POTENTIAL FOR SUSTAINABLE ECO-DEVELOPMENT OF ROORKEE TOWN

A DISSERTATION

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

of

MASTER OF URBAN AND RURAL PLANNING.

By

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POTENTIAL FOR SUSTAINABLE ECO-DEVELOPMENT OF ROORKEE TOWN

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CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in the Dissertation etitled POTENTIAL FOR SUSTAINABLE ECO-DEVELOPMENT OF ROORKEE TOWN in partial fulfillment of the requirement for the award of the degree MASTER OF URBAN AND RURAL PLANNING submitted in the Department of ARCHITECTURE AND PLANNING of the University, is an authentic record of my own work carried out during a period from 25th July 1992 to 10 Feb.,1993 under the supervision of SRI R. SANKAR (Reader) the matter embodied in this Dissertation has not been submitted by me for the award of any other degree.

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

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_A_C_K_N_O_W_L_E_D_G_E_M_E_N_T_

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SUNIT KUMAR BHAGABATI

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CHAPTER-1:

INTRODUCTION

1.1 ENVIRONMENTAL IMPACT OF MODERN DEVELOPMENT :

There is substantial documentation or environmental degradation by man's actions and of adverse impacts of the use of energy intensive and polluting technologies in the course of the present urban, industrial and economic development (Schumcher; 73, Sarla Devi; 82, Illich; 73, Commoner; 73 and Cooks; 76). The future state of global environment would indeed be very ominous if the present trends in the pattern of consumption of resources to achieve the prevailing goals of development continue (Clarke and Howell 77, Lasslo and Bierman; 77). This grave situation of global environmental degradation, has promoted many international experts (Scientists, technologists and environmentalists) to work on alternative patterns of development to revive our dying planet THE EARTH.

The adverse impact of man made system particularly of the built environmental system, as contrasted with the beneficial effects of natural system are given in Table which clearly outlines the need for patterning a man made development on the basis of natural system.

A simplified comparison of some system properties between a Natural Eco-system and a Man-made system, taken from the book, 'Ecology and the Quality of our Environment', by Charles H. Sowthwik, D. Van Nortrand Co. N.Y. Second Edn. 1976 is as given in Table T-1.1.

T - 1.1

Comparison between Natural Eco-system and Man-made System

	Natural Eco-system	Man made System
1.	Examples : Pond, Marsh, Grass land, Forest etc.	House, Factory, Village, Town
2.	Captures, connect and stores energy from the Sun.	Consumes energy from fossil or nuclear fuels.
3.	Produces oxygen and consumes carbon dioxide	Consumes oxygen and release Carbon dioxide
4.	Produce Carbohydrates and proteins, accomplishes organic synthesis	Can not accomplish organic synthesis; produces only chemical degradation.
5.	Is capable of self maintaining and renewal	Is not capable of self maintaining and renewal.
6.	Filters and detoxifies pollutants and waste products.	Produces waste material which needs treatment
7.	Maintains silence	Noise polluting
8.	Maintains beauty if not disturbed	Usually causes unsightly scenerio if not properly maintained.

9.	Creates richer soil	Destroys soil
10.	Stores and purifies waters	Often contributes to water pollution and losses
11.	Provides wild life habitat.	Destroy wild life habitat.

1.2 CONCERN FOR SUSTAINABILITY :

Just as the 1972 stockhom Conference heraleled a world wide concern on environment. The 1992 Earth Summit held at Rae De Janerio (Brazil) has generated global interest on sustainable development.

The challenge of sustainable development, as presented by the World Commission on Environment and Development (WCED), is to continue the worlds economic development while maintaining the essential integrity of the Earth's ecological system (Commissions report, 1987).

Through out the world we are now approaching or exceeding critical threshold in the balance between economic development and population growth on one hand, and resource conservation and environmental quality on the other hand. Among the important examples are soil loss, forest loss, extinction of speecies etc. Other equally important thresholds are closely related to prospects and policies in Urban areas. For example, the prospect of major and irreversible climate change, and the rapid deteripration of Earth's 'Ozone shield' are caused in

large part by patterns of Energy Consumption and release of Chloroflurocarbons (CFC) that are concentrated in urban areas.

If human numbers do double, the WCED estimated that a further five to ten fold increase in economic activity would be required to enable them to meet their needs and the minimal aspirations. An increase in economic activity of five to ten times in five decades may appear enormous and unrealistic. In fact, it translates into annual growth rates of only 3.2 to 4.7 percent, and very few governments aspire to less than that. In many developing countries, it is hardly enough to keep up with projected rates of population growth, let alone reduce levels of poverty. (WCED's report, 1987) - Such growth, without irreversible damage to the environment is not possible. Many of the crisis that are now encountered in both developing and developed countries are due to in large part to the forms and pattern of economic growth since the World War II. The growth rates envisaged are realistic only if major changes take place in the character of growth - only if the development that takes place is sustainable.

This challenge is largely an urban challenge, given the dominate place of urban areas in population distribution, in governace at all levels and in the production and consumption of goods and services which impact on inter-dependent ecological and economic systems. To meet the challenge successfully requires new thinking, new policies and decisive actions in the urban domain.

1.3 WHAT IS SUSTAINABLE ECO-DEVELOPMENT

Sustainable development has emerged as the concensus alternative development pattern. Also known as eco-development os sustainable eco-development, it can be described in terms of some of its main features stated below :

i. Based on ecological principles.

ii. Conservation of energy and other natural resources through sustainable use.

iii. Use of appropriate technologies which are humane and based on resource potential.

iv. Sustainace of environmental quality and quality of life as a goald.

v. Decentralization of planning and development activities.

vi. Active community participation.

In practical terms sustainable eco-development means :

1. Achieving self sufficiency :

Firstly in basic needs to the maximum extent possible as permitted by resource potentials. The basic needs include fresh air, water, food, shelter, energy and other essential needs such as health, recreation and education.

2. Conservation of Resources :

Conservation of energy and other non renewable resources,

this means :

a. Conservation of non renewable energy resources.

b. Conservation of other non renewable resources like minerals.

c. Increasing dependence on renewable resources.

d. Proper management of renewable resources, such as Solar Energy, Biomass, Water, air, etc.

3. Use of technologies materials which are humane, appropriate and environment friendly.

4. Voluntary reduction of avoidable consumption needs.

5. Concerted and determined action to reduce human population.

6. Adopting life style based on environmental ethics.

1.4 A NEW OUTLOCK FOR SETTLEMENT PLANNING :

'As a reaction to the failures of urban environmental management, a close linking of interdisciplinary and cross referenced theory is a pre-requisite. It is also necessary to foster the understanding of ecological urban restructuring as an international task'. (U.N. Conference on human settlement 1976).

It is no way relevent to apply totally new criteria of thought and action to reform the interaction between society and environment. Rather, principles of environmentally and

and socially compatible technology and forms of settlement, verified by centuries of experience, should be systematized, thus, leading to a new outlook for settlement planning.

The existing settlement systems, particularly the higher order urban settlements, not only of the energy rich countries but also of the energy poor countries like India have been developed to be highly energy intensive and energy wasteful. It is an irony that 'human settlements are consuming more and more energy just when mankind has become aware of the need to cease environmentally, depending and wasteful use of non renewable energy resources. The same is the case with other resources also.

The settlement planners who have, so far, remained insensitive to changes in the scarecity of energy and other resources ought to assume a new role and responsibility in making towns and cities resources conserving rather than resource consuming. The key tasks in their new role could be summarised as :

1. Study and understanding of the potential for resource conservation in existing settlement development and its adaptability to new and changing resource systems that one renewable and ecologically sound.
2. The design and layout of resource conserving buildings and hyman settlements.
3. The planning of energy efficient spatial relationships among land uses and built environments.
4. Build relevant theoretical foundation and work out

plans for alternative patterns of settlement development which would conserve energy and other resources, in consonance with broader goals of self sustainable development, both at macro and micro levels.

It is in the context in the underlaying need for the emerging task mentioned above for the planners, that the author has taken up this topic in an attempt to make a small but hopefully significant contribution to the vast unexplored ground of planning ~~rep-er-toire~~.

CHAPTER-2:

LITERATURE REVIEW

2. LITERATURE REVIEW

Literatures related to sustainable development has been found to have been published and attracted people attention from early 70's. The causes are multifaceted. They can be said to be the environmental problems, the Stockholm Conference, fossil fuel crisis, etc. Most publications and important informations available are on technology development, stress on need to plan for conservation, case study of rural types etc. Proposals mostly theoretical and schematic types. Nothing much is available on city level sustainable settlement planning and no urban case study had been taken up earlier.

The literature survey outlined below includes only the selected few which are considered most relevant to the thesis project undertaken. The other sources referred to, have been added to the Bibliography, given at the end of this report.

2.1 ECOLOGICAL APPROACH

"Ecological Urban Restructuring", Ekhart Hahn and Udo E. Simonis, Ekistics, 348, 349 May/June, July/August, 1991.

Hahn and Simonis in this paper looks at the prevailing type of industrial urban development as a dead end street. They consume more energy, ignores significant elements of human behaviour, gives rise to grave socio physiological problems. City as they are today are on symbol for neglect

of organic, cultural, traditional and distribution of the identity.

The authors also sees the human temptation of modern urban life style and the attraction to the cities, but they say that it need not necessarily be provided with the tower likes in Chicago which consumes as much energy in 24 hours as that by an average American city of 1,50,000 inhabitants or any Indian city of 1,50,000 or more than 1 million.

They advocate Ecological urban restructuring to adapt urban structures to the requirements of ecological compatibility on an Industrial scale.

The authors indicate that this is the only way to ease the burden on the environment. The reasons for failure of the urban environmental protection have also been discussed, according to them :

1. The environmental policies has concentrated on technical protection measures on sectoral basis,
2. They were employed when problems existed,
3. None of them were real solutions,
4. Anti ecological technologies,
5. Technocratic solving view, and
6. Insufficient public participation

The authors conclude this paper with relevant strategies for ecological urban structuring. The stragegies were divided to three components :

1. Points of Orientation

2. Fields of action and Building blocks with possibilities of necessities.

3. Concept of ecological neighbourhood Development, the most important level of action.

The eight orientation points serves as guide lines. They are dealt separately as under the following heads :

1. Human Ethological Orientation

2. Participation and Democrtisation

3. Orientation to cycles and net works

4. Orientation to the Nature and the senses

5. Orientation to qualified density

6. Orientation to Genius loci

7. Ecology and Economy

8. International Orientation

2.2 ECO-COMMUNITY

"Energy Autonomous Econommunities for New Urban Development in Tropics" - P.Kasi and Dr. C.L. Gupta (TERI).

The planning of the eco community resolves around the rationalisation of node size with respect to a biogas plant and the requirement of the resident of a node.

Each node consists of 64 housing units divided in four blocks, each consisting of four storeys. Bio gas plant, land

for intensive vegetable gardening enough to fulfil the entire vegetable needs of the node. Space to grow water hyacinth from domestic waste water to feed the bio gas plant to supplement gas yield. A tot lot, a dairy, a poultry, an algae pond and space for fodder cultivation.

Four such nodes are grouped to form a cluster, with SILVICULTURE wood lot and certain infrastructure facilities such as shops/depots, a nursery school, a community centre and a water point provided at this level.

A population of 1920 is accommodated in an area of 9.8 hectares. Thus achieving a gross density of 128 per hectares.

The above figures are aimed to be a model one and is not in reference to any particular site or community. The housing block being storeyed and with all vegetable garden area on ground it may pose problem for the residents of the higher floors to manage their vegetable garden.

Stagnant water in the water hyeinth ponds near the housing units could be aplace for effective breeding of mosquitoes. Also the site for silviculture wood lot has not been specifically earmarked and whether it is suitably located for the convenience of the residents of the cluster is not known.

2.3 (a) SUSTAINABLE DEVELOPMENT IN THE URBAN CHALLENGE

The Urban Challenge by JimMacNeill, John E.Cox and Ian Jackson. Ekistics 348, May/June, 1991, 399, July/August, 1991.

In this paper, the authors alarm the people of the

exceeding critical threshold in the balance between economic development and the population growth on one hand and resource conservation and environmental quality on the other hand.

About the urban settlements, the environmental impact of such growth rates, may be embodied in current forms of urban development, w ould make them unsustainable. They criticise the growth of the bigmetropolis for the chao's created but at the same time defends their growth cause which is fundamental to a development process without which the economics of most countries would not survive.

The authors state that, 'Dependence on a network rather than on the servicing of a surrounding region or a wider hinterland, existed for a few exceptional cities in the past, but now it has become a general rule for the majority of substancial cities any where.

The authors define sustainable city in terms of increased efficiency. A city consuming lesser energy, material, water, land, less chemicals, producing less waste and less pollution. To them, need for sustainability arises from economic, environmental and resource considerations.

The paper is highlighted with the WCEDS report to the UN. containing the strategic imperatives for the sustainable city which are as briefed below :

1. Increase the social and economic opportunities and entitlement available to all urban residents.

2. Minimise the production of wastes (solid, Liquid, Gaseous), and maximise recycling of wastes that are produced.

3. Create urban government system with the necessary power to reconcile and achieve economic, social and environmental objectives.

4. Reorient urban technologies towards sustainable objectives.

5. Strengthen the ability of urban areas to prevent or cope with threats to economic, social and environmental objectives arising from natural or human causes.

The authors conclude by emphasizing the need for a better statistical data base on the urban component of sustainable development.

(b) 'ECO DEVELOPMENT APPROACH TO ENVIRONMENTAL PLANNING' by R. Sankar, Faculty Member, Department of Architecture and Planning, U.O.R., Urban Planning, Urban India, Vol. 2, No. 3'

The author in this paper highlights the detoriating condition of the cities in the world talks of the Indian urban atmosphere as one of worsening environmental condition. He quotes Barry Commoner, according to whom the root cause of environmental degradation is the technologies, we have adopted so far. And he

visualises environmental degrading factors to be many faceted. Population, landuse, misplaced economics priorities, value systems, depletion of resources, health aesthetics and so on.

According to R.Sankar, key strategies for solving the environmental problems are and population control, choice of technology,technologies which are labour intensive and low level technology approach can lead to conscious improvement, technology must be related to the needs and capacities of the masses. Management of resource and waste, such as recycling etc. Public awareness and participation pressurising, influency government and politician and last but the most important proper implementation of environmental legislation and control.

He emphasise on energy conscious settlement planning and its urgency for proper studies, he also categories the broad areas to be studied for Indian settlements a few are list below :

1. Energy efficiency related to form
2. Energy in different sectors
3. Conserving potential of different types
4. Adoptability to non conventional

He conclude by saying that we need not look west ward to plan, we just have to use our potential planners

alongwith other scientist and technologiests have to take the lead and meet one of the biggest challenges in the history of man's civilization.

2.4 ENERGY

'Energy a critical decision' by Samuel M. Dix, Energy Education Publishers, Michigan 77.

According to Dix, the source of energy is given. Energy is provided by geologist who locate the source. The energy crisis is understood only by individuals who understand the numbers and understand the limitations of our scientific development.

Dix states, it is perhaps two years since the leading physicists of the country began to disclose the fact that there was no break through in atomic fusion, that none could be expected for a decade, and that the breeder could not be counted on to carry the primary electric load in this country.

As analysed by Dr. Human being is an adjustable lot, we can learn to accept more limited expectancies. Adoption is the sceret of survival. He advocates a few changes in the Energy consumption regulation :

1. Gradation of price beyond minimum quality.
2. A 50% reduction in the qualities of fuel used for transportation. Substantially more than 50%.

3. A four times increase in retail cost of transportation fuel.

4. Subsidy on inter and intracity mass transportation.

5. Necessity of private automobiles eliminated to maximum.

6. Mass transportation from mass housing areas.

7. Relocation of homes to solve transportation problem.

8. Modern multiple family structures all within walking distance of cultural, recreational, educational, business and other interest.

9. The close knit suburban areas will develop their own bus services.

10. Reduced availability of transport will increase their social dependence.

11. FOOD-Home gardening, canning, baking will be worth the effort.

12. RECREATION - Vacations on wheels purchable. Vacations will be longer, transport will be confined to coming and going. The arrived guest expected to walk, cycle, soil, paddle, row etc.

Dix suggests a total change in social set up itself by regulating the energy control measures. By doing this he visualises a socially which is much chosen to the native.

ENERGY - The guest editors forward by constantinos A. Kakissopoules, Ekistics : The problem and Science of Human Settlement, Vol. 97, No. 344/345, September/ October, 1990.

The author in his forward in the journal Ekistics, highlights on the Energy and the Environmental problem. He says the utilization of fossil fuels towards energy production is, in fact, extremely dangerous to the ecological balance of our planet, due to substances the former release when burnt.

He also discusses the advantages of renewable energy should be closely connected in the search of lown planners, architects, traffic engineers as well as of the general programmers and decision makers involved in design and functioning of human settlement.

The author discussies briefly of efficiency in energy consumption and cites of the example of Japanese efficiency. He states that fossil fuel will (if not only) be one of the principal source of energy for decades to come, so, technologies against pollution by fossil fuel must be developed. He says as per data of commission of European Committee, thermonuclear fusion seems to be at distance from today in the developed countries.

He concludes by pointing out the following :

* When aiming at solving energy question, the most important development is public awareness over the past two decades.

* Gradual substitution of renewable and safe energy sources for fossil fuels, a substitution that will have to be accelerated by all means.

* Energy factor should acquire a determinant significance in planning and hence increased responsibility for planners.

2.5 'The impact of Energy considerations on the Planning and development of Human Settlement'. Economic Commission for Europe. Recommendations of a Seminar held in Canada in October 1977, under the auspices of the Committee of Housing, Building and Planning of the Economic Commission for Europe.

Recommendations were made under different headings :

PART I : 'Overall policies and strategies relating to energy use in human settlement'

1.1 Recommendation need for action in a situation of uncertainity.

1.2 Coordinated policy development

1.3 Data and research needs

1.4 Participation and cooperation of all concerned

1.5 Special responsibilities of public agencies

PART II : 'Impact of Energy Considerations on Community Planning and Development'

Recommendations :

2.1 Energy problems and human settlement

2.2 Energy conscious physical planning

2.3 Production and conversion of energy

2.4 Energy distribution in human settlement

2.5 Energy economy in heating and services

2.6 Transportation

PART III : 'Impact of energy considerations of the designer construction, improvement and utilization of buildings'

Recommendations :

3.1 Energy saving and the quality of life.

3.2 Need for a national policy for energy conservation in buildings

3.3 Ways and means

3.4 Resources for implementing the energy saving goals

3.5 Design of new buildings

3.6 Existing Techniques

2.6 'The Coming post petroleum metroplis : The role of Planner', Edmund N.Bacon. Ekistics Journal, Sept./Octp., Nov./Dec. 1990.

Bawn in this paper critisizes the U.S. Metropolitan

planning in U.S. He considers the suburban development wasteful in terms of land consumption and cost of providing public facilities. According to him, cost benefit analysis is always bound to be wrong as far as planning is concerned, human poasions, traditions, human will which is more important to analyse.

The author says, the true planner of metropolitan cities is not the planner, not even human being but automobiles. And, this is only a passing phenomenon because petroleum will be used up very soon. In visualizing the big metropolis without automobile, he indicates it is time to reform them to the post petroleum age and sites the example of Beijing, the only modern city with its four million bicycles.

The future without petroleum will improve our quality of our lines, and will bring about the rediscovery of values we had almost forgotten. This will be the great message of innovative strategies and conservation in the future. There will be all sorts of physical changes, bicycle tracks on trains, bicycle storage place at work, places to shower and charge clothes at work, new fashions for clothing adapted to bicycle dinner party. Perhaps there will be a four-day work so that the contact with nature will be achieved by bicycling or hiking the rail station to ones weekend camp.

Becon, in this paper suggests that planner should include the factors of DIMENUTION OF WORLD PETROLEUM SUPPLY in the plans. The author is not optimistic about the public

response to the initially but is sure of it being appreciated two to three decades later. He concludes by stating that the demise of oil can enrich the way we live if we are prepared for it.

2.7 ALTERNATIVE TECHNOLOGY :

"Beyond the petroleum age : designing a solar economy" Christopher Flavin and Nicholas Lenssen, EKISTICS, Sept./Oct. Nov./Dec. 1990.

This paper reveals the importance of renewable energy sources in general and solar power in particular. According to Flavin and Lensen Solar Energy is specially well suited to supplying heat at or below the boiling point of water, (used largely for cooling and heating), which accounts for 30 to 50% of energy used in industrial countries and 70 - 80% in developing countries. Advanced solar collectors can produce water as hot as 200 degree celsius. Solar collectors, alongwith other renewable technologies can turn the sun's rays into electricity. A southern Calfornian Company generates 354 Megawatt of power with these collectors. The newest version of solar thermal system turns 22% of incoming sun light in to elextricity. Spread over 750 hectres the collector produce enough power with these collectors, produce enough power for about 1,70,000 homes, for a competative price. Solar cells could be installed widely on roof tops, along transportation rights of way, and at central generating facilities. A Japanese company has incorporated them into roofing shingles.

The cost of photostheic electricity has fallen in the decade. The forces behind one steady improvement in cell efficiency and manufacturing. Solar cells are also the least expensive source of electricity for much of the third world, more than 6,000 villages in India now relay on them.

The author critisizes the government policies to be biassed with much financial sanction to renewal energy system and says this will also protect them from the fluctuating oil market.

The author critisizes the government policies to be biased with more financial sanction to renewable sources. This is not only with the developed countries but also the developing nations like India where 19 only 1% of governments energy outlay goes to renewable sources (excluding large hydroelectric dams). He advocates an to the shift towards a solar economy, which in turn will create more jobs, economic landuse and protect the globe from the environmental disasters.

2.8 'SOLAR ENERGY TECHNOLOGIES' by Dr. J.S. Saini, U.O.R., Roorkee - Annual Progress Report for 1985-86 of State Bank Chair of Appropriate Energy Technology for Rural Development.

In this paper, Dr. Saini has discussed the low energy scenario of the country and hence the cause of low productvity and perpetual productivity. He indicates also the

scarecity of fossil fuel, the need for ecologically sound technologies and ther by emphasizing the need for solar energy.

The author discusses the sources and various forms in which it can be put to use and the technologies available, both direct and indirect. He goes in details of some of the active solar energy collection and storage techniques. Techniques to reduce losses.

Both Flat Plate collectors and Focussing collectors, their efficiency, cost and applications are discussed.

Some important solar energy systems are discussed with detailed drawings, such as solar coolers, Solar heaters - water heaters, air heaters, space heaters, refrigeration and air conditioning, solar ponds, solar power generation - photovolteic conversion and solar thermal conversion.

The paper is concluded by remarks of the authors noted below :

1. Solar energy resources has the capacity to replace all other resources put together.
2. Viable technologies are available for thermal applications like cooling, heating, agricultural and industrial applications.
3. Technologies for solar power generation are available but are not yet commercially viable.

2.9 BIOMASS

'Development of Downdraft Gosifiers'
from the Annual report of A.H.E.C., University of Roorkee, Roorkee 1985-86.

Biomass in the form of fire wood, Agricultural and forest wastes, is most extensively used in developing countries.

Technologies available :

Energy can be harnessed from biomass by two processes Biological and Thermochemical. Among all thermochemical processes, the gasification deserves extensive attention because it helps in sowing disposal problems, reducing environmental pollution and producing combustible fuel gas for thermal and power generation application. It encourages reafforestation of barren land for energy plantation.

In India M/s Jyoti Limited, Baroda has developed gasifier engine system for thermal and electrical power applications. The design is based on wood chips.

CHEMISTRY OF GASIFICATION PROCESS :

Gasification is a thermochemical process to convert chemical energy, contained in biomass fuels, into a gaseous fuels which can be burnt efficiency with a low amount of excess air either in a gas burner for thermal application or in an I.C. engine for power generation.

The Biomass is successively heated, dried and pyrolyse to produce gases, tar and char. The gasification media may

be air, oxygen, steam, hydrogen etc.

$C + 2H_2 = CH_4$, the methane found is the product of pyrolysis reaction during gasification process. Based upon experimentation, the material balance has been calculated as follows :

Input			Output		
Wood chips	...	20 Kg.	Dry gas	...	41.5 Kg.
Air	...	26.9 Kg.	Char	...	1.6 Kg.
			Tar	...	0.90 Kg.
			H_2O	...	2.09 Kg.
Total	...	46.9 Kg.			46.09 Kg.

Energy Balance :

Input = 20 x 4500 = 90,000 Kcal

Output = Dry gas = 49,800 @ 1200 Kcal/kg.

Char (@ 7000 Kcal/kg.) = 11,200

Tar (@ 6000 Kcal/kg.) = 5,400

66,400

Efficiency of gasifier for thermal application = $\frac{66,400 \times 100}{90,000}$

= 73.7%

For electrical power generation, it would be low, i.e., 55.3%.

CHAPTER-3:

IDENTIFICATION OF THE PROBLEM

3. IDENTIFICATION OF THE PROBLEM :

3.1 SIGNIFICANCE AND INTRODUCTION TO THE THESIS PROJECT

'The sign that many of the present cities and towns are inherently unsustainable are sometimes direct, as in their decaying physical and social fabrics. They are also indirect for example, Ozone holes and green house effect. If these and other unsustainable characteristics are to be reversed, decisive changes are needed in policies and action that will shape urban areas'. (Mac Weill, John, E.C., Jackson Ian).

3.2 DEFINING THE PROBLEM

It is in the towns and cities and metropolitan areas that onefifth of the worlds population produce majority of the worlds goods and services. In the process, they use vast qualities of energy and other resources, and discharge large amounts of solid, liquid and vapour wastes. The urban challenge is to achieve major reduction in energy, other natural resources and wastes.

Because of the limited resources and the growing developmental needs of the developing countries including India, there is an urgent need to plan for self sustaining human settlements based on autonomous life support system using renewable energy sources and materials recycled in an ecological manner. The settlement which would essentially be urban (rural urban) in character.

The ideas of self reliance and sustainability are highly practical. Applied widely enough, they would rejuvenate neighbourhoods and communities, reduce environmental costs, lower energy demands minimise burdens on Government, cut inflation and unemployment and preserve islands of diversity in a homogeneous and vulnerable society. The problem of our urban settlements could be attributed to lack of planning methodology, which after integrated and viable alternatives. The inherent assumption in conventional planning are essentially based on the fact that fossil fuel and other non renewable resources are available in plenty. However, these philosophies no longer hold good in view of the present resource crisis and environmental degradation. There has to be a new outlook in planning process, considering the energy crisis and to eradicate these problems and make the settlements sustainable for environment friendly alternative technologies.

3.3 JUSTIFICATION OF THE THESIS TOPIC

Over the last decade and a half many theoretical and descriptive models have been proposed for the establishment of new eco-communities and eco-settlements which would achieve self sustainability in varying degrees (C.L. Gupta, Adity Prakash etc.), but the question of making the existing communities and settlements, particularly the urban settlements resource conserving and self sustainable has not been tackled. It is with this intent of studying the feasibility of transforming viable urban into a sustainable one that the author has taken up this particular project for the dissertation work.

WHY ROORKEE TOWN ?

The selection of Roorkee for the feasibility study was done because of many advantages :

1. Roorkee is neither too large nor too small and its size being very closed to what could be termed ideal, within the parameter of the town centre and other facilities being within walking distance.

2. It consists of distinct physical entities or units viz., the Cantonment, the University, the Cemtral Building Research Institute, the Irrigation Research Institute, the Civil Lines, the old town and Industrial area, hence compared to other urban settlements this is less complex.

3. The potential for 'retrofitting' into eco-settlement is very high for Roorkee as already many of the environmental problems existing in other cities are absent, hence resource potential is relatively high.

4. Implementing the proposals would be easier in Roorkee town because of greater public awareness, higher literacy and expected institutional cooperation.

5. Familiarity of the place and easier means of data collection.

3.4 AIMS AND OBJECTIVES

AIM :

The aim of this study is to assess the potentials

and to out line strategies for sustainable eco-development of Roorkee town.

OBJECTIVES :

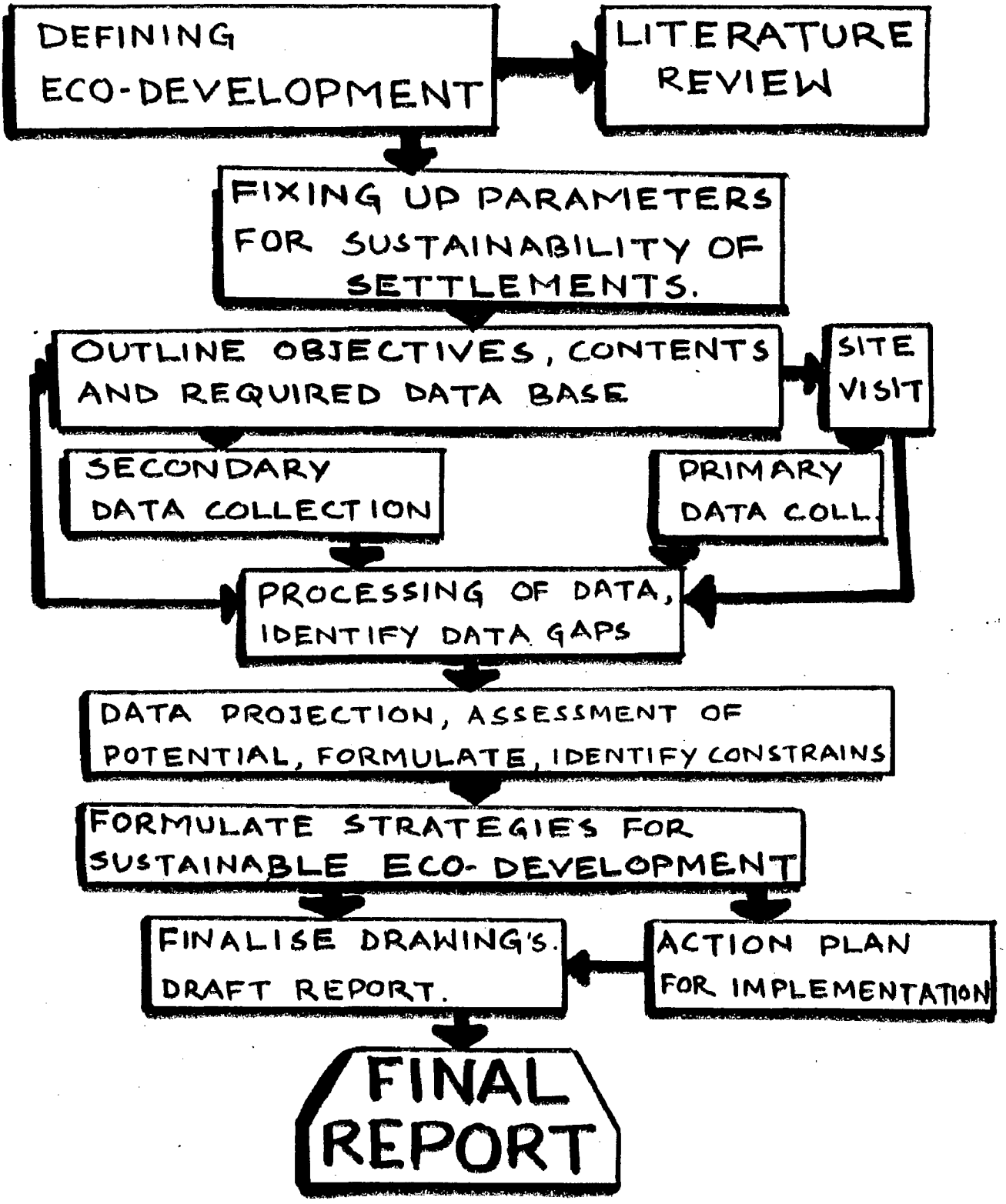
1. To interpret the need and idea of sustainable eco-development as applicable to settlement planning and formulate its objects, contents, data base etc.
2. To survey and analyse the resource potential for sustainable eco-development with respect to basic needs namely, air, water, food and energy.
3. To formulate action plan for sustainable eco-development of Roorkee town.
4. To outline strategies for implementation.

3.5 METHODOLOGY (Ref. Flow diagram Fig. F-3.1)

1. Literature survey
2. Survey of the town (Roorkee) and data collection - Secondary and Primary
3. Study and Analysis of the town and data
4. Processing of data
5. Identification of problems and potentials
6. Formulate strategies for sustainable eco-development
7. Prepare action plan

fig 3.1.

METHODOLOGY



3.6 LIMITATIONS OF THE STUDY

The limitation faced during the course of preparation of this report are :

- Non availability of data on energy consumption by different sectors at town level.
- Non availability of statistics on the use of various resources by the town.
- Non availability of information, literature on energy implication of alternative transport pattern, alternative energy services.
- The character of wide field to be considered for sustainable development which demands detailed study which will be limited due to time and other limitations.
- Non availability of adequate and accurate data and information.

Due to the limitation of time, data and other resources the assessment of potentials for self sustainability has been done only with respect to selected basic need and resources of the settlement viz., water, food, energy resources and waste management only.

CHAPTER-4:

STUDY OF

ROORKEE TOWN

CHAPTER 4 : STUDY OF ROORKEE TOWN

4.1 INTRODUCTION :

4.1.1 History and Stages of Growth :

Roorkee is locally said to have derived its name from Ruri, the wife of a Rajput Chieftan. It was the capital of a paragona during the time of Mughal Emprer Akbar, but nothing of that age is traceable now.

It is said that before the Ganga Canal, the settlement was in the form of a village of mud houses. (Ref. Figs. F-4.1 - 4.5). There were kutcha roads leading to Hardwar Saharanpur and Delhi.

Roorkee had its importance first as the Headquarter of the Canal Workshop and Iron Foundary, which were established in 1945-46. The other considerable land marks which accelerated the growth and development of the town are as mentioned below in cronological order :

1845 - Thomson Engineering College

1853 - Bengal Sappers and Miners H.Q.

1854 - Gangaes Canal Commissioned

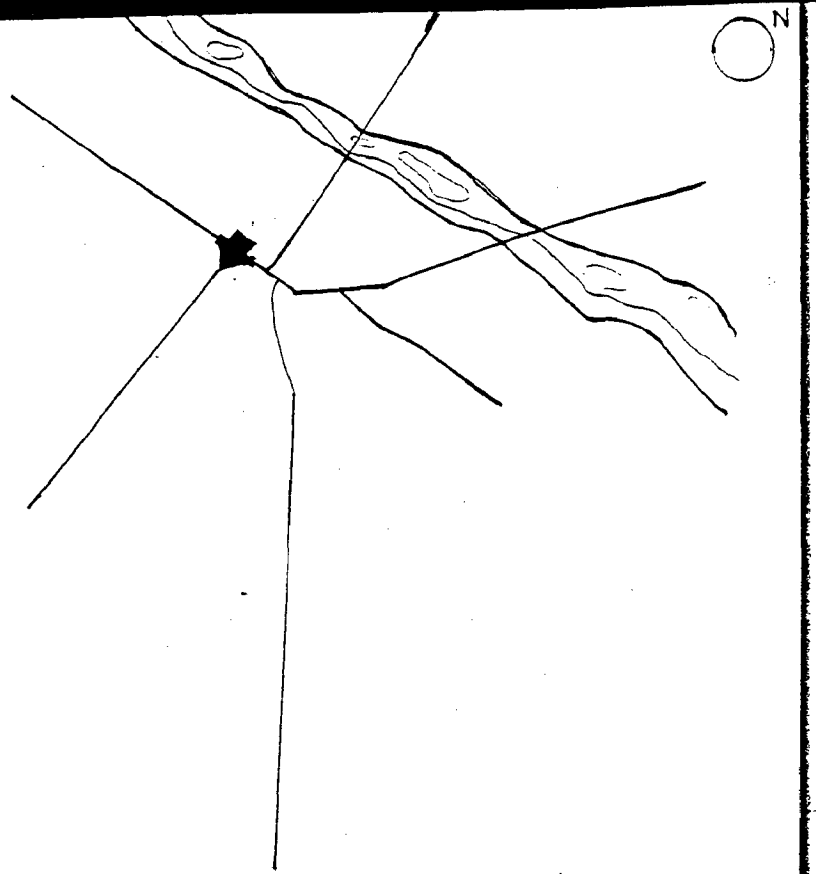
1868 - Municipality was created

1886 - Railway links to Saharqnpur and Hardwar

1946 - Irrigation Research Institute

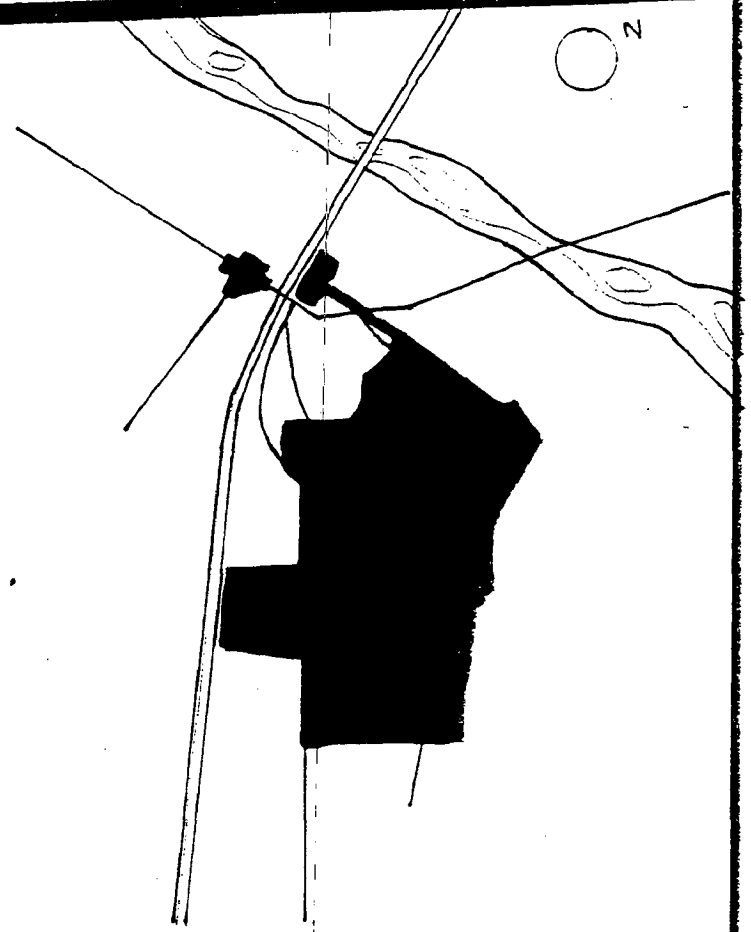
1947 - Central Building Research Institute

1971 - Irrigation Design Organisation



MAP OF ROORKEE 18-CENTURY (early)

fig-4.1

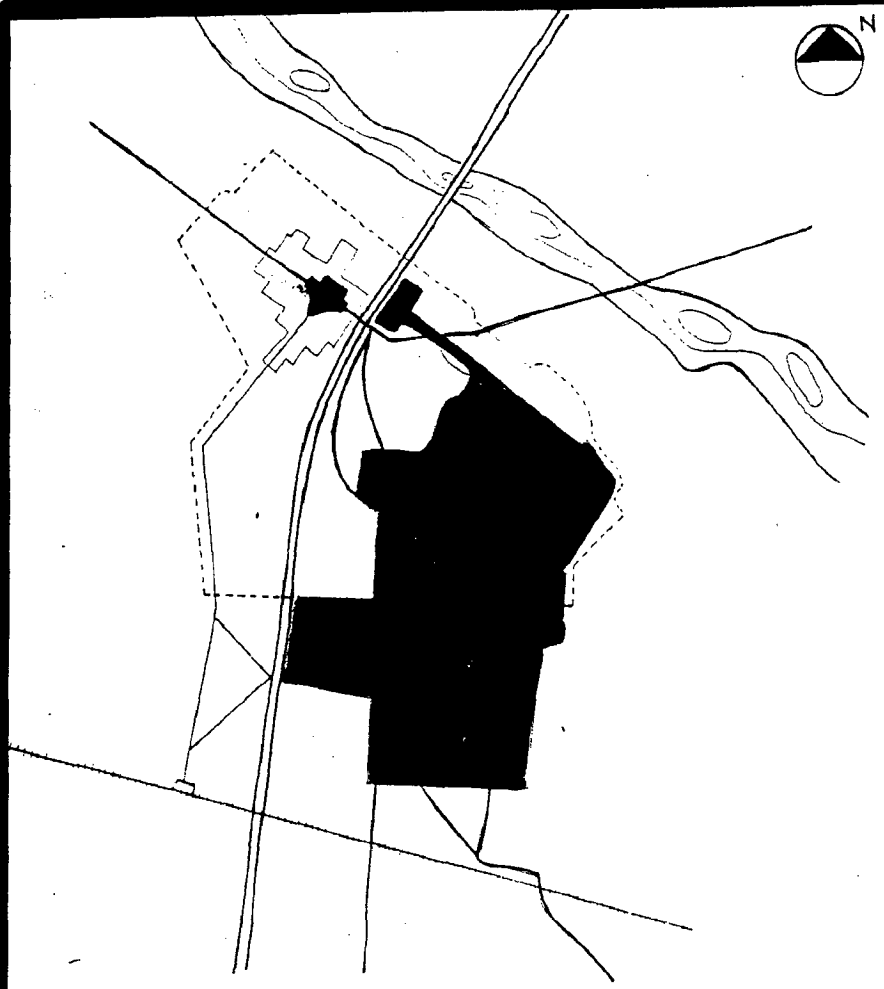


GROWTH OF ROORKEE UPTO 1856: GANGES CANAL, THOMSON COLLEGE OF ENGINEERING & CANTONMENT ESTABLISHED
POPULATION: 8596 PERSONS

NTS

MAP OF ROORKEE fig-4.2

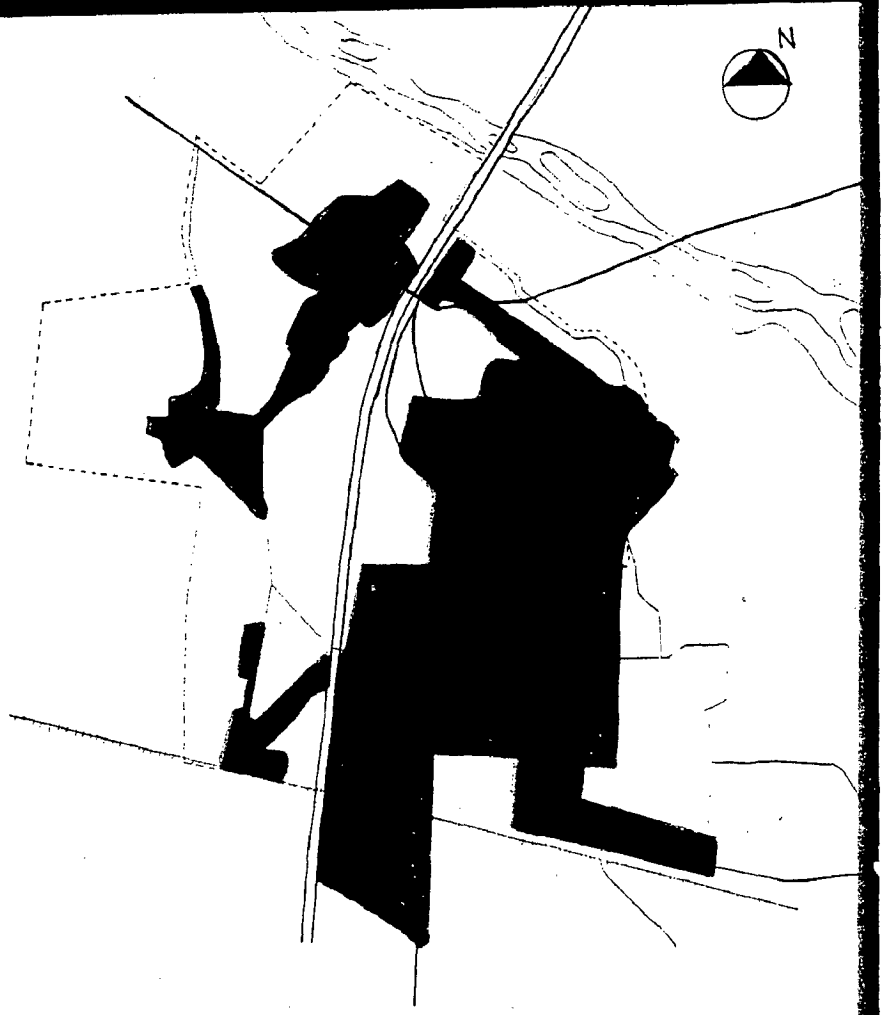
SOURCE: Env. Std. of Roorkee. 1983-84.



GROWTH OF ROORKEE UPTO 1886 LAYING OF RAILWAY LINE. N.T.S.

POPULATION : 17367 PERSONS

MAP OF ROORKEE fig-4.3 Source: EnvH Study of Roorkee Town.

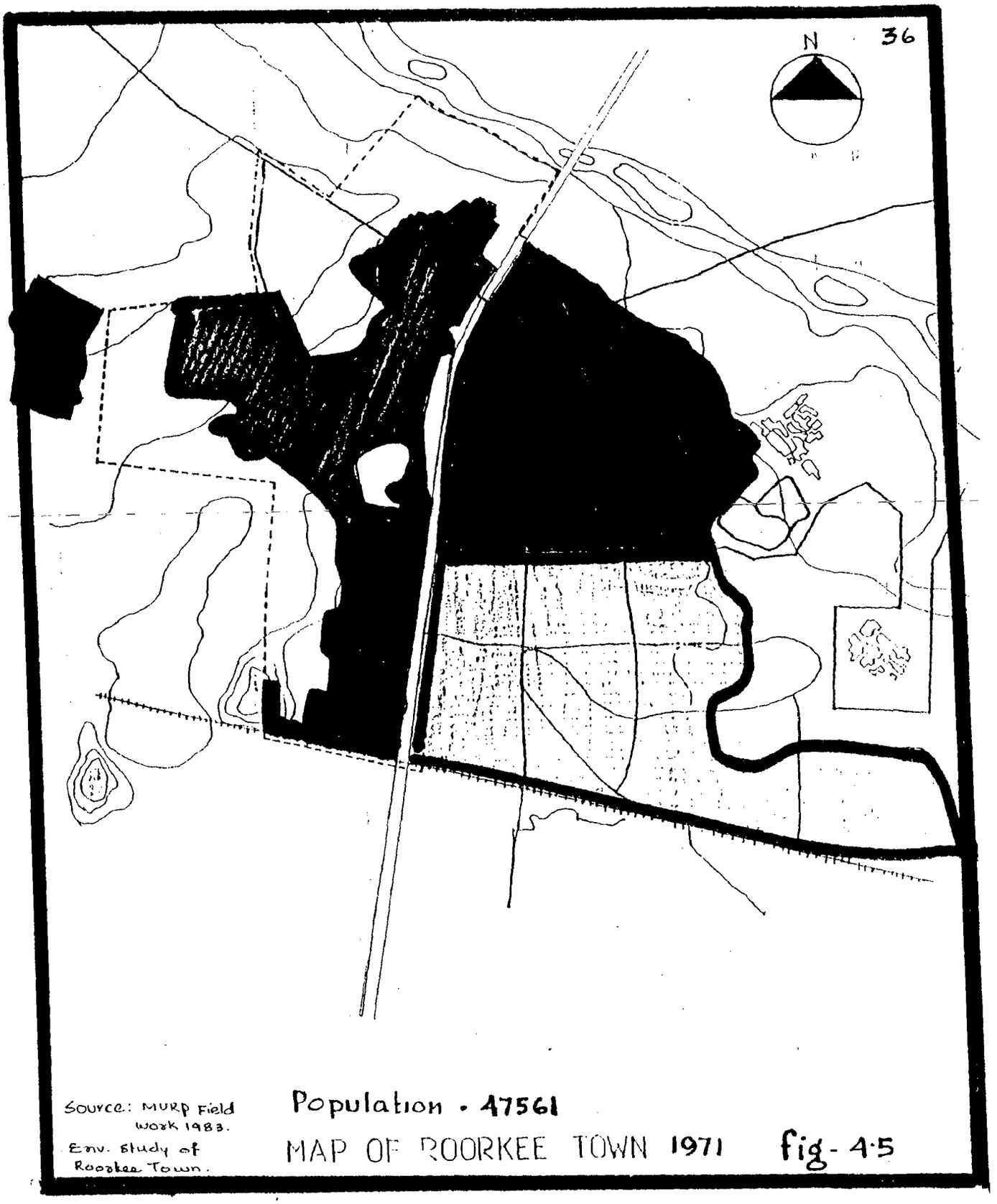


GROWTH UPTO 1951

POPULATION : 33092 PERSONS

MAP OF ROORKEE

fig-4.4.



Source: MURP Field Work 1983.
Env. Study of Roorkee Town.

Population - 47561

MAP OF ROORKEE TOWN 1971 fig-4.5

Roorkee town as per Gazette of India 1903 publication, in 1947 population was 5,511. The population of Roorkee Urban Agglomeration as per 1981 census was 89,076.

4.1.2 Location :

Roorkee town is situated in the Indo Gangetic plains, overlooked by the mighty Himalayas. It is situated at $29^{\circ}51'$ N and $77^{\circ}53'$ E at an altitude of 268 mts. above M.S.L. It is in Hardwar District of Uttar Pradesh State of India. Fig. F-4.6 - 4.7.

4.1.3 Regional Linkage and Importance :

Roorkee town is the Tehsil Headquarter of Roorkee Tehsil, which is the largest of the three Tehsils of Hardwar District and it has three blocks. Ref. Fig.4.8.

Roorkee Tehsil fells within $29^{\circ}38'$ N - $30^{\circ}08'$ N and $77^{\circ}43'$ E - $78^{\circ}12'$ E. The tehsil is divided in three administrative blocks, i.e., Roorkee, Bhagwanpur and Narsan.

Roorkee town falls on the north western part of Meerut Commissionary, on the Delhi Mussorie and Delhi Rishikesh Highways. The Grand Trunk Howrah - Amritsar Railway line passes through Roorkee and a break line from Laksar to Haridwar, Dehradun and Rishikesh.

Roorkee is well connected to state and national capital. Its linkages to important towns and cities are as mentioned below in Table T-4.1.

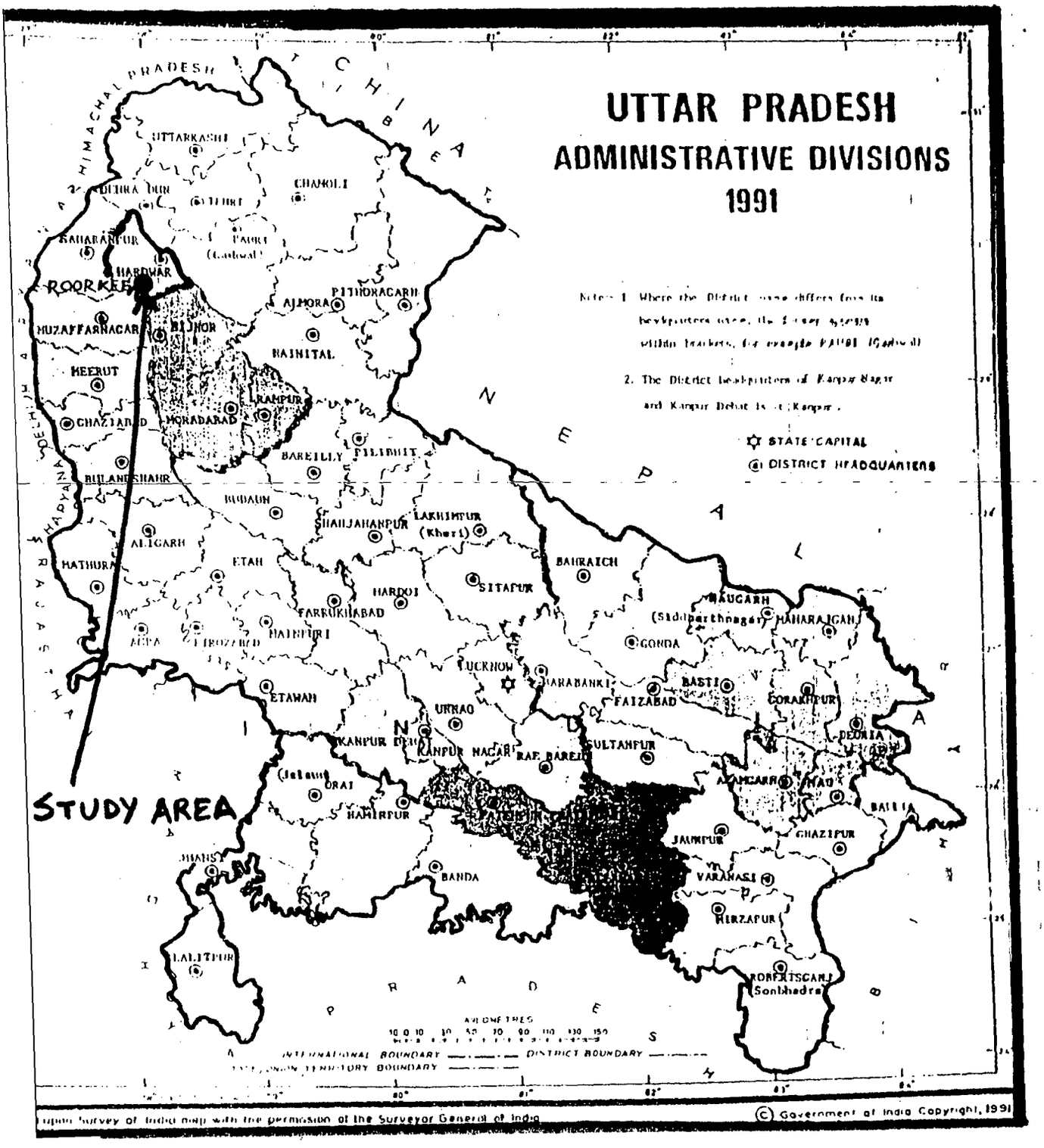
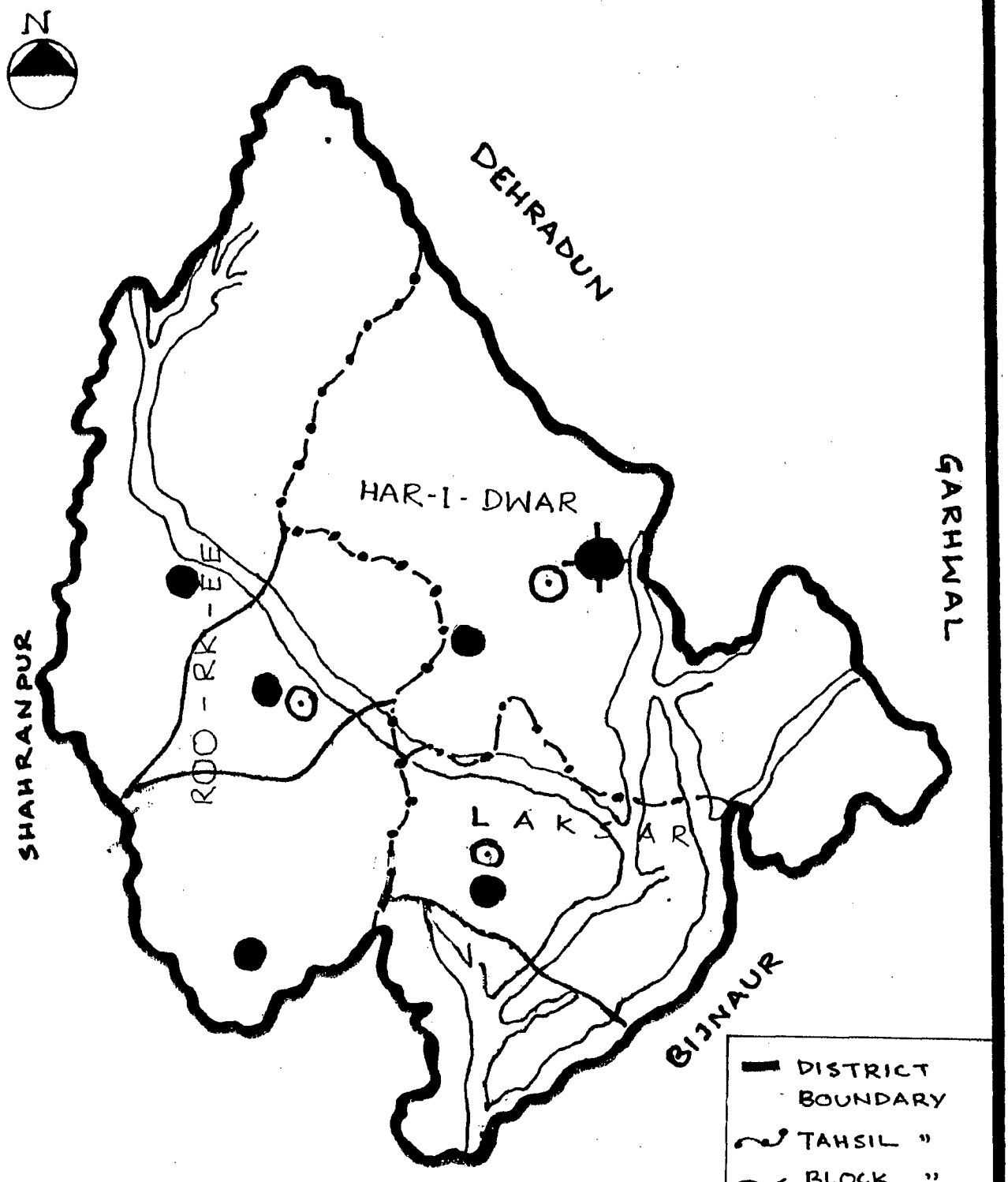

UTTAR PRADESH
ADMINISTRATIVE DIVISIONS
1991
STATE CAPITAL
DISTRICT HEADQUARTERS
STUDY AREA
HIMACHAL PRADESH
CHINA
NEPAL
HARYANA
RAJASTHAN
MADHYA PRADESH
UTTARKASHI
DEHRA DUN
TEHRI
CHAMOLI
SAHARANPUR
HARDWAR
ROORKEE
PAURI (Garhwal)
PITHORAGARH
AJMORA
MUZAFFARNAGAR
BIJNOR
NAINITAL
MEERUT
RAMPUR
GHAZIABAD
MORADABAD
BAREILLY
PILIBHIT
BULANDSHAHR
BUDAUN
SHAHJAHANPUR
LAKHIMPUR (Kheri)
ALIGARH
ETAH
HATHRAS
HARDOI
SITAPUR
BAHRAICH
FARRUKHABAD
MAINPURI
AGRA
FIROZABAD
GONDA
BALRAMPUR (Siddharthnagar)
MAHARAJGANJ
LUCKNOW
BARABANKI
FAIZABAD
BASTI
ETAWAH
UNNAO
KANPUR DEHAT
KANPUR NAGAR
RAE BARELI
SULTANPUR
GORAKHPUR
DEORIA
AZAMGARH
MAU
BALLIA
(Jalaun)
ORAI
HAMIRPUR
JAUNPUR
GHAZIPUR
JHANSI
BANDA
VARANASI
MIRZAPUR
LALITPUR
SONBHADRA (Robertsganj)
KILOMETRES
INTERNATIONAL BOUNDARY
DISTRICT BOUNDARY
UNION TERRITORY BOUNDARY
Based upon survey of India map with the permission of the Surveyor General of India
© Government of India Copyright, 1991

Fig 4.6

FIG. 4.7

HARIDWAR DISTRICT



MUJAFFAR NAGAR

Population : 1,22781 1991

Source : Tahsil Office Roorkee.
Statistical hand book 1988.

TAHSIL ROORKEE

fig- 4.8

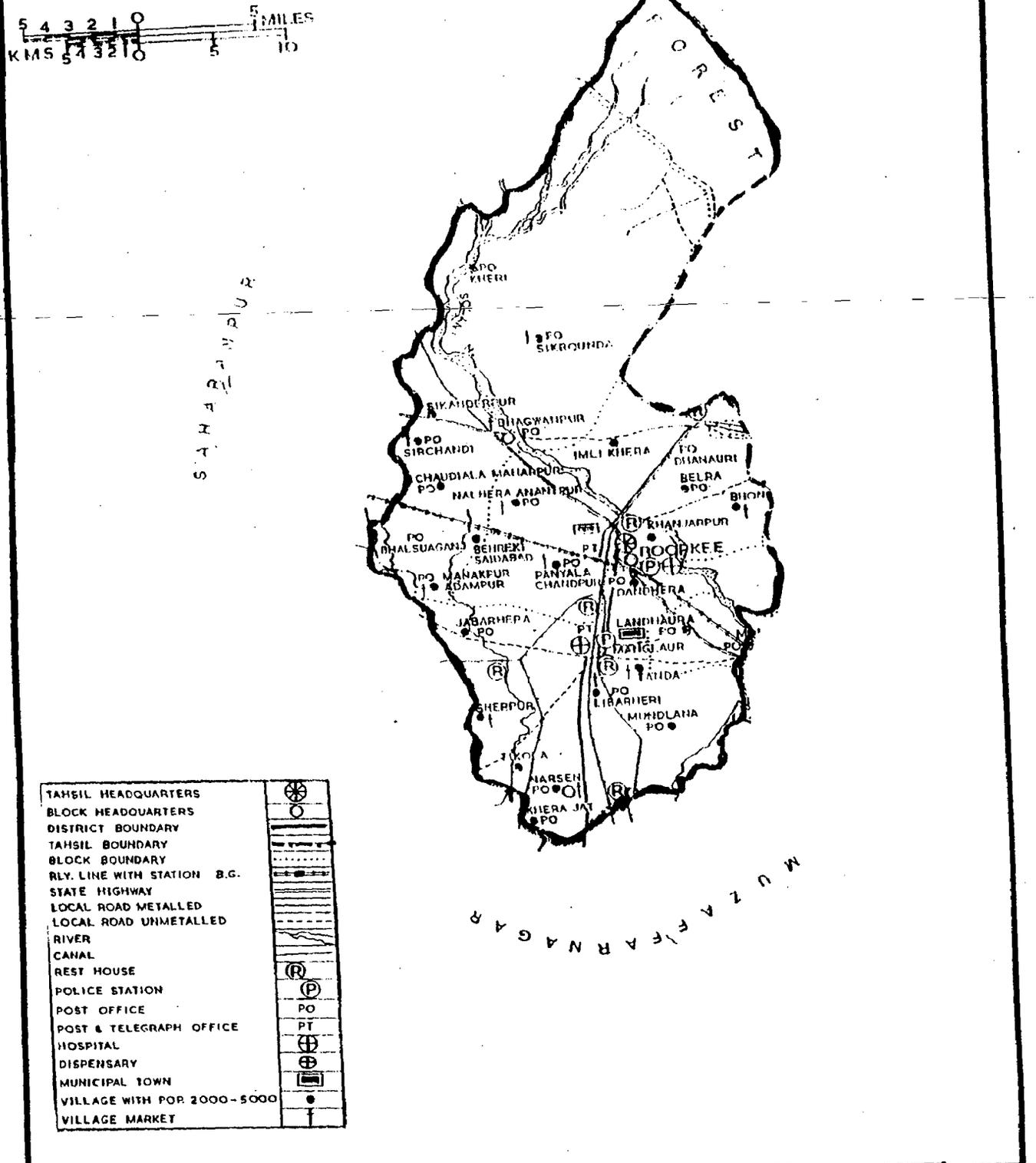


Table 4.1

Regional Linkage and Importance

S.No.	Town	Type of Town	Distance By Rail	Distance By Road
1.	Delhi	Country's Capital	217	170
2.	Lucknow	State capital	491	538
3.	Mussoorie	Hill Station	-	100
4.	Dehradun	Hill Station	97	68
5.	Saharanpur	Distt. HQ till 1986	36	46
6.	Haridwar	Pilgrimage and tourist centre	46	31
7.	Piran Kaliyar	Pilgrim Cent.	-	08
8.	Muzaffarnagar	Main Mandi	42	52
9.	Badrinath	Pilgrimage Cent.	-	200
10.	Kedarnath	-do-	-	200
11.	Meerut	Commissionary	148	104

Importance :

Roorkee is famous for the pioneer Engineering Institute of India, now called the University of Roorkee. It is also important for the existence of B.E.G., Headquarter, a brigade H.Q., Existence of other important Technical and Research Organizations like I.R.I., N.I.H., C.B.R.I. makes Roorkee an important place in the country. Roorkee is also well known for its Drawing and Survey Instruments Industries.

Roorkee falls on the way to the some of the most famous pilgrim centres of India, Haridwar, Rishikesh, Badrinath, Kedarnath, Gangotri and Yamonotri. It is also on the way to Dehradun and Mussoorie which are places of tourist attraction. Piran Kaliyar, the religious shrine of 'Shabir Sahaib' is situated six kilometers from Roorkee town. A fair is held every year which attracts Mohammadas from all over the country and abroad also.

4.1.4 Geophysical and Climatic description :

a. Physical characteristics :

To the north of the town lies the solani river, the railway line and the cantonment to the south. The University, C.B.R.I., Khanjarpur and other fringe villages to the east. To the west lies the Industrial Estate Ramnagar and Roorkee Dehradun road. All these factors restrict the growth of the town to the west. (Refer Fig. 4.9).

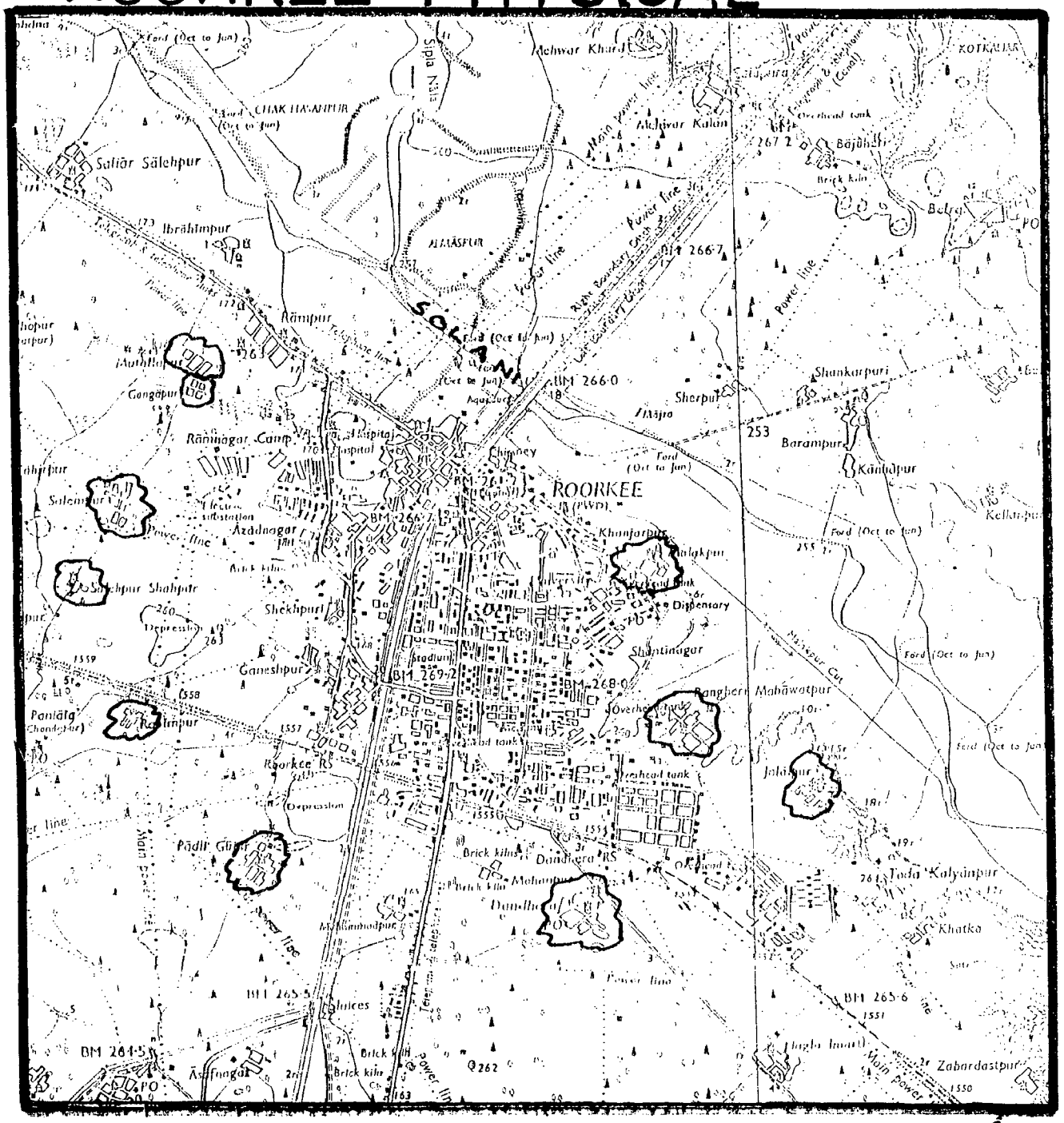
Area within Municipal boundary is 8.11 Km. and it roughly correspond in shape to finger shape.

b. Soil Characteristics :

There are two types of soil in the area, soil with admixture of sand, soft clay, the other one is clayee with very less sand content. A small area of land with 75 percent of sand content also exists near the Solani river bed.

fig- 4.9

ROORKEE PHYSICAL CHARACTERSTICS



VILLAGES INHABITED

TEMPLE, CHURCH, MOSQUE

TUBE WELL ▲

POST OFFICE, POLICE STATION : P.O. PS

SOURCE: Survey of India 1973

c. Topography :

The topography is plane in nature with gradual slope towards the river and agricultural field around.

Solani bed, C.B.R.I., Ramnagar, Mahigran areas are low lying. Maximum difference in altitude is 9.2 mt. B.M. at Cantt. is 268.2 mt. and 260 mt. at Khanjarpur. From Khanjarpur to Solani river bed there is again a gradual slope with a difference of seven meters. This part is low lying subjected to flood during rainy season. (Refer Fig. F-4.10).

d. Climate :

Roorkee has extreme type of climate. Hot summer and cold winters. April to September is hot, August to October is the rainy season, October is comfortable. November to March is the winter season. The early summer period is dry, humidity increases with the rains.

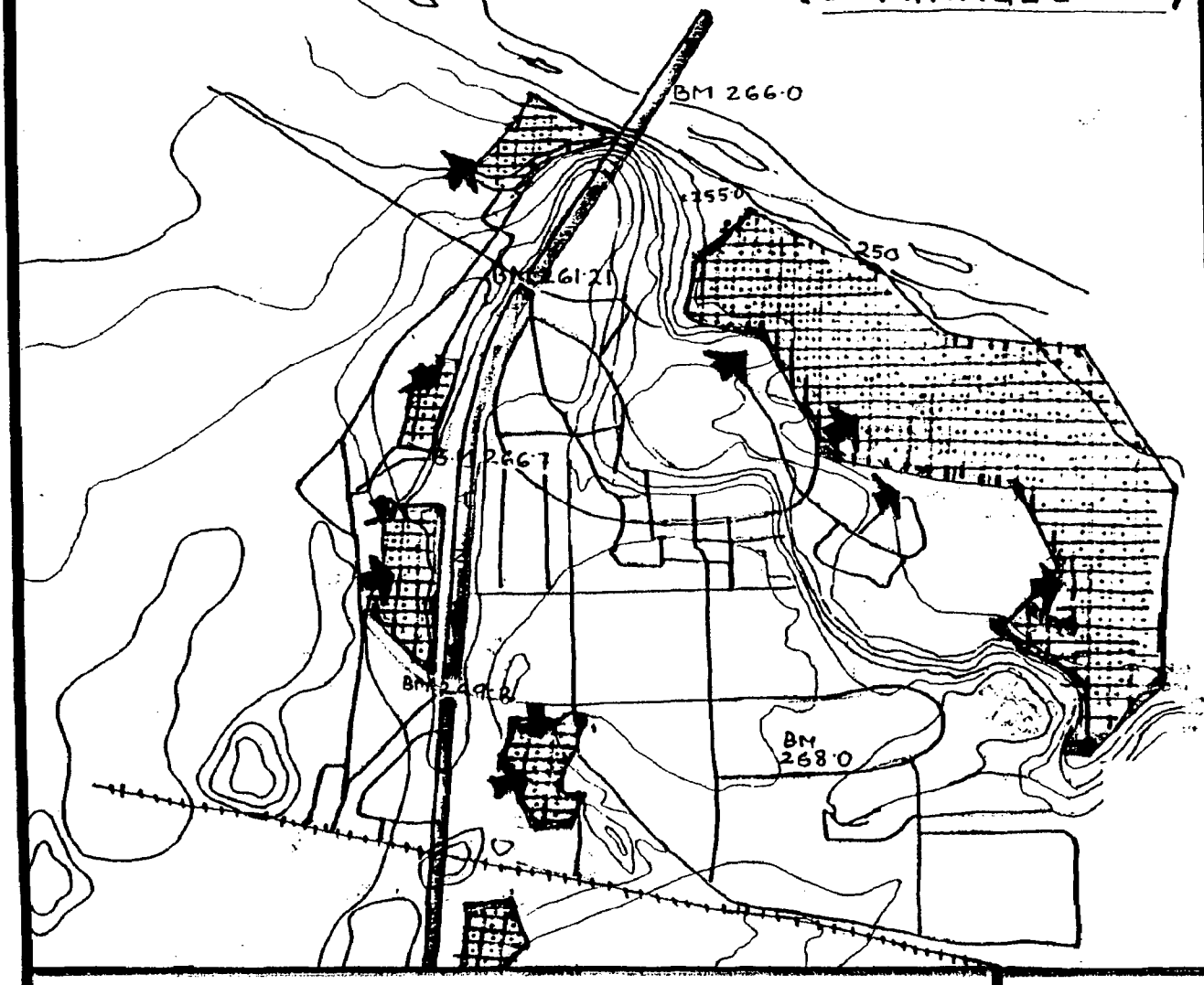
Meterological data as per I.M.D. report is summarised below :

Climatic zones :

Temperate period : Temperature 20^{o} - 30^{o} month of October, Novamber and March

Hot Dry period : Temperature 30 - 35^{o}C, months of April, May and June.

ROORKEE TOWN (TOPOGRAPHY & DRAINAGE [natural])



B.M.- BENCH MARK.

Max. alt = 269·20

Min alt = 250·00

LOW LYING AREA SUBJECT TO FLOODING

Fig·4.10

SOURCE: AS PER SURVEY OF INDIA (1976)

Hot Humid period : Temperature 25 - 35°C months of July, August and September

Cold period : Temperature below 20°C months of December, January and February

i. Temperature :

Mean monthly : Maximum temperature in °C.

January	:	22.2	May	:	39.0
August	:	32.1	November	:	26.4

Mean monthly minimum temperature in °C.

January	:	6.5	May	:	23.6
August	:	25.1	November	:	9.7

Mean Yearly Temperature in °C (1991)

Highest	Lowest
41.1	1.3

ii. Relative Humidity :

Mean Relative Humidity %

January	:	86	May	:	42
August	:	85	November	:	79

iii. Rainfall :

Mean monthly total rainfall in mm :

January	:	42.4	May	:	19.3
August	:	28.5	November	:	5.8

Heaviest rainfall within 24 hours 266.7 mm

Mean Annual total rainfall in mm = 2183.5 mm

iv. Wind :

Mean monthly wind speed Km/hr and direction :

Month	Wind direction		Speed
	Morning	Evening	
Jan.	NW	NW	2.90
May	SE	NW	
		SE	5.15
August	SE	NW	3.22
		SE	
November	NW	NW	1.61

v. Sunshine :

Number of sunny days :

100%	=	169	Fully sunny
70-90%	=	64	Partly
40-60%	=	55	Partly
10-30%	=	47	Partly
0	=	30	Over cast
		365	

Source : IMD weather report 1991.

NOTE : Number of sunny days for Roorkee is taken based on weather report of Modipuram which falls at $28^{\circ}0'$ N and $77^{\circ}30'$ E and that of Roorkee is $29^{\circ}51'$ N and $77^{\circ}53'$E.

Overall climate of both the places has similarity.

4.2 DEMOGRAPHIC CHARACTERISTICS :

In District census Hand Book 1981, Roorkee has been shown as an urban Agglomeration (U.A.). U.A. is defined as the continuous urban spread at a place which may cover one or more than one town with their outgrowths. The Roorkee U.A. comprises of Roorkee Municipal Board township enclosed within the Municipal boundary and Roorkee Cantt. The population of Roorkee within the Municipal limits in 1991 is 80,236 according to Roorkee Municipal Board Report which includes University, C.B.R.I. and other institutions. Population of Cantt. Board in 1991 was 21,810. The total 1991 population of Roorkee U.A., thus works out to 1,02,046 more than one lac, justifying enhancement of its status to Class I town, as against Class II town at present.

The trend of growth of population of Roorkee town has been shown with the help of bar graph. Ref. T-4.2 and Fig. F-4.11.

4.3 Projected Population :

The projected population of Roorkee U.A. for years 2001 and 2011 have been computed by Geometric Progression method as given below :

(a) Roorkee Town within present Municipal Limits :

P_o = 61851 (1981 population)

P_m = 80236 (1991 population)

r = Rate of growth of population

n = No. of years from P_o to P_m, i.e.

$1991 - 1981 = 1.0$

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

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

$= (\frac{80236}{61851})^{1/10}$

$= 1.026$

i. 2001 population :

$P_{2001} = P_{1991}(1 + r)^n$

$= n = 2001 - 1991 = 10$

$= 80236\ (1.026)^{10}$

$= 104086$

ii. 2011 Population :

$P_{2011} = P_{1991}(1 + r)^{20}$

$= n = 2011 - 1991 = 20$

$= 80236\ (1.026)^{20}$

$= 135025$

(b) <u>Roorkee Cantonment</u> :

$P_{1971} = 14895$

$P_{1991} = 21,810$

$1 + r = (\frac{21,810}{17,225})^{1/10}$

$= 1.023$

TABLE : T-4.2

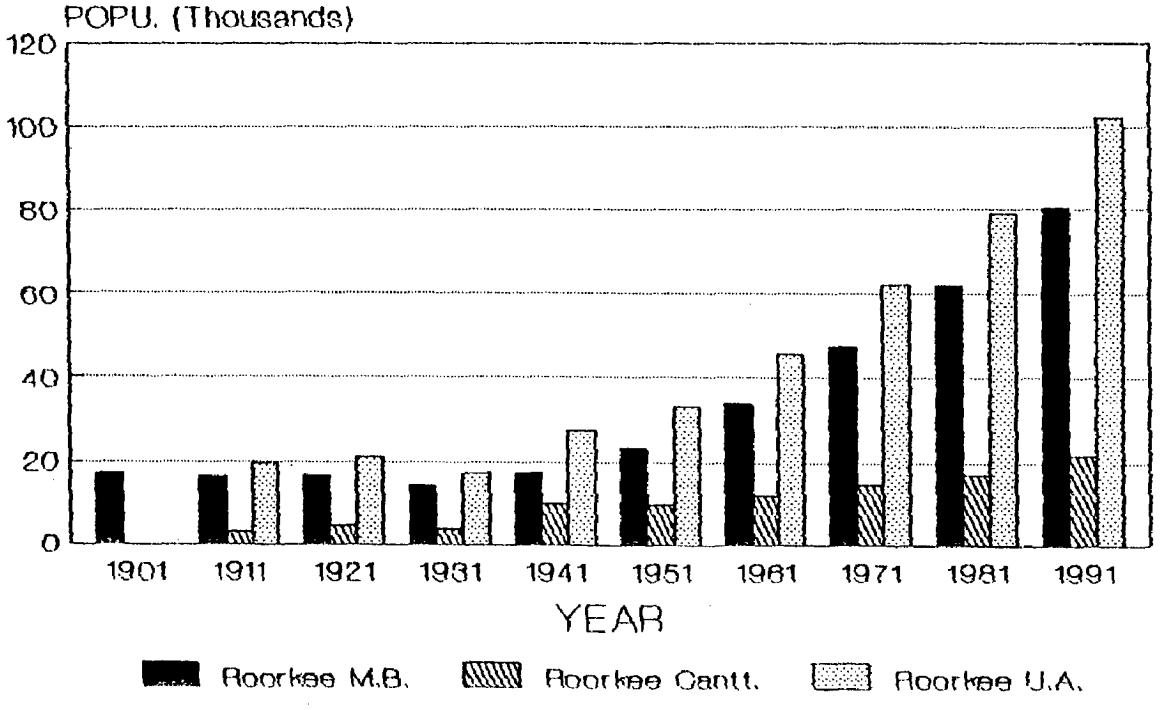
POPULATION GROWTH ROORKEE TOWN GROUP 1901 - 1991

Year	ROORKEE M.B.				ROORKEE CANTT.				ROORKEE U.A.	
	Status	Area	Population	%Variation	Status	Area	Population	%Decinnial Variation	Population	Decadal variation
1901	-	-	17148	-	-	-	-	-	-	-
1911	-	-	16584 (-)	3.29	-	-	2734	-	19318	-
1921	-	-	16716 (+)	0.80	-	-	4470 (+)	63.50	21186	(+) 9.70
1931	-	-	13944 (-)	16.58	-	-	3532 (-)	20.80	17476	(-) 17.50
1941	-	-	17334 (+)	24.31	-	-	10030 (+)	183.98	27364	(+) 56.58
1951	-	-	23239 (+)	34.07	-	-	9853 (-)	1.76	33092	(+) 20.93
1961	M.B.	7.51	33651 (+)	41.80	C.B.	-	12150 (+)	23.31	45801	(+) 38.40
1971	M.B.	7.74	47561 (+)	41.34	C.B.	9.30	14895 (+)	22.59	62456	(+) 36.36
1981	M.B.	7.74	61851 (+)	30.05	C.B.	9.30	17225 (+)	15.64	79076	(+) 29.05
1991	M.B.	8.11	80236* (+)	29.72	C.B.	9.30	21810@ (+)	26.66	102046	(+) 29.05

* Census Report 1991

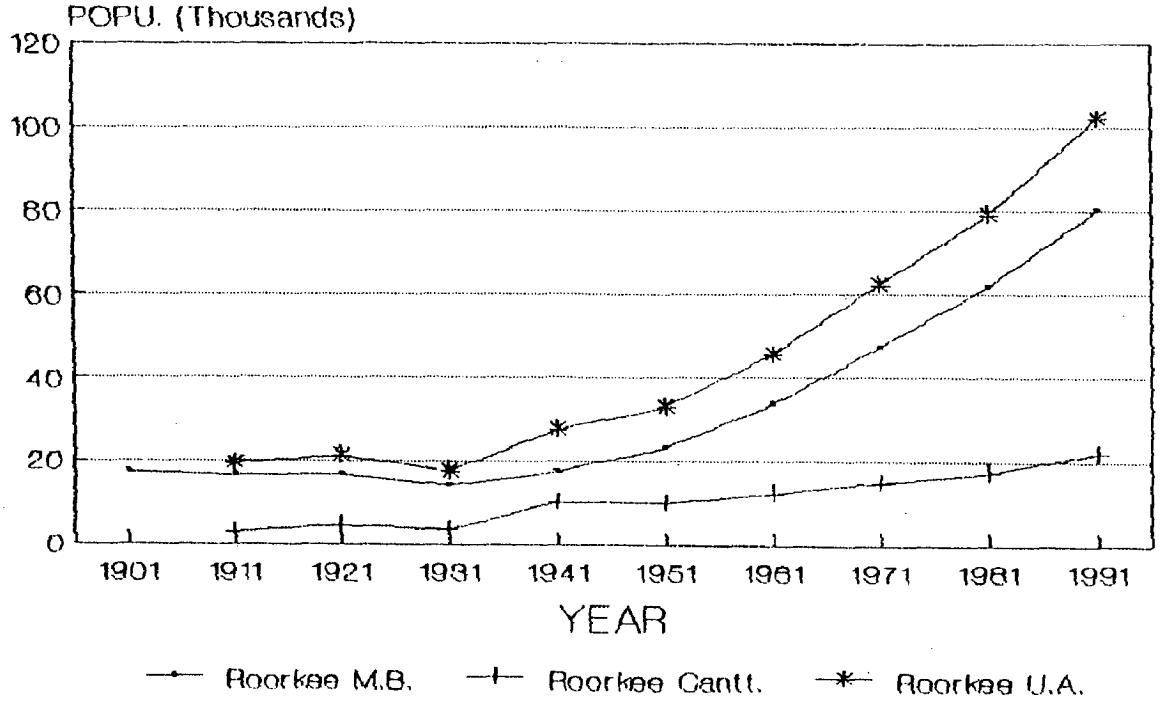
@ Station Headquarter, Roorkee Cantt. & Municipal Board

FIG.4.11(A):TREND OF POPULATION GROWTH
Roorkee M.B.;Cantt.BRD.& U.A. (1901-91)



Source:CENSUS '91;Cantt.;M.B.Report

FIG.4.11(B):TREND OF POPULATION GROWTH
Roorkee M.B.;Cantt.BRD.& U.A. (1901-91)



Source:CENSUS '91;Cantt.;M.B.Report

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

$= 21,810\ (1.023)^{10}$

$= 27,378$

$P_{2011} = P_{1991}(1 + r)^{20}$

$= 21,810(1.023)^{20}$

$= 34,369$

(c) Roorkee U.A. (within present limits of Municipal and Cantonment Boards)

i. P_{1991} = 80236 + 21,810

= 1,02,046

ii. P_{2001} = 1,04,086 + 23,378

= 1,31,464

iii. P_{2011} = 1,35,025 + 34,369

= 1,69,394

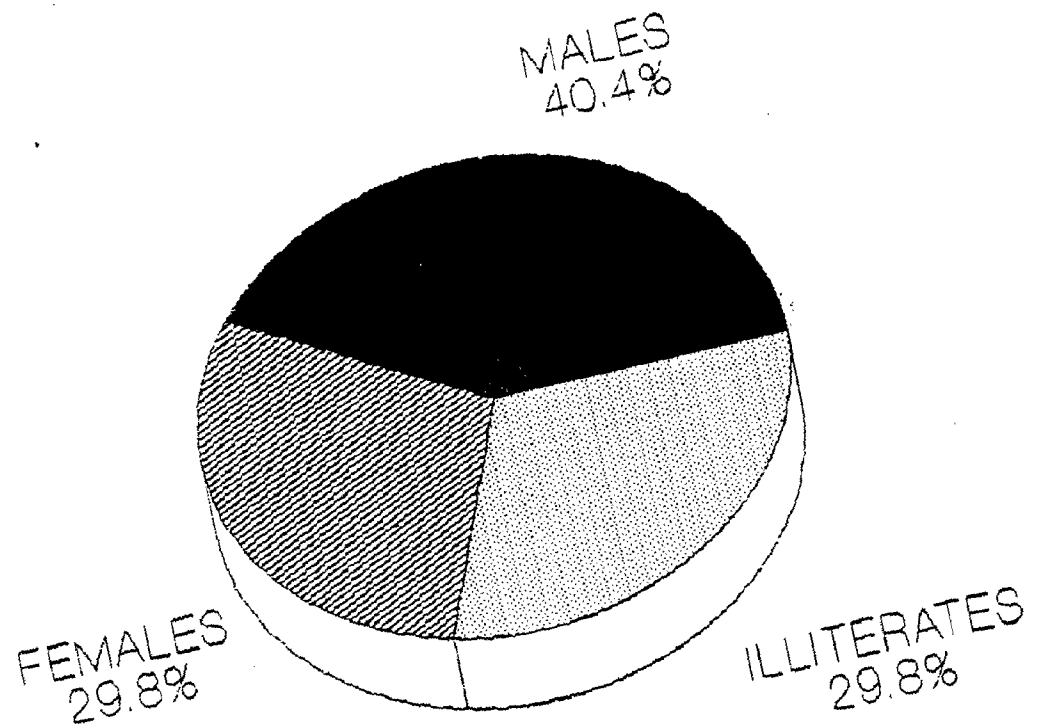
4.2.2 Literacy :

Roorkee town, Cantonment andRoorkee U.A. as a whole has maintained good literacy rate compared to the other nearby towns, the district and the state literacy rate.

T - 4.3 : LITERACY

Area	Literacy rates in %
Nation (India)	42.94
State (U.P.)	41.71
District (Hardwar)	
Roorkee Town (M.B.)	

FIG.4.12:LITERACY RATE ROORKEE TOWN-1991



Source:M.B. Report

TABLE 4.4

LITERACY - ROORKEE TOWN

		1971	1981	1991*
Total Population :		47,566	61,851	80,236
Literates :				
i.	Male	17,225	26,834	32,393
ii.	Percentage	36.21%	41.77%	40.39%
iii.	Female	10,601	16,177	23,920
iv.	Percentage	22.29%	26.15%	29.81%
	Total Literates	27,826	42,011	56,313
	Percentage of Literates	58.50%	67.92%	10.18%

Source : Census Report and (*) M.B. Report

The figures above reflect a very high percentage compared to State and National average. The institutional character of the town has greatly influenced the literacy of the people. (See also Fig. F-4).

4.3 ECONOMIC PROFILE :

The economic base of Roorkee is provided by the University , the Cantonment, The Irrigation Research Institute, The C.B.R.I., Other Government and Semi Government Institution. There is a good amount of financial inflow to the town from the State and the Central budge. In addition export of Drawing and Survey Instruments. The District Industries Centre of Hardwar District is also located in Ramnagar area on the

Municipal boundary. (Ref. Fig. Land use map of Roorkee town).

4.3.1 Occupational structure :

The town being of institutional character mainly, the percentage of service class is much higher than all the rest together. As seen from the Fig. 4.13, the percentage of service class 52.76% and all the other classes together is 47.24%. (Refer Table T-4.5).

Most of the Informal Sector activities, construction, selected retail trade in the town are run by rural population of the surrounding villages.

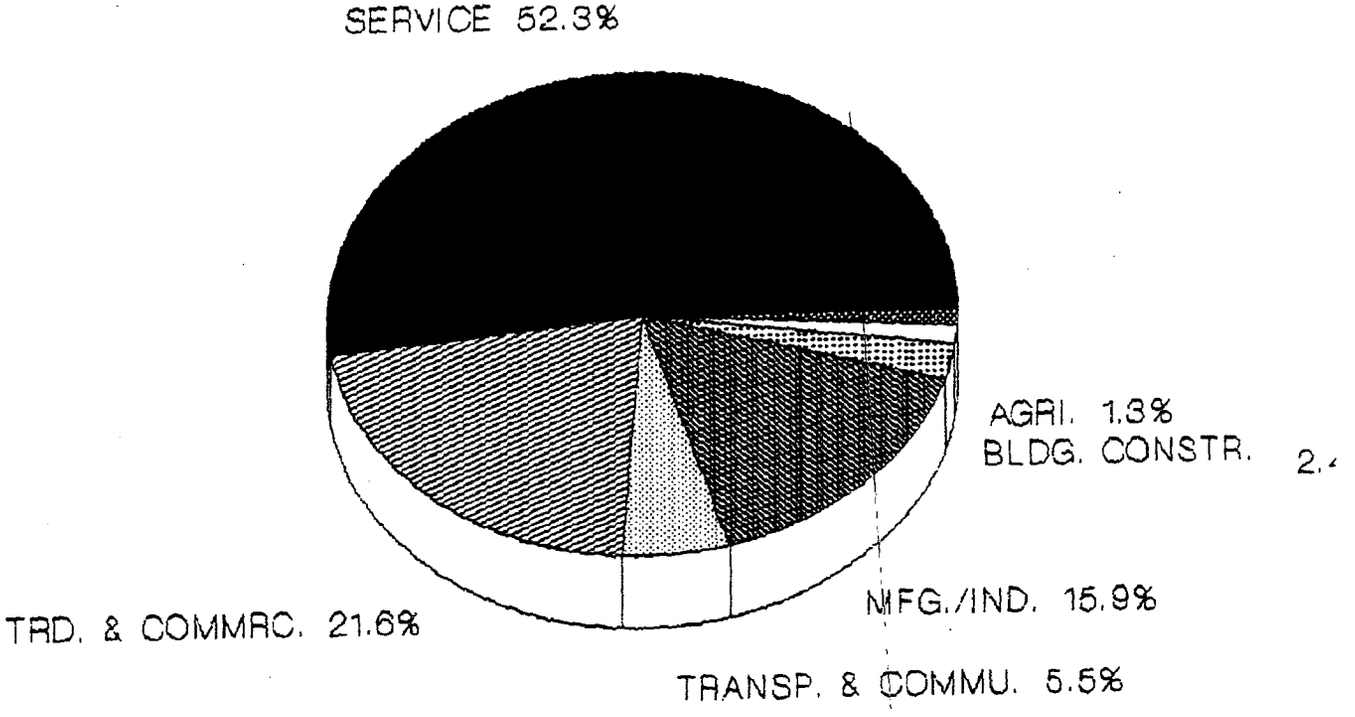
TABLE 4.5

OCCUPATIONAL STRUCTURE OF ROORKEE TOWN

Sl.No.	Occupation	Percentage
1.	Agriculture and Agricultural Labour	1.32
2.	Dairy	1.02
3.	Manufacturing/Industries	16.12
4.	Building construction	2.45
5.	Trade and Commerce	21.00
6.	Transportation and Communication	5.33
7.	Service	52.76
		100.00

Source : Census of India 1981.

FIG.4.13:OCCUPATIONAL STRUCTURE
ROORKEE TOWN



Source:Census Report 1981

4.3.2 Commercial Activity:

The old commercial areas are Anaz Mandi, Sabji Mandi, Gur Mandi, Kabari Bazar. The earlier sale grain business of Roorkee has been shifted to Mangalore. In the 60's due to heavy conjestion in the old Commercial area new shops developed along with Civil Lines.

The present commercial characteristics can be understood from Table in Appendix I showing the break up of the shops in both parts of the town. Both the parts do attract people for different commercial activities.

The commercial development is in the form of ribbon development, along the most busy roads except the Sabji Mandi which is a Municipal Board property. The other commercial establishments are along the road and residence above and behind it.

4.3.3 Industrial Profile :

The District Industries Centre, Hardwar has its Industrial Shed at Ramnagar area which is outside the Municipal boundary. It has 56 sheds in which 356 units exists. Main industries in it are Drawing, Survey and Mathematical Instruments, Electrical goods and Iron works.

The U.P. Govt. Workshop, which is a large industry, is unable to expand because of shortage of land. It produces structueal iron goods.

Agricultural implements and sanitary wares are also manufactured in town along the old Railway road area.

The town is famous for its (DSMI) units. The products are sent all over India and abroad.

Drawing and Survey Instruments are being manufactured within the town area also, as it needs less space and less labour. Only a power line is necessary to run the units.

4.4 LANDUSE :

Roorkee can be said to be constituted of the Institutions and the residential areas with commercial strips.

The existing landuse as per the field survey is as in Fig. 4.14. Landuse map of Roorkee town (1992). The existence of a large number of educational institutions, the market area and high residential population which encourage high density in old Roorkee area. Most of the Government and Semi Government establishments are to the north, i.e., in the Civil Lines area.

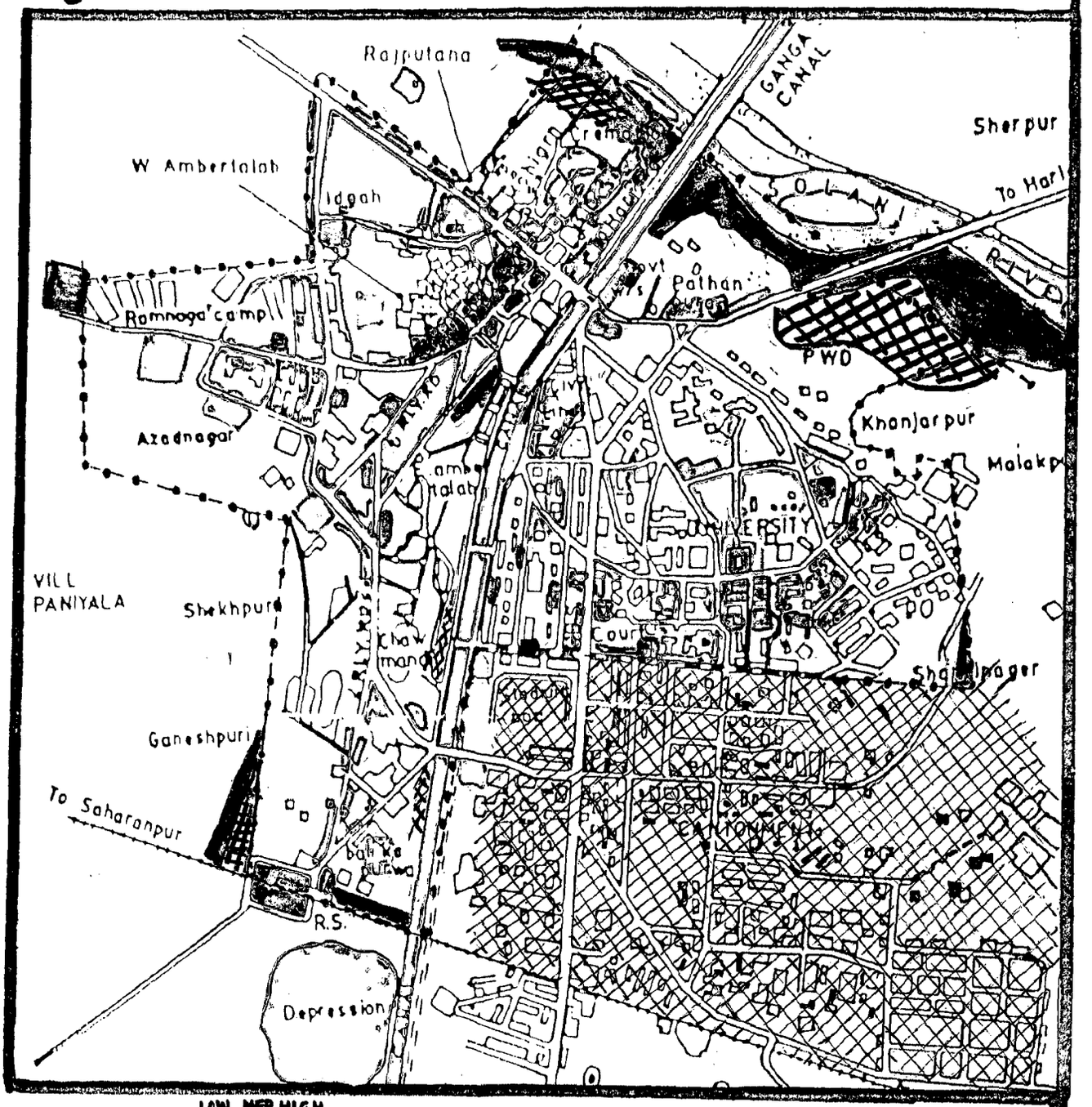
Existing land use break up is as shown in Table 4.6. The land within Municipal area is expected to increase by 2011 A.D. The landuse break up for 2011 A.D. is projected for a population of 1,35,000 and area assumed to increase to 10 sq. Km. as against 8.11 sq.km. now. (Refer Table 4.6).

TABLE 4.6 'A'

LANDUSE

1.	Total area of town in 1991 A.D.	8.11 Km^2	= 811 hect.
	in 2011 A.D.	10.00 Km^2	= 1000 hect.
2.	Total developed area in 1991 A.D.	88%	= 713.68 hect.
	In 2011 A.D.	99.96%	= 960.00 hect.

fig-4.14 R RKEE T WN EXISTING LAND USE



RESIDENTIAL LOW MED HIGH
COMMERCIAL
PUBLIC
RECREATIONAL
INDUSTRIAL
USE UNDEFINED
AGRICULTURAL
EDUCATIONAL
BARREN (PLOTTED)

POTENTIAL FOR SUSTAINABLE EC - EVEL , MENT F .. RKEE T WN

NOT TO SCALE

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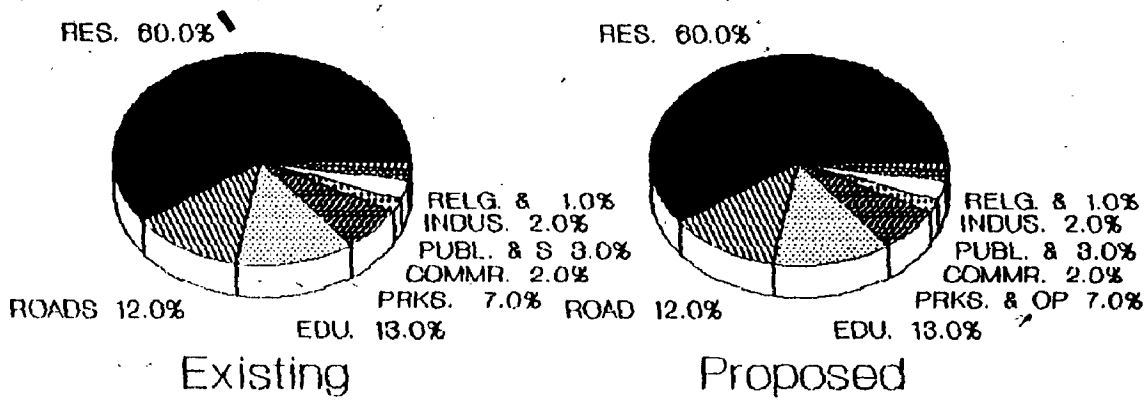
FIG.4.15:ROORKEE TOWN(Municipal Area)
Breakup of Landuse



Source:As per Field Survey

Use	Existing		Projected 2011 A.D.	
	Hectres	%	Hectres	%
1. Residential	401.08	56.2	576.0	60.00
2. Roads	99.91	14.00	115.2	12.00
3. Educational	85.64	12.00	124.8	13.00
4. Industrial	14.98	2.10	19.2	2.00
5. Commercial	21.41	3.00	19.2	2.00
6. Pub. and Semi Pub.	17.84	2.50	28.8	3.00
7. Religious and Others	9.27	1.30	9.6	1.00
8. Open spaces, Recreation	63.51	8.90	67.2	7.00
	713.64	100	960.0	100

* Residential and Community uses

Residential Density :

The residential population density varies from 16 persons per acre at C.B.R.I. to 707 per acre at Rajputana area. The details of population, area and density area and desntiy are given in Table T-4.7 on the next page.

TABLE : T-4.7

WARDWISE POPULATION, AREA AND DENSITY

Sl. No.	Name of the Ward	Area	Population 1981	Population 1991*	Gross Density 1991	Residential Area 2011**
1.	Purbabali	0.539	2950	3826	28	38
2.	Ganeshpur Central	0.3780	3208	4160	44	60
3.	Chow Mandi	0.4671	3969	4794	41	55
4.	Amber Talab East	0.2033	3678	4771	94	128
5.	Purba Din Dayal	0.1551	2948	3824	99	135
6.	Maktulpuri	0.4125	2784	3621	28	39
7.	Ram Nagar South	0.2842	3542	3594	51	70
8.	Ram Nagar North	0.2542	2863	3715	58	81
9.	Amber Talab West	0.0709	2976	3960	217	281
10.	Amber Talab East	0.0749	2775	3599	192	249
11.	Purana Tehsil	0.2371	2884	3754	63	86
12.	Mahigram	0.3744	3386	4392	46	63
13.	Sati Mohalla	0.2352	3930	5097	86	118
14.	Sot	0.20335	3016	3912	76	104
15.	Rajputana	0.0214	2990	3787	707	917
16.	Civil Lines (North)	1.0113	3756	4872	19	26
17.	Civil Lines (West)	0.7010	3641	4723	27	36
18.	Roorkee University (Western part)	1.0610	3602	4672	18	24
19.	C.B.R.I.	1.1772	3730	4838	16	21

* Estimated. 30% decadal growth

** Probable

4.5 FACILITIES, SERVICES AND UTILITIES :

4.5.1 FACILITIES :

1. Community facilities :

Roorkee town as it stepped towards development after the independence and large number of people setting in the town led to need for facilities in the town for education, health recreation etc.

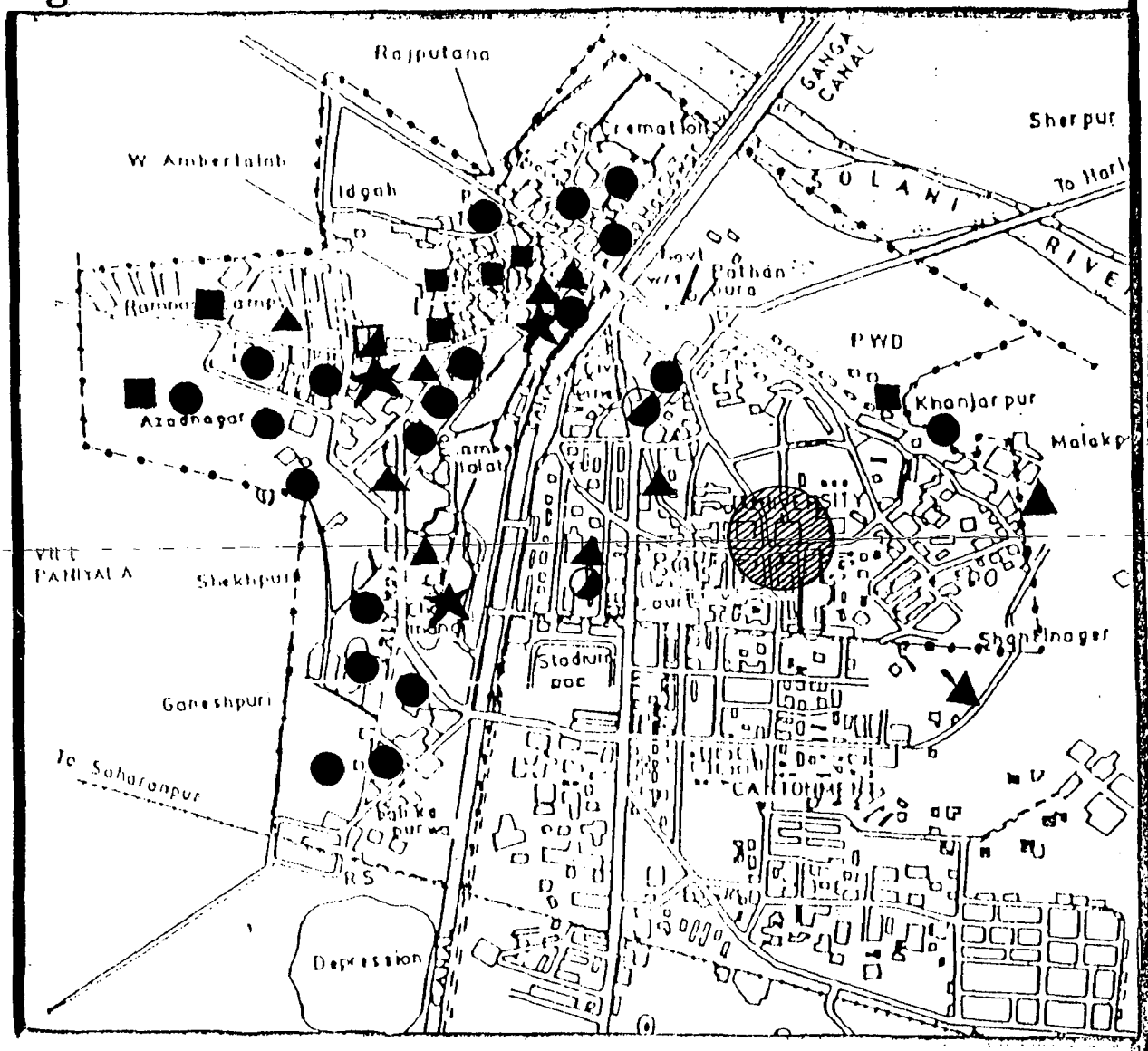
a. Educational facilities :

Roorkee has adequate educational facilities for its inhabitants and it also serves the nearby areas. As per District Statistical Report, it has 30 primary schools, 12 Junior Secondary Schools, 5 Senior Secondary Schools, 5 Inter Colleges, 3 degree colleges (One Science and two Arts), One University, One Polytechnic, 7 short hand and type schools, One Adult literacy centre. Other than these are adequate number of Kinder Garten and Nursery schools. Tutorial, Music Schools, Knitting, Embroidary, Stiching Schools also do exist in good numbers in the town. (Refer Fig. 4.16).

b. Recreational and Cultural :

Roorkee lacks in recreational area. The University, C.B.R.I. has their own recreational area which is adequate for them and is not open to

Fig 4.16 **ROORKEE TOWN** EDUCATIONAL



★ College ● Higher Sc. ■ Primary Sc. ◯ University

Inter College ◑ Jr. Higher Sc. ◪ Polytech.

POTENTIAL FOR SUSTAINABLE ECO-DEVELOPMENT OF ROORKEE TOWN	NOT TO SCALE
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the public.

The University also has a boat club functioning using the canal for recreation.

The Army alo uses the canal for training their people.

The general town people are deprived of recreational facilities due to lack of resources, both of land and finance.

Play grounds exists in a few colleges and schools But no community, cluster level recreational area exists in the town.

In the old Roorkee area, it is common to see children playing on the streets which is a good indicator of lack of recreational space in the town.

Roorkee has five Cinema halls of which three are functioning now. It is adequate for the population

Roorkee has one Community hall used for meeting, marriages etc.

There is one public library and a reading room in the Municipal building.

Religious :

Due to the mixed population of Roorkee consisting of Hindu, Muslim, Christian, Jain, Punjabis, it has religious places for all the sects scattered at different places.

4.5.2 Services :

In the course of growth of town, it demands for more and more services from the Government, local Govt. community etc. Services available in Roorkee town are as under as discussed below also ref. Fig. F-4.17.

a. Transport :

Roorkee has a Railway Station as stated in Chapter I, it is well connected both by road and rail, all express trains stop at here. (Ref. Fig. F-4.18 road map of Roorkee Tehsil).

Busstand :

The U.P.State Roadways provides with good bus servuce, it also has a private bus stand on Haridwar road which does not have proper stand.

Taxi Stand :

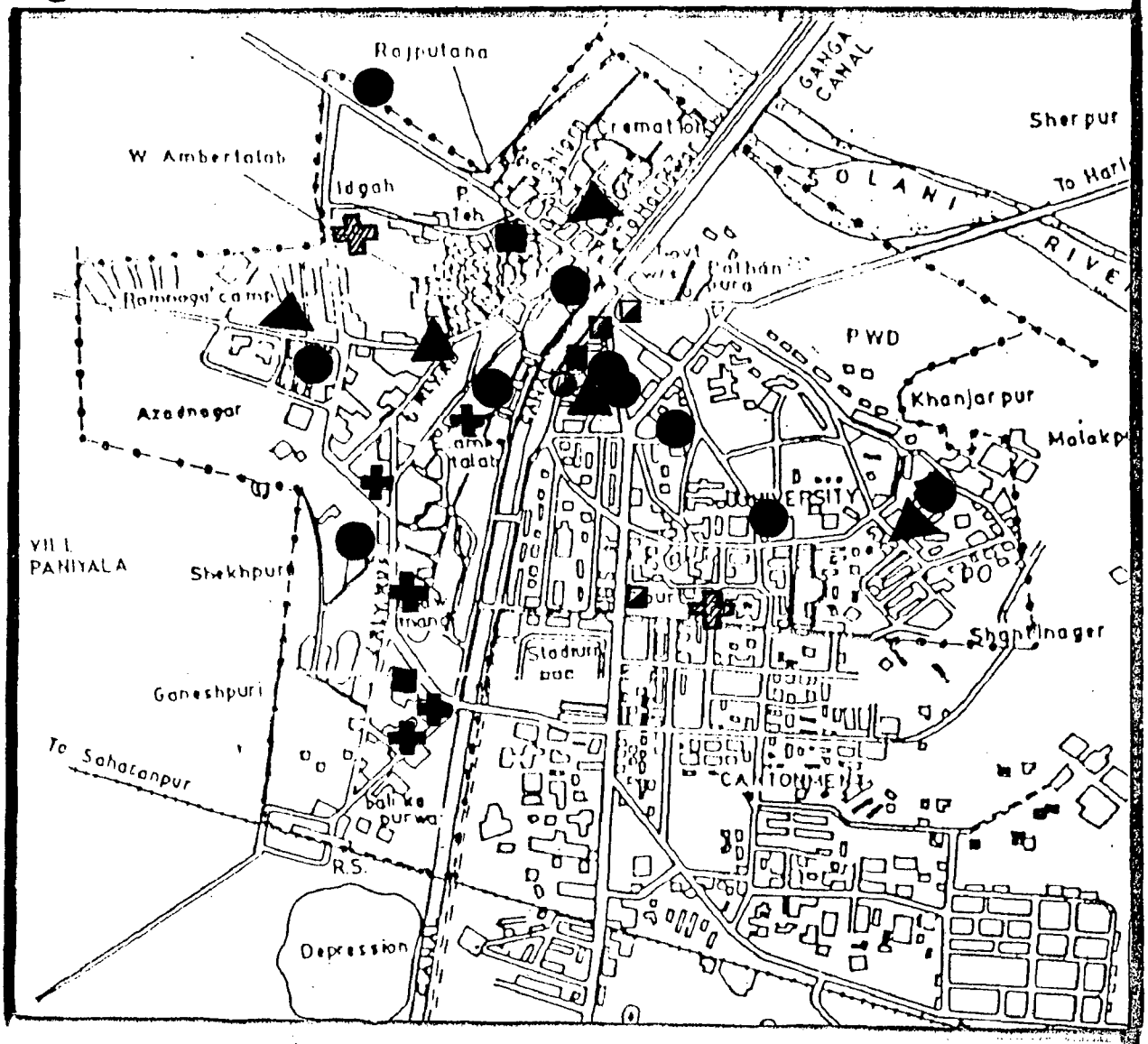
Taxis are available in stand U.P. roadways. They are connected by telephone and well organised.

Trucks :

Trucks are easily available and parked on canal bank road and Govt. Workshop road. There is no allotted parking area.

Tongas, Rikshaws, Thelas, Bullock carts are abundant in number, mostly run by nearby village people.

fig-4.17 ROORKEE TOWN SERVICES.



POTENTIAL FOR SUSTAINABLE ECO-DEVELOPMENT OF ROORKEE TOWN	NOT TO SCALE
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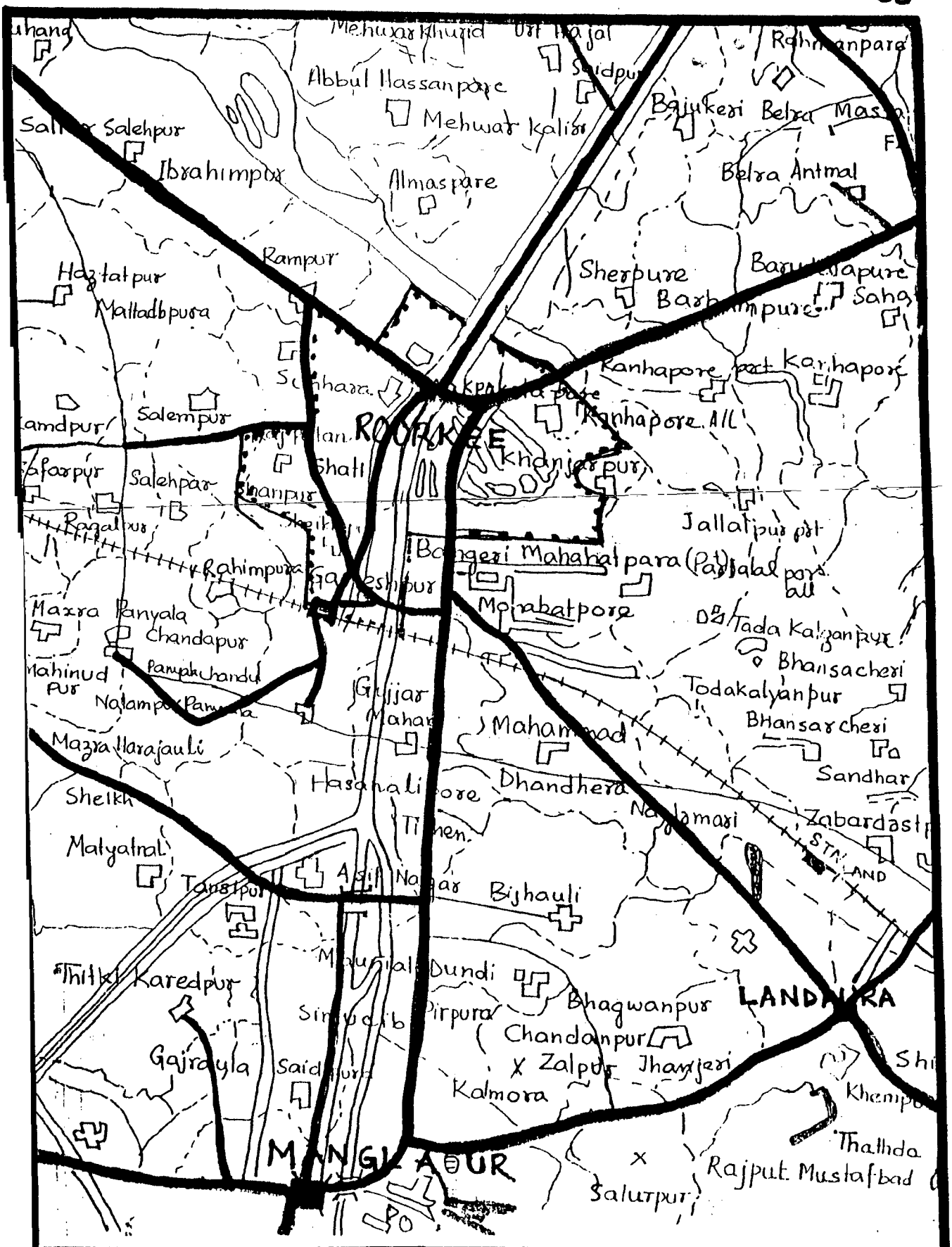


fig. 4.18 ROORKEE & SORROUNDING AREA ROAD NETWORK

Scale 1: 1 mile

N

SOURCE: P.W.D. HARIDWAR

Tractors are also seen carrying passengers from villages to town.

All other data collected on automobile, thela, tona, carts, auto dealers, cycle dealers in town are in Appendix II.

b. Post and Tele Communication :

Roorkee town has its main post office in Civil Lines area serving the town with its 13 sub post offices located conveniently.

Telegraphic facility exists in 6 post offices, There are 8 S.T.D. and I.S.D. services in the town. Telephone exchange is near the Govt. Workshop. Roorkee exchange had six lines and 965 number of telephone connections till 1988.

The University, C.B.R.I. and I.R.I. has their own exchanges with a good net work in their own Institutions.

c. Security :

Roorkee town has two Police Stations, one in Civil Lines and other in Ganeshpur called the Ganga Nahar Thana. And 3 police chaukies in old Roorkee. Total number of employees in town in all is 136 as listed below :

Inspector	...	1
Sub Inspector	...	13
Head Constable	...	15

Constable	...	109		
Driver	...	4		
Mali	...	4		
Vehicles	...	Jeep	...	3
		Van	...	1
		M/cycle	...	3

Number of cases registered under I.P.C. in 1981 - 365, 1991 - 385, a 5% increase in number of cases registered under acts in 1981 - 290, 1991 - 223, 19% increase.

Number of cases of accidents registered in 1981 - 35 and 1991 is 46, i.e., 30% increase.

Fire Station :

Roorkee town has a fire service station in Civil Lines. It has 3 fire bridgades. In Roorkee, there are 26 fire hydrants.

d. Health :

Roorkee M.B. area has 3 govt. hospitals and two dispensaries, and one Family Health Centre. The Civil Hospital is near Ramnagar Chowk which was initially in Purana Tehsil area.

Nos. of beds	Hospitals	Doc-tors	Nurse/ Asstt.
106	Civil Hospital	14	32
	B.T. Ganj	4	12
12	Univ. Hospital	4	12
2	Family Welfare Centre	1	2

Nursing Homes 5, Ayurvedic doctors 6, Unani 11, Homeo 15, Medical stores 56.

There were only three allopathic doctors in town in 1945 now there are around 100 doctors including those of Govt. Hospitals.

Sales of medicines at present is to the tune of Rs.2,000/- to Rs.3,000/- per day by each medical stores, i.e., more than Rs. one lac per day. In 1981, it was Rs.800 to Rs.1,000 per day and there were less number of stores.

Overall health condition of people are good as per doctors view.

The nearest medical college is in Meerut approx. 100 Km. from this place. Muzaffarnagar has a good hospital. People go either to AIIMS or PGI, Chandigarh for specialized treatment. Other than M.B.B.S. doctors, Registered Medical Practioners are also seen practicing, specially in the nearby villages. The Government medical facilities seems inadequate leading to mushrooming of private nursing homes.

4.5.3 Municipality Services :

The Municiaplity is the main body which caters for many of the essential services of the town. Municipal Board is an elected body by the people. The term is 5 years. It has a President, at least 10 elected members and appointed members and also the M.L.A. of

the constituency who becomes a member. Municipal fund and property is as per U.P. Municipality Act 1916 (Section 114 - 117). Municipal taxation as per Sec. 128 - 165 U.P. M.Act. 1916.

Local Self Government, Roorkee :

Roorkee Municipal boundary has been divided into 19 wards as per Table 4.7. The members are elected from each ward to the Municipal Board. Discussed below is the services carried out by Municipal Board. Fig. 4.19 indicates the income and expenditure of the Board for different years.

a. Services :

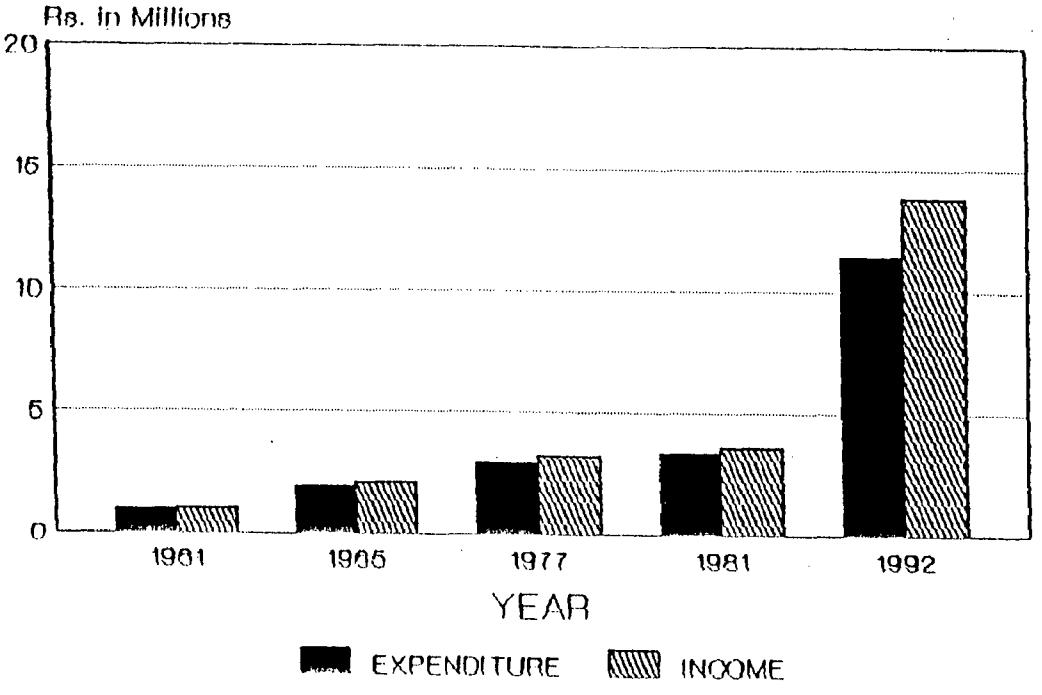
Provided by Municipality in town are as discussed below :

Street Illumination is done by the Municipality along the main roads. In 1981, there were 1322 number of points and in 1991 it increased to 1861.

Bulb points	...	547
Tube sets 1 x 40 W	...	930
Tube sets 1 x 20 W	...	297
Sodium Vapour Lamp	...	86
Mercury Vapour Lamp	...	01
Total	...	1861

The inner community lanes are not well illuminated. The stress of road before and after. Roorkee Talkies junction and the old Roorkee bridge needs proper illumination considering the quantity of evening

FIG.4.19:ROORKEE TOWN
INCOME & EXPENDITURE OF M.B.



Source:ROORKEE M.B.

traffic. Considering the 185 Km. of municipal road network the lighting is inadequate.

b. Water Supply :

The water supply scheme started in 1951 and at present it is classified as a 'C' Class water supply scheme. The source is ground water.

Total number of pumps	...	10
Total qty. of water pumped	...	216,83,040 Lit.
Per capita supply	...	270 lit/day
Hours supplied for	...	19 hrs.
Overhead tanks	...	4 Nos.

Capacity : 1700 + 450 + 450 + 750 K.Litres.

One of capacity 2500 K.L. is ready sto start.

Total number of connection	...	8073
Domestic	...	7013
Hand pumps	...	27 Nos.
Commercial	...	1060
Length of net work	...	65 Kms.

The University, C.B.R.I., I.R.I. are not served by the municipality they have their own water supply works.

Details of place of water tanks and pumps are as in Fig. F-4.20 and the capacity and power of pumps, running hours of pump, quantity of bleaching pwder are

as discussed in Table T-4.8.

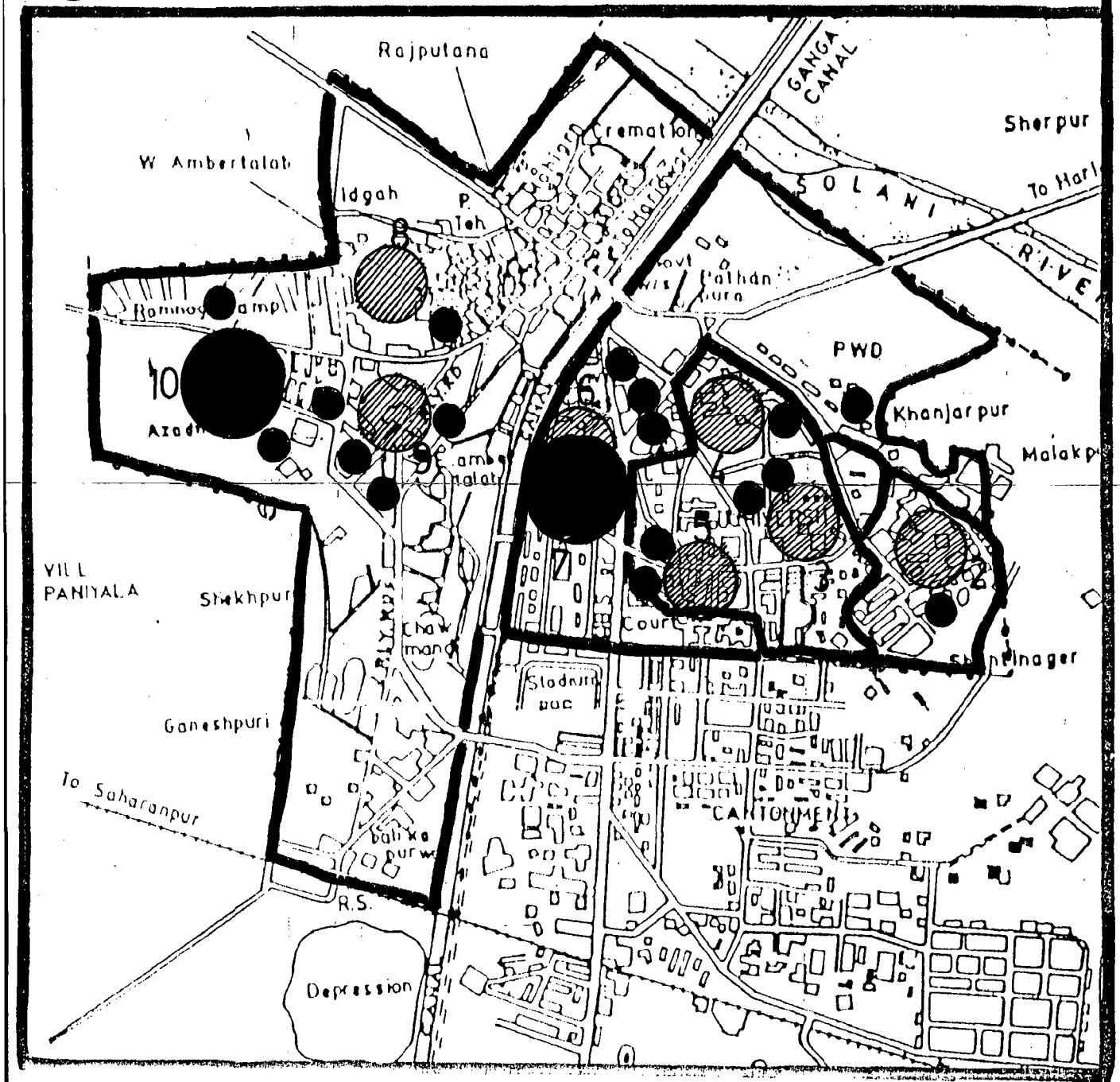
TABLE T-4.8

MUNICIPAL WATER SUPPLY

Place of O.H. tank	Capacity K.Litres	Tubewell connection	Power in H.P.	Times to fill	Bleaching Powder used
1. Gandhi Vatika	1700	i.Gandhi Vatika	45	9 Hrs. when both pumped	4 Kg.
		ii.Municipality Campus	45		
2. Gandhi Vatika	450	Roorkee Talkies	30	4.5 Hrs.	2 Kg.
3. Maktulpuri	450	i.Chanderpuri	45	1.25 hrs.	2 Kg.
		ii. Paswan Mohalla	25		
		iii. Ramnagar	45		
		iv. Maktulpuri			
4. Avas Vikas	750	Avas Vikas	45	5 hrs.	2.5 kg.
5. Ramnagar *	2500	i. Ramnagar ii. Ramnagar	45	18Hrs.	3 Kg.
	5850				

* The Ramnagar O.H. Tank was not functioning due to some technical faults. The Ramnagar well which is used for Maktulpuri tank now will be connected to Ramnagar tank in due couese.

Fig. 4.20 ROORKEE TOWN WATER SUPPLY WORKS.



1 : IRI
2 : CBRI
3,4,5 UNIV.
6,7 : Civil Lines
8 : Avas Vikas
9 : Maktulpuri
10 : Ramnagar

Over Head Reserv.

Tubewell.

Over Head Reserv.

POTENTIAL FOR SUSTAINABLE

DEVELOPMENT

OF ROORKEE TOWN

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Supply Intermittent supply 5.00 to 9.00 a.m., 12.30 to 1.30 p.m. and 7.00 to 9.00 p.m. in winter and 4.00 to 8.00 a.m., 12.30 to 1.30 and 8.00 to 10.00 in summer. Supply is adequate except in a small area of the town which is due to lack of storage. This will be met by the Ramnagar tank. The supply of 270 l.p.c.p.d. seems to have been arrived at by calculating the total population as users. Since the population of University, C.B.R.I. and I.R.I. have their own W.S. System. The per capita supply is much higher , i.e.

216,83,040 divided by 69236 (i.e. population except of University, C.B.R.I., I.R.I. = 313 litres p.c.p.d.

The over head storage capacity which is 15% now will increase to 27% which will be adequate for the town now but will face deficit by end of the decade.

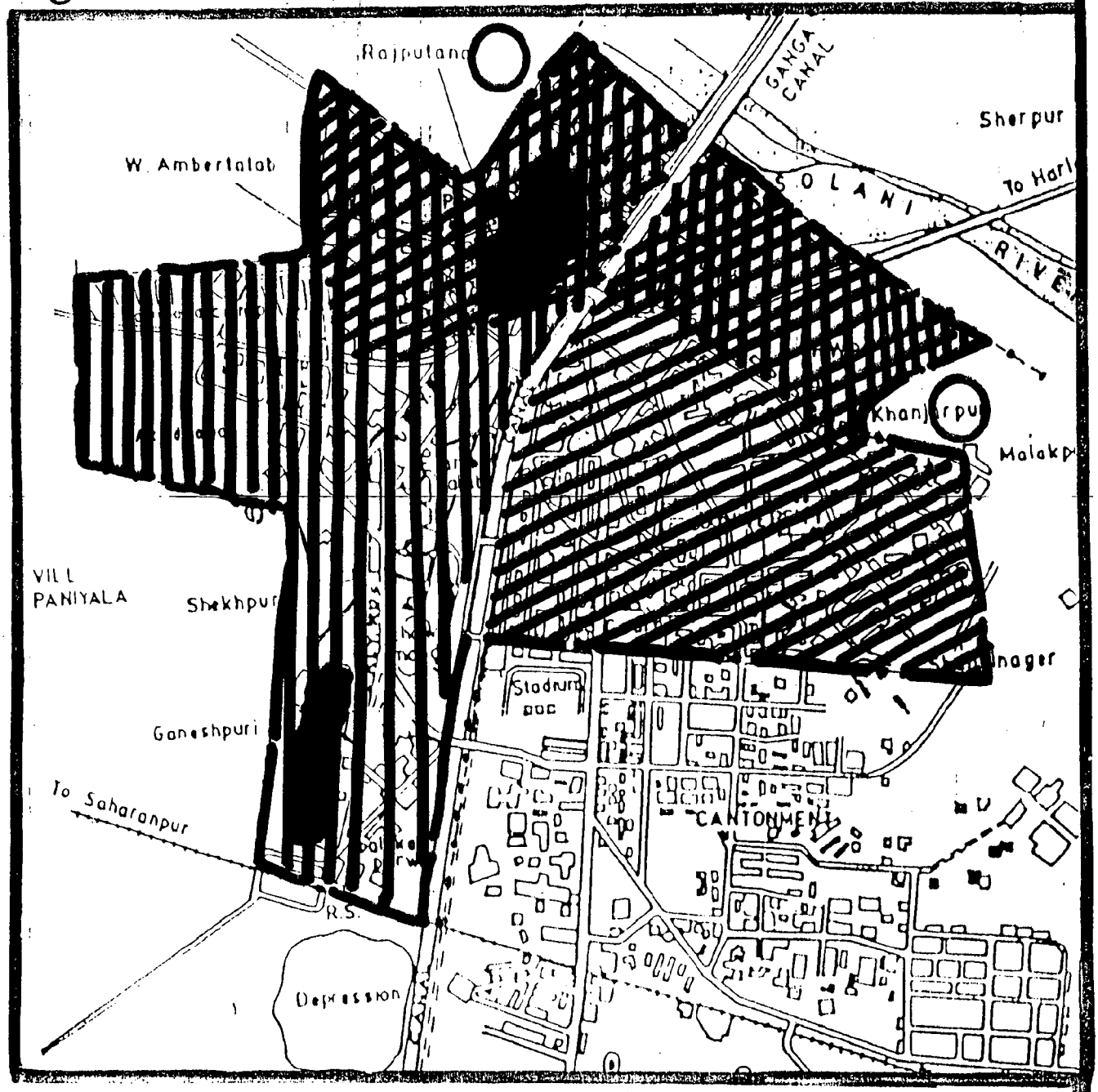
The quality of water supply is generally satisfactory, it is found to be of high iron content, bacterial content and hard in some places. A detail discussion of quality is made in the next chapter.

c. Sanitation :

Sewer lines are provided at some parts of old Roorkee and Civil Lines area. The sewer collects both kitchen and toilet wastes. The University Cantonment and I.R.I. with C.B.R.I. has their own sewer net work, for both storm water and domestic disposal.

The seepage is pumped to the agricultural field owned by Municipality as Mahigram point. The Sewage from Civil

fig-4.21 R ORKEE T WN SEWERAGE



Sewer Line

Conservancy

Septic Tank

Wells.

TENTIAL FOR SUSTAINABLE ECO-DEVELOPMENT F RKEE T WN

NOT TO SCALE

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Lines, University and C.B.R.I. is pumped to the Solani river from Khanjarpur well. As shown in the Fig. 4.22. Five 30 H.P. pumps are used at Mahigram and two 30 H.P. pumps used at Khanjarpur.

Total number of sewer connections till 1992 was 2252 only.

Garbage Collection :

The Municipality collects garbage from different parts of the town the University, C.B.R.I., and I.R.I. has their own disposal arrangements. There are all together 13 collection points. They are Saligaon, Sheikhpuri, Maktul-puri, Sabji Mandi, Fish Market, Mahigram, Dehradun road, Imli road, Baraph Khana and Hotel Polaris. (Refer Fig. F-4.22)

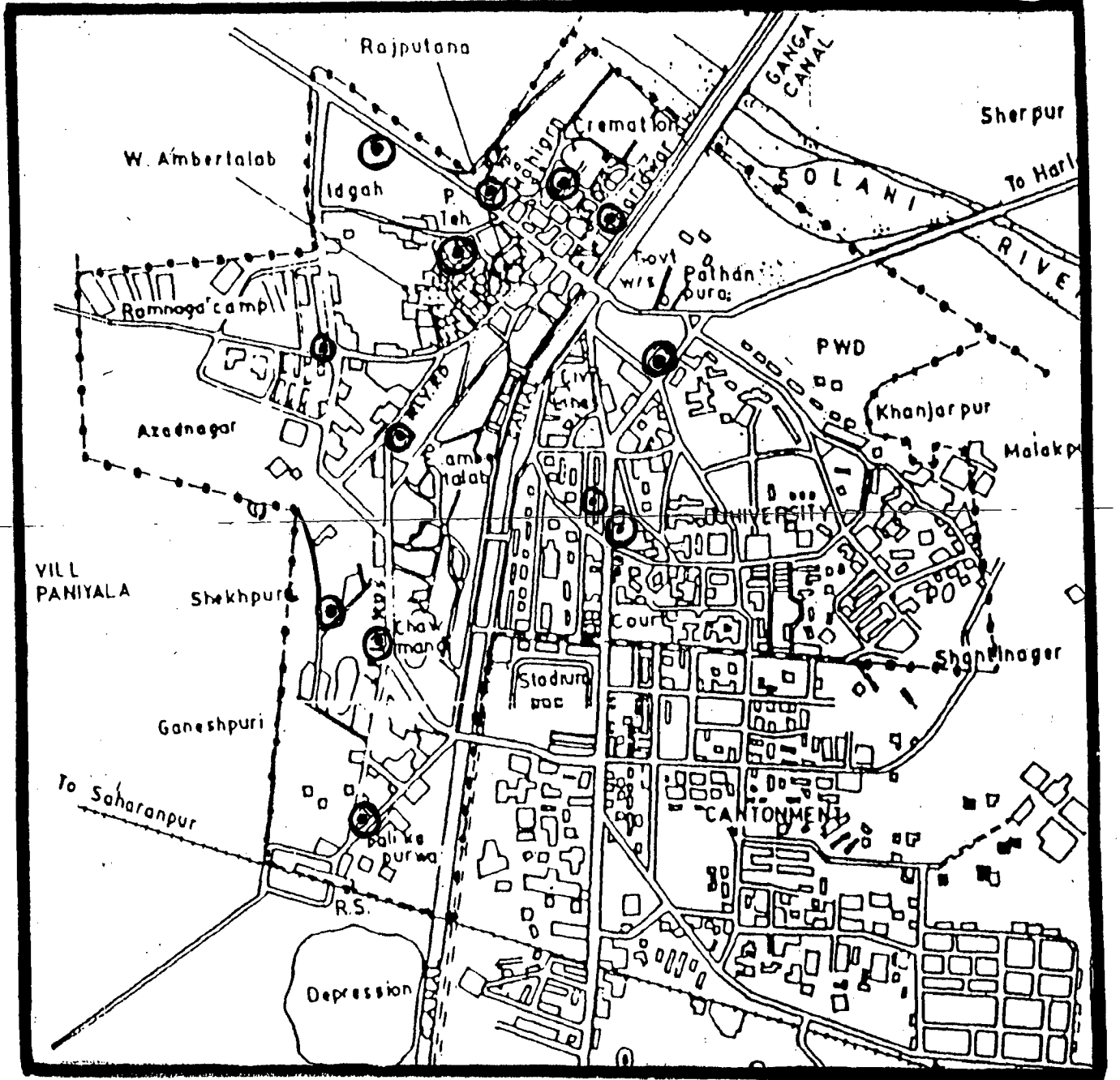
The garbage is dumped at trenching ground along Solani bed to the west of the canal. 3 Nos. of tractors and 26 labourers are employed for the puprose. Total six trips per day made for the disposal.

The University and the C.B.R.I. does land filling of low lying areas within the campus. The C.B.R.I. burns up the waste in incenerators and dumps in a pit made for the purpose. Compared to other cities and towns of U.P.Roorkee has a better garbage collection system. Even than it leaves some areas untouched.

4.5.4 ELECTRICITY :

There are two Hydel Power station near Roorkee town. The Pathri (20,000 KWS) and Mohammadpur (9,300 KWS).

fig-4.22 R RKEE T WN GARBAGE COLLECTION



⊙ COLLECTION POINTS: SALIGAON, SHEIKHPURI, MAKTULPUR, SABJI MANDI, FISH MARKET, MAHIGRAM, DEHRADUN ROAD, IMLI ROAD, BARAPH KHANA, HOTEL POLARIS, NEELAM TALKIES, GANESH PUR, RAMNAGAR, CIVL LINES

TENTIAL FOR SUSTAINABLE ECO-DEVELOPMENT F ... KEE T WN

NOT TO SCALE

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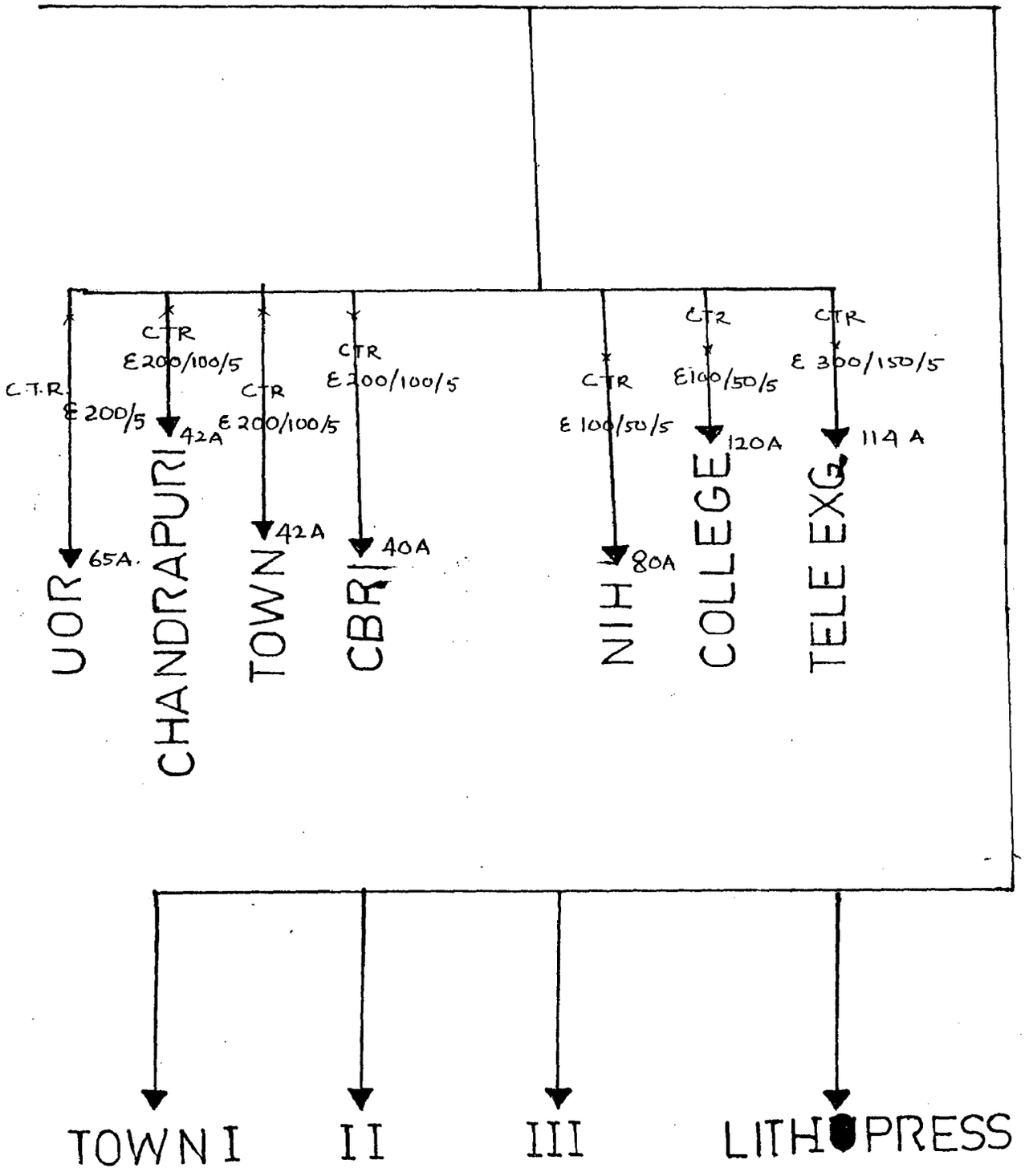
fig 4.23.

ELCTRICITY DITBN.

33 KV S S NO 6 ROORKEE 33/11

33 KV LINE FROM 132 KV S S (RAMNAGAR)



SOURCE: EXE ENGINEER
ELECT. DIST. DIVISION

Both approximately 20 Kms. from Roorkee. The Hydel sub station of UPSEB which distributes the power from these two stations is located on the fringe of Roorkee Municipal boundary near Ramnagar Industrial Estate. (Ref. Fig. 4.14).

Distribution of power to the town from 132 KV S/S Ramnagar Roorkee is as in the Fig. 4.23.

As per discussion with the Executive Engineer, Elect. Distribution Division, Roorkee, the main reasons for power failure are :

1. Due to Roasting in the Hydel dams
2. Shortage of power
3. Electrical Break down

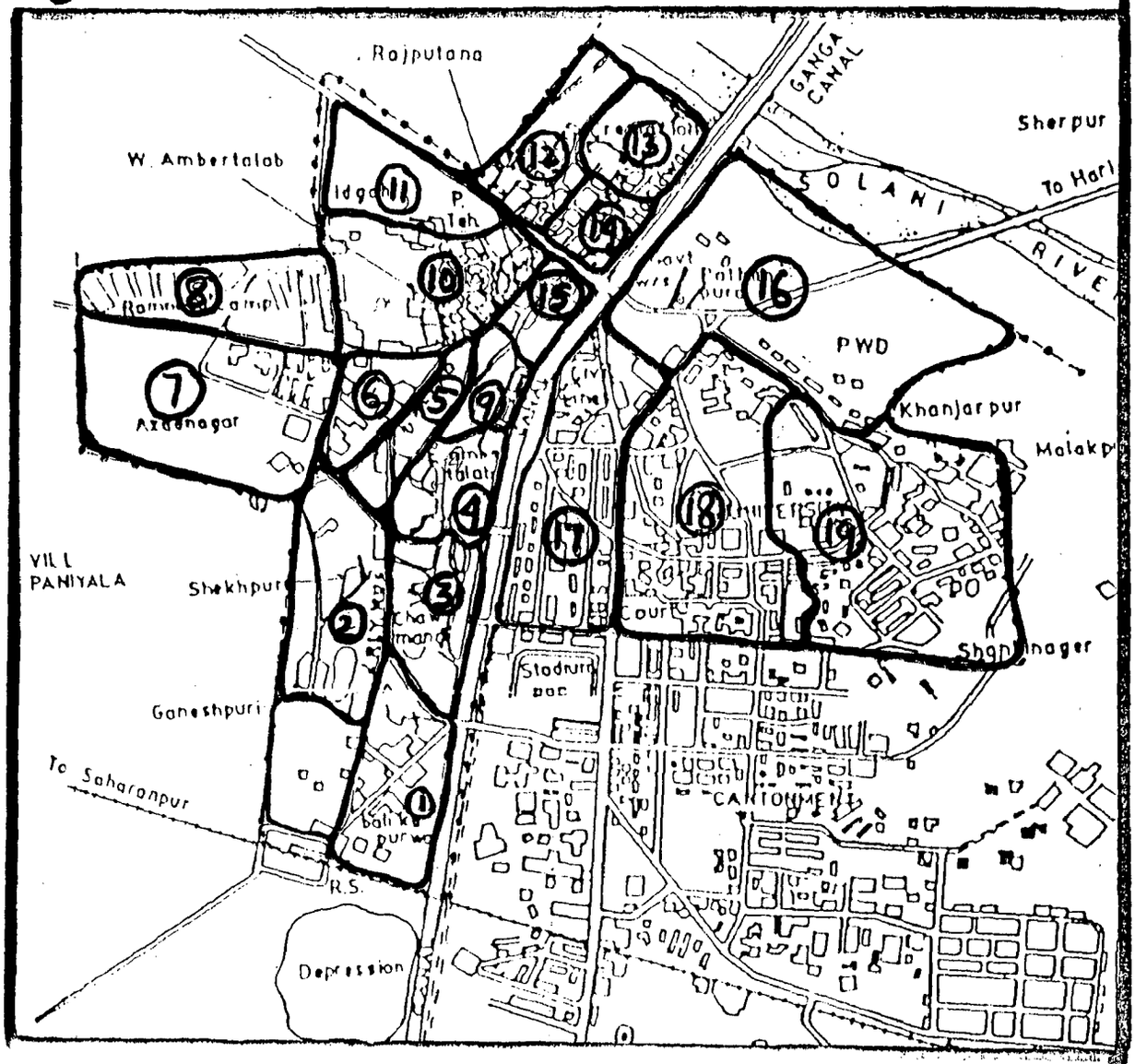
There are no shut down of power supply to the industrial Estate. The projects are financed by the State Industrial Department and hence they enjoy the privillage.

The supply and consumption pattern of electricity will be dealt seperately while assessing the energy potential in the next chapter.

4.5.5 Road Net work :

The Roorkee town road net work is as seen in Fig.4.25. Geometric (width) detail at related location as surveyed by the post-graduate students of Transportation Department (U.O.R.) are as given in Appendix - III

fig 4.24 ROORKEE TOWN WARDS



WARDS - PURVABALI ①, ② GANESHPUR ③ CHOW MANDI ④ AMBAR TALAB Es ⑤ PURVA DIN DAYAL ⑥ MAKTULPURI ⑦ RAMNAGAR SOUTH. ⑧ RNN NORTH ⑨ AMB. TALAB WEST ⑩ ABR TLB WEST (2) ⑪ PURANA TAHSIL ⑫ MAHIGRAM ⑬ SATI ⑭ SOT ⑮ RAJPUTANA ⑯ CIVIL LINES NORTH ⑰ C.L. WEST ⑱ ROORKEE UNIV ⑲ CBRI.

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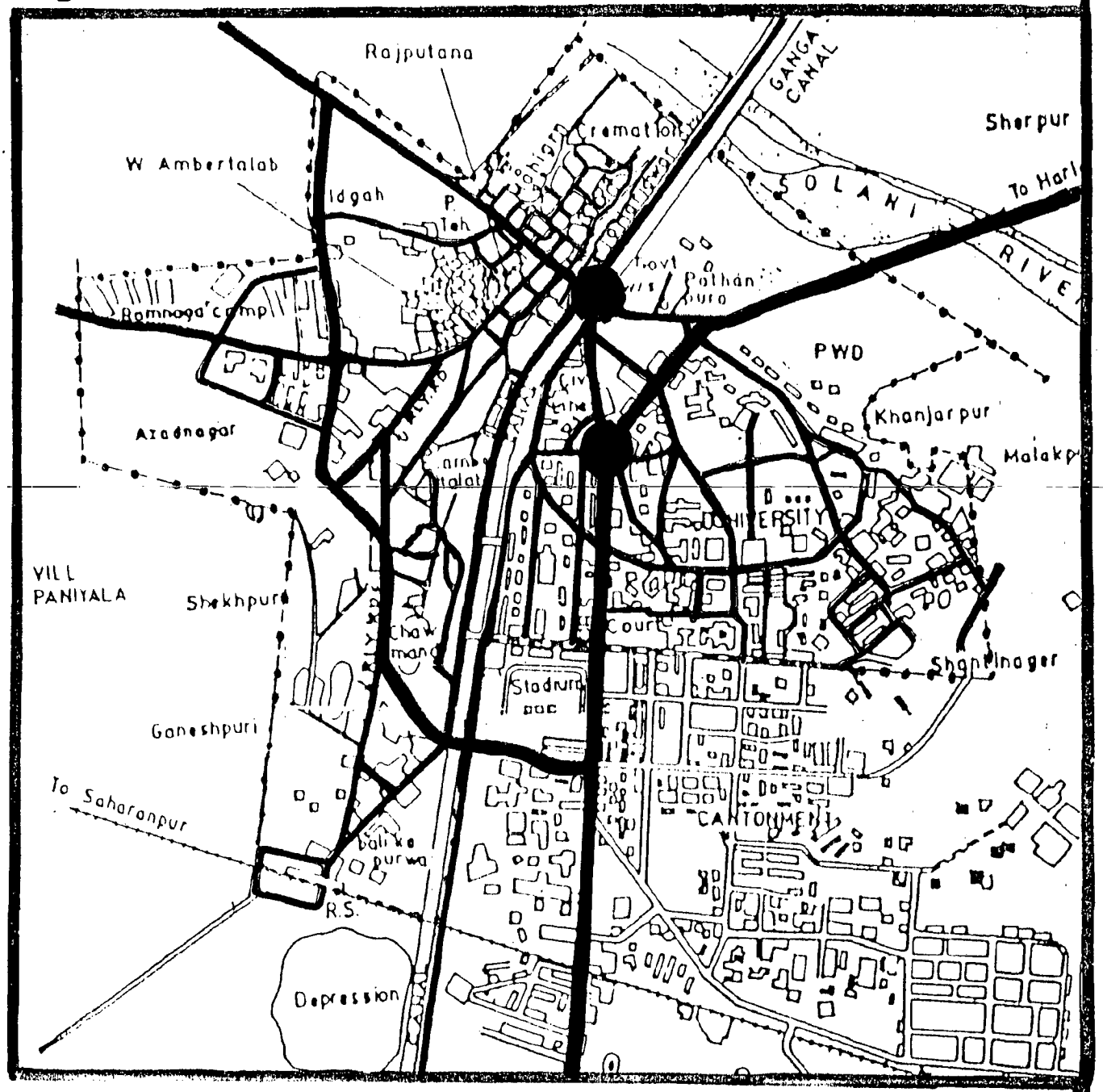
fig-4.25 ROORKEE TOWN ROAD CHARACTER



MAJOR BOTTLE NECK'S ●

MAJOR ROADS

HIGH WAYS (state)

ARTERIES

TENTIAL FOR SUSTAINABLE

EC - EVEL , MENT

F N KEE T WN

NOT TO SCALE

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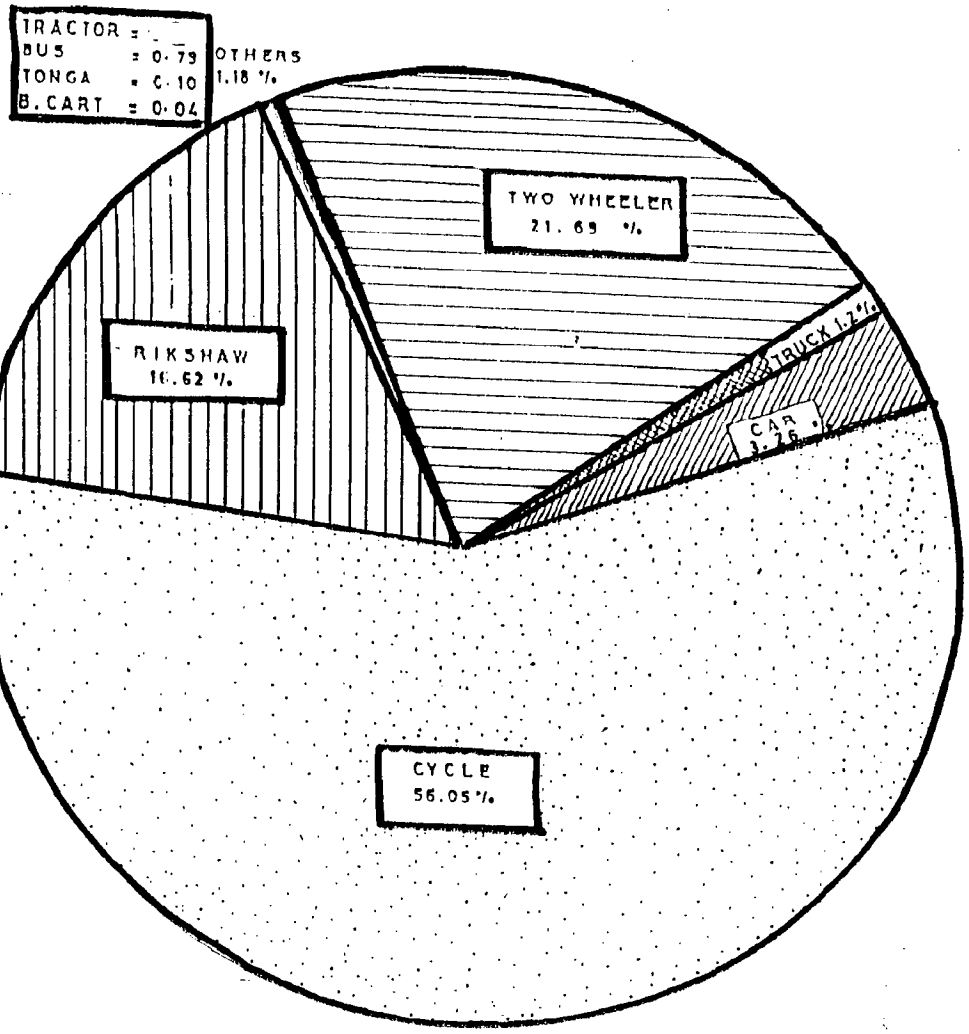
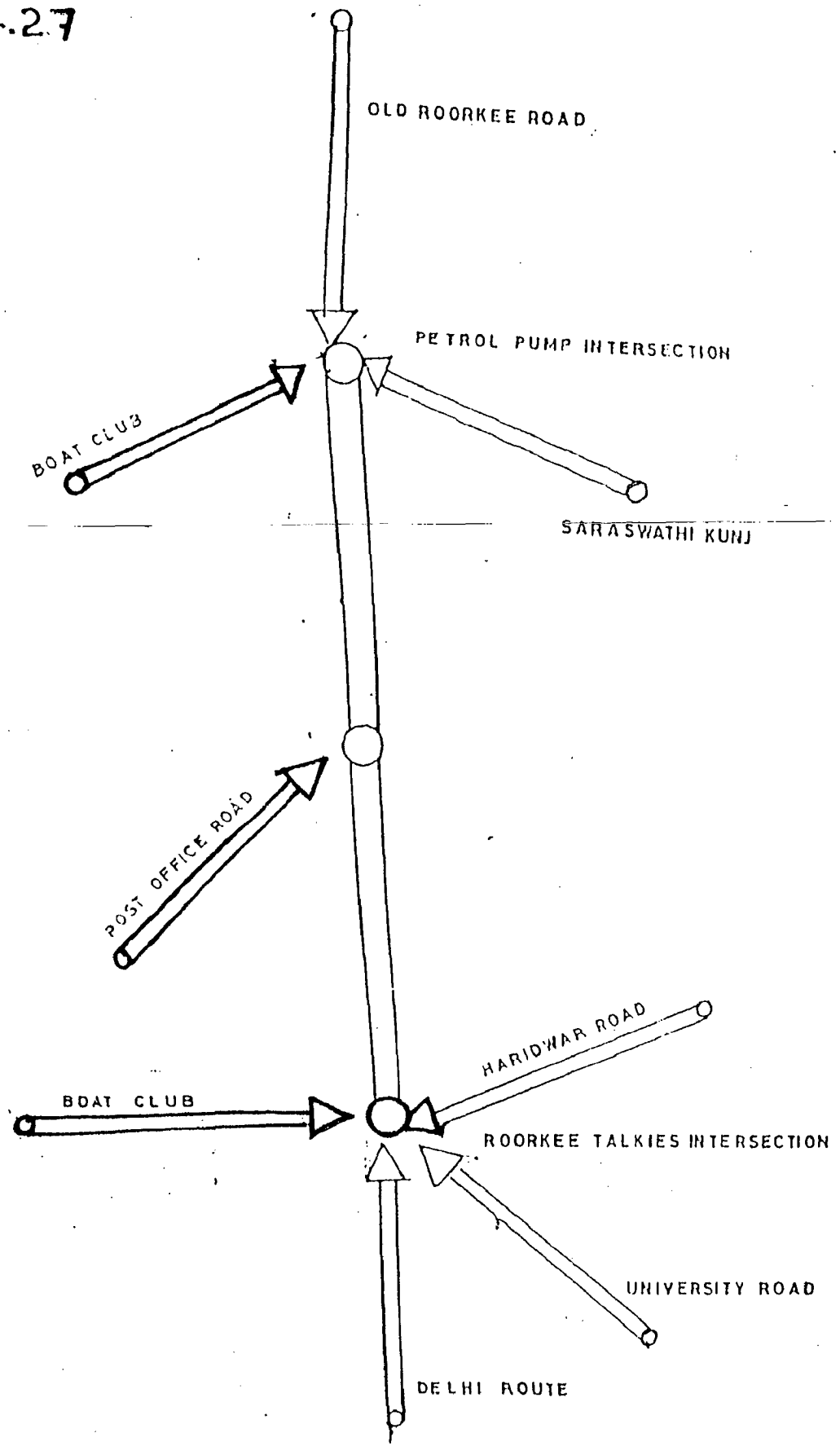


fig 4.26

PEAK HOUR TRAFFIC COMPOSITION

fig- 4.2.7



TRAFFIC CORRIDORS.

Source : Transp Engg. Dept U.O.R Roorkee

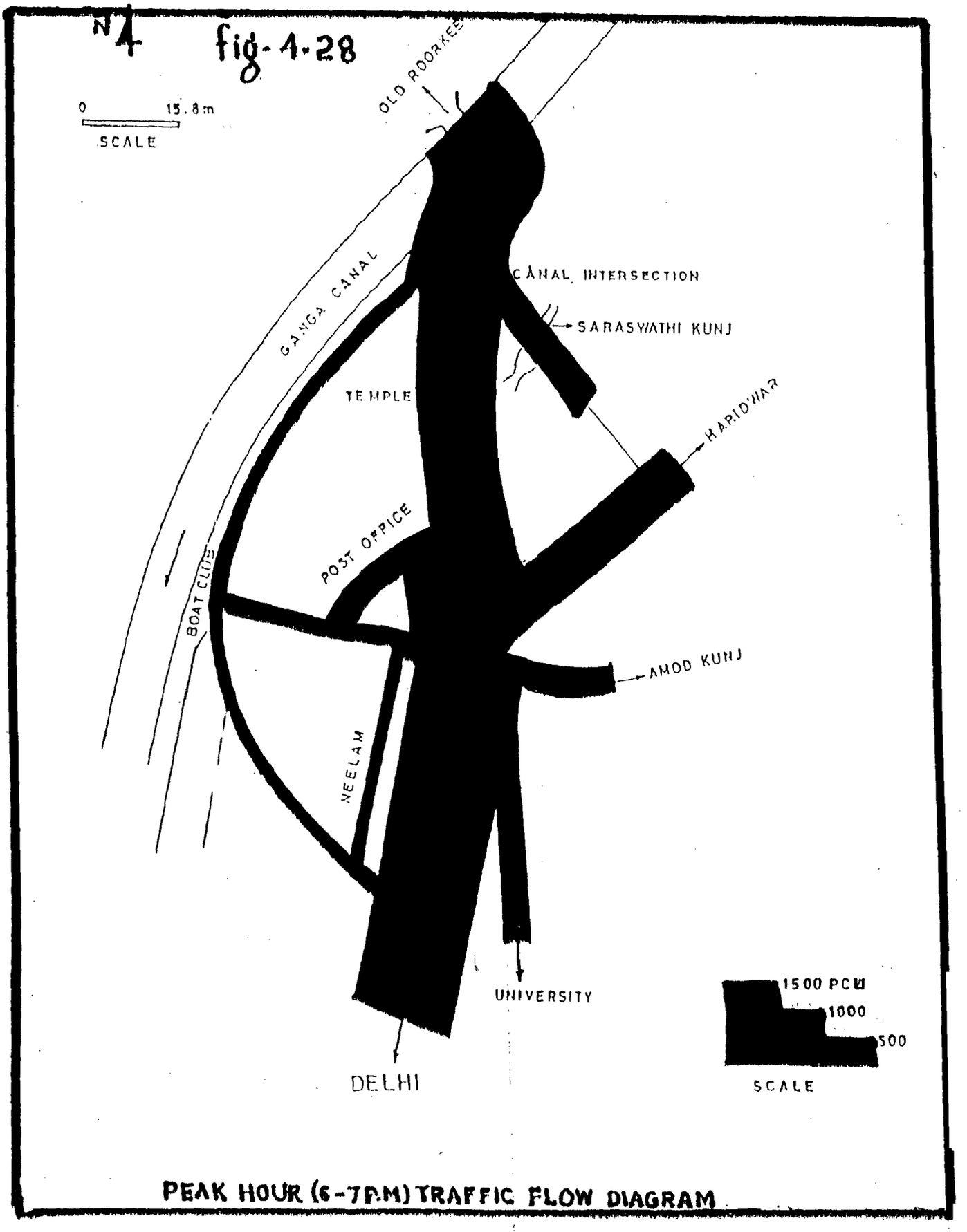


fig-4.28

PEAK HOUR (6-7P.M) TRAFFIC FLOW DIAGRAM

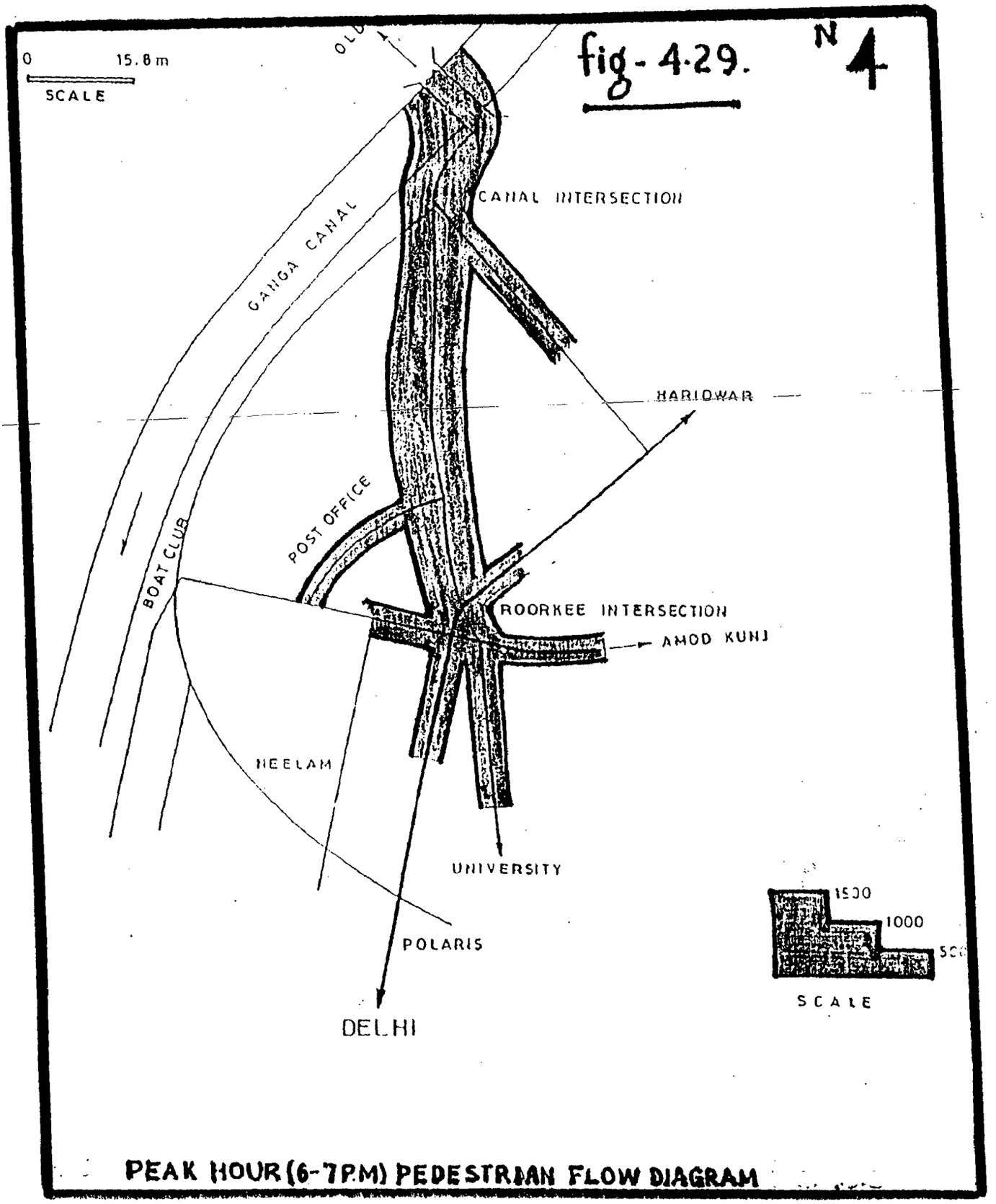


fig-4.29.
N
0 15.8 m
SCALE
CANAL INTERSECTION
GANGA CANAL
HARIDWAR
POST OFFICE
BOAT CLUB
ROORKEE INTERSECTION
AMOD KUNJ
NEELAM
UNIVERSITY
POLARIS
DELHI
1500
1000
SCALE
PEAK HOUR (6-7P.M) PEDESTRIAN FLOW DIAGRAM

The traffic flow pedestrian flow and the peak hour consumpton of traffic of some critical junctions is as described in the Fig. 4.26, 4.27, 4.28 and 4.29. 4.30

Traffic Volume condition on Road net work :

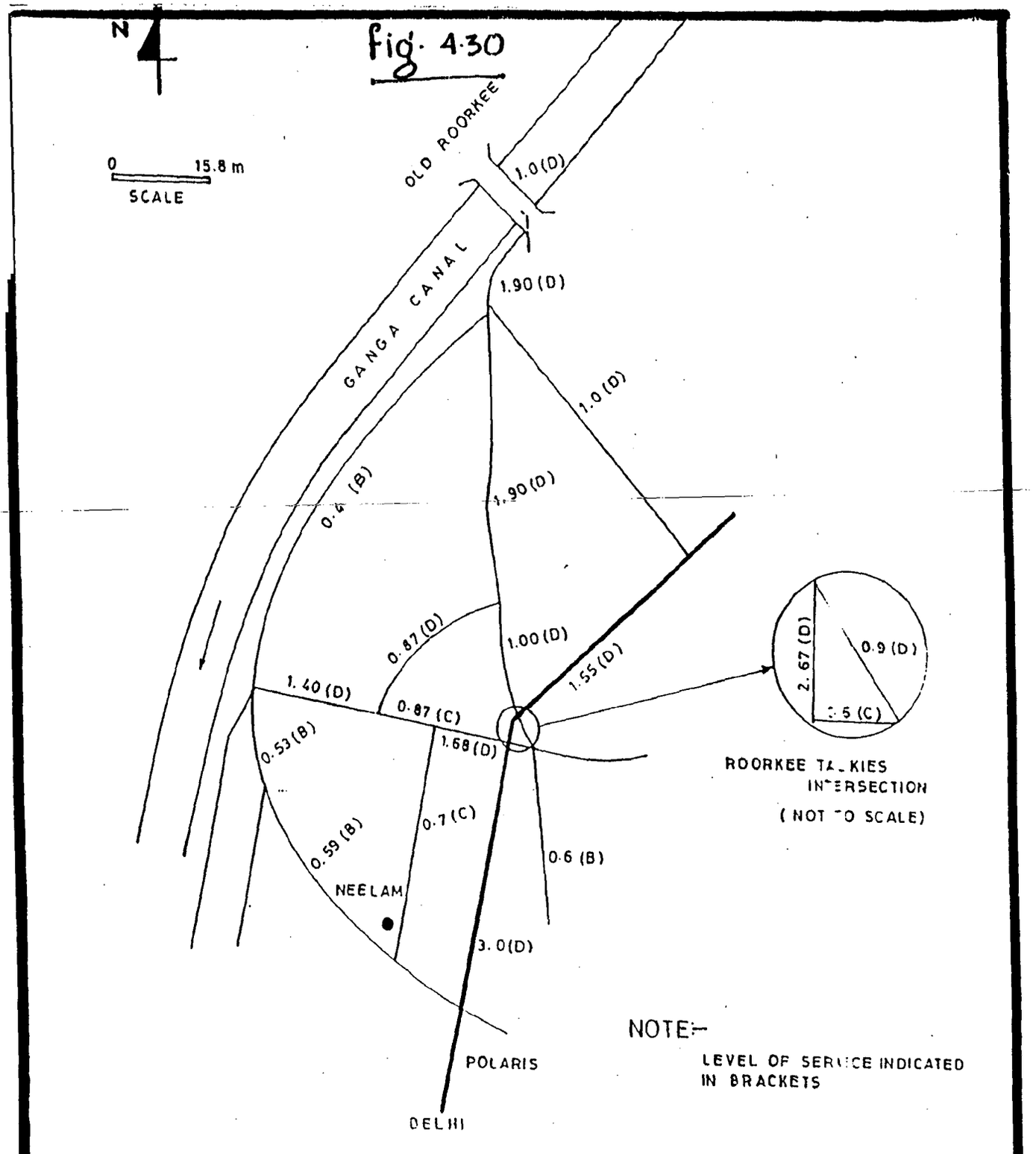
Mainly two traffic corridors in the Roorkee town. Delhi Hardwar road and Civil Lines main Hardwar road a shopping street. Ref. Fig. 4.27.

Most of the peak hour traffic is for shopping, recrw-ational and social purposes. The bottleneck at Petrol pump intersection and Roorkee Talkies and intersection are critical problem observed.

For Roorkee intersection volume/capacity ratio was found to be 1:40 (capacity 3240 PCU) for Petrol pump intersection 0.90 (Capacity 2720 PCU).

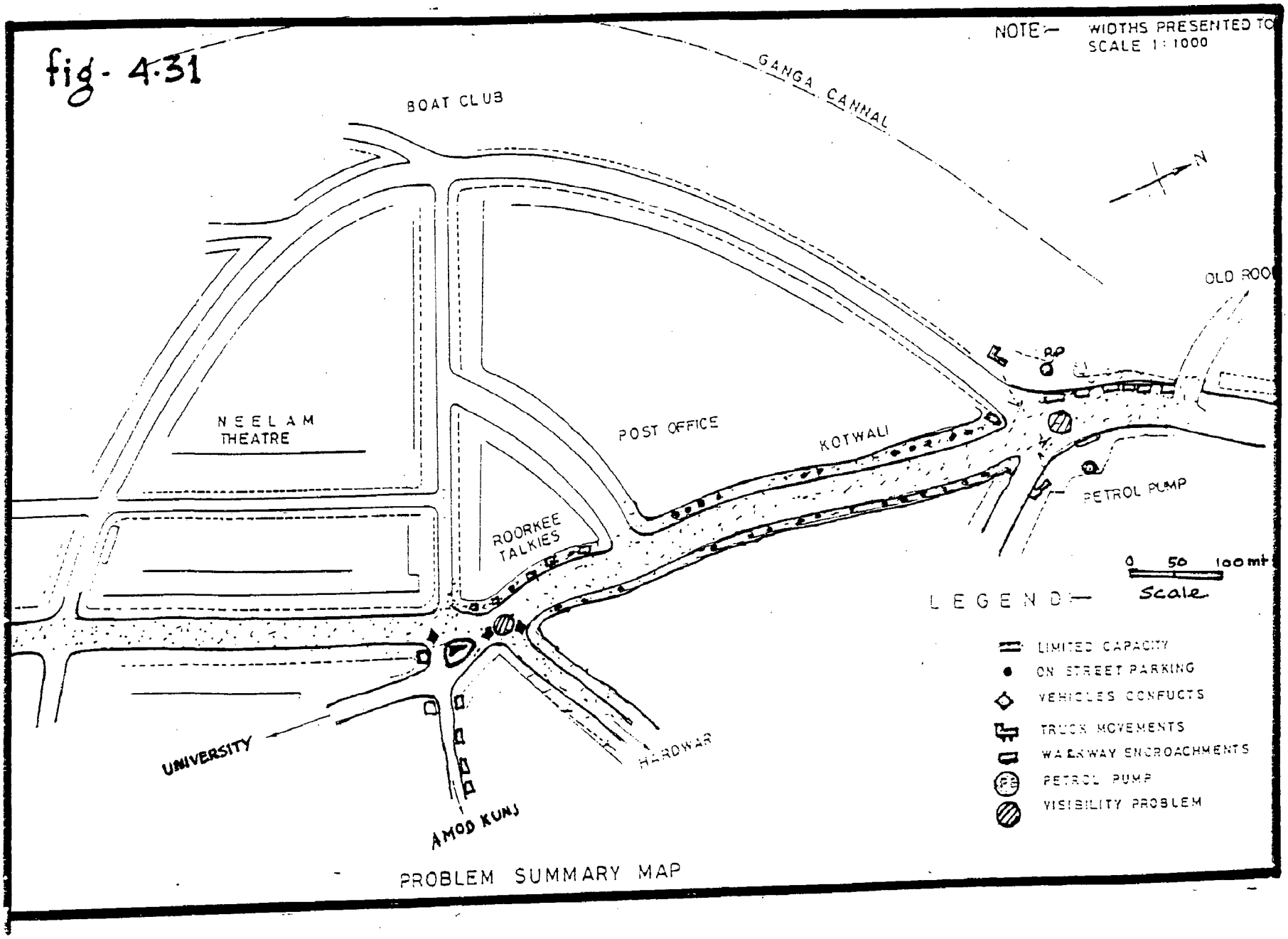
GENERAL TRAFFIC PROBLEMS :

1. Hawkers occupying the walk way.
2. Encroachment of walkway by shop display extensions.
3. Sign boards on walkway.
4. Truck terminal on the boat club approach road, moving across to the Civil Lines and old Roorkee. Some trucks parked at Saraswati Kunj approach also.
5. Saraswati Kubj road is used by private busses disturb-ing the flow of traffic.
6. Petrol Pumps being situated near old Roorkee, the long waiting and uncontrolled traffic is hazardous to



LEVEL OF SERVICES V/C RATIOS OF STUDY AREA NETWORK

fig - 4.31



PROBLEM SUMMARY MAP

smooth traffic movement.

7. Cinema halls traffic is anothe traffic hazard causing sudden impact on the road and illegal crossing by all types of road users.

8. Street furnitures, Telephone, Electricity poles haphazardly placed are a common scene in the area.

9. Parking lot in front of the Kotwali, there exists a parking lot but is not utilized as there is no restriction on parking on the street.

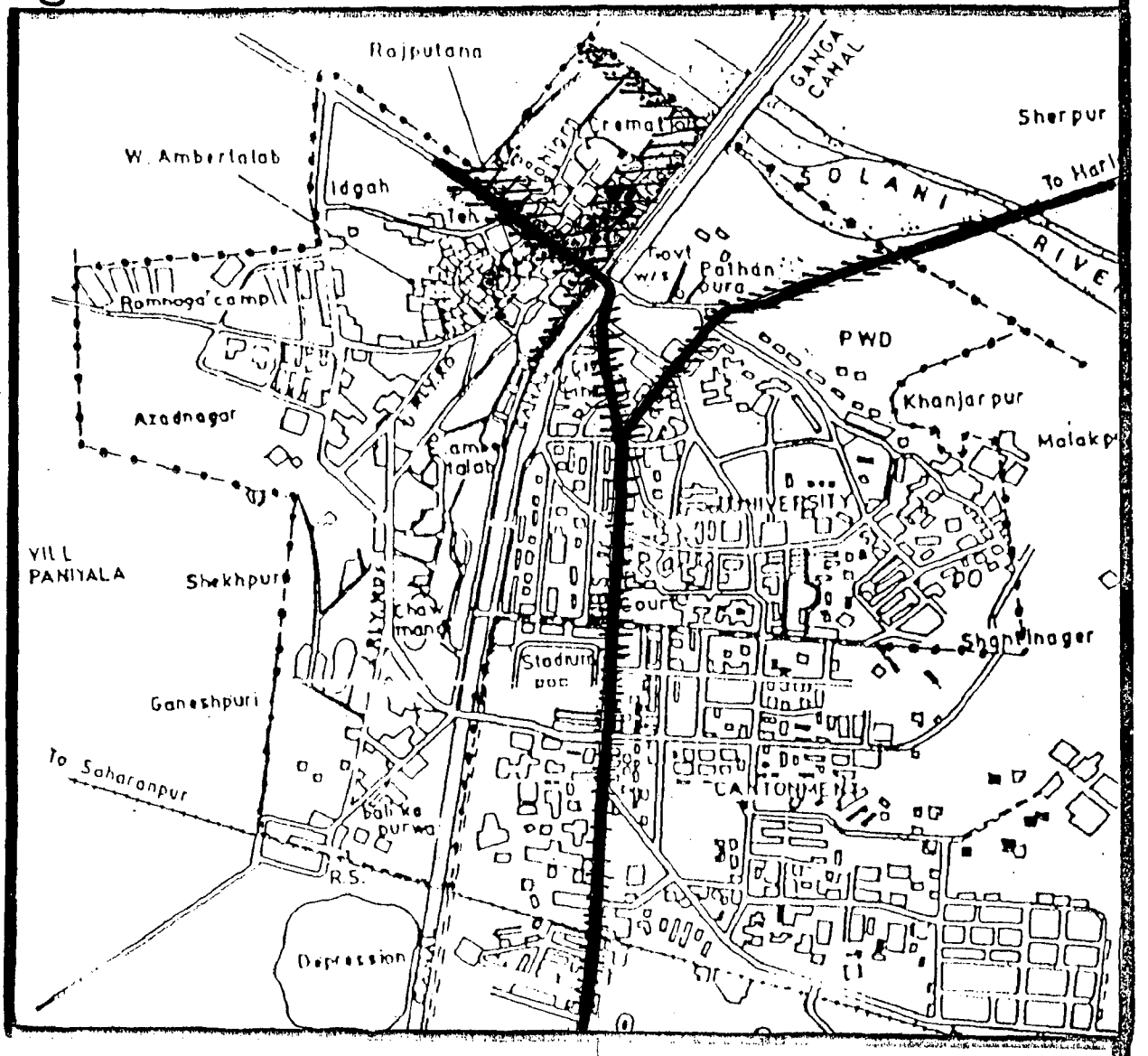
10. Traffic rules, lack of enforcement leads to violation of all traffic rules by all types of masses. A problem survey map given in Fig. shows the traffic problems of the area. (Ref. Fig. 4.31).

4.6 ENVIRONMENTAL QUALITY:

Air pollution by solid particles include actual deposition and suspension of dust in the air. When these conditions are taken into consideration and related with the existing conditions of Roorkee town, the air pollution is very less at present. The main air pollution to the town is caused by heavy traffic on the Delhi Rishikesh and Delhi Dehradun road, further the congested old Roorkee area where no smooth flow of traffic can be obtained in the prevailing condition leads to air pollution in the areas. (Ref. Fig.4.32)

Noise pollution in town is also due to the traffic only. So the area with air pollution are also subjected to noise pollution.

fig 4.32. ROORKEE TOWN POLLUTION



Air Pollution — LAND POLLUTION

Noise Pollution

POTENTIAL FOR SUSTAINABLE ECO-DEVELOPMENT OF ROORKEE TOWN

NOT TO SCALE

Sunit k. Bhagabati.
murp thesis 1992-93.

Ground pollution in the town is caused by the garbage dumping in the municipal dumping ground without treatment and protection, Unhygenic condition of the Sabji Mani, dumping of garbage by individuals on to the road and open drains.

Water Pollution :

The canal water gets polluted due to dumping of rotten vegetable and house hold effluent disposal which may not be harmful as it has a high flow and this water is not used for drinking purpose.

The Solani river is getting polluted by sewage disposal by municipality, cantonment, University and C.B.R.I. which is a cause for deteriorating quality of water and detrimental to acquatic life support system.

High density, circulation problem in central market area of old Roorkee, the cremation ground near B.S.M. College. Less vegetation in Rajputana, Amber Talab, Chow Mandi, Purana Tehsil, Sot Satti, Areas of old Roorkee are the other environmental problems of the town.

CHAPTER-5:

ASSESSMENT OF SUSTAINABILITY POTENTIAL

CHAPTER 5 : ASSESSMENT OF SUSTAINABILITY POTENTIAL OF ROORKEE TOWN :

5.1 INTRODUCTION :

The degree to which sustainability is achieveable within considerable paremeters for any aspect of setlement depends on the potential of resources and its utilization pattern. As already stated the aspect for which sustainability potential of Roorkee Town will be assessed are primary need (air, water, food), the primary resources (energy) and essential utility (waste management). The selection of these have been largely determined by-

a. Availability of data.
b. Importance
c. Simplicity
d. Possibility of comptetion within time and resources.

In this chapter the assessment of environmental potential has been done within the following paramenters and assumptions.

(i) The target year is taken as 2011 A.D.
(ii) All calculations are based on requirement of population per year 2011 A.D. i,e. for 1,35,025 persons.
(iii) The land area of Roorkee municipal Board area assumed to increase to 10 squire kilometer by 2011 A.D.

The primary or basic needs of human life are those which are essential for physical sustenance. Without air, water, and food there monkind will not exisr. Moreover deterioration of quality in these leads to lower wuality of life. Hance all attempt possible should be made to presure and maintain quality of these and enhance the quality of life.

5.2. PRIMARY NEED.:

5.2.1 Air:

Roorkee being a service town of institutional charecter and not having industries of air pollution types in large scale other than exceptions of many small boilers and furnaces of smaller scale, is free of industrial air pollution.

No relevant study on air quality related to the area was available during the course of this work. Hance field study of therarea had to be carried, and only general assessment could be done.

The major source of air pollition in therearea as observed was by the traffic on the Delhi Hardwar state High ay and the Delhi Dehradun Highway. The treffic which is also the only source of noise pollution in the town. Other areas where air pollution was bserved in the busy market area of Roorkee, i.e. Rajputana and sot Mohalla area.

Here the pollution is due to the congested settlements high density and spillage of rotten table waste from the vegitable market.

Overall air quality as assessed from the general field survey can be siad to be good. It can be improved by maintaining proper traffic rules on the highway, enforcement of appropriate building bye lawas specially for high density areas, proper management and remodelling of the sabji, Mandi, environmental pollution.

Considering the size, the settlement pattern of Roorkee town and comparing with settlements under similar conditions, Roorkee has very high vehicle ownership indicating the presence of highly paid institutional staff and the prosperous businessman. As already stated. The volume of traffic passing through the two corridors in the twon in very high. The combined effect of these two facts is the existance of air and noise pollution along the streets.

It will not be out of place to stress the need for carrying out field air pollution studies in specific loccations along the corridor as well as monitoring smoke emission, noise pollution ete. caused by automobile vehicles.

5.2.2 Water:

For assessing water, both quality and quantity is of equal importance. Assessment had been done as discussed below with the available field and laboratory works done on quality and ground water table observation by reliable persons and gevernment authority. Water quantity is assessed based on available rainfall data, ground quality for water percolation and discussion with persons from water Resour Development Centre (U.O.R.), Roorkee, Irrigation Design office Roorkee (U.P.).

a. Quantity of Water :

As per census of India's report, average annual rainfall in Roorkee for the period 1971 to 1981 was 1016 mm.

The ground water table varies from 6 to meters during premonsoon and post monsoon. Water table at different stations around Roorkee reveals that there has been no exhorbitant changes in the ground water table in last two decades. Ref. Appendix 4.

Considerable amount of water is also retained by the soil due seepa ge of water is also retained by soil due seepage of water from the canl surface.

Availability of ground water from rain can be calculated as under:

Annual average rainfall = 1016 mm = 100%

A Ground percolation =50% = 508 mm

i. Evaporation = 30%

ii. Ground storage = 10%

iii. Seepage to surface = 10%

B. Immediate surface run off= 50% = 508 mm

C. Total run off = B+ A iii = 60%

I. Ground water availability from rain water is calculated as below :

Area of town = 8.11 km^2

Water available (1991AD) = 10% (Ground storage All)

$$= \frac{8.11 \times 1000 \times 1000 \times 1016 \times 10}{100 \quad 100} \ m^3$$

$$= 811 \times 1016 \ m^3$$

$$= 823976 \ m^3$$

Availability (1991 AD) = 823976 Kltrs.

Availability (2011 AD) = 1016000 Kltrs.

II. Ground water from canal (yearly ground percolation)

Length of canal in town area 3950 km.

Average curvature of the canal in contact with water = 50 mtrs.

Area = 3950 x 50 = 197500 m^2

Seepage of water at the rate of 20 to 30 litres per sq. mt. considering the soil condition of the canal. Taking average to be 25 litres per hour per year

ground storage

≒ 365 x 24 x 25 x 197500

Availability 1991 = 43252500000 ltrs.

Availability 2011 = 54065625 klts.

Total ground water availability = I + II

In 1991 = 44076476 Klts/ Year

In 2011 = 5508165 Klts/Year.

Notie : Present supply by municipality is at the rate of 270 lts. p.c.p.d.

At the present municipal supply rate i.e. 270 lts. p.c.p.d.

$$\text{Availability 1991} = \frac{44076476 \times 1000}{270 \times 365} = 4,47,249$$

(for persons)

$$\text{Availability 2011} = \frac{55081625 \times 1000}{270 \times 365} = 5,58,920$$

(for persons)

Hence, it can be stated that Roorkee town will not face shortage of water till 2011 AD provided the prevailing conditions and assumptions folds good.

Quality of water :

Water quality of Roorkee (Rampur area) and other nearby area as tested in the chemical laboratory of Ground Water Department, Roorkee in 1992 is as presented Appendix 4. As per their assessment of different chemical constituent for agricultural purpose, the quality of water in all cases were good.

The sample of Roorkee (Rampur) water was Found to be hard, non corrosive and non incrustrative.

Test of water quality for drinking purpose was also done by a student, during 1991-92, in the University of Roorkee. Samples from the water supplied by the municipal water were collected at the consumers end from six different points as shown in Fig. 5.1. Bar chart and figures indicating the toral residue, dissolved residue, suspended residue, chloride, sulphates, Alkalimity, Hardness, pH. Acidity and Dissolved oxygen and chemical oxygen demand are as enclosed in Appendix 4. A summary of the sample characteristics of all the sample are given in Table 5.1.

The table clearly shows that water from four of the eight stations can be rejected on grounds of high iron content. Water from Ganeshpur and Civil Lines is tolerable for iron content. The Railway Station area

(3 mg/l)

(500 mg/l)

Iron

TABLE 5.1

SUMMARY OF GROUNDS FOR ACCEPTABILITY/REJECTION

(10 mg/l)

Total-Count
(1x10^6)

Coliform
(10/100 ml)

Manganese
(0.5 mg/l)

Magnesium
(150 mg/l)

Sulphate
(1000 mg/l)

DO
(3 mg/l)

TDS
(500 mg/l)

Iron
(1.0 mg/l)

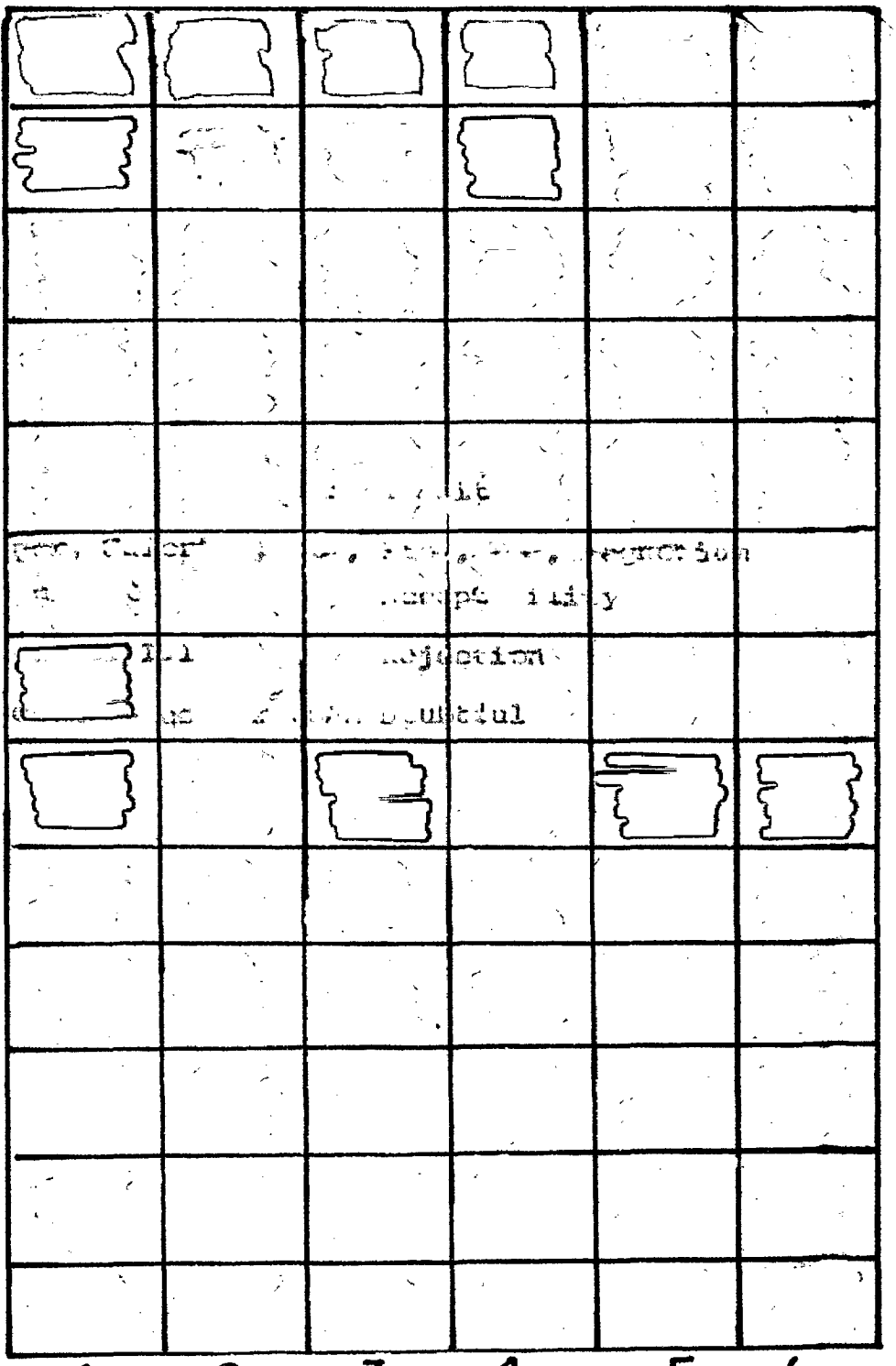
CCD
(10 mg/l)

Chloride
(500 mg/l)

Copper
(1.5 mg/l)

Calcium
(100 mg/l)

pH
(6.5-9.2)



pH, Calcium, Copper, Chloride, CCD, Iron, TDS, Magnesium Manganese - as per WHO

DO, Sulphates - as per ISI

Total Bacterial count - as per USPH

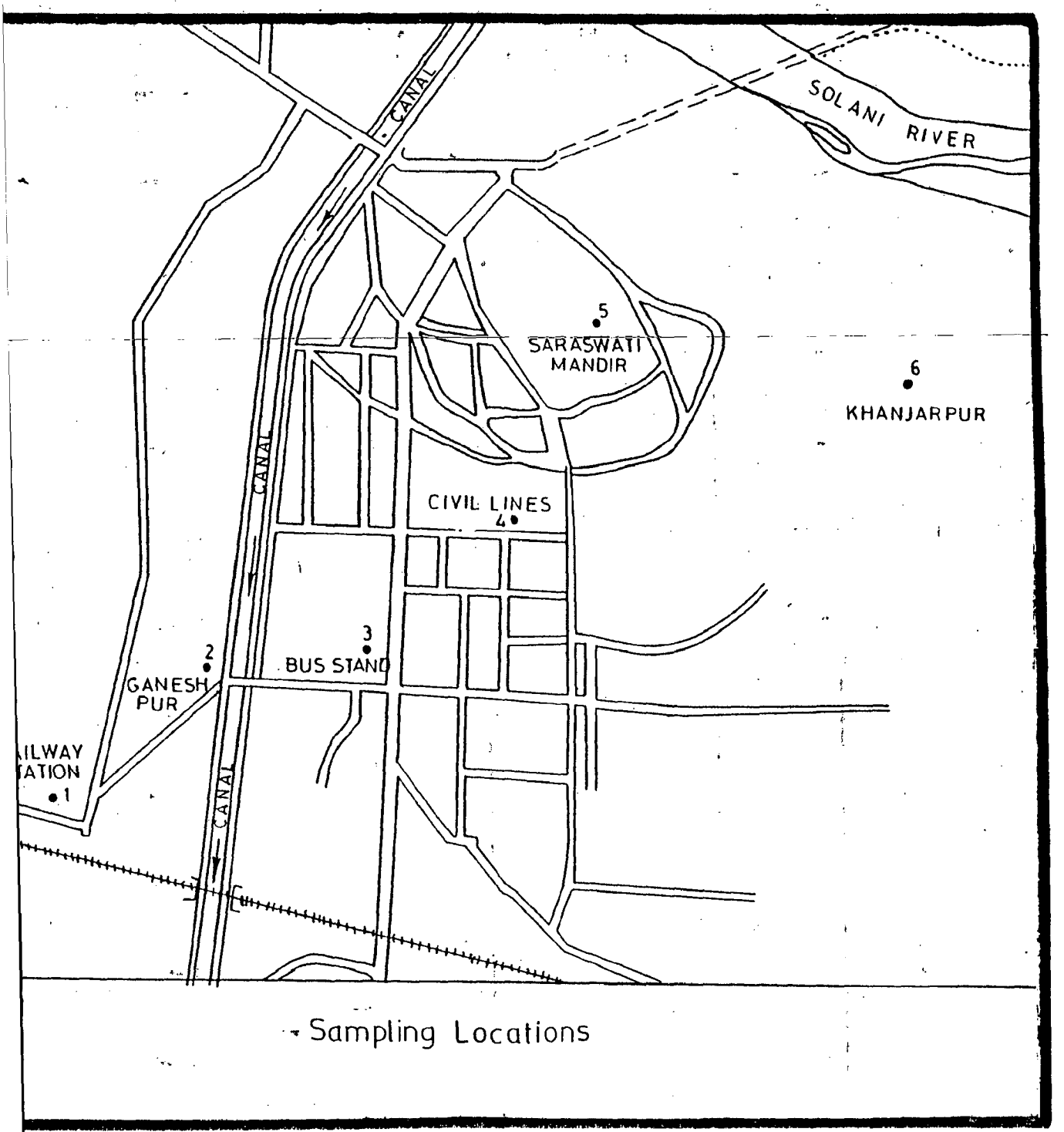
Acceptability

Rejection

Doubtful

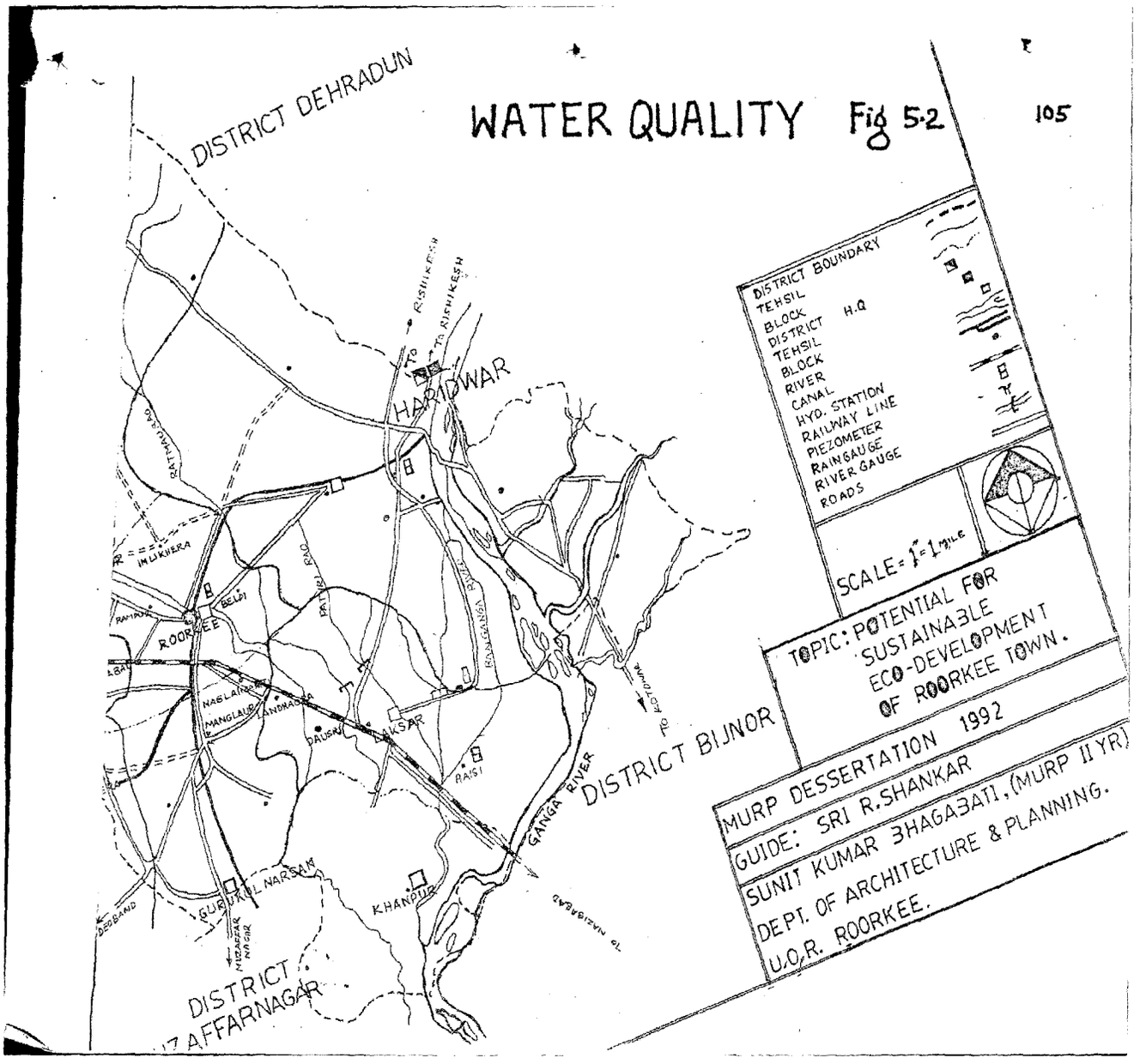
fig - 5.1

WATER QUALITY ROORKEE TOWN



SOURCE: Chem Dept. Univ. of Roorkee.

WATER QUALITY Fig 5.2



sample has more dissolved solids, coliform bacteria, iron content and has also got grounds to be rejected for total bacteria count. Sample from Civil Lines area has more coliform bacteria and is doubted of total bacteria count.

Excessise iron content is a common factor with ground water and needs to be treated for removal for better results. Hardness is within tolerance it leads to high detergent consumption. Excess iron content leads to stomach disorder, falling of hair, consumption of more detergent, drying up of skin etc. Coliform bacteria causes diohrea and other stomach problems. Total bacteria which increases more in the hot rainy season are the main causes of the seasonal disease. Shallow water (from hand pumps) consumers are more prone to seasonal diseases which are water borne.

Of the samples sent by the Municipal Board for testing of chemical content and Bacteria content at State Health Depts. laboratory at Haridwar in 1989, 1990 and 1991 all were good except one in 1989.

Ref.

5.2.3 FOOD

Roorkee being in the heart of the ferile and high productivity agricultural region a large part of its food supplies including wheat, rice, pulse, vegetable, sugar, fruit etc is met by the rorrounding villages. Though classified as urban, Roorkee has imbibed the spirit of the farmers and demonstrates spontamiously its potential for achieving food self sufficiency to the maximum possible extent.

Though in recent times the consumer market has been flooded with increasing varieties of packed, canned and preserved food items, most of which are manufactured in larger urban centres. It is felt thatassesment of self sufficiency is ought to be made only with respect to the basic essential food materials. For the purpose of the study, the list of the basic food materials include. Vagetables, Fruits, Dairy Products, and some non vegetarian food productionly.

The Roorkee Urban Agglomerate as a whole is dependent for its food or three sources viz. fringe villages, government supply, the distant markets and with a very small portion particulafty of vegetables, fruits, poultry and dairy products

ASSESSMENT OF FOOD REQUIREMENT

S.No.	Items	standard demand	Demand 1991	Demand 2011	Present source: Local	Present source: Outside
1.	Wheat	0.30 kg /c/d	8785.84	14782.5, t.		V G
2.	Rice	0.13 "	3807.19	6405.72, t		V G
3.	Pluses	0.66 "	17571.68	2956.50, t		V D
4.	Vegetable	0.30 "	8785.84	14782.5 t		V
5.	Sugar	0.05 "	1464.30	2463.75 t		V G
6.	Fruit	0.20 "	5857.22	9855.00 t		V D
7.	Edible oil	0.03 lt"	8785.84	1478.25 t		V D G
8.	Milk and Dairy prod.	0.50 "	146430.070	24637500 lts.		V D
9.	Egges	2 nos/c/ w.	8,367 th	14,078 th.		V D
10.	Fish/ Meat	0.20kg/5/ w.	167.34 t	281.62 t.		V D

= Local G = Government Supply

V = Nearby village D = Distant Market.

being contributed by the local production. To areas verying degrees of food self sufficiency the first step is to calculate the consumption, this is calculated using consumption standards. Summary of the consumption of the selected products are as in table 5.2

Role of Government Supply :

The government

With all the good intent of distributing and controlling prices of basic commodities including food items, retails its collection from different areas through their outlets. In Roorkee town there are 79,097 of Government ration unit supplied. There were 17,186 number of cards issued 1991-92. The information as collected from the tehsil H.Q. is as below and area wise distribution of retail shops and number of units is as given in Appendix 5 .

General items supplied by government are Rice, wheats, sugar, kerosene and palm oil. All items have been supplied in total for the year 1991-92. The demand of wheat, sugar, kerosene and palm oil is more than what is supplied. Rice is supplied in excess. Kerocene is available in the black market where they charge much higher than the government price. It is generally observed, in distribution of scarce commodity by government departments, malpractice is almost unavodable. Overhead cost for collection, storage is much more than that by private organisation.

A list of items supplied by the government supply department and the comparative cost in the open market as per 1992-93 is as given below.

Table 5.3

Govt. Food Supply

Items Supplied	Quantity Per month	Cost in Rs. per unit Govt. retail	Open Market
Wheat	8 kg. p.h.	3.10	4.00
Rice	6 kg. p.h.	5.20/4.20	7.00/6.00
Sugar	8 kg. p.h.	6.90	9.50
Kerosene	5 to 7 lts.p.c.	2.75	5.00
Palm oil	2 kg. lts. "	31.90	36.00

P.h- Per head, p.c. - per card.

POTENTIALS

The crucial dieterminants while assessing potential for food self sufficiency are as listed below

Table 5.4

FOOD POTENTIAL DETERMINANTS.

Determinants	High	Medium	Low	Remarks
1. Availability of land	0			Agricultural land, Institutional area , low residential density.
2. Fertility of Soil	0			Fertile Soil
3. Water availability	0			Canal, Rainfall, river.
4. Know how background	0			Developed agricultural back ground
5. Time availability	0	0	0	Serviceclass, wamen folk.
6. Fabourable atritude	0	0	0	Educated lot. easy motivate
7. Climatic suitability	0			Good production, no flooding.
8. Man Power		0	0	Rural fringes area and within
9. Incentives			0	No incentives, things easily available, No reduction on taxes.
10. Other Raw materials availability		0		Available at central market only. Not available at home.

Land availability for different uses at town level have been summarised in table 4.6. Now the projected residential and community level land use need to be projected for different uses to make an assessment of the future potential Table 5.5 summarises the land allocation for different uses:

Table - 5.5

PROPOSED LAND DISTRIBUTION RESIDENTIAL AND COMMUNITY LEVEL SERVICES.

S.No.	Uses	Standard	Nos.	Area in meters.
1.	Residential	I.75 SM Built II.75 SM Open	27000Unit	405.00
2.	Circulation	6%		34.56
3.	Dairy	30 SM per cattle	12,166	36.49
4.	Community centre, play ground etc,	1500 SM Built 2700 open	70	29.40
5.	Green house	500 SM	70	1.75
6.	Fodder	5000 SM	40	20.00
7.	Orchard	3800 SM	35	17.50
8.	Algae pond	2500 SM	70	17.50
9.	Fish pond	4000 SM	20	8.00
10.	Wood lot	10000 SM	10	10,000

Total area = 576.00 hectres.

It is neither feasible nor desirable to try and achieve self sufficiency in terms of pulses, cereals edible oil, sugar etc. But, proper utilization of agricultural land, residential and commenly vacant land, institutional area, keeping in view the agricultural background of the town, fertility of the soil availability of water and over all environment of the town, can help achieve vareying degree of self sufficiency in terms of vegetables, fruit, Dairy, poultry and some non vegetarian food products as discussed below.

a. Vegetables

Seasonal vegetables of various kinds can be grown on indivdual home gardens, terrace cultivation, tubs, community gardens. It is not necessary that every individual will be gardening but the land utility can be done by leasing to willing gardeners.

Total vegetable demand of the town as per tableT-5.2 is 14782 tonnes. General standard adopted for production is 45 tonnes/hect/year.

Area required = 14782/45 = 327 hectres

Area required per capita = 24 sq.mt.

Area required per capita = 24 sq.mt.

Area available at house hold level is 150 sq.mt.

Average breale up is as given below for both double and single storeyed cases Ref. Table T-5.6.

TABLE T-5.6

Storied	Total	Bruilt up	Vegetable garden	Fruit garden	Service Lawn, etc.
1	150	75	35 *25	20	20
2	150	40(D.S)	70 *10	20	20

* Roof top vegatable garden space.
D.S. Double storaged.

CASE-I Single storied

Max potential = 60 x Z = 7290 tonne

= 35 x Z = 4252.5 tonnes

CASE-II Double Storeyed

Maximum potential = 80 x Z = 9720 tonnes.

= 70 x Z = 8505

Note Z = 27000 (nouse holds) x 45 (Production per metre) x 10000 (converter to heetre) = 121.5

Within the assumed limited area there was no provision for vegetable gareleming at higher heiraely otherthan house hold level.

Maximum potential by 2011 is 425.5 tonnes and maximum potential of 9720 tonnes per year.

Self sufficiency in terms of vegetable in Roorkee town by 2011 AD can vary from 28% to 66% depending on other development factors.

b. **Fruits**

Where as the vegetable cultivation will be at house hold level and to some extent at community level (in the institutional areas and where there is group housing). The fruit production can not entirely take place at the develling or communityleve as is seen in the prevailing siheation, various types of fruit yielding trees are grown on the institutional area, roads etc. However, the priority wise location for fruit tree cultivation are

(1) At the house hold level (2) At the community level (3) Institutional building premisses. (4) Institutional Roads. (5) Community Roads. (6) Public Roads. For assesing the potential of fruit frees only the first five will be considered.

Varieties of local fruit can be grown, within the town area to meet the towns demand. Fruits commonly grown in the area are Banana, Papaya, Goave, Mangoes, Lichi, Naspati, Black berrys, Oranges, Jack fruit etc.

Potential

Assessment is done with the following calculated parameters.

(1) Road side plantation - 200 trees per hecter of total road area.

(2) Orchard plantation - 400 trees per hectre.

(3) Yield - 200 kg. per tree per year. (average)

Land available by 2011 AD :

(a) house hold level (Ref. Table 5.5) = 20 x 27000 Sq
= 54 hectres.

(b) Community level (Ref. table 5.5 USE. 6) = 13.3 hu.

(c) Institutional permisses (Ref. table 4.6)

Educational = 124.8 hect.

Pub. semi = $\frac{28.0}{152.8}$ hect.

Roads = 35.0 hect

117.8 hect.

assuming 20% area to be under fruit fruit tree plantation area available = 23.58 hect.

(d) Institutional roads. 35.00 km, average width 10 mts.
= 35 hectres.

(e) Community roads (Ref. tabel 5.5) = 34.56 hectres.

I. a + b + c = 90.88 hctrs.

II. d + e = 69.56 hectrs.

Number of trees = 90.88 x 400 + 69.56 x 200
= 36352 + 13912 = 50264 Nos.

Xield = 50264 x 200 % 1000 = 10052.8 tonnes

Yearly demand (ref table 5.2) = 14,782 tonnes,

76.11% of the fruit requirement can be met with the above mentioned utilization. 37.6 % can be met by house hold, community and institutional permisses and 29.5% on road side plantation at Institutional and community roads.

Minimum potential = 37.6% = 5558 tonnes

Maximum potential = 67.11% = 9920 tonnes

The balance demand can be met by roads side plantation on public roads, and from outside market.

C. DAIRY PRODUCTS

The milk and milk products produced in the town is not adequate. At present it has to depend 90% on the rural areas around it and even on further areas for milk and its products. Total demand for a population of 1,35,000 (population of 2011 as predicted:

Total early demand for town = 135,000x0. 50x365
500 ml. P.C. P.D.

= 246,36,500 Lts.

Considering average location period 180 days per year and 5 liters of milk production per day.

One amimal yield per year = 5 x 180

= 900 liters.

Total milk giving animals needed = 24636500/900

= 27375 nos.

Total cattle head requirement = 27375 $(1+\frac{1}{3})$ = 36500 It is not possible to achieve full sufficiency in Dairy products unless enough land for fodder is not availavle, thus in order to have enough grazing land and some fodder within the town, provision for only one third of the total need of town is envisaged for ie 12166 number of cattle head in total.

Dairy farm either at node cluster of community level can be run profitably by individuals or co-operative. The land allocated for each cattle head is 30 S.M. which includes land for shed, haystock, other feed, grazing-and Gobar gas plant.

Maximum potential by 2011 = 33.3%= 8212166 its minimum potential is calculated by finding the probable areas where Dairy farming will be feasible without alliration in present

Poultry farming can be done by making stepped arrangement for the poultry at community level neer the algae pond and the acquaculture poultry feed - partly from domestic waste and partly purchared.

v **Fish a Meat**

Yearly demand = .200 gm. per week per month veg.

Consumer i.e. one fifth of total population

= 135025x.2 5 x 365 7 = 282 tonnes.

Mutton = 25% = 70.5 tonnes.

Chicken = 50% = 141

Fish = 25% = 70.5

Mutton demand can be net from outside as is procticed now

Chicken requirement per year = 41000 numbers.

to farming for meat consumption of 23,500 number space requirement = 2350 S.M. which can be met at different community centres.

Fish Requirement per year 70.5 tonnes.

Production @ 9 tonnes per hect. per year

Land available for fish pond 8 hectres. (ref. T-5.5)

Potential = 8x9 = 72 tonnes.

Thus full sufficiency in the fish demand can be met.

TABLE - 5.7

SUMMARY OF FOOD DOTENTIAL

PRODUCT	Self Sufficiency		
	Maximum	Minimum	Persent
Vegetable	65	28	10%
Fruit	67.11	37.6	10%
Milk	33.3	17.00	15%
Fodden	17.88	6.2	2%
Poultry product	100.00	50.00	10%
Fish	100.00	50.00	

5.3 WASTE RECYCLING POTENTIAL

There are two types of wastes. The Bio-degradable and the non bio- degradable ones. The Bio-gradable wastes can be used either to generate Bio-gas or composted to yield humus. The non Bio- degradable ones can either be reused or recycled to gain maximum benefit and conserve resources. Fig. 5.3 indicates the flow of waste from production to the and use and also the recycling process.

5.3.1 Bio- Degradable wastes

All Bio- degradable waste can be composted and reused without producing any wastes as discussed below.

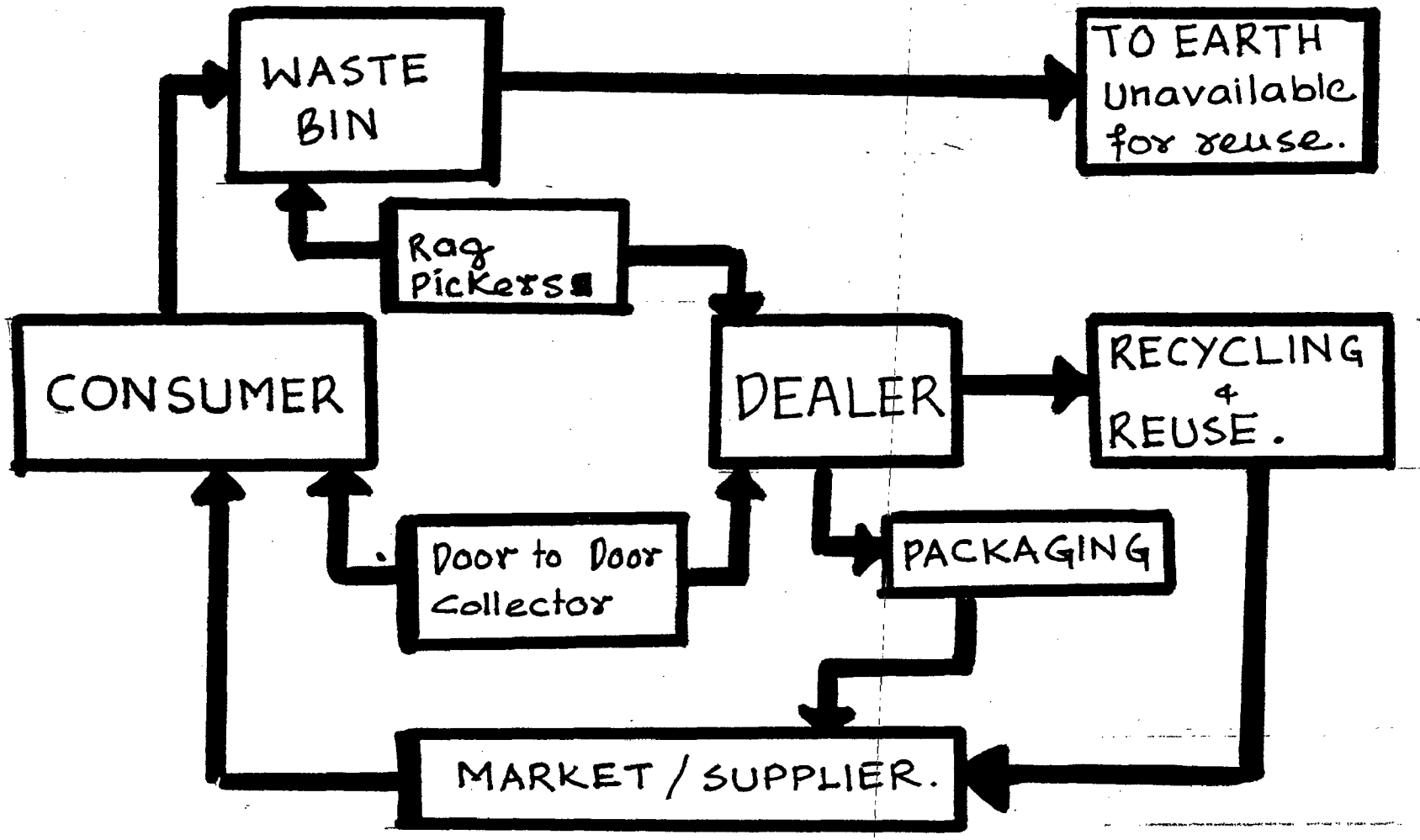
a.) Human and Animal wastes :- Bio- gas production, can be used for lighting, cooling.

b.) Biomass :- For fodder, heat generation, fëelling of i.e. engines, replacing fossil fuel etc.

c.) Domestic food waste, vegetable garden waste etc.- Composted and use as manse in agricultural work, animal food, fish food etc.

The potential from Bio- degradable waste will be discussed in detail in the energy part of the same chapter.

WASTE RECYCLING & REUSE FLOW DGM.



Recycling of paper, polythene, plastics, rubber & metals.

5.3.2 Non- Biodegradable Wastes:

They are mainly news paper, polythene container bags, paper packets, variety of plastic goods and containers. Damaged iron and steel goods, other metal goods, tin material, glass old clothings and foot ware etc.

Roorkee town has a scrap material market called the Kabadi Bazar. This is an unrecognised activity of the Society which is very organised and adding much to the world resources by the process of recycling and reuse of materials and goods. In India, it is a common practic.

An estimate of non bio degradable waste is made as discussed below :

A. Paper :

I. News Paper:

Presently received in town 12,281 copies on week days, of which approximately 80% is for the town is 9,824 nos. for 80.236 people, i.e.,one paper for eight persons. Assuming this ratio to be 1:5 by 2011 AD.

Number of News papers. in town will be 27000 copies.
@ 50 gm. per paper per day supply = 1350 kg.
Per year = 492 tonnes.

II. Magazines, Journals:

2 per family of 5 persons per month @ 150 gms per issue

= 2 x 27,000 x 0.15 x 12 % 1000

= 97.5 tonnes.

III. Books and Stationery of school/ college students:

2 students per faimily @ 10 kg. per year

2 x 10 x 27,000/1000 = 540 tonnes.

IV. Other Paper Articles:

a) 10 gms. per capita per day = 10 x 135000 % 1000 x 365 kg per year.

= 49.27 tonnes per year

Total paper waste per year = 1179 tonnes.

Recycled and reused at present = 80%

End uses are Recycling for manufacture of paper, of vareying quality, Packaging, retail shops, household uses, During the course of use loss at every use is higher than the precctomg ise. Thus there exists a possibility of Reusing upto 95% by increasing the efficiency with proper organised management of this activity.

b. Plastics and Polythene :

The last decade has been an increasing use of plastic and polythene products. This a common phnomenon with all developing and devellopeed countries, 75% of the products are disposable, 25% is durable but the durability is much less than that of the materials used in earlier period. Consumption of there producs are as discussed below.

i) Polythene :- At the rate of 1 kg. per 5 Persons per month

= 1 x 135000 % 5 x 12 = 322 tonnes per year. of which 50% collected and 50% goes back to the earth uncorrposted.

with efficient collection system upto 75% of these can be collected and recycled.

ii) Plastics in the form of tooth brush, pens, etc. containers and other packaging materials is calculated to be 250 grammers per person per month.

Per year plastic consumption = 0.25 x 135,000 x12% 1000 =

= 405 tonnes

60% is recycled and 40% is wasted. This also can be improved by proper collection network i.e. upto 95% can be recoverd for reuse and recycling.

All possible means should be tried to replace the low quality plastic and polythene to make possible makimum reuse. It will also be a good practice to go back to lower consumption of throw away plastic a polythene packaging and carry bags, to be backed by material policy).

c. Rubber:

In the form of foot ware, considering 80% of the population to use rubber foot ware and 50% of them to ware out by one year and a pair to weigh 100 gms. average when disposing.

Per Year waste = 0.8 x 0.5 x 135,000 x 100 % 1000

= 4.5 tonnes.

d. Glass material :

Glass containers for food and other materials is conumed approximately @ 50 bottles per family per year.

Total 135,000 x 50 = 6750,000, average weight of bottle taken as 100 gms. will generate

6750000 x 0.100/1000 tonnes.

= 675 tonnes per year.

Of the total glass materials of 675 tonnes consumed in the town 75% is reused and recycled and 25 % is wasted and dumped. This can also be improved and proper incentives, organised market can improve the recycling to 95% and hence reducing the glass demand.

Glass is recycled at Rishikesh. (J.J. glass Industries) where IDPL is a big consumer of glass products.

e. Metals :

Of all the metallic wastes tin is the most consumed ones. Tin in the form of containers, sheets, utensils are consumed in domestic and other uses. The average number of hins consumed per family is 5 per months, with average weight 150 gms.

Total consumption per year = 0.150 x 5 x 135000 % 5 x 12 =

= 243 tonnes

Of this 30% gets nuted and reused and unused, 30% reused for manufacturing in small scale units, 40% is collected for recycling.

An improved management can reduce the musted unused part of consumption from 30% to 10%, thus saving 48.6 tonnes of tin metal.

Other Matallic Wastes :

Iron, steel, tin brass, and copper and aluminium are collected and sent outside the town for recycling. Of these some are recycled in the town in small furnaces in small scale casting industries.

Brass, steel and iron is also used in the manufacture of Drawing ans Survey instruments.

Overviwing the above waste generation, there exists a scope for recycling and manufacturing goods from all the wastes discussed above. Thus, there exists scope board packing.

paper manufacturing, rubber and plastic foot ware, glass recycling plant, metal extraction etc.

5.3.2 Degradable Waste :

Roorkee town has a scrap material market called the kabadi Bazar. This is an unrecognised activity, which is very much organised and adding much to the resources by the process of reusing and reuse of goods and materials. In India it is a common feature.

Table 5.8 is a summary of existing and projected recycling and reuse potential of the town.

Table 5.8

RECYCLING POTENTIAL SUMMARY

S.N.	Items	% Reused & Recycled		Probable excess recycled
		Existing	Projected	
1.	Paper	80	95	176.85 ton.
2.	Polythene	50	75	48.30 ton.
3.	Plastic	60	95	141.75 ton.
4.	Glass	75	95	168.75 ton.
5.	Tin	70	90	48.60 ton.
6.	Rubbar	30	75	2.02 ton.

5.4 ENERGY

THE NATIONAL ENERGY SCENARIO

During the twenty two year period 1953-54 to 1975-76 because of major thrust in industrialisation, increased use of lift irrigation in agriculture and development of organised transport sector, commercial energy consuption more than quadrupled. While consumption increased at the rate of about 7% per annum during this period, rate of growth of non commercial energy expanded at a much slower rate of 2% per annum.

The report of working group on energy policy (Chairman N.B. Prasad , 1979 estimated that the share of non commercial energy in total energy demand had declined from 68% in 1953-54 to 40% in 1982-83. According to more recent official estimate by Energy Demand Group, 1986, commercial energy accounted for 58%. of the total energy demand in 1984-85 Ref. Table in appendix.

The total energy demand in 1986-90 was 1025 million tonnes of coal replacement (MCTR . About two thirds of this demand was met through the commercial sources of energy. The total energy demand is expected to be about 2048 MTRC in year 2004-05. The area of renewable sources is expanding rapidly. Emphasis is laid on research and development and early commercialisation of technologies. However, the level of financial allocation for the development of this field is very inadequate.

Supply of primary sources of commercial energy is estimated to have increased at a rate of 7.4% during 1980-81 to 1984-85. During the seventh plan this rate was around 8.8% p.a. The share of primary sources of energy picture for 1970-71 to 1990-91 can be seen from Table in Appendix

The supply and demand of energy, of the study area will be assessed by assessing some energy aspects of commercial and non-commercial energy used in the town.

5.4.1 COMMERCIAL ENERGY

Electricity, coal, oil. L.P.G. and Kerosene are the common forms of commercial energy used in the town.

a. Electricity

The Electrical energy received by the town is from the Hydel sources. The Hydel power sub station is situated in Ram Nagar area. The power distribution to different parts of the town is done through 11 KV feeder line as shown in Fig. 4.23

The consumption pattern for 1981-1991 can be studies from Table T-5.9.

TABLE - T- 5.9

Electricity Consumption 1981 to 1991 (Roorkee Town

Type of consumption	Number of connections 1981	Number of connections 1991 U	Present load KWH	Addition in 1991-92
Domestic	6000	37629	38493	3310
Commercial	1000	4318	7700	
Industries	150*	658	10096	2
Irrigation :				
a. D.T.W.	-	4689	23585	355 for Irrigation
b. S.T.W.	-	315	4655	
c. W.B.T.	-	21	340	
H.T. Connections	-	6	7535	

Source : UPSEB (Dist. Div. Roorkee
District Census Hand book.

Total power consumption in Roorkee town for the year 1991-92 was 211.537 MU (Million Units where as it was only 42,30 MU in 1981-82. It can be said from the number of connection and load demand that maximum consumption is from the domestic sector as not many industries and commercial activities exists in the town.

National capacity of power production = 64,928 MW

Per capita peak hour supply = 64928

= 0.08 KW

Peak hour consumption in Roorkee = 56289 KWH
(considering Irrigation in off peak hours

Per capita consumption in Roorkee = $\frac{56289}{80236}$ = 0.7 KWH

Hence, peak hour demand of Roorkee town is 9 times that of national energy.

DEMAND

Domestic need during both windter and summer season i.e. November to February and June to August is higher than the other months.

Unit consumed per Household connection (4-8 hrs.

8 Nos. 100 watt bulb equivalent = $\frac{8x100x30}{100}$ per month

96 to 192units.

Heater/Refrigerator/Other appliances/
T.V./V.C.R./Tape Recorders etc. = $\frac{1000 \text{ x } (1-3 \text{ x } 30}{1000}$

= 30 to 90 Units.

Consumption Range -122 to 282 Units. Most consumers lie in this group. Per unit cost as per 1991-92 Rs 1.40 per unit (1981-82 Rs. 0.75 per unit .

Estimated domestic demand at the rate of 202 Units per month. Demand 1991 = 39 Million Units.

Least Probable Demand 2011 AD:

= 27,000 x 3000 x 12 units per year

= 97200000 units

= 97 Million units

b. Fossil Fuels

Commonly used fossil fuels are petrol, diesel, kerosene, I.P.G. and Kerosene.

(i . Petrol and Diesal

Consumption of both petrol and diesal is also used for running stand by generators of produce electricity for institutional and commercial establishments. The consumption of petrol and diesal can be approximately estimated from the sale of both at various petrol pumps (Ref. table T-5.10)

TABLE - 5.10

SALE OF PETROL AND DIESAL (ROORKEE TOWN

Name of Petrol Pump	Sale in litres			
	Petrol		Diesal	
	1981-82	1991-92	1981-82	1991-92
Near Tahsil Office	123,945	856,745	290,856	1259,625
Near Municipalitt	75,692	763,210	210,108	888,053
Near Canal	78,238	778,360	223,920	1430,814
TOTAL	277,875	2398,315	724,884	3578,492
Decadal increase of sale		8.63 times		4.93 times

Consumption of Diesal = 3579492 lts.

Consumption of petrol = $\frac{2398315}{5976807}$ lts.

= 0.038 MICR.

20% decadal increase by 2011 AD consumption will be = 8606601.7 = 0559 MTCR

considering 50% to be consumed by local consumption = 4303300 lts = 02795 MTCR

Probable Demand 2011 = 4.3 Million lts.

= 027.95 MTCR

The 80's saw a substancial development in the automobile Industry in India. The production of a good number of fuel efficient two wheeler, automobile and four wheeler automobiles. This along with the increase in G.D.P. (Gross Deoestic Products and economic development of the area led to consumption of more petroleum.

The decadal increase of oil products energy in transportation sector 1965-66 to 1975-76 was 122%. In terms of Million tonnes of coal (replacement oil used in transportation sector in 1978-79 = 78.18 and 1989-90 was 131.49 which is just 66% in 11 years say 60% in 10 years, which is much less compared to the increase in consumption rate of Roorkee town. (of the total consumption of oil, some percentage is used for

agriculture and industrial sector also, it is also not possible to assess the consumption by the rural areas due to lack of information of such type.

Comments

Highly petroleum Consuming types for the last decade. Use of two wheeler automobile and cycles are in large numbers as seen from the sale of both from different dealers in Roorkee. Ref. appendix 6.

To bring down consumption following points are recommended:

1. Public transport oriented development.
2. Parking facilities for Bicycles, Rikshaw, Thela, Bullock carts etc.
3. Clear priorities to non automobile modes in terms of provision of infrastructure and transport operation.
4. Reduction in per capita road provision to be commemsurate with improvement in public transport infrastructure.
5. Provision of extensive walking and cycling including pedestrianization of central area (Traffic calming

ii. Cooking Gas

Use of L.P.C. (Cooking Gas is convenient for the users than any other cooking fuel. It pollutes less than the other's. But high cost of transportation, the gas extraction process and the container manufacturing is polluting and

the fuel is non renewable and in short supply for the town as well as the country.

There exist 3 gas agencies in Roorkee town, this area and number of connections is as given in T-5.11

Cost of L.P.G. has increased by 150% in the last decade. The demand of new connections since 1984 has not been met. The pending demand of all the three agency's is approximately 10,000 nos. The increase in consumption in the decade has been 61%. Black marketing and cheating of customers is a common practice observed in the gas business.

TABLE 5.11

DISTRIBUTION AND CONSUMPTION OF COOKING GAS

Agency	Area	No.Of connection
DEEPALI GAS AGENCY (Old Roorkee Market	Amber Talab, Sati Mohall, Ram Nagar BT. Ganj, Rajputana, Maktulpuri, Sanjay Gandhi Colony, Kashupuri Purva Din Dayal, Prem Nagar Mahigram.	9792(91-92 6640(1981
INDIAN GAS AGENCY (Civil Lines	Civil Lines, Unversity, Khanjarpur, Sheel Kunj, World Bank, Colony, Milap Nagar, Pathanpura, Cantt., Lal Kurti.	7811(91-92 5430 (1981

Tables Cont... next.

CHAVI GAS AGENCY	Railway Colony, Ganeshpur, Chandpuri 2790(91-92 Hanuman Colony, Chow Mandi, Sainik
Ganeshpur	Colony, IRI Colony, Subhash Nagar, Gandhi Nagar, Rajendra Nagar, Shekh Puri, Azad Nagar

Number of connection in Roorkee has increased from 14,000 to 20,393 from 1981 to 1991. But it has been dssemed from field survey that approximately 40% of the cylinder are consumed by areas outside the U.B. Hence, consumption and demand will be anrred accordingly

Consumption 1991 = 20;393 x 0.6 x 12 x 16 kg.

= 2349619.2 Kg.

= 0.01527 MTCR.

Demand 2011:

Least possible = 0.01527 x 1.5

= 0.0229 MTCR

Mixiмum Possible = 0.03054 MTCR.

iii. Kerosene

Demand of Kerosene has not gone down in the period 1981 to 1991. There was same balance in demand and supply of kerosene due to the introduction of L.P.G. for cooking in early 70ls. But the rise in population again demanded more kerosene in the later decade.

Kerosene used both of cooking and lighting is not openly available in market. It is supplied by Govt. supply department at the rate of 5-7 litres per card per month. It has been supplied for all the 12 months in the year 1991-92. The demand is still more. There are malpractices in the distribution.

Total kerosene supplied to Roorkee in 1991-92

= 12 (months x no. of cards x 6 lit.

= 12 x 17,186 x 6

= 1.25 million lit.

= 0.00125 million tonnes

= 0.00775 million tonnes of coal replacemnt per yeqr

The demand of kerosene is projected to remain same or come down by 2 011 A.D.

iv. **COAL**

There are two types of coal available in the market. The Hard and the Soft coal, i.e. coke and Charcoal. Coal is used for cooking and room heating in winter. Sale in winter is much more. It is also used for Black smithy work, Metal casting and furnaces. (Metal casting industry quite common in Roorkee.

There are two coal depots in Roorkee :-

1. NAVEEN COAL DEPOT (OLD ROORKEE

Suppliers of both wood coal and hard coal. Average monthly sale 20 tonnes.

2. DAYAL COAL DEPOT

Suppliers of Hard Coal only. Average monthly sale 15 tonnes per month.

Cost in 1991-92 was Rs. 250.00 per quintal (100 ke.

There are approx. 20 Halwai (sweet shops) and 80 small and big restaurants and hotel using coal for cooking. Assuming average daily need to be 20 kg. of coal

Per day need = 10 x 100 = 1000 kg.

Monthly = 1000 x 30 = 30000 kg.

= 30 tonnes

yearly = 360 tonnes.

60 tonnes for hotels and restaurents only. Domestic and industrial consumption is unaccounted So, the data produced hy the dealer may not be very authentic which stales sale of 35 tonnes per month or there are other sources also.

COAL DEMAND

Domestic Need

Considering 30% of the households to be using 30 kg. of coal per month. Yearly demand for Roorkee town = 12 x 30 x 3720 (H.H.) = 1339.2.00 kg per year.

Commercial Need

Considering 100 restaurants to consume 300 kg. Monthly. Yearly demand 1 30C x 100 x 12

= 360,000 kg.

= 360 tonnes.

Industrial Need

Workshop, furnances, brick field, black smithy metal casting etc. Avderage 2000 kg. per day for 300 workihg days 300 x 2000 = 600000 kg. Total of the above three come to 1140 + 360 +600 = 2100 tonnes.

= 0·0021 MT Per year (1991) L.P.D (2011) = 0·002 MTCR

5.4.2 NON COMMERCIAL

a. Fire Wood

Fire wood is used for cooking in the restaurents and 10% of the homes in Roorkee town. It is availalbe from the timber saw mills and the local dealers.

DEAMAND

1. Domestic Cooking

10% of house hold i.e. 1240 h.h. @ 5 kg. per dya

= 1240 x 5 x 365 per year = 2263000 kg.

= 2263 tonnes.

1k. Restaurent hotels @ 25 kg. per day

100 x 25 x 365 = 912500 kg.

= 912.5 tonnes.

b. Animal Dung and Others

4.7% of the energy consumption in household was supplied by animal dung and other sources (sources not discussed earlier in the year 1977-78. For Indian urban area, considering the above to be lower and have gone down for Roorkee and assuming it to be 3% now, i.e. considering that total cooking requirement of 3% of the household is met by Animal dung and other sources.

Cooking need for family of 6 persons = 10 kg. of dung for 372 house hold for a year

= 372 x 365 x 10

= 1359800 kg.

= 0.00136 million bonnes.

Demand 1991 = .0005 MTCR.

Demand 1991 of Animal dung for urban settlement is decreasing. Hence, considering it to be half by 2011 AD least proble demand = 0.00025 MTCR.

COMMENT:

Nation, per capita annual rate of energy consumption 1991-92 was 1.35 tonnes of coal replacement including all sectors. In Roorkee town enly household and transport sector consumed 1.1 tonnes of coal replacement which is 20% of total energy. Thus, Roorkee per capita consumption will be minimum 5.5 tonnes per head. (Ref. Appendix 6.

By 2011 AD the national per capita is predicted to rise to 2.1 million tonnes where as Roorkee least problable demand will be 1.75 in house hold and transport and over all minimum of 8,75 tonnes. This does not include the power spent at higher levels of commercial Industrial and other sectors.

The urban settlements in all are highly power consuming and at present, deficit of commercial energy exists in the town and it is likely to increase by 2011 AD. Ref. Rable 5.11

Keeping in view the energy scenario, all possible attempt should be made to generate energy from resenable resources and thus decrease the shortage of commercial energy at least.

Summary of Energy Demand of Roorkee Town. in 1991 and the demand from 2011 is AD in Table T-5.12

TABLE - 5.12

Sl. No.	Source	Yearly Demand in MTCR	
		1991	Least probable 2011 AD
1.	Electricity	0.039	0.097
		0.0039	0.0144
2.	Petrol and Diesal	0.019	0.0295
3.	L.P.G.	0.015	0.030
4.	Kerosene	0.007	0.007
5.	Coal	0.003	0.002
6.	Fire wood	0.003	0.002
7.	Animal dung and others	0.0005	0.00255
	Deficit	0.0865	0.16775

Least probable demand 2011 AD = 0.16775

Maximum probable demand = 0.1395 x (1.5)

= 0.3355 MTCR

5.5 REPLACEMENT POTENTIAL (by 2011 AD)

Energy replacement by use of renewable energy sources by 2011 2011 AD is estimated by calculating only the energy availability from available technology.

Assessment of potential for replacement is done considering the following sources i.e. Solar, Biomass and Biogas. (ref. Appendix 6 for standards adepted.

a. Biogas

Can be produced from the following wastes as discussed below.

(i Human wastes : @ 0.027 M^3/C/d = 3645 M^3
for a population 135000

(ii Animal wastes : @ 2.5 kg. fo dung per animal
= 12166 x 2.5 = 30415 kg. p.d.
@ 0.040 M^3 of gas/kg of dung = 1216 M^3

(iii Agricultural waste
Veg. garden area = 35 x 27000 Sq. = 945000
fodder area = 20 x 10000 = 200000
1145000
@ 0.00365 kg/m^2/day = 417925 M^3

(iv Food waste (Domestic @ 0.25 kg/C/d poodueing gas
@ 0.175 m^3 per day
= 135000 x 0.175 = 23,625 m^3
Total Bio-gas potential = 32665 M^3

Cooking demand @ 0.34 m^3 per cap. per day

= 45,9000 m^3 per day for the town.

Thus 71% of the cooking demand can be met, from bio-gas production in the town.

LPR (Least possible replacement = 35% = 16332 M^3 per day

MPR (Maximum possible replacemtn = 71% = 32665 M^3 per day

1 Kg of LPG = 3.18 m^3 of bio-gas.

.. LPR = $16332 \times 365 \div 3.18 \times 6.5 \div 10^9$ = 0.0128 MTCR

and MPR = 0.02236 MTCR

V. Biogas Generator

Animal waste plants of size 250 m^3 are available which can generate 3.75 kw of electricity. 130 cows dairy unit will be necessary to support the plant thus 40 hectare farm plant size should be 1.5 H.P. or 1 KVA to 12 H.P. or 7.5 KVA.

It is ideal for farm pumping and electrification, cooking and lighting. The starting up time is 30 to 40 days plus 20 days for gas production.

Bio-gas generators can be constructed at cluster level to meet part of the electricity demand for pumping of water for farm and domestic water supply. Hot and cold.

b. BIOMASS

In the form of fire wood, agricultureal forest wastes can be subjected to processes to harness more energy from it.

Barren and waste land may be bought under fast growing plantation for energy production. Gasifiers which are fed with wood chips, palletised and fine biomas material are commercially available which can be used for thermal and electric power generation.

For the town of Roorkee hot water supply and heating of room can be accomplished by use of gasifiers.

1 Kg. of wood chips produce 2.07 m^3 of gas which can be burnt and its calorific value is 12000 KCal/m^3.

For heating water to 25°C, heat requirement per liter of eater = 80 x 1000 x 25/100 Cal

= 20 K.Cal.

To provide hot water @ litres per capita per day for 135000 people requirement,

= 50 x 135000 x 20 KCal.

= 13500000 Kcal

Fuel i.e. wood chips requirement per day,

= 135000000/2.07 x 1200 kg.

= 5434 per kg day

Biomass gasifier can replace some of the power requirement of commercial and Industrial sector of Resu

Maximum possible Replacement

MPR = 4000 (number of ind + comm organixation

x 20 units per day x 365 = 2920000 units.

= 2.92 million units.

= 1983410 kg per year

Say 2000 Tonnes a year.

Yield per tree average 3000 kg. per year demand is 666 trees. Consider maturity period trees to be 3 years and 10 square meter per tree. Land requirement for the wood will be.

= 665 x 3 10 sq.mt.

= 19980 sq.mt.

= 2 hectres only.

and allocated for energy plentation is 10 hectors.

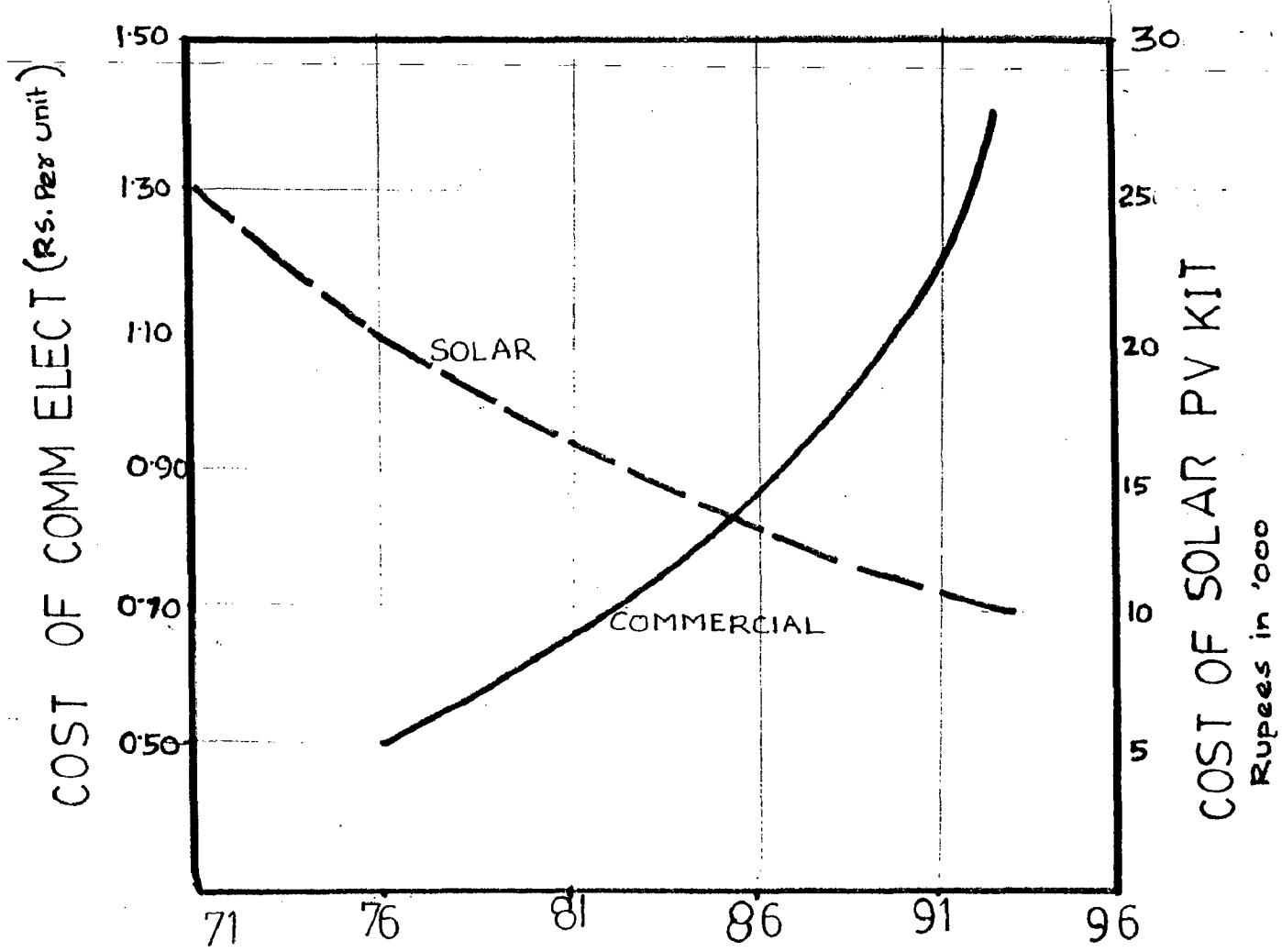
C. SOLAR ENERGY

Accordingly to the present level of technology cal development in the country in this area, 1 m^2 of a fixed array (Solar collector plate facing south, yields nearly 0.5 KWH of electrical energy on a normal clear sunny day. (i.e., almost 30% efficiency . Photovaltaic cells can be store this energy. But, under the present conditions the cells are costly and not cost effective without subsidey.

But, never the less, Solar Energy can has got bright such of substituting commercial energy to a substancial extent by 2011 A.D. As observed from Fig. 5.4, the cost of electricity produced from solar energy has fallen by over 50% in the last decade where as commercial energy cost has doubled.

Fig - 5.4

SOLAR - COMMERCIAL COST ANALYSIS



Total solar potential with the available technique, for the present area of Roorkee is as calculated below :

Considering 25% of the area to be collecting solar radiation including roof taps etc. with 288 days of the year with more than eight hours sunlight (as per sun path diagram of the region.

Electrical Engery Availability

= 0.5 KWH x 8 x 288 x 8.11

= 9342.72 million units.

Electrical energy consumption of Roorkee for 1992-93 was 211.53 Million units.

Technologies available one solar cooking, water heating, room heating and cooling. Refrigeration, electricity generation but all are not commercially viable now.

1. SOLAR COOKERS

TYpes of cookers commercially available :-

(i) Hot box type solar cooker - low temperature size 100-1200^{o}C and during sun set cooking is not possible.

(ii) Storage type solar cooker - cooking at any time with higher cooking temperature and allow cooking inside the kitchen not yet commercially avilable.

Domestic Solar Cooker

Having size 60 cm x 60 cm having 4 utensils per cooker can cook rise, dal vegetables in one and a half hour and can cook mutton in two and a half hrs. during sun light only. Can serve five to six persons ideal for a family.

Community Solar Cookers

Having size 175 cm x 175 cm can cook in the same time and serve 25 persons.

These two types of cookers are commercially available and cost is Rs.1000/- and Rs. 2000/- respectively. There is 40% and 50% subsidy respectively. They both have the limitation that it does not wash during monsoon and cloudy days, it can not be used for frying purpose. Advantages are as defined below :

(i Does not consume conventional fuel or energy.

(ii Does not exit smoke or smell and does not pollute the environment.

(iii It does not require constant attention while cooking.

(iv . It preserves the nutritional value of the food.

(v . Keeps food hot for four tp five hours.

Fuel saved per year (approx.

	a	b
Kerosene	90 Lit.	327 Lit.
Wood	365 kg.	1328 kg.
Electricity	198 KWHS	720 KWHS

Per year saving in tersm of MTCR

27000 x 90 (Kerosene 6.5 = 0.015

27000 x 365 (wood x 0.95 = .009

27000 x 190 (Electricity x 1 = .005

Average = .0096

Considering 35% of hourse hould be be using solar cooker

LPR 35% = .0096 ÷ 3 = .0033 MTCR

MPR 70% = .0067 MTCR.

2. Solar Water Heaters

Solar water heating can be done with flat collector Arranagement for individual unit, community water supply, hotels etc. The cost varies according to the quantity of water required to be heated.

Solar water heaters of 56,000 l.p.d. costed Rs. 2,00,000.00 (Rupees 2 lacs in 1986 . The cost 5 likely have reduced by now. Small solar heating system for individual houses, community and holtels and for individual houses, restaurants can be used in Roorkee throughout the year.

The amount of sun shine hour required is less, the water should be stored in thermally effective reservoirs for better results during winter andhence can be operated throughout the year. This can replace all the water he-ting energy of the town. Energy saved by use of solar water heater by 2011 A.D. by the town at the rate of 50 l.p.d. per person,

Per day energy saved

= 1,35,000 X 1000Xx 20/60

= 45000000 watts

= 45000 KWH

Per year i.e. for 180 days

8.10 million units

MPR = .0081 MTCR

LPR = .0091 MTCR

3. Solar Electricity Generation

Technology readily available and durrently used widely is the flat plate colletors with photovoltaic cells.

Cost of the PV. kit to illumihate two fluorscent tubes of 40 Weach is Rs. 10,000/- one hour of charginh (i. . sun light can store 125 Wi.e. 125 KWH of electricity and can illuminate for one and half hour. This can work for all weather throughout the year in Roorkee excdpt for 10 to 20 days of fully clouded days of the year.

Solar photovoltaic cells have gained efficiency, popularity and hence reduced price of electric generation leading to reduced cost of the equipment in the last decade. Begining of the decade the set costed to Rs. 20,000/-. Unlike

commercial energy production cost of this has decreased by 50% and even more and yet is expected to reduce.

PHOTO VOLTAIC

Photo Volhaic kit manufactured in the country is comme ercially available. This kit can store and convert day time energy sun light to electrical energy for night use. The kind of kit to illuminate 2 fluourescent tubes of 40 W each is available for RS. 18,000/-, there is 50% government subaidy over it, reducing the users cost to Rs. 9,000/- only.

Energy saved per day by using one kit of 2 x 40 watt fluorescent tube

Hours of lighting = 6 hos. per day

Power saved by one pair = 2x40x6 watt per year

= 175200 per year

= 175 units

Maximum possible replacement by 2011 A.D.

Considering 1 set at each house hold	=	27,000 sets
4 sets at each community of 1900 penom	=	280 sets.
2000 sets at in public semi public	=	2000 sets
4000 sets for street lighting	=	4000
		33280 sets

MPR = 33,280 x 175 units per year

= 5824000 units

= 5.8 million units

= 0.0058 MTCR

L.P.R = 2.9 million units

= 0.0029 MTCR

TALBE : T- 5.13

ENERGY REPLACEMENT POTENTIAL (SUMMARY

L.P.D. = 0.1675 MTCR

M.P.D. = 0.3355 MTCR

L.P.R. = 0.2744 MTCR

M.P.R. = 0.7416 MTCR

Sl. No.	Energy Source	Use	Substitution in MTCR		Replace
1.	Bio-gas	Cooking	0.01218	L	L.R.G. Kerosene
			0.02436	M	wood etc.
2.	Biomass & Power generation	Heating & power generation	0.0016	L	wood, coal, Elect.
			0.00292		
3.	Solar	Cooking	0.0033	L	Kerosene L.P.G. etc.
			0.0067		
		Water heating	0.0041	L	Electri etc.
			0.0081	M	
		Lighting	0.0029	L	Electric
			0.0058	M	

SUBSTITUTION

End use	Min.	Max.	Replacement%
Cooking	0,0161	0.0310	37-71
Water heating	0.00606	0.01102	31-56
Lighting	0.0029	0.0058	3.7-7.4

ASSESSMENT OF RENEWABLE ENERGY SOURCES

Source	Affordability	Maintenance	Availability	Durability	Efficiency	Reliability	Accedtibility	Degree of Substitution	% Grading
Bio Gas	H	L	H	H	H	H	M	H	87.5
Bio Mass Generators	L	M	M	M	H	M	L	H	66.6
Solar Cooker	H	H	M	H	H	H	M	M	87.5
Solar Water Heater	M	M	M	H	H	H	H	H	66.6
Solar Photo voltaic	L	H	L	H	H	M	L	H	70.8

H - High = 3 M = Medium = 2 L = Low = 1.

Comments :

As observed from Tables 5.7, 5.8, 5.13 and 5.14 a substancial ammionit of sufficiency can be achieved in terms of food, Material like plastic, metals etc. and energy. All efforts possible should be made to achieve these. Policies should be oriented to arrive at and strategic plans should be enolved base on proper shidy of the area.

CHAPTER-6: STRATEGIES AND POLICIES

6.1 STRATEGIES :

Strategies relevant to urban settlements, depending on their individual character and function will have to be evolved, to successfully orient the settlements for a sustainable eco-development Path. Devices have to made for realisation of the available potential of the settlements. Steps have to be taken at all levels from the individual to national and international level for maximum benifit and hence to enhance the quality of our life.

Strategies discussed below will be specific to Roorkee Municipal Board area, the existing and the predicted Municipal Board area only.

The strategies adopted are to realise the potentials as discussed in the previous chapter.

1. Feasibility study : A study of the area with respect to the socio- economic effect of sustainable development is done and feasily in terms of economic, social and environment is made. Also the acceptability of the public at the time.

2. Mobilising Fund: If the project is feasible. Fund is neccessary to implement it. Fund can be generated by N.G.O.'s (Non govt. organisation from international and

national aid partly. Some part can be borne by national, state and local government.

(3 Mobilising Public Awareness and Participation:

Public participation, awareness and co-ordination of the organisation, institutions, leaders, Association etc will be necessary for the implementation.

(4 Finalising Implementation Strategy :

Who will do it, how and when to do will be finalised. Involvement of different organis and their co-ordination, Finalisation of organisational structure.

(5 Local Government to freeze all development temporarly.

(6 New Bye-laws to be evolved to suit suitanable development patter.

(7 Construction of infrastructure as per new guide lines in the developing area.

(8 Organise marketing outlets for the Renewable energy systems, recycling, vegetable products and requirements.

(9 New developmental paln to acquire land and include Rahim pura, Sunhera, Shanpur, Rajputana, Khanjarpur and Mahobatpur within the town area. ash shown in fig. 6.1.

(10 Indentification of potential area where easy to operate.

(11 Intensive use of land and building : Farming in Government, Semi Government, building permisses, School buildings, Terrace Cultivation etc., shift wise use of buildings and land, for Education, Religious, Recreation, commity facilities etc.

(12 Restructuring of the town-Decentralised policy, more autonomy to smaller communities.

13. Community Functions :

Water supply, Sanitary, Bio-gas plant, street lighting from Bio-gas, Acque culture, Bee culture, Dairy farming, Poultry; Kinder garten, adult and women education. small commercial, Traing, Industrial activity Vegetable gardening and fruit culture, fodden production.

14. Town Level Functions

Local government to break up its work load to community level workers. Town and sub level education, Energy plantation, Forestry, veternary, health intensive use of town level buildings.

15. Technology: Technology transfer from higher heirarehy in research i.e. from University, CBRI etc. to flow wright down to the communities.

16. Energy : To evolve maximum from Human and animal wastes, Sun, wind, water and the materials used.

Solar : Solar cooker at homes, hostels, hotels etc.

: Solar water heater for hotesl, hostels, communities

: Solar Photo voltaic kit for streets, public lightly and individual homes.

Biogas : Cooking (domestic ; Gasifiers : for Industries.

17. Recyding plant for paper, plastic, rubber etc.

18. Roads : Divert traffic fram the desired line Civil lines road and old Roorkee main road.

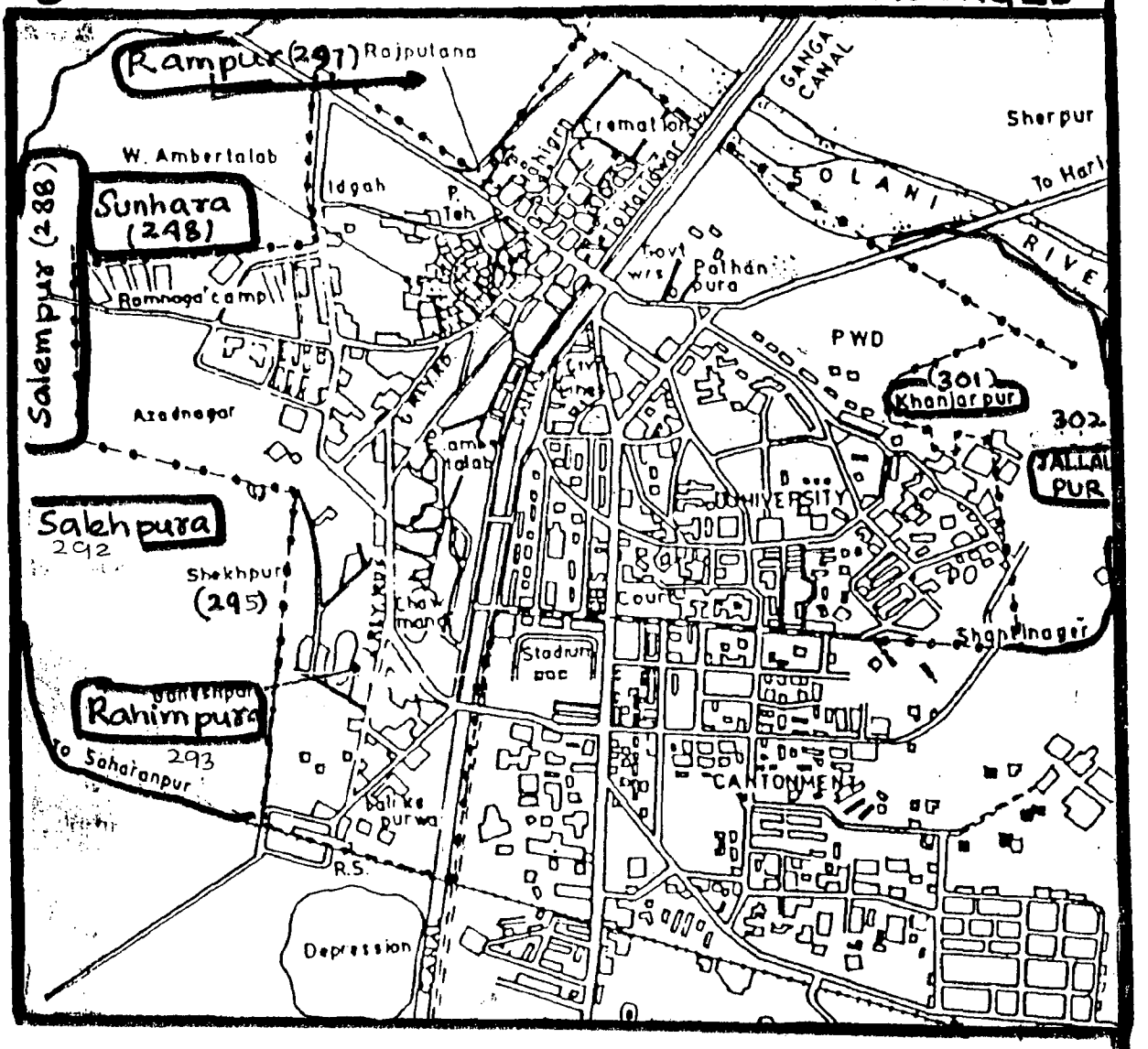
: More foot bridge an cenal, Reserved walk way by the canal. Divest through traffic from the town.

19. Telecommunication : Develop tele communication network within the community improve upon the existing town level and other connection.

20. Recreation : To develop all water bodies, fields etc. for better recreation. Community level recreation by utilising the institutional buildings.

21. Security : Community level security chouki's to be controlled by the town level town level police station.

fig-6.1 ROORKEE TOWN FRINGE VILLAGES



FRINGE VILLAGES TO BE INCLUDED IN NEW TOWN AREA - ▭ , ( ) Code (village as per census)

POTENTIAL FOR SUSTAINABLE ECO-DEVELOPMENT OF ROORKEE TOWN	NOT TO SCALE	Sunit k. Bhagabati. murp thesis 1992-93.

fig - 6.2

BAR CHART (ACTION PLAN)

Sl. no	STEPS.	1993	-94	-95	96	97	98	99	2000	2001	2002	2003
1	REPORT PREPARATION & APPROVAL											
2	FUND MOBILIZATION											
3	MOTIVATION											
4	FINALISE ACTION PLAN											
5	LEGAL CHANGES (local level)											
6	FREEZE DEVELOPMET.											
7	IDENTIFY POTENTIAL AREAS & impliment											
8	NEW DEV AS PER PLAN (Repost)											
9	AQUIRE LAND.											
10	SHUFFLE OF RES. PUB & BUILDINGS & LAND											
11	MULTIPLE USE OF BUILDINGS.											
12	ESTB. DECENTRALISED MARKET											
13	FORESTRY, HORTICULTURE, AGRI etc.											
14	DECENTRALISE SERVICES											
15	TRAFFIC - INCREASE DESIRED LINES											
16	DIVERT THROUGH TRAFFIC.											
17	-USE OF ALTERNATIVE Tech/Mat.											
18	REASEARCH											

6.2 ACTION PLANT :

Action plan developed on the basis of the straligies are outlined in the earlier pages are laid out as given below in four steps.

The Basic idea is to replan the town to a sustainable pattern so that the potentials can be achieved and a less energy consuming urban settlement is arrived at by end of the century.

1. Reparation of Proposals and Approval
2. Mobilisation of Fund.
3. Organising and Finalising action Plan.
4. Action plan implementation.

6.3 BASIC DESIGN CONCEPT :

Basic design concept, developed on the basis of eclogical principles and thus for sustainable growth and development of urban settlements can be said to be with the following aims and objectives as outlined below :

AIMS AND OBJECTIVES

- To provide thermally efficient and energy conserving shelter.
- To utilise waste as a resource chiefly by suing Bio-Bas plants at node and community level.
- To supply the basic requirements of the community from within and achieve partial self sufficiency and autonomy in therms of :

1. ENERGY REQUIREMENTS VIZ :

Cooking fuel

Energy for drawing sun-soil water

Reduction in energy consumption for maintaining comfort Condition inside buildings by using passive system.

Domestric water heating.

The above are to be achieved by utilising renewable energy sources such as sun, biogas and Biomass.

2. FOOR REQUIREMENTS VIZ :

Vegetables, fruits, honey, Poultry products, Dairy products, aquaculture products (FISH , foodes (cattle feed).

The above will be met intensive agriculture (Green house including poultry, dairy, and Aquancluture fodder cultivation and orchards.

3. CONSERVATION VIZ :

Conservation of non-renewable energy re-sources,

commercial energy, Biomass, materials by all means possible, Recycling, Reuse, rationing etc.

4. FERTILISER REQUIREMENTS :

To be met entirely by residue from Bio-gas plants.

5. CULTURAL AND SOCIAL REQUIREMENTS :

To be met by promoting, social interaction at node, community, and cluster levels in created informal space viz: tot-lots, parks, and community centre and also by common pursuits.

- To create job opportunities which in turn will be made available as a result of the self reliance programme for members of the community as supplementary income sources.
- To create a homogeneous integrated neighbourhood community which is as far as possible autonomous and self contained, pollution-free and ecologically stable.
- Provide scope for expansion of the community.

The above mentioned strategies and concept and the action plan discussed in the earlier pages can not be achieved unless policies at different levels are adopted to suit sustainable development of urban settlements.

6.4 POLOCIES :

The policies outlined are general and not perfaining to any place but in relation to the present situation all over the world.

Policies have to be evolued at different heirareting to arrive at conscious settlement plans which will be less energy intensive or energy consening in nature, based on natural systems and human feeling.

List of policies given below consists of all local, state, nation and international ones.

a. Prevention rather than cur-of the depleting quality of air water and life as a whole.

b. Reformation legistations and acts to suit the sustainable growth pattern.

c. Focal areas of the towns to evolve a sustainable settlement (commity of sector.

d. Planning for restructuring

e. Reorganise at commity level.

f. Urban restructuring

g. Decentralised urban imfrastructure, municipal network etc.

h. community participation in planning

i. Develop data base for detailed planni g work.

j. Reduced consumption of processed food.

k. Reduce transportation of goods and people

l. More bicycle per capita.

m. More increase in cost of fossil fuel and electricity.

n. Development in renewable technologies.

o. Banning the polluting industries.

p. Reforming the acts, by lows and legal measures.

q. International National orientation to urban problems and findings.

r. Educating and orientation to ecological problems.

s. Improved Tele communication and masstransit network. Microchips technology.

t. Recreational, food habits, production technologies to be environment firendly.

u. More holidays.

v. More outings to the nature.

w. More community, social interection.

x. Less Inter city, state country interation by person.

y. More interaction by telecommunication.

z. Balance of resources and Human growth.

6.5 PLANNING OF AND IDEAL COMMUNITY

In the community provision and utilisation of various sources of energy along with the production, distribution and consumption of food items are to be the explicit determinants of the planning process. The uses of energy for various purposes and the production of essential food items are to be applied at a scale that is manageable by the community, economical and at the same time human in scale.

The Heirarchy interlinking of acting spaces and the circulation pattern are all to be determined so as to suit the functional and social requirements of the community.

A hienarchial system of planning starting from the lowest level of an individual house, a node, a cluster and finally to community is to be adopted for distribution various hierarchial functions.

A housing unit is to be so planned such that the entry is to the multipurpose room and from the multipurpose room are accessible the kitchen, bedroom, toilets, and the vegetable gradens. The orientation of the suit should be suitably for the exploitation of solar energy for cooking and water heating.

A node will be the primary functional unit with one bio-gas plant, centrally located, to serve a fixed number of houses. The size of the node is to be determined by the economy of the

bio-gas plant size with respect to the number of houses it will serve, its distance from them, the vegetable garden area to be provided on the ground and also the appropriataness of the size of the node in relation to the whole community.

A group of nodes should from a cluster that will be the primary social unit with common cluster space such as that for tot-lot and silvi-cultore wood-lot.

The community that is to be the socio-economic unit will comprise of a number of clusters all suitably linked to each other, the community open spaces (playground) and to the community centre.

The community facilities, service, training and production centre is to be the heart of the community. It is to consist of a shopping centre, multi-purpose hall, multi-purpose class rooms, open court (for games and gatherings), production and employment wing and some offices. This is to also act as a fulcrum between the areas of production, viz; the dairy, poultry, agriculture, horticulture and bee farms and the areas of consumption viz. the residential culsters.

The shopping area should have separate sccess to community members who come to the centre only to shop. The stores of shops should have connection to the production wing of the community centre, as well as to other production areas with offices suitably interposed to keep an account of the goings on.

The class rooms and multipurpose hall should be close to each other with the open court which could be used for outdoor gatherings as well as for some games like badminton etc.

The production wing should be within easy reach of the dairy, poultry, aquaculture, horticulture and bee-farms and also the community level bio-gas plants sothat the community prduce may be suitably processed and, or stored before being sold for consumption.

In the dairy ancillary open space that is equal to the covered area has to be provided in order to serve as paddocks. The water storage and dung storage have to be centrally located in order to allow easy transfer of items to and from the animal chambers and also to the bio-gas plant. The hay storage and the milk processing areas should be as far from each other as possible to eliminate fire hazards. The dung storage too should be suitably segregated from milk processing chambers, because milk is very vulnerable to contamination and absorption of odours. The sick bay, maternity and dispensary should be isolated in one corner of the unit.

The Poultry should be close to the community bio-gas plant for transfer of dipping home and office, chicken, feed store and a store for eggs suitably linked to the enclosure for the layers.

The Aquaculture unit with algae and fish ponds should be in proximity to the community bio gas plants and poultry so that the filter effluent can be conveniently transported to the algae ponds and algae to the poultry.

The Vegetable farms, green houses and Orchards should be close to the dairy, poultry and bio-gas plants for easy transport of agricultural waste to them and fertilisers from there.

All animal husbandry and horticultural activity areas should be in close proximity to the production wing of the community centre so that various produce could be conveniently transferred to be suitably processed if required before being sold at the shopping centre.

The planning of the entire community should be such that, there is scope for expansion within the existing frame work, is conducive to social interaction at various levels that could lead to the creation of a homogenous integrated community with a spirit of brotherhood and amity, and is as self-sufficient and autonomous as possible.

Since most physical space and energy requirements of the community are a relative function of the basic needs ofthe community the spaces to be provided are determined by the l[illegible]ter.

FLOW OF ENERGY AND MATERIALS

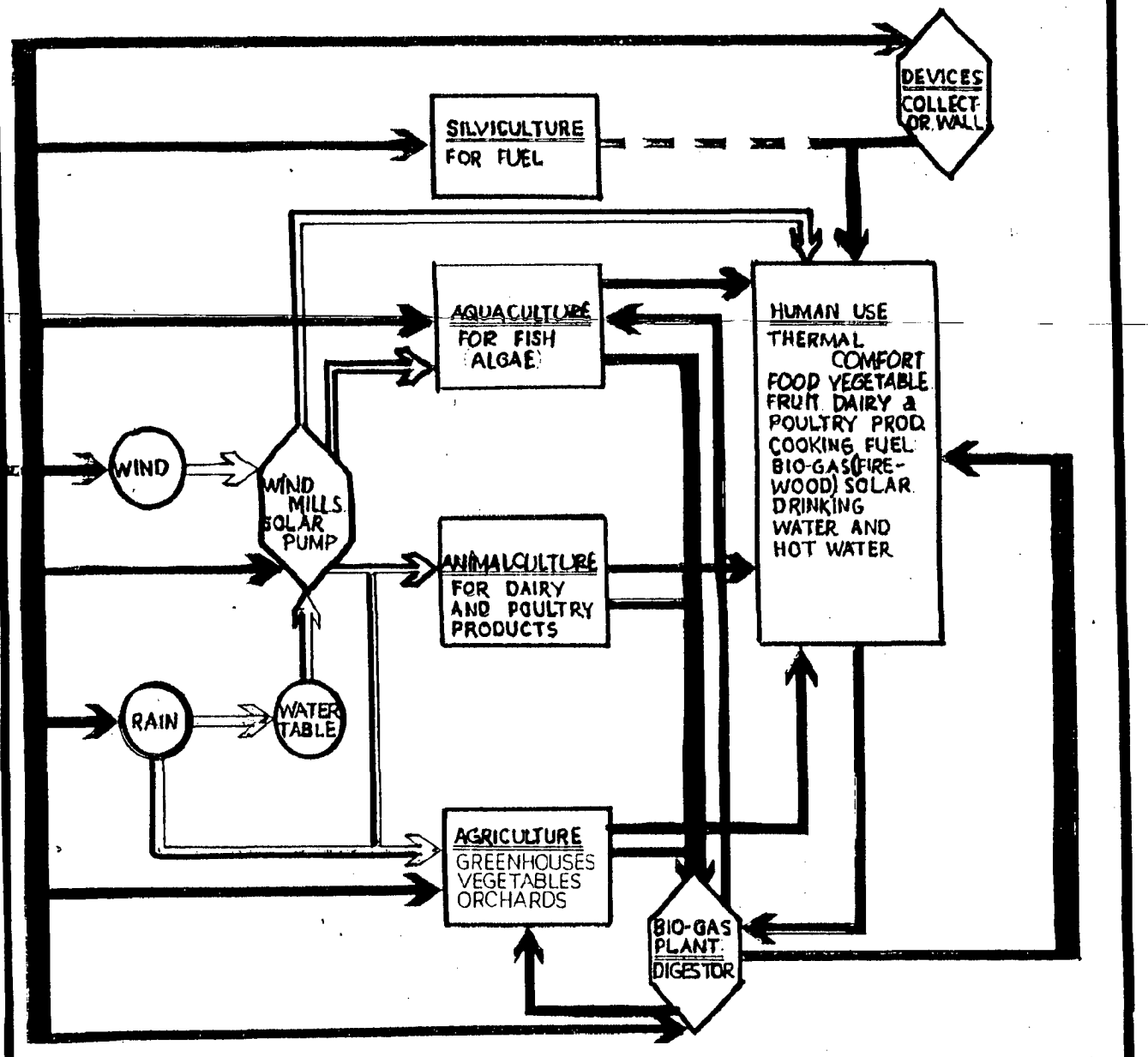
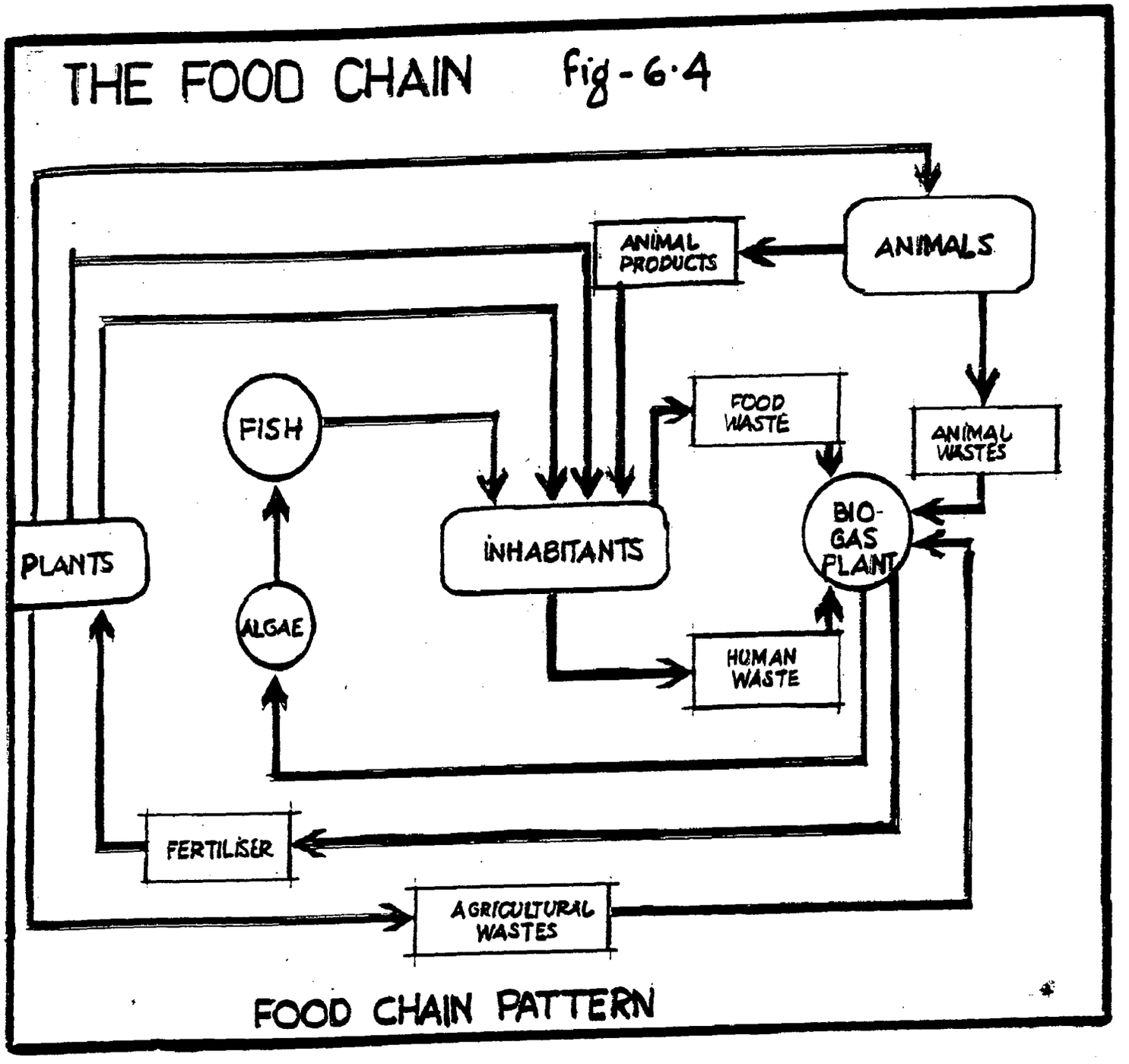


fig - 6.3

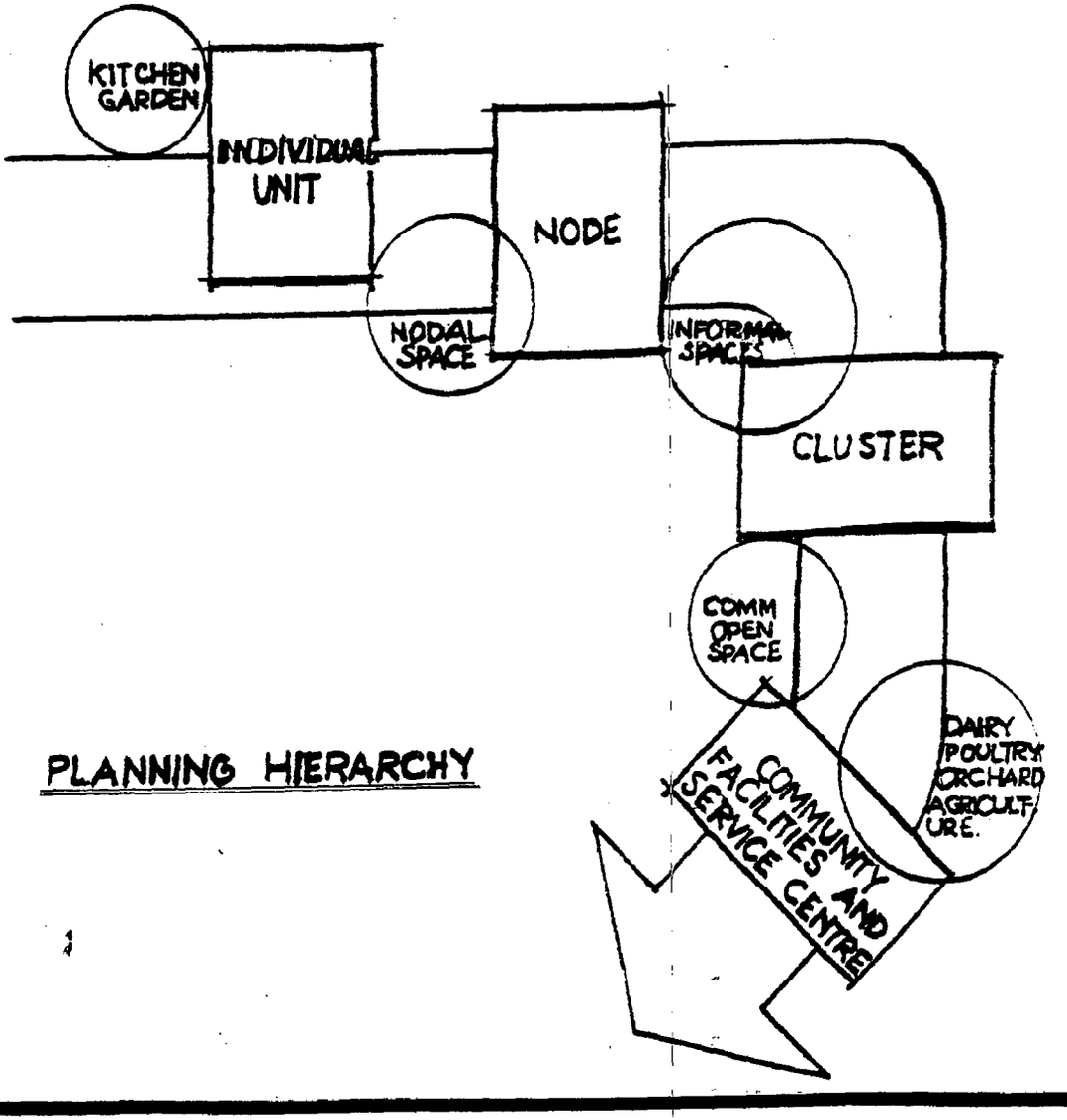
THE FOOD CHAIN fig-6.4



FOOD CHAIN PATTERN

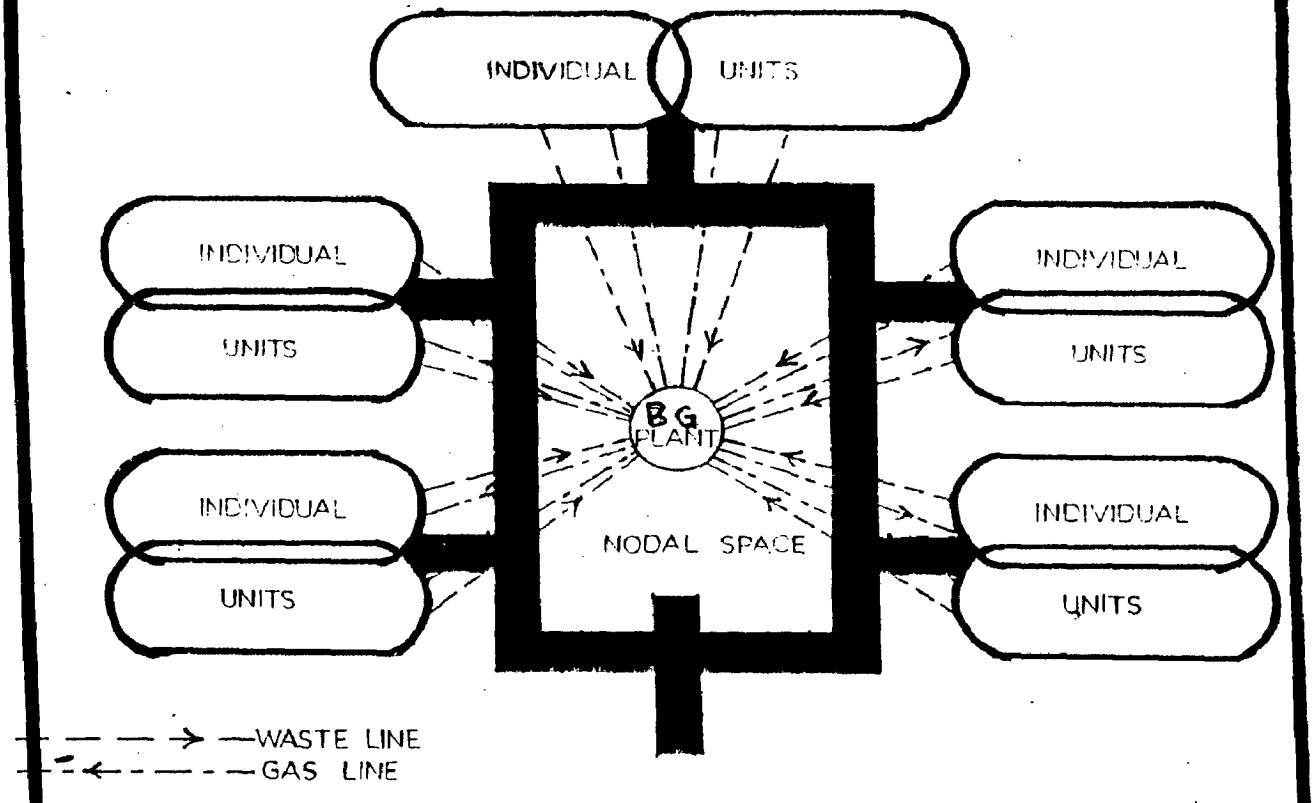
HIERARCHY IN COMMUNITY

fig 6·5



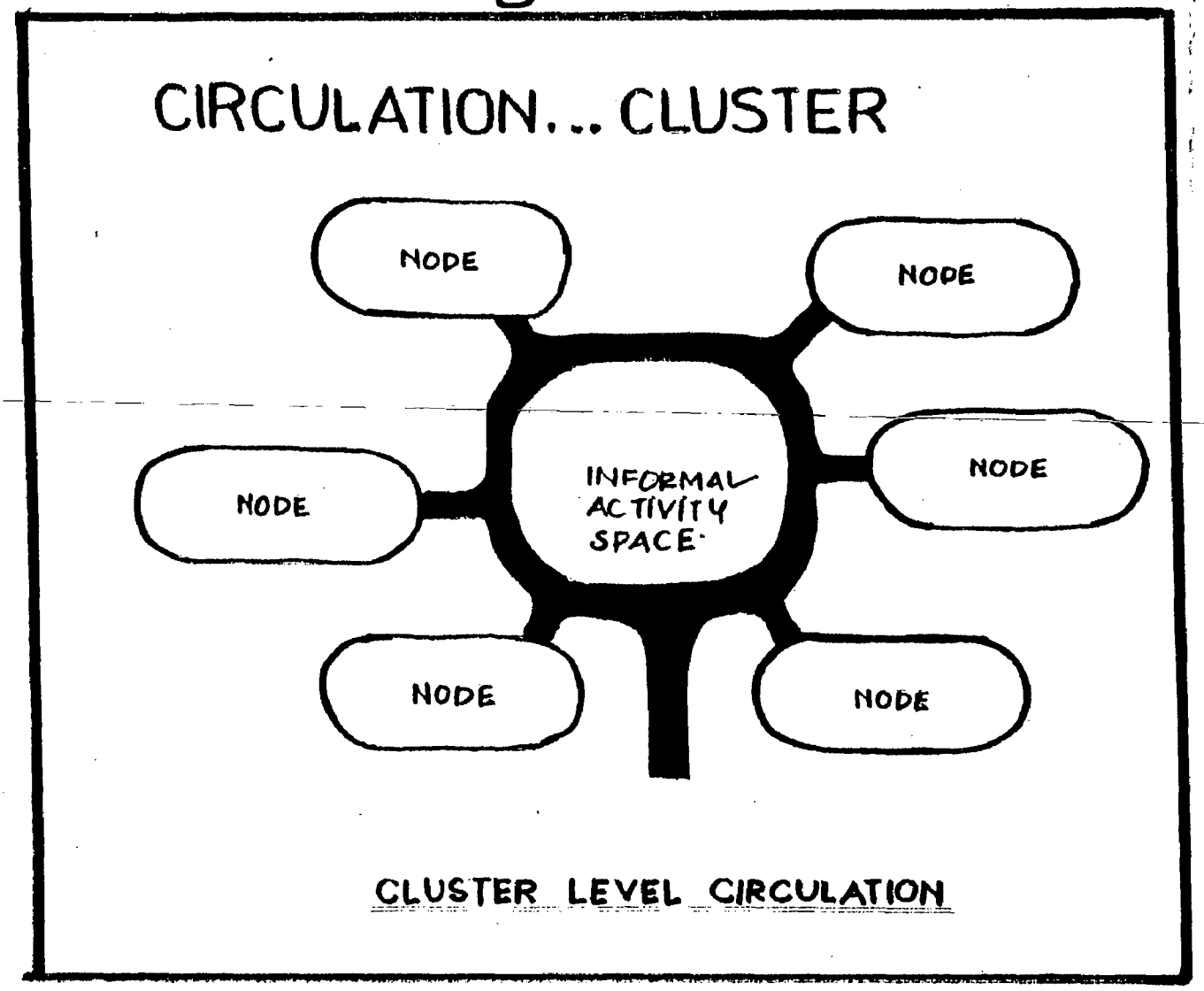
CIRCULATION NODE

fig- 6.6



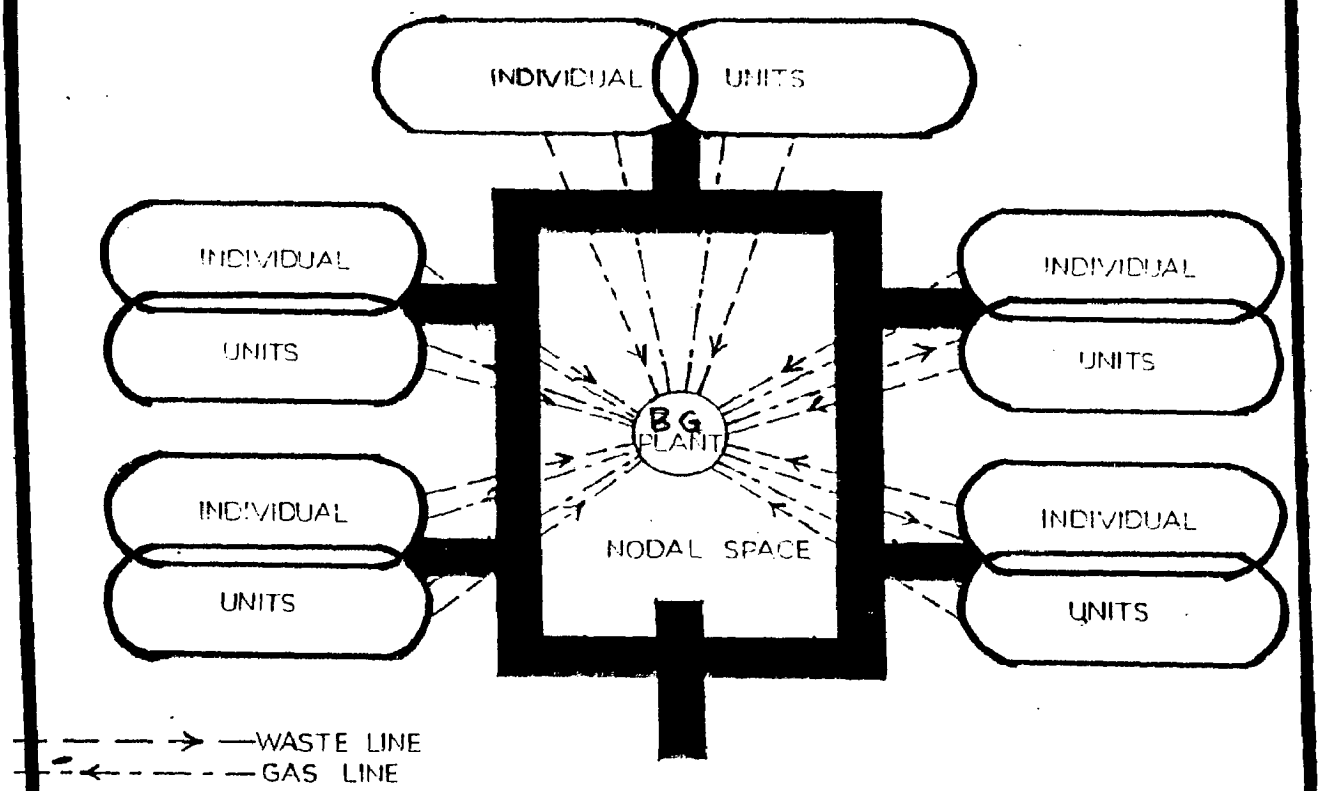
NODE LEVEL CIRCULATION PATTERN

Fig-6·7


CIRCULATION... CLUSTER
NODE
NODE
NODE
NODE
INFORMAL ACTIVITY SPACE
NODE
NODE
CLUSTER LEVEL CIRCULATION

CIRCULATION NODE

fig-6.6



NODE LEVEL CIRCULATION PATTERN

Fig-6·7

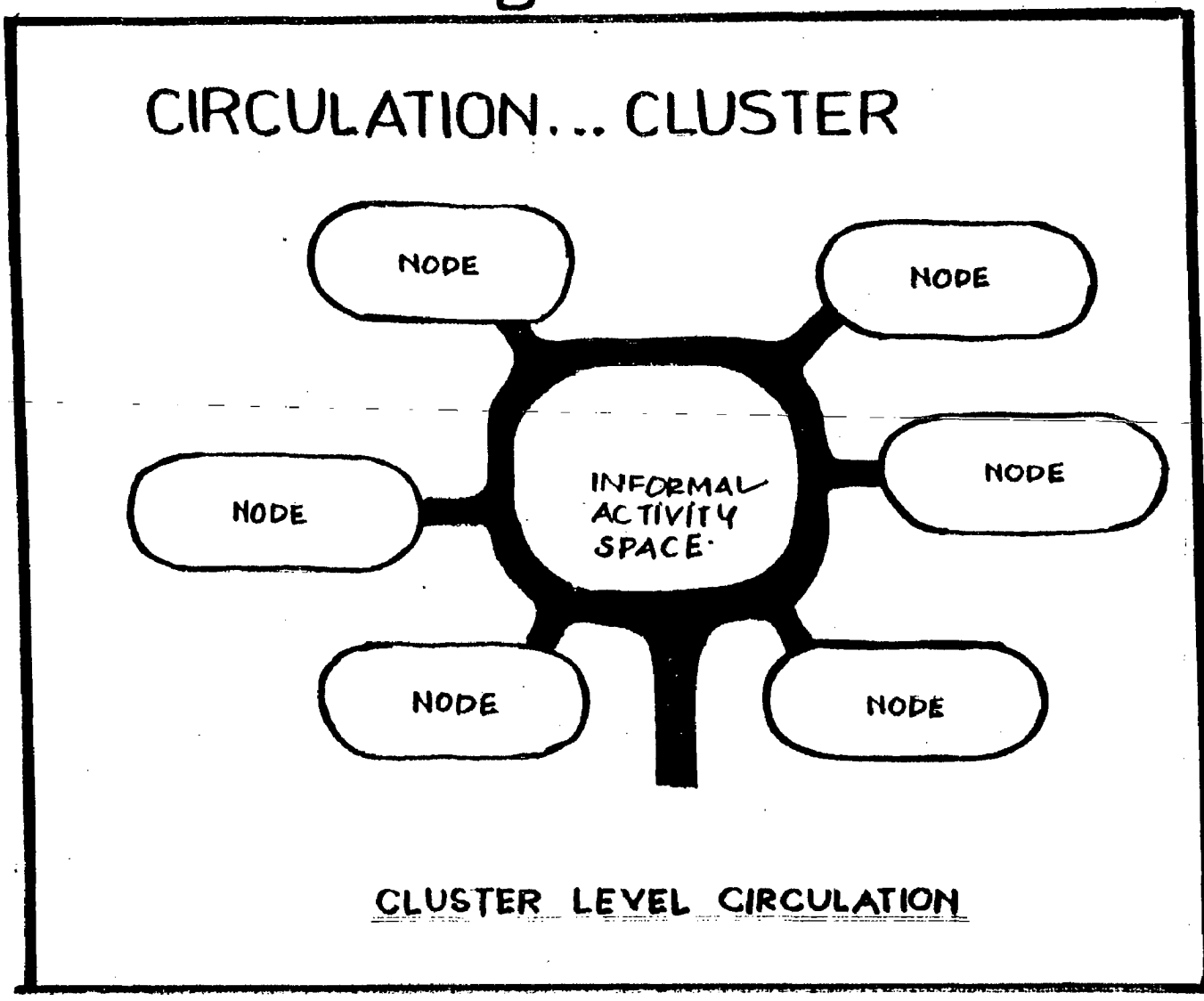
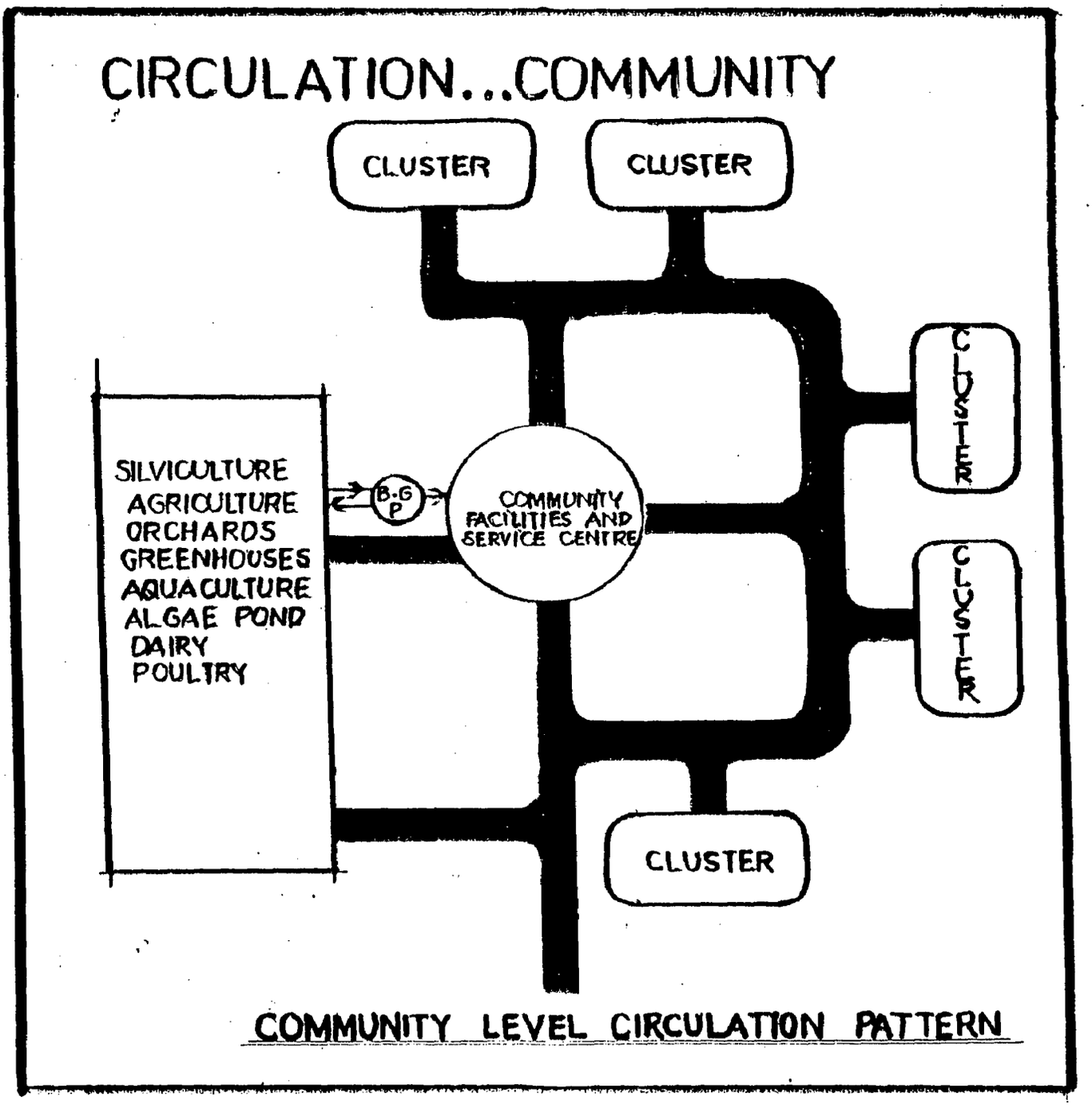

CIRCULATION... CLUSTER
NODE
NODE
NODE
NODE
INFORMAL ACTIVITY SPACE
NODE
NODE
CLUSTER LEVEL CIRCULATION

fig - 6·8


CIRCULATION...COMMUNITY
CLUSTER
CLUSTER
CLUSTER
CLUSTER
CLUSTER
SILVICULTURE
AGRICULTURE
ORCHARDS
GREENHOUSES
AQUACULTURE
ALGAE POND
DAIRY
POULTRY
B·G P
COMMUNITY FACILITIES AND SERVICE CENTRE
COMMUNITY LEVEL CIRCULATION PATTERN

The basic needs of a community of 1920 population are as follows :

No.	Item	Standard followed	Requirements/ Day	Comments
1.	Pulses	0.06kg/capita/day	115 kg.	To be supplied from outside.
2.	Rice	0.13kg/capata/day	25 kg.	-do-
3.	Wheat	0.30 kg/capita/day	576 kg.	-do-
4.	Vegetables	0.30kg/capita/day	576 kg.	To be supplied from within
5.	Milk	500 ml/capita/day	960 litres	-do-
6.	Eggs	2 eggs/capita/day	563 eggs	-do-
7.	Water	100 litres/capita/day 5000 cu.m./hect/year (agriculture) 1000 cumm./hect./year (fodder) + more for cattle etc. (bio-gas)	270,000 litres.	To be drawn by bullock sowened pumping system/Biomass fueled I.C. engines.
8.	Cooking fuel	0.34 cu.m./capita/day or fuel equivalent	652.8 cu.m. or fuel equivalent.	To be met in partly by gas from bio-gas plants, firewood from wood lots and rest by solar energy

The Physical space requirements of the community are as follows :

No.	Space for	Standard followed	Area	Remarks
1.	384 housing units each with : 1 Bed Room. 1 Multipurpose room. 1 Kitchen 1 Bath 1 W.C.	As per average housing norms		Housing units are to be so designed and oriented so as to be able to utilise solar energy for cooking and domestic water heating and also be thermally efficient.
	Storage space Court yard or (Open terrace)		37 sq.m. built up area. 10 sq.m. open space	
2.	Vegetable gardens	Production of 45T/ hect./ year.	46,800sq.m. of land.	About 50% of vegetable requirements to be met at individual house level and rest at community level.
3.	Green houses (4 Nos.)		60 sq.m. Each	Chiefly for plant propagation.
4.	Dairy units for 180 cattle (120 milk giving cows, 40 calfs 12 draft animals & 8 bulls.	10 sq.m./ cattle head	1800 sq.m. of land.	fodder to be supplied from within outside
5.	Fish pond for aquaculture.	Production 9000 kg/ heck/year.	8000 sq.m.7	Fish is to be consumed by only part of the community.
6.	Algae pond.	Production	2500 sq.m	Algae for fish and poultry feed to be grown on filter effluent from Bio-gas plants.
7.	Orchards	150T/hect.	15000sq.m.	
8.	Fodder Cultivation.	Production	10000sq.m.	
9.	Bee-culture	130T/hect./y year.	300 sq.m.	

1.	2.	3.	4.	5.
10.	Community multi-purpose open space		10000 sq.m.	For play grounds and open air functions.
11.	Silviculture Woodlots (Schmor)	50T. fuel wood/hect./ year.	20000 sq.m.	Fire wood to be used as cooking fuel
12.	Community Centre : Areas for Community facili ties and service centre.			
	(a) Entrance court		100 sq.m.	Access to various parts of community centre.
	(b) Class rooms. (4 Nos.)		30 sq.m. each.	For K.G.Classes and training lectures.
	(c) Open court		625sq.m	For Badminton courts and outdoor functions.
	(d) Multipurpose hall.		460 sq.m.	with backstage facilities and hall for a capacity of 400 indoor and outdoor stage.
	(e) Offices (4 Nos.)		12 sq.m. each.	
	(f) Toilets		50 sq.m. each.	
	(g) Changing rooms and lockers.		25 sq.m.	
	(h) Food processing		50 sq.m.	Production wing of community centre.
	(i) Bio-gas storage		50 sq.m.	
	(j) Carpantary and cood working.			
	(k) Poultry		30 sq.m.	
	(l) Handicrafts		30 sq.m.	
	(m) Shops	15 sq.m.	225 sq.m.	To sell community and outside products.

1.	2.	3.	4.	5.
(n)	Stores		150 sq.m. 1500 sq.m. of built up area	
(o)	Outdoor activity area		1000 sq.m.	For sun drying water pumping etc.
(p)	Flower garden.		1500 sq.m.	
13.	Circulation		10% - 15% of total community area.	Including all roads and path-ways.

CHAPTER-7:

RECOMMENDATIONS AND CONCLUSION

7. RECOMMENDATIONS AND CONCLUSION

7.1 RECOMMENDATIONS

Strategic imperatives for sustainability of urban settlement are to -

i. Increase the social and econimic opportunities and intitlement available to the residents.

ii. Reduce the energy content of the urban growth.

iii. Minimize the production of waste (solids, lequid, gasecius) and maximising the recycling of wastes that are produced.

iv. Create urban government sustems with necessary power to reconcile and achieve economic, social and environmental objectives.

v. Reorient urban Technologies towards sustainable objectives

vi. Strengthen the ability of urban areas to prevent or cope with threats to economicm social and environmental objectives arising from natural or human causes.

vii. Identify the opportunities and needs that exist to shift economic growth and social development in urban areas towards sustainable pathe.

Viii Emphasise preventive and anticipating policies and action promoting sustainable development in urban areas.

ix. Develop a statistical database for sustainable development in urban areas, that will enable the urban component of sustainability to be adequately appreciated, and that will permit valid comparisions between urban areas.

7.2 CONCLUSION :

The deciding factor for development in any sector is the potential of resource and finance availability. The decision now is how best they can be integrated into a concept of ecological urban restructuring to attain self sufficient to the maximum extent, by reducing environmental degradation and thus moving the globle into the sustainable path.

Sustainability problem as observed is really a social problem. They begin with people as the cause and end with people as the victims. We are the victims of our own causes. So, it is mankind only, who will have to cure the desease. There is possibility to attain sustainability to certain extent by all settlements which will decrease consumption of resources and improve quality of life of all the livings and non living on our planet. THE EARTH.

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APPENDICIES

APPENDIX-I

COMMERCIAL ACTIVITIES ON STREETS

Sl. No.	Trade	Shops in Civil Lines	Shops in Old Market	Total	Registered with Sales Tax Office
1	2	3	4	5	6
1.	Bakery, Bread, Eggs., Toffee, Biscuits etc.	6	3	9	-
2.	Books/Stationery	11	10	21	10
3.	Brass/Stove repairs etc.	2	4	6	-
4.	Building materials, cement, steel & asbestos etc.	3	15	18	15
5.	Cloth merchants	34	30	64	10
6.	Crockery utencils	5	15	20	4
7.	Chemists	8	8	16	4
8.	Cycle shops	10	6	16	8
9.	Clinics	7	10	17	-
10.	Confectionary goods	6	10	16	-
11.	Bangle shops	1	3	4	-
12.	Cooking gas	1	1	2	-
13.	Dairy products	2	4	6	4

1	2	3	4	5	6
14.	Drawing Survey	6	6	12	-
15.	Dry Cleaners	3	8	11	-
16.	Electrical Goods	18	10	28	8
17.	Furnitures	6	4	10	8
18.	Glasion glass	2	4	6	-
19.	Grocers	15	30	45	4
20.	Green grocer/fruit	4	14	18	-
21.	Hand Walls paints	4	10	14	-
22.	Jewwllers/Goldsmith	3	20	23	6
23.	Petrol Pump	3	1	4	-
24.	Pen/Ink/Opticals	4	10	14	-
25.	Photographer/Studio	10	5	15	-
26.	Perfumers	1	1	2	-
27.	Printers/Binders	3	10	13	-
28.	Radio/Records	10	5	15	5
29.	Restaurants	10	3	13	-
30.	Sanitary wares	2	2	4	3

1	2	3	4	5	6
31.	Shoes	6	15	21	-
32.	Spare parts (Scooter/Motor/Moped)	9	3	12	4
33.	Sports goods	2	1	3	-
34.	Tobaccoo Merchants	-	4	4	-
35.	Trunks/attaches	4	6	10	-
36.	Wine/Spirit	2	1	3	-
37.	Repair shops :				
	(a) Turner	3	5	8	-
	(b) Uncleaner	2	2	4	-
	(c) Watch/Clocks	8	10	18	-
	(d) Welders	3	2	5	-
	(e) Pen shops	13	10	23	-
	(f) Hair dressers	6	10	16	-
	(g) Beauty Parlours	2	-	2	-
	(h) Tailor	10	6	16	-
	(i) Electrical	3	10	13	-
	(j) Shoe repairing	3	5	8	-

1	2	3	4	5	6
38.	Gur shops	2	-	2	-
39.	Band	1	5	4	-
40.	Cafe	27	10	37	-
41.	Fertilizers	2	2	4	-
	(i) Cycle repairs	10	20	30	-
	(ii) Wqtch repairs	5	10	15	-
	(iii) Mini Workshops	57	83	140	-

APPENDIX - II

TRANSPORT : Mini Busses, Taxi Union, Truck Union, Medical, Cable T.V. etc.

1.	Mini Busses	Number of busses	40	
2.	Private busses		129	
3.	Ricksh	Registered	2200	
		Unregistered	3000	(approx.)
4.	Trucks	Registered	259	
		Unregistered	50	
5.	Taxi	Registered	30	
		Unregistered	300	
6.	Medical Stores		50	

AUTO DEALERS :

1.	U.P.Automobiles	Two wheelers Sale 315 Nos.3/91 to 3/92
2.	Mahindra Motor Store	Two wheelers Sale 171 Nos.3/91 to 3/92

CABLE T.V. NETWORK :

1.	Top Row Cable Vision Civil Lines	...	76 connections in 3 months (June to Sept.9
2.	Vijay Star and Cable Centre...		63 connections in 3 months
3.	Pritam Cable Centre	...	85 connection in 3 months

(2 and 3 - Avas Vikas, Maktulpuri, Sanjay Gandhi Colony, Azad Nagar, Purana Tehsil, Chanderpuri)

Source : Field survey

APPENDIX-III

TABLE

GEOMETRIC (WIDTH) DETAILS AT SELECTED LOCATIONS

Location	Stretch x	Distance segment	Distance (m)	Widths (m)				
				Carriage way	Walkway		Frontage	
					L	R	L	R
1	AB			7.0	4.9	3.6	-	6
2	AB	1-2	190	7.0	1.5	2.0	2.9	9.6
3	AB	1-3	380	7.0	1.5	1.5	2.0	9.6
4	BC	3-4	17	7.4	3.0	2.0	-	3.5
5	BC	3-5	50	7.8	2.4	1.5	-	-
6.	CD	5-6	60	8.2	2.3	2.5	1.1	0.9
7	CD	5-7	144	8.0	2.3	2.5	-	-
8	DE	7-8	123	8.2	2.6	2.35	-	-
9	DE	8-9	21.3	8.2	2.35	2.00	-	-
10	DE	9-10	24.6	8	5.3	3.2	-	-
11	DE	10-11	147	8.4	5.9	3.2	-	-
12	DE	10-12	239	8.0	5.0	3.2	-	-
13	EF	12-13	16	8.0	5.3	-	-	-
14	EF	13-14	88	8.7	1.5	1.2	-	-
15	EG	E-15	10	7.5	2.4	2.0	-	5.3
16	EG	15-16	580	6.0	2.0	2.0	6.0	4.4
17	GH	16-17	10	6.4	4.6	3.0	-	-
18	HI	16-18	140	4.1	3.3	3.8	1.5	5.3
19	IA	A-19	15	3.6	3.3	2.0	1.5	3.0
20	IJ	I-20	25	3.6	1.5	1.2	8.3	11.9
21	BJ	B-21	6	3.35	1.0	1.5	4.2	4.2
22	BJ	B-22	29	3.9	2.0	2.0	7.0	3.7

Table

23	JK	B-23	150	3.1	4.1	3.5	2.0	4.6
24	KG	K-25	75	3.2	4.1	3.5	2.0	4.6
25.	KD	D-25	150	6.3	5.0	5.8	-	-
26	CL	C-26	10	3.0	3.0	3.5	-	-
27	EM	E-27	18	5.5	2.0	4.2	3.9	5.4
28	CM	C-28	10	6.6	2.5	3.0	-	-
29	BL	B-29	7	4.65	2.7	4.3	-	-

NOTE :

1. Length measured according to segment direction.
2. Directions left and right to be decided by segment direction.
3. For stretch symbols and locations refer Fig.

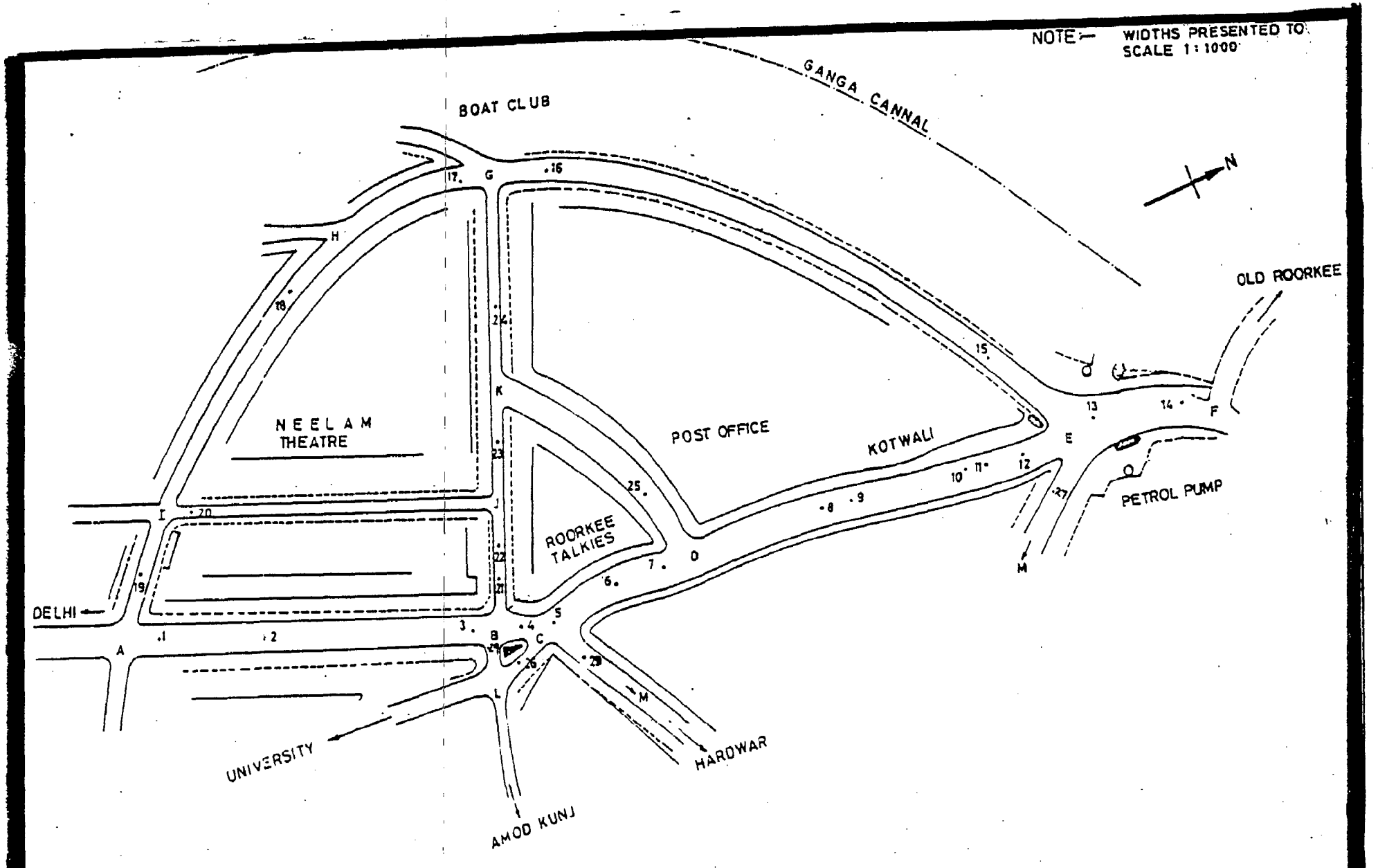

FIG. GEOMETRICS-SELECTED LOCATIONS

APPENDIX-IV.- A1

RESULTS OF CHEMICAL ANALYSIS AND QUALITY OF WATER IN SHALLOW AQUIFERS FOR IRRIGATION PURPOSES

CHEMICAL LABORATORY

GROUND WATER DEPARTMENT U.P.

ROORKEE DIVISION

District	Block	Location	Type of well	year	Date of Collection	Total dissdved Solids ppm.	Electrical conductivity Micromhos/cm.	pH	Chemical constituents in ppm.								Chemical Quality						
									SO_4	Cl	HCO_3	$+4$ Si	Fe^{+3} + Al^{+3}	$+2$ Ca	$+^2$ Mg	$+$ Na	S.AR	S.I	Salinity Group	Quality	Class	Corrosive Property	Type of Incrustation
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
HARIDW-AR	ROOR-KEE	Imli-Khera		1990-91		228	400	7·5	4	7	205	6	3	19	17	9	0·35	23·63	C_2S_1	Good	Hard	Non-Corrosive	Non-Incrustatives
"	"	Beheri ki Sadabad				312	480	7·5	13	60	195	8	4	19	23	21	0·77	22·41	"	"	"	"	"
"	"	Beldi				314	480	7·6	12	7	264	4	3	28	17	30	1·09	21·54	"	"	"	"	"
"	"	Roorkee (Rampur)				322	480	7·8	13	7	273	5	3	32	14	31	1·13	21·42	"	"	"	"	"
"	GURU KUL NARs	Nangla Imarti				228	360	7·6	4	6	195	3	1	28	17	4	0·14	24·1	"	"	"	"	"
"	"	Mang-laur				178	240	8·4	11	17	137	7	4	13	6	12	0·52	23·3	"	"	Moderately hard	"	"
"	BHAG BAN PUR	Bhag-ban Pur				212	423	7·5	15	19	205	7	1	30	19	14	0·52	23·12	"	"	Hard	"	"
"	LAKSAR	Landh-aura.				326	480	7·6	12	7	283	4	3	48	19	9	0·28	23·58	"	"	"	"	"

APPENDIX- IV. A-2

WATER QUALITY OF WATER.

SAMPLING SITE 1 Rly station.
2 Ganeshpur.
3 Bus stand.
4 Civil lines.
5 Saraswati Mandir.
6 Khanjarpur.

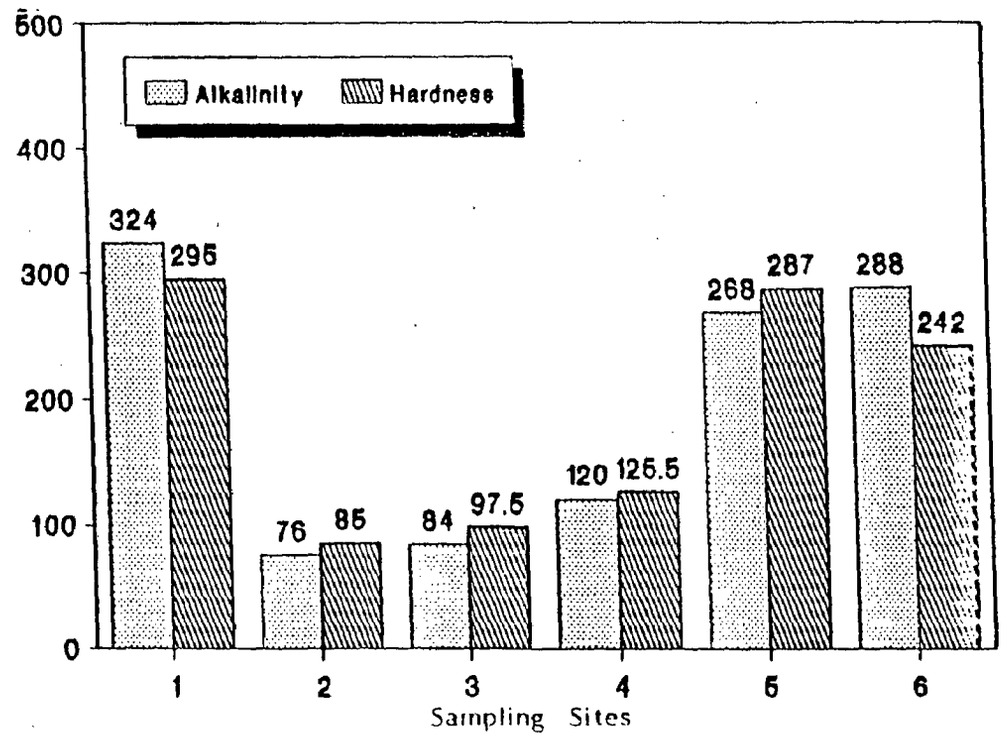

Figure 1 Variation of Quality Parametres

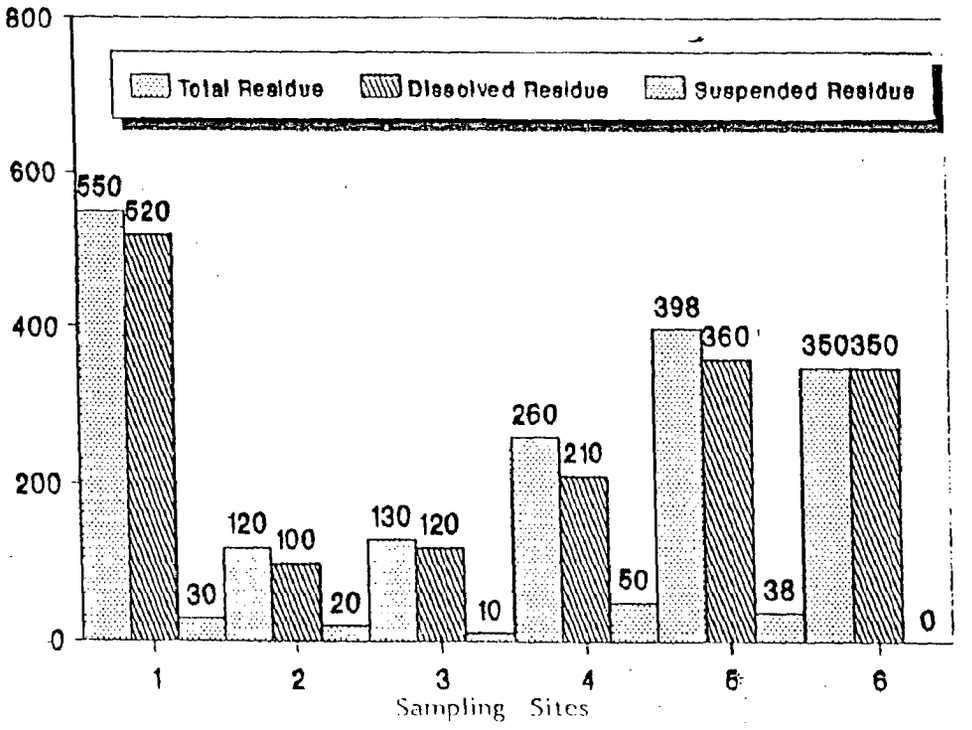

Figure 2 Variation of Quality Parametres

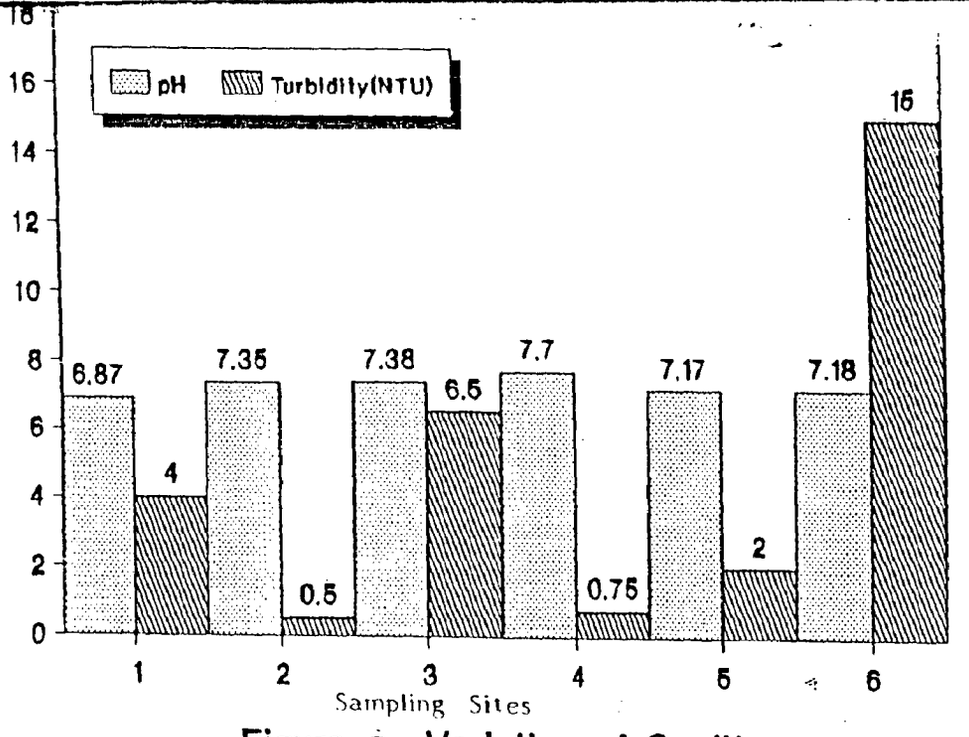

Figure 3 Variation of Quality Parametres

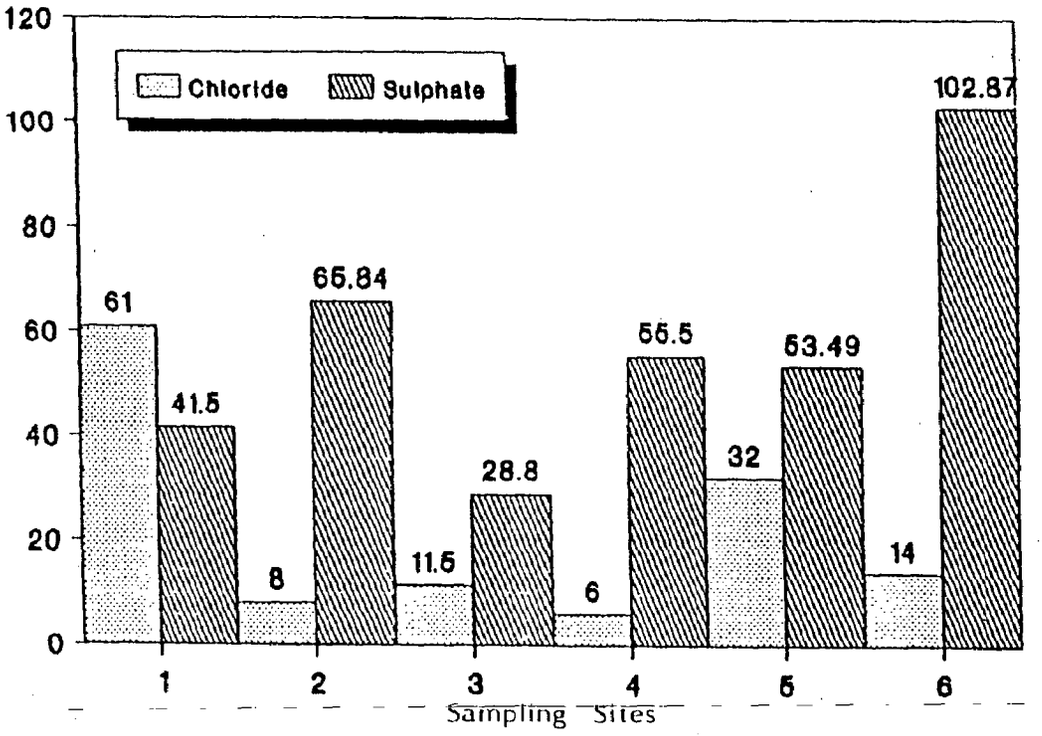

Figure 4 Variation of Quality Parametres

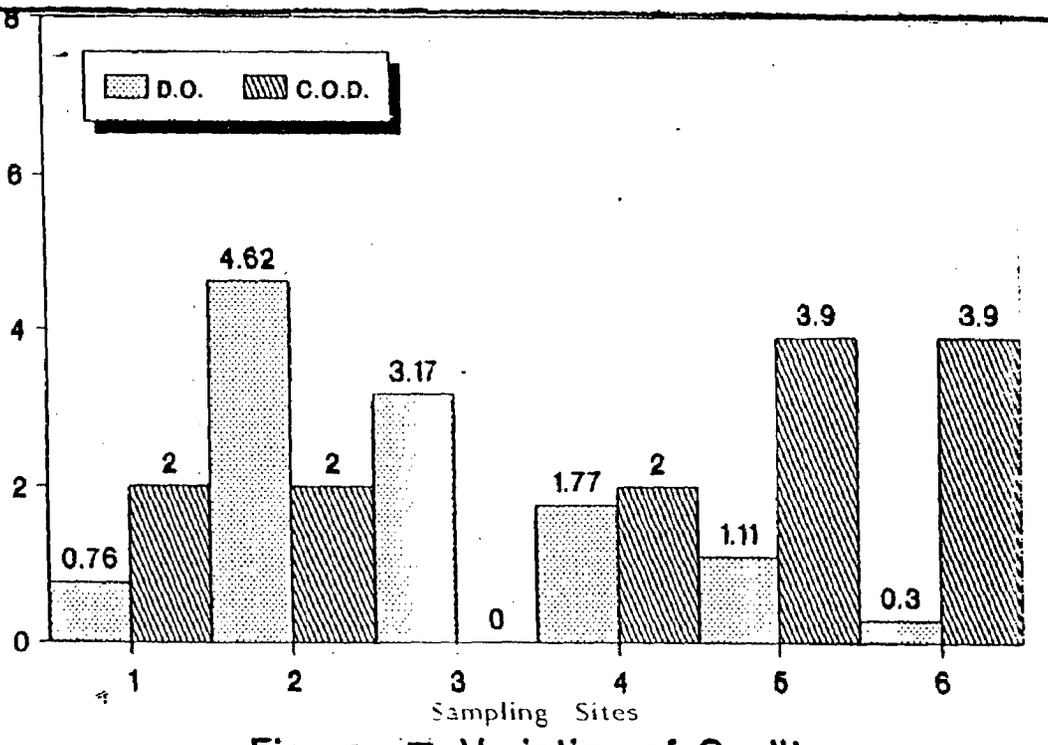

Figure 5 Variation of Quality Parametres

APPENDIX IV-B.1

Sl. no.	Name of Hydrographic station	Datum level in mtrs	Ground level in mtrs.	Depth of water table below ground level in metres
				PREMONSOON
1	2	3	4	5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
1	Roorkee	266·23	269·207	– – 8·32 8·20 9·42 9·98 9·53 9·06 10·35 9·70 9·36 9·23 9·47 8·59 9·59 7·79 9·61 10·27 9·31
2	Rampur	266·900	265·800	– – – – 5·39 4·68 5·36 4·59 4·69 6·88 5·13 4·50 4·79 5·70 6·27 5·69 5·50 Dry 5·18
3	Beldi	256·954	256·554	– – – – 6·10 5·29 5·88 5·25 5·12 5·98 5·23 5·05 5·50 5·35 5·69 5·40 6·00 6·89 5·89
4	Imli-khera	275·152	273·452	9·66 9·91 10·00 9·80 9·50 9·67 9·08 9·70 8·75 9·39 9·97 10·05 9·79 10·51 10·40 9·95 10·30 11·53 10·56
5	Bahare ki Sabahad.	269·797	268·457	– – – – – – 10·33 7·22 6·17 8·45 10·52 8·31 8·46 8·52 9·55 8·78 9·35 Dry 8·95
6	Bhagwanpur	272·670	276·920	– 5·15 6·86 6·51 7·30 6·27 6·06 5·68 4·29 7·35 6·50 7·15 8·65 8·05 8·27 8·40 8·67 9·25 8·37
7	Landhaura	262·297	263·997	– 16·62 15·49 14·97 17·00 16·66 16·76 14·55 – 16·96 17·96 16·98 17·09 16·13 16·95 16·98 17·34 18·16 17·32
8	Nagla Imarti	264·958	264·256	– 11·97 12·68 12·09 13·23 13·35 13·65 – 13·64 13·76 13·79 14·08 13·71 14·03 14·10 14·57 15·54 14·39 14·40
9	Manglaur	262·662	261·222	4·10 3·31 3·65 3·26 3·57 3·44 4·03 3·81 3·81 4·12 3·81 4·12 3·94 3·78 4·35 4·48 4·40 8·20 7·14
10	Jhabrera	263·889	263·089	– 4·12 4·88 4·63 6·00 5·55 5·80 5·7 – 6·36 6·00 6·36 6·80 6·00 6·87 6·96 7·57 Dry 6·59
11	Daulatpur	274·102	272·702	– 6·15 6·50 6·60 6·50 5·97 6·07 5·97 5·32 6·26 7·12 5·82 6·07 6·79 6·66 7·38 6·49 7·39 6·67
YEAR →				71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89

APPENDIX IV-B.2

Sl. no.	Name of Hydrographic station.	Datum level in mts.	Ground level in mts.	Depth of water table below Ground level in metres																	
				POST MONSOON																	
				71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1.	Roorkee			–	–	5·84	6·73	7·02	6·00	7·30	6·40	8·10	7·22	8·03	7·84	7·49	5·65	5·66	7·87	9·25	6·26	6·14
2	Rampur			–	–	–	–	2·71	2·67	3·56	2·35	3·13	3·18	2·97	3·88	2·40	3·82	4·67	4·72	5·20	3·13	4·35
3	Beldi			–	–	–	–	3·75	3·43	3·00	2·48	4·52	3·96	3·86	3·97	3·45	2·91	3·76	4·08	5·79	2·77	3·61
4	Imli khera			8·35	8·33	8·41	8·62	8·30	8·32	8·21	7·48	7·97	8·36	8·74	9·03	9·09	9·15	8·12	9·92	9·52	9·33	9·63
5	Baheri ki Sadabad.			–	–	–	–	–	–	7·20	1·75	5·44	5·37	8·50	7·40	6·98	7·00	8·00	8·42	9·49	9·28	7·85
6	Bhgwanpur			–	4·91	2·51	5·05	3·60	3·00	3·48	0·35	3·50	3·98	6·10	5·32	5·10	5·05	5·30	6·99	8·76	4·75	4·75
7	Landhaura			–	14·78	14·09	14·60	15·40	16·32	16·43	12·55	15·53	16·57	16·58	16·93	16·28	16·25	16·52	16·79	17·32	16·53	16·55
8	Nangla Imarti			–	11·38	11·20	11·20	10·50	13·07	13·50	12·35	–	13·47	13·52	13·68	13·34	13·40	13·71	14·07	14·80	14·43	13·86
9	Manglaur			0·60	2·80	0·81	2·47	1·20	2·11	3·21	0·55	3·08	2·42	2·77	3·07	2·78	2·89	3·03	3·24	3·96	5·69	5·27
10	Jhabrera			–	3·16	2·12	4·00	2·82	3·33	5·40	1·00	5·12	5·12	5·23	5·52	5·03	5·80	6·23	6·34	1·87	5·86	5·35
11	Daulatpur.			–	5·25	4·81	6·03	5·05	4·65	4·39	2·65	4·91	4·62	5·03	5·37	5·50	4·30	4·82	5·42	6·11	4·82	4·94

PRE MONSOON FOR JUNE AS

APPENDIX V

GOVT. SUPPLY - RETAILERS, AREAWISE

Sl.No.	Name of Retailers	Area covered	No.of Unit
1.	Anil Kumar Gupta	Rajputana	2499
2.	Anil Tandon	Soat, Mahigram	3062
3.	Anresh Kumar	Old Tehsil, Old and New Hospital, Avas Vikas, West Amber Talab	3473½
4.	Ahsan Ahmed Ansari	Maktulpuri, Sukhdevnagar East Amber Talab	3290½
5.	Rajesh Kumar and Brijesh Kumar	East Amber Talab, B.T. Ganj, Rajputana	4450
6.	Baldev Raj and Kishan Pal	Railway Station, Ganeshpur	5133
7.	Chanan Lal	Old Tehsil	2723½
8.	D.C.D.S.Ajad nagar	Ajad nagar, Nehru nagar	3846½
9.	Radhey Shyam and Sita Ram	Ramnagar, Hydel Colony	5588
10.	Madan Lal Bhardwaj	Lal Kurti, Mishon School, Double Phatak, Cantt.	1870½
11.	Abdul Rasid Ansari	Civil Lines, Pathanpura, Sheel Kunj	8405½
12.	Mohammed Hanif & Sons	East Amber Talab, Irrig. Colony, Chow Mandi, Chander puri	7505½
13.	N.C. Agarwal	Civil Lines, C.B.R.I. Colony	4907½

Contd....

14.	Ram Sahai Gupta	Irrigation Colony, State Bank Colony and Kaluram Quarters.	
15.	R.C.C. Society	Civil Lines	2521½
16.	R.C.L.C.	West Amber Talab and Avas Vikas	3627½
17.	R.C.L.C.	Kanoongoyan	1902½
18.	R.C.L.C.	Soat	2570½
19.	R.U.C.C.Store	University and C.B.R.I. Colonies	2882½
20.	Sarif Ahmed & Sons	Civil Lines	2068
21.	Surendra Kumar	West Amber Talab	1981½
22.	Roorkee Univ. Mess		2300
23.	Roorkee Jail		
24.	PAC/Public reserved		
		Grand total	79097

Source : U.P.Govt. Supply Dept., Roorkee

APPENDIX VI-A

COMMERCIAL AND NON COMMERCIAL ENERGY CONSUMPTION
1953-54 TO 2004-05

(Million tonnes of coal replacement)
(MTCR)

Year	Commercial	Non-Commercial	Total
	1. N.B. Prasad Working Group		
1953-54	60	126	186
1960-61	101	146	247
1961-62	108	150	258
1962-63	126	151	278
1963-64	130	156	286
1964-65	137	158	295
1965-66	147	160	307
1966-67	155	167	322
1967-68	165	171	335
1968-69	177	173	350
1969-70	192	176	368
1970-71	197	172	370
1971-72	253	195	448
	2. Advisory Board on Energy Study		
1982-83	340	225	565
2004-05	1,485	500	1,985
	3. Energy Demand Screening Group		
1984-85	428	313	741
1989-90	682	343	1,025
1990-95	907	359	1,276
1999-00	1,224	407	1,631

2004-05	1,637	411	2,048
Annual rate of increase ( ) between			
1953-54 & 1975-76	6.8	2.0	4.1
1984-85 & 1989-90	9.8	1.8	6.7
1989-90 & 1994-95	5.9	1.5	4.5
1994-95 & 1999-00	6.2	2.0	5.7
1999-00 & 2004-05	6.0	0.2	4.7
% share in total energy consumption in			
1953-54	32	68	100
1960-61	41	59	100
1970-71	52	48	100
1975-76	56	44	100
1982-83	60	40	100
1984-85	58	42	100
1989-90	67	33	100
1994-95	71	29	100
1999-00	75	25	100
2004-05	80	20	100

Source : CMIE

TABLE A-2

SHARE OF PRIMARY SOURCES OF ENERGY FROM 1970-71 TO 1990-91

(Percent)

Year	Lignite	Coal	Oil	Natural gas	Hydro	Nuclear
1970-71	2.8	60.1	31.1	2.1	3.5	0.3
1975-76	1.9	63.1	28.5	2.6	3.6	0.3
1980-81	2.7	64.2	29.3	2.2	4.2	0.3
1984-85	3.1	59.7	29.3	5.0	3.6	0.3
1985-86	2.9	56.0	32.7	5.1	3.1	0.3
1989-90	3.5	55.8	29.7	8.1	2.9	0.2
1990-91	3.5	56.5	28.5	8.1	3.2	0.3

Note : Row totals need not add upto 100.

Source : C.M.I.E.

TABLE A.3

PLANWISE INVESTMENT IN POWER SECTOR

(Rs. crores)

Plan	Total Plan Outlay	Investment in power sector	Share of power sector in total outlay
I	1,960.0	260.0	13.3
II	1,600.00	460.0	10.0
III	8,576.5	1,252.3	14.6
IV	16,160.0	2,931.6	18.1
V	39,303.0	7,540.0	19.2
VI	1,09,291.0	18,298.6	16.7
VII	1,80,000.0	34,273.6	19.0

Source : C.M.I.E.

TABLE A-4

PLANWISE CAPACITY ADDITION

Plan	Period	Target MW	Achieve-ment	Sippage	Achievement (%)
First	1951-56	1300	1100	200	84.6
Second	1956-61	3500	2250	1250	64.3
Third	1961-66	7040	4250	2520	64.2
Annual	1966-69	5430	4120	1310	75.8
Fourth	1969-74	9264	4579	4685	49.4
Fifth	1974-79	12499	10202	2297	81.6
Annual	1979-80	2945	1799	1146	61.1
Sixth	1980-85	19666	14226	5440	72.3
Seventh	1985-90	22245	22402	+ 157	100.7

Source : C.M.I.E.

TABLE A-5

FINANCIAL DATA OF ALL STATE ELECTRICITY BOARDD

Rupees in Crores

Item	1988-89	1989-90	1990-91*
1. Revenue receipts	11035	12915	14595
2. Operating expenditure	10017	11954	13637
3. Gross operating surplus(1-2)	958	961	958
4. Depreciation due	908	1061	1248
5. i. Interest due to Institution	1301	1650	1952
ii. Interest due to State Governments	1577	1697	2078
6. Net surplus (+)/Deficit(-) (3-(4+5)	- 2929	- 3447	- 4320
7. Internal resources	- 608	- 1538	- 1654
8. Operating ratio	106	106	107
9. State Electricity duty	649	757	855

* Estimate

Source : Planning Commission

TABLE A-6

PROJECTIONS FOR MAJOR PETROLEUM PRODUCTS

Unit -000 tonne

Sector	Years			
	1989-90	1994-95	1999-00	2004-05
Household	9170	12492	18654	27857
Agriculture	7083	9059	8452	6147
Industry and Services	9088	12896	18513	26280
Fertilizer	3970	4240	4240	4240
Power	3162	4088	5489	10077
Transport	20227	28569	40631	59116
Total :	52700	71344	95989	133717

The above figures are for 6% GDP Growth rate.

For 5.5% GDP Growth rate ... 121.380 MT

For 7.0% GDP Growth rate ... 158.72 MT

Source : Perspective Planning and Policy for Commercial Energy, Planning Commission, 1988

SECTOR WISE SHARES IN TOTAL DEMAND AND COMMERCIAL ENERGY DEMAND

1984-84, 1989-90, 1994-95, 1999-2000, 2004-05

		1984-85	1989-90	1994-95	1999-200	2004-05
Total demand (mtcr)		741	1025	1276	1631	2048
		Sectorial shares in Percent of Demand (A: Percent of Total energy demand, B: Percent of Commercial energy demand)				
Industry	A	18.2	21.1	22.7	24.8	25.2
	B	31.4	31.5	32.0	33.1	31.7
Transport	A	15.0	17.1	18.9	19.5	21.7
	B	25.5	25.5	26.6	26.1	27.1
Agriculture	A	3.8	3.9	3.7	3.4	2.9
	B	6.5	5.9	5.2	4.5	3.6
Household Commercial	A	5.0	7.6	9.3	10.9	12.9
	B	8.6	11.4	13.1	14.6	16.2
NonCommercial	A	41.9	33.2	29.0	25.1	20.5
	B	-	-	-	-	-
Orhers	A	2.2	2.3	2.5	2.8	3.0
	B	4.0	3.5	3.5	3.7	3.8
Auxiliary Consumption	A	13.9	14.8	13.9	13.4	14.0
	B	24.0	22.2	19.6	18.0	17.6
		100	100	100	100	100

Source : CMIE

APPENDIX VI B

STANDARDS (ESTIMATED) ADOPTED

D A T A

AGRICULTURE :

PRODUCTION :

Water Hyacinth	:	560 Kg.Dry/Hect/Day
Para grass	:	130 Ton/Hect./Year (with sewage, sullage)
Vegetables	:	45 Ton/Hect./Year (3 crops year)
Algae	:	12 G./Sq.M./Day

MANURE REQUIREMENTS :

Vegetables	:	210 Ton/Hect./Year (F.Y.M.)
Fodder	:	6 Ton/Hect./Year (F.Y.M.)

From the same amount of dung from a Bio gas plant one gets 1.43 times the amount of F.Y.M. The manure of the Bio gas plant has double the amount of humus of farm yard manure.

WATER REQUIREMENTS :

Vegetable gardens	:	5000 Cu.M./Hect./Year
Fodder	:	1000 Cu.M./Hect./Year

AGRICULTURAL WASTES :

Vegetable gardens	:	13 Ton/Hect./Year

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Vegetable gardens	:	5000 Cu.M./Hect./Year
Fodder	:	1000 Cu.M./Hect./Year

AGRICULTURAL WASTES :

Vegetable gardens	:	13 Ton/Hect./Year

GAS PRODUCTION :

Paddy husk	:	0.1 Cu.M./Kg.
Human Excreta	:	0.027 Cu.M./Capita/day
Chicken droppings	:	0.95 Cu.M./100/Day
Water Hyacinth	:	0.374 Cu.M./Kg.
Cattle dung	:	0.062 Cu.M./Kg.

APPENDIX VI-C

U.P. STATE ROAD WAYS

Fare (1992) 17.94 paise per km.
16% tax
10 paise per ticket
5% L.I.C.
50 paise per ticket for Delhi (Vehicle tax and Moradabad bridge tax)

Total no. of buses passing through Roorkee = 450 per day

No. of busses at Rooree Depot ... 36

		(To and from)
Haryana	...	20
Punjab	...	20
D.T.C.	...	24
Rajasthan	...	13
Agra	...	08
Moradabad	...	04
Hardwar - Delhi	...	16
Rishikesh - Delhi	...	16
Puskar	...	02
Roorkee-Dehradun	...	02
Mussorie-Delhi	...	02
Muzaffarnagar (Local)	...	23

1/2 hr, service from 7.30 a.m. to 8.30 p.m.

Dehradun (45 min. service) 8 to 10.30 p.m.

Hardwar - Saharanpur 20 min. service

(10 buses 5 times each)