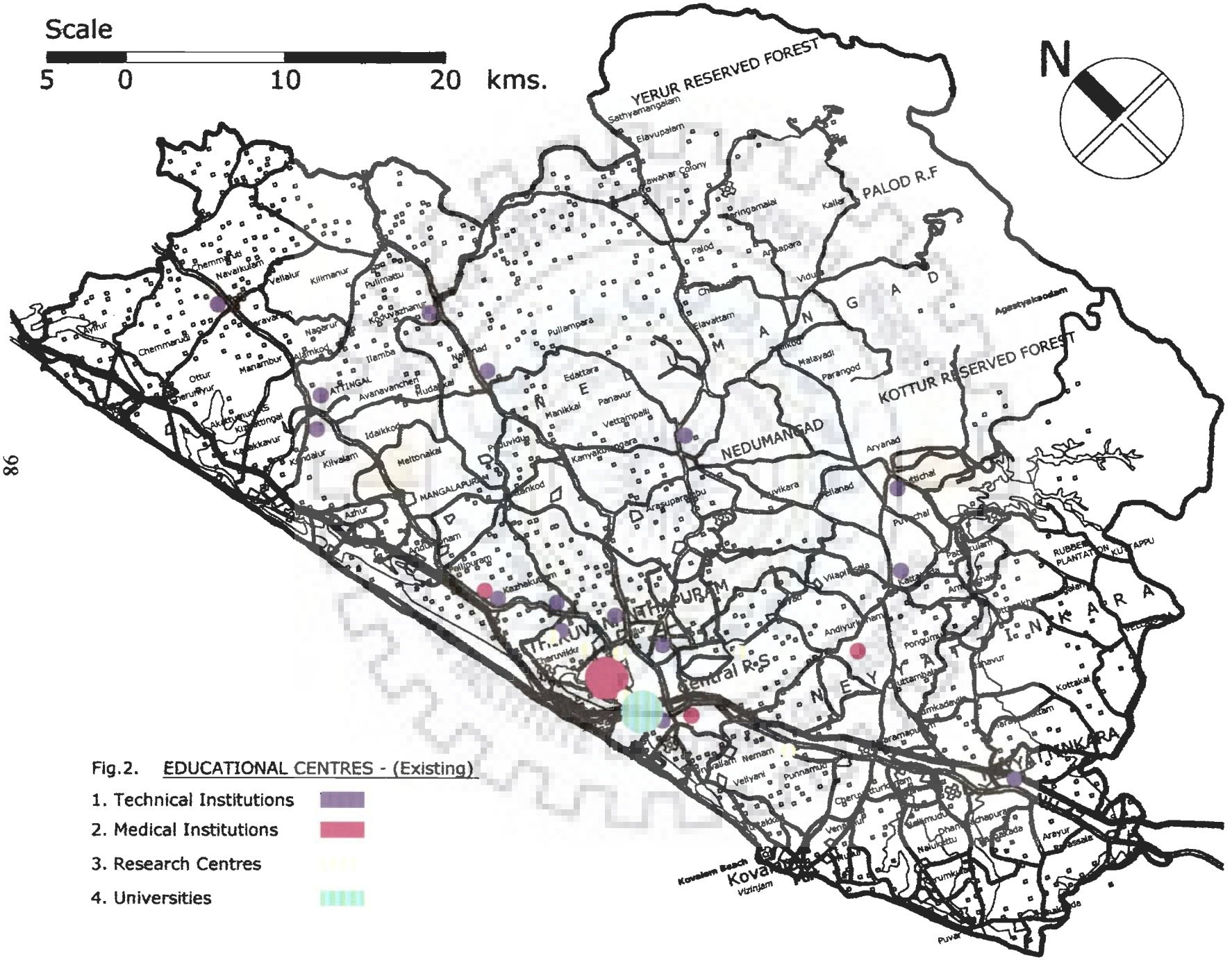


Fig.2. EDUCATIONAL CENTRES - (Existing)

1. Technical Institutions
2. Medical Institutions
3. Research Centres
4. Universities

considerably low compared to the neighboring states, which shows that this District impart highly qualitative education

Kerala state is spending the highest per capita amount of money for imparting qualitative education among the States of the Country. In the year 1999-2000, the per capita education expenditure was Rs. 884, which is 61.90 per cent higher than the National average of Rs. 546. The details of per capita expenditure on education from 19990-91 to19999-2000 are presented in Table 2.22.

Table 2.22 Per Capita Expenditure in Education (in Rupees)

Sl. No.	Unit	Year									
		1990-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-2000
1	India	190	208	231	-	278	360	357	395	499	546
2	Kerala	269	282	334	-	443	464	528	569	717	884
3	Per cent in excess	41.57	35.57	44.58	-	59.35	28.88	47.89	44.05	43.68	61.00

Source: Budget brief, Government of Kerala, Thiruvananthapuram-2001

The table explains that the State Government has been spending more amount for imparting qualitative education to its people than from the national level from the year 1990-91 to1999-2000, and the per capita expenditure is increased from 41.57 per cent to 61.90 per cent in the corresponding period. This clearly shows that this State Government is very much conscious to impart highly qualitative education to its people.

2.13.2.2 Health

The Government of Kerala State gives more priority towards health next to education since health is also one of the major parameters in human resource development. Having this in mind, the Government of Kerala tries its level best to have good health system even at the grassroots level in the State. The study area is also blessed with good Government and Private health institutions, clinics,

etc. It has been observed that this study area has one Medical College each in Allopathic, Ayurvedic and Homeopathic Medicines, one District General Hospital, one Hospital for women and children, one Institute of Medical Science and Technology, one Regional Cancer Center, one Tuberculosis Sanitarium, one Mental Hospital and 15 Primary Health Centers, which are owned by the State Government. Very recently, private owned Medical Institutions are started in this District and noted among them are Cosmopolitan Hospital, G. G. Hospital, Kerala Institute of Medical Science (KIMS), Lords Hospital, Sree Uthradam Thirunnal Hospital (SUT), etc (Figure 2.11). The details of number of beds and hospitals in the three divisions of medicine (allopathic, ayurveda and homeopathic) are presented in Table 2.23.

Table 2.23: Medical Institution in the District as on 1999-2000

Sl.No	Type of medicine	No of hospitals	Percentage	No of beds	Percentage
1	Allopathic	115	44.74	7187	93.86
2	Ayurveda	88	34.24	285	3.72
3	Homeopathy	54	21.02	185	2.42
4	Total	257	100.00	7657	100.00

Source: Directorate of Medical Education, Government of Kerala, Thiruvananthapuram-2001.

The table illustrate that this District is blessed with 257 hospitals owned by the state government. Of which, allopathic occupies about half of the hospitals (44.74 per cent), followed by Ayurvedic occupies the second place, i.e., 34.24 per cent and the rest are grouped as homeopathic hospitals. The District has a total of 7657 beds in all the hospitals together. Of which, more than nine tenth of the total beds (93.86 per cent) are confined in allopathic hospitals, and the rest are

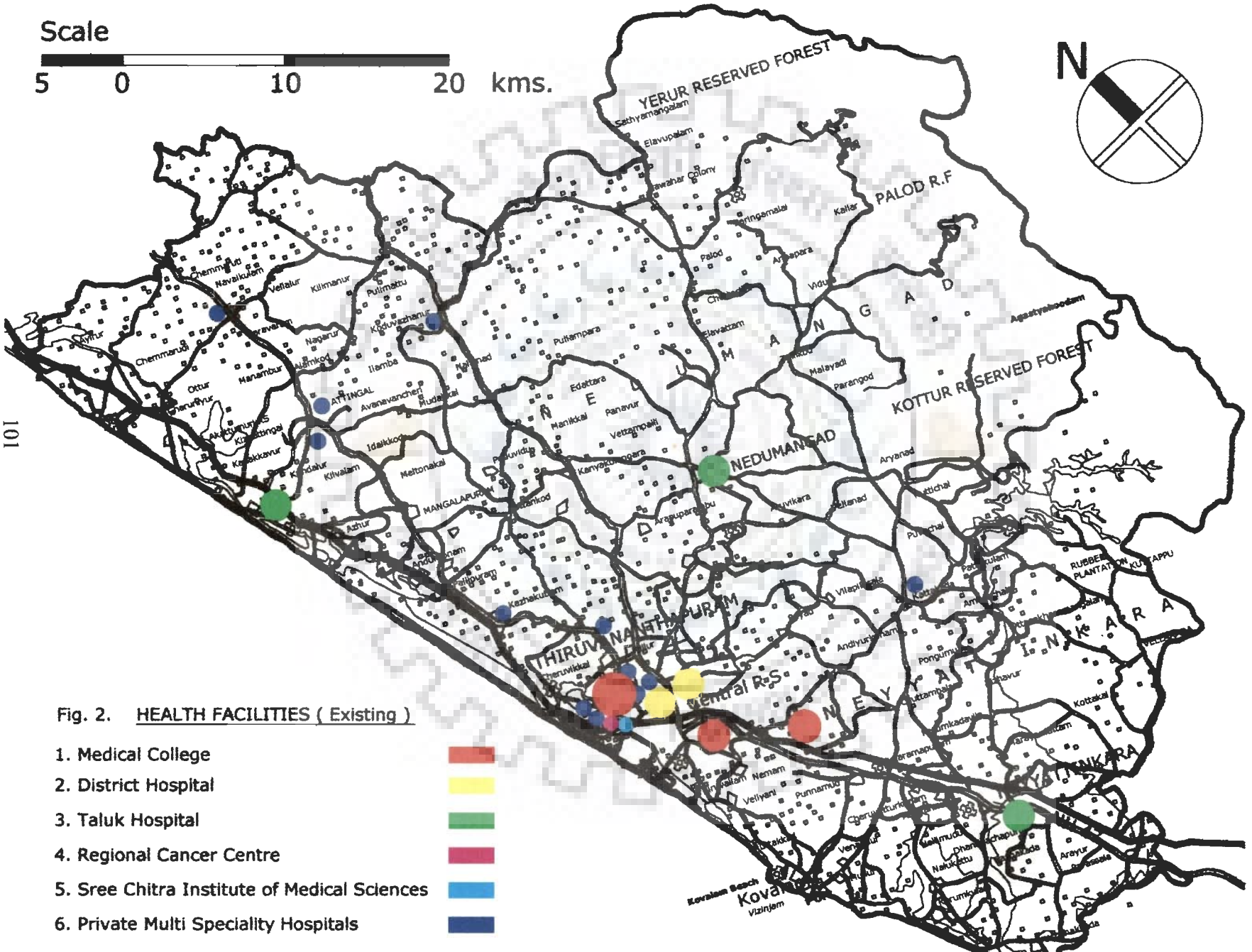


Fig. 2. HEALTH FACILITIES (Existing)

1. Medical College
2. District Hospital
3. Taluk Hospital
4. Regional Cancer Centre
5. Sree Chitra Institute of Medical Sciences
6. Private Multi Speciality Hospitals

distributed between the other two categories. This trend clearly shows that people mostly prefers allopathic medicines.

2.13.3 Transportation

Transportation is another parameter, which decides the functions of the system. In, fact, efficient transportation facilities work as a catalyst for the development of the system. The study area is blessed with all modes of transportation, such as, road, rail, air and water connecting the city from different parts of the country and also across the globe. The study area is also well connected to the surrounding regions and other parts of the State. Road-based mode of transportation is mostly used for intra-city transportation, while rail and air based modes cater the long distance.

It has been observed that the availability of road length is not increasing along with the number of vehicle growth in the city. During the year 1980, the total numbers of vehicles were 31136, and the total road length was 1557 km. In the year 1998, the number of vehicle rose to 210067 (674 per cent) and the road length increased to only 1902 (122 per cent). The available number of vehicles have increased successively and reached to 319199 (1028 per cent) in 2002, but the road length increased only by 1940 km (124.5 per cent). The details of the growth of number of vehicles, and increase in road length, which are maintained by the public work department, are presented in Table 2.24.

Table 2.24: Growth of Vehicles and Road Lengths in the District

Sl. No.	Year	No of vehicles	Growth rate	Road length (in km).	Growth rate of road length
1	1980	31136	100	1557	100.00
2	1990	88103	283	1779	114.00
3	1998	210067	674	1902	122.00
4	1999	241932	777	1911	122.75
5	2000	266174	855	1941	124.63
6	2001	293199	941	1934	124.21
7	2002	319199	1028	1940	124.59

Sources: National Transportation Planning and Research Centre, Thiruvananthapuram-2001

The table explains the availability of vehicles and the road length from the year 1980 to 2002, and it clearly shows that the growth of vehicle is increased to 1028 per cent and the growth of road length is increased to only 124.59 per cent during the same corresponding period, which shows that vehicle growth is increased 10 times than the actual growth of road length.

The District is blessed with National highways, state highways and other district roads. These roads are used for transportation purposes. The availability of these roads by their length is presented in Table 2.25

Table 2.25: Length of Roads in the District as on 1999- 2000

S. No.	Type of road	Road length (km)	Per cent
1	National Highways	70	3.60
2	State Highways	180	9.27
3	Others	1689	87.03
4	Total	1941	100.00

Source: State Public Work Department, Government of Kerala, Thiruvananthapuram-2001

The table explains that the district has 1941 Km of road. Of which, about nine tenth of the total road (87.03per cent) are grouped under other roads category, which include district roads, other district roads and village roads. Followed by State highways, and national highways occupy 9.27per cent and 3.6 per cent respectively. It clearly shows that the district is mostly blessed with other roads, which is purely managed by the local bodies.

The topography of the city is characterized by highly undulating terrain. Since the road network is confined in this terrain, there are very steep grades in many places and are having very poor geometry. The present road network also suffers from lack of access control, lack of pedestrian facilities, and segregation of traffic. The intermixing of local and through traffic results in unsafe travel conditions and low speeds along the network.

Major portion of the city roads has right of way between 10 and 12 m. The heterogeneity of the traffic reduces the road capacity considerably. This coupled with frequent intersections and crossing of pedestrians that reduces the journey speed to a level of 10-15 km per hour during the peak hours. The existing on street parking system further reduces the width and the capacity of the road, as well as the speed of transit. Access control is very minimal in the city level road network. There are many uncontrolled junctions are observed in the city. The authorized and unauthorized construction and the advertisement boards obstruct the visibility of roads. Warning and prohibitory signs are also absent or even the existing some are poorly located in the city. All these factors lead to distraction and confusion among the road users ultimately resulting into accidents. The accidents indicate a strong need for improvement of junction-geometry and traffic control at almost all the junctions.

2.13.3.1 Vehicles

Number of available vehicles in the system reflects the people's purchasing power. In 1980 the district had only 31316 vehicles, which was risen to 319199 in the year 2002, i.e., just within two decades, the increase in vehicle is multiplied by 10 times. This shows that there is a considerable amount of improvement in the purchasing power of the people of the system. The available number of vehicles by different types is presented in Table 2.26

Table 2.26 Number of vehicles by different types

Sl.No	Type of vehicles	No of vehicles	Per cent
1	Two wheelers	201095	63.00
2	Light motor vehicles	57456	18.00
3	3 wheelers	32878	10.30
4	Heavy motor vehicles	12768	4.00
5	Buses	12768	4.00
6	Others	2234	0.70
7	Total	319199	100.00

Sources: National transport planning and research centre, Thiruvananthapuram-2001

The table illustrate that two wheelers occupy about two third (63.00per cent) of the total vehicle available in the system. Followed by Light motor vehicles has accounted for about two fifth (18 per cent), and three wheelers accounted for (auto-rickshaws) one tenth (10.30per cent) of the total vehicles. The following vehicles, such as, Heavy motor vehicles, Buses and others share only very meager quantity of the total vehicle availability, and are 4.0 per cent, 4 per cent, and 0.70 per cent respectively of the total vehicles in the system.

The vehicle availability by different types clearly shows that the District is economically not so much developed. The least availability of Heavy motor vehicles, which are used for good transportation reflect the industrially backwardness of the district. Further, the increase in number of two wheelers shows that most of the people are living in the middle-income group, because generally middle-income group people used to have two wheelers for their mobility. Since it's operating cost is very less.

2.13.3.2 Rail Transport

Railway is the cheapest mode of transportation in the State. Safety and reliability are added advantage to this mode. In this study area, the Central Railway Station is located at Thampanoor, which is one of the major Railway Stations in South India. This is connected with almost all major State Capitals and other important Cities of the Country. There are 19 small Railway Stations lie in this District for passenger movement. This railway system is used for passenger movement and goods movement. It has been observed that there are 318 trips are operating and terminating from this Railway Station carrying about 20000 passengers daily. In addition to the passenger movement, goods movement is also managed through the Railway, which include – transportation of Petroleum Product, Natural gas, Cement, Steel, Food grains, etc.

2.13.3.3 Air Transport

This city is blessed with an International Airport, which occupies 190 hectares of land, and is located on the Western side of the city at Sangumugham. This is considered as one of the major International Airports in South India. In a week period, about 69 International flights are operated from this terminal to different destinations and majority of these are flying to Middle East Countries,

such as, United Arab Emirates (UAE), Kuwait, Bahrain, Mascot, Saudi Arabia, Qatar, and other Asian countries like Sri Lanka, Maldives and Far Eastern Countries like Singapore. The Domestic Terminal operates 35 trips every week. Altogether, 30000 passengers are traveling from this Airport in a week period. In addition to above, an average of 100 tones of vegetable is also exported to Middle East Countries in a week through this airport.

2.13.3.4 Water Transport

The Thiruvananthapuram District is blessed with lot of lagoons, rivers, canals etc. These lagoons and canals had been used for navigation purposes for upto just last two decades, effectively. At present, most of these are neglected, and some parts of these recourses are used for navigation sparingly. These waterways are connected up to Hosdurg, which lies in the Northern parts of the State. Though the waterway is the cheapest mode of transportation, it is unattended. The Thiruvananthapuram Sherthalai canal passes through the Western part of the city. The present State Government has realized the importance of these resources and setup an agency to study the feasibility for the development of this canal stretch for using navigation and tourism purposes named as "Theerapadam" project.

2.13.4 Telecommunication

Telecommunication system proves to be one of the most important network systems for proper functioning of a city. Kerala State has a good communication network. Though the number of Post Offices in Kerala State during 2001 remained the same as that of the previous year, i.e., 5071, on an average the services of one post office to population has increased to 6138

persons as against 5774 persons during the same year.. There are at present 420 Post offices in this District spread over the entire area depending upon the density of population.

The District is blessed with 214029 Telephone connections, which form 12.65 per cent of the total telephone connections in the State. There are 91 Telephone Exchanges are spread all over the District. In addition to the above, there are about 2500 public Telephone booths, which are operating in the District facilitating the needs of the people including travelers.

2.13.5 Fire Stations

The city has five Fire Stations, which are located at Chenkalchoola, Chakkai, Attingal, Nedumangad, and Neyyattinkara. These Fire Stations are functioning effectively to fulfill the demand of the study area.

2.13.6 Cremation and Burial Grounds

The city has two cremation grounds, one at Karamana and the other at Thycaud. Of which, the later has electric cremation facility. Though the law prohibits the cremation in household premises, such practices are still the ongoing process in this city. The city has several burial grounds, which are attached to Religious Institutions, and few of them are located even in the C.B.D areas. These areas practically serve as green open spaces in the city.

2.13.7 Recreational Open Spaces

The city has several recreational open spaces within the reachable limit. The important recreational open spaces available in the city are presented in Table 2.27.

Table 2.27 Recreational open spaces

Sl.No	Name	Area in acres
1	Poojappura Junction	3.25
2	Putharikandom and East Fort	5.68
3	Museum and Zoo	46.87
4	Kanaka Kunnu Palace	21.04
5	Observatory Hills	23.00
6	Water Works Complex	16.00
7	South Street Maidan	2.14
8	Beach	10.00
9	Boat Club	10.00
10	Other Parks	2.00
11	Stadium	25.00
12	Total	165.00

Source: Department of Town Planning, Government of Kerala, Thiruvananthapuram-2001

The table enumerates that the city has about 165 acres of land, which is used for recreational purposes. It has been observed that considerable amount of population use these open spaces. Besides these, centrally open spaces few Stadiums and parks lie in each Panchayat and Municipality area of the city. It has also been observed that there are 1542 ponds available in this District spread across 88 Panchayats, 4 Municipalities and Thiruvananthapuram Corporation area and are used for multiple proposes, like irrigation and recreation.

2.14 TOURISM

Tourism is considered as one of the major economic activities of the State. The District has abundant natural resources including vegetation and water bodies and is attracting a large number of Domestic as well as Foreign Tourists.

Important tourist destinations in this District are Kovalam Beach, Sangumugham Beach, Veli Beach, Varkala Beach, Vizhinjam Beach and Poovar Beach. The entire stretch of coastal line lies in this District is in the process of development of Tourism related activities. The hill station located at Ponmudi and the Bio Diversity area at Agastiarmala, are also lying in this District, which are attracting major chunk of tourists. The important tourism spot in the district is presented in Figures 2.12,2.13, 2.14,2.15,2.16,2.17,2.18,2.19 and 2.20 respectively.

2.15 POLLUTION

Growth of population, increase in number of motor vehicles, burning solid waste in the open spaces, dumping the raw wastes in the open spaces, run-off fertilizers and pesticides in the agricultural lands, etc., cause serious environmental degradation (pollution) in the city. As a result, the city is experiencing several kinds of diseases. The water-bodies in the coastal zone are polluted mainly due to effluents discharged from the available industries (Titanium products and coir retting), domestic and community sewage, storm water flow along with garbage, debris and silt, drainage from agriculture lands mixed with fertilizers, pesticides, fungicides, and coir retting. Titanium products factory discharges effluents into the sea directly and is estimated that about 100 tones of sulphuric acid along with 50 to 60 tones of iron sulphate are discharged everyday.

In this chapter, Thiruvananthapuram district profile is presented with facts and figures. The most important control parameters, which decide the functions of the system, are identified and their characteristic features are analyzed in detail and presented in the subsequent (third) chapter.

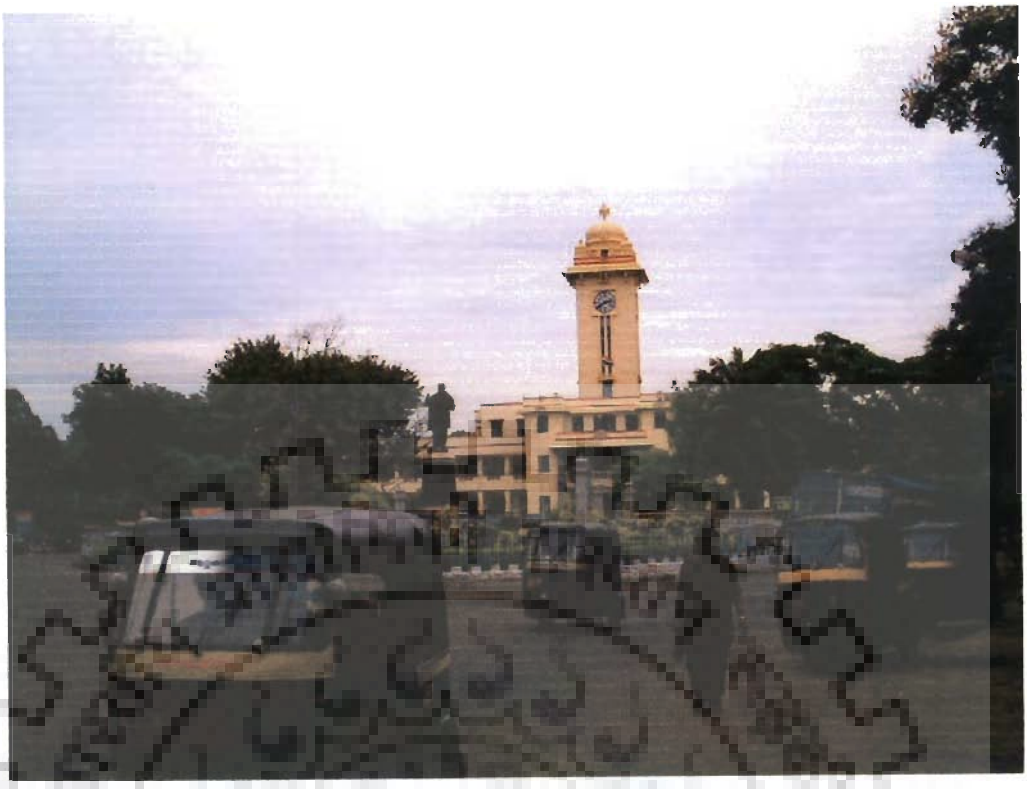


Fig 2. KERALA UNIVERSITY, THIRUVANANTHAPURAM

Fig 2. GOVT: AYURVEDA COLLEGE, THIRUVANANTHAPURAM.

Fif 2. LEGISLATORS' HOSTEL, THIRUVANANTHAPURAM.

Fig 2. UNIVERSITY COLLEGE, THIRUVANANTHAPURAM.

Fig 2. CORPORATION OFFICE, THIRUVANANTHAPURAM.

Fig 2. MUSEUM, THIRUVANANTHAPURAM.

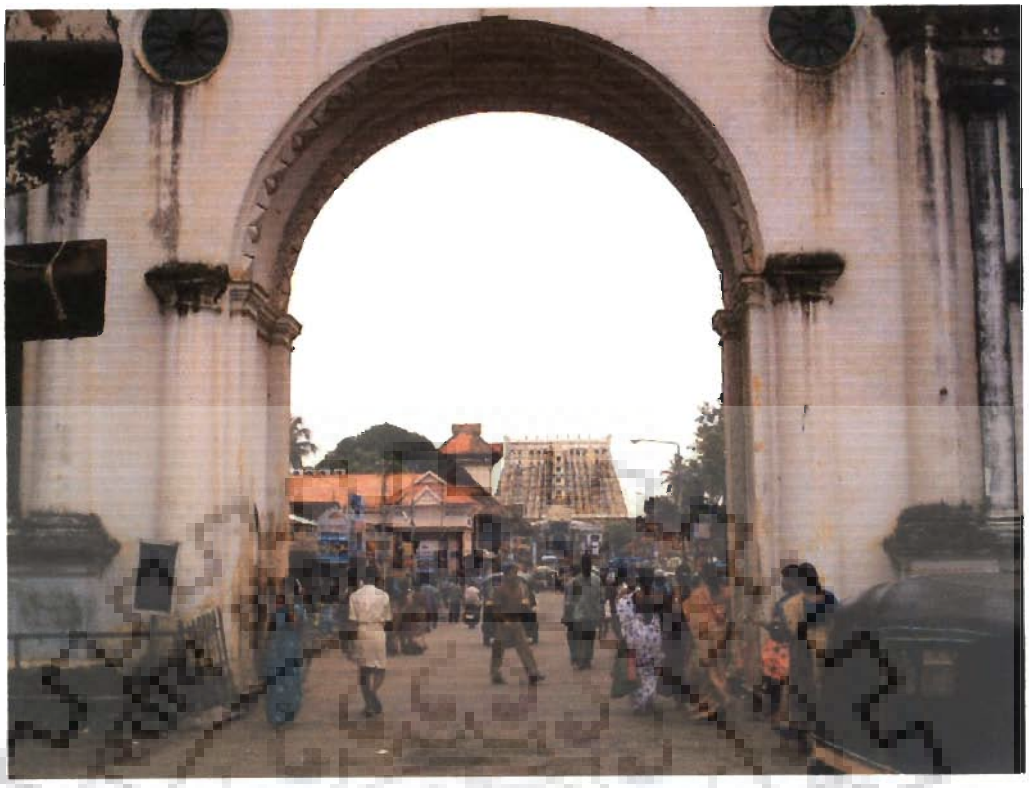


Fig. 2. PADMANABHASWAMY TEMPLE, THIRUVANANTHAPURAM.

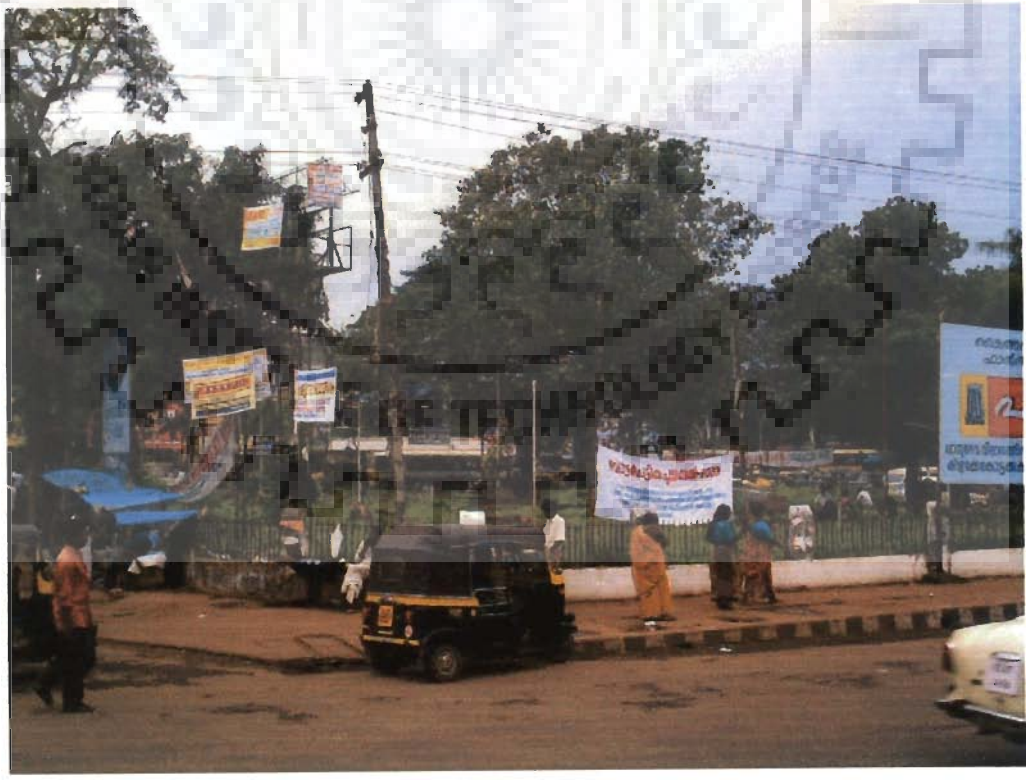


Fig 2. GANDHI PARK, THIRUVANANTHAPURAM.

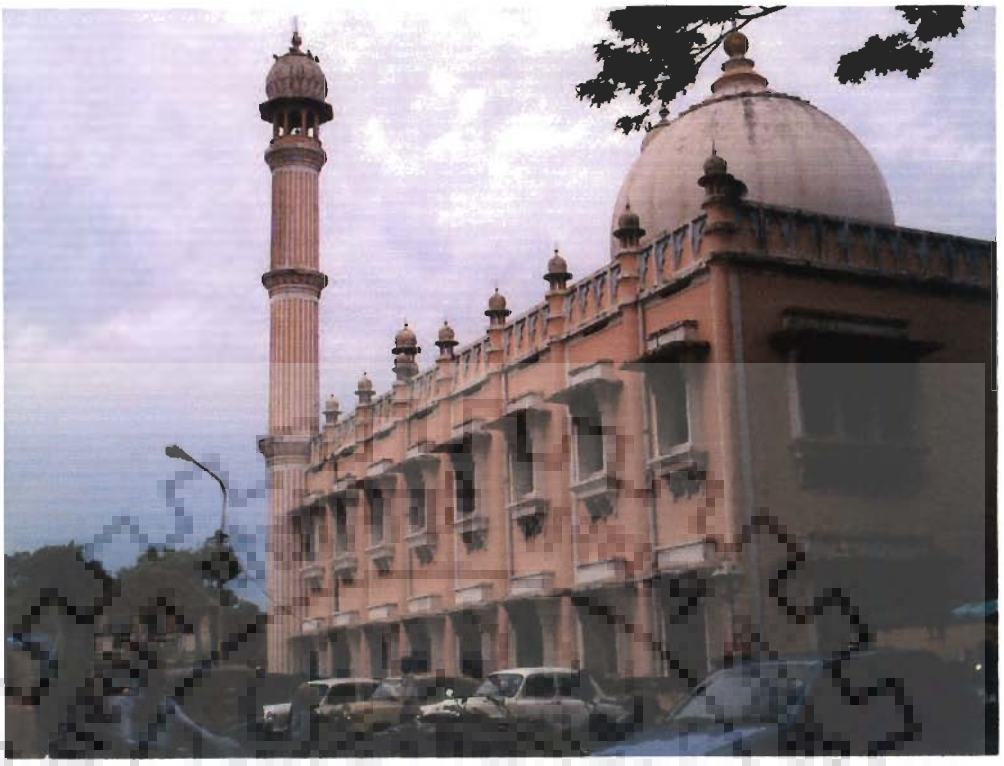


Fig 2. PALAYAM MOSQUE, THIRUVANANTHAPURAM

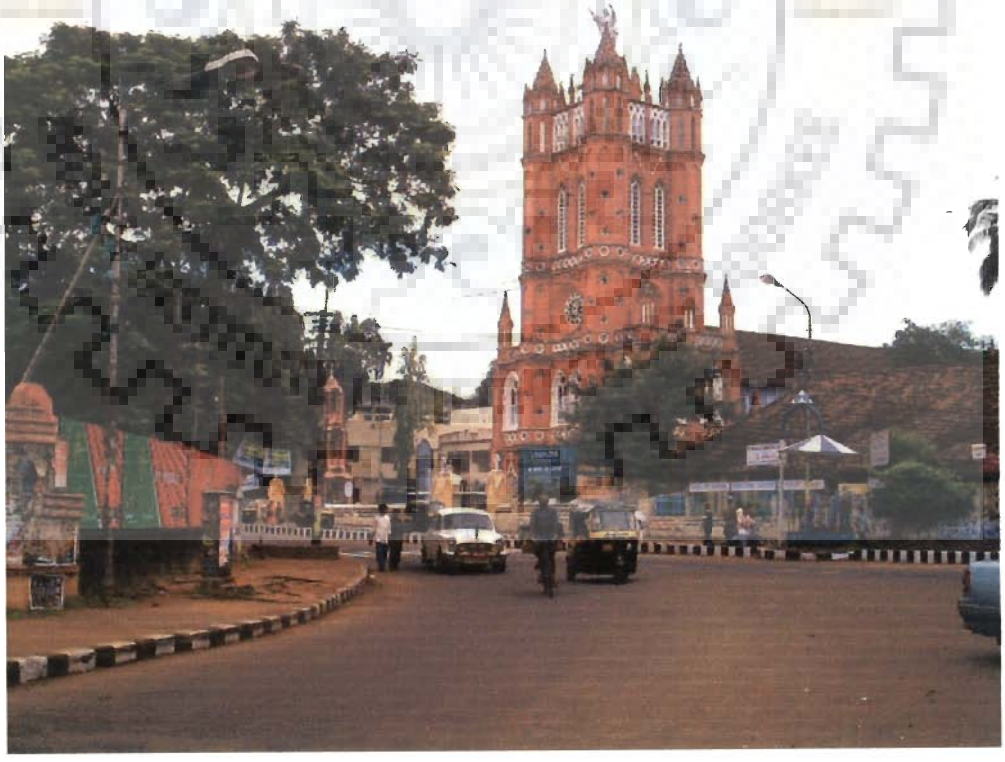


Fig 2. PALAYAM CHURCH, THIRUVANANTHAPURAM.

Fig 2. NAPIER MUSEUM, THIRUVANANTHAPURAM.

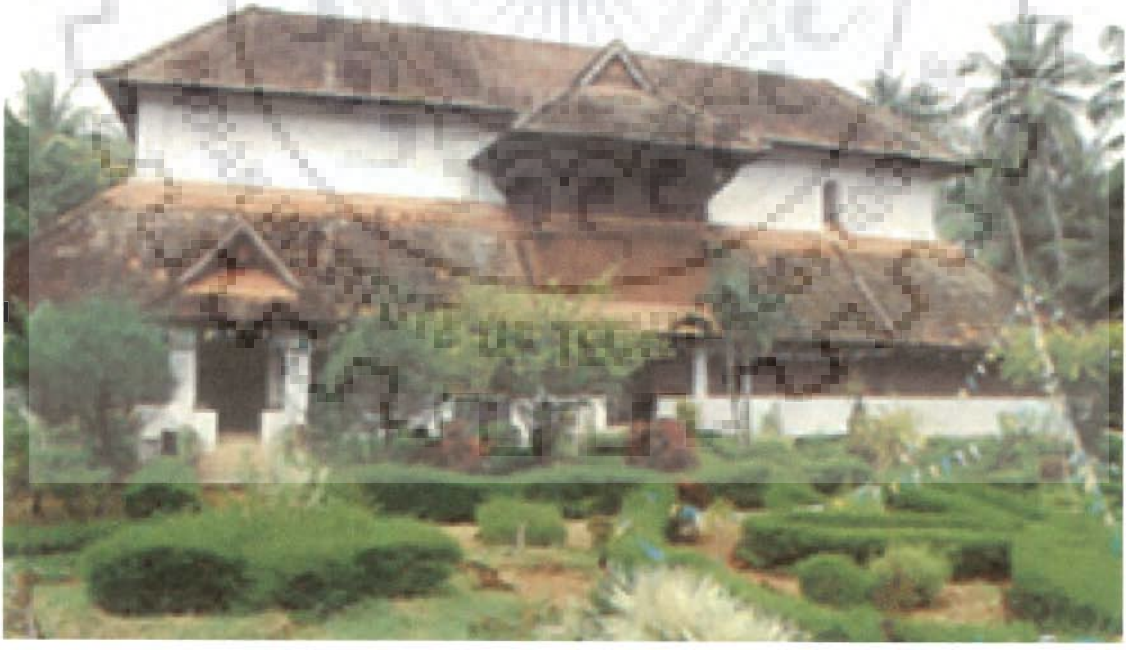


Fig 2. KOIKKAL PALACE – NEDUMANGADU.

Fig 2. KOVALAM BEACH

Fig 2. VARKALA BEACH

Fig 2. COASTAL SCENARIO – REPAIRING OF FISH NET

Fig 2. COASTAL SCENARIO - COIR PROCESSING

Fig 2. TECHNOPARK, THIRUVANANTHAPURAM.

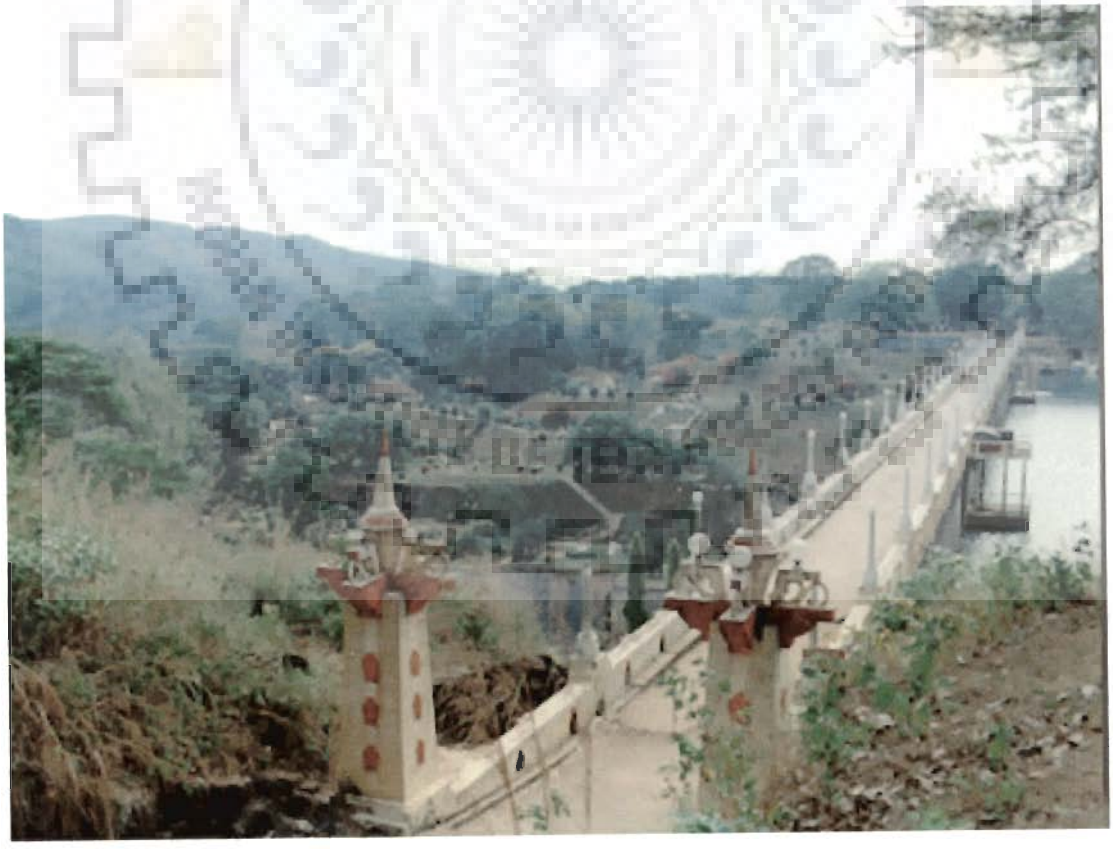


Fig 2. NEYYAR DAM, THIRUVANANTHAPURAM.

CHAPTER 3

URBANIZATION IN THIRUVANANTHAPURAM CITY

3.1 INTRODUCTION

In an urban system, generally the growth is measured by the following parameters, such as, area, population, population density, socio-economic condition, and the availability of infrastructure facilities. In this present investigation, 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., are considered for analyzing the growth of the city. The control parameters, which are used for analysis, are presented as below.

3.2 GROWTH OF THIRUVANANTHAPURAM CITY

This city has been growing since its inception in 1200 A.D. It had undergone lot of changes over the years, several kings ruled the city and even became the capital of several kingdoms. It has been observed that though the city was incepted in 1200 AD, the administration maintains the data pertaining to demographic details since 1901. Demographic profile is one of the most important parameters to be considered since it reflects the growth of the city by both qualitative and quantitative aspects. Having these in mind, an attempt has been made to analyze the growth of the city in terms of area, population, and population growth, population density over the years, i.e., from 1901 to 2001, and presented in Table 3.1.

Table 3.1 Growth of Thiruvananthapuram city

Sl No	Year	Area in Sq.km	Per cent increase	Population	Decadal growth rate	Density/sq.km
1	1901	25.6	100.00	57882	8.90	2261
2	1911	25.6	100.00	63561	9.80	2481
3	1921	25.9	100.00	72784	14.50	2810
4	1931	29	113.28	96016	31.90	3310
5	1941	30.6	119.53	128365	33.70	4194
6	1951	43.9	171.48	186931	45.60	4258
7	1961	44.58	174.14	239815	28.30	5379
8	1971	74.93	292.69	409627	70.84	5466
9	1981	74.93	292.69	483086	17.90	6467
10	1991	74.93	292.69	523733	8.40	6989
11	2001	142.00	554.68	744739	42.12	5245

Source: census – 2001, Government of India, NewDelhi-2001

This table illustrate that the land area of the city has grown tremendously, i.e., about six times (554.68%) from 1901 to 2001, whereas the total population of the city has grown thirteen times in the same corresponding period. It has been observed from the table that in 1951, 1971 and in 2001, the city administration had annexed majority of the fringe areas along with the city, and the city limit was extended in the fringe areas, where the density of population was very less compared to the core area of the city. As a result, in these years (1951, 1971 and 2001), though area under the city had increased the density of the population decreased compared to just previous data points. However, the density of the population has increased to 232 times from 1901 to 2001. This clearly shows that this city is grown tremendously from 1901 to 2001, and the urbanization process is also observed very high.

3.3. DEVELOPMENT

Development within the city is one of the most important parameters, which can be used to understand the growth of the city. Intensity of development can be studied by analyzing several parameters, such as, availability of

infrastructure services and their consumption, conversion of agricultural land into non-agricultural use (agricultural land into residential land, residential land into commercial land, agricultural land to industrial land, agricultural land into institutional and recreation land, etc.), vertical expansion of the city, and so on. However, in this investigation an attempt is made to study the intensive development of the city by analyzing the conversion of field crop (paddy) area into residential land. The data pertaining to total area of the city, and area under paddy crop were collected for the year 1901, 1961, 1971, 1981, and 1991 and analyzed very carefully, and the results are presented in Table 3.2.

Table 3.2 Reduction in field crop (Paddy) area in the city

(area in sq.km)

Sl No	Year	Area of the city	Area of paddy field	Percentage
1	1901	25.60	15.13	59.03
2	1961	44.58	05.05	11.31
3	1971	74.93	05.89	7.86
4	1981	74.93	04.51	6.02
5	1991	74.93	03.19	4.26

Source: Centre for Earth Science Studies, Thiruvananthapuram, 1992.

This table illustrate that the field crop (paddy) area is decreased from 59.03 percent to the total area in 1901 to 4.26 percent in 1991. It is also observed that during the period between 1971 and 2001, the city administration never expand the city limit, which force the population of the city to adjust themselves within the city limit to avail better infrastructure facilities.

As a consequence, the population density has increased in the city to the larger extent, i.e., in 1991 it has touched 6989 persons per sq. km. Moreover, the land value of the paddy field is very less compared to the developed dry land. These situations forced the people to convert the available field crop (paddy) area into residential area to meet the requirement of residential land; in turn the filed crop area is decreased. These show that the intensity of development in this

city, but the quality of the eco-system of the city is decreased to such an extent, that often drought and flooding occur in certain pockets of this city in an extreme conditions in different seasons.

3.4 LITERACY

Literacy is on of the most important factors, which decide the functions of the system. To measure the human resource development, literacy rate of a system is considered as on of the prime parameters (World Bank 2004). Therefore, growth of literacy rate is considered to analyze the growth trend of the city. To analyze the growth trend of this city, attempts is made to collect data pertaining to population and literacy rate for different periods starting from 1981 to 2001, and are presented in Table 3.3.

Table 3.3. Literacy

Sl No	Year	Population	Literacy rate in per cent
1	1981	483086	80.00
2	1991	523733	89.20
3	2001	744739	92.00

Source: census- 2001,Government of India, NewDelhi, 2001

The table explain that the literacy rate is increased from 80.00 percent in 1991 to 92.00 percent in 2001 in this city, which slows that the literacy rate is quite high in this city, and it is still growing at higher rates.

3.5 EDUCAITON

Education is on of the major control parameters, which decide the functions of the system. Good education work as a catalyst for multifaceted development in the system, pertaining socio-economic, cultural, and so on. It not

only brings development but also brings laurel in the system. In fact the Governments of Kerala has been working for the development of education system in this State in general and in this study area in particular, and it really develop a pathway for the development of educational system. Besides the government larger numbers of private institutions are also working for the development of education, particularly in basic education and technical educational field in the system. It has been observed that the Government of Kerala spends a substantial amount of money for the development of human resource, particularly in education. Having these in mind, an attempt is made to analyze the expenditure made by the Government for this purpose for the last decade, and the results are presented in Table 3.4.

Table 3.4 Per Capita Expenditure in Education

(In Rupees)

SI.No	Year	Amount	Increase in per cent
1	1990-91	269	100.00
2	1991-92	282	104.83
3	1992-93	334	124.16
4	1993-94	-	-
5	1994-95	443	164.68
6	1995-96	464	172.49
7	1996-97	528	196.28
8	1997-98	569	211.52
9	1998-99	717	266.54
10	1999-2000	884	328.62

Source: Budget brief, Government of Kerala, Thiruvananthapuram, 2001

This table explain that the Government of Kerala has been spending a large amount of money for education, and it has been increased from Rs 269 in 1990-91 to Rs. 884/- in 1999-2000 financial years per capita per annum. This clearly shows that the per capita expenditure made by the Government for education is increased considerably over the last decade, and it is increased to

328.62 percent from 1990-91 to 1999-2000. It has been observed that the State Government spend more money for education than the all India figure, i.e., 62.00 percent expenditure is higher than the all India average in the year 1999-2000. It has been also observed that this State Government spends more money towards education than all other states in India and the human resource index is also the highest among all the states in India.

3.6 OCCUPATION

Occupation is an important parameter, which decides the functions of the system. The economic functions of the system can be measured by considering the occupational structure of the people in the system, per capita income of the people, per capita expenditure, etc. In India, higher income earning occupation yields more social values along with economic strength. Good occupation leads to earn more income, which leads to higher standard of living, higher saving, etc, which directly reflects the functions of the city. Urbanization trend can also be measured by using shift in occupational characteristic feature. Number of persons working more in secondary and tertiary sectors of the economy in an urban system shows that the system is more urbanized, whereas if more number of persons in the system confined towards the primary sector of the economy (agricultural occupation), it is considered as less developed. If a shift in occupation is observed from agricultural to other sectors, it is really a good symptom, since it fetches constant and continuous income to the society. Having these in mind an attempt is made to analyze the occupational behavior of the people for the period of four decades, and the results are presented in Table 3.5.

Table 3.5 Occupation

(figures in per cent)

Sl No	Year	Occupational structure			
		Cultivators	Agriculture Labour	Household Industry	Other Workers
1	1961	20.90	17.40	8.70	53.00
2	1971	17.80	30.70	4.30	47.20
3	1981	13.10	28.20	3.70	65.00
4	1991	7.20	16.10	3.50	73.20
5	2001	6.80	12.50	6.30	74.40

Source: census- 2001, Government of India, New Delhi, 2001

This table explain that there is a tremendous amount of shift in the occupational structure of the system. The person had worked in different activities, such as, cultivation, agricultural labour activities, and household industries shifted the occupation considerably, and are observed in decreasing trend from 1981 to 2001. The persons engaged in cultivation are observed in decreasing trend drastically from 1961 to 2001, i.e., more than two-third of the total cultivators shifted their occupation during this period. Among the agricultural laborers, it is also observed that the availability of agricultural laborers also in decreasing trend, i.e., about one-third of the agricultural laborers shifted their occupation to other activities during the same period. In household industry, the persons engaged are also observed in reverse trend, i.e., in 1961 it was 8.70 percent, whereas in 1991 it was just 3.50 percent, and in 2001 it was 6.30 percent. In fact, the govt. of kerala intervened to safeguard these activities particularly during the period of 1990's, which lead to survive these activities. Otherwise it would have been vanished from the system. In other workers category, it has been observed that considerable amount of increase from 1961 to 2001, i.e., from 53.00 per cent in 1961 to 74.40 per cent in 2001, which shows that about three-fourth (74.40 percent) of the total worker's engaged in tertiary

sector of the economy. It is interesting to state that the above shift in occupation is a real positive trend towards urbanization and development in the system.

3.7 INCOME

Income is one of the most important parameters, which decides the functions of the system. Increase in income leads to increase in purchasing power in the system. Increase in purchasing power leads to multifaceted development in the system. Though this city administration is almost concentrating on human resource development, and the functions of other segments in the system are negligible, and this city's economic growth is not bad compared to few cities in India since considerable amount of persons from this city working in abroad as Non-resident Indians and sent huge amount of money to this system. The per capita income of this city from 1997-98 to 1999-2000 are studied carefully, and the results are presented in Table 3.6

Table. 3 .6 Annual income (per capita)

Sl.No	Year	Per capita income	Per cent
1	1997-98	14668	100.00
2	1998-99	16641	113.45
3	1999-2000	19293	131.53

Source: Directorate of Economics and statistics, Thiruvananthapuram, 2001.

This table explains that the annual per capita income has increased of from Rupees 14668/- in 1997-98 to Rupees 19293/- in 1999-2000, which shows that about one-third (31.53 per cent) of the total income has increased with in the span of two financial years. This increases in per capita income shows that this city has good purchasing power, and also has a chance for further development.

3.8 HOUSING

Housing is one of the important parameters to be considered for assessing the performance of the system. In an urban system, if majority of the houses are in good conditions, which reflect the socio-economics strength of the system. At the same time, if the system is mostly covered by dilapidated condition houses (slum) that reflects the pitiable condition of the system. In this study area, it has been also observed that the houses are almost spread all over this city, and the availability of walk-up apartments is very much negligible in number. Moreover, it has been observed that a considerable amount of houses are available in such a good conditions like mansions in the system. Further, the housing conditions in the coastal area is very poor and most of then even do not have title deeds, which prevent them even to avail social housing schemes, and electric connections. Having all these in mind, an attempt is made to analyze the housing condition and its growth over the period from 1981 to 2001 in the system, and the results are presented in Table 3.7.

Table 3 .7 Housing Stock

Sl No	Year						
	Quality of the houses	1981	Per cent	1991	Per cent	2001	Per cent
1	Good	51029.00	56.08	72408.00	69.06	96816.00	65.00
2	Livable	15976.00	17.56	15639.00	14.93	43641.00	29.30
3	Dilapidated	23973.00	26.35	16770.00	14.93	8490.00	5.70
4	Total	90978.00	100.00	104747.00	100.00	148947.00	100.00

Source: census – 2001, government of India, New Delhi, 2001.

This table illustrate that the total number of houses are increased from 90978 in 1981 to 148947 in 2001, which is 63.71 percent increase in the system. Of the total number of houses under good condition, the number of houses under good conditions is increased from 51029 in 1981 to 96816 in 2001, which shows that a considerable amount of good houses (89.72%) and added up in this system. The available number of houses under dilapidated conditions is in decreasing trend. Of the total houses, the dilapidated condition houses are 26.35 percent in 1981, and it was decreased to 5.70 percent in 2001, since considerable amount of livable houses are constructed under social housing schemes, and the people who reside in the dilapidated houses shifted in those livable houses, which also reflects the number of houses available in the livable group, i.e., the number of houses available in this group is increased from 15976 in 1981 to 43641 in 2001, which is 73.16 percent increased. This shows that the housing condition of this city has improved considerably, which reflects a strong urban dynamic characteristic features available in this city.

3.9 DRINKING WATER SUPPLY

Drinking water supply is an important parameter, which decides the function of the system. In fact, this city was blessed with huge quality of water, but over the years some pockets of this city also has been suffering from drinking water scarcity due to artificial problem created by the people of this city. This city had been enjoying good monsoon, but recently onwards monsoon fails occasionally, which lead to water scarcity. The government has made substantial investment for providing better drinking water supply to this system, but a part of this city (costal area) does not have this facility, where higher density of population is observed. It is interesting to note that in certain pockets of this city

water supply system function round the clock. It is also observed that most of the water distribution system (pipe lines) laid during the British Raj periods, which are damaged over the years leading to heavy water loss in this system. Having this knowledge in mind, an attempt is made to analyze the quantity of drinking water supply since 1932 to 2001 in the system, and the results and presented in Table 3.8. This table illustrates that the total quantity of water distribution is increased from 10.80 MLD in 1932 to 97.00 MLD in 2001, which is a remarkable increase (898.14 per cent) in drinking water supply system. The per capita availability of water is also increase from 100 lpcd in 1932 to 126 lpcd in 2001. This shows that the quality of living has increased in relation to drinking water supply in this system.

Table 3.8 Water supply systems

Sl.No	Year	Total Capacity (MLD)	Percentage addition
1	1932	10.80	100.00
2	1966	17.80	168.81
3	1971	25.80	238.88
4	1972	35.80	331.48
5	1976	36.60	338.88
6	1979	42.40	392.59
7	1988	42.65	394.90
8	1990	42.85	396.75
10	2001	97.85	898.14

Source: Kerala water Authority, Government of Kerala, Thiruvananthapuram, 2001.

3.10 ELECTRICITY

Electric power is one of the most important parameters, which decides the functions of the system. Availability of electric power and the supply of power in a system decide setting up of industries in the system. In India, States like Maharashtra, Gujarat, Tamilnadu, etc, are having good electric power supply, and these States are industrially developed compare to some other States like

Orissa, Kerala, Madhya pradesh and so on. In Kerala, the power supply is very meager, and this situation leads the local entrepreneurs to go out of the State for setting up of industries. The per capita power consumption in the State is also very less compare to the developed States. Having this knowledge in mind, an attempt is made to analyze the accessibility of power supply in three data point of two decades, i.e., 1981,1991 and 2001 in this city and the results are presented in Table 3.9

Table 3.9 Access to Electricity and sanitation

Sl No	Year	No of household in per cent	
		Electricity	Sanitation
1	1981	54.57	59.00
2	1991	67.65	72.00
3	2001	84.30	78.90

Source: census – 2001, Government of India, New Delhi.

The table illustrates that the accessibility of power supply in the city is increasing from 1981 to 2001. In 198i, just above half of the households (54.57per cent) had accessibility to power supply, whereas it has increased upto 84.30 per cent, in 2001 which is almost 55 per cent hike from the year 1981. This shows that a substantial amount of money has been spent for the development of power supply system in this city during these periods. Moreover, it has been observed that provision of infrastructure cost per household is much higher in this city compared to the neighboring State capitals, since the households are not concentrated much in the city like the neighboring state capitals cities. As a result infrastructure provision cost (poles, grid connection material, lobour and maintenance, etc.,) is escalating in the city.

3.11 SANITATION

Sanitation is an important parameter, which decides the functions of the system. Good sanitation system leads to good health, better quality of life and better environment in the system. Sanitation is also used as one of the parameters, to measure the quality of life index in the system ®. The Government of Kerala has been concentrating much on human resources development, and it gives equal importance to sanitation segment too. Moreover, the people of the city are also much aware of the sanitation related problems, since they are having higher literacy rate and awareness. These two factors lead to have better sanitation facilities in the system. However, the coastal area in this city is suffering from acute shortage of sanitation facilities. During the monsoon season, problem is so aggravated in these areas due to non-availability of proper drainage system, and the entire area is filled with filth. Having this knowledge in mind, an attempt is made to analyze the accessibility of sanitation facilities at the household level from 1981 to 2001 and the results are presented in Table 3.9, and this table reveals that the accessibility of the sanitation facilities to the households in the city is increased from 59.00 per cent in 1981 to 78.90 per cent in 2001, which shows about 43.00 per cent hike in sanitation facilities accessibility. Though the figure is slightly less (almost 80.00 per cent of the households have this facility in this city), it is much higher than the neighboring state capital cities like Chennai and Hyderabad. These also show that there is a strong dynamic functional characteristic feature available in the city.

3.12 TRANSPORTATION

Transportation is another important parameter, which decides the functions of the system. Inefficient transportation system leads to various kinds of

chaos in the system, such as, traffic jams in various locations, intermixing of goods vehicles, passenger vehicles, bullock cart, pedestrians, bicycle and animals, generation of higher quantity of smoke and shoots in the system, etc., which hamper the transportation system, and intern create adverse effects in smooth functioning of the system. Effective transportation systems not only allow the city function in smooth manner, but also keep the environment clean and the people are psychologically motivated. Good roads and efficient administration are very much essential for keeping the transportation system feasible and efficient. Vehicular growth in the system shows the dynamic growth of the city, the purchasing power of the people, and the demand for goods movement, marketing strategies of the vehicle manufacturers and the financial institutions, peoples attitude, etc., Keeping these in mind, an attempt is made to analyze the number of vehicle growth, and the length of road from 1998 to 2002. The data is available only at the district level, but not at the city level. Therefore, district level data is considered for analysis, and the result is presented in Table 3.10.

This table reveal that the number of vehicles and the road length is increasing from 1998 to 2002 in the system. The number of vehicles is increased more than 50.00 per cent from 1998 to 2002, whereas the road length has increased only two per cent during the same period, which shows that there is a stress in the system with regards to transportation. It has been observed that though the stress is prevails in the system, flow of traffic is not altered much since the available services are scattered all over the city.

Table 3.10 Growth of Vehicles and Road Lengths in the District

Sl. No.	Year	No of vehicles	Growth rate	Road length	Growth rate of road length
1	1998	210067	100.00	1902	100.00
2	1999	241932	115.16	1911	100.47
3	2000	266174	126.70	1941	102.05
4	2001	293199	139.57	1941	102.05
5	2002	319199	151.94	1941	102.05

Sources: National Transportation Planning and Research centre, Thiruvananthapuram-2003

In this chapter an in-depth analysis was made to understand the functions of the system by studying its most important control parameters, which decide the functions of the system. A detailed household survey was done to collect upto date data to supplement the data, which are not available in any form of the secondary sources and are having more socio-economic bearing in the system, and are presented in the subsequent (fourth) chapter.

CHAPTER 4

DYNAMIC FUNCTIONS OF THE STUDY AREA

4.1 INTRODUCTION

An attempt is made to understand the physical, socio-economic and environmental conditions, and infrastructure facilities availability in the system at the grassroots level, and is presented in this chapter. To understand the functions of the study area at the grassroots level, survey research methods have been employed to conduct the investigation, and the detail methodology is presented in chapter I.

The following major variables are considered for conducting this present investigation to understand the dynamic function. They are: 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 the 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 methods, 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, which is presented in the chapter 1. Once the data were collected, the investigator vetted all the schedules, crosschecked the schedules, corrected the discrepancies based on crosschecking, and subsequently transferred the data into code-sheets to avoid errors. Thereafter the Investigator feed the data into the computation and used EXELL Software for analysis. To analyze the data, household income has been considered as the dependant variables and other variables are considered as independent variables, and the results are presented in the sequel. They are:

4.2 INCOME

Income is the most important parameter, which decides the functions of the system. The family's status in the society is increased along with increase in income. Moreover, income decides the purchasing power of the family in particular, and the system in general. The growth of income in any system leads to multiple effects in the system, i.e., increase income leads to increase in standard of living, increase in using infrastructure services, etc. Increase in investment leads to increases in production, increase in trades and commercial activities, which further lead to increase in income, increase in saving, increase in capital formation, and increase in investment. In this process a dynamic function takes place in the system, which is very much essential for the development of any system. Heaving these in mind, the Investigator analyzed the economic strength of the households by choosing income as a parameter. To analyze the income of the households, the collected data have been classified into nine income groups. They are annual income below Rs 40,000; Rs 40,000 –

80,000; Rs 80,000 – 120,000; Rs120,000 – 160,000; Rs160,000 – 200,000; Rs 200,000 – 240,000; Rs 240,000 – 280,000; Rs 280,000 – 320,000 and above Rs 320,000. The number of families in various income groups is presented in the Table 4.1 and Figure 4.1.

Table 4.1 Classification of Families by income Group

(Income in Rs 000')

Sl.No	Income	No of Families	Percentage
1	0-40	107	41.2
2	40-80	69	26.5
3	80-120	23	8.80
4	120-160	22	8.50
5	160-200	08	3.00
6	200-240	07	2.70
7	240-280	06	2.30
8	280-320	04	1.50
9	Above 320	14	5.41
	Total	260	100.00

Source: Primary Household Survey –2003.

The table and the figure enumerates that little above two fifth (41.2 per cent) of the total households are having income below Rs 40,000; little above one fourth (26.5 per cent) of the households having income in between Rs 40,000 and 80,000 Followed by, a set of about one tenth of the households(8.8 per cent 8.5 per cent) are having the income in between 80,000 and 120,000 and between 120000 and 160000 respectively. The remaining households are almost evenly distributed under other income group categories. This clearly shows that more number of households is confined in the first and second income group category, which is considered as economically backward group. It also further shows that availability of households decrease along with increase in income, and the number of households having income above 200,000 is only 11.92 per cent of the total households.

The Investigator once more revisited the households, which have income more than Rs. Above 320,000/- per annum, held discussion, and observed that they belong to either working in multinational companies, or working in Gulf countries, or engaged in commercial activities or traditionally land lords.

4.3 POPULATION

Population is the major parameter, which decides the functions of the system. In India, the higher 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., and also leads to various kinds of socio-economic problems. Since population is the major parameter, the available number of population is also figured in the schedule, which is used for conducting the household survey, and classified into male and female categories, for analysis. Moreover, understanding the trend of population growth in different income groups is also very much essential to decide the function of the system.

Household size is also one of the major parameters, which decides the functions of the system. If a household has higher size of population, and the annual income is very less, the household suffers socially, and economically, definitely. On the other hand, if a household has a small size of population and earn reasonable amount of annual income, it prosper and it can have better standard of living compared to the previous one. Having the above in mind, the available number of population in all classified income groups by males and females, family size in all income groups, etc., are analyzed and presented in Table 4.2 and Figure 4.2.

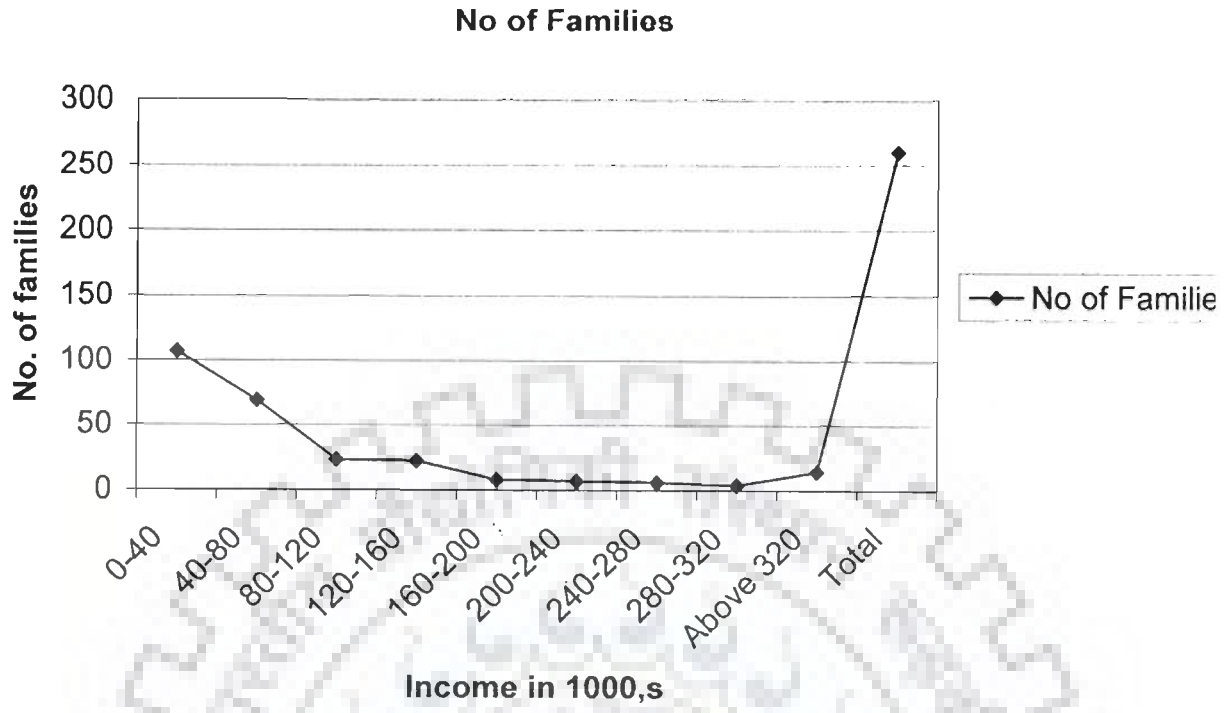

No of Families
300
250
200
150
100
50
0
No. of families
0-40
40-80
80-120
120-160
160-200
200-240
240-280
280-320
Above 320
Total
Income in 1000,s
No of Familie

Fig 4.

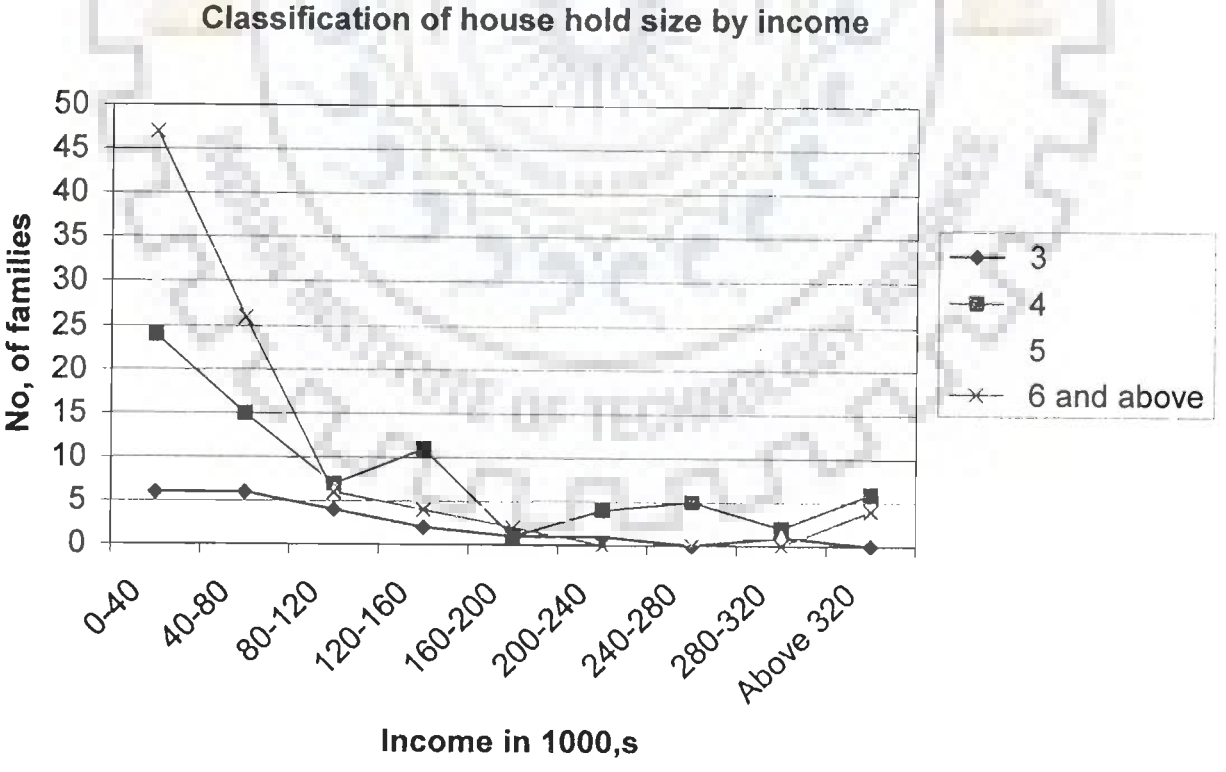

Classification of house hold size by income
50
45
40
35
30
25
20
15
10
5
0
No, of families
0-40
40-80
80-120
120-160
160-200
200-240
240-280
280-320
Above 320
Income in 1000,s
3
4
5
6 and above

Fig 4.

Table 4.2 No of males, females and household size

(Income in Rs 000')

Sl.No	Income	Males		Females		Total		Family size
		No	Per cent	No	Per cent	No	Per cent	
1	0-40	269	43.17	301	44.46	570	43.84	5.32
2	40-80	169	27.12	188	27.77	357	27.46	5.17
3	80-120	53	8.51	56	8.28	109	8.38	4.73
4	120-160	50	8.03	51	7.54	101	7.76	4.59
5	160-200	17	2.74	19	2.81	36	2.77	4.50
6	200-240	14	2.24	16	2.36	30	2.31	4.28
7	240-280	13	2.08	12	1.78	25	1.92	4.16
8	280-320	9	1.45	7	1.04	16	1.23	4.00
9	Above 320	29	4.66	27	3.99	56	4.31	4.00
10	Total	623(47.92)	100.00	677(52.08)	100.00	1300(100)	100.00	5.00

Source : Primary Survey 2003

The table and the figure explains that there is 1300 population available in all the 260 households having the average size of five members in a family. Of the total population, more than half of the population (52.08 per cent) are females, and the rest are (47.92 per cent) male population. It has been observed that the availability of the population (male and female population) is decreasing along with increase in income from first to eighth groups. Of the total population, about half of the population are grouped under the lowest strata of income groups, i.e., income upto Rs. 40000/- per annum, and little more than one-forth (27.46 per cent) falls under the next income category, i.e., annual income between Rs. 40000 and 80000, and the remaining population is almost evenly distributed among all other income groups categories. Similar trend is also observed among the male and female population classification too. It is also observed that the average family size is five, and it is decreased along with increase in income. The first lowest income group categories (annual income upto Rs 40000 and between 40000 and 80000) have more than the average, i.e.,

size of family, 5.32 and 5.17 respectively, and remaining groups have lesser than the average family size of five. It clearly shows that the economically well-off personals produce less number of children, and live improved standard of living compared to the first and second group of income categories.

4.4 LITERACY AND EDUCATION

Literary and Education are the two pillars of socio- economic development of any system. The study area has 90 per cent literacy rate. The literacy rates in the coastal belt of the study are is only 70 per cent, where the majority of the economically weaker section is confined.

To understand the status of the education among the sample households, at the outset, the population is classified as qualified and non-qualified persons. Subsequently, the qualified personnel's are classified further into qualified upto SSLC, Graduation, post graduation and technically qualified personnel's for analysis and are presented in Table 4.3 and Figure 4.3.

Table.4.3. Educational qualification

(Income in Rs 000')

Sl.No	Income	Qualification									
		S.S.L.C	Per cent	Degree	Per cent	P.G	Per cent	T.Q	Per cent	Total	Per cent
1	0-40	101	43.91	35	21.65	10	14.28	24	18.75	170	29.31
2	40-80	73	31.73	47	29.94	6	8.57	30	23.44	156	26.89
3	80-120	22	9.56	20	27.38	14	20.00	19	14.84	75	12.93
4	120-160	20	8.69	30	19.12	6	8.57	14	10.94	70	12.07
5	160-200	5	2.17	11	7.00	5	7.14	6	4.69	27	4.66
6	200-240	3	1.31	8	5.09	2	2.86	7	5.47	20	3.45
7	240-280	1	0.43	1	0.63	8	11.43	7	5.47	17	2.93
8	280-320	0	0	0	0.00	3	4.29	6	4.69	9	1.55
9	Above 320	5	2.17	5	3.19	16	22.86	15	11.73	36	6.21
Total		230	100.00	157	100.00	70	100.00	128	100.00	580	100.00

Source: Primary Household survey- 2003

The table and the figure explains that there are 580 educated persons available among the sample households. Of the total qualified population, about one third of the population (29.31 per cent) confined in the lowest income group, and the availability of qualified persons is decreased along with increase in income. It has been observed that among the qualified persons in different income groups, persons qualified up to SSLC is much higher in the lowest two groups (income groups up to Rs 40000 and Rs 40000-80000 per annum). These two groups together accounts for more then three-fourth of the total SSLC qualified persons, and the remaining of them are distributed among all other income groups. Available number of Post graduate and technically qualified persons is higher in number in the higher income group categories. The highest income category alone has about one-fourth of the available Post graduate (22.85 per cent) and more then one-fourth of the total technically qualified persons (11.73 per cent). It clearly shows that households have more income are highly qualified in this system.

4.5 CHILD POPULATION

The child population in an urban/rural community reflects the growth of population in the system. In a system, if the child population growth rate is exceeding than the percentage of total population growth rate, then it can be concluded that the population growth is much higher in the system, and it will create adverse effect in the system in future, definitely. Having this in mind, the available children among the households under 15 year old are analyzed among the sample households and the results are presented in the Table 4.4 and the Figure 4.4.

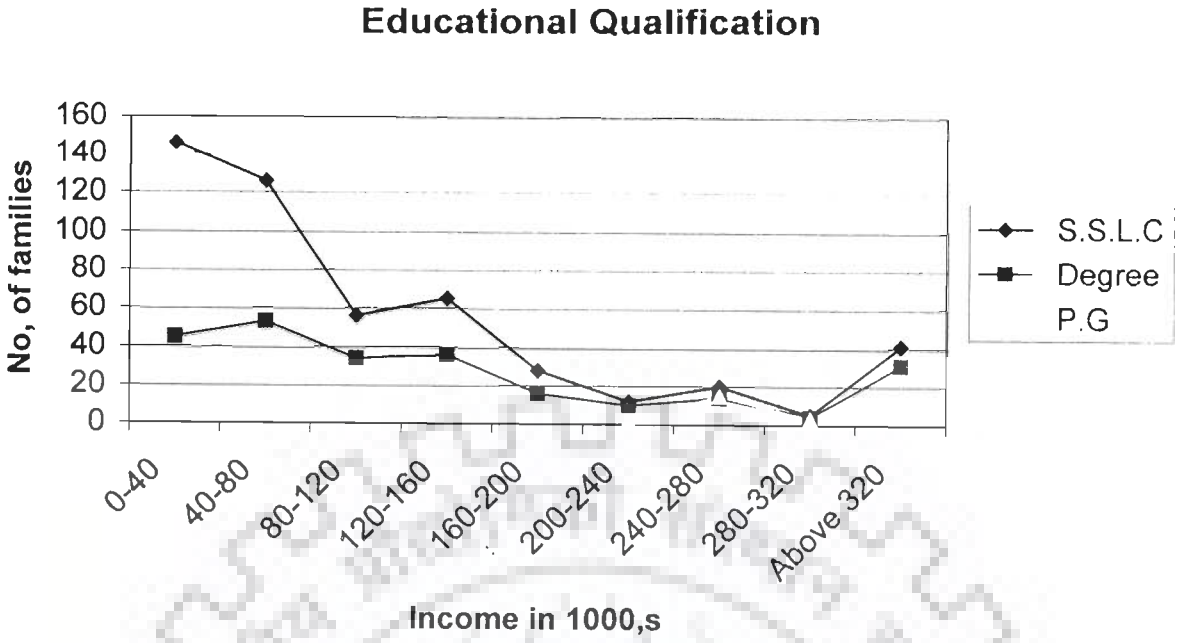

Educational Qualification
No, of families
160
140
120
100
80
60
40
20
0
0-40
40-80
80-120
120-160
160-200
200-240
240-280
280-320
Above 320
Income in 1000,s
S.S.L.C
Degree
P.G

Fig 4.

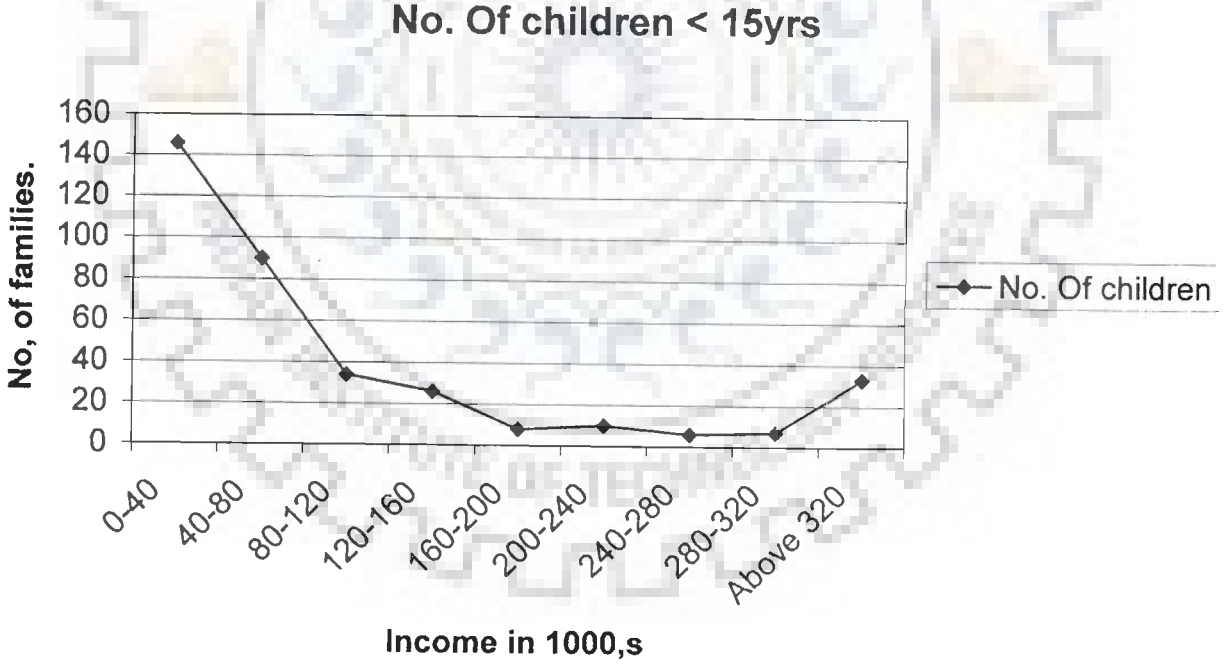

No. Of children < 15yrs
No, of families.
160
140
120
100
80
60
40
20
0
0-40
40-80
80-120
120-160
160-200
200-240
240-280
280-320
Above 320
Income in 1000,s
No. Of children

Fig 4.

Table.4.4. Number of children below 15 years

(Income in Rs 000')

Sl.No	Income	No of children	
		No. Of children	Percent
1	0-40	146	42.69
2	40-80	90	26.31
3	80-120	34	9.94
4	120-160	26	7.60
5	160-200	8	2.34
6	200-240	10	2.92
7	240-280	6	1.75
8	280-320	7	2.04
9	Above 320	15	4.38
		342	100.00

Source: Primary Household survey- 2003

Of the total children, more than two fifth (42.69 per cent) are confined in the lowest income category. Followed by, more than one fourth (26.31per cent) of them are confined in the second income group category. It has been observed that more than two third (69.00per cent) of the total child population are confined in the first two groups of households i.e., Income upto 80000, and rest are evenly distributed like the population distribution. It has been observed that the percentage of available population in different income groups and the percentage of availability of child population in different income groups are almost identical, which shows that all income groups are well aware of population controlling measures and they follow the same.

4.6 EMPLOYMENT

Employment is considered, as the 'back borne' of the economy in this system since activities of secondary sector of the economy is almost absent in the system. The employment opportunities in the primary, secondary and tertiary sectors have been considered in this investigation, and have been observed that the tertiary sector of the economy is functioning well in the system. Primary

sector based activities are prevalent in the sub- urban, highland and in the coastal areas, and the processing or secondary sector is very meagerly functioning in selected pockets of the system. The employed persons confined in various income groups are analysed and presented in Table 4.5

Table.4.5. Employed Personnel's

(Income in Rs 000')

Sl.No	Income	No. Of Employed persons	Percentage to total
1	0-40	116	34.73
2	40-80	86	25.75
3	80-120	28	8.38
4	120-160	37	11.08
5	160-200	18	5.39
6	200-240	8	2.40
7	240-280	9	2.69
8	280-320	7	2.10
9	Above 320	25	7.49
Total		334	100.00

Source: Primary Household survey- 2003

The table indicates that there are 334 employed persons available in the sample household. Of which, one third (34.73 per cent) of the employed persons confined in the lowest income category, and one fourth (25.75 per cent) of them are confined in the second group (Rs 40000-80000) category and the remaining employed persons are almost evenly distributed among all other income groups. In the last income group category, i.e., Income above Rs 320000 per annum, almost half of the populations are working, and it is interested to note that more than two third of the population is qualified Post graduation and technical education. It clearly shows that education plays a major role in occupation and occupation decides the income and the standard of living in the system

4.7 HOUSING

Housing is one of the most important parameters, which decides the functions of the system. House is a place where one can rest, finds shelter from natural and artificial hazards. A major parts of ones life is spent in this house." Good house is essential for decent living, which plays a great part in providing convenience in the performance of the daily chores of life for comfortable living. It has great significance for promoting social well-being and good neighborliness". Though the city does not have handsome amount of industries, migration takes place to enjoy the available infrastructure facilities, and also searching for employment opportunities. Having these in mind, the sample households are grouped into native residents and migrant for analysis and put under various income group categories and are presented in Table 4.6 and Figure 4.5.

Table.4.6 Details of housing

(Income in Rs 000')

Sl.No	Income	By birth		Migrated		Total
		No	Percentage	No	Percentage	
1	0-40	99	44.80	8	20.52	107
2	40-80	61	27.6	8	20.52	69
3	80-120	20	9.05	3	7.72	23
4	120-160	18	8.14	4	10.26	22
5	160-200	6	2.71	2	5.13	8
6	200-240	4	1.81	3	7.72	7
7	240-280	5	2.26	1	2.56	6
8	280-320	2	0.90	2	5.13	4
9	Above 320	6	2.71	8	20.52	14
Total		221(85)	100.00	39(15)	100.00	260

Source: Primary Household survey- 2003

The table and the figure illustrates that about nine tenth (85 per cent) of the total households are native residents, and the rest (15 per cent) are the migrated residents in the city. Of the 260 sampled households selected for the investigation, there are 221 households (85 per cent) are resident in nature and

the remaining 39 (15 per cent) are migrated. The migrations from the lower income category are very less compared to the high-income group. The highest income category holds about 20.52 per cent of the migrated population to the city, even though their household contribution is only 5.41 per cent. This is a clear indication that higher income group people migrated to the city for enjoying the benefits of the city.

4.8 CHARACTER OF RESIDENTIAL SITES

The terrain of the landform governs the quality of the environment of the system The study area has undulating terrain, small hill locks, valleys, paddy fields and coastal areas, which are more prone to natural calamities. During the monsoon seasons the low-lying areas are covered with water, and water logging is common in this plane areas. Though the low-lying areas are prone to water logging during the monsoon, larger number of buildings are constructed in these areas. In some areas, it has been observed that the paddy fields are filled with soil and the crop area is converted in to residential areas too. Having these knowledge in mind, an attempt is made to analyze the characteristic features of the residential sites, and the residential sites are classified in to filled area, dry area and wet area along with income categories for analysis and are presented in Table 4.7 and Figure 4.6.

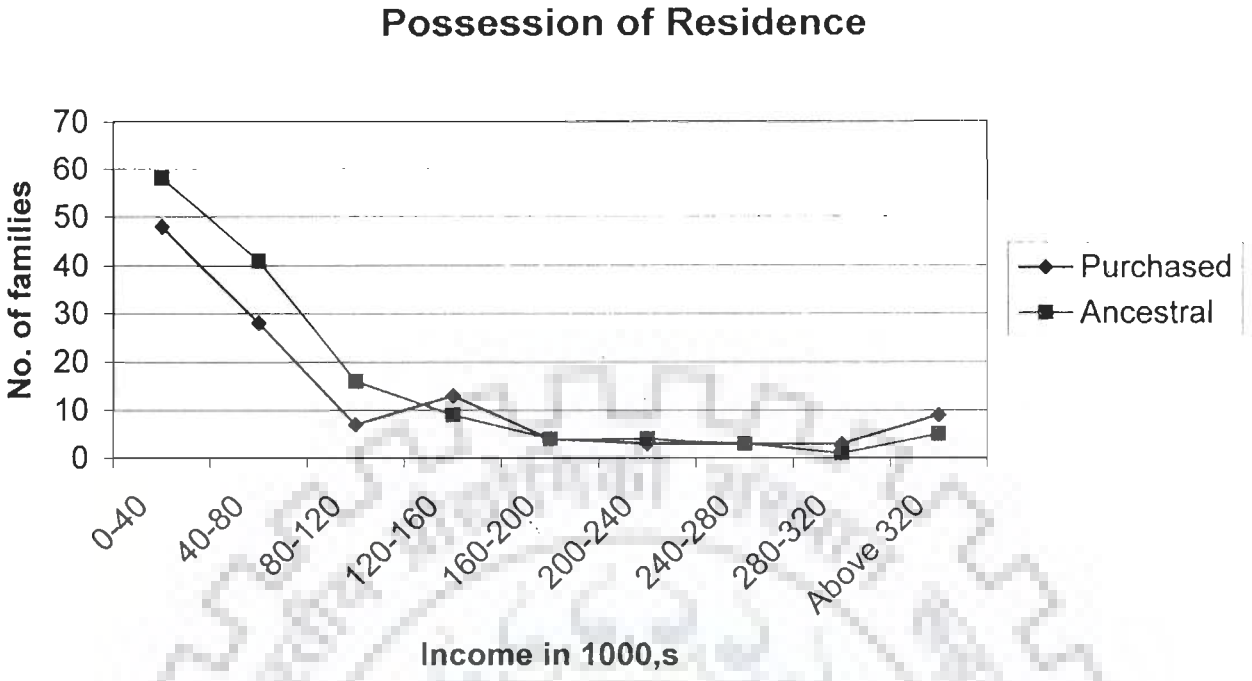

Possession of Residence
No. of families
70
60
50
40
30
20
10
0
0-40
40-80
80-120
120-160
160-200
200-240
240-280
280-320
Above 320
Income in 1000,s
Purchased
Ancestral

Fig 4.

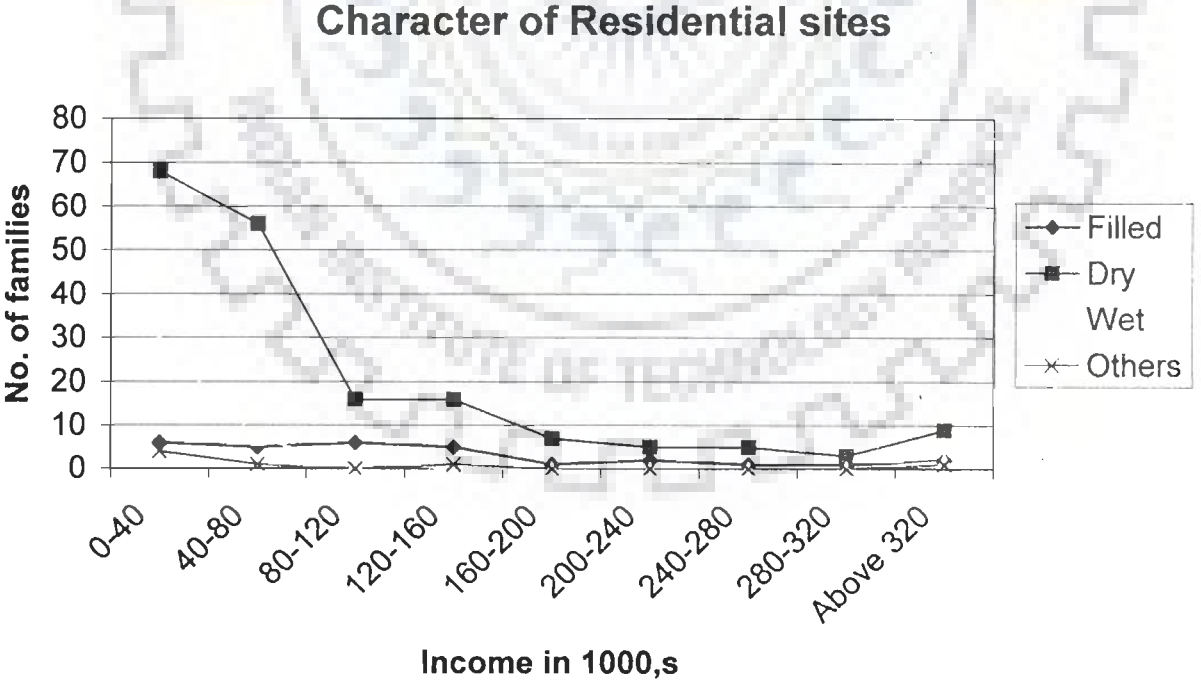

Character of Residential sites
No. of families
80
70
60
50
40
30
20
10
0
0-40
40-80
80-120
120-160
160-200
200-240
240-280
280-320
Above 320
Income in 1000,s
Filled
Dry
Wet
Others

Fig 4.

Table 4.7. Character of residential sites

(Income in Rs 000')

Sl.No	Income	Character of residential sites					
		Filled	Per cent	Dry	Per cent	Wet	Per cent
1	0-40	6	20.00	68	35.56	33	75.00
2	40-80	5	16.67	56	30.10	8	18.18
3	80-120	6	20.00	16	8.60	1	2.27
4	120-160	5	16.67	16	8.60	0	2.27
5	160-200	1	3.33	7	3.76	0	0.00
6	200-240	2	6.67	5	2.68	0	0.00
7	240-280	1	3.33	5	2.678	0	0.00
8	280-320	1	3.33	3	1.61	0	0.0
9	Above 320	3	10.00	10	5.38	1	2.27
Total		30(11.53)	100.00	186(71.54)	100.00	44(16.93)	100.00

Source: Primary Household survey -2003

This table and the figure narrates that about three-fourth (71.54 per cent) of the households are constructed in the dry area, followed by about one-sixth (16.93 per cent) of the households are constructed in the wet areas where water-logging is prevalent, and rest of them (11.53 per cent) are constructed in the filled area, which is converted from the paddy field to residential area. It has been observed that the number of houses available in all the three categories (dry area and the wet area, filled area) decreased in number along with increase in income. It gives displeasure to add that most of the lowest income group (75.00 per cent) reside in the wet area, where water logging is prevalent, and about two-fifth of the persons (18.18 per cent) belong to the second income category (Rs 40000 to 80000) are also reside in this areas. It shows that these economically weaker sections together occupy more than nine-tenth of the total households confined in this wet area, where land value is very less compared to the dry area, and the filled area. It is of interest, the investigator further went to the households in the wet area, which belong to the highest income group category and investigated

the reason for staying in the wet area and observed the following two reasons. They are: (1) traditionally the household belong to this particular site, (2) water logging started to occur very recently, that is why then house comes under the water- logging area. It is of interest; the Investigator made investigation for identifying the reason for water logging and observed the reason for the same. They are: (1) the available water bodies in the system are not attended properly, and started to use as a waste dumping yard, (2) encroachment in the river bank, (3) cleaning the ponds, and filling the crop area, and (4) increase in the density of dwelling units which reduce the open space.

4.9 ACCESS TO RESIDENCE

Accessibility is another parameter, which decides the functions of the system. Since this urban system has very interesting physical characteristic features, such as, undulating terrain, water logging, flooding, deteriorating surfacing, etc., it is worth to study the accessibility. Generally, the higher income group category personals used to settle in a place where all the infrastructure facilities are available. As a result, in these posh areas land value is much higher, whereas, the downtrodden communities try to settle in a place where the land value is much cheaper because their purchasing power is quite low, and in these places where, not much infrastructure facilities are available. Since accessibility also one of the parameters, which decide the functions of the system, and also useful to understand the level of economic development of the system, an attempt is made to analyze the number of households having different types of accessibility level among the sample households. The selected households are sub divided into three categories, such as, pedestrian access households, two-

wheeler access households and household having vehicular access, and grouped along with their income category for analysis and the results are presented in Table 4.8.

Table 4.8 Accesses to Residences

(Income in Rs 000')

Sl.No	Income	Access to Residences						Total	Per cent
		Pedestrian	Per cent	Two wheeler	Per cent	Vehicular	Per cent		
1	0-40	34	77.28	34	64.15	39	23.92	107	41.20
2	40-80	9	20.45	16	30.19	44	26.99	69	26.50
3	80-120	1	2.27	3	5.66	19	11.66	23	8.80
4	120-160	0	0.00	0	0.00	22	13.49	22	8.50
5	160-200	0	0.00	0	0.00	8	14.91	8	3.00
6	200-240	0	0.00	0	0.00	7	4.29	7	2.70
7	240-280	0	0.00	0	0.00	6	3.68	6	2.30
8	280-320	0	0.00	0	0.00	4	2.45	4	1.50
9	Above 320	0	0.00	0	0.00	14	8.59	14	5.41
Total		44(16.9)	100.00	53 (20.40)	100.00	163(62.7)	100.00	260(100)	100.00

Source: Primary Household survey- 2003

The table illustrates that about two third (62.70per cent) of the total households have vehicular access. Followed by, one fifth of the households have two-wheeler access, and about one sixth (16.90 per cent) of the total households have only pedestrian accessibility. It has been observed that the lowest and the lower income group personals are living in the pedestrian and two wheeler accessible areas. It has also been observed that the pedestrian access areas have the least land value compared to the other places. Therefore, most of the economically weaker section lives in these areas.

4.10 NUMBER OF FLOORS IN DWELLING UNITS

Generally, in the capital cities, high-rise buildings and multiple family residences characterize the urban form. In India, New Delhi, the national capital city and few other State capital cities like Mumbai, Bangalore, Chennai, Kolkota, Hyderabad, etc., have similar characteristic features, while this study area

(Thiruvananthapuram city) has peculiar characteristic features though it is situated in the Southern tip of the country, and the capital of Kerala State.

The city has number of special characteristic features. It is interesting to note that most of the people are living in their own individual units on their own land in this city, which shows that rurbanism is dominant in the city. Majority of the people prefer the ground floor, where they can have their own gardens. It gives pleasure to add that almost all households have coconut trees in their house premises, which grow above the houses, spread the leaves above the houses and develop a conducive environment for living. In some cases the higher income group people construct double storied houses (ground+one floor), which is also covered by the coconut trees. In recent years few multistoried apartments have boomed up in this city, but their number is very negligible, and this trend is also almost stopped. At this juncture, the number of floors of the residences are analyzed along with their income groups and are presented in Table 4.9 and Figure 4.7.

Table 4.9 No of Floors in the residence

(Income in Rs 000')

Sl.No	Income	No of Floors in the residence.				Total	Per cent
		Single	Per cent	Double	Per cent		
1	0-40	103	50.00	4	7.40	107	41.20
2	40-80	65	31.55	4	7.40	69	26.50
3	80-120	17	8.25	6	11.11	23	8.80
4	120-160	14	6.79	8	14.81	22	8.50
5	160-200	5	2.43	3	5.55	8	3.0
6	200-240	2	0.98	5	9.25	7	2.70
7	240-280	0	0.00	6	11.11	6	2.30
8	280-320	0	0.00	4	7.40	4	1.50
9	Above 320	0	0.00	14	25.93	14	5.41
Total		206(79.23)	100.00	54(20.77)	100.00	260(100)	100.00

Source: Primary Household survey -2003

The table and the figure illustrates that four-fifth (79.23 per cent) of the total households have single story only, and the rest (20.77 per cent) of them have upto two floors (ground with first floor). It is interesting to note that the availability of houses in single floor is decreasing along with increase in income, and the trend is other way round or just opposite among the double floor residents. It shows that majority of the single floor residents confined in the lowest income group categories. This is also evident from the data, which shows that half of the single storied residents are confined in the lowest income group (<Rs 40000), and about one-third (31.55 per cent) of them live in the income group of Rs 40000-80000, and the rest of them are spread over upto income Rs. 240000 category. It is also interesting to note that most of the higher income group resident live in double story buildings, have two storied buildings, and are having preference to have double storied buildings.

4.11 NUMBER OF HABITABLE ROOMS

Privacy is one of the key factors of family living. Family may consist of people of different age group, sex and relation. Privacy is highly essential for development of human activity. Modern dwelling units require space to receive guest, common areas, dining hall, and space for kitchen and bedroom. The peculiar characteristic feature of the study area, it has been observed that the number of habitable rooms function as an indicator of economic advancement and quality of living. Therefore, the number of rooms available in the household is more suitable to analyze the quality of living than the built up area of the dwelling units. Having the above in mind, an attempt is made to analyze the sample households by having number of rooms in their houses in various income

groups. The houses are grouped into three categories, such as, one bed room houses, two bed room houses, and three and above bed room houses and incorporated based on their income groups for analysis and the results presented in Table 4.10 and Figure 4.8.

Table 4.10. Number of habitable Rooms

(Income in Rs 000')

Sl.No	Income	No of bed Rooms in the residences					
		1	Per cent	2	Per cent	3&above	Per cent
1	0-40	57	57.00	50	48.54	0	0.00
2	40-80	43	43.00	26	25.25	0	0.00
3	80-120	0	0.00	15	14.56	8	14.04
4	120-160	0	0.00	12	11.65	10	17.54
5	160-200	0	0.00	0	0.00	8	14.04
6	200-240	0	0.00	0	0.00	7	12.28
7	240-280	0	0.00	0	0.00	6	10.52
8	280-320	0	0.00	0	0.00	4	7.01
9	Above 320	0	0.00	0	0.00	14	24.56
Total		100(38.46)	100.00	103(39.62	100.00	57(21.92)	260(100)

Source: Primary Household survey- 2003

The table and the figure explains that the available number of houses in different income groups is decreasing along with increase in income. It is interesting to note that about two-fifth of the total population lives in one (38.46 per cent) and two (39.62 per cent) bed room houses. The rest of the houses (21.92 per cent) are having three and above bedrooms. Further, it has been observed that the one-bed room houses are confined in the lowest and the next to the lowest income groups (Rs< 40,000 and Rs. 40000 to 80000) categories. In two bed room category houses, about half of them (48.54 per cent) are confined in the lowest income group and one-fourth (28.25 per cent) of them confined in the next to the lowest income group (Rs 40000-80000) category, and the rest are confined upto the income group of Rs 120000-160,000. The three and above bed room houses are confined in the economically well-off households, and it is

staring from the income group of Rs. 80000-120000 only, which clearly shows that the economically well of personals have more number of room in there houses. It is interesting to note that all the houses of the highest income group category have three or more than three bed rooms in there houses, which reflect their economic strength.

4.12 MATERIALS

Application of materials in house construction decides the durability of the buildings, quality of the building, etc. It also reflects the economic strength of the people that decides the procurement of the quality and quantity of the material. In case the construction materials are abundantly available in the system, the cost of construction may be less, but if the required materials are not available in the system and the materials are to be brought from outside, then the cost of construction will increase, definitely. The study area is blessed with three natural divisions, and all the divisions have different types of resources, which are abundantly used for construction activities. It has been observed that mud and rubble are plenty available in the highlands, which are used for foundation activities: Mud, rubble, laterite, brick, sand etc., are abundantly available in the midland and mud laterite and sand are available in the coastal areas. It has been also observed that wood is another resource, which is commonly available in all the three divisions. Though these resources are available in the system, due to high labour cost prevail in this system, most of the construction materials are brought from outside to this system. Moreover, the State Government of Kerala banned the sand mining in this area which also force the people to bring sand from outside of the system, leading to increase in building cost.

It has been also observed that the lower income group personals apply low cost materials, and the higher income group use higher cost, qualitative and solid materials in their house construction.

Having these in mind, an attempt is made to analysis the types of materials used in different components of the buildings, such as, foundation, wall, roof and flooring by different income groups, and are presented in Tables 4.11, 4.12. 4.13, and 4.14 and Figures 4.9,4.10,4.11 & 4.12.

Table 4.11. Materials used for foundation in the residences
(Income in Rs 000')

Sl. No	Income	. Material used in the residences							
		Mud	Per cent	Rubble	Per cent	RCC	Per cent	Brick	Per cent
1	0-40	38	77.55	64	33.68	2	16.60	3	33.33
2	40-80	8	16.33	58	30.53	0	0.00	3	33.33
3	80-120	1	2.04	19	10.00	1	8.30	2	22.22
4	120-160	2	4.08	18	9.47	1	8.30	1	11.11
5	160-200	0	0.00	8	4.22	0	0.00	0	0.00
6	200-240	0	0.00	5	2.63	2	16.60	0	0.00
7	240-280	0	0.00	4	2.10	2	16.60	0	0.00
8	280-320	0	0.00	3	1.58	1	8.30	0	0.00
9	Above 320	0	0.00	11	5.79	3	25.00	0	0.00
Total		49(18.9)	100.00	190(73.1)	100.00	12(4.6)	100.00	9(3.4)	100.00

Source: Primary Household survey -2003

Table 4.11 and the figure 4.9 explains the material used for constructing of foundation by different income groups. It is observed from the table that about three-fourth (73.1 per cent) of the sample households use rubble for foundation construction. Followed by, about two-fifth (18.9 per cent) of the total sample households use mud for foundation and the rest use R.C.C. and brick for the same purpose. Of the total household use mud for foundation, more than three-fourth (77.55 per cent) confined in the lowest income group category (up to annual income of Rs 40000), and it is decreasing along with increase in income. Moreover, the higher income group households (the annual income group from

Rs 160000 onwards) do not use mud at all for foundation construction. At the same time, the higher income group households use either rubble or R.C.C. from the same purpose. It is also observed that the economically weaker sections use brick as a source of material for foundation construction, since the cost of brick is cheaper in the market. It clearly shows that the economically weaker sections use mud, and bricks, which is a cheaper source of material for foundation construction, and the haves use either R.C.C. or rubbles for the same purpose.

Table 4.12. Wall Materials used in the residences
(Income in Rs 000')

Sl.No	Income	Material used in the residences									
		Mud	Per cent	Sundries Block	Per cent	Laterite	Per cent	Brick	Per cent	Concrete Block	Per cent
1	0-40	32	80.00	14	58.33	3	25.00	55	30.55	3	75.00
2	40-80	8	20.00	8	33.33	8	66.67	44	24.44	1	25.00
3	80-120	0	0.00	1	4.17	0	0.00	22	12.22	0	0.00
4	120-160	0	0.00	1	4.17	1	8.33	20	11.11	0	0.00
5	160-200	0	0.00	0	0.00	0	0.00	8	4.44	0	0.00
6	200-240	0	0.00	0	0.00	0	0.00	7	3.88	0	0.00
7	240-280	0	0.00	0	0.00	0	0.00	6	3.33	0	0.00
8	280-320	0	0.00	0	0.00	0	0.00	4	2.22	0	0.00
9	Above 320	0	0.00	0	0.00	0	0.00	14	7.78	0	0.001
Total		40(15.4)	100.00	24 (9.23)	100.00	12 (4.6)	100.00	180(69.24)	100.00	4(1.53)	100.00

Source: Primary Household survey- 2003

The table 4.12 and figure 4.10 explains the material used for construction of walls by different income groups among the sample households. It has been observed that different types of materials, such as, mud, brick, sun dried block, laterite blocks, and concrete blocks are used for wall construction in the system.

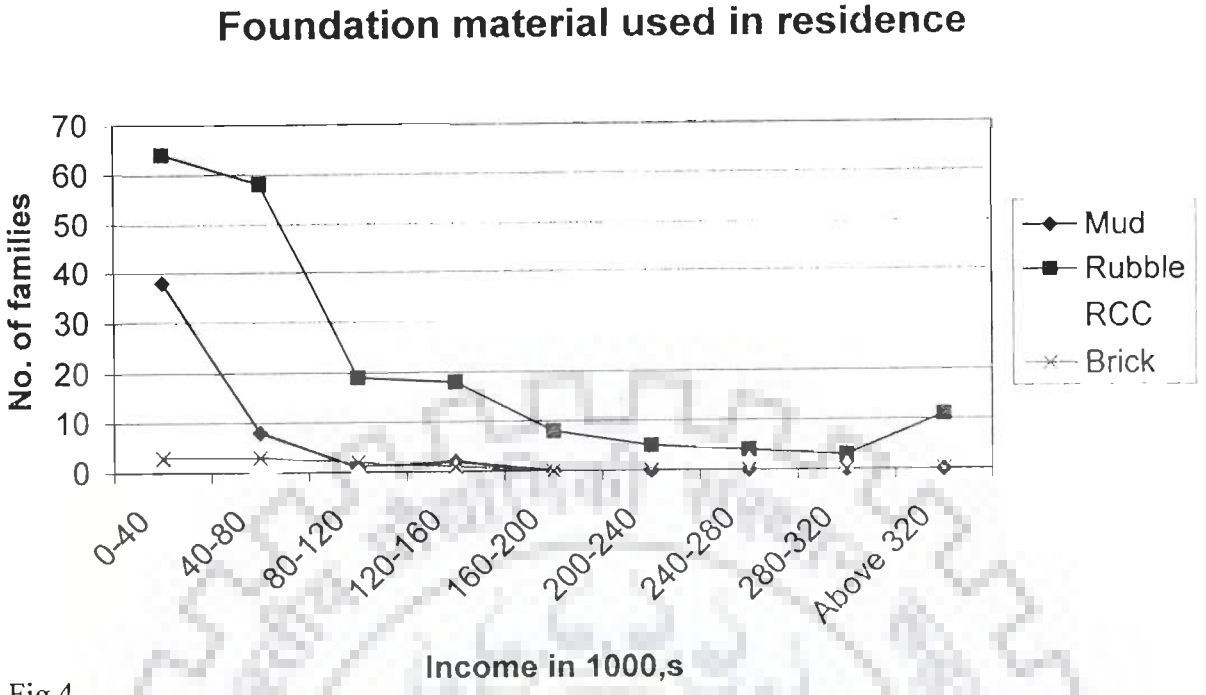

Foundation material used in residence
No. of families
70
60
50
40
30
20
10
0
0-40
40-80
80-120
120-160
160-200
200-240
240-280
280-320
Above 320
Income in 1000,s
Mud
Rubble
RCC
Brick

Fig 4.

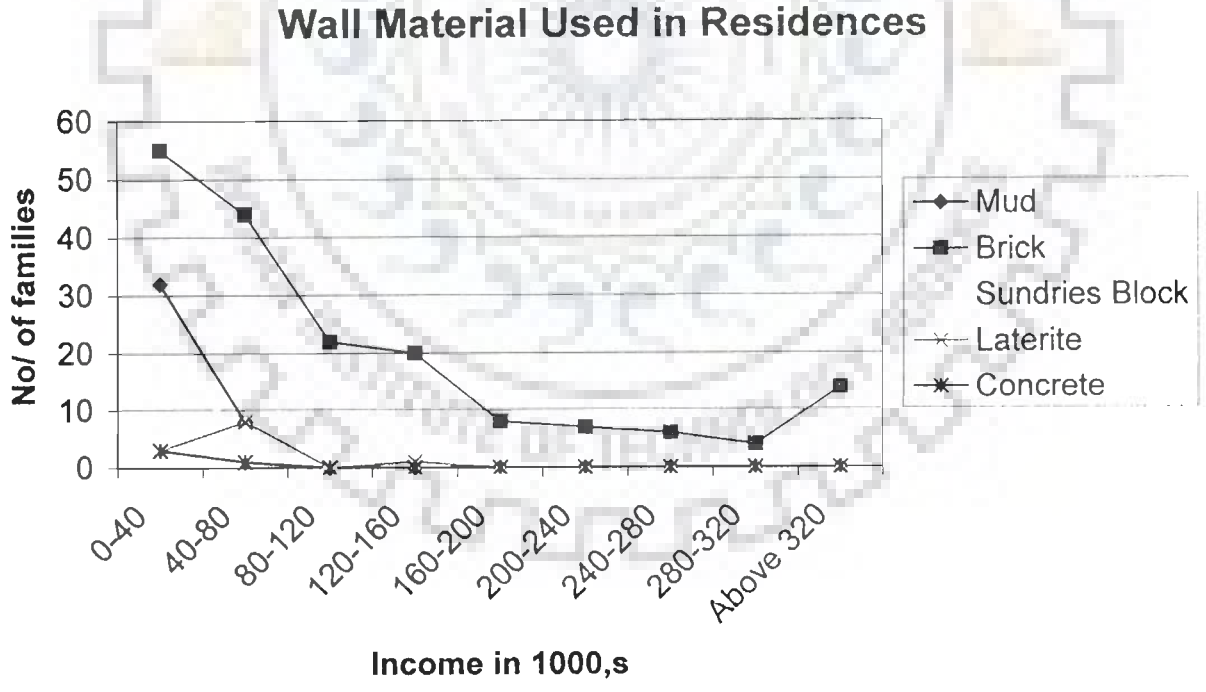

Wall Material Used in Residences
No/ of families
60
50
40
30
20
10
0
0-40
40-80
80-120
120-160
160-200
200-240
240-280
280-320
Above 320
Income in 1000,s
Mud
Brick
Sundries Block
Laterite
Concrete

Fig 4.

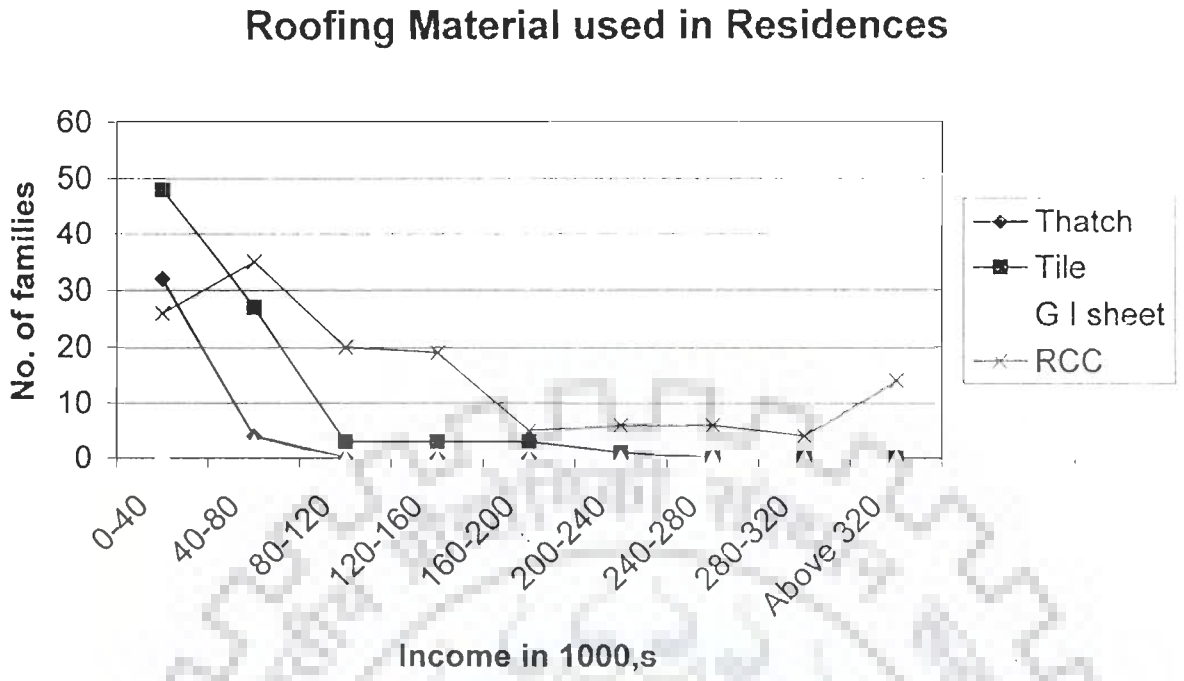

Roofing Material used in Residences
No. of families
60
50
40
30
20
10
0
0-40
40-80
80-120
120-160
160-200
200-240
240-280
280-320
Above 320
Income in 1000,s
Thatch
Tile
G I sheet
RCC

Fig 4.

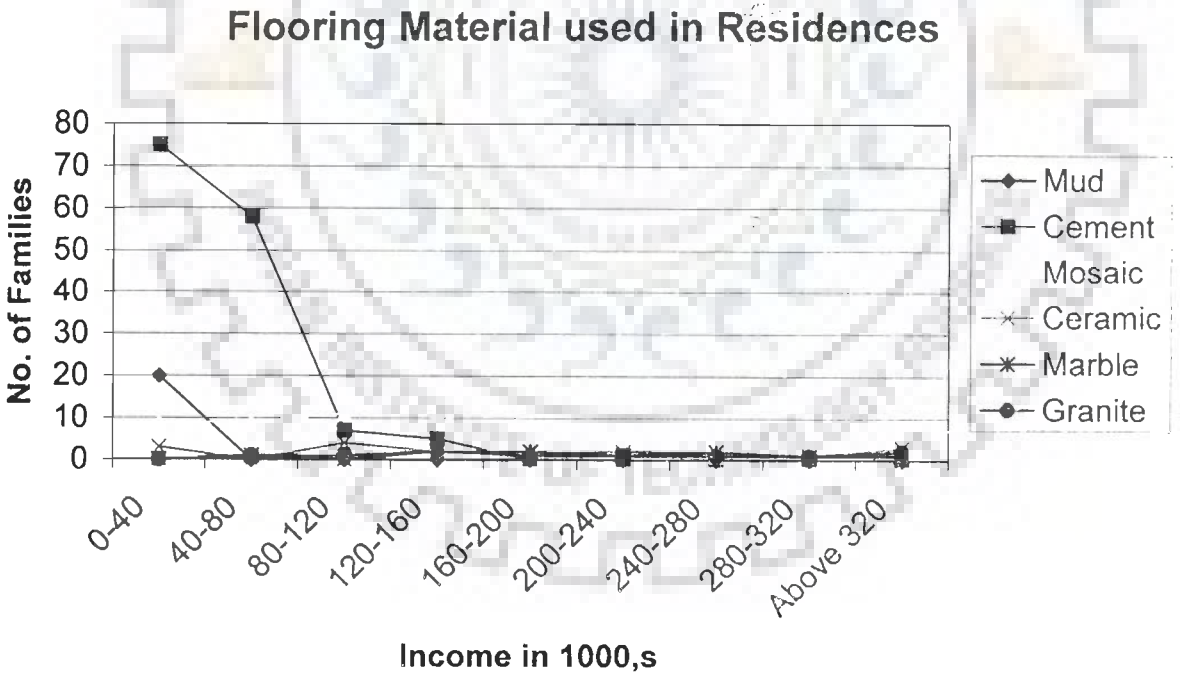

Flooring Material used in Residences
No. of Families
80
70
60
50
40
30
20
10
0
0-40
40-80
80-120
120-160
160-200
200-240
240-280
280-320
Above 320
Income in 1000,s
Mud
Cement
Mosaic
Ceramic
Marble
Granite

Fig 4.

The table explains that more than two-third (69.24 per cent) of the households used bricks for wall construction. Followed by, about one-sixth (15.4 per cent) of the households use mud, about one-tenth (9.23 per cent) of the households used sun- dried mud block and rest used either laterite or concrete block. It has been observed that mud, sundered, mud block, laterite and concrete block are used among the lowest and next to lowest income group categories, (annual income upto Rs 80000), and all the higher income groups have used backed bricks, which has higher value in the market. These clearly explain that the haves are using higher quality of materials in construction of walls than the have-nots in the system.

Table 4.13. Roofing Material used in the residences

(Income in Rs 000')

Sl.No	Income	Roofing Material used in the residences								Total	
		Thatch	Per cent	Tile	Per cent	G I sheet	Per cent	RCC	Per cent	No	Per cent
1	0-40	32	88.88	48	56.47	1	25.00	26	19.26	107	41.20
2	40-80	4	11.12	27	31.76	3	75.00	35	25.93	69	26.50
3	80-120	0	0.00	3	3.53	0	0.00	20	14.81	23	8.80
4	120-160	0	0.00	3	3.53	0	0.00	19	14.07	22	8.50
5	160-200	0	0.00	3	3.53	0	0.00	5	3.70	8	3.00
6	200-240	0	0.00	1	1.17	0	0.00	6	4.44	7	2.70
7	240-280	0	0.00	0	0.00	0	0.00	6	4.44	6	2.30
8	280-320	0	0.00	0	0.00	0	0.00	4	2.96	4	1.50
9	Above 320	0	0.00	0	0.00	0	0.00	14	10.37	14	5.41
Total		36 (13.85)	100.	85 (32.69)	100	4	100	135 (51.92)	100	260	(100)

Source: Primary Household survey- 2003

Material used for roof is another important aspect in building construction. In this study area, people use different types of materials for roof construction based on their purchasing power. Generally the haves use R.C.C., whereas the have-nots use coconut leaves (thatching) and the rest use tiles, galvanized Iron

sheets, etc., for roofing. It has been observed from the table 4.13 that more than half (51.92 per cent) of the households used R.C.C. Followed by, about one-third (32.69 per cent) of the households used tiles, just above one-tenth (13.85 per cent) of the households use coconut leaf (thatched), and rest (1.54 per cent) used galvanized iron sheets for roofing purposes. The table and the figure further explains that thatched and galvanized iron sheets are confined only among the have-nots. Households applying of tiles in roofing are decreased along with increase in income, and almost all the higher income groups used R.C.C. for roofing. The Investigator further made inquiry about the lowest income category households who have R.C.C. roofs and found that the Government under the social housing scheme provides most of the houses, with R.C.C. roofs only under this scheme. This clearly shows that the haves use highly qualitative materials in their house construction than the have-nots.

Table 4.14. Materials used for flooring in the residences
(Income in Rs 000')

Sl. No	Income	Flooring Material used in the residences												Total	
		Mud	Per cent	Cement	Per cent	Mosaic	Per cent	Ceramic	Per cent	Marble	Per cent	Granite	Per cent	No	Per cent
1	0-40	20	100	75	55.55	9	16.07	3	15.78	0	00	0	00	107	41.2
2	40-80	0	0.0	58	42.96	9	16.07	2	10.53	0	00	0	00	69	26.5
3	80-120	0	00	7	5.18	11	19.64	2	10.53	2	16.67	1	9.09	23	8.80
4	120-160	0	00	5	3.70	11	19.64	2	10.53	2	16.67	2	18.18	22	8.50
5	160-200	0	00	0	00	3	5.36	2	10.53	2	16.67	1	9.09	8	3.00
6	200-240	0	00	0	00	3	5.36	2	10.53	1	8.33	1	9.09	7	2.70
7	240-280	0	00	0	00	1	1.78	2	10.53	2	16.67	1	9.09	6	2.30
8	280-320	0	00	0	00	0	1.78	0	5.26	1	8.33	3	27.27	4	1.50
9	Above 320	0	00	0	00	8	14.20	3	15.78	1	8.33	2	18.18	14	5.41
Total		20	100	145	100	55	100	18	100	11	100	11	100.	260	100

Source: Primary Household survey -2003

The table 4.14 and the figure 4.12 illustrates that materials used for flooring by different income groups in the system. It is observed from the table that the following materials, such as, mud, cement, mosaic, ceramic, marble, and granites are commonly used for flooring In the system. Of the sample households, more than half (51.90 per cent) of the total households used cement as flooring materials. Followed by, about one-fourth (21.5 per cent) of the households use mosaic, about one-thirteenth (7.7 per cent and 7.37 per cent) person used mud and ceramic respectively, and the higher cost materials like marbles and granites are sparingly used. This shows that cement becomes a common material in flooring. It is also observed that who ever used mud as a flooring material, they are confined among the lowest-income group, which shows that the have-nots are forced to use the low cost and low quality materials when they construct their own houses since their purchasing power is so meager.

4.13 HOUSEHOLD FACILITIES

Household's facilities are considered as indicators of development. In an-urban system, if the household has more modern facilities, such as, computer with internet facilities, televisions, telephones, radio, newspaper, etc., it is considered to be that the system is well developed, and if the same system does not have such modern facilities, it is considered to be developing or under developed, since possession of these modern facilities directly have linkage with economic strength of the system. The economically developed people of the system have almost all modern facilities in the system since they have purchasing power, and the have-nots are living just in the reverse trend. In the study area, a segment of the community have more economic strength, and another segment of the community suffer quite a lot for their day – to –day

survival. Having this knowledge in mind, an attempt is made to understand the available household facilities at different income groups of these sample households and the results are presented in Table 4.15.

Table 4.15 Household facilities

(Income in Rs 000')

Sl.No	Income	Household Facilities Owned					
		Radio	Television	Newspaper	Telephone	Computer	Internet
1	0-40	91	44	75	24	4	0
2	40-80	62	61	63	48	4	1
3	80-120	22	22	20	22	19	1
4	120-160	21	21	22	21	9	2
5	160-200	8	8	8	8	6	2
6	200-240	7	7	7	7	4	1
7	240-280	6	6	6	6	5	1
8	280-320	4	4	4	4	4	2
9	Above 320	14	14	14	14	12	9
Total (260)		235(90.38%	187(71.92)%	219(84.23)%	154(59.23)%	87(33.46)%	19(7.3)%

Source Primary Household survey 2003

Note: Since majority of households have more than one or two appliances in their households, it is not possible to workout separately by appliances and household wise

The table explains that more than nine-tenth (90.38 per cent) of the total household is having radio in their households. Followed by about nine-tenth (85.38 per cent) to the households have news paper, about tow-third (61.92 per cent) have televisions, about two-fifth (59.23. per cent) of the households have telephones, about two-sixth (33.46 per cent) have computer facilities, and one-fourteenth (7.3 per cent) of the households have internet connections in their households. This trend clearly shows that the people of this system use more communication and entertainment medium in their households, which reflects their economic strength, attitudes, culture, awareness, etc. It seems that these also may be the reason for better human resource development in the system. It is also interesting to note that even the lowest strata of the income groups (Rs. upto 40,000) have more number of radios, televisions, and news paper in their

households, which reflects their awareness in all aspects of lives. The higher income groups have all facilities, which include radio, television, telephone, and new paper, computer and Internet facilities in their houses. The above analysis reflects their socio economic and cultural strength of the systems.

4.14 TRANSPORTATION

Transportation is one of the important parameters, which decides the functions of the systems. As already stated, efficient transportation system leads to more dynamic functions of the system. In this study area, different kinds of mode of transportation are available. Even though different kinds of mode of transportation is available, people used to have their own vehicles for their mobility since the present of public transportation system, which is available in the system is inadequate. It has been observed that the poor people also used to have at least bicycles for their mobility. Moreover, ownership of vehicles reflects the purchasing power of the system. Having these in mind, an attempt is made to analyses vehicle ownership pattern among various income groups in the system, and the results are presented in Table 4.16.

The table reveals that two wheelers are very much prominent in the study area, and more than two-fifth (40.38%) of the total households have two wheelers. Followed by, about one- third (32.69%) of the total households owned bicycles, and more than one-sixth (16.53%) of the sample household's own cars.

Table 4.16 Vehicles Owned by the Households
(Income in Rs 000')

Sl.No	Income	Vehicles Owned by the Households			
		Cycle	Scooter	Motorbike	Car
1	0-40	51	18	7	-
2	40-80	20	19	18	2
3	80-120	3	9	3	4
4	120-160	3	8	4	6
5	160-200	3	3	4	6
6	200-240	1	2	3	5
7	240-280	1	1	1	4
8	280-320	1	1	0	4
9	Above 320	2	3	1	12
Total	260	85(32.69)	64(24.61)	41(15.76)	43(16.53)

Source: Primary Household survey –2003.
Note: Since majority of households have more than one or two vehicles in their households, it is not possible to workout separately by appliances and household wise.

It has been observed that the availability of cycles at the households level is decreasing along with increase in income, and about two-third (60 per cent) of the total available cycles are confined in the lowest income group category, and about one-fourth (23.52 per cent) are lying in the hands of next to the lowest income group category (income of Rs. 40000-80000), and the remaining are scattered over all other income groups. Availability of two-wheeler is almost distributed the higher income group category and the cars are confined among the higher income group category. These shows that the persons who have more economic strength own cars, while the have-nots own bicycle, and the medium class personals own more two wheeler for their mobility, which clearly shows that the system does not have proper transportation systems, and the people are forced to have their own vehicles for mobility.

4.14.1 Distance to Work Place and Duration of Travel

Availability of employment opportunities, population density, economic strength of the people, availability of working force, etc., decide the distance and duration of travel in the system. Generally, lower income people try to adjust

within the neighborhood or village itself. They engage as casual labour, head load, traffic and transportation activities, cleaning, maidservants, rickshaw-pulling, Auto- rickshaw driver, in small work centers or market, etc., and they can't spent more money on for traveling because their income is also very less and limited. The middle income and technical personals have permanent employment opportunities in industries; government and quasi government institutions and private establishments and they have to travel long distances, and spent longer time for their destinations. Their income is insufficient to manage accommodation facilities nearer to their workplace. This is due to the fact that the land value and other related components are high and the middle-income group cannot afford the same. Hence, this segment is forced to live in the outskirts of the city and rendering service to the urban centers by spending major share of their income to travel. The condition of the higher income personnel's is entirely different. Their income allows/permit them to have an additional house nearer to work place. This enables them to travel short distance, which requires short duration of time. Moreover, the higher income group used to have their own car too. This also reduces the duration of travel. The aforesaid trend is observed in the study area as well, and an attempt has been made to understand the distance to workplace of the people and their travel duration in the study area among the sample households along with their income and the results are presented in Table 4.17.

Table 4.17 Distance to Workplace and Duration of travel.

(Income in Rs 000')

Sl.No	Income	Distance to Workplace (km)	Duration of travel (minutes)	Total
1	0-40	2.7	20	107
2	40-80	6.4	30	69
3	80-120	8	40	23
4	120-160	10	45	22
5	160-200	13	46	8
6	200-240	14	47	7
7	240-280	10	30	6
8	280-320	8	20	4
9	Above 320	6	25	14

Source: Primary Household survey -2003

The table illustrates that people are traveling for minimum 2.4 km to 17 km daily for their employment. This varying with the income groups too. The average distance traveled by the lower income group is 2.7 km per day and the duration of the travel is 20 minutes. They used to either walk or use bicycles, or use public transportation system. The second income group has to travel on an average of 6.4 km, and 30 minutes minimum spent per day for reaching their work centers. The distance of travel is increasing along with income among the income group between Rupees 40000 and Rupees 240000, and a reverse trend is observed among the higher income groups, since they reside in the posh area of the city, which nearer to their workplace, and the travel duration is also less since they posses their own car. It has been observed that though the middle income group are forced to reside in the outskirts of the city, their travel distance is very less and the travel duration is also very less compared to some other State capitals like Mumbai, Chennai, Kolkota, Delhi (national capital), etc., and the situation is worse in these compared to this study area. This is due to the small size of the city, compared to the above said cities, opportunities are very less, density of

population is less, and whatever facilities are available are scattered allover the city

4.14.2 Distance to Social Infrastructure

Accessibility is another important parameter, which decides the functions of the system. Effective planning and development system provides reasonably good accessibility to the people. In this study area, since almost all the infrastructure services are scattered all over the District, people need not to travel for more distances and important services for their day-to-day requirement is available within the reasonable limit. When the facilities are available within the reasonable limit, the housewives can have an easy access to the market; the children can reach play schools without elderly assistance. Those who want to visit the recreation centers can even walk directly to the same without much assistance, and aged or elderly personals can reach the clinics without assistance. Access to these facilities, generally, varies along with income groups. Generally, the higher income groups used to have better access to all these facilities within their reach, whereas the poor people have to travel a lot to avail these facilities, but in the study area it is not so. It has been observed that all the essential infrastructure facilities are more or less equally distributed in the study area, and are reachable to all income group irrespective of income. Having these knowledge in mind, an attempt is made to conduct a detailed investigation to understand the availability of social services like of shopping, nursery school, recreation and primary health centre facilities in to the urban system, and analyzed. The results are presented in Table 4.18.

Table 4.18. Distance to Social Infrastructure

Sl.No	Income	Distance to Social Infrastructure. (Km)			
		Shopping	Nursery	Recreation	Health
1	0-40	1.55	0.96	1.19	1.65
2	40-80	1.50	0.9	1.09	2.00
3	80-120	1.7	0.8	1.0	1.90
4	120-160	1.7	0.6	1.63	1.63
5	160-200	1.7	0.7	2.0	2.00
6	200-240	1.5	1.3	1.43	1.43
7	240-280	1.5	1.2	1.58	1.58
8	280-320	1.0	1.2	1.12	1.12
9	Above 320	2.2	1.1	2.2	2.00

Source: Primary Household survey- 2003

The table illustrates that the essential infrastructure facilities are available within the reachable limit of the people irrespective of their income. It has been observed from the table that all facilities, which have studied are available within two-kilometer distance to all income groups. This trend shows that the social infrastructure facilities spread across the study area, and it is accessible to all needy communities without hindrance, this is a sign of real development.

4.15 HOUSEHOLD EXPENDITURE

Income and expenditure are having direct linkage, and income decides the purchasing power of the people in any system. Generally, the higher income group people spend more amount of money than the lower income group personals, since they have more purchasing power. The lower income group generally spends more amounts of money (in some cases the entire income) for their food expenditure, whereas the higher income group spends a little percent of their income for food. The higher income group used to spend money to enjoy the infrastructure facilities much, whereas it is not so in the case of lower income group since their purchasing power is very less. In this study area, people are mixed with several kinds of income groups, and their expenditure in kinds of

activities are varies. Even though the income varies, among different income group categories, people used to spend more money towards education. The lowest income group personals also send their wards (children) to the school where the higher income group's wards study due to having awareness among the lowest and lower income group categories. It is interesting to note that even the poorest among the poor personals send their wards to the private schools, where the quality of education is better than the government schools. In this study area, larger number of private schools is functioning and offers good qualitative education, collect fee for the same, and produce good output. The fee structure among the private school is varying from one to another. The higher income group used to send their wards where the fee is much higher among the private schools anticipating that they provide better services. Expenditure among various income groups towards other expenses, which include power consumption, fuel used for cooking, food, clothing, heath, recreation and for other items are varying. Having this knowledge in mind, an attempt is made to analyze the expenditure pattern of various income groups, pertaining to major activities, such as, power, fuel for cooking, food, clothing, education, heath, recreation, and other, and the results are presented in Table 4.19 and Figure 4.13.

The table and the figure explains that the expenditure towards electric power, fuel for cooking, food, clothing, education, heath, recreation, and others per households in different income groups is increasing along with increase in annual household income. Income group wise expenditure towards the aforesaid activities gives a clear picture about their spending in various activities. It has been observed that of the total expenditure all the income groups spent more money towards food. It explains that the lowest income group spends more

Table4.19 Household Expenditure

Sl.No	Income	Household expenditure																	
		Electric power	Per cent	Fuel for cooking	Per cent	Food	Per cent	Clothing	Per cent	Education	Per cent	Health	Per cent	Recreation	Per cent	Social	Per cent	Total	Per cent
1	0-40	1691	7.69	1842	8.37	9455	42.99	2826	12.84	2995	13.62	1160	5.27	750	3.41	1270	5.77	21989	100.00
		2.61		(5.63)		(3.41)		(1.940		(1.95)		(1.39)		(1.71)		(1.94)			
2	40-80	4056	7.85	1920	3.72	18975	36.73	8237	15.94	7350	14.23	4518	8.75	2572	4.97	4027	7.79	51655	100.00
		6.26		(5.85)		(6.85)		(5.66)		(4.79)		(5.44)		(5.87)		(6.15)			
3	80-120	5424	7.70	3000	4.26	27173	38.61	10260	14.58	10870	15.44	6395	9.08	2930	4.16	4325	6.14	70377	100.00
		(8.37)		(9.15)		(9.82)		(7.05)		(7.09)		(7.70)		(6.69)		(6.61)			
4	120-160	6312	7.45	3012	3.55	27700	32.72	16880	19.93	11650	13.76	10000	11.81	3818	4.50	5285	6.24	84657	100.00
		(9.74)		(9.19)		(10.00)		(11.47)		(7.59)		(12.05)		(8.72)		(8.08)			
5	160-200	7644	7.78	4056	4.13	29500	30.04	19000	19.34	15565	15.84	10750	10.95	4700	4.78	7000	7.13	98215	100.00
		(11.80)		(12.36)		(10.66)		(13.06)		(10.19)		(12.95)		(10.73)		(10.70)			
6	200-240	7824	6.82	4200	3.66	33428	29.14	20000	17.43	25300	22.05	11160	9.72	5200	4.53	7600	6.62	114712	100.00
		(12.08)		(12.80)		(12.08)		13.75)		(16.50)		(13.44)		(11.88)		(11.62)			
7	240-280	8400	7.01	4320	3.60	33500	27.96	21500	17.94	25500	21.28	12500	10.43	5700	4.75	8400	7.01	119820	100.00
		(12.97)		(13.17)		(12.10)		(14.78)		(16.63)		(15.06)		(13.02)		(12.84)			
8	280-320	9000	6.62	5160	3.80	42000	30.93	22500	16.57	26000	19.15	13000	9.57	6100	4.49	12000	8.83	153760	100.00
		(13.89)		(15.74)		(15.17)		(15.47)		(16.96)		(15.66)		(13.93)		(18.34)			
9	>320	14400	8.56	5280	3.14	55000	32.72	24400	14.51	28000	16.65	13500	8.03	12000	7.14	15500	9.22	168080	100.00
		(22.23)		(16.10)		(19.87)		(16.78)		(18.27)		(16.26)		(27.41)		(23.69)			
10	Total	64751		32790		276731		145403		153290		82983		43770		65407			
	Per cent	(100)		(100)		(100)		(100)		(100)		(100)		(100)		(100)			

Source primary survey 2003

priority towards food, and more than two-fifth (42.99 per cent) of their total income is spent for food item. Followed by, expenditure on clothing, fuel for cooking, electric power, other social activities, heath and recreation are occupying important, and the expenditure for the same are 13.62, 12.84, 8.37, 7.69, 5.77, 5.27 and 3.41 percent of the total expenditure respectively. Among the annual income group between Rs 40000 and 80000 also spend more amount for food products, but their priority changes compared to the lowest income groups. This group spent just above one-third (36.73 per cent) of the total expenditure for food consumption. Followed by, clothing, education, health, power, social activities recreation, and fuel occupy priorities, and they spent money for 15.94, 14.23, 8.8.75, 7.85, 7.79, 4.9, 3.72 percent of the total expenditure respectively for each activities. The third category of income group (annual income between Rs. 80000 and 120,000) spent more money (38.61 per cent of the total expenditure) towards food. Followed by, they spent more money towards education, clothing, health, power, social activities, fuel and recreation by priority wise and their corresponding per cent of expenditure to total expenditure is 15.44, 14.88, 9.08, 7.70, 6.14, 4.27 and 4.16 respectively. The fourth income group (annual income between Rs. 120000 and 160000) spent more amounts towards food, i.e., 32.72 percent of the total expenditure. Followed by, they spent more money towards clothing, educations, health, power, social activities, recreation and fuel and the corresponding expenditure to total expenditure are 19.93, 13.76, 11.81, 7.45, 6.24, 4.50, and 3.55 percent respectively. The fifth income group (annual income between Rs 160,000 and 200000) spent more amount to food, i.e., about one-third of the total expenditure (30.04 per cent).

Followed by, they give priorities to clothing, education, health, power, social activities, recreation and fuel, and the corresponding expenditure for the same to the total expenditure is 19.34, 15.84, 10.95, 7.28, 7.13, 4.78, and 4.13 percent respectively. The sixth income group (annual income between Rs 200,000 and 240,000) also spent more money towards food, and the expenditure on food to total expenditure is 29.14 percent. Followed by, they give priority to education, clothing, health, power, social activities, recreation, and fuel, and the corresponding value to total expenditure is 22.05, 17.43, 9.72, 6.82, 6.62, 4.53 and 3.66 percent respectively. The seventh income group category (annual income group between Rs. 240,000 and 280,000) also spent more money toward food of the total expenditure i.e., 27.96 per cent. Followed by, they give priority to education, clothing, health, social activities, power, recreation and fuel, and the corresponding value is 21.28, 17.94, 10.43, 7.02, 7.01, 4.75 and 3.60 percent respectively to the total expenditure. The eighth income group category (annual income between Rs. 280,000 and 320,000) spent more amount to food of the total expenditure, i.e., about one-third (30.93 per cent) of the total expenditure. Followed by they give priority to education, clothing, heath, social activities, power recreation and fuel and the corresponding expenditure value to the total expenditure is 19.15, 16.57, 9.57, 8.83, 6.62, 4.49 and 3.8 percent respectively. The ninth income group category (annual income above Rs 320,000) also spent more amount towards food of the total expenditure, i.e., about one-third (32.72 per cent) of the total expenditure. Followed by, they given priority towards education, clothing, social, power, health, recreation and fuel and their corresponding value of expenditure to total expenditure is 16.65, 14.51, 9.22, 8.56, 8.06, 7.14, and 3.14 respectively. This table further explain that education

occupy the second priority next to food among almost all the income groups except three income group categories, i.e., annual income between 40000 and 80,000, Rs 120,000 and 160,000 and 160,000 and 200,000 respectively. These clearly shows that the entire system gives more importance to education, and education really play a major role in the development of the system. World Bank Report 2004 also supports this statement (R). Further, it is interested to note that almost all the income groups, except the lowest and the highest income groups give priority towards health next to education and clothing. This clearly shows that the people are more awareness about human resource development. They spent more money towards education and health next to basic needs like food and clothing. Expenditure towards other activities, such as, power consumption, recreation, fuel for cooking, etc., is negligible compared to basic needs and human resource development activities. This clearly shows that this system peoples are more conscious about their expenditure, and spent more money for productive purposes, which lead to total development in the system.

4.16 SAVINGS

Saving is own of the important parameters, which decides the functions of the economy of any systems. More savings lead to more capital formation, which lead to more investment. More investment lead to more production, more production lead to more trade and commercial activities, more trade & commercial activities lead to more income and more income leads to more savings. Like these, a cycle of economic activities function, which lead to better economic growth and development in the system. In fact, the people of kerala are much aware of about the importance of saving and practically doing more

savings too, and the huge amount of deposit is stagnant in the banks (c.r. Table 2.16.). Having these in mind, an attempt is made to analyze the savings pattern of the sample households, and their saving behavior per household along with their respective income categories is presented in Table 4.20 and Figure 4.14.

Table 4.20 Household savings

(Income in Rs 000')

Sl.No	Income	Savings (Rs)	Per cent
1	0-40	1020	0.100
2	40-80	8411	0.80
3	80-120	34623	3.29
4	120-160	62143	5.90
5	160-200	96275	9.15
6	200-240	118228	11.25
7	240-280	130180	12.38
8	280-320	169240	16.08
9	Above 320	431920	41.05
10		1052100	100.00

Source: Primary Household survey- 2003

This table and the figure reveals that per household saving in different income group is increasing along with increase in income. It is also evident that the higher income household saves more amount of money than the low-income households. The lowest income group category household contributes 0.10 percent of the total savings, whereas the highest income group household alone contributes more than two-fifth (41.05%) of the total saving. It is very much interesting to state that the lowest income group category also save money for their future needs in spite of their income is very low. This tendency leads them towards progress.

4.17 LAND VALUE

Land value is one of the most important parameters, which decides the functions of the system. In an urban system land value is much higher than the

rural system, since it fetches more income. In the urban system, where more economic activities function, the land value is also tend to increase, since land value is being decided by the functions of the economic activities in an area and income generated from the particular area. For example, in India, cities like Mumbai, Bangalore and Delhi, the land value is so high compared to other cities like Madurai, Thiruvananthapuram, Bhopal, Raipur, Patna, etc., This clearly shows that economic activities decide the land value of the particular system. Moreover, the land value in a city also differs from place to place in accordance with its demand in the particular location. Availability of infrastructure facilities in the particular area of the city also alters the land value in the city. The available infrastructure facilities in the area lead the quality of the land in the urban system. The quality of land is also controlled by several other factors, such as, accessibility, topography, vegetation, subsoil conditions, sunlight, water table, etc., in addition to the available infrastructure facilities.

The serviced and developed plots within the core urban area cost more and the land value in this particular locality is sky rocketing, because affluent families mostly tend to reside inside the developed and posh area within the core area of the city. The low- income households, generally, resides the fringe areas of the city, where the land value is comparatively very less.

In this study area, land value varies from one place to other, though the study area does not have much industries based economic activities. The land value is much higher, where more trade and commercial activities function, institution are located, more infrastructure facilities available, etc. Having this knowledge in mind, an attempt is made to analyze the land value of the

residential area of the sample households and the results are presented in Table 4.21

Table 4.21. Residential Land Value
(Income in Rs 000')

Sl.No	Income	Land Value per square meter (in Rupees).
1	0-40	250-600
2	40-80	600-1200
3	80-120	1200-1800
4	120-160	1800-2500
5	160-200	2500-3200
6	200-240	3200-3750
7	240-280	3750-4300
8	280-320	4300-5000
9	Above 320	5000-7500

Source: Primary Household survey- 2003.

The table reveals that the residential area is land value of different income groups are varying to the larger extent, and it is increasing along with increase in income groups. The lowest income group (annual income below Rs. 40,000) resides in an area where the land value is also the lowest, i.e., Rs 250-500 per square meter while the land value is the highest, i.e., Rs 5000-7500 per square meter where the highest income group (annul income above Rs 32,000) personals live. This clearly shows that the higher income group personals spent more money, i.e., more than ten times of the lowest income groups for acquiring serviced land with more infrastructure services.

In this present chapter, a detailed analysis was done pertaining to socio-economic condition, of the system based on the grassroots level data. Analysis of this data provided an insight about this system, its functions, and also paves the way for identifying the most important control parameters, which decide the functions of the system. To understand the functions of the system, system dynamic theory was employed, and an urban dynamics model was developed based on the system dynamic theory, employed in this investigation and are presented in the subsequent (fifth) chapter.

CHAPTER 5

APPLICATION OF THEORIES AND MODELS

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 most important parameters, which decide the functions of the system are considered for analysis and presented in chapter 4. Further, the Investigator had discussed with all the households surveyed all income groups based on their priorities of requirement in future and recorded. These priorities of requirements are analyzed very carefully based on their order of preference, and is presented in Table 5.1.

Table 5.1. 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

The table illustrate that people give more preference towards education. Followed by they give priority to industries, agriculture, health, trade and commerce, tourism, fishing and fish processing, housing, transport and communication, and information technology respectively.

WEIGHTED INDEX METHOD

Weighted index method is used to analysis their order of preference by various income groups. The formula of the weighted index method, which is followed in this investigation is presented in Appendix II. The results of the weighted index method are presented in Table No. 5.2.

Table 5.2. Priorities for long term planning

Sl.No	Income	Priorities for long term planning									
		Education	Industries	Agriculture	Health	Trade Commerce	Tourism	Fishing	Housing	Transport	IT
1	0-40	4.42	4.11	4.10	5.5	5.49	5.73	4.72	6.27	7.32	8.01
2	40-80	3.76	3.91	4.15	4.92	6.08	6.17	6.26	7.63	8.08	7.24
3	80-120	4.69	4.6	5.08	4.52	5.56	6.13	7.86	7.13	5.91	6.34
4	120-160	4.54	4.42	4.13	4.50	5.28	5.42	7.59	7.10	6.95	6.3
5	160-200	3.75	4.25	4.6	3.5	5.37	7.0	7.75	7.62	7.87	7.12
6	200-240	3.28	4.71	4.5	3.9	5.71	9.0	7.71	7.0	7.16	6.42
7	240-280	3.16	4.83	4.5	3.83	6.83	5.3	8.0	8.3	7.83	6
8	280-320	3.75	4.25	6.0	3.25	5.25	5.5	8.25	8.2	7.25	6.25
9	Above 320	4.1	4.23	5.8	3.2	5.07	5.78	8.5	7.85	7.0	6.0
Weighted average		4.13	4.18	4.34	5.03	5.73	5.93	5.96	6.91	7.21	7.94
Priority Rank		1	2	3	4	5	6	7	8	9	10

Source: Primary Household survey- 2003.

The results of the weighted index method presented in table 5.2, clearly shows that the people of the study area give more priority to education. Followed by, they give priority to industries, agriculture, health, and trade & commence, tourism, fishing, housing, transport, and Information Technology respectively. It also shows that the average priority points are not much deviating, and it is observed that the first priority gain 4.13 points, and the least one gains 7.94 points, which shows that almost all the parameters to be considered in strategic planning. It is also interested to note that the preference of the people in different location is changing. For example, the coastal area personals give more priority towards fishing, and coir based industries. The investigator, further, has conducted series of discussion with various experts working in different organizations, such as, State Planning Board, Town Planning Department, Government of Kerala, Thiruvananthapuram Development Authority, National Transportation Planning and Research Centre- Thiruvananthapuram, and all other concerned Authorities related to urban planning and development issues pertaining to the priorities of requirement for the development of the study area. They have opinioned that the Government is giving more importance towards human resource development in this study area particularly, and the State in general than other area of development, and the Governments Administration is also tuned for the development of the same. Further, they opined that the Government gives more priority towards education and health among other human resource development activities. The Investigator, further, analyzed the opinion of the sample households and the experts, and finally considered five major controlling parameters, which decide the functions of the system and also they are very much important for the development of the systems. They are

population, housing, education, health and power (electric power supply). It is interesting to note that the sample households also prefer education on the first priority and health as the fourth priority, but the difference of points between them is very negligible, in the weighted index method, i.e., 0.9. Housing becomes an inevitable requirement for human resource development. Power supply system occupies the central place of any development, and without adequate power supply one cannot even imagine the development in any system. The study area does not have adequate power supply and it becomes so scarce in recent period. In this situation, it is very much required to improve the power supply. Therefore, the Investigator considered the aforesaid most important control parameters for further analysis.

5.2 URBAN SYSTEM CONCEPT

"A system function 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 seen in the whole system". In this present investigation the whole district is considered as a system, since it has several sub- systems and all the sub -systems are interlinked and interdependent on each other, and function as a whole. Urban system has different subsystems, such as, land, population, agriculture, industries, trade and commerce, infrastructure, ecology, environment and institutions. These all subsystems are interlinked and interdependent on each other and functions as a whole. The dynamic functions of an urban system along with its different sub-systems is presented in Figure 5.1.

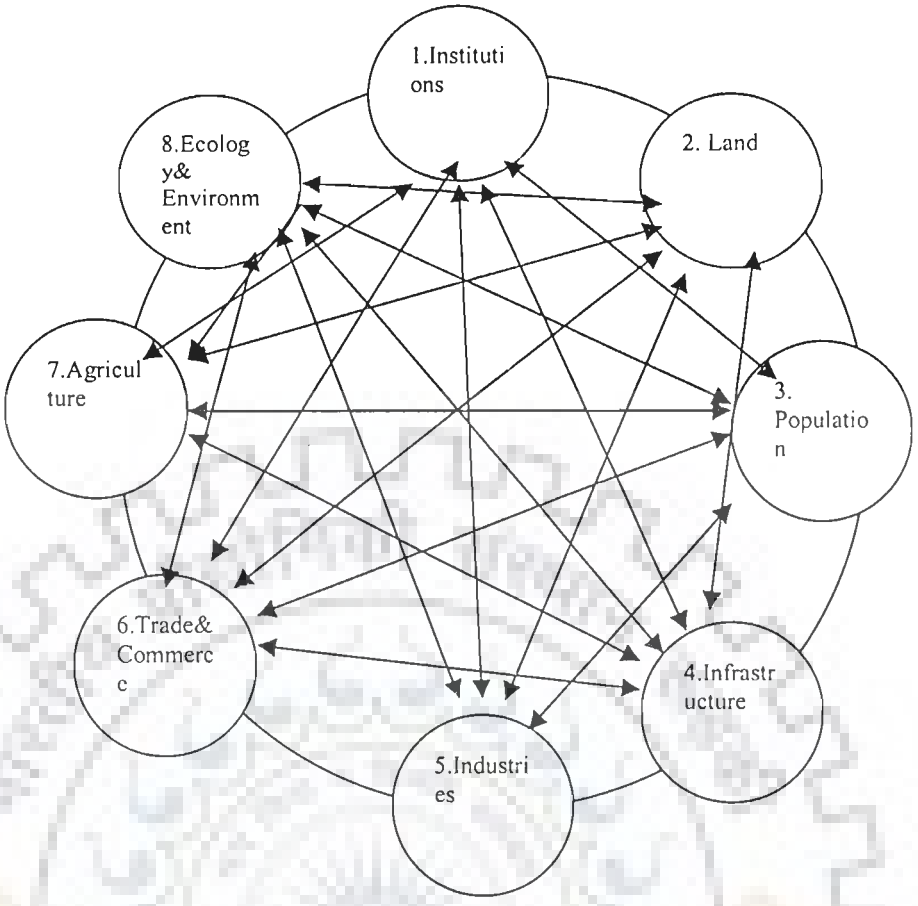


Figure 5.1 Functions of an urban system

CONCEPTUALIZATION OF THE URBAN SYSTEM MODEL

In this present investigation, the study area is considered as a system and it has different sub systems. To undertake detailed investigation pertaining to the functions of the system, the most important sub systems of the system are considered in this present investigation, which are arrived based on the weighted index method application, and the opinion of the experts. The functions of these five important sub systems, such as, population, housing, education, health, and power in the system are presented in Figure 5.2

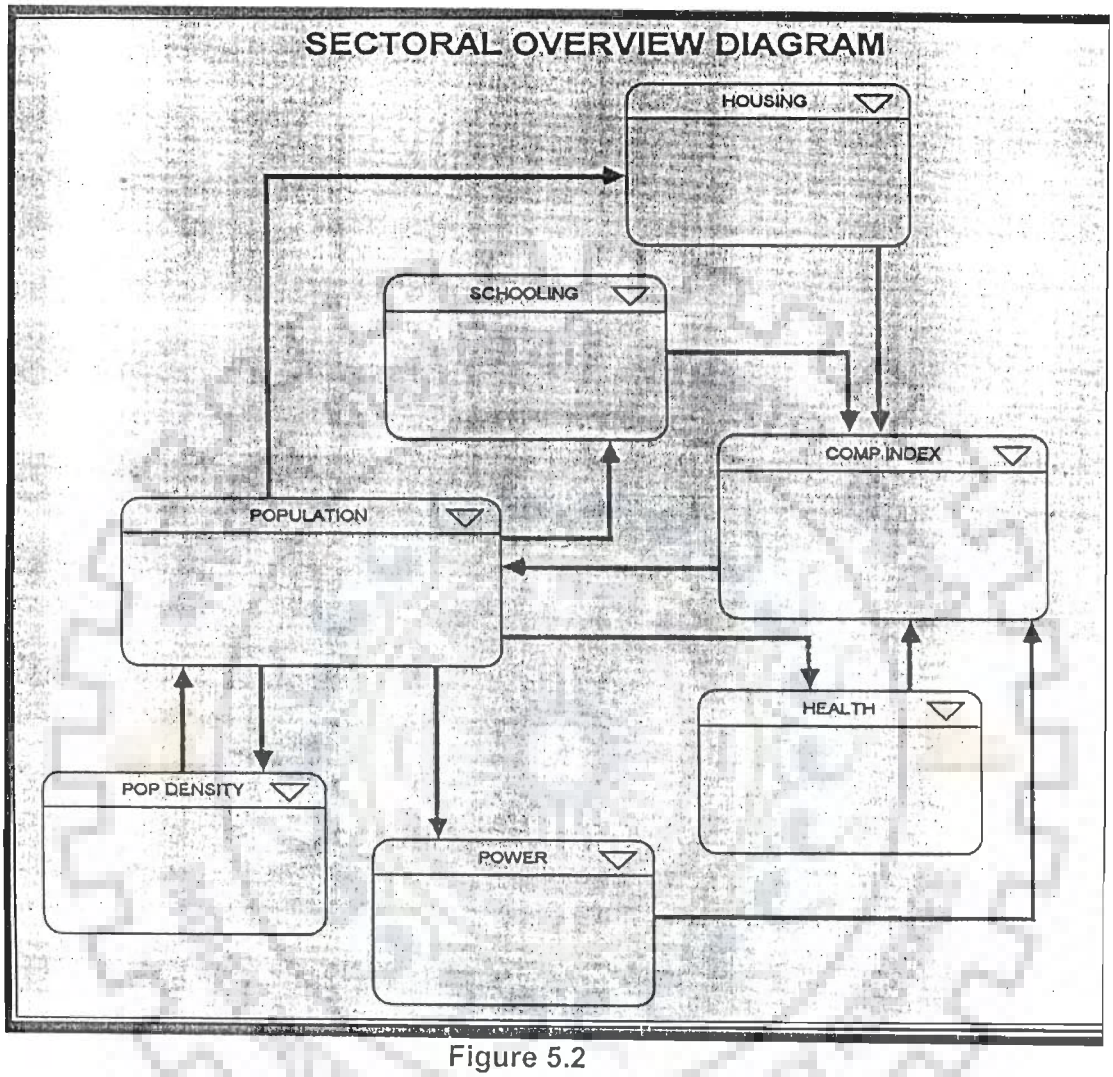

SECTORAL OVERVIEW DIAGRAM
HOUSING
SCHOOLING
COMP.INDEX
POPULATION
HEALTH
POP DENSITY
POWER

Figure 5.2

5.3 APPLICATION OF THE SYSTEM DYNAMIC MODEL

In this present investigation, as already pointed out, the following subsystems (controlling parameters), such as, population, housing, education, health, and power are considered for evolving a system dynamic model. At the outset all these subsystems are developed separately, and amalgamated together for arriving at a detailed urban system dynamic model. The detailed methods used for developing the model by subsystem wise is presented as below:

5.3.1 Population

To calculate the quantity of population, (1) Birth rate (BR) (2) Death Rate (DR), (3) Normal birth rate fraction (NBRF), (4) Normal death rate fraction (NDRF) (5) In migration (IM) (b) Normal In migration fraction (NIMF) (7) Index on in migration (8) Out migration (9) Out migration fraction (10) Effect on out migration and (11) Index on out migration are considered along with the total quantity of population and a functional diagram is developed and is presented in Figure 5.3

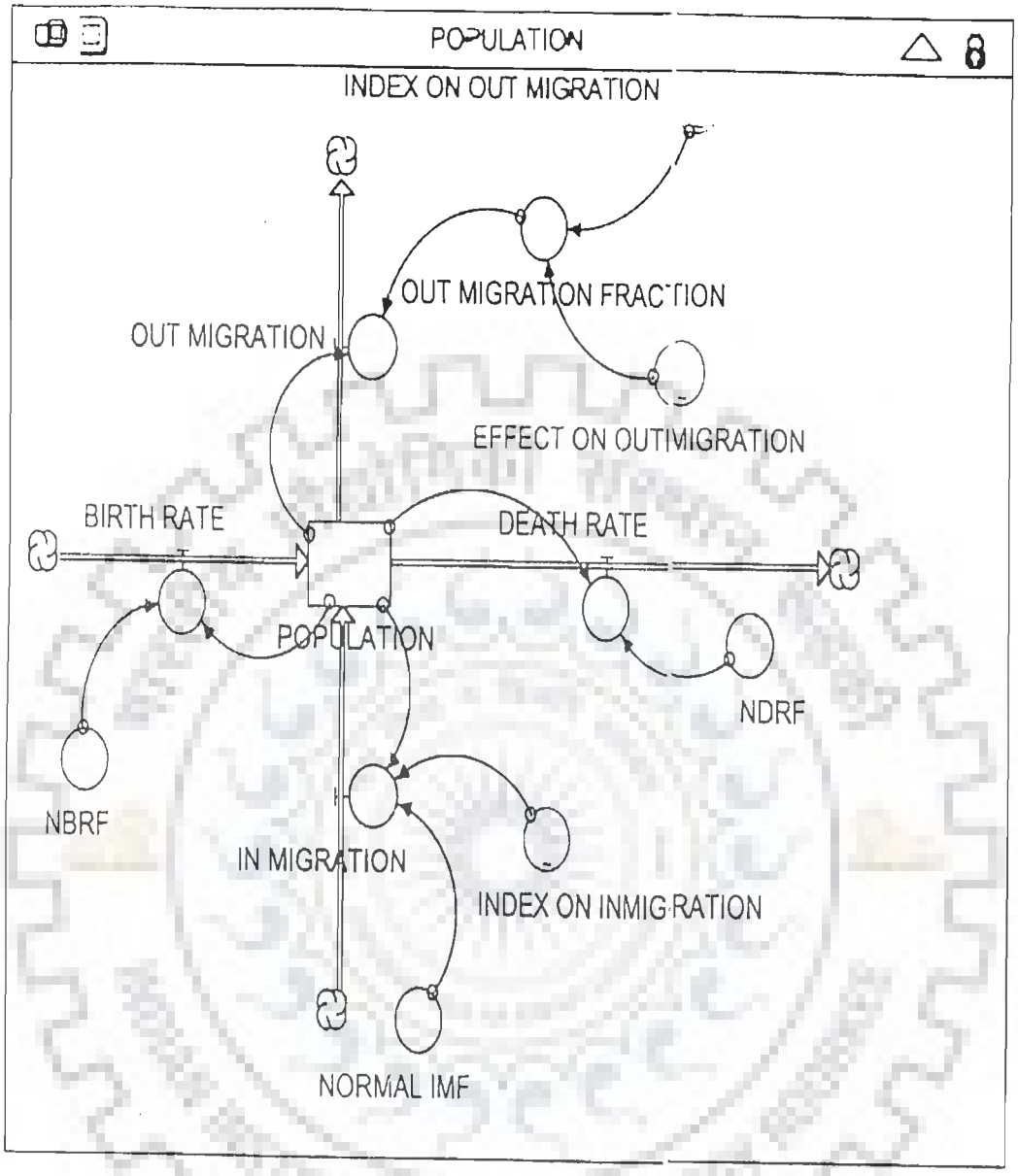

POPULATION
INDEX ON OUT MIGRATION
OUT MIGRATION FRACTION
OUT MIGRATION
EFFECT ON OUTMIGRATION
BIRTH RATE
DEATH RATE
POPULATION
NDRF
NBRF
IN MIGRATION
INDEX ON INMIGRATION
NORMAL IMF

Figure 5.3

The method, which is employed for computing the population, is presented as below:

POPULATION
POPULATION(t) = POPULATION(t - dt) + (BIRTH_RATE + IN_MIGRATION - DEATH_RATE - OUT_MIGRATION) * dt
INIT POPULATION = 2946650
INFLOWS:
BIRTH_RATE = POPULATION*NBRF
IN_MIGRATION = POPULATION*(NORMAL_IMF+INDEX_ON_INMIGRATION)
OUTFLOWS:
DEATH_RATE = POPULATION*NDRF
OUT_MIGRATION = POPULATION* OUT_MIGRATION_FRACTION
NBRF = .009
NDRF = .0027
NORMAL_IMF = 0.00275
OUT_MIGRATION_FRACTION = 0.00042+EFFECT_ON_OUTMIGRATION -INDEX_ON_OUT_MIGRATION

5.3.2 Population Density

Population density is refers to number of persons residing per square kilometer of land area. The following variables are considered for the development of population density model. They are: (1) Area, (2) Population, (3) population density (4) planning standard (Government standard of population). (5) Density ratio and (6) Effect on out migration. The functional diagram developed to quantify the population density is presented in Figure 5.4

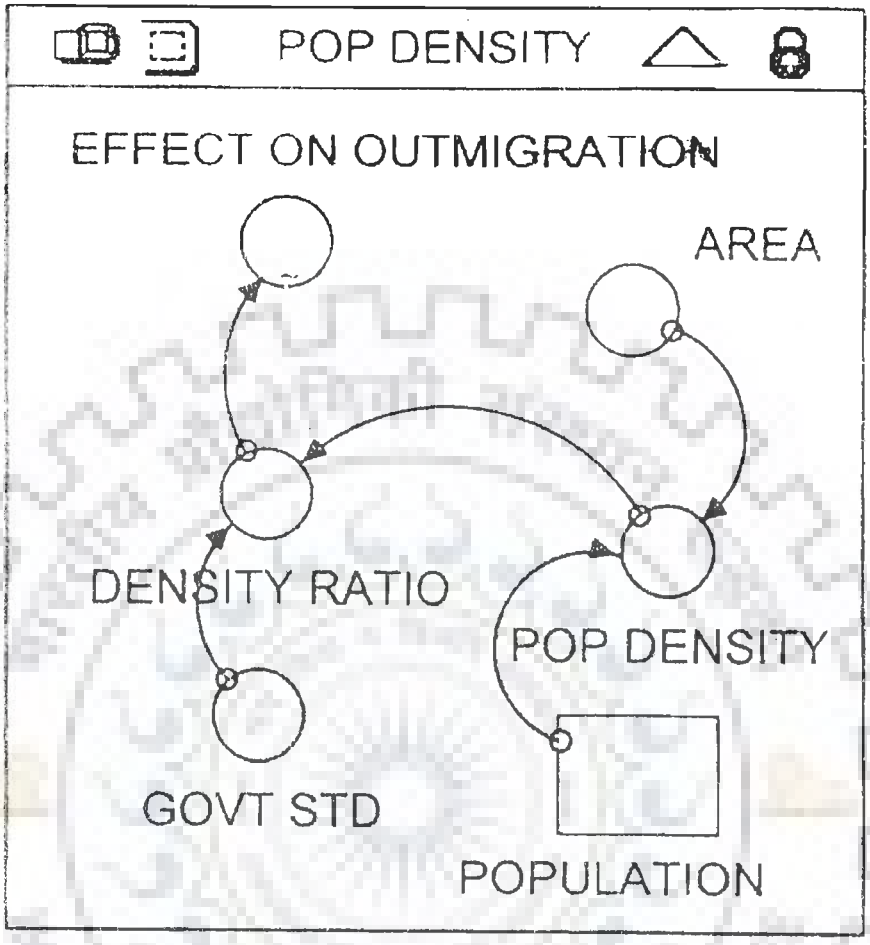

POP DENSITY
EFFECT ON OUTMIGRATION
AREA
DENSITY RATIO
POP DENSITY
GOVT STD
POPULATION

Figure 5.4

The method, which is employed for computing the population density is presented as below:

POP DENSITY

- AREA = 1450
- DENSITY_RATIO = POP_DENSITY/GOVT_STD
- GOVT_STD = 2000
- POP_DENSITY = POPULATION/AREA
- EFFECT_ON_OUTMIGRATION = GRAPH(DENSITY_RATIO)
  (1.00, 0.00), (1.10, 0.001), (1.20, 0.0023), (1.30, 0.0047), (1.40, 0.0108), (1.50, 0.0153), (1.60, 0.0176), (1.70, 0.019), (1.80, 0.0197), (1.90, 0.0199), (2.00, 0.0199)

5.3.3 Housing

Housing is another important sub system in an urban system. This is considered as the 3rd basic necessities for human life. The people of the study area have different income groups with a wide gap between them, which reflects the quality of housing as well. The number of available houses is inadequate for good habitation. The following variables are controlling the housing stock of the study area. They are (1) Population, (2) House of ratio, (3) housing standard (4) Actual number of housing, (5) Housing built up rate (6) Built up fraction (7) Total houses in construction (8) House completion rate (9) Construction delays (10) Deprecation, and (11) Age of the buildings. The model diagram of housing is presented in Figure 5.5.

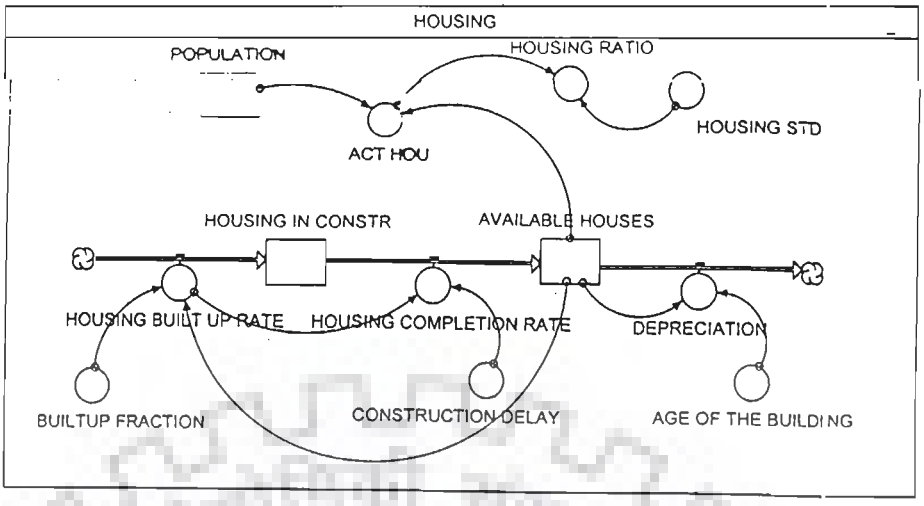


Figure 5.5

The method that is employed for computing the housing requirement in the system, and is presented as below:

HOUSING

AVAILABLE_HOUSES(t) = AVAILABLE_HOUSES(t - dt) + (HOUSING_COMPLETION_RATE - DEPRECIATION) * dt
INIT AVAILABLE_HOUSES = 606000
INFLOWS:
HOUSING_COMPLETION_RATE = SMTH3(HOUSING_BUILT_UP_RATE,CONSTRUCTION_DELAY)
OUTFLOWS:
DEPRECIATION = AVAILABLE_HOUSES/AGE_OF_THE_BUILDING

HOUSING_IN_CONSTR(t) = HOUSING_IN_CONSTR(t - dt) + (HOUSING_BUILT_UP_RATE - HOUSING_COMPLETION_RATE) * dt
INIT HOUSING_IN_CONSTR = 8240
INFLOWS:
HOUSING_BUILT_UP_RATE = AVAILABLE_HOUSES*BUILTUP_FRACTION
OUTFLOWS:
HOUSING_COMPLETION_RATE = SMTH3(HOUSING_BUILT_UP_RATE,CONSTRUCTION_DELAY)

ACT_HOU = AVAILABLE_HOUSES/POPULATION
AGE_OF_THE_BUILDING = 50
BUILTUP_FRACTION = 0.0272 +STEP(0.03,2004)
CONSTRUCTION_DELAY = 2
HOUSING_RATIO = ACT_HOU/HOUSING_STD
HOUSING_STD = 0.2

5.3.4. EDUCATION

As already pointed out, education is one of the important parameters, which decides the functions of the system. It has been observed that the study area is blessed with all type of education facilities. The State Government has introduced a new education policy, which made a breakthrough to bring more and more private educational institutions in the system. As a result, a number of schools, colleges including professional are started in and around the study area, which attracts more no of students. In this present investigation the Investigator considered the school education system only of the total education system, since schools provide basic education. Moreover, qualitative school education function as a catalyst for higher education. Therefore, school education is considered in this present investigation. The following variables are considered to analyze the growth of schools in the system. They are (1) Population, (2) Education ratio (3) Government standards of schools (4) School density ratio (5) Schools start up rate (6) School start up fraction, (7) Schools in construction (8) School commencement rate (9) Time to complete and (10) Number of school. A functional model has been developed based on the above parameters to the study the dynamic behavior of education facility in the system, and is presented in figure 5.6

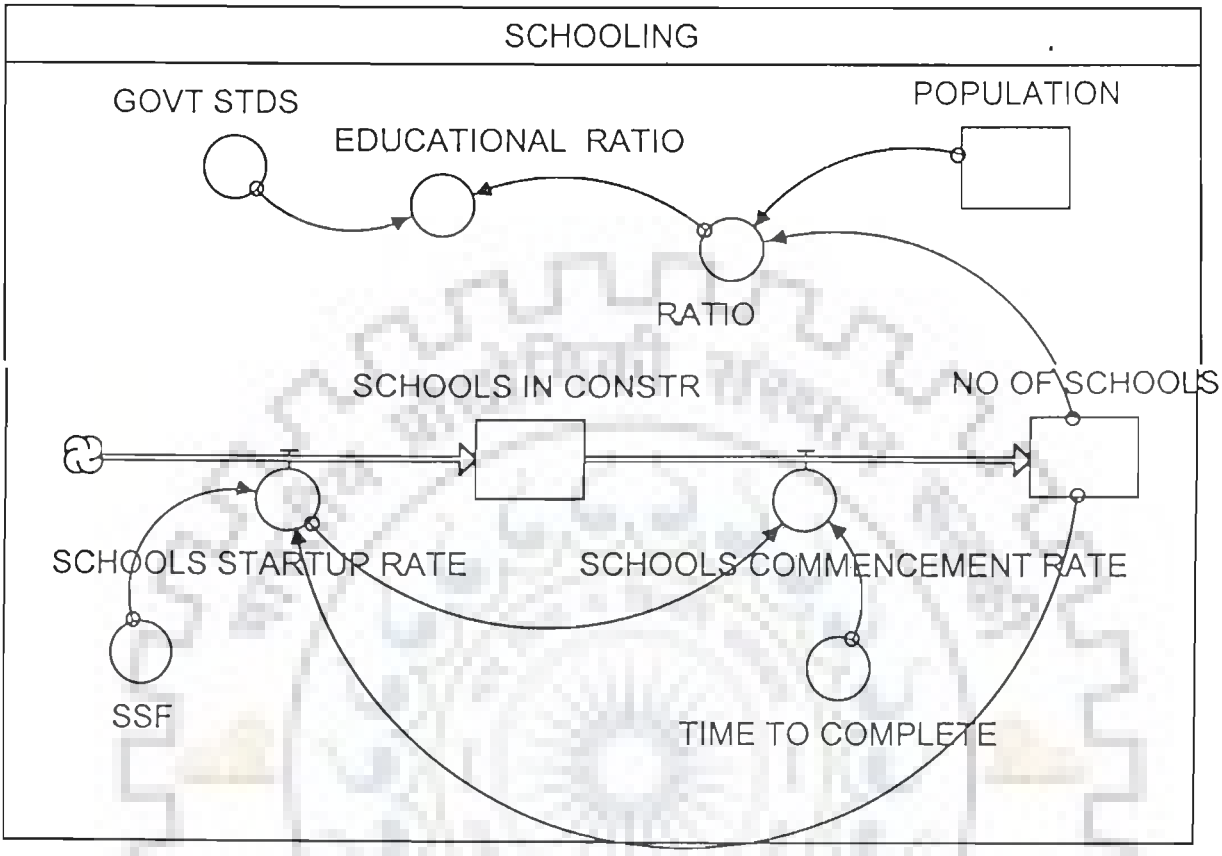

SCHOOLING
GOVT STDS
EDUCATIONAL RATIO
POPULATION
RATIO
SCHOOLS IN CONSTR
NO OF SCHOOLS
SCHOOLS STARTUP RATE
SCHOOLS COMMENCEMENT RATE
SSF
TIME TO COMPLETE

Figure 5.6

The method used for computation of the schools growth is presented as below:

SCHOOLING

- NO_OF_SCHOOLS(t) = NO_OF_SCHOOLS(t - dt) + (SCHOOLS_COMMENCEMENT_RATE) * dt
  INIT NO_OF_SCHOOLS = 1042
  INFLOWS:
  - SCHOOLS_COMMENCEMENT_RATE = SMTH3(SCHOOLS_STARTUP_RATE,TIME_TO_COMPLETE)
- SCHOOLS_IN_CONSTR(t) = SCHOOLS_IN_CONSTR(t - dt) + (SCHOOLS_STARTUP_RATE - SCHOOLS_COMMENCEMENT_RATE) * dt
  INIT SCHOOLS_IN_CONSTR = 27
  INFLOWS:
  - SCHOOLS_STARTUP_RATE = NO_OF_SCHOOLS*SSF

  OUTFLOWS:
  - SCHOOLS_COMMENCEMENT_RATE = SMTH3(SCHOOLS_STARTUP_RATE,TIME_TO_COMPLETE)
- EDUCATIONAL__RATIO = RATIO/GOVT_STDS
- GOVT_STDS = 1/3500
- RATIO = NO_OF_SCHOOLS/POPULATION
- SSF = 0.0261+STEP(0.005,2004)
- TIME_TO_COMPLETE = 2

5.3.5 Heath

The available health facilities in the district is not only catering the domestic population, but also catering the neighboring District of the State like Kanyakumari district of Tamil Nadu, and foreign countries like Srilanka, Maldives and few middle East countries. The Government of Kerala, which gives more impetus to start new Medical Colleges, Nursing colleges, etc., in the study area, which will attract further more people in this district. This will affect the overall system, definitely. In order to identify the effects of health facility in the system, this particular control parameters is considered as a subsystem, and the following variables are considered for computation. They are (1) Population (2) Bed ratio, (3) Ratio of beds (4) Effects of bed on in -migration (5) Bed addition fraction (9)

Number of bed construction (10) No of bed deletion and a diagram is prepared for understanding this functions and is presented in Figure 5.7

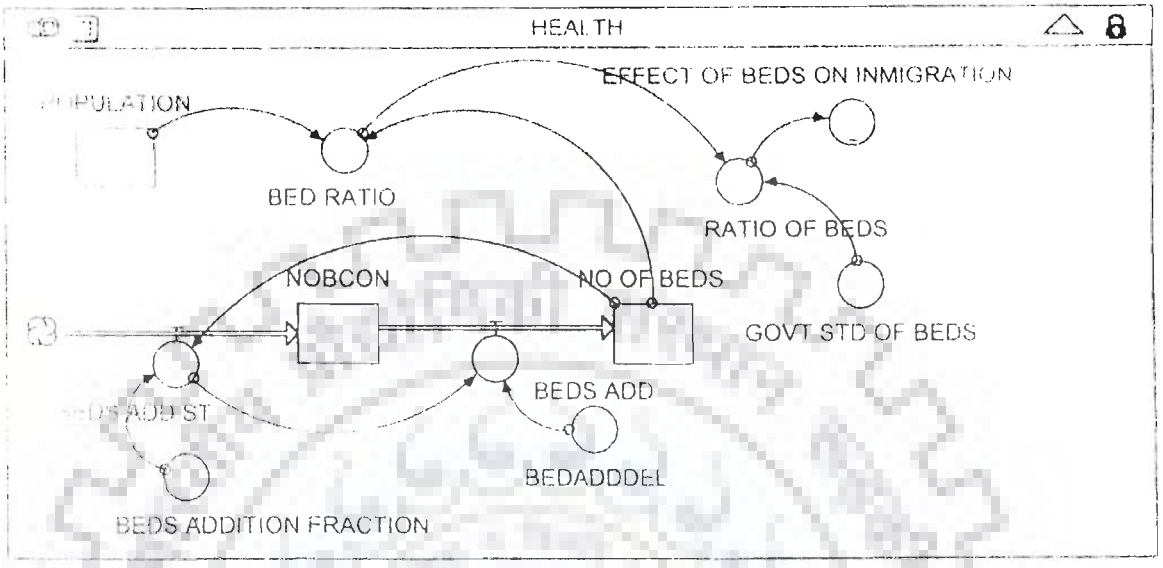


Figure 5.7

The method for computing the bed requirement in the study area is presented as below:

HEALTH

NOBCON(t) = NOBCON(t - dt) + (BEDS_ADD_ST - BEDS_ADD) * dt
INIT NOBCON = 150
INFLOWS:
BEDS_ADD_ST = NO_OF_BEDS*BEDS_ADDITION_FRACTION
OUTFLOWS:
BEDS_ADD = SMTH3(BEDS_ADD_ST, BEDADDDEL)

NO_OF_BEDS(t) = NO_OF_BEDS(t - dt) + (BEDS_ADD) * dt
INIT NO_OF_BEDS = 7616
INFLOWS:
BEDS_ADD = SMTH3(BEDS_ADD_ST, BEDADDDEL)

BEDADDDEL = 1

BEDS_ADDITION_FRACTION = .0263+STEP(0.02,2004)

BED_RATIO = NO_OF_BEDS/POPULATION

GOVT_STD_OF_BEDS = 0.001

RATIO_OF_BEDS = BED_RATIO/GOVT_STD_OF_BEDS

EFFECT_OF_BEDS_ON_INMIGRATION = GRAPH(RATIO_OF_BEDS)
(0.00, 0.00), (0.5, 0.0148), (1.00, 0.0285), (1.50, 0.0365), (2.00, 0.0413), (2.50, 0.0443), (3.00, 0.047), (3.50, 0.0483), (4.00, 0.0493), (4.50, 0.0498), (5.00, 0.05)

5.3.6 Power

The people of the study area are facing serious energy crisis, during the drought season, since more or less the State depends on Hydel power stations and the hydel power stations defunct during the drought seasons. The scarcity of power supply leads people to move out of the state for setting up of Industries. At present, the people of the study area are getting on an average of 0.85 kWh per day, which is less than the national average and also far below the consumption rate of the nearby States of the country. Hence, power supply becomes one of the important controlling factors, which decides the functions of the system. In order to develop the dynamic functional model, the following variables such as, (1) Population, (2) Power demand, (3) Power ratio, (4) Requirement per person, (5) Power supply capacity, (6) Capacity in negotiation, (7) Time to negotiate, (8) Additional power completion rate, (9) Capacity on negotiation, and (10) Capacity addition are considered for developing a diagram, and the diagram is presented in Figure 5.8

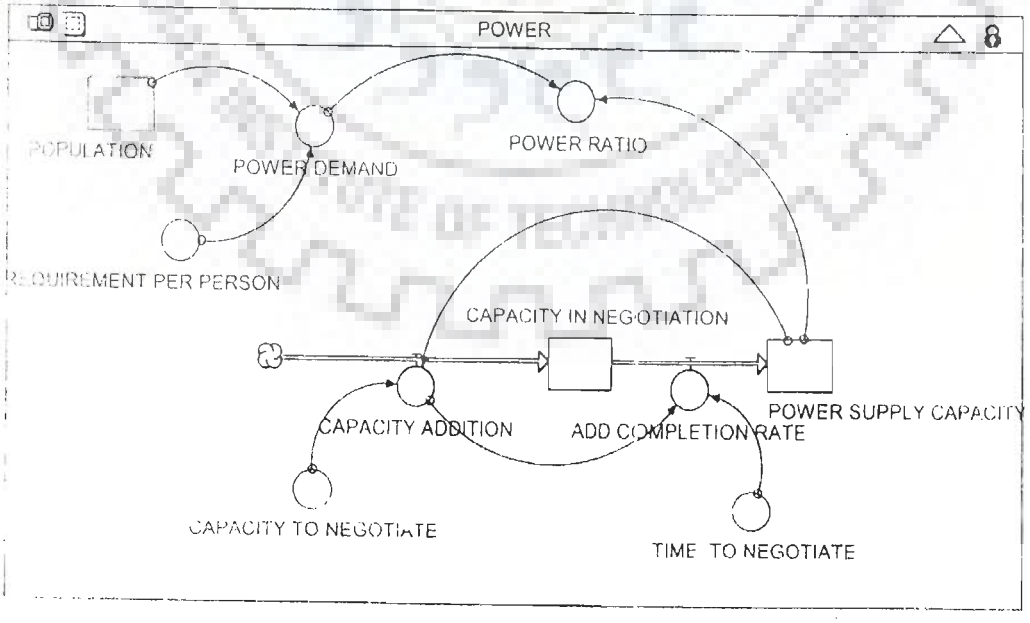


Figure 5.8

The method, which is used, for computing the power supply requirement is presented as below:

POWER
□ CAPACITY_IN_NEGOTIATION(t) = CAPACITY_IN_NEGOTIATION(t - dt) + (CAPACITY_ADDITION - ADD_COMPLETION_RATE) * dt
INIT CAPACITY_IN_NEGOTIATION = 0
INFLOWS:
CAPACITY_ADDITION = PULSE(POWER_SUPPLY_CAPACITY*CAPACITY_TO_NEGOTIATE,2001,0)
OUTFLOWS:
ADD_COMPLETION_RATE = SMTH3(CAPACITY_ADDITION,TIME__TO_NEGOTIATE)
□ POWER_SUPPLY_CAPACITY(t) = POWER_SUPPLY_CAPACITY(t - dt) + (ADD_COMPLETION_RATE) * dt
INIT POWER_SUPPLY_CAPACITY = 1066159360
INFLOWS:
ADD_COMPLETION_RATE = SMTH3(CAPACITY_ADDITION,TIME__TO_NEGOTIATE)
○ CAPACITY_TO_NEGOTIATE = 0.1
○ POWER_DEMAND = POPULATION*REQUIREMENT_PER_PERSON
○ POWER_RATIO = POWER_SUPPLY_CAPACITY/POWER_DEMAND
○ REQUIREMENT_PER_PERSON = 400
○ TIME__TO_NEGOTIATE = 4

5.3.7 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. In this investigation, all the subsystem, which are considered for analysis, and the sum of their index, which represent the quality of life have been considered for analysis. To calculate the index value of individual subsystem, Government standard value is considered and then the sum of this value is considered to develop a composite index. The formula used for calculating the composite index is presented as below:

$$Q.OL = \oint(\text{composit infra Index})$$
$$= \oint(\text{Infra1},\ \text{infra 2},\ \text{Infra 4})$$

A composite index is prepared based in the above and is presented in Fig 5.9

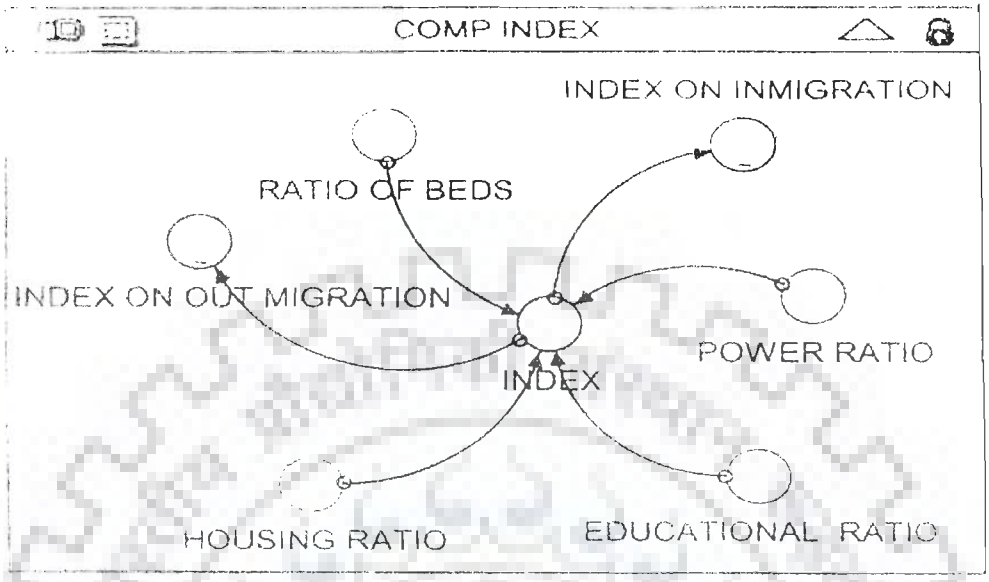


Fig 5.9

The method, which is employed, for computing the composite index (quality of life) is presented as below:

COMP INDEX

- INDEX = POWER_RATIO*.45+RATIO_OF_BEDS*.1+EDUCATIONAL__RATIO*0.15+0.3*HOUSING_RATIO
- INDEX_ON_INMIGRATION = GRAPH(INDEX)
  (0.00, 0.00025), (0.2, 0.00075), (0.4, 0.00225), (0.6, 0.005), (0.8, 0.00875), (1.00, 0.0233), (1.20, 0.04), (1.40, 0.0453), (1.60, 0.0478), (1.80, 0.0493), (2.00, 0.0498)
- INDEX_ON_OUT_MIGRATION = GRAPH(INDEX)
  (1.00, 0.00), (1.10, 0.00), (1.20, 2e-005), (1.30, 5e-005), (1.40, 9e-005), (1.50, 0.00018), (1.60, 0.00027), (1.70, 0.00044), (1.80, 0.00076), (1.90, 0.00114), (2.00, 0.00198)

5.4 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 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, and the results are presented in Figures, 5.10, 5.11, 5.12, 5.13, and 5.14.

5.4.1 Results

The figures 5.10, 5.11, 5.12, 5.13, and 5.14 clearly indicate that the total population available in the study area is 3331748. The total number of available houses is 649141. The total number of schools availability is 1353. The total number of bed availability in the hospital is 9907, and the per capita power consumption is 360. k.w-h per annum. The figure 5.10 clearly explain the quality of life (index no. 5) in decreasing trend from 1991 to 2001 under the present condition of infrastructure provision, such as, housing, schools, hospital, and power supply.

5.5 MODEL VALIDATION

The developed model is employed to compute the output from a set of input for the year 2001, referred to as the 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.

5.6 PROJECTION

In this present investigation, the subsystem (control parameter) such as, population, housing, education, health, and power have been considered for projecting their value up to 2031AD for strategic planning. STELLA software is

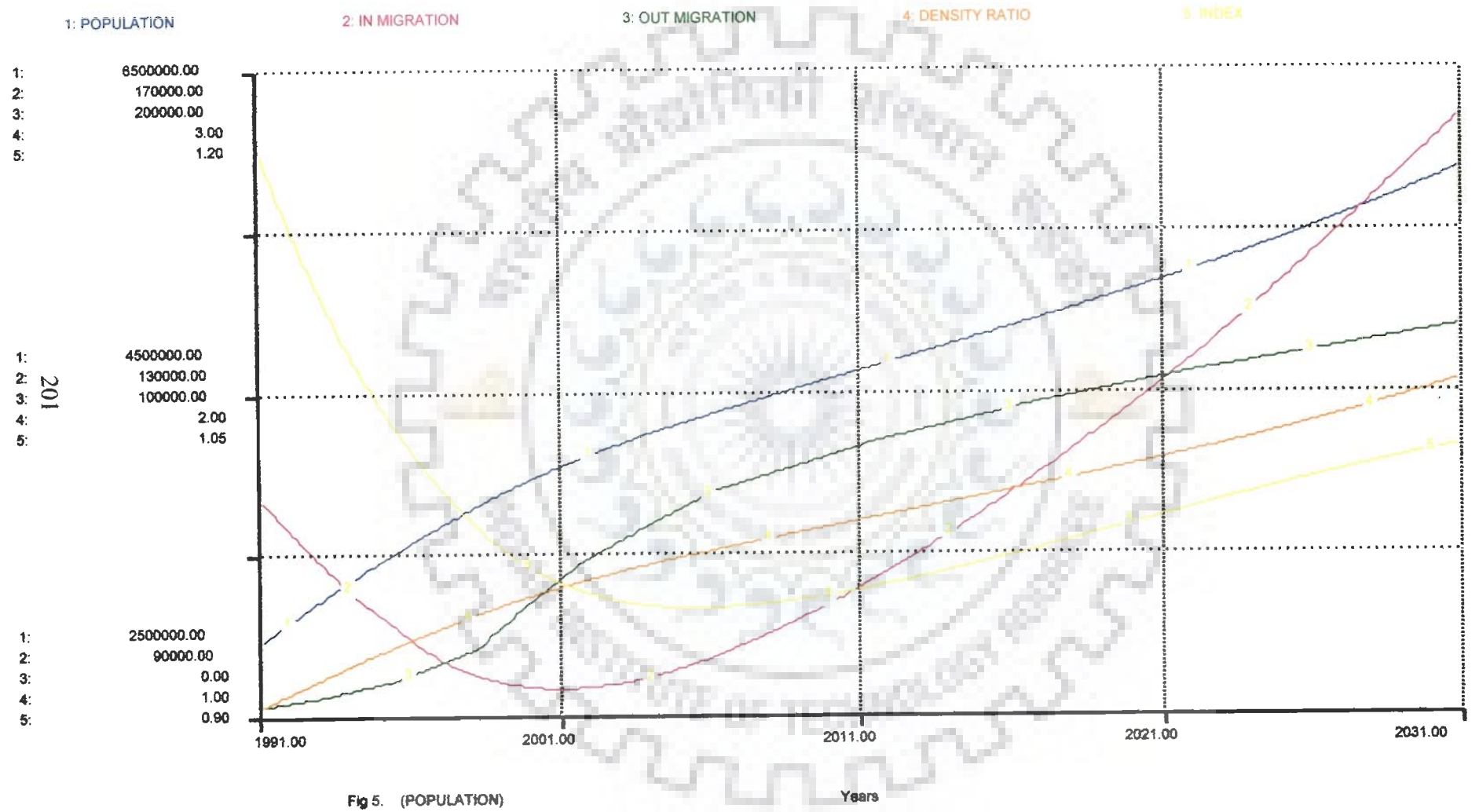


Fig 5. (POPULATION)

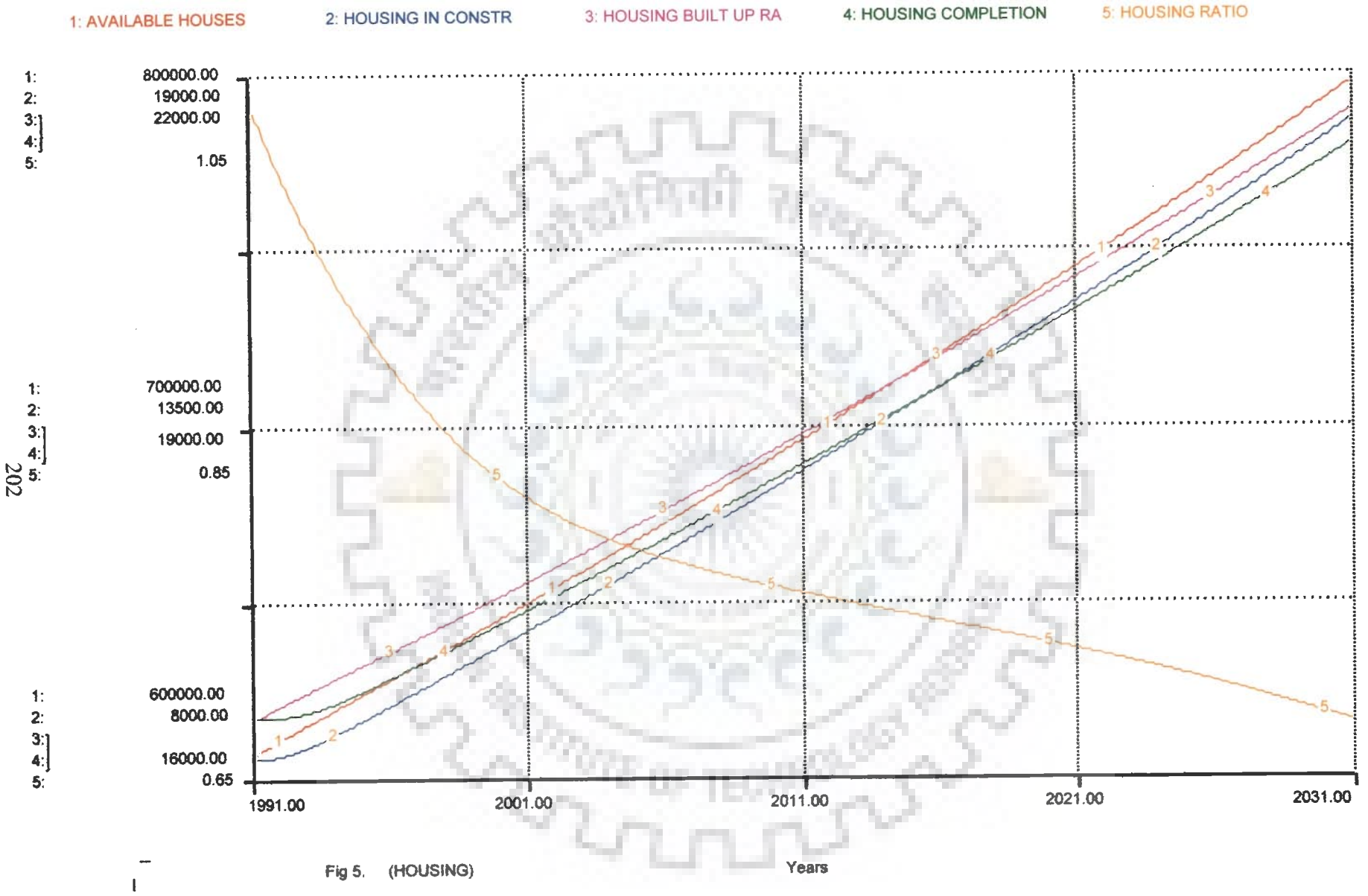


Fig 5. (HOUSING)

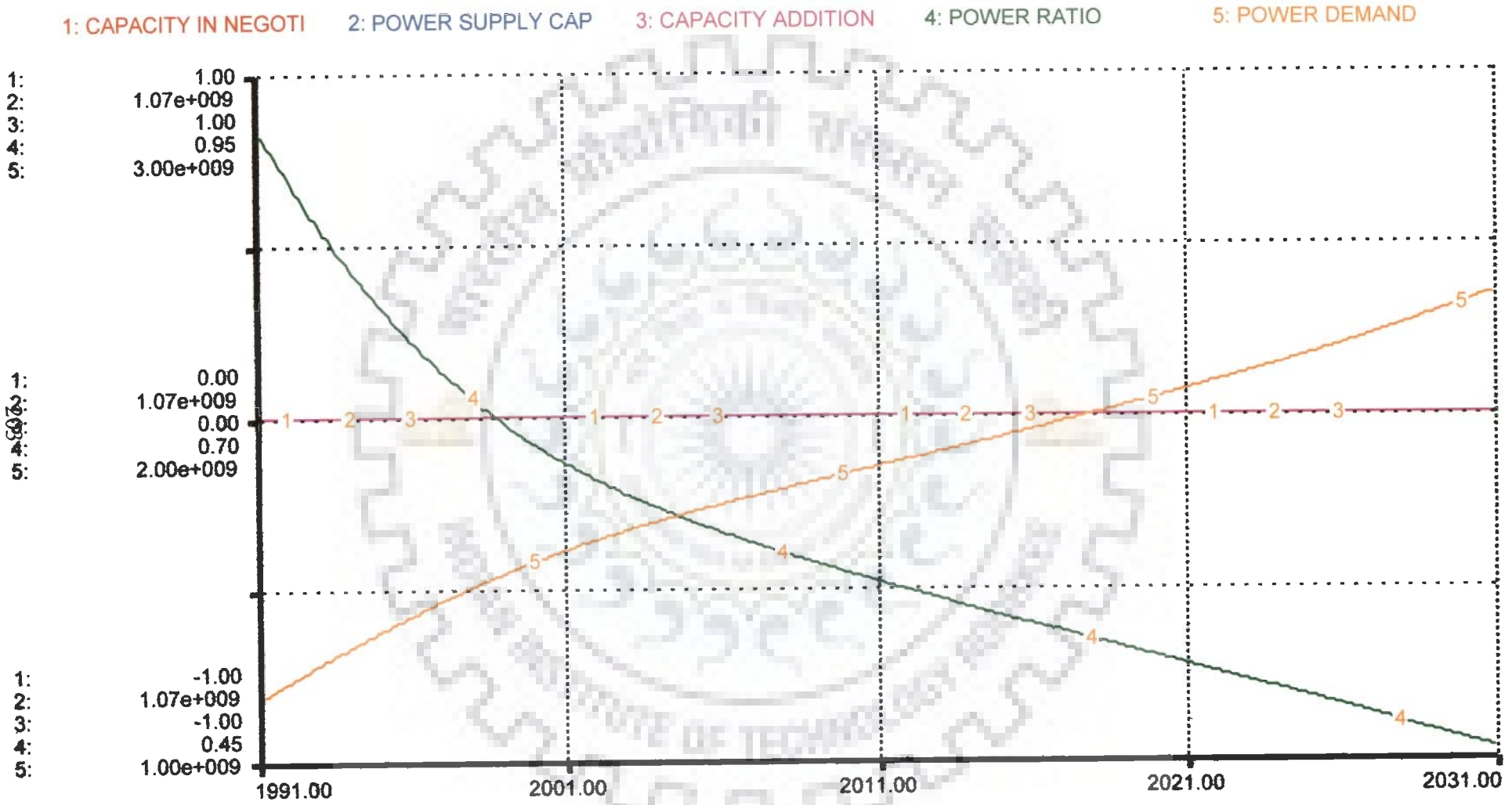

1: CAPACITY IN NEGOTI
2: POWER SUPPLY CAP
3: CAPACITY ADDITION
4: POWER RATIO
5: POWER DEMAND
1: 1.00
2: 1.07e+009
3: 1.00
4: 0.95
5: 3.00e+009
1: 0.00
2: 1.07e+009
3: 0.00
4: 0.70
5: 2.00e+009
1: -1.00
2: 1.07e+009
3: -1.00
4: 0.45
5: 1.00e+009
1991.00
2001.00
2011.00
2021.00
2031.00
Years

Fig 5/ (POWER)

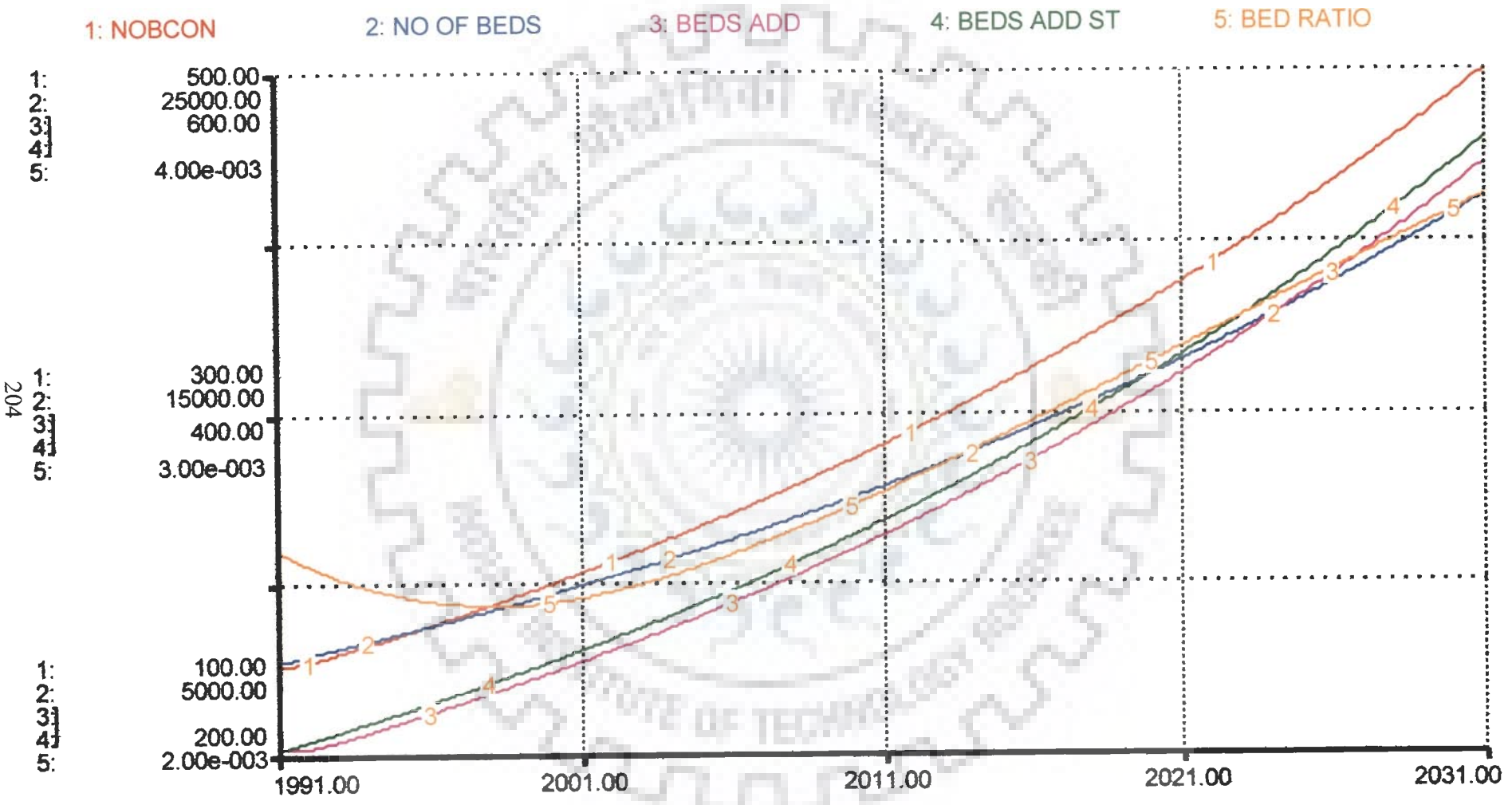

1: NOBCON
2: NO OF BEDS
3: BEDS ADD
4: BEDS ADD ST
5: BED RATIO
1: 500.00
2: 25000.00
3: 600.00
4:
5: 4.00e-003
1: 300.00
2: 15000.00
3: 400.00
4:
5: 3.00e-003
1: 100.00
2: 5000.00
3:
4: 200.00
5: 2.00e-003
1991.00
2001.00
2011.00
2021.00
2031.00
Years

Fig 5. (HEALTH)

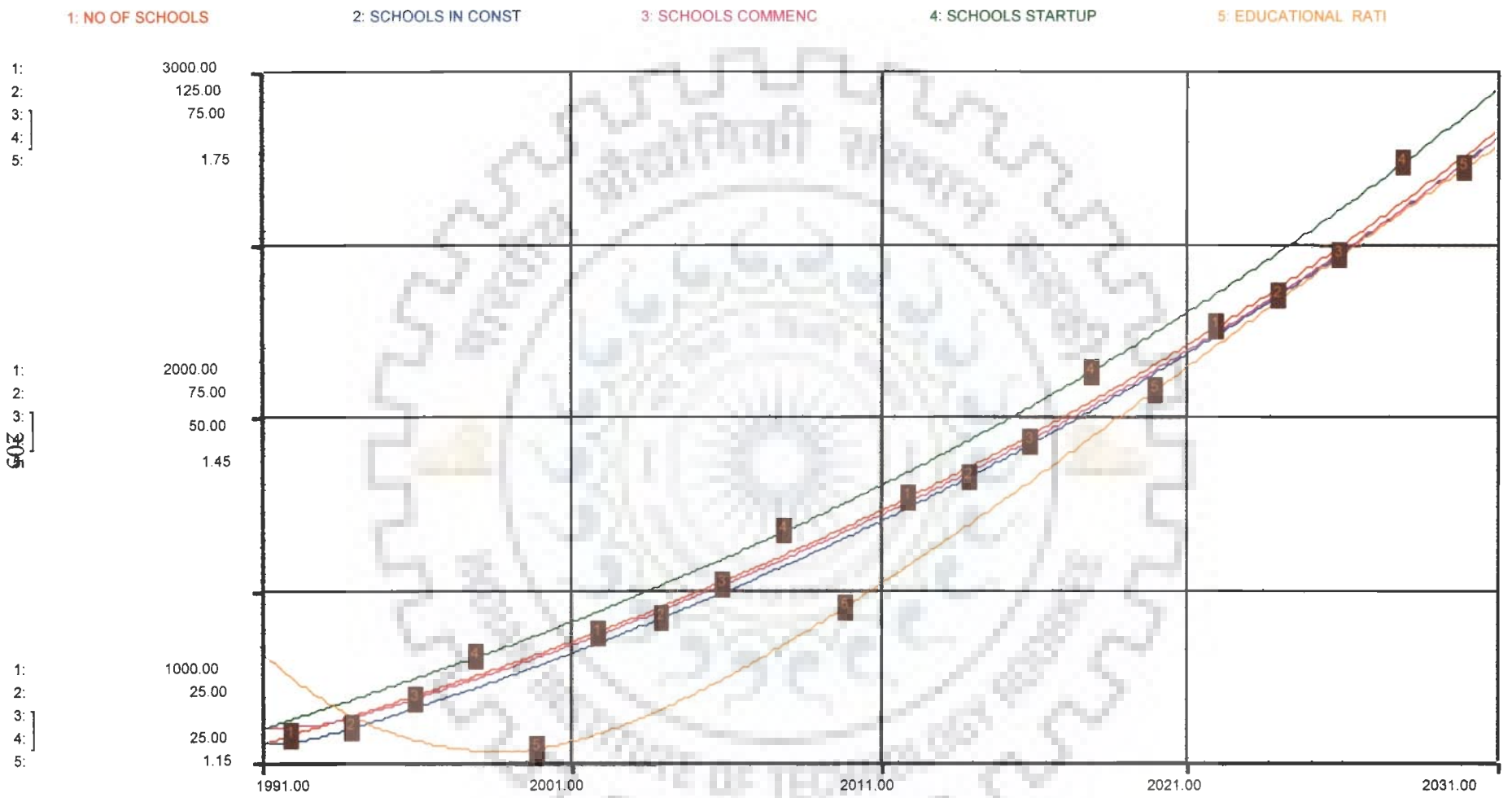


Fig 5. (EDUCATION)

used for doing projections by considering time series data of the said control parameters. The values of the output for the year 2031 AD for each control parameters are considered for arriving at the projected year model-2031 AD.

5.6.1 Projected Year Model (2031 AD)

The projected year model results that the population of the study area would be 58 lakhs in the year 2031 AD. The requirement of houses would be 11.6 lakhs as per the standards for the model results population of 58 lakhs, but the available houses as per the present rates of construction would be 7.95 lakhs and is presented in Fig. 5.11. If this trend in allowed to be continued the deficiency of houses would be 3.65 lakhs in 2031 AD. In education, the number of school required would be 1657 as per the standard for the population of 58 lakhs, but the model results for 2031 AD would have 2950, and is presented in Fig 5.12. It clearly shows that the system will have excess of 1293 schools in the year 2031 AD as per the standard. In health segment, the number of beds in the hospitals requirements would be 5800 as per the standard, but the model results that the requirement of bed would be 25000 in the year 2031 AD. The excess of beds would be 19200 in 2031. If the present trend continues, and the results are presented in fig .5 13. 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 the deficiency of power supply would be 10180 mw-h in the year 2031 AD. The results of the power supply of the model is presented in Fig 5.14 .The projected year model results are summarized up and presented in Table 5.3, This table explains that is the present trend continues in the system pertaining to population, housing, school,

education, health (number of beds), and power supply, there would 31.46 per cent and deficiency in housing (no of houses availability), and deficiency in power supply 48.75 per cent in 2031 AD. They excess in number of schools would be 78.03 per cent, and excess in number of beds in hospitals would be 331.00 per cent in the year 2031 AD, in the system. Further, this table clearly explains that this system would met acquit shortage in number of houses, and power supply on one hand, and abundant supply in number of schools and beds in hospitals in the year 2031 AD if this present trend prevails. It has been observed that though the number of schools and beds in hospitals are much higher in number than the requirement as per the standards, all the available schools and the beds in hospitals are functioning well due to the following reasons, such as, (i) these facilities are not only serving for the population of this study area, but also catering the population of neighboring district of the state, neighboring states and few foreign countries (ii) the acute shortage of power supply and the number of houses in the system practically hamper the development of the system, and also it would aggravate the crisis further. In this situation, it is an inevitable requirement to enhance the power supply and housing built up rate in the system.

5.7 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 in the projected year model 2031 AD to arrive at plausible decisions. The following control parameters are considered for developing the scenarios. They are:

1. Increase in number of houses.
2. Increase in number of schools.

3. Increase in number of beds in the hospitals.

4. Increase in power supply in the system.

5. Combination of increase in the number of all the aforesaid parameters.

The scenarios, which are tested with their values, are presented in Table 5.4. The tested scenarios and their results are presented as follows:

5.7.1 Scenario 1: Addition of Number of Houses by 2 Percent

It has been observed that there is a higher demand of housing in this system. As already pointed out, the study area would have a huge gap between the demand and supply of houses i.e., 3.65 lakhs in 2031 AD. Therefore, and attempt is made to understand the functions of the system by increasing 2 per cent houses in the system, and tested this model by incorporating the additional value of 2 per cent houses in the model. The model results are presented in Figure 5.15 and it reveals that the total population of the system remain the same as in the projected year model- 2031, and the available houses would be increased upto 12.75 lakhs, and the density ratio would be remained the same. At the same time, the quality of living index would increase from 1.025 to 1.075, which is 4.88 per cent .In migration increase from 17,0000 to 200,000 by the year 2031, which is 47 per cent excess of the projected year. This shows that housing plays a major role in the quality of life.

5.7.2 Scenario 2: Addition of Number of Houses by 3 Percent

An addition of three per cent in number of houses in the projected year model, 2031AD was tested by keeping all other parameters value are constant as in the projected year model, and the model results are quite interesting. The model results are presented in Figure 5.16. This figure illustrates that the

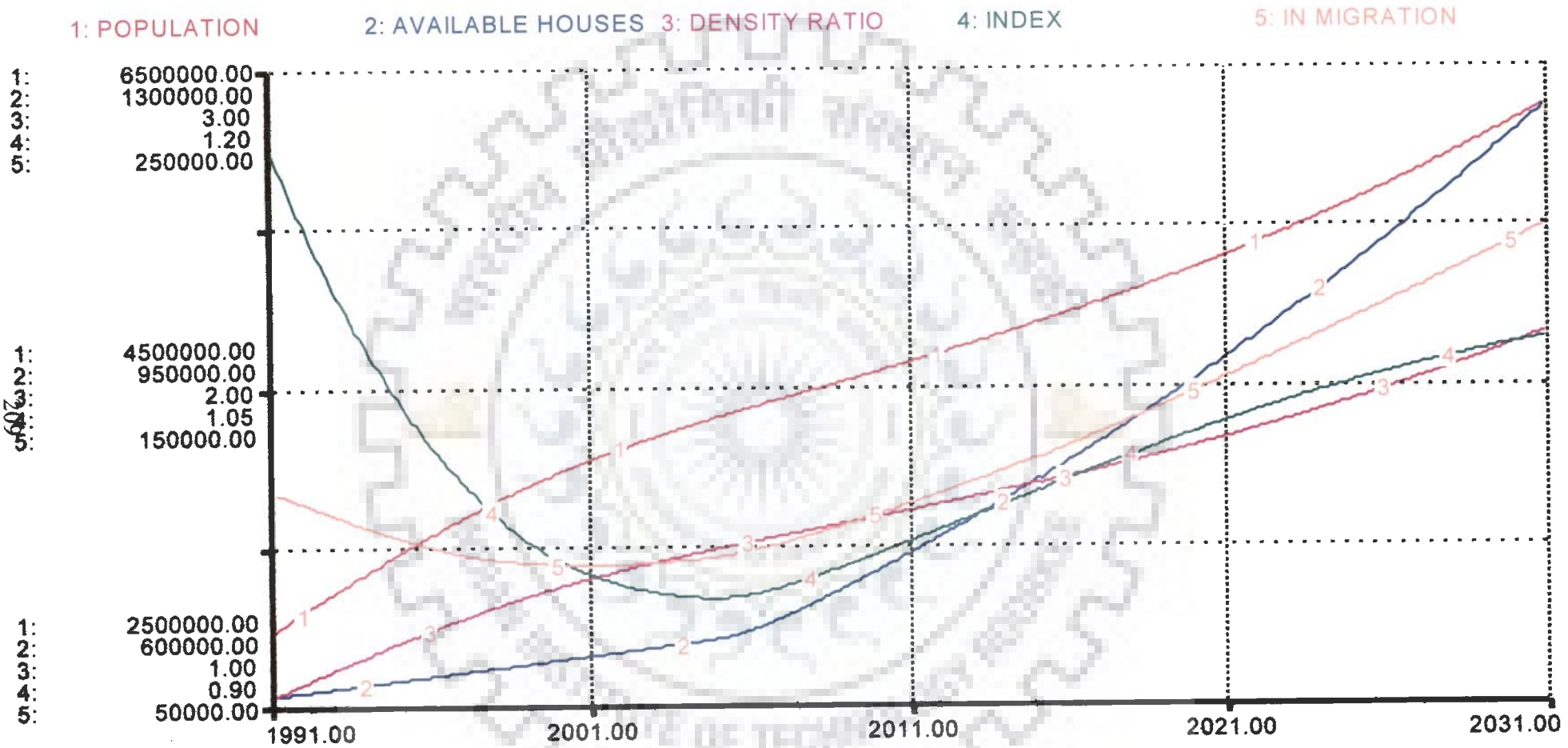


Fig 5. (SCENARIO 3 (HOUSING ADDITIO

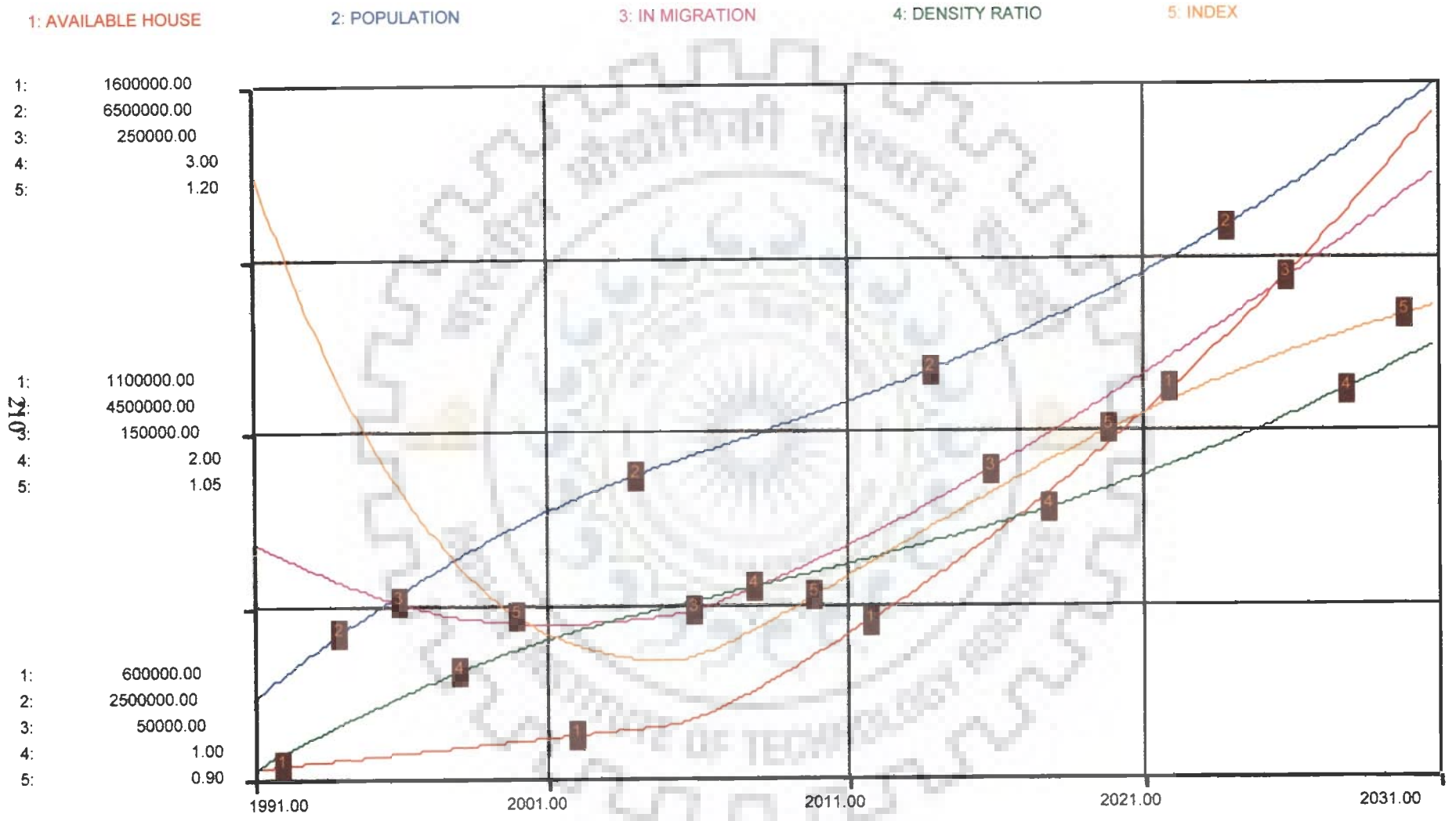


Fig 5. (SCENARIO 4 (HOUSING ADD 3%)

population would reach about 65 lakhs and in migration would touch upto 2.25 lakhs, with a hike of 23 per cent. Similarly the quality of living index would increase from 1.075 to 2 per cent. The available number of houses would increase to15.60 lakhs, which shows an increment of 7.3 per cent from the projected year model. These also clearly indicate that housing is one of the key parameter, which decide the quality of life in the system.

5.7.3 Scenario 3 : No More Addition of Houses

A scenario was tested without adding the number of houses and all the other parameters value are constant as in the case of the projected year model. The results of the model in presented in the Figure 5.17. This figure illustrates that the total population would be reduced to 55 lakhs from 58 lakhs showing a reduction of 5.17 per cent of population. The housing- stock would be reduced from 7.95 lakhs to 3.75 lakhs, since the current rate of construction is stopped. In this situation, the in-migration of population would also be reduced from 1.52 lakhs to 1.35 lakhs, which shows a reduction of 11.18 per cent from the projected year model. Similarly the density of population would also reduced from 4000 to 3793 persons per sq.km, which shows a reduction to 5.17 per cent from the projected year. Regarding to the quality of index, it once again shows a reduction from 1.025 from the projected year to 0.98 with a reduction of 4.39 per cent, which explicitly shows the importance of the requirement of houses in the system.

HEALTH

Health is one of the most important parameters, which decides the functions of the system. Good health system leads to better quality of living in any system. To have good health, qualitative health institutions are absolutely

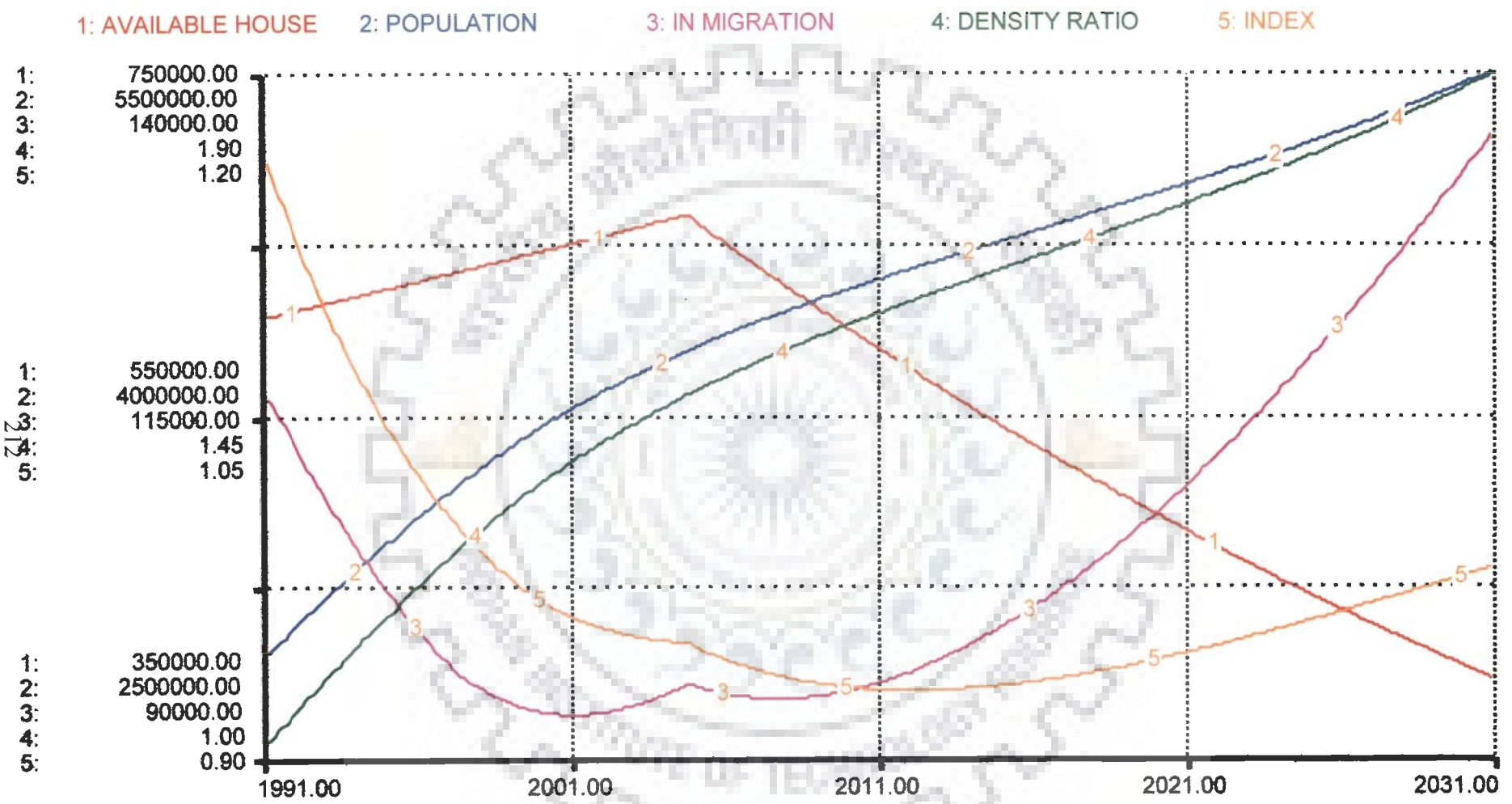


Fig 5. (HOUSING(NO ADDITIOI))

necessary. Though the system is blessed with more number of health based institutions, an attempt is made to analyze the systems behavior by addition of beds in the hospital by 2 per cent and 5 per cent separately and also with out adding any beds. The scenarios related to health and their results are presented in the squeal.

5.7.4 Scenario 4: Bed Addition by 2 Percent

A scenario of bed addition by 2 per cent was tested in the projected year model, by maintaining all other parameters value were the same and the model yielded very good results, and the results of the model is presented in Fig 5.18. This figure reveals that the total number of bed availability would be increased to 35000 against 22500 in the projected year model, with an increment of 55 per cent. The total population in the system would be increased from 58 lakhs to 65 lakhs showing an increase of 12 per cent. Similarly, the in- migration would also increase from 1.52 lakhs to 2.35 lakhs, which shows an increment of 54.6 per cent. The quality of living index would also increase from 1.025 to 1.125, with an addition of 9.75 per cent.

5.7.5 Scenario 5: Bed Addition by 5 Percent

The effect of heath facility to the population growth is once more tested in the model with an addition of 5 per cent bed in the projected year model. The model shows very interesting results, and the results are presented in Figure 5.19 .The figure illustrates that the number of bed would be increased to 63300 against 22500 in the projected year model, showing a hike of 281 per cent. It has been observed that during the same period the available population would also

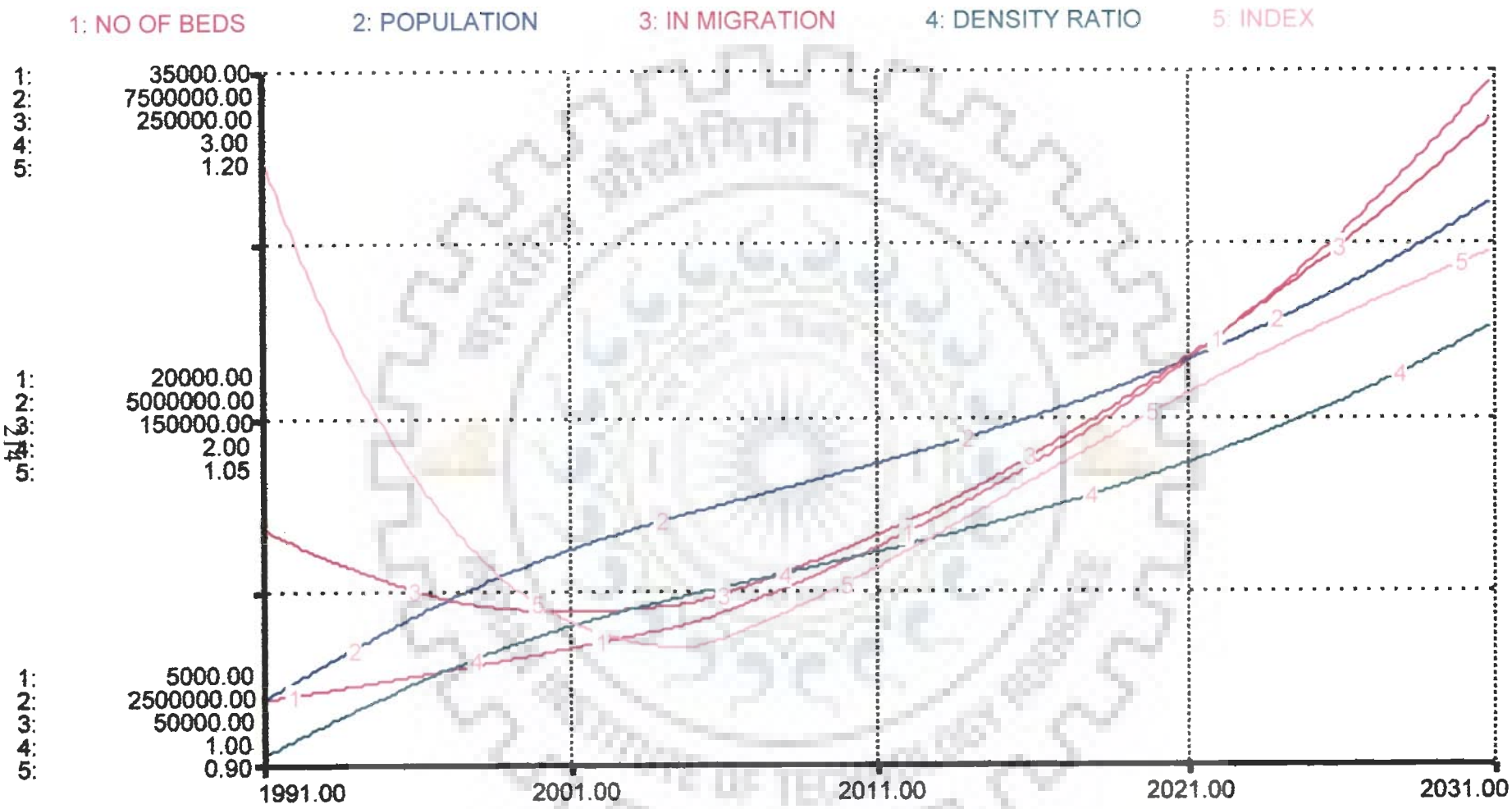


Fig 5. (SCENARIO 2 (BED ADDITION 2%))

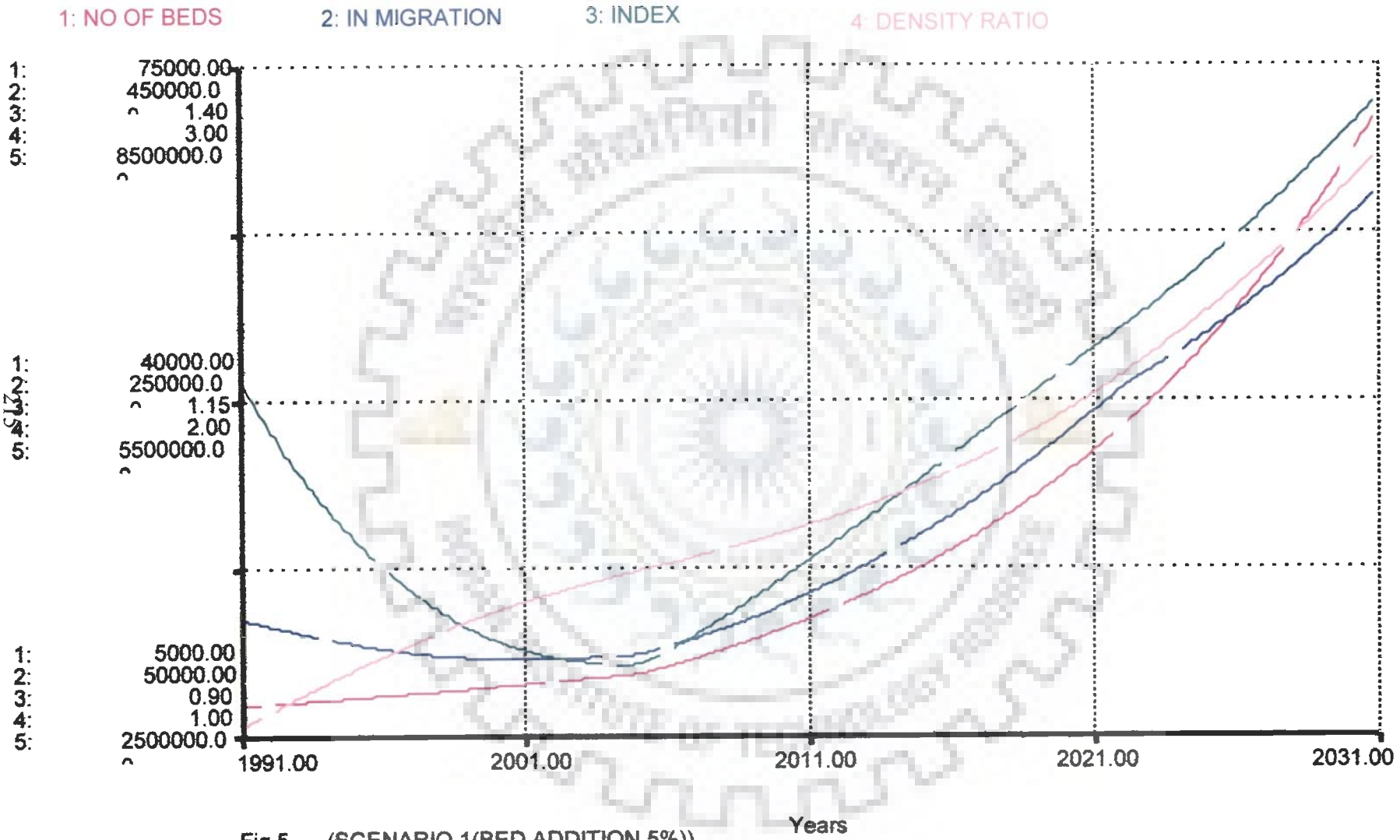


Fig 5. (SCENARIO 1(BED ADDITION 5%))

increased to 77.5 lakhs against 58 lakhs showing 33.62 per cent from the projected year model due to the addition of medical facilities in the system. Similarly, the quality of living index would also increase from 1.025 to 1.2166 to a hike of 15.7per cent from the projected year model. The in -migration of people to this urban system would also increase from 1.52 lakhs to 3.75 lakhs showing a remarkable growth of 246.7 per cent.

5.7.6 Scenario 6: No Bed Addition

Similarly the model was tested with no further addition of beds in the system, by considering the remaining values are constant in the model. The result of the program is presented in Figure 5.20. This figure illustrates that the total number of beds remains constant. The population in the system would be reduced from 58 lakhs to 53 showing a reduction 8.62 per cent. The in migration also shows a drastic reduction from 1.52 lakhs to 1.12 lakhs with 26.31 per cent. Similarly the quality of living index decreased from 1.025 to 0.9375, with a reduction of 8.53 per cent. The additions of beds in the hospitals play a significant role in this system. Slight increment in the availability of beds in the hospitals, attract more number of population from outside of the system, and the total population of the system would also increase considerably. This shows that a well-established health system prevails in the system, and the people have also more confident about the medical facilities available in the system.

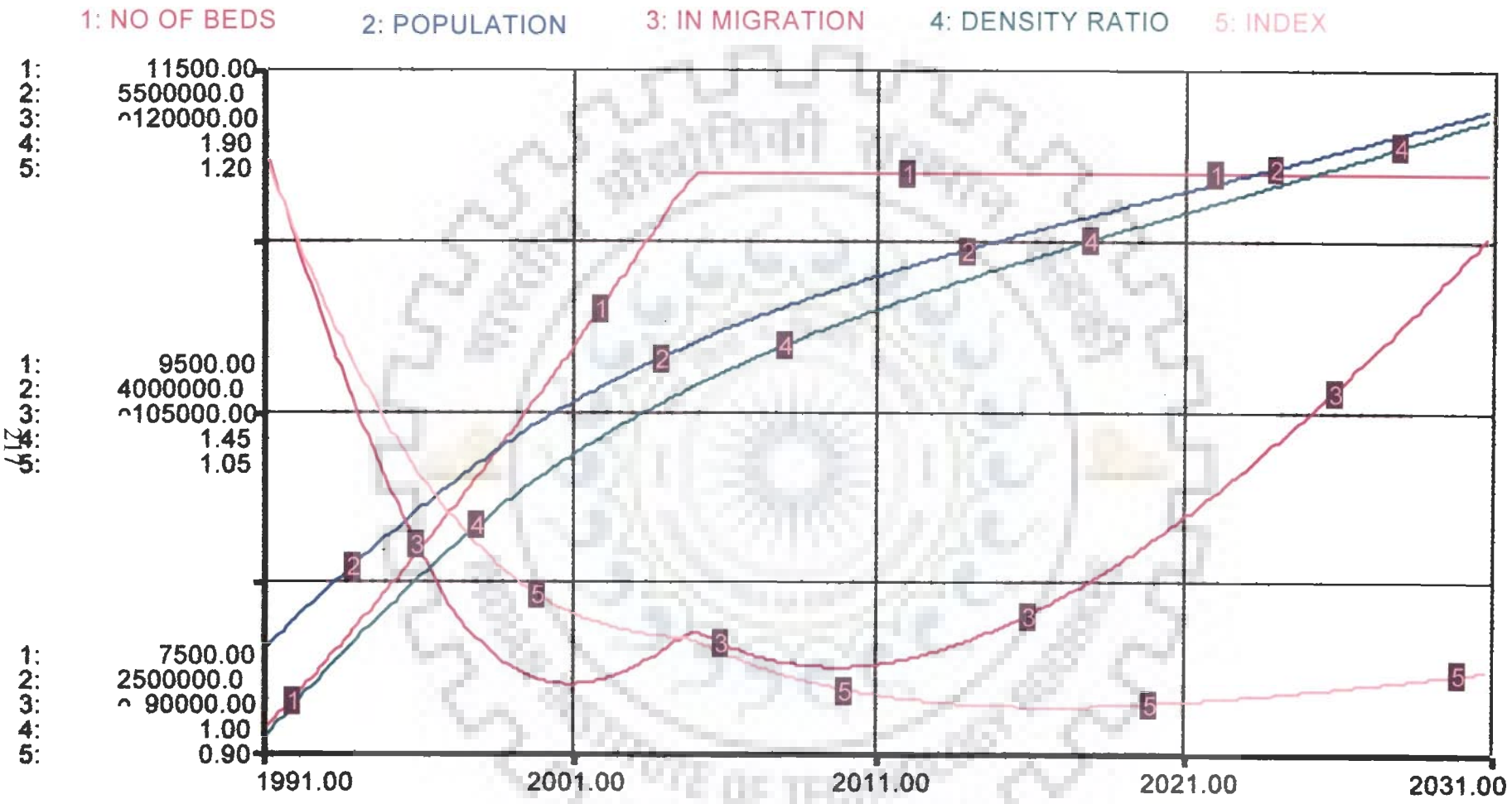


Fig 5. (HEALTH(NO ADDITION))

EDUCATION

As already pointed out, education plays a major role in the development of the system. Quality education at the school levels becomes a catalyst in human resource development. Though the system has more number of schools than the requirement of school as per the planning standard, an attempt is made to understand the systems behavior by testing the model by adding the schools by 0.5 per cent, and by 1.00 per cent and without addition of schools, and the results are quite encouraging. The scenario and their results pertaining to education are presented in the sequel.

5.7.7 Scenario 7: Addition of Schools at the Rate of 0.5 Percent

An addition of schools by 0.5 per cent and by keeping all other parameters value remain same as in the projected year model and tested the model. The results of the model are presented in the Figure 5.21. The figure illustrates that the number of schools would increase from 2750 to 3100 with an increase of 12.72 per cent. The population growth does not show a marked variation, but a slight growth is observed, i.e., it would increase from 58.00 lakhs to 59.50 lakhs. The in- migration of population would increases from 1.52 lakhs to 1.72 lakhs with an increase of 13.5 per cent. The quality of life index would increase from 1.025 to 1.035, which is 0.97 per cent.

5.7.8 Scenario 8: Addition of Schools at the Rate of 1.00 Percent

A scenario is tested by an addition in number of school in the system by 1.00 per cent from the projected year model and keeping all other parameters values constant. The results of the model are presented in figure 5.22. This figure illustrates that the number of schools would be increased from 2750 to 3550 with an increase of 29.00 per cent. The population of the system would increase from

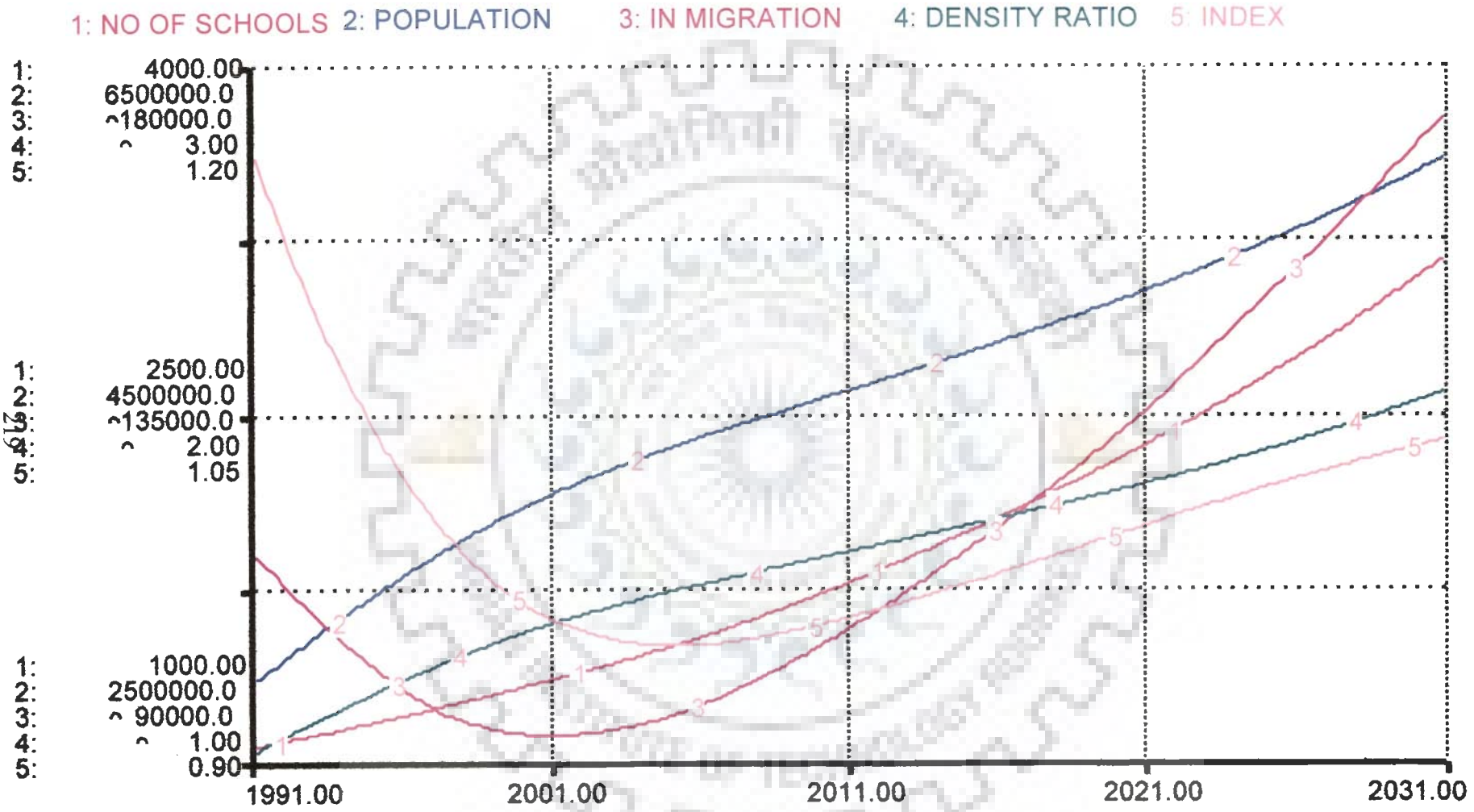


Fig 5. (SCENARIO 6 (SCHOOLING ADD 0.5%)

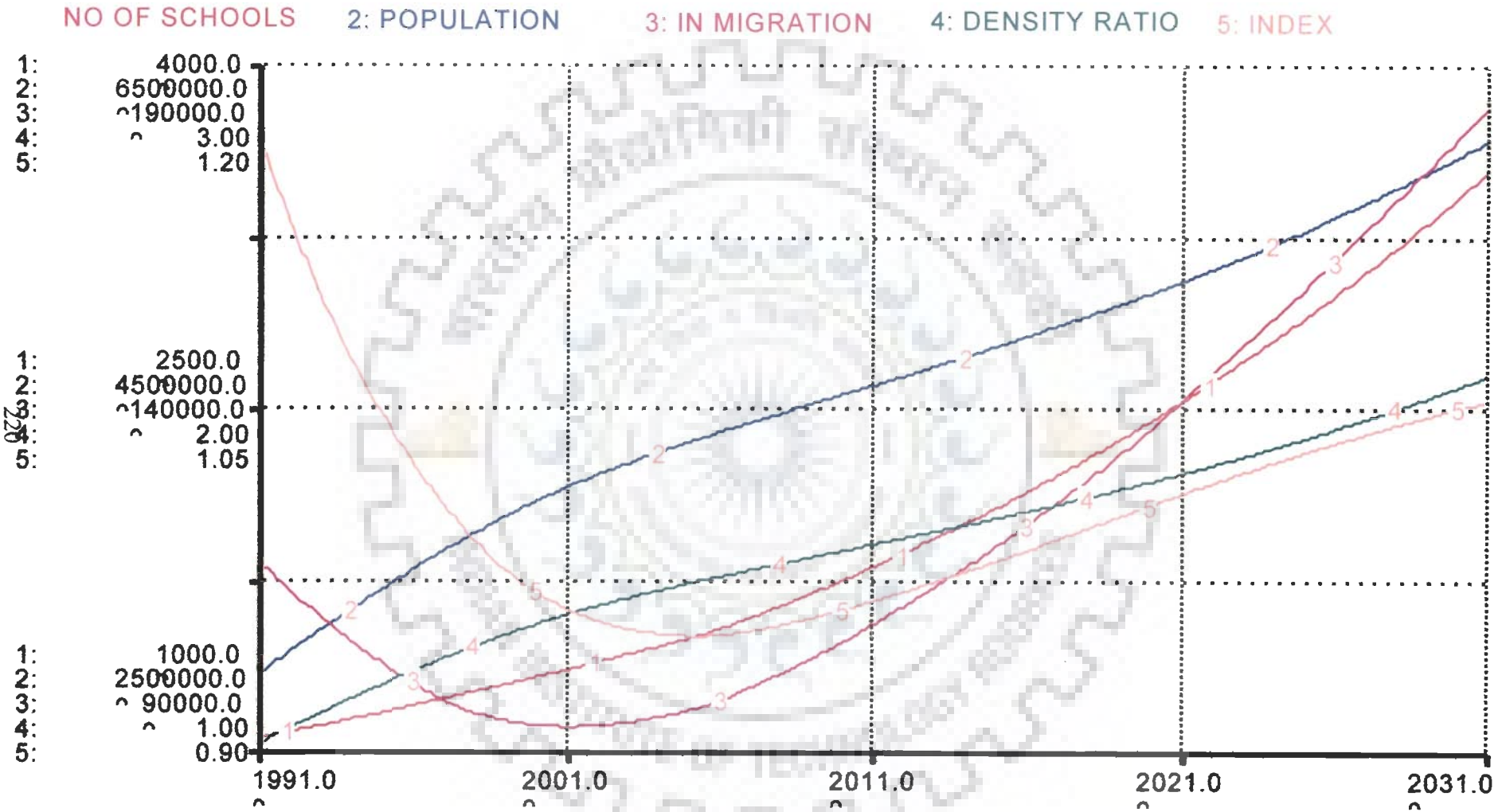


Fig 2. (SCHOOLING(ADDITION 1%))

58 lakhs to 60 lakhs by showing an increase of 3.4 per cent. The in-migration of population would also increases from 1.52 to 1.825 lakhs with 20.00 per cent. The quality of living index would also increase from 1.025 to 1.055 with an escalation of 2.92 per cent.

5.7.9 Scenario 9 : No More Addition of Schools

A Scenario was tested with no more addition of school further and by keeping all other values was same as in the projected year model. The results of the model are presented in the figure 5.23. The figure illustrates that the population trend shown a marked reduction, and the total population would be decreased from 58 lakhs to 55 lakhs with a reduction of 5.17 per cent and the number of schools remain constant. The in -migration of population also would decrease from 1.52 lakhs to 1.28 lakhs with a reduction of 15.7 per cent. The quality of living index also decrease from 1.025 to 0.96 with a reduction of 6.34 per cent. This analysis clearly infers that the schooling is one of the most important factors, which decides the functions of the system, definitely.

POWER

Power supply is one of the most important parameters, which decides the functions of the system. As already pointed out that this system is suffering from acute power supply and an attempt is made to analyze the behavior of the model by adding power supply by 5 per cent, and 10 per cent respectively, and the model results are presented as below.

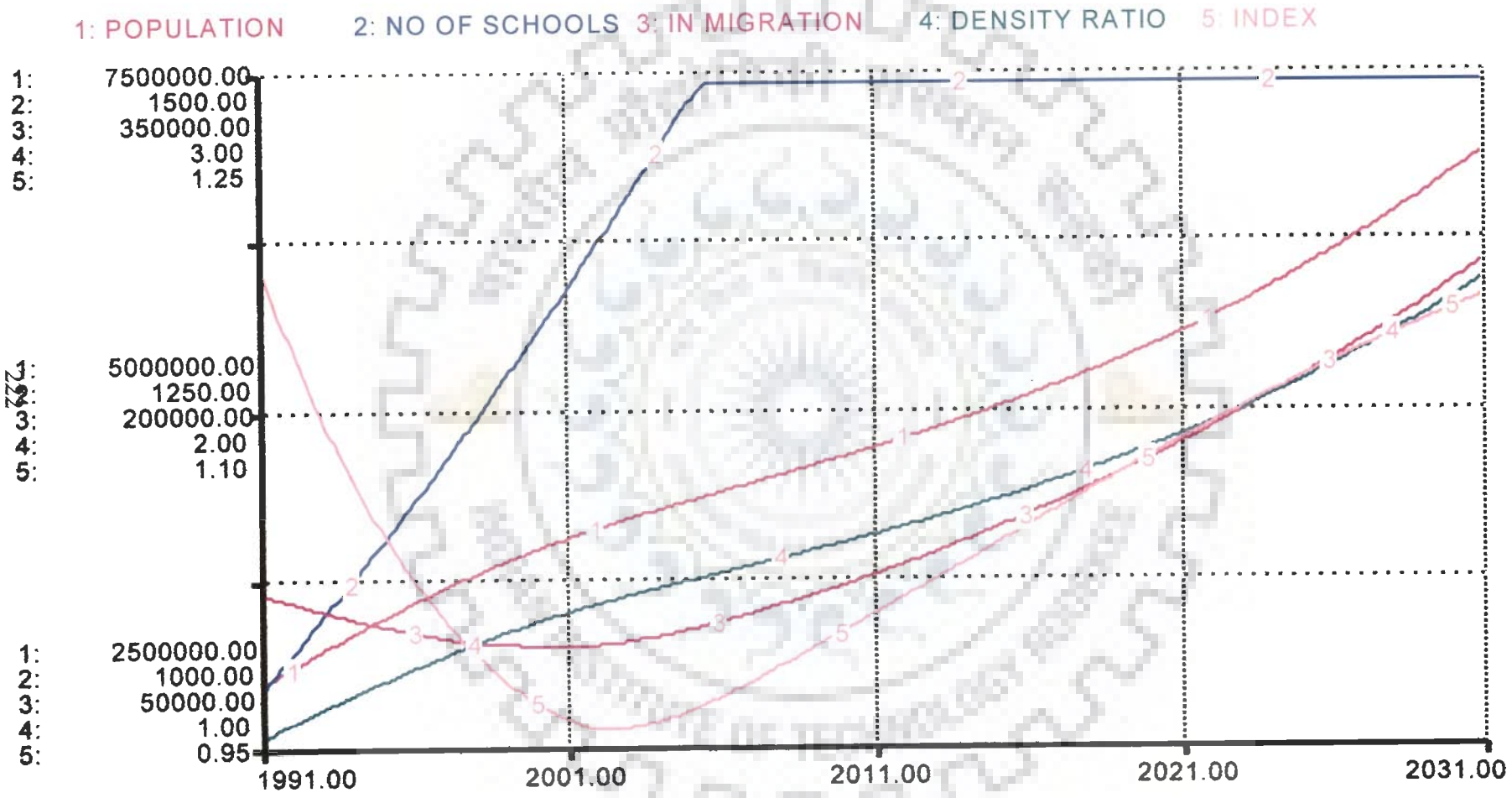


Fig 5. (SCENARIO7 (NOMORE ADDITION OF SCHOOLS)

5.7.10 Scenario 10: Addition of 5 Percent of Power

An additional power supply of 5 per cent is tested in the projected year model by keeping all other parameters values as constant. The results of the model are presented in the figure 5.24. The figure reveals that the behavior of the system is almost constant as in the case of the projected year model. However, the total population would increase from 58.00 lakhs to 59.00 lakhs, which just 0.72 per cent. The in-migration of population would increase 0.78 per cent, which is also very negligible and the quality of living index remain the same.

5.7.11 Scenario 11: Addition of 10 Percent Power Supply

An addition of 10 per cent power supply is tested in the model by keeping the values of all other parameters constant as in the projected year model, and the results are presented in Figure 5.25. The figure illustrates that the addition of 10 per cent power in the system shows that slight increase in population, and in-migration and other parameters remaining the same as in the projected year model. The number of population would increase from 58.00lakhs to60.00 lakhs with an increase of 3.40 percent and the in-migration would be 0.98 per cent.

COMPOSITE SCENARIOS

A set of composite scenario is developed and tested in the model to understand the behavior of the system. They are:

1. Bed addition by 2 per cent + House addition by 2 per cent + School addition by 0.5 per cent +Power addition by 5.00 per cent.
2. Bed addition by 5 per cent + House addition by 3 per cent + School addition by 1 per cent+ Power addition by 10 per cent.

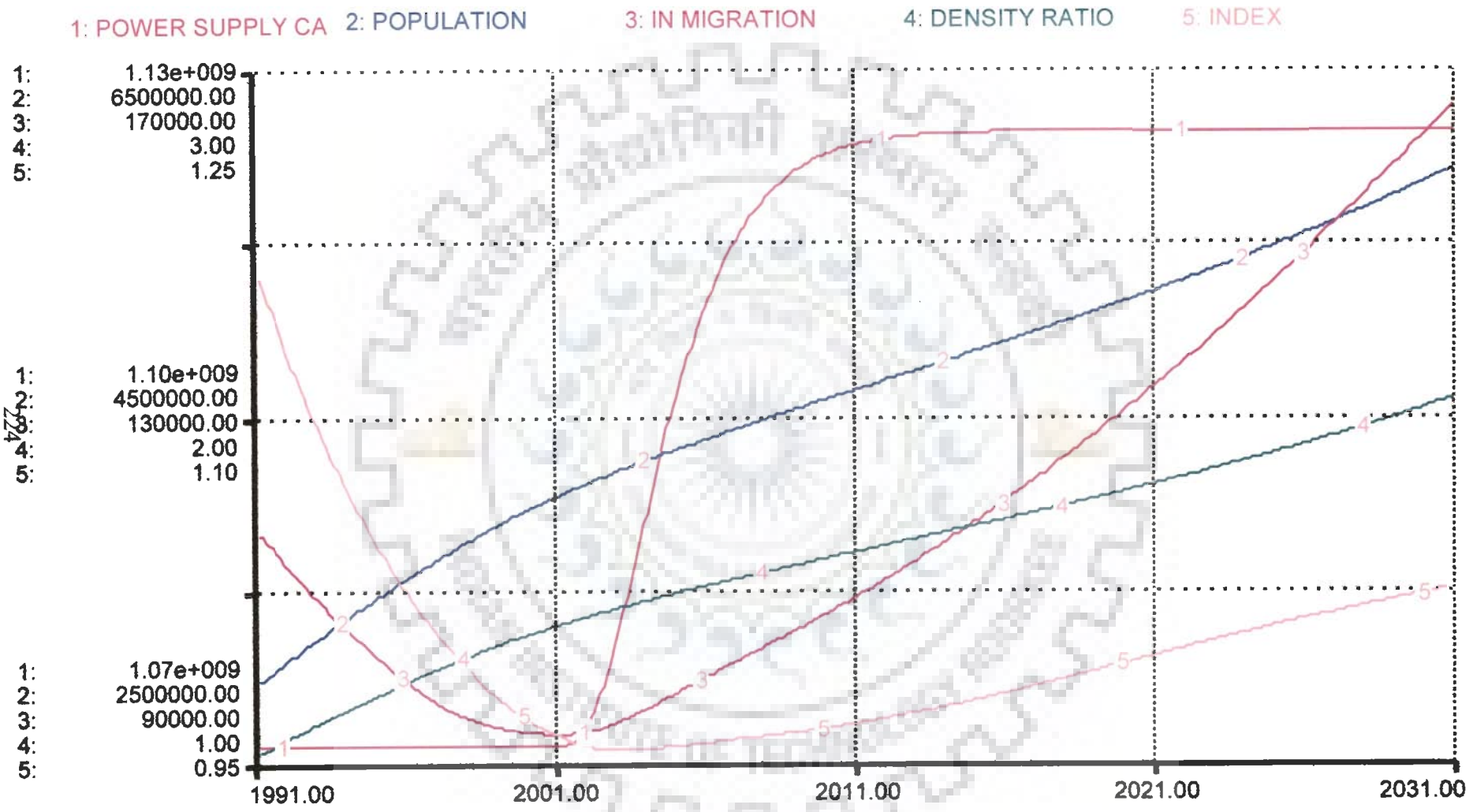


Fig 5. (POWER(ADDITION 5%))

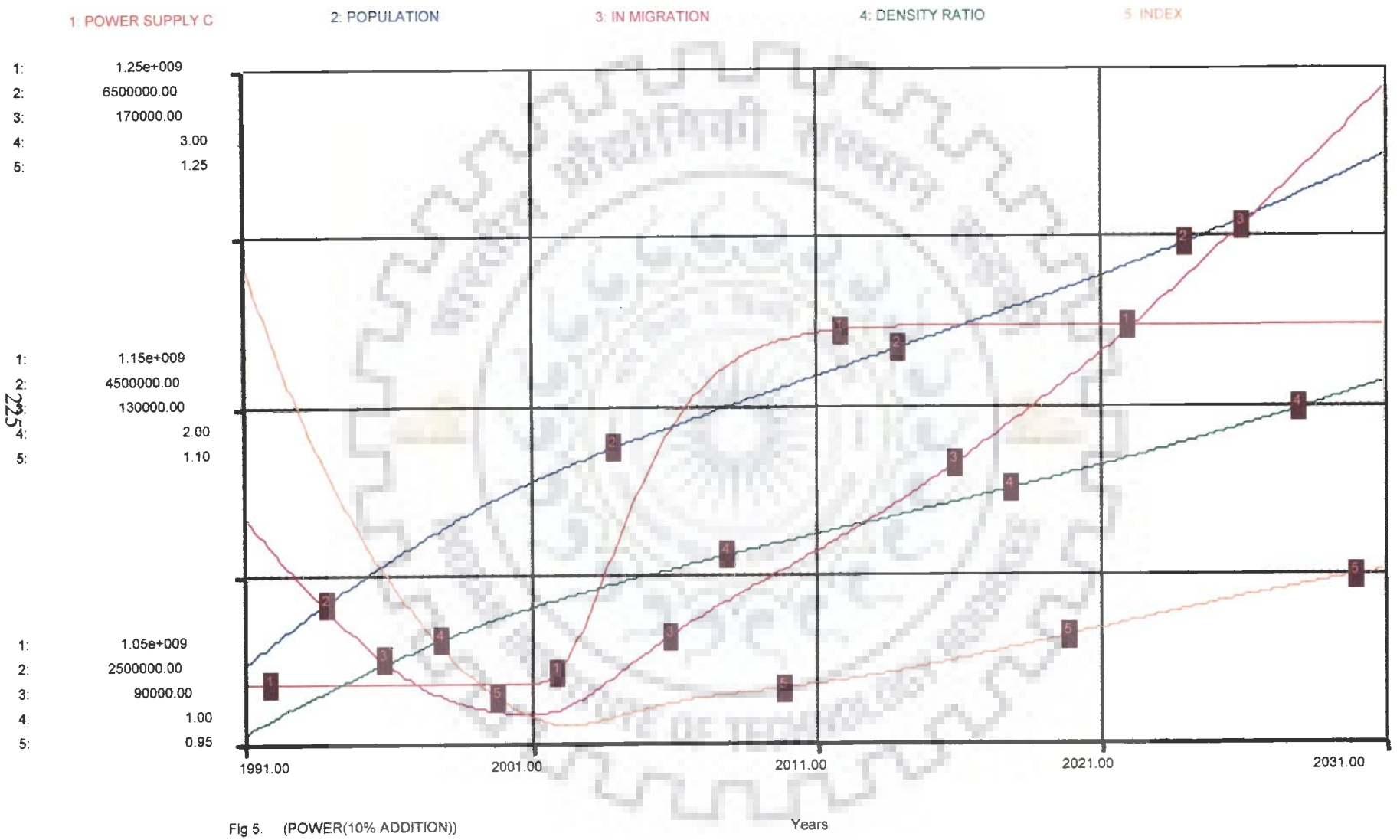


Fig 5. (POWER(10% ADDITION))

3. Bed addition by 2 per cent + House addition by + 2 per cent + School addition by 0.5 per cent + Power addition by 10 per cent.
4. Bed addition by 2 per cent + House addition by 3 per cent + School addition by 0.5 per cent + Power addition by 10 per cent.

These composite scenarios are also tested in the model to understand the behavior of the model. The model gives various alternative results. These results are presented in the sequel.

5.7.12 Scenario 12: Bed Addition by 2 Percent + House Addition by 2 Percent + Schools Addition by 0.5 Per cent + Power Addition by 5.00 Percent

Additions of 2 per cent beds in the health sector, 2 per cent in housing, 0.5 per cent in schooling and 5 per cent in power sector together tested in the model and the model shows very interesting results. The model results are is presented in figure 5.26. This figure illustrate that the population increased from 58 lakhs to 70.75 lakhs with the variation of 22 per cent. The in- migration would increase from 1.52 lakhs to 2.8 lakhs showing a sky rocketing rate of 84 per cent, but the out- migration would increase in very negligible trend, i.e., it would increase from 1.2 lakhs to 1.4 lakhs with an addition of only 16.7 per cent. The quality of living index would also increase from 1.025 to 1.15 with 13.2 per cent escalation. This kind of behavior shows that this system functions very actively since all the subsystem function with dynamic characters.

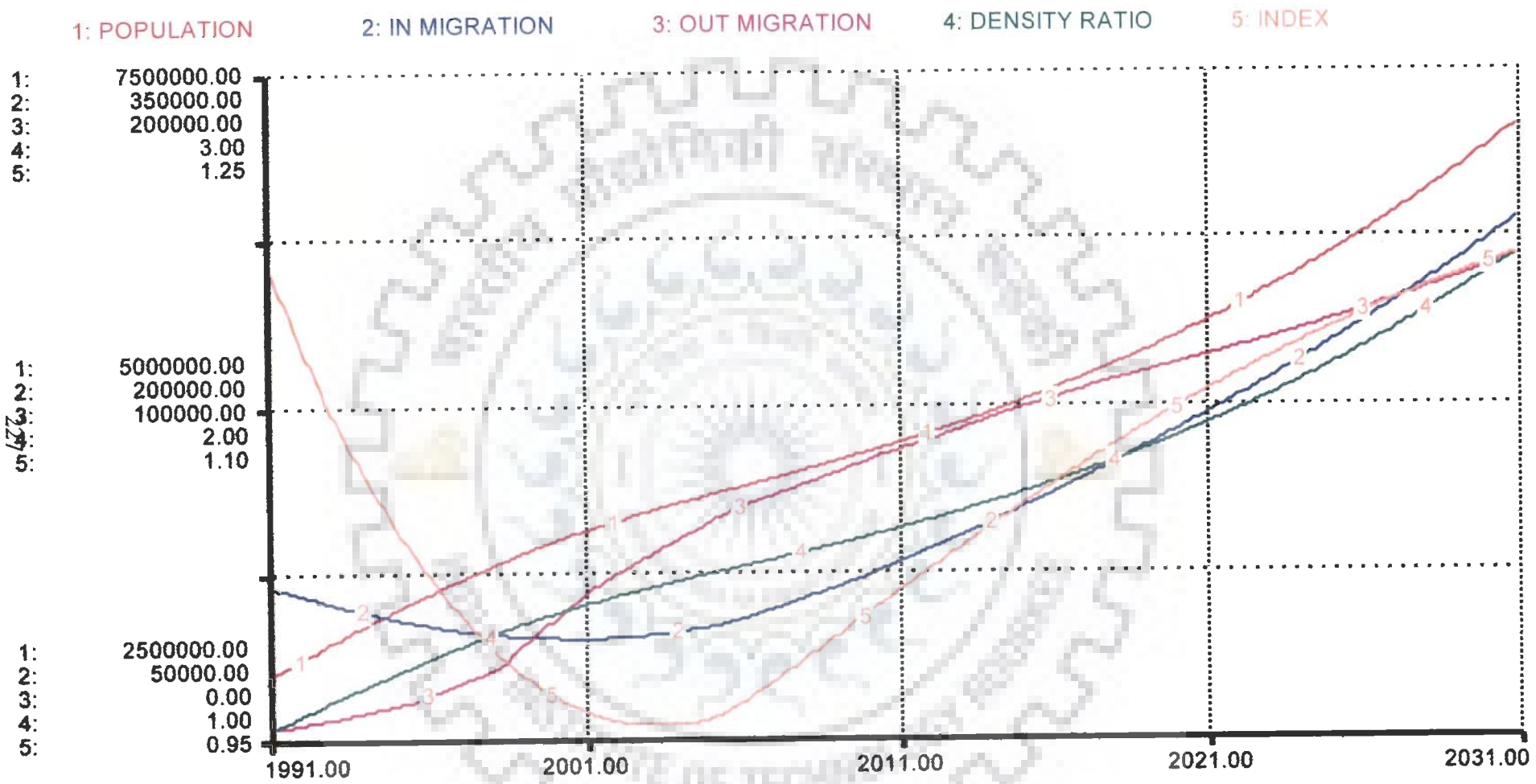


Fig 5. (2%,2%,0.5%,5%BHSP)

5.7.13 Scenario 13: an Addition of 5 Percent Bed, 3 Percent Housing 1 Percent Schooling, and 10 Percent Power

An addition of 5 per cent Bed,+ 3 per cent housing, +1 per cent schooling and +10 per cent power are tested together in the projected year model, and the results are quite amazing. The results are presented in Figure 5.27. The figure reveals that the population would increase from 58.00 lakhs to 91.5 lakhs and with a variation of 57.8 per cent. The in -migration also shows a rapid growth from 1.52 to 4.1 lakhs with an addition of 170 per cent. The out- migration rate also would increase from 1.2 lakhs to 1.75 with an increase of 45.80 per cent. The quality of living index would also increase from 1.025 to 1.46, which shows a hike of 42.4 per cent.

5.7.14 Scenario 14: an Addition of 2 Percent Bed, + 2 Percent Housing, + 0.5 Percent Schooling, + 10 Percent Power

An addition of 2 per cent bed, + 2 per cent housing, + and 0.5 per cent schooling and +10 percent power together tested in the model to understand its behavior and the results are presented in Figure 5.28. The Figure illustrates that the population would increase from 58 lakhs to 70.75 lakhs with a variation of 22 per cent. The in–migration would increase from 1.52 lakhs to 2.8 lakhs with an increase of 84 per cent. Similarly the out migration would also increase from 1.2 lakhs to 1.4 lakhs with an addition of 16.7 per cent. It has been observed that the quality of living index would increase from 1.025 to 1.16 with a hike of 13.2per cent. This scenario is very well matched with the effect of 2 per cent Beds, 2 per cent housing, 0.5 per cent schooling and 5 per cent increment in power. This shows that lesser quantity of power supply increase would not bring any

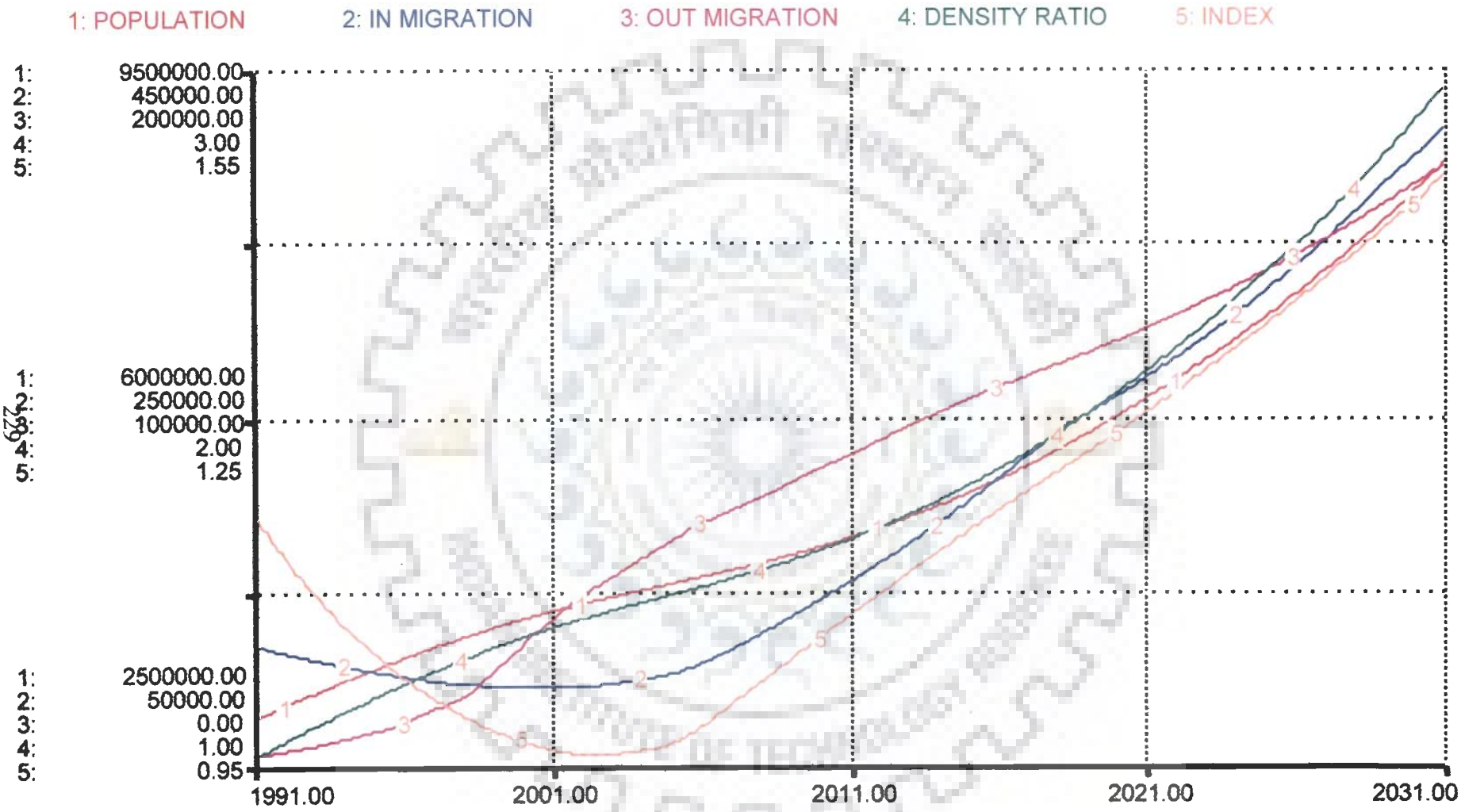


Fig 5. (5%,3%,1%,10% BHSP)

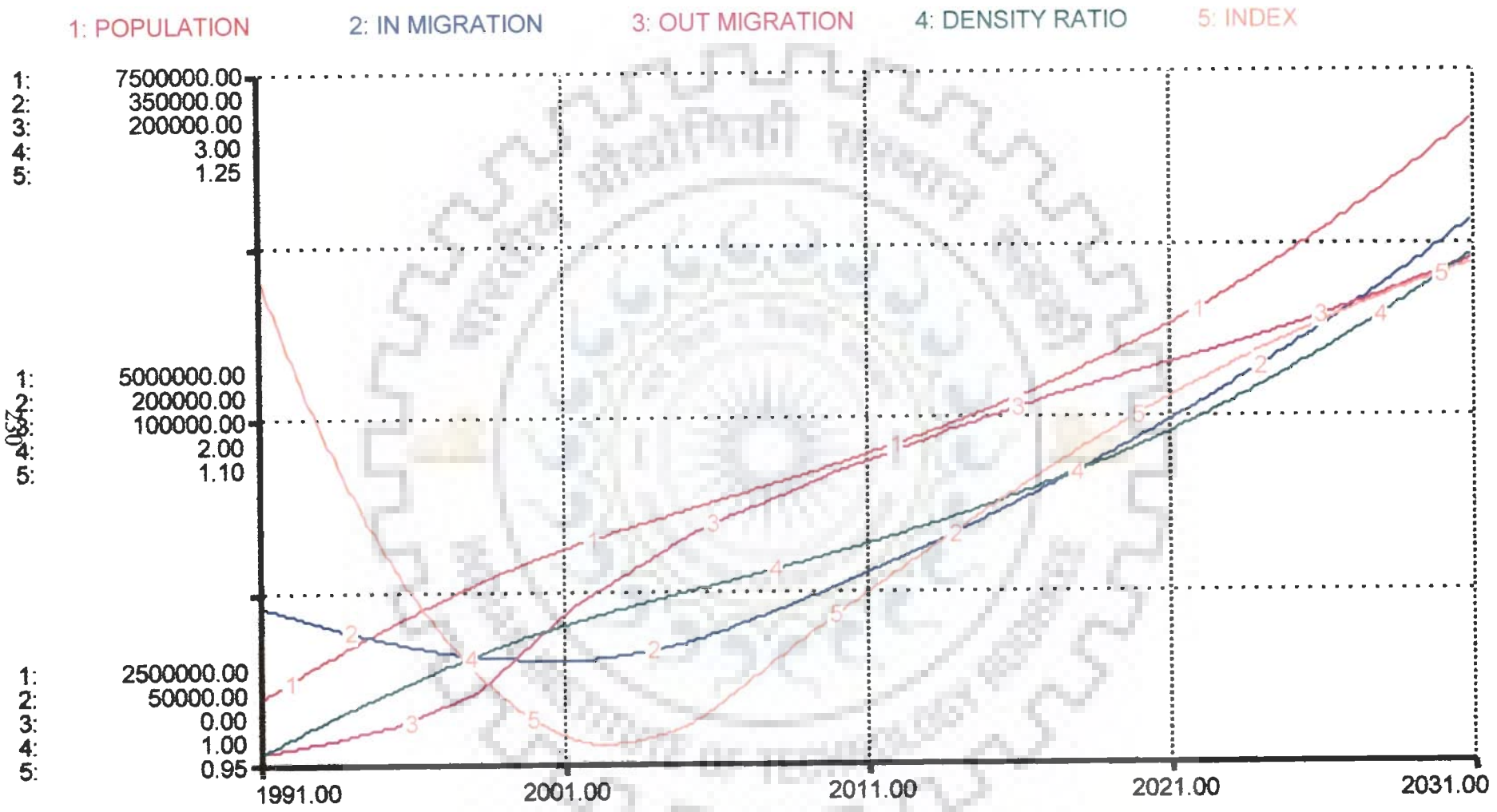


Fig 5. (2%,2%,.5%,10% BHSP)

considerable change, since the system has acute shortage of power. Therefore to fulfill the gap between demand and supply of power drastic measures would be an inevitable requirement.

5.7.15 Scenario 15: Addition of 2 Percent Bed, +3 Percent Housing, + 0.5 Percent Schooling and + 10 Percent Power

An addition of 2 per cent bed, 3 per cent housing, 0.5 per cent schooling and 10 per cent power together tested in the model to understand the behavior of the system, and the results are presented in the figure 2.29. This figure illustrate that the population would increase from 58 lakhs to 72.5 lakhs with a variation of 25 per cent. The in -migration trend also shows a hike of 3.1 lakhs against 1.52 in the projected year model by 104 per cent growth, but the out -migration would increase negligibly from 1.2 lakhs to 1.5 lakhs showing an increment of just 25per cent. The quality of living index would also increase from 1.025 to 1.19 with an increase of 16.1 per cent.

The results of the tested scenarios (individual scenarios and composite scenarios) are put together, prepared a consolidated report and presented in table 5.4 for discussion. This table illustrate that the quality of living index would increase the highest, i.e., 42.43 per cent with the combination of bed addition by 5 per cent, addition of housing by 3 per cent, addition of schools by 1.0 per cent, and addition of power by 10 per cent. Followed by, the quality of living index is recorded as16.09 per cent, when the combination of 2 per cent bed addition, 3 per cent housing addition, 0.5 per cent school addition and 10 per cent power addition operates. It is interesting to note that addition of bed by 5 per cent alone

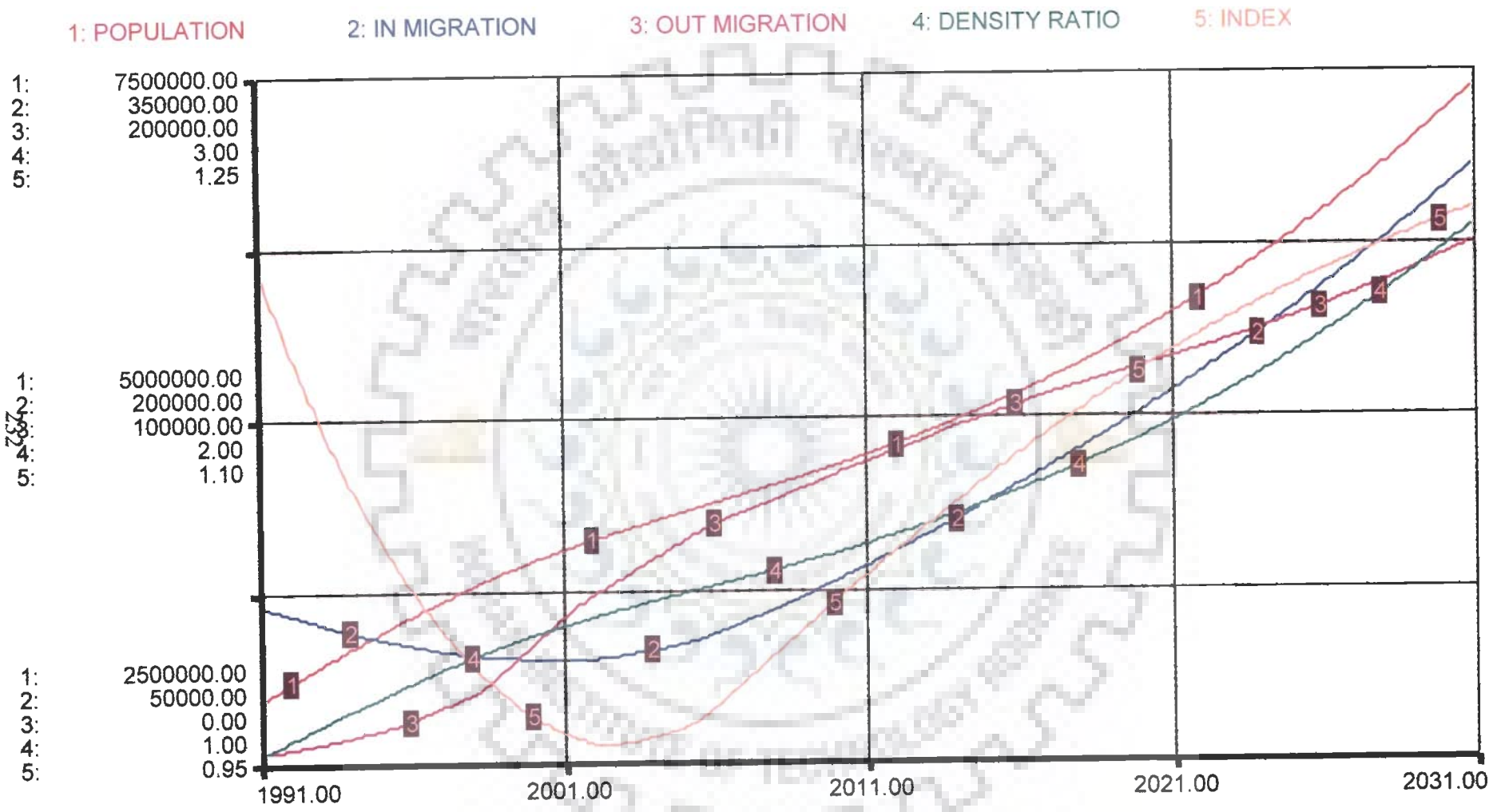


Fig 5. (2%,3%,.5%,10% BHSP)

increase the quality of living index to 18.63 per cent. However, no addition of bed decreases the quality of living index by 8.53 per cent. This shows that the health system would play a very major role in the system. Combination of bed addition by 2 per cent, housing by 2 per cent, school addition by 0.5 per cent and power by 5 per cent would respond similar behavior like the combination of 2 per cent bed addition,2 per cent housing addition,0.5 per cent school addition and 10 per cent power addition, i.e., for both scenarios, the quality of living index would be increased to13.17 per cent. In these two combined scenarios the quantity of power addition rate is increased or decreased, but no output is observed by the addition of 10per cent power. This clearly shows that, the power situation in the study area is worse, and therefore, not much visible effect is observed. In case the power addition capacity is futher increased it may be possible to observe some kind of visible change in the system. Scenarios like no addition of schools, and no addition of houses individually explain that the quality of living index of the system would decrease, when there is no addition of these activities. However, the schools are playing a major role compared to housing segment since the quality of living index is much more affected, while no addition of school operates, i.e., -6.34 per cent, and for housing it is-4.39 per cent, while no addition of housing operates in the system. Addition of housing by 2 per cent and 3 per cent individually results that the total population increase up to 6.89 per cent, and12.06 per cent respectively, but in both cases the quality of living index remained constant, i.e., increase in 4.87 per cent in both cases. This clearly shows that slight improvement in house construction, does not have any effect in quality of living index in this system. It has been observed from the above

analysis that health and education are playing a pivotal role in providing better quality of life in this system. It is also observed that enhancing the power supply in the system is an inevitable requirement to safeguard the interest of the system. Therefore, the Investigator, opined that all kinds of infrastructure facilities to be strengthened, to have better quality of life in the system.

In this chapter, the dynamic functions of the urban system are quantified by considering the most important control parameters, which decide 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. In this model, several plausible scenarios were tested to have a look at the system under various alternative conditions to arrive at plausible decisions. The findings of the whole investigation are presented in the subsequent (sixth) chapter.

10. Three types of sewage disposal system prevail in the study area, such as, pit, septic tank and Municipal sewage system. About 69.00 per cent of the households use pit as the sewage disposal means, 19.21 per cent have septic tank facilities, and the remaining 11.90 per cent have Municipal sewage connection.

11. The existing road network is unable to cater the present requirement of the urban transportation system. The existing public transportation facilities are very poor that compelled the people to procure their own vehicle for movement. It has been found that 32.30 per cent of the households have cycles, 24.60 per cent has scooters, 24.20 per cent has cars, and 15.76 per cent has motorbikes. (In some households, they possess more than one type of vehicles)

12. There is a marked variation of annual income among the families. About 41.20 per cent of the families has an annual income below Rs 40000, 26.5 per cent has between Rs. 40000 and Rs 80000, 8.80 per cent of has between Rs. 80000 and Rs120000, 8.50 per cent has between Rs120000 and Rs160000, 3.00 per cent has between Rs160000 and Rs 200000, 2.70 per cent has between Rs. 200000 and Rs 240000, 2.30 per cent has income between Rs 240000 and Rs 280000,1.50 per cent has between Rs 280000 and Rs 320000 and the remaining 5.41 per cent has above Rs 320000.

13. The lower income group spends about 6.72 per cent of their annual income towards fuel. Whereas, the second income category spends 9.44 per cent of their income for the same. The expense on fuel decreases along with

increase in income and the highest income group spends only 6.00 per cent of their annual income.

14. It has been observed that the lower income group tries to work within the neighborhood itself, and the duration of travel time is also very less. Whereas, the middle and higher income groups, especially those who are working in the tertiary sector, travel more distance.

15. 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.

16. Setting up of professional educational institutions, including engineering and medical colleges is an ongoing process in the study area, which attracts more number of migrants in the city.

17. The study area is blessed with all types of health facilities, and are scattered through out the Districts. The expenditure on health facility varies among the income groups. The lower income group spends about 4.93 per cent of their annual income, whereas the higher income group spends 7.52 per cent of their annual income for the same purpose.

18. It has been observed that there is a marked difference between the lower income groups and the higher income group that spend on education. The average expenditure on education among them ranges between Rs. 2995 and Rs 25000 per annum, which is 10 times higher than that of the lower income group. This shows that the higher income group has more access to qualitative higher education.

Table 5.4 scenarios

Sl.No.	Scenarios	Population	Increase/decrease(per cent)	In-migration	Increase/decrease(per cent)	Out-migration	Increase/decrease(per cent)	P.D	Increase/decrease(per cent)	Index	Increase/decrease(per cent)
1	Base model	58	-	1.52	-	1.2	-	4000	-	1.025	-
2	Addition of 5per cent power	59	+1.72	1.64	+7.89	-	-	4068	+1.70	1.025	0.00
3	Addition of 10per cent power	60	+3.44	1.67	+9.86	-	-	4137	+3.42	1.025	0.00
4	Addition 2per cent housing	62	+6.89	2.0	+31.57	-	-	4275	+6.87	1.075	+4.87
5	Addition 3per cent housing	65	+12.06	2.25	+48.02	-	-	4482	+12.05	1.075	+4.87
6	No addition of housing	55	-5.17	1.35	-11.18	-	-	3793	-5.17	0.98	-4.39
7	Addition of bed by 2per cent	65	+12.06	2.35	+54.60	-	-	4482	+12.05	1.125	+9.75
8	Addition of Bed by 5per cent	77.5	+33.62	3.75	+146.71	-	-	5344	+33.60	1.216	+18.63
9	No addition of Bed	53	-8.62	1.125	-25.98	-	-	3655	-8.62	0.9375	-8.58
10	Additional of school by 0.5per cent	59.5	+2.58	1.725	+13.48	-	-	4103	+2.57	1.035	+0.97
11	Addition school by 1per cent	60	+3.44	1.825	+20.06	-	-	4137	+3.42	1.055	+2.93
12	No addition of school	55	-5.17	1.28	-15.79	-	-	3793	-5.17	0.96	-6.30
13	2per cent, 2per cent, 0.5per cent, 5per cent (BHSP)	70.75	+21.02	2.8	+84.21	1.4	+14.28	4879	+21.97	1.16	+13.17
14	5per cent, 3per cent, 1per cent, 10per cent (BHSP)	91.5	+57.75	4.1	+169.73+45.83	1.75	+45.83	6310	+57.75	1.46	+42.43
15	2per cent, 2per cent, 0.5 10per cent (BHSP)	70.75	+21.02	2.5	+64.47	1.4	+14.28	4819	+21.97	1.16	+13.17
16	2per cent, 3per cent 0.5, 10per cent	72.5	+25.00	3.1	+103.97	1.5	25.00	5000	+25.00	1.19	16.09

CHAPTER 6

FINDINGS

In this present investigation, different kinds of analysis are made at various stages, such as, review of literature, analysis of primary household survey, and the analysis of model results. The findings of the analysis are grouped in to two categories and are presented as below.

6.1 FINDINGS BASED ON LITERATURE AND HOUSEHOLD SURVEY

The following very important findings are observed from the survey. They are:

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 undulating terrain; and also affected by water logging, flooding, and erosion of topsoil during the monsoon season, which affect the day-to-day life of the households by flooding in roads, residential areas, work places, which block the traffic movement.
3. The high- land is characterized by dwelling units predominantly built by using boulders, mud, thatch and leaves. The mid- land is blessed with a wide variety of building materials, such as, rubble, bricks, mud, sun dried blocks, laterite, thatch, sheet, tiles and R.C.C. The coastal stretch is predominately used with building materials, such as, rubble, mud, thatch and tiles.
4. In the study area, the dwelling units are detached in nature and scattered though out 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.

5. About 15 per cent of the population is migrated to the city from other parts of the country.
6. There are 1542 ponds, which are perennial in nature scattered through out the study area and are owned by private, community and local bodies.
7. The City Corporation and the neighboring Panchayats are having water supply system catering the population of 6 lakhs. The Neyyattinkara, Nedumangad, Attingal and Varkala Municipalities have only limited water supply system. About 57.70 per cent of the households fetch water from the wells, 29.60 per cent receive water from Municipal water supply scheme within their premises, and 11.50 per cent use public taps and the remaining 1.20 per cent depends on other sources of water.
8. During the summer season, severe drought occurs in the study area. The people live in the high-land and the coastal areas, struggle for drinking water supply during this season. About half of the district population (43.50 per cent of the households) face serious problems in this regard. Of which, the majority of them belong to the lowest income group category.
9. The existing garbage collection, segregation, treatment and disposal system available within the study area is not properly organized. An average of 600 tons of garbage is produced daily in the system. Of which, half of them (50.00 per cent) are unattended and the same creates environmental problems leading to spreading of various kinds of decease in this system.

19. It has been observed that there is a 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.
20. Trained, educated human resource is abundant in the study area. Unemployment is rampant and majority of them are migrating to Middle East, European, and other countries for employment.
21. The people of the coastal area belong to fishermen community. Fishing and its allied activities are the sole income earning opportunities to this community, and their economic condition is very poor. They are prone to all kinds of natural hazards, during monsoon season, due to having poor quality of housing. Their residential areas are characterized by congestion, pollution, and shortage of drinking water supply, sanitation and health facilities.
22. A sizable number of people engage in coir-based industries that are located in the Chirayinkil Taluk of the study area, considered as on of the oldest traditional industries of the state. Balaramapuram, a small town that is located in the Neyyattinkara Taluk is traditionally famous for Handlooms.
23. Kovalam beach, Varkala beach, Ponmudi a hill station, Padmanabha Swami temple, Beemapalli (a Muslim religious place), Vettukadu church, Veli and Poovar (tourist villages), etc., are confined in this study area that attract lot of domestic as well as international tourists.

24. The average size of the family in the study area is 5 persons and it varies with income groups slightly. The lower income group has the average size is 5.32 persons per family.
25. The literacy rate of the study area is about 90 per cent. The literacy rate in the coastal parts of the study area is only 70 per cent.
26. The size of the child population in a family in the study area is about 1.39, which is almost uniform in all the income groups.
27. Tertiary sector activities are dominant in the City center and Taluks head quarters.
28. The primary sector activities are dominated in the sub urban, high land and in the coastal areas.
29. The secondary sector based activities are confined only in the selected pockets of the study area.
30. The availability of technically qualified person among the lower income group in this system is very low compared to the other groups population share. The technical education is much costlier, and it is not accessible to a large section of the lower income group people.
31. About 93 per cent of the households are residing in owned houses and the rest are residing in rental houses.
32. About 71.15 per cent of the residences are located in the dry area, 11.15 per cent are in filled up sites, 15 per cent are in the waterlogged areas and the rest (2.70 per cent) are in the other category of lands.
33. More percentage of lower income group families are residing in the water logged and filled up lands than the higher income groups, because the land value in these areas are less compared to the other areas.

34. Higher income group people concentrate mostly on elevated and dry areas that are generally costlier, having good natural drainage, air movement and less pollution.

35. About 62.70 per cent of the households are having vehicular access, 20.4 per cent of the households having two wheeler access, and the remaining 17.00 per cent are having only pedestrian access.

36. About 63.5 per cent of the lowest income group households have either pedestrian or two wheeler access.

37. The highest income group households have 100 per cent vehicular access.

38. About four- fifth (79.23 per cent) of dwelling units are single stored, and the rest of them are having two or more floors.

39. Of the 79.23 per cent of the single storied houses, 50 percent of them belong to the lowest income group, and 31.55 per cent belongs next to the lowest income group. The highest income group possesses more percentage of double storied dwelling units.

40. In the study area, there are 15.8 per cent single bedroom houses, 38 per cent double bedroom houses, 25 per cent triple bedroom houses and the remaining 21.15 per cent houses are 4 or more number of bedrooms. Among the 15.8 per cent single bedroom houses, the lowest income group itself occupies more than four fifth of the households, i.e., 82.9 per cent. Income is the governing factor, which controls the number of bedrooms in a house.

41. There are 18.84 per cent of houses constructed with mud foundation, 73.07 per cent with rubble foundation, 4.6 per cent with Reinforced cement

concrete foundation and the remaining 3.47 per cent with brick foundation. Of the 18.84 per cent of the house with mud foundation, 77.6 per cent belong to the lowest income group itself. Rubble foundation is predominant in the study area.

42. In construction of walls, there are 1.54 per cent building with concrete blocks, 4.6 per cent with laterite blocks, 9.23 per cent with sun-dried blocks, 15.4 per cent with mud-wall and the remaining 69.2 per cent is made of bricks. Of the 15.4 per cent of dwelling units with mud walls, 80 per cent belong to the lowest income group category.
43. Sloping roof form is predominant in the study area. There are 51.95 per cent residences with Reinforced cement concrete roofing, 32.70 per cent with tile roofing, 13.85 percent thatched roof, and the remaining 1.54 per cent of the dwelling units are made of galvanized iron sheet roofing.
44. Of the 13.85 per cent thatched roof houses, 88.8 per cent belong to the lowest income group category itself.
45. There are 51.9 per cent with cement flooring, 21.5 percent with mosaic flooring, 7.7 per cent with mud flooring, 7.3 per cent houses with ceramic flooring, and remaining 3.8 per cent houses each with granite and marble flooring.
46. The entire 7.7 per cent of the residence with mud flooring confined with in the lowest income category itself.
47.. Household facilities, such as, newspaper, radio, television, telephone, computer and Internet are available at varying magnitude among the income groups. The lower income group possesses items like newspaper, and radio, the succeeding higher income group process number of

facilities. About 90.40 per cent of the households have radio, 84.20 per cent have newspaper access, 720 per cent have televisions, 59.2 per cent have telephone, 33.40 per cent have computers, and 7.30 per cent has Internet facilities.

48. The expenditure of the lower income group households is highly limited to procuring basic minimum requirement for living, such as, food, clothing, power, education and recreation. It has been observed that the percentage of the annual income spend by the lower income group is much higher than the higher income group for availing these facilities. This leads to poor economy of the lower income group, and an accumulation of economy is visible among the higher income group.

49. The lower income spends about 6.72 per cent of their annual income towards electrical energy, which is a huge amount for them. On the other hand the highest income group spends only 2.40 per cent of their annual income, which is comparably very lesser part of their income.

50. A range of materials is used as fuel in the study area such as, firewood, kerosene, and liquefied petroleum gas. The lower income households spend about 7.84 per cent of their annual income towards procuring fuel, whereas the highest income households spend only 0.88 per cent of their annual income.

51. About 40.25 per cent of the annual income of the lower income group spends towards food expenditure. On the other hand, the higher income group people spend only 9.16 per cent of their annual income towards food expenses. It has been found that about 13.03 per cent of the annual income of the lowest income group spends towards clothing, whereas the

highest income group spends only 4.06 per cent of their annual income for the same purpose.

52. There is a wide gap between savings among various income groups of the study area. The lowest income group saves only 4.3 per cent of their annual earnings, whereas, the highest income groups saves about 72 per cent of their annual income, which shows that the lowest income is also tend to save though their income is very less. This tendency of the lower income group leads to steady development.

53. The T.S. canal (Thiruvananthapuram to Shornur),which is running parallel to the National Highway 47 was a major transportation corridor during the reign of Royal Kingdom of Travancore. Later it was abandoned, and it can be retrieved and used for transportation of goods and water base tourism.

6.2 URBAN SYSTEM MODEL BASED FINDINGS

An urban system model is developed and employed in this investigation. To develop the urban system model, 2001-year data are considered. Therefore, year 2001, become the base year (reference year) for this model. This 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 **58.00 lakhs** of population with an in-migration of 1.52 lakhs, and the density of population would be 4000 people per square km in the year 2031A.D, 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 of the district would be about 59.50 lakhs, with an in migration of 1.72 lakhs, and the density of population would be 4103.00 persons per square kilometer, and the quality of living index would be 0.9700.
3. A scenario, addition of school opening rate by 1 per cent in the system, resulted that the population would be 60.00 lakhs, with an in-migration of 1.82 lakhs, and the density of population would be 4137.00 persons per square kilometer, and the 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 lakhs, with an in-migration of 1.28 lakhs, and the density of population would be 3793.00 persons per square kilometer, and the quality of living index would be 0.9600.
5. A scenario, addition of 5.00 percent of power in the system, resulted that the population would reach upto 59.00 lakhs, with an in migration of 1.64 lakhs, and density population would be 4068.00 persons per square kilometer, and the quality of living index would be1.025
6. A scenario, addition of 10.00 per cent of power in the system, resulted that the population would reach upto 60.00 lakhs, with an in migration of 1.67 lakhs, the density population would be 4137.00 persons per square kilometer, and the quality of living index would be1.025.
7. A scenario, addition of house construction by 2.00 per cent in the system, resulted that the population would increase to 62.00 lakhs, with an in migration of 2.00 lakhs, and the density of population would be 4275.00

persons per square kilometer, 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 increase to 65.00 lakhs, with an in migration of 2.25 lakhs, and the density of population would be 4482.00 persons per square kilometer, 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 reduced to 55.00 lakhs, with an in-migration of 1.35 lakhs, and the density of population would be 3793.00 persons per square kilometer, and the quality of living index would be 0.9800.
10. A scenario, bed addition of 2.00 per cent in the system, resulted that the population of the district would reach upto 65.00 lakhs with an in -migration of 2.35 lakhs, and density of population would be 4482.00 persons per square kilometer, 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 increase to 77.50 lakhs with an in- migration of 3.75 lakhs, and the density of population would be 5344.00 persons per square kilometer, and the quality of living index would be 1.216.
12. A scenario, no more addition of bed in the system, resulted that the population would reduced to 53.00 lakhs with an in-migration of 1.125 lakhs, and the density of population would be 3655.00 persons per square kilometer, 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 per cent power together in the system,

resulted that the population in the district would be at the range of 70.75 lakhs with an in migration of 2.50 lakhs and the density of population would be 4879.00 persons per square kilometer, 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 per cent power together in the system, resulted that the population in the system would reach to 91.50 lakhs, with 4.10 lakhs in- migration, and the density of population would be 6310.00 persons per square kilometer, 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 schools and 10 per cent power together in the system, resulted that the population in the system would reach to 70.75 lakhs, with 2.50 lakhs in- migration, and the density of population would be 4819.00 persons per square kilometer, and the quality of living index would be 1.1600.

16. A composite scenario, addition of 2.00 per cent beds, 3.00 per cent houses, 0.50 per cent schools and 10 per cent power together in the system, resulted that the population in the system would reach to 72.50 lakhs, with 3.10 lakhs in- migration, the density of population would be 5000.00 persons per square kilometer, and the quality of living index would be 1.1900.

In this chapter, the most important findings of the investigation were presented. A set of policies and recommendation are made based on these findings and are presented in the last (seventh) chapter.

CHAPTER 7

POLICIES, RECOMMENDATIONS AND CONCLUSION

7.1 DEVELOPMENT CONCEPT

The study area has unique characteristic features with thick vegetation, scattered homesteads with coconuts that develop a good canopy, undulating terrain, water bodies, etc. that together make this city different from other State Capital Cities in India. These features must be maintained to have a better ecosystem while expanding the city, for meeting the growing demand.

In fact, in almost all Indian cities, the existing eco-system has been fading away from the system during the process of urbanization. In this study area, though the process of urbanization took place in a moderate form, the characteristic features of the city were not spoiled much, but few setbacks were observed in this system, such as, (1) most of the water bodies were 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) forest areas were converted into plantation and residential areas, (4) drinking water and sanitation related problems are aggravated, (5) dilapidated housing conditions are observed, (6) through traffic is halted and traffic jams are observed in few important junctions, (7) power supply related problems are aggravated, 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 in-depth investigation done, i.e., model results, survey findings, observation made, having discussion with experts, and other administrators, to develop the system at the grassroots level. 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 Table 7.1. Subsequently, the requirements of the major infrastructure services in the study area for he year 2031AD is calculated based on the model results and the scenario results, and are presented in Table 7.2.

Table 7.1 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

Source: Urban development planning, formulation and implementation guidelines, Government of India, New Delhi.

Table7.2 infrastructure requirement-2031AD

Sl.No	Projected year model and Scenarios	Population in lakhs	No of houses required(in lakhs)	No of beds in lakhs	No of schools	Water Demand (LPCD) MLD	Power Demand (MW)	Road Length/Million population (Km)	Population Density (persons per sq.km)	Quality of living Indéx
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 a huge demand of infrastructure services in the year 2031 in the system. The projected year model and the 15 policies, which are tested show a distinct demand of infrastructure services in the year 2031 in this system. The requirement of infrastructure services in the projected year model and in each policy is calculated based on the Planning standards, cited in table 7.1 and are presented in the sequel as below:

7.2 PROJECTED YEAR MODEL

The projected year model (2031AD) results that the population of the study area would be 58.00 lakhs. The density of population would be 4000 persons per sq.km, and the quality of living index would be 1.025. The number of houses required in the same period would be 11.60 lakhs, the number of beds in the hospital requirements would be 0.058 lakhs, the number of schools requirement would be 1657, water requirement would be 870 MLD, power requirement would be 580.00 MW-h and road length requirement would be 5800 km.

7.2.1 Policy.1

A policy has been developed based on adding 5 per cent power supply in the projected year model and found that the population in the study area would be 59.00 lakhs (increased by one lakhs) in 2031AD. The population density would be 4068 persons per sq.km, and the quality of living index would be 1.025. When this policy operates in this system, the requirement of houses would be 11.80 lakhs, the requirements of beds in the hospitals would be 0.059 lakhs, the requirement of schools would be 1685, the water demand would be 885 MLD, power supply

requirement would be 590 MWH and the requirement of length of road would be 5900.00km.

7.2.2 Policy.2

A policy has been developed based on adding 10 per cent power in the projected year model and found that the population in the study area would be 60.00 lakhs(increased by two lakhs) in 2031AD, the population density would be 4137 persons per sq.km and the quality of living index would be 1.025. When this policy operates the requirement of houses would be 12.00 lakhs, the requirements of beds in the hospitals would be 0.060 lakhs, the requirement of schools would be 1714, the water demand would be 900 MLD, power supply requirement would be 600 MWH and the requirement of length of road would be 6000.00 km.

7.2.3 Policy.3

A Policy has been developed based on adding 2 per cent houses in the projected year model and found that the population in the study area would be 62.00 lakhs (increased by four lakhs) in 2031AD, the population density would be 4275 persons per sq.km and the quality of living index would be 1.075. When this policy operates the requirement of houses would be 12.40 lakhs, the requirements of beds in the hospitals would be 0.062 lakhs, the requirement of schools would be 1771, the water demand would be 930 MLD, power supply requirement would be 620 MWH and the requirement of length of road would be 6200.00 km.

7.2.4 Policy.4

A Policy has been developed based on adding 3 per cent houses in the projected year model and found that the population in the study area would be 65.00 lakhs (increased by 7 lakhs) in 2031AD, and the population density would be 4482 persons per sq.km and the quality of living index would be 1.075. When this policy operates, the requirement of houses would be 13.00 lakhs, The requirements of beds in the hospitals would be 0.065 lakhs, the requirement of schools would be 1857, the water demand would be 975 MLD, power supply requirement would be 650 MWH and the requirement of length of road would be 6500.00 km.

7.2.5 Policy. 5

A Policy has been developed based on no addition of houses in the projected year model and found that the population in the study area would be 55.00 lakhs (decreased by 3 lakhs) in 2031AD, the population density would be 3793 persons per sq.km and the quality of living index would be 0.9800. When this policy operates, the requirement of houses would be 11.00 lakhs, The requirements of beds in the hospitals would be 0.055 lakhs, the requirement of schools would be 1571, the water demand would be 825 MLD, power supply requirement would be 550 MWH and the requirement of length of road would be 5500.00 km.

7.2.6 Policy.6

A Policy has been developed based on adding 2 per cent beds in the hospitals in the projected year model and found that the population in the study area would be 65.00 lakhs (increased by 7 lakhs) in 2031AD, the population density would be 4482 persons per sq.km and the quality of living index would be 1.125.

When this policy operates, the requirement of houses would be 13.00 lakhs, The requirements of beds in the hospitals would be 0.065 lakhs, the requirement of schools would be 1857, the water demand would be 875 MLD, power supply requirement would be 650 MW-h and the requirement of length of road would be 6500.00 km.

7.2.7 Policy.7

A Policy has been developed based on adding 5per cent bed in the hospitals in the projected year model and found that the population in the study area would be 77.50 lakhs (increased by 19.50 lakhs) in 2031AD; the population density would be 5344 persons per sq.km and the quality of living index would be 1.216. When this Policy operates the requirement of houses would be 15.50 lakhs, The requirements of beds in the hospitals would be 0.077 lakhs, the requirement of schools would be 2214, the water demand would be 1163 MLD, power supply requirement would be 775 MWH and the requirement of length of road would be 7750.00 km.

7.2.8 Policy .8

A Policy has been developed based on no addition of beds in the hospitals in the projected year model and found that the population in the study area would be 53.00 lakhs (decreased by 5 lakhs) in 2031AD; the population density would be 3655 persons per sq.km and the quality of living index would be 0.9375. When this policy operates, the requirement of houses would be 10.60 lakhs, The requirements of beds in the hospitals would be 0.053 lakhs, the requirement of schools would be 1514, the water demand would be 795 MLD, power supply requirement would be 530 MWH and the requirement of length of road would be 5300.00 km.

7.2.9 Policy. 9

A Policy has been developed based on adding 0.5 per cent schools in the projected year model and found that the population in the study area would be 59.50 lakhs (increased by 1.5 lakhs) in 2031AD; the population density would be 4103 persons per sq.km and the quality of living index would be 1.035. When this Policy operates, the requirement of houses would be 11.90 lakhs, The requirements of beds in the hospitals would be 0.0595 lakhs, the requirement of schools would be 1700, the water demand would be 893 MLD, power supply requirement would be 595MWH and the requirement of length of road would be 5950.00 km.

7.2.10 Policy.10

A Policy has been developed based on adding 1.00 per cent schools in the projected year model and found that the population in the study area would be 60.00 lakhs (increased by 2 lakhs) in 2031AD; the population density would be 4137 persons per sq.km with quality of living index 1.055. When this Policy operates, the requirement of houses would be 12.00 lakhs, The requirements of beds in the hospitals would be 0.0600 lakhs, the requirement of schools would be 1714, the water demand would be 900 MLD, power supply requirement would be 600 MW-h, and the requirement of length of road would be 6000.00 km.

7.2.11 Policy. 11

A policy has been developed based on no addition of schools in the projected year model and found that the population in the study area would be 55.00 lakhs (decreased by 3 lakhs) in 2031AD; the population density would be 3793 persons per sq.km and the quality of living index would be 0.09600. When this policy

operates, the requirement of houses would be 11.00 lakhs, the requirements of beds in the hospitals would be 0.055 lakhs, the requirement of schools would be 1571, the water demand would be 825 MLD, power supply requirement would be 550 MW-h and the requirement of length of road would be 5500.00 km.

7.2.12 Policy.12

A Policy has been developed based on the composite addition of 2 per cent beds in the hospitals, 2 per cent houses, 0.5 per cent schools and 5 per cent power in the projected year model and found that the population in the study area would be 70.75 lakhs (increased by 12.75 lakhs) 2031AD; the population density would be 4879 persons per sq.km and the quality of living index 1.160. When this policy operates, the requirement of houses would be 14.15 lakhs, the requirements of beds in the hospitals would be 0.070 lakhs, the requirement of schools would be 2021, the water demand would be 1061 MLD, power supply requirement would be 707MW-h and the requirement of length of road would be 7070.00km.

7.2.13 Scenario.13

A Policy has been developed based on the composite addition of 5 per cent beds in the hospitals, 3 per cent houses, 1.00 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 91.50 lakhs (increased by 33.50 lakhs) in 2031AD; the population density would be 6310 persons per sq.km and the quality of living index would be 1.460. When this Policy operates, the requirement of houses would be 18.3 lakhs, the requirements of beds in the hospitals would be 0.091 lakhs, the requirement of

schools would be 2614, the water demand would be 1373 MLD, power supply requirement would be 915 MW-h and the requirement of length of road would be 9150.00 km.

7.2.14 Policy.14

A policy has been developed based on the composite addition of 2 per cent beds in the hospitals, 2 per cent houses, 0.5 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 70.75 lakhs (increased by 12.75 lakhs) in 2031AD; the population density would be 4879 persons per sq.km and the quality of living index would be 1.160. When this policy operates, the requirement of houses would be 14.15 lakhs, the requirements of beds in the hospitals would be 0.070 lakhs, the requirement of schools would be 2021, the water demand would be 1061 MLD, power supply requirement would be 707MW-h and the requirement of length of road would be 7070.00 km.

7.2.15. POLICY .15

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 2031AD; the population density would be 5000 persons per sq.km and the quality of living index would be 1.190. When this policy operates the requirement of houses would be 14.50 lakhs, the requirements of beds in the hospitals would be 0.072 lakhs, the requirement of schools would be 2071, the water demand would be 1088 MLD,

power supply requirement would be 725 MW-h and the requirement of length of road would be 7250.00 km.

7.3 RECOMMENDED POLICIES

The Investigator observed that the policy number 15 would be more suitable for the development of this system based the 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. This policy is developed based on the composite addition of 2.00 per cent, bed in the hospitals, 3.00 per cent, houses, 0.50 per cent schools and 10.00 per cent power. Thereafter, the Investigator has considered this policy for reccomendation, and a phase-wise requirement of infrastructure services has been worked out from 2004 to 2031AD, and is presented in Table 7.3

The table illustrates that the thrust area (priority areas) at deferent phases varies in the system considerably. The details of infrastructure requirements in deferent phases are presented below. They are:

Table7.3 phase wise requirement of infrastructure facilities

Sl.No	Parameters	Existing 2004	Phases			
			I	II	III	IV
			2004-2011AD	2011-2018AD	2018-2025AD	2025-2031AD
1	Population (lakhs)	32.3	43.00	53.00	63.00	72.50
2	Population density (persons/sq.km)	2227	2965	3655	4344	5000
3	Houses (lakhs)	6.20	8.60	10.60	12.60	14.5
4	Water supply (MLD)	150	645	795	945	1088
5	Power (MWH)	430	430	530	630	725
6	Road length (KM)	2041	4300	5300	6300	7250
7	Schools (primary, secondary and technical)	1353	1228	1514	1800	2071
8	No of bed in hospitals	9907	4300	5300	6300	7250

7.3.1 Phase I

Phase I considers the period between the year 2004 and 2011, i.e., for a span of seven years. During this period, the population would increase from 32.3 lakhs to 43.00 lakhs with a hike of 10.00 lakhs, and the population density would also increase from 2227 in 2004 to 2965 in 2011 persons per sq.km in the system. The number of available houses at present (2004) is 6.20 lakhs. Of which it has been estimated that 15.00 per cent are in dilapidated condition, which has to be replaced. Hence, the actual number of livable houses available in the system is 5.27 lakhs.

The demand of the houses in the year 2011 would be 8.60 lakhs, i.e., a deficiency of 3.33 lakhs.

As discussed in chapter 2, about 57.00 per cent of the people of the study area depends on dug wells for their major source of drinking water. In an urban system, the percentage of people who have piped water supply system is considered as an indicator of development. Hence, it is assumed that the system should have a proper water supply system, which will enhance the quality of living of the people. At present, the total water supply system available only at the range of 150 MLD. The total requirement of water supply in 2011 would be at the range of 645 MLD, i.e., an addition of about 500 MLD would be required to fulfill the gap between the demand and supply in 2011 AD. The undulating terrain of the study area is a major obstruction to have a centralized water supply distribution system. It has been observed that there are 1542 water bodies, which includes ponds, canals, rivers and reservoirs in this study area. Proper utilization of these water resources, which are available at the local level can be effectively utilized by developing an efficient local level water supply network system with the support of the local administration bodies.

The per capita power consumption rate in the system is only 260 KWh per year, which is far below the consumption rate at the national level i.e., 400 KWh. If this 400 KWh were use as a standard, the total power supply requirement in the study area would be about 430MWh. At present, the system is getting only 232 MW-h, which shows a deficiency of about 200 MW-h in 2011AD.

Transportation is another area, which require immediate attention in this system. At present (2004), the total road length available in this system is only 1941 km. The road length as per the standard requirement for the year 2011 would be about 4300 km, i.e., an addition of 2359 km road has to be constructed in this phase, to provide efficient transportation network in the system.

Considering schools and hospitals in this phase, the available number of schools and the beds in the hospitals are numerically sufficient to meet the requirement of this system in 2011 as well. The enhancement of quality in these sectors would improve the quality of living in this system, which would attract more population in this system definitely.

These analysis show that the phase-I of the perspective planning has to give more thrust on housing, water supply, power and transportation segments in this system.

7.3.2 Phase-II

This phase considers the period between the year 2011 and 2018,i.e., for a span of seven years. During this period, the population would increase from 43.00 lakhs to 53.00 lakhs with a hike of 10.00 lakhs, and the population density also would increase from 2965 in 2011 to 3655 in 2018 persons per sq.km in the system. Therefore, the demand of houses at the year 2018 would be 10.60 lakhs, i.e., a deficiency of 2.00 lakhs.

The total requirement of water supply in the year 2018 would be at the range of 795 MLD, i.e., an addition of about 150 MLD would be required to fulfill the gap between the demand and supply of water in the year 2018 AD.

The power supply requirement in the second phase would be about 530 MW-h i.e., an addition of 100 MW-h to be required in the system.

In transportation, the requirement of road length for this phase would be 4300 km, i.e., an addition of 1000 km of road length will be constructed to fulfill the demand. Arterial highways, sub arterial highways, collector roads and local streets, in proportion to the total demand of roads in the system, would share this 1000 km road.

In education, the number of schools requirement in this phase would be 1514, i.e., an addition of 161 schools covering primary secondary and technical would be developed, and to be placed in proper location on the basis of the need and the demand in the system

In health, the available number of beds in the hospitals is numerically sufficient as in the phase-1 to meet the requirement of this system in 2018 as well. The enhancement of quality in this sector would improve the quality of living in this system, which would attract more population in this system.

These analysis show that the phase-2 of the perspective planning has to give more thrust on housing, water supply, power, school and transportation segment in the system.

7.3.3 Phase-III

This phase considers the period between the year 2018 and 2025, i.e., for a span of seven years. During this period, the population would increase from 53.00 lakhs to 63.00 lakhs with a hike of 10.00 lakhs, and the population density would increase from 3655 in (2018) to 4344 in (2025) persons per sq.km in the system. The demand of the houses in the year 2025 would be 12.60 lakhs, i.e., a deficiency of 2.00 lakhs.

In drinking water supply, the total requirement of water supply in the year 2025 would be at the range of 945 MLD, i.e., an addition of about 150 MLD would be required to fulfill the gap between the demand and supply in the year 2025AD

In power supply, the power requirement in the third phase would be about 630MW-h, i.e., an addition of 100 MW-h in the system, which would be almost the same requirement in the phase -2

In transportation, the requirement of road length for this phase would be 6300 km, i.e., an addition of 1000 km is necessary to fulfill the demand. Arterial highways, sub arterial highways, collector roads and local streets, in proportion to the total demand of roads in the system, would share this 1000 km road.

In education, the number of schools requirement in this phase would be 1800, i.e., an addition of 286 schools covering primary, secondary and technical would be developed and to be placed in proper locations, on the basis of the need and demand in the system

In health, in this phase the available number of beds in the hospitals are numerically sufficient as in the phase-2 to meet the requirement of this system in the year 2025 as well. The enhancement of quality in this sector would improve the quality of living in this system, which would attract further more population in this system.

These analysis show that the phase-3 of the perspective planning has to give more thrust on housing, water supply, power, school and transportation segments in the system.

7.3.4 Phase-IV

This phase considers the period between the year 2025 and 2031, i.e., for a span of six years. During this period, the population would increase from 63.00 lakhs to 72.50 lakhs with a hike of 9.50.00 lakhs, and the population density would increase from 4344 in 2025 to 5000 in 2031 persons per sq.km in this system. The demand of houses in the year 2031 would be 14.50 lakhs, i.e., a deficiency of 1.90 lakhs.

The total requirement of water supply in 2031 would be at the range of 1088 MLD, i.e., an addition of about 143.00 MLD would be required to fulfill the gap between the demand and supply in the year 2031AD.

In power supply, the power requirement in the fourth phase would be about 725 MW-h i.e., an addition of 95 MW-h in the system.

In transportation, the requirement of road length in this phase would be 7250 km, i.e., an addition of 950 km is necessary to fulfill the demand. Arterial highways,

sub arterial highways, collector roads and local streets, in proportion to the total demand of roads in the system, would share this 950 km road.

In education, the number of schools requirement in this phase would be 2071, i.e., an addition of 271 schools covering primary, secondary and technical would be developed and to be placed in proper locations on the basis of the need and the demand in the system

In health, the available number of beds in the hospitals is numerically sufficient as in the phase-3 to meet the requirement of this system in the year 2031 as well. The enhancement of quality especially in the hospitals run by the state government (including primary health centres, Taluk hospitals, district hospital and medical colleges) would improve the quality of living in this system, which would attract further more population in this system.

These analysis show that the phase-V of the perspective planning has to give more thrust on housing, water supply, power, school and transportation segments in the system.

Optimal projects/ schemes have to be evolved pertaining to population, housing, health, school and power supply by considering micro location control parameters (Terrain, accessibility, infrastructure facilities etc.,) in the system and shall be implemented for the development of the system. The proposed projects/ schemes should be technically feasible, economically viable and socially acceptable.

7.4 RECCOMMENDATION BASED ON THE SURVEYS, DICCUSSION WITH THE EXPERTS AND THE POLICIES OF THE GOVERNMENT

In addition to the recommendations presented above in 7.3. in this chapter, the following recommendations are evolved based on the surveys, discussion with experts and the policies of the Government. They are:

1. Convert the present Thiruvananthapuram Development Authority in to a Metropolitan Planning and development Authority by adding the neighboring urban agglomerations, towns and Municipalities along with the Thiruvananthapuram City Corporation.

2. Development of integrated land use plan for the three natural divisions of the District, by protecting the reserved forest area.

3. Development of small and medium urban centers in the Thiruvananthapuram District, and develop regional, sub regional trade and commercial centres in the newly developed small and medium urban centres. It has been observed that people from the nearby district even come to the city for their regular needs. Once small towns are developed in between the Districts, the medium towns can fulfill the daily and occasional demands. KazhaKuttom, Attingal, Venjaramood, Pothencode, Vembayam, Nedumangad, Kattakada, Balaramapuram, Neyyattinkara, and Varkala can be developed as satellite towns of the city.

4. Effective utilization of natural, and artificial resources for productive purposes

5. Creation of special economic zones in the District. Three special economic zones will be developed in the fringe areas of major cities of Kerala State such as, Kozhikode, Cochin and Thiruvananthapuram with better connectivity among them, for the development of the State. Since one of the special economic zones shall lie in the fringe area of the study area, it will have more effect pertaining to the Scio economic growth and development of the system.

6. Delineation of new higher education and research institution zone.

7. Delineation of new medical zone for hospitals and medical research institutions.

8. Relocation of certain activities of which are lying within the city and do not require for the development of the urban population, such as Central jail at Poojappura, sub jail at Attakulangara, Special armed police Camp, and Psychiatric Hospital at Ulanppara, to the outskirts of the city. The valuable urban land occupied by these activities can be utilized for the development of the city.

9. The city has to be extended physically, which will reduce the pressure inside the city, and in turn will boost the development of the fringes. These fringe areas should be connected by means of ring roads.

10. Planning for infrastructure provision shall be strategic and have vision. For example, water supply schemes must cater for the need of the next 30 years.

11. Shifting of Government offices to the outskirts of the city especially towards the Northern side may reduce the traffic volume in the core area of the city.

12. The construction of high-rise flats in the city must be controlled.

13. The proposed district administration building at Kawdiar will make the area more congested, and that will destroy the existing greenery in the system. Therefore, suitable location shall be identified, which will have ample development chances so that more and more government offices, corporate office, institutions, etc., can be accommodated.

14. Specific building byelaws have to be evolved and implemented by considering the historical importance, heritage and future development options of the city.

15. Developments of Vizhinjam port, a natural one, which is located in the southern part of the study area as a major one in Southern India. This port has all the pre requisite qualities. Once this port is developed, it will attract container ships of all grades, and in turn the economic prosperity of the study area will be improved.

16. It has been observed that, proper urban design features are not followed in the study area at present. To develop this city in a proper way, feasible urban design have to be evolved by considering location characteristic features, and shall be implemented in the system.

17. This study area is blessed with enormous amount of potentiality for the development of tourism. It is an inevitable requirement to evolve a feasible

development plan pertaining to tourism development and shall be implemented in the system

18. To have a balanced ecosystem in the study area, feasible development plan pertaining to ecology and environment of the study area shall be evolved and implemented by considering the characteristic features existing in the system along with the total development of the system. The details of the proposals are presented in Figures 7.1, 7.2, 7.3, 7.4, 7.5 & 7.6.

Generally, there would be some kinds of backlog of infrastructure provisions in the system over the years due to the following reasons (1) Lack of fund, (2) Inefficient planning and administration, (3) Political reasons, etc. Incase, the phase wise requirements are not fulfilled in each and every aspect in the system, the existing problems would aggravate further, which leads to disaster in the system. Therefore, the recommended above infrastructure provisions based on the thcrough investigation conducted in the system shall be implemented efficiently. The Investigator hopes that if the above recommended infrastructure provisions are implemented in time (phase wise) a steady, and dynamic growth and development can be anticipated in the system.

7.5 CONCLUSION

The prime objectives of a realistic urban development plan is achieving integrated development in a particular system, for which the plan is evolved, 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. In this

present investigation, an attempt was made to prepare an integrated development plan for total development in a system (Thiruvananthapuram city) by considering the most important control parameters, which decides the functions of the system. An urban system model was developed, by considering the important subsystems and the functions. A long range projections are made to understand the demand and supply of the most important infrastructure services, which decide the functions of the system and incorporated the data to develop a projected year (2031A.D) urban system model. The functions of the urban system are closely examined by using simulation technique, to arrive at alternative policy decisions. Finally, a set of policy guidelines is prepared by phase wise requirement in alternative conditions for 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.

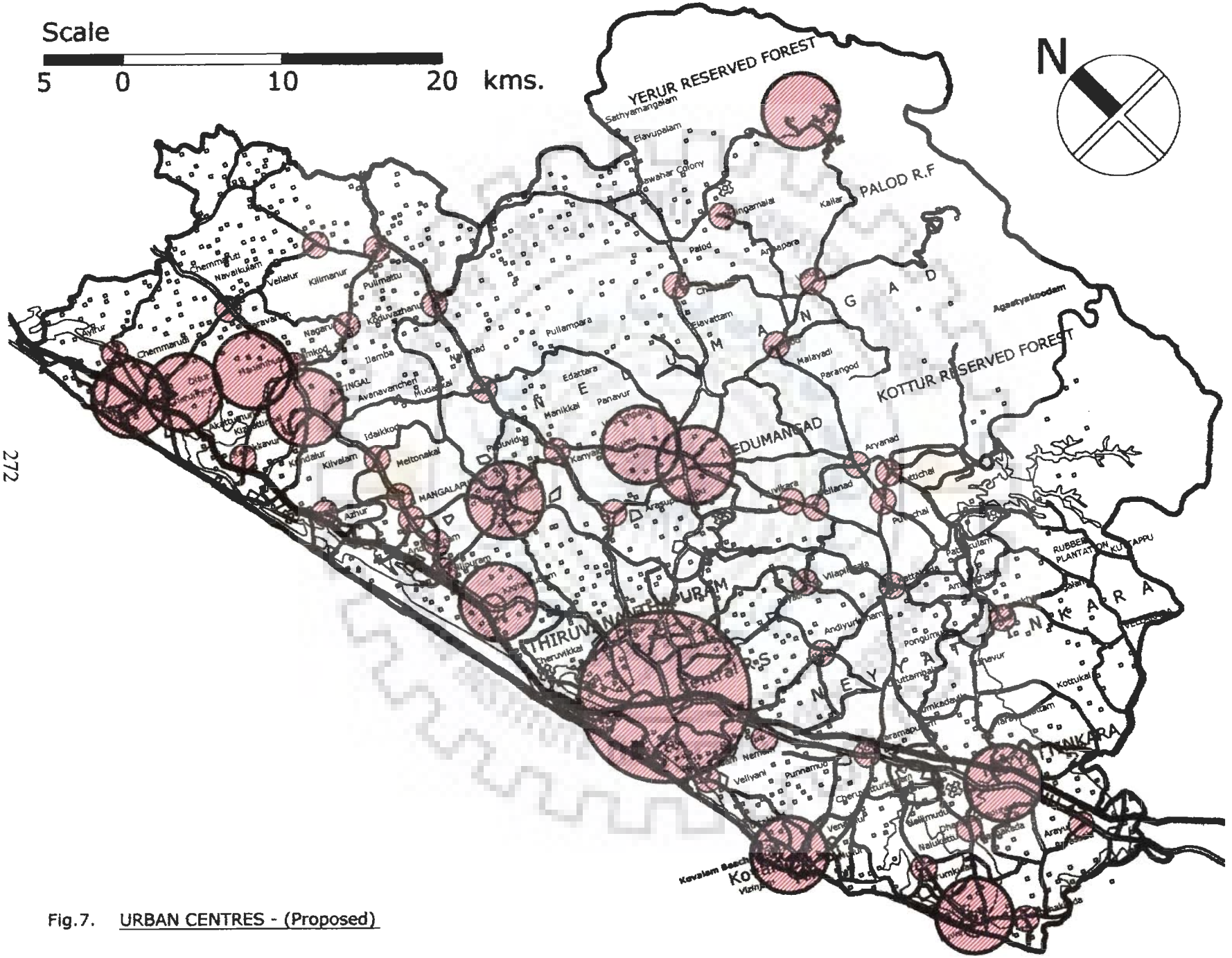


Fig.7. URBAN CENTRES - (Proposed)

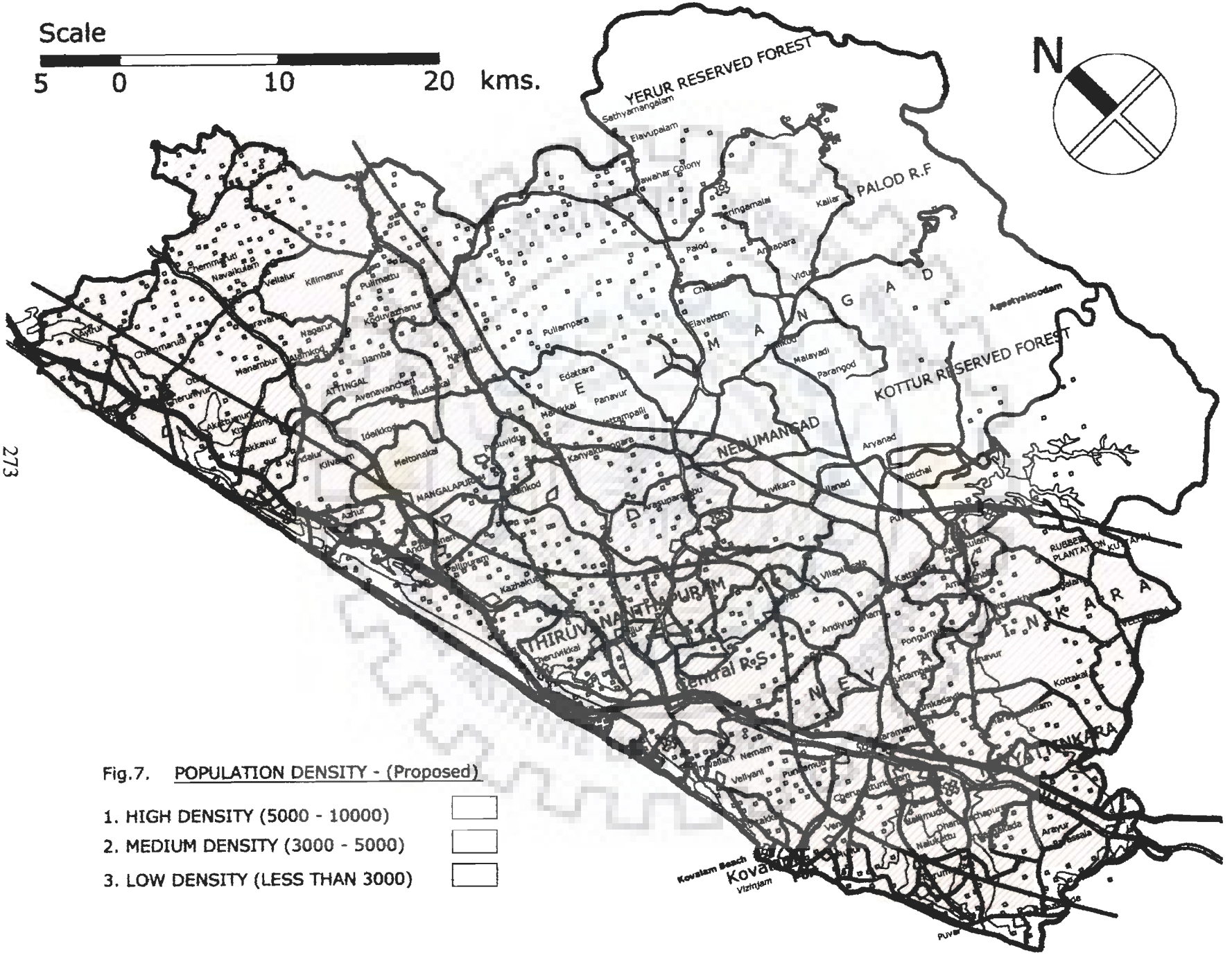


Fig.7. POPULATION DENSITY - (Proposed)

1. HIGH DENSITY (5000 - 10000)
2. MEDIUM DENSITY (3000 - 5000)
3. LOW DENSITY (LESS THAN 3000)

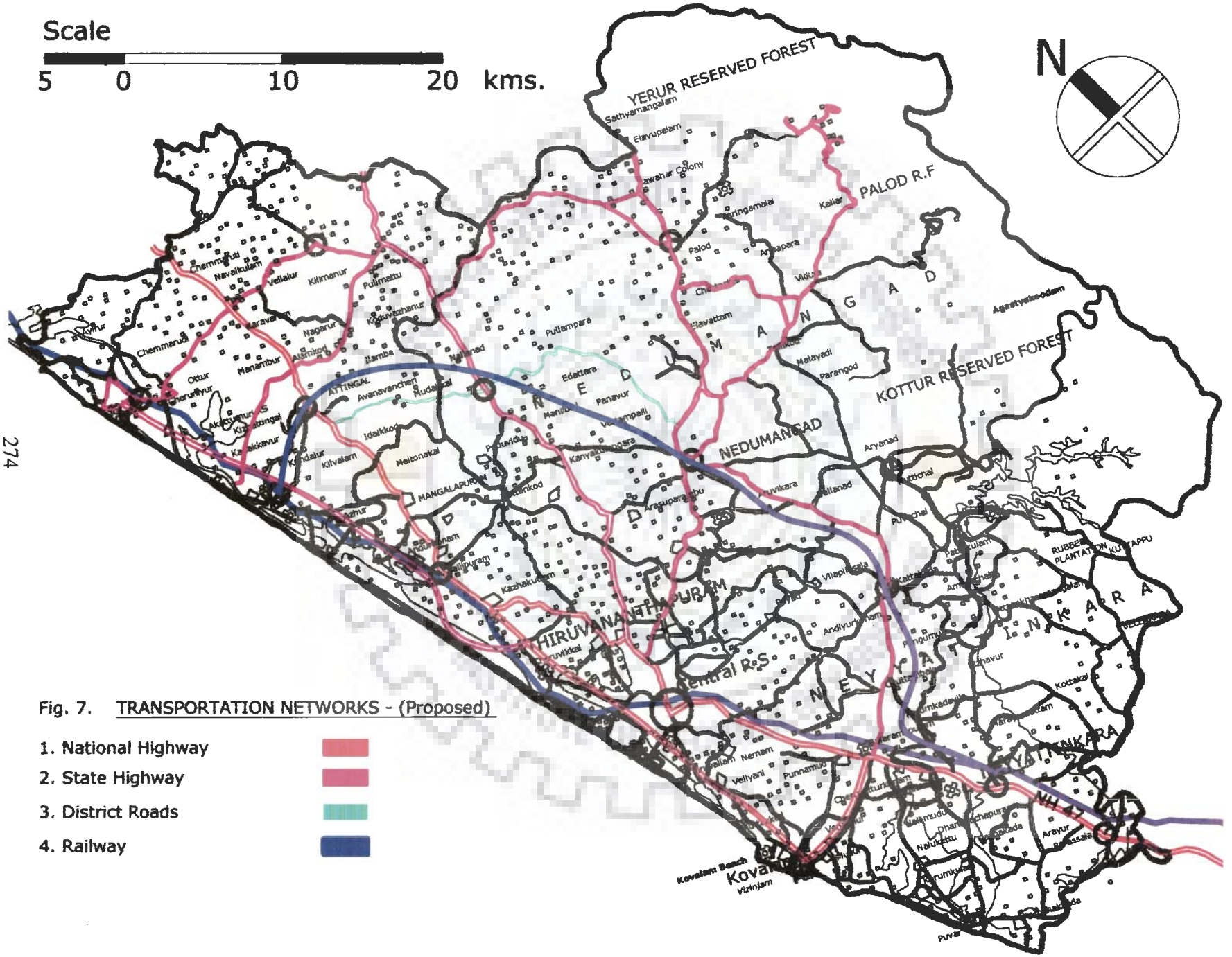


Fig. 7. TRANSPORTATION NETWORKS - (Proposed)

1. National Highway
2. State Highway
3. District Roads
4. Railway

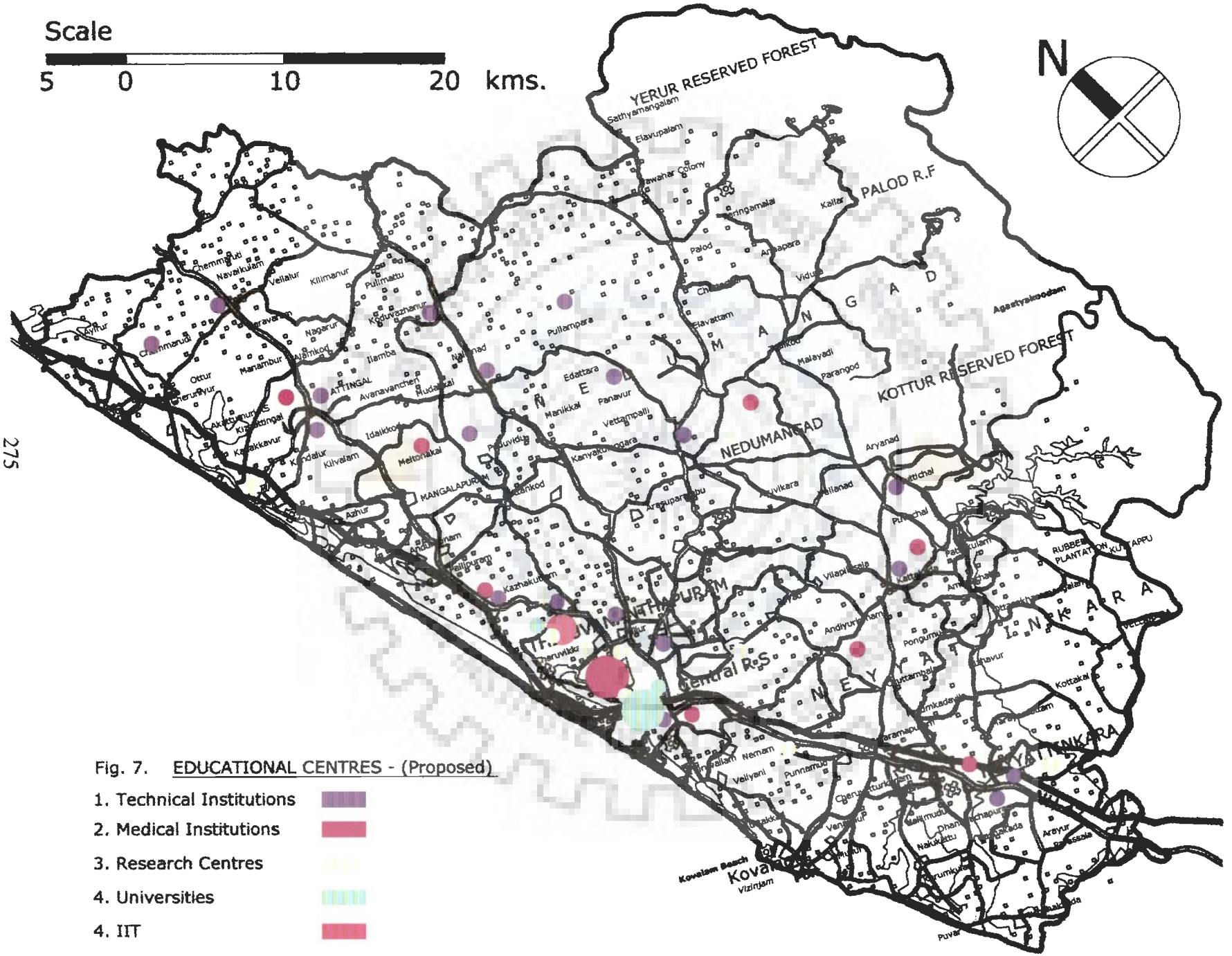


Fig. 7. EDUCATIONAL CENTRES - (Proposed)

1. Technical Institutions
2. Medical Institutions
3. Research Centres
4. Universities
4. IIT

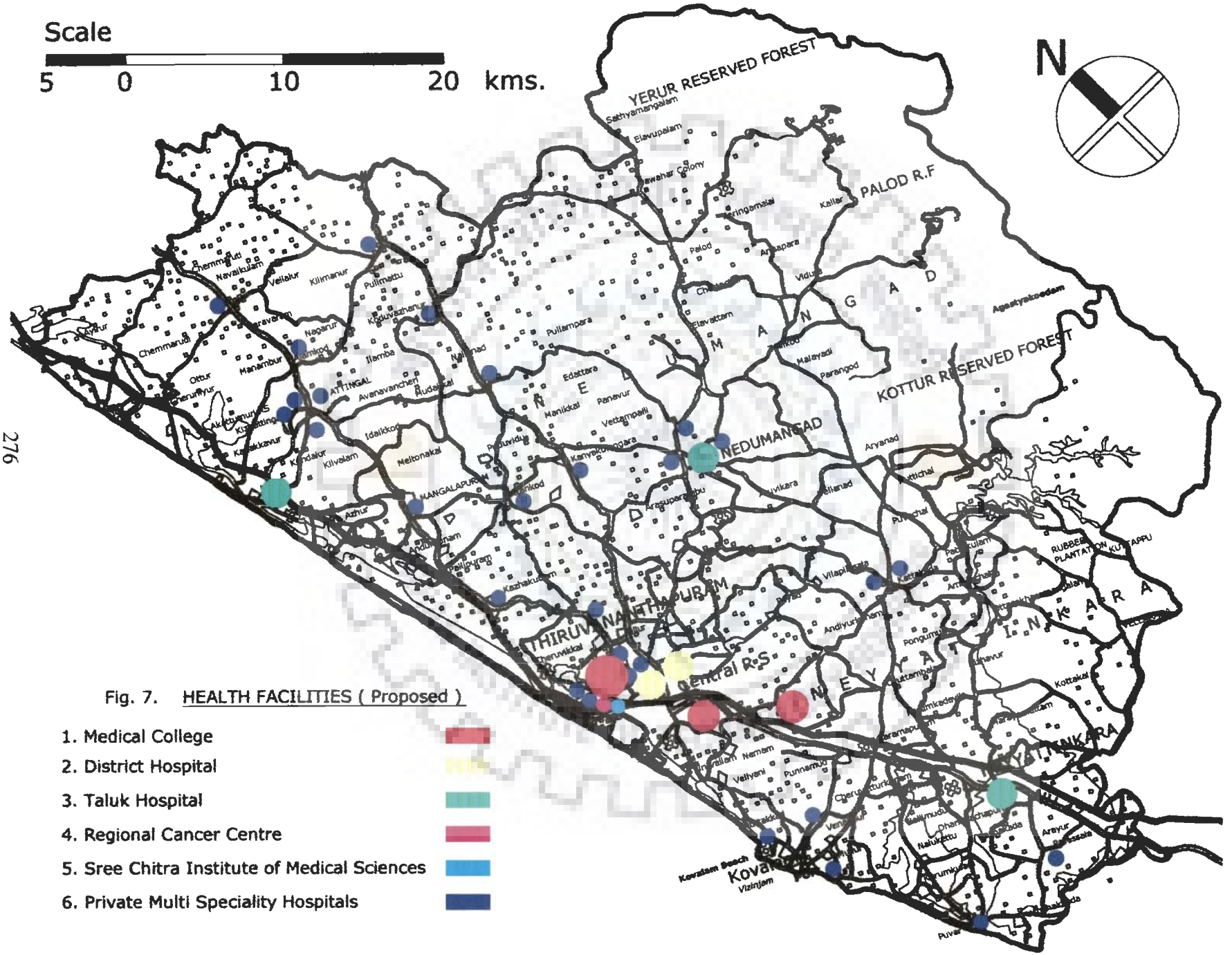


Fig. 7. HEALTH FACILITIES (Proposed)

1. Medical College
2. District Hospital
3. Taluk Hospital
4. Regional Cancer Centre
5. Sree Chitra Institute of Medical Sciences
6. Private Multi Speciality Hospitals

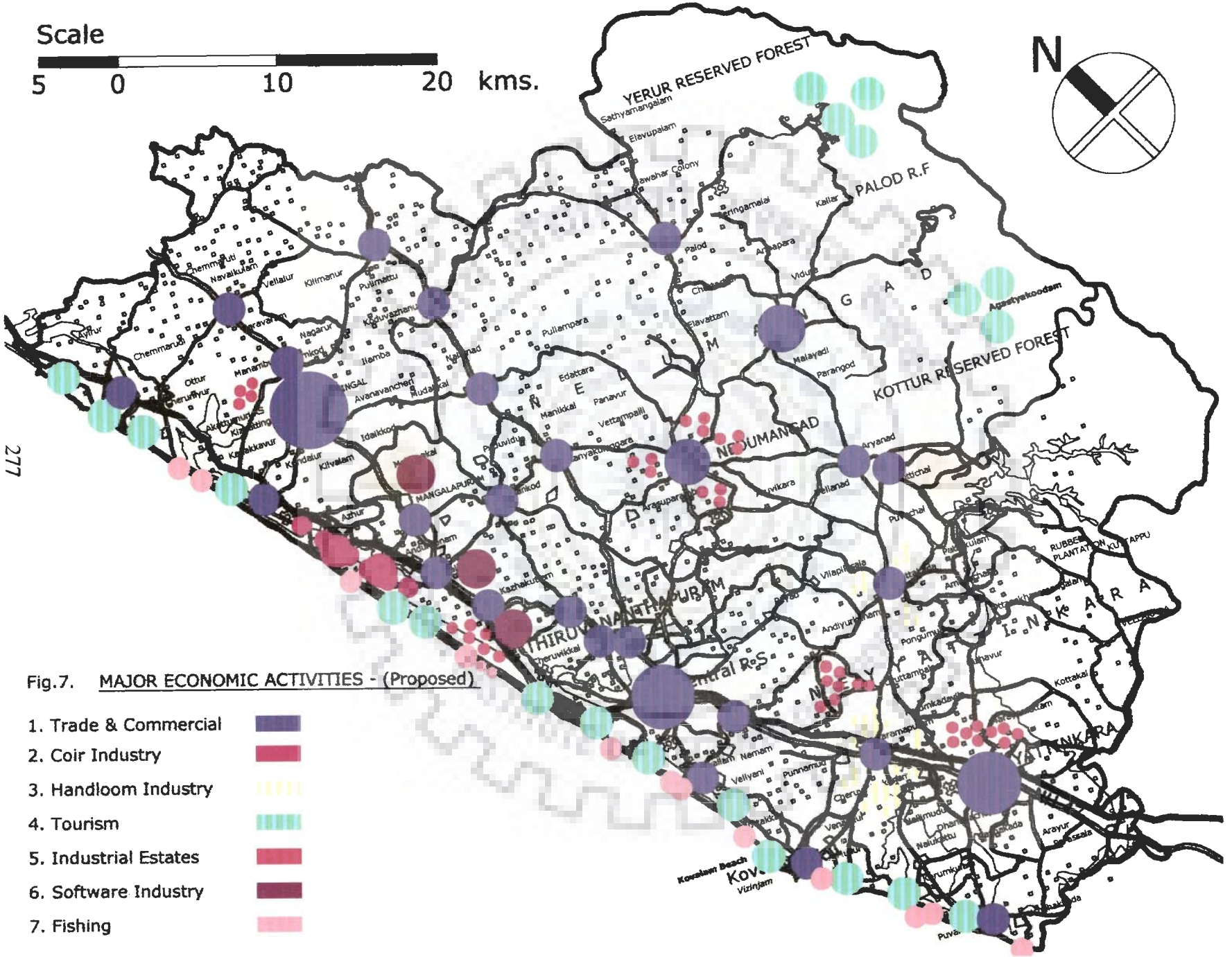


Fig.7. MAJOR ECONOMIC ACTIVITIES - (Proposed)

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Appendix-I

PLANNING FOR INTEGRATED DEVELOPMENT OF THIRUVANANTHAPURAM CITY

By

DEPARTMENT OF ARCHITECTURE AND PLANNING, INDIAN INSTITUTE OF TECHNOLOGY/ ROORKEE 247667

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1. Name of the Location:.....
2. Lane/street name:.....
3. House No. .....
4. Name of the head of the family:.....
5. Total No. of family members: .....
6. .Male: .....
7. Female:.....
8. Matriculate: .....
9. Graduate: .....
10. Post-Graduate:.....
11. Children:.....
12. Employed: .....
13. Technically Qualified: .....
14. Residency: By Birth/Migrated
15. Purpose of migration: .....
16. Year of migration: .....
17. Type of residence. Owned/ Rented/ Others:.....
18. Purchased/ Ancestral properties.
19. If rented monthly rent Rs/.....
20. Type of Premises: Filled up land/ Dry/ Wet/ Others: .....
21. Access to Residence: Pedestrian/Two wheeler/Vehicular
22. Type of Access: Mud/Finished
23. Quality of the Access: Good/ Bad
24. Type of Dwelling Unit: Individual/Group/Others:
25. Number of floors: .....
26. Number of rooms other than common areas:
27. Number of bathrooms inside: .....
28. Number of bathrooms outside:.....
29. Material of construction: (a) Foundation: Mud/ Rubble/ RCC/ Brick/ Others:.....
    (b) Super structure: Mud/ Brick/ Sun-dried Bricks/ Laterite/ Concrete Blocks/ Others:...

(c) Roof: Thatched/ Tile/ GI Sheet/ AC Sheet/ RCC/ Others.....
(d) Floor finish: Mud/ Cement/ Mosaic/ Ceramic Tiles/ Marble/ Granite/ Others.....

30. Open space around the building (a) Front:..... mts. (b) Back:..... mts.
(c) Side : Right: .....mts. (d) Side Left: .....mts.
31. Source of water: Well/ Municipal connection inside the building/ Public tap/Others:
32. Monthly water charge: Rs.....
33. Peak hours of use (a) Morning from .....to..... (b) Evening from..... to.....
34. Availability of water adequate/sufficient/not satisfactory
35. Method of waste- water disposal: Own premises/Drainage line/Others.....
36. Quality of drainage: Good/Bad.
37. Drainage line: Open/Covered.
38. Method of garbage disposal: Own premises/Garbage bins by association/Municipal Corporation.
39. Use of plastic bags for storing and disposal of garbage Yes/No.
40. Segregation of garbage into dry and wet at domestic level: Yes/No.
41. Dumping of garbage: At allotted space/ Road side/ collection bins/Others.....
42. Method of disposal of garbage: Personal/Authorized agent/ Residence Association/Others.....
43. Mode of sewage disposal: Pit/ Septic tank/Sewerage lines/Others.....
44. Efficiency of sewage system satisfactory/ good/bad.
45. Household appliances available: Fridge/Cooking range gas connection/ Microwave Oven/ AC/Others
46. Household facilities available:
Radio/Television/Newspaper/Telephone/computer/Internet/
47. Vehicles owned: Cycle/Scooter/Motorbike/Car/Others.....
48. Average monthly fuel expenditure Rs/.....
49. Distance to work place from residence.....km.
50. Duration of travel in hours.....
51. Distance to nearest (a) Market .....km. (b) Nursery school .....km. (c) Recreational center .....km. (d) Health center.....km.
52. By monthly Electricity expenditure Rs/.....
53. Monthly expenses of cooking gas Rs/.....
54. Annual expenditure (a) Food Rs/.....(b) Clothing Rs/.....(c) Education Rs/.....
(d) Health Rs/..... (e) Recreation Rs/..... (f) Others Rs/.....
55. Total annual income of the family Rs/.....
56. Extend of residential land ... .Cent .....sqm

57. Please give your priorities for the development of the city.
(In preferential Order 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11)

SHORT-TERM PLANNING		LONG-TERM PLANNING	
Drainage		Agriculture	
Education		Biotechnology	
Garbage		Education	
Health		Fisheries	
Housing		Health	
Pollution		Housing	
Recreation		Industries	
Sanitation		Information Technology	
Security		Tourism	
Transportation		Trade and Commerce	
Water supply		Transportation	

Name of the respondent. Signature.....

Appendix. II

Weighted Index method

In this present investigation, the Investigator employed weighted index method to analyze the preferential order of priorities under consideration. This is obtained by summing up the preferential values obtained for a particular variable, which is under consideration to the total number of response for the particular variable, using the formula

$$X_1+x_2+x_3+.....x_n/N$$

Where X_1, x_2, x_3 are the preferences for a particular variable and 'N' the total number of response

Appendix. III

BIODATA

Name:	**Salim, A.**
Address for Communication	Shahdara, Pothencode post Thiruvananthapuram, Kerala State, South India, Pin. 695584.
Phone:	0471-2419307(Residence)
Date of Birth	15- 05 – 1963
Qualifications	
Academic:	Master of Urban and Rural Planning University medal. IIT.Roorkee-1999 Bachelor in Architecture, Kerala University-1988 Bachelor of Science, Kerala University-1983
Teaching	10years, as Assistant professor, Department of Architecture, College of Engineering, Thiruvananthapuram. External Examiner, Regional Vocational Training Institute for Women, KazhaKuttom, Thiruvananthapuram.
Professional	15 years as practicing Architect, covering about 200 residences, Half a dozen shopping centres, half a dozen Auditoriums, Trade centres, Industrial building, Educational

campuses, schools, Hospitals, Religious Centres and Museum.

Consultant for two urban local bodies.. years.

Worked as a member, District Planning Committee, Thiruvananthapuram.

Preparation of Master plan for Thirurangadi, Kerala State (on going)

Coordinator, Information Technology Exhibition at Thirurangadi, Kerala State, a part of Technology transfer- Peoples IT movement, Thirurangadi.

Coordinator, Architecture Draftsmanship course as a part of extension of Technology to the masses, college of Engineering Thiruvananthapuram.

Awards owned

University medal for Master Degree from IIT, Roorkee

Winner, Essay competition for college students on **Housing problems and solution in India**, in connection with International conference on mud Architecture-1987 held at Thiruvananthapuram.

Research work:

1. Planning for Integrated development of Thiruvananthapuram city, India (Doctoral Studies)
2. Planning for Redevelopment of East fort area of Thiruvananthapuram city (Master Thesis)
3. Vaikom Satyagraha Memorial Museum (bachelors thesis)

4. Planning for integrated development of Thirurangadi, Kerala state.

5.Redevelopment of Palayam area of Thiruvananthapuram city (studio-Project)

6. Redevelopment of Puthanchantha area of Thiruvananthapuram city (studio Project)

7. Fishermen of Poonthura area of Thiruvananthapuram city. (Studio Project)

8. Master plan for University Campus, Kariavattom, Thiruvananthapuram (studio project)

8. Report prepared for Revamping Technical Education, Kerala State.

LIST OF PUBLICATION

The following papers have been published

1. **Salim .A & Devadas .V,** (2002), Infrastructure provision in Trivandrum city, Kerala State, India, Report of the human rights and the town, Valladoid, Spain.

2. **Salim .A & Devadas .V,** (2003), Low cost house construction materials and appropriate technology, Indian habitat & infrastructure, Need for innovative approach. Central Building Research Institute, Roorkee.

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PLANNING FOR INTEGRATED DEVELOPMENT OF THIRUVANANTHAPURAM CITY - INDIA.

I thank the examiners of my thesis for making valuable comments. I am submitting the clarifications based on an examiner's comment, which is transferred to me for reply, herewith.

Cities are engines of economic growth. In India, earlier, the Metro Cities had major industrial activities and have been providing employment opportunities to larger number of people and also paving way for more and more income-earning opportunities. In recent years, due to the advent of globalization, State Capital Cities, i.e., other than the Metro Cities, also started to function as engines of economic growth. As a result, requirements of infrastructure facilities have grown up at large scale in the Sate Capitals. Thiruvananthapuram city, the capital of Kerala State of India is also not an exceptional one in this regard. This city has good number of social infrastructure facilities, such as, educational institutions, health institutions, etc., which attract more number of institutions. As a consequence, new types of development, new types of industries (knowledge based industries), new types of consumerism, etc., emerged in this city in recent years, which lead to further more requirements of infrastructure facilities, and the city also grown physically to the larger extent. In this situation, the Investigator has studied this city by considering this city (Thiruvananthapuram City) as a '**system**' based on the view of Forrester, W.J. (1969). Further, since the city is growing rapidly, the Investigator hopes that the Thiruvananthapuram city would spread in the entire Thiruvananthapuram District by the year 2031 AD. Therefore, the Investigator selected Thiruvananthapuram District as the study area for investigation.

Page 2: Urban area, System and Urban System

In fact, number of distinguished Authors has done work on Urban Area, System and Urban System. At the out set, I am presenting the definitions of **Urban Area** and

System evolved by various distinguished Authors, and subsequently the definition of **Urban System** for clarity.

Urban Area

Definition of Urban Area is presented as follows based on different Authors view. They are:

1. According to Arthur B. Gallion and Simon Eisner (1986), "An urban area can be defined as a composite of cells, neighborhoods, or communities where people work together for the common good. The types of urban areas can vary as greatly as the variety of activities performed there: the means of production and the kinds of goods, trade, transportation, the delivery of goods and services, or a combination of all of these activities".

2. According to Arthur B. Gallion & Simon Eisner (1986), "the urban areas are those locations where there is opportunity for a diversified living environment and diverse life-styles. People live, work, and enjoy themselves in social and cultural relationships provided by the proximities of an urban area".

3. According to Arthur B. Gallion & Simon Eisner (1986), "Urban areas can be simple or complex. They can have a rural flavor or that of an industrial workshop. They can be peaceful or filled with all types of conflict. They can be small and easy to maintain, or gargantuan and filled with strife and economic problems".

4. According to Prakash M Apte, (2000), "Urban area is a complex organism. "It is a great human enterprise serving the material and spiritual needs of man. It is a segment of land on which the people have selected their places to live and to work, to learn and to trade, to play and to pray. It is a mosaic of homes and shops, factories and offices, schools and libraries, theaters and hospitals, parks and playgrounds, meeting places and government centres, fire stations and post offices. These are woven together by a net-work of streets and transportation routes, water, sanitation and communication channels".

System:

The definition of system is presented as follows based on different Authors view:

1. A **system** may be defined literally as "an organized or complex whole; an assemblage or combination of things or parts forming a complex of unitary whole. System concept has had a substantial impact on both the planning and the execution functions of management. This effect is best illustrated in the planning context by the increasing emphasis which is being placed on the scientific analysis of managerial decisions". (William R. King, - 1967, David I. Cleland & William R. King - 1968).
2. "System is a collection of parts organized for a purpose" (Coyle, R. G. - 1977).
3. "A system is a set of object together with relationship between the objects, and between their attributes". A 'system' can be defined as a complex of elements standing in interactions (George Chadwick - 1971).
4. "A system is defined as a set of input - output pairs" (Zadeh, & Polak - 1969).
5. A system is defined as "an aggregation or assemblage of objects joined in some regular interaction of inter-dependence. In a dynamic system, the interaction caste changes overtime" (Wadhwa & Agarwal, A. - 1993).
6. "A system is a collection of interacting diverse human and machine elements integrated to achieve a common desired objective by manipulation and control of materials, information, energy and humans" - System Science Symposium of the IEEE (Bernad H. Rudwick - 1964).
7. "A system is a combination of components acting together to perform a specific objective. A component is a single functioning unit of a system. By no means limited to the realm of the physical phenomena, the concept of a system can be extended to abstract dynamic phenomena, such as those encountered in economic, transportation, population growth and biology. In a dynamic system, the output changes with time if the system is not in a state of equilibrium" (Katsuhiko Ogate - 2004).

Urban System

1. Forrester, W. J., (1969) had done extensive work on urban dynamics and developed **"Urban System"** concept, which provide computer simulation to formulate realistic goals and to predict the long-term effects of those goals. In this work, the Author has considered the urban area as "**System**", and population or labour force, industry or employment available and housing are considered as subsystems. Each of these three subsystems is in turn subdivided into three: Population subsystem into managerial-professional, labor, and unemployed. The labor is skilled labor fully participating in the urban economy. Unemployed workers include, in addition to the unemployed and unemployable, people in unskilled jobs, those in marginal economic activity, and those not seeking employment who might work in a period of intense economic activity. Housing subsystem into "premium", "worker" and "underemployed". The managerial-professional group lives only in premium housing; the labor group, in worker housing; and the underemployed, in underemployed housing. This relates the housing to its cost and to the economic classificatien of the population. The other subsystem 'industry' or 'employment' is further classified into new enterprise, mature business and declining industry. In this work, the inter-relationship between the subsystems in the **urban system** is established based on feedback loop. Finally, the Author has observed the behaviour of the **'urban system'** in certain alternative conditions by doing simulation work. This work made a real breakthrough in the field of urban planning since interrelationship and interdependence of the subsystem in a system by spatial context is established. Subsequently, several distinguished Authors have done commendable amount of work in this particular field.

2. Louis Edward, (1974), established the functions of the **'urban system'** by using different urban models, and thereby considering the following as subsystems, such as, area (land area), population, business structures, availability of jobs, and availability of housing. In this study, attractiveness of area for migration, influence of migration in population, interactions between two components such as housing and jobs are established. It is interesting to note that this 'Urban Dynamics' model

established the functions, such as, influences on migration, job and housing availability, upward socio-economic mobility, house construction, house construction respond to population, tax rates, public expenditure, changes in socio economic status, etc., in the urban system and finally concluded with evolving plausible alternative policies for urban renewal.

3. According to Martin Puris and Alan Granger (2004), **"City as a System** in which interactions take place between people, land use and services. They also explored how and where these interactions are realized as social and economic subsystems within the city. Vital components of such urban models typically included population, employment and housing, residence and workplace location, and the provision and use of services and infrastructure."

4. According to Michael Batty (1974), the 'Urban Systems Research Unit' at Reading in United Kingdom, considers **'Space'** as a **'System'**, and application of dynamic models is the best option to understand the function of the **"Urban System"** in over a period of time. The Urban System Research Unit used simulation technique quite extensively to understand the growth and changes in Central Berkshire between 1951 and 1966 by employing dynamic models. Further, this Unit has advocated that to understand the functions of the urban system by change in strategy building, employing different kinds of dynamic models are the best options.

5. According to Emery and Trist (1972), the **'Urban System'** has the following characteristic features:
    - "The urban system is not a mechanistic system, but rather an adaptive system.
    - It is an open system and thus can not be studied or regulated apart from its contextual environments.
    - It is characterized by extreme inter-relatedness of its parts, calling for the need for viewing the system in its entirety.
    - The urban system is also characterized by substitutability of parts."

The **'Urban System'** concept is explained in detailed to understand the functions of the system (Ruchita Garg 2003). In this work, the system concept and the urban system concept are defined. "System" is defined as "a system functions as a whole with the interaction of several subsystem. All the subsystems of the system are inter-linked and interdependent on each other. If one of the subsystems of the system defunct its effects 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 seen in the whole system". Further, the urban system is defined as: "The urban system has similar characteristic features of system, and It has different subsystems, such as, land, population, agriculture, industries, trade and commerce, infrastructure, ecology, environment and institutions. These are interlinked and interdependent on each other, and functions as a whole". The dynamic function of an urban system along with its different sub-systems is presented in Figure 5.1, page 185 of the thesis.

Various distinguished Authors have pointed out their views on application of models and their importance in understanding the functions of the urban system. A few of them are presented as below:

1. Lee (1973) has pointed out that the application of dynamic models is the best option in understanding the real world situation in an **'Urban System'**. The following quotations are the best examples for the same. They are:

- "There is a growing acceptance that the use of models can help the Planners to understand, and in appropriate circumstances, predict the behavior of **'Urban System'.** However, models represent only a small (although increasingly important) part of planning methodology, and it is important for the potential model-builder and user to appreciate the place of this particular aspect of methodology within the wider contexts of the planning process as a whole" (Lee - 1973).

- "Indeed, unless, urban models are used by researchers, it is unlikely that the body of theoretical knowledge about the way '**urban systems'** work will be substantially increased, for, in urban planning, as in other fields, models actually assist in the development of theory. What are needed in planning are more hypotheses about the way the **'Urban System'** and its component parts operate. The use of models in research can help to overcome this shortage" (Lee - 1973, p. 16).

- "The use of models within the planning process, therefore, would seems to be relevant to understand the behavior of **'Urban System'** (system description) and to the elaboration of alternatives (system forecasting)" (Lee - 1973, p. 10).

- "Essentially, a model is a representation of reality. It is usually a simplified and generalized statement of what seem to be most important characteristics of a real world situation; it is an abstraction from reality, which is used to gain conceptual clarity to reduce the variety and complexity of the real world to a level we can understand and clearly specify. The value of a model is that it can be used to improve our understanding of the ways in which a system behaves in circumstances where it is not possible (for technical, economic, political or moral reasons) to construct or experiment with a real-world situation" (Lee - 1973).

2. "The application of a model to a real-world problem is not a simple process. Any step of a research involve in model development may suggest that earlier ideas may be improved on. It seems inevitable, therefore, that a realistic approach to model-building should be an iterative one" (Hamilton, et. al., 1969), and the theoretical model developed by Hamilton (1969) is presented in Fig. No.1

Further, the Investigator has come across few more interesting studies, which were done by employing System Dynamics Theory.

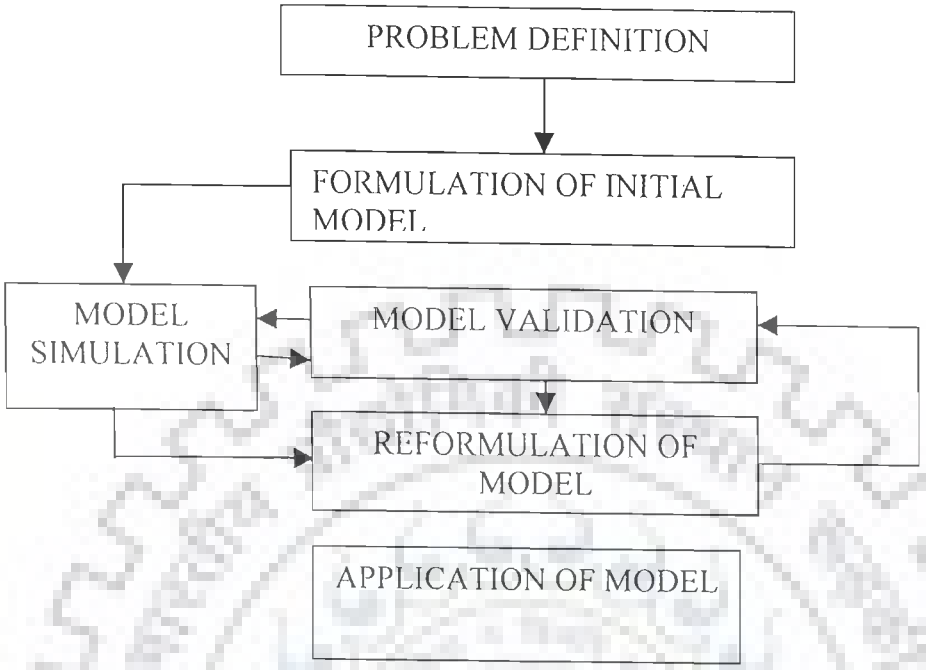

Fig 1: Model development as an iterative process (after Hamilton, et al., 1969)

System Dynamics

Various distinguished Authors have defined System Dynamics in different ways and few noteworthy definitions are presented as below:

1. "System Dynamics is the study of information and feed back characterization of industrial enterprise to show how structure, amplification and time delays interact of influence the success of the enterprises" (J.W. Forrester - 1961).

2. "A System Dynamics approach is mainly adopted for investigating dynamic behavior of feedback systems. A system Dynamics model represents feedback systems by differential equations and simulates them to trace their dynamic and transient evolution" (Forrester-1961 & Goodman - 1974).

3. "System Dynamics is a methodology for analyzing the behavior of complex dynamic systems to show how system structure based on the policies used in decisions making govern the behavior of the system" (Barlas and Dicker-1996, Francis-1995, Galbraith - 1998a & 1998b, Kennedy - 2000, Singh, et. al., - 2000, Larson-1997).

4. System Dynamics is defined as "that branch of control theory, which deals with socio - economic systems and that branch of Management Science which deals with problems of controllability" (Coyle - 1977).

5. "System Dynamics is a computer aided approach for analyzing and solving complex problems with a focus on policy analysis and design" (Forrester - 1961).

6. "Experimental or simulation approaches was chosen by Forrester, and was utilized in System Dynamics (Vennix 1996). However, the essential viewpoint taken by System Dynamics is that feedback and delay cause the behaviour of systems, i.e., dynamic behavior is a consequence of system structure" (Richardson and Pugh 1981).

7. "System Dynamics has been used for understanding the dynamic behaviour of the **urban system**" (Forrester – 1969, Forrester and Hamilton – 1969, Louis - 1974, Chadwick – 1971, Lee – 1973, Michard Batty – 1974, Ruchita Garg – 2003, Katsuhiko Ogate - 2004).

Application of System Dynamics Theory

System Dynamics theory has been employed to a wide range of problem domains. It includes work in corporate planning and policy design (Forrester 1961; Lyneis 1980), economic behavior (Sterman, et. al. 1983), public management and policy (Homer and St. Clair 1991), biological and medical modelling (Hansen and Bie 1987), energy and the environment (Ford and Lorber 1977), theory development in the natural and social sciences (Dill 1997), dynamic decision making (Sterman 1989), complex non-linear dynamics (Mosekilde et al. 1991), software engineering (Abdel Hamid 1984), and supply chain management (Towill 1996a; Barlas and Aksogan 1997, Akkermans et al. 1999).

In this present investigation, Thiruvananthapuram City is considered as a '**system**' as Martin Puris & Alan Granger (2004), Chadwick (1971), Forrester (1969) and Ruchita Garg (2003) considered. In this present work, the theoretical framework developed by Chadwick (1973) and Ruchita Garg (2003) are followed to establish the functions of the urban system, a diagram is developed and presented in the thesis in page no.185. However, in this present investigation, System Dynamics theory has been employed to understand the functions of the **urban system**, i.e., **Thiruvananthapuram City.**

Explanation for page 33 & page 44

As mentioned in page 34, under the subheading 'scope of the study, the study area has multidimensional problem. All the problems are presented in pages 31-33 of the thesis. The Investigator clearly spells out the lacuna in the existing planning process, which is adopted by the city administration and the importance of the integrated development plan for solving the multidimensional problems that are prevail in the system (city). In chapter no.2 of the thesis, i.e., study area profile of the thesis, the problems of the study

area is clearly and quite extensively discussed, which gives clear understanding to develop the 'urban system' model for evolving an integrated development plan.

Objectives

The objectives are developed based on the analysis of the existing literature and having discussions with experts who work in this particular field of study. Once the objectives are developed, it has been thoroughly discussed with the urban planners who are directly dealing the subject in the study area. In the course of the entire work, the Investigator carefully handled the work and not allowed any kind of deviation from the objectives. Therefore, it can be verified from the thesis that the work is done systematically by step by step based on the objectives, and presented in the thesis. The Investigator opinions that the objectives of the thesis are developed constructively and the work was carried out systematically.

Research Problem

As the examiner pointed out in his remarks, "a research problem is usually set in the context of either theory testing or theory development". In this present investigation, the entire Thiruvananthapuram City is considered as system, and System Dynamic theory is employed to understand the functions of the '**urban system'**. An urban system model was developed based on System Dynamics theory, by considering the Thiruvananthapuram City as a system, and the following segments, such as land population, agriculture, industries, trade, commerce, infrastructure, ecology & environment and institutions are considered as sub systems of the urban system. These all sub systems are interlinked and interdependent on each other and functions as a whole. The dynamic functions of the urban system, i.e. the theoretical conceptualization of the urban system is presented in Fig. No.5.1 in page 185 of the thesis. System Dynamics theory is employed in this thesis to understand the functions of the urban system. Thus, the Investigator opinions that the thesis satisfies the requirement of 'theory testing' as the examiner pointed out in his remarks.

Research Design

As the examiner's remark 'research design' is as extremely important aspect of research. I do fully agree this statement. In this present investigation, it has been clearly pointed out that survey research methods have been employed (please refer Page: 35) and the method of sampling is clearly presented in page numbers 38 and 40 of the Thesis. The methodology employed in this work is presented in page no.36 of the thesis.

Sampling Frame:

As mentioned in page 40 of the thesis, the sample survey was chosen by using the K = N/n, where N and n represent the total number of households and the sample size respectively. In this present investigation, the study area has 6.2 lakhs households. So capital 'N' represents 6.2 lakhs households and the 'n' represent the selected samples i.e., 260 housesholds.

In fact, 260 sample size is too small in size, but it is not possible to select more number of samples for conducting surveys since the Investigator alone conducted the survey at the grassroots level, i.e., conducted door to door survey to the selected households and the period available for the research is also too small, i.e., total research period is only for three years. Therefore, the Investigator has limited the sample size to 260 households.

Primary Survey

The importance and the necessity of the primary survey in this investigation are clearly presented in page no.37 of the thesis. The third sentence of the first paragraph of page 37 of the thesis onwards it is clearly explained the importance and the necessity of the survey in this present investigation.

As the examiner pointed out, information on population density can't be obtained from the primary survey. In this investigation, to obtain information on population density,

secondary sources of data have been used, and are presented in table no. 2.3 in chapter 2, page no. 61 of the thesis.

The examiner has made a remark on district level schedule and the necessary of the survey at the Officer level. In fact, the Investigator clearly explains in page 41 of the thesis that the survey is done to understand the development trend in the district. Moreover, the said officers in page 41 of the thesis have been interviewed for the said purpose, which was more helpful to decide the policies in later part of the work. The views of the officials were considered during the modeling, particularly when the simulation work was entertained.

Photographs

As the remark of the examiner on photographs, the following are submitted:

1. Photographs are presented in this investigation to depict the distinct physical characteristic features of the study area.
2. The photographs also illustrate the functional characteristic features of the study area. Therefore, the investigator has presented the photographs in the thesis for better clarity.

Remarks on flooring material

Application of flooring material in house construction is studied to understand the relationship between the income of the households and the material used for flooring. In this urban system model flooring material is not considered at all. Selected sub-systems, such as, housing, education, health, power and population have been considered in the urban system model since they decide the functions of the system.

Model Validation

Model validation is done as per the published methods in existing literature (Lee 1973, Andrew P Sage 1999, Forrester 1968, Forrester and Singe 1980, Coyle 1978,

Mahapatra, et. al., 1994 and Hamilton, et. al., 1969 and the System Dynamics Group MIT Solan School of Management 1999).

According to Lee (1973), "Once the initial formulation of the model has been completed, its ability to reproduce the characteristics and behaviour of the real-world system must be tested. It is important to realize that the details of a model formulation may be altered as the understanding of the system being dealt with increases, and that computer simulation experiments with the initial model may contribute to this understanding. As a result of these experiments, it may be necessary to amend or extend the initial formulation; this may be the case; for example, where the results of some particular relationship in the model produce results which seem unreasonable on the basis of past data and experience. If this does happen, then further investigation into the form of that relationship may be necessary (and that may involve the collection of additional data), and this in turn must be tested against the available data".

According to Lee (1973), "Although accuracy in terms of system behaviour is of obvious importance, the validity of the model's structure, in terms of the relationships between the variables, is of equal if not greater significance. The importance of model structure springs from the fact that if all of the system components are adequately described in the model and if the inter-relationships are adequately specified, then the performance of the model can hardly fail to be accurate. On the other hand, it is not impossible for a variety of invalid combinations of components and relationships to produce apparently accurate behaviour, as compared to the existing system behaviour. It is unlikely, however, that an invalid structure will provide a sound guide to the future behaviour of **urban systems**. Each equation in the model should therefore express a reasonable relationship, preferably a direct causal relationship, between the variables incorporated in the model. The problem is how to identify the chain of cause and effect in a complex situation. However, the behaviour of the model is most likely to be valid if it is formulated on the basis of a reasoned hypothesis which has been subjected to rigorous testing".

In this present investigation, the model is validated as suggested by Forrester (1968), Forrester and Senge (1980), Coyle (1918), and Mohapatra et al. (1994). Validation has been treated as multi-level process. This has been towards (a) fixing model boundary, (b) deciding parameter values and initial values of level variables, (c) the table function values, and (d) the structural relationships. In this present investigation, the base year for the model run was chosen as 2001. Numerical values of different table functions and some of the parameters were so chosen that the values of the model generated key variables matched closely with the historical data. For this, a large number of simulation runs was made. The model was run for a period of 30 years, i.e., 2031 A. D.

Thus, the model validation is done and the model becomes the replica of the real life situation. Further, this validated model is used for simulation work.

Remarks on projections

Bourne (1974) has done extensive descriptive comparative analysis of the **'Urban System' by employing** forecasting procedures for Central Canada. In this, the following methods, such as, individual city forecasting methods, demographic models, employment models, stochastic spatial forecasting models, city-size distribution models, Markov models, city proportional share models, employment share models and the urban system models are considered for comparative analysis. The Author concluded that the **'Urban System'** concept model is the best option for forecasting because of its stress on interrelationship and interdependent of subsystems in a spatial context compared to all other analyzed models. Therefore, in this present investigation, the 'Urban System' concept is employed for forecasting in this present investigation

The examiner has made remark about page 200 - 218 of the thesis related to projection. In this investigation, the Investigator developed the projected year model for the year 2031 A. D. Plausible scenarios are developed based on historical data, discussion with experts and the development trend visible in the study area, and tested in the model. The results of the projected year model and the simulation work (tested scenarios

results) are presented in page 200 - 218 of the thesis. The scenario tested results helped the Investigator to arrive at plausible recommendation.

As already stated, urban system is a complex one. To understand the functions of the urban system, a dynamic functional model was developed by employing **System Dynamics theory**, thereby considering the most important sub systems, such as, population, health, education, power and housing. Further, a projected year model was developed for the year 2031 AD, and simulation work was done by testing scenarios in this model to arrive at plausible alternate options. Optimal policies are identified based on the results (both model results and the simulation results) and recommendations are made for achieving integrated development.

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