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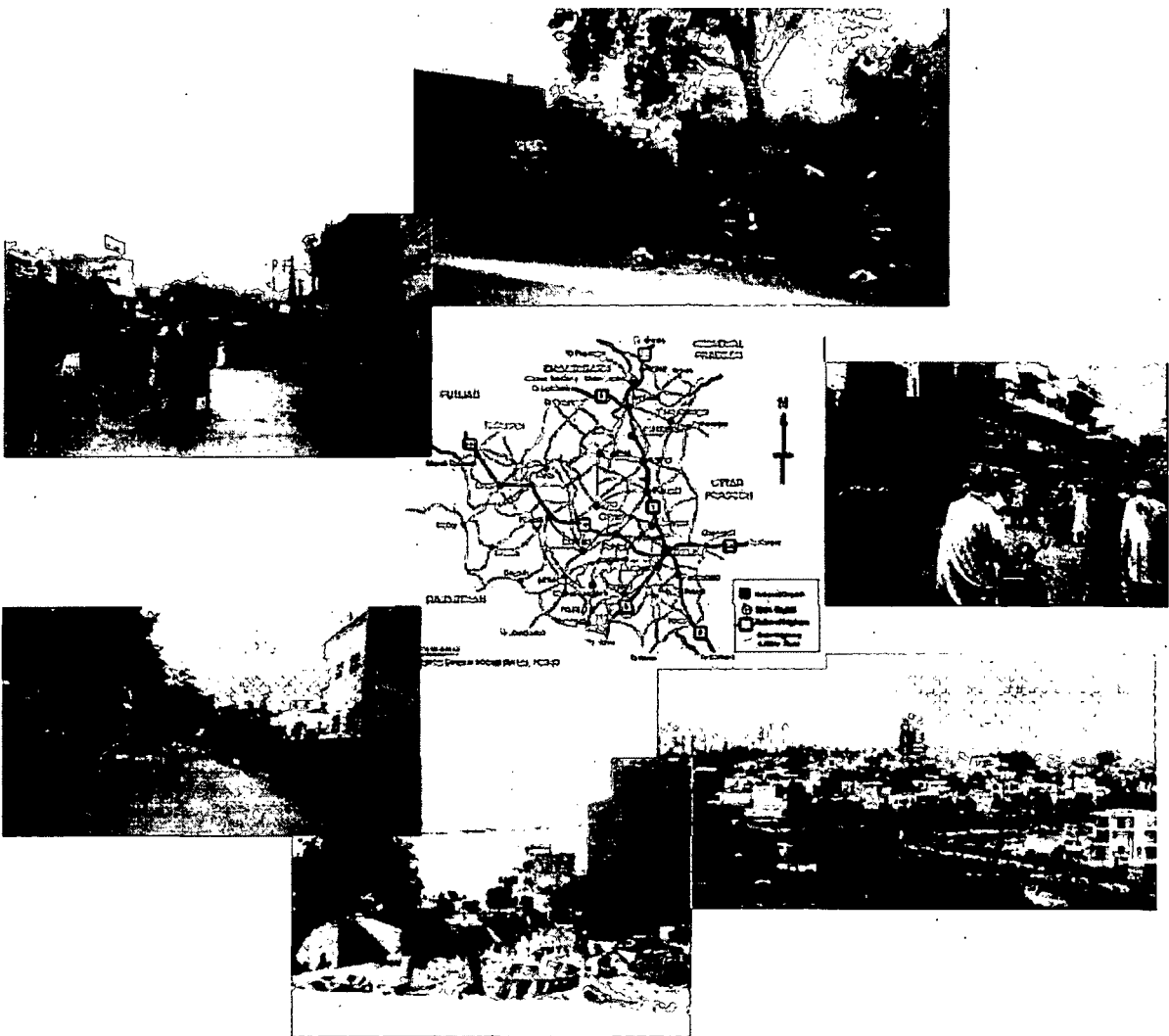
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**Feasibility study
for
implementation of "Green City" concept
in Gurgaon City, Harayana State, India**

Part I



This feasibility study is co-financed by UNDP - and undertaken by UNIDO with technical assistance from Green City Denmark A/S in co-operation with Green City India Pvt. Ltd. including appointed national and international experts

May 2001

Preface

The "Green City" Concept was introduced to the State Government of Haryana and the Local Administration of Gurgaon by Green City Denmark A/S and Green City India Pvt. Ltd. in October 1998.

A two-day seminar under Asia Eco Best programme was organised in Gurgaon to discuss project possibilities and specific main areas of concern regarding Gurgaon urban development focusing on environmental sustainability. The target was to create and improve environmental awareness and to introduce key issues for sustainability.

Cooperation started up by defining project possibilities, by initiating data registration and by looking for possible financing of a feasibility study. As a follow up on the seminar a cooperation agreement was signed between Green City and the Gurgaon local Government in July 1999.

Throughout 1998-'99 Green City India collected preliminary information and data through discussions with the various stakeholders about Gurgaon as part of the preparatory work in the application for funding. UNDP showed a very positive interest to support a feasibility study in Gurgaon.

In December 1999 Terms of Reference for the feasibility study were developed and a contract was entered between UNIDO (The United Nations Industrial Development Organisation) and Green City Denmark, with the scope to prepare a feasibility study to support the Indian authorities in planning to transform the City of Gurgaon in Haryana State into a modern Green City, as model for other parts of India.

Haryana State and UNDP initiated Gurgaon Green City project during stakeholder meetings and presentation of the Green City concept in February 2000.

In November 2000 all the task groups including national and international experts presented and discussed which proposals and suggestions should be of high priority - so that the feasibility study could be finalised including the Action Plan for implementing Gurgaon Green City.

In April 2001 draft project report and action plan proposals were discussed among project partners and the worked out proposals etc. were found ready for finalising project report as hereby Part I and Part II reports.

An overview of the many involved Gurgaon stakeholders in preparing this feasibility study is given in enclosure of Part II report – comprising managers and staff members from Haryana State and Gurgaon Municipality in Steering Committee and the 5 Task Groups, national and international experts and project partner participants from UNDP/ UNIDO and Green City team.

UNDP/ UNIDO and Green City project team in India and Denmark want to thank our Gurgaon project partners for most pleasant cooperation and meetings – always providing a constructive and very targeted dialogue in each meeting and very keen to see a quick progress towards a future good place for living in environmentally much more sustainable surroundings for Gurgaon citizens.

Quoting Chairman of the Steering Committee, Mr. L. S. M. Salins, Haryana State Commissioner for Gurgaon, from last meeting: "Two Gurgaons are emerging – one is Gurgaon and the other is "Badgaon" – arising from the separating highway NH8, which was not expected".

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1.0 Summary - proposal for implementing Gurgaon Green City

Haryana State and UNDP initiated Gurgaon Green City feasibility study in December 1999, which was followed by stakeholder meetings and presentation of Green City ideas in February 2000. Main areas of concern were lacking proper waste collection and sanitation, water supply, reliable energy supply and coherent urban development regarding the very fast population growth rate in Gurgaon.

As technical consultants for UNDP, UNIDO, Green City Denmark and local partners, Green City India prepared an interim report on the feasibility study to be discussed among stakeholders in June 2000. Main focus areas suggested were urban planning, waste management, water resources, low-energy buildings and people's participation/ information strategy.

A Task Group for each of the 5 focus areas were established - involving local stakeholders together with selected national and international experts. During meetings in October 2000 national experts brought in a lot of Indian experiences for sustainable solutions implemented elsewhere in India and from international experts and Green City Denmark the Danish/ European experiences on sustainable urban management were brought in.

In November 2000, all the task groups including national and international experts presented and discussed the proposals and suggestions that should be given high priority so that the feasibility study could be finalised including the Action Plan for implementing the "Green City" in Gurgaon.

Main concern is the very fast growth rate of population in Gurgaon as it is one of the most attractive amongst 22 "satellite" cities around Delhi. From around 100,000 in 1980, Gurgaon's total urban population has reached nearly 500,000 today and is expected to reach 2 million around 2020 - or maybe 4-5 million!

Basic needs for proper water supply, sanitation, waste cleaning and health care in the urban slums of Gurgaon's Old Town, in some of the urban villages, within informal settlements and amongst the floating population is a number one priority for urban sustainability regarding short term actions.

Thus, Gurgaon Green City Action Plan initiates improving daily life conditions in a pilot area comprising a part of the Old Town, a part of Gurgaon village and a part of Jharsa village.

Mixed waste being dumped anywhere in a haphazard and inefficient way is a serious threat to human health in Gurgaon as the waste is blocking up open sewerage pipes, causing infectious diseases especially in the urban slums and probably poisoning water supply directly or through infiltrating leachate from open dumpsites like the major dumpsite at Basai Road near inner city.

Thus, Gurgaon Green City Action Plan also initiates demonstration projects for proper waste collection and disposal comprising the above mentioned pilot areas in Old Town, Gurgaon village, Jharsa village together with a more average standard residential area in HUDA sector 14.

However, these demo projects will have no effect or only very short term effects, if they are not closely linked to simultaneously starting up of the Green City holistic approach for urban sustainable planning methods comprising integrated urban infrastructures for ensuring proper water supply & wastewater treatment, waste management, energy efficiency, traffic, greenings etc.

The one most important initiative recommended by the local Gurgaon stakeholders is that the project responsibility for implementing Gurgaon Green City concept should be given to a public/ private partnership Steering Committee (Special Purpose Vehicle) heading the 5 selected Task Groups.

2.0 Purpose of Gurgaon Green City project

With recommendation from Government of India, Haryana State and Gurgaon Local Government, UNDP has given financial support to work out this feasibility study focusing on how to implement the "Green City" concept of urban sustainability in Gurgaon City.

The objective is to make Gurgaon Green City project a showcase for sustainable urban development as a model for other Indian cities - including primarily the region around New Delhi comprising of 22 "satellite" cities, all of which, like Gurgaon, are challenged by a very fast population growth rate.

Thus Gurgaon Green City will be an important contribution towards implementation of India's Agenda 21 and besides this, UNDP has an interest in the showcase of Gurgaon Green City to possibly give inspiration for other cities in developing countries facing similar problems.

3.0 Inspiration from Denmark

Green City Denmark was established in 1994 as a worldwide showcase of environmentally sound solutions within water supply, waste management, energy supply, traffic, building sector, industrial production and urban development etc.

Denmark has been at the environmental forefront since implementing the Environmental Protection Act in 1974 through a close public/ private co-operation that has continued and strengthened ever since.

As the first country Denmark had a Minister of Environment in 1972 and it was natural to locate the European Environment Agency in Copenhagen, Denmark, in 1994.

Green City Denmark has arranged more than 300 foreign delegations to visit Danish environmental projects, Danish "Green Cities", manufacturing companies etc. and has developed a number of international environmental project co-operations.

The aim is to provide environmental inspiration and facilitate international co-operation to achieve environmentally sustainable development.

Green City India was established in 1998 as a joint venture to promote Danish environmental technologies in India financially supported by Danish governmental funding through DANIDA Private Sector (PS) Programme.

4.0 Green City concept for Sustainable Urban Management

For Danish and other European "Green Cities", which have achieved a high degree of sustainability regarding the environment, quality of life and economy, – Sustainable Urban Management is the key word.

When you visit a big city you may often find it far too complex to see any relation with an integrated urban management. It is easier to recognise a management system when you visit a company or an organisation. Infact, it is a very similar situation but on a somehow on a higher level and within a political context and reality, where long term and short term objectives may differ greatly amongst the individual responsible politicians.

Therefore urban mangement is very complex and there is always the risk for too many "missing links" between good political intentions and visible practical results.

Illustrating potentially usefull methods to achieve more sustainable urban mangement, we can focus on a simple model showing how Danish "Green Cities" utilise demonstration projects to ensure development in a sustainable manner. This Green City model is shown below in 9.0, page 9.

5.0 GURGAON

Gurgaon is a fast developing city near New Delhi, which has the potential to become either a self-organised green, nice, and healthy place or a disorganised crowded and polluted suburb to New Delhi.

Traffic through the town is heavy but some parts of Gurgaon are still clean with green areas. The growth of Gurgaon in the near future is being planned and the development must be directed to ensure that it continues to remain as an organised place.

The local government as well as the private developers seem to have the same vision of a green and open spaced Gurgaon developing in a pace and direction which is as sustainable as possible thereby ensuring a pollution free environment for people.

Feasibility study findings indicate that planning and implementation must have a holistic policy and need to include regional water supply, improved living conditions, sanitation, pollution abatement, anti-poverty program, job development, improved services and maintenance as well as financial means.

Institutional buildings, new organisations and payment for services and maintenance are needed. In Denmark and other places the premises have been

managed in a context of public and private partnership, which will need an adjustment according to Indian culture and government.

Living is not only a matter of survival. Green and shady areas will be central places for joy, child's play and spiritual well being also.

5.1 Main areas of concern - problems to be addressed in Gurgaon City

Primary:

- Garbage being dumped in a haphazard and inefficient way, lack of reuse and energy recovery.
- Fast depleting of groundwater reservoir and only part of the population are supplied with treated potable water, lack of water saving initiatives.
- Limited public sanitation system with only part of the households connected.
- Lack of efficient energy use, frequent power cuts and insufficient energy supply.
- Lacking urban infrastructures and urban villages not integrated with the urban infrastructure.

Secondary:

- Lack of renewable energy sources.
- Traffic access to the inner city/ insufficient public conveyance.
- Air pollution from heavy traffic due to the crossing highway connections.
- Preservation of natural resources to avoid being affected by construction/ industrial activities.

Generally, important for both primary and secondary core areas mentioned above is the need for:

- Quality of life improvements, especially regarding poor, disabled and urban villages.
- Environmental awareness rising amongst citizens, public authorities, private developers etc.

5.2 The identity of Gurgaon City - main attractions

Gurgaon City has a high attraction value for many multinational big companies entering the Indian market due to availability of cheap land and its location being near to airport and the Indian capital.

For many Delhi citizens, Gurgaon City has a high attraction value, as the other surrounding cities near by Delhi has for similar reasons of cheaper availability of land and newly built residential housing.

Improved living standard in the new modern private developers' housing areas compared to housing standards in Delhi also is an obvious reason for citizens' interests in Gurgaon.

This tendency to move out from Delhi to Gurgaon has contributed to the very fast growth rate and increase in population of Gurgaon.

Thus the identity of Gurgaon City comprises several population groups like one group of residents born in Gurgaon, one fast growing group of new-comers from Delhi and several groups of residents from former separate "encapsulated" villages and migratory workers.

6.0 Starting points for Gurgaon Green City process

A "Green City" approach to establish Gurgaon City as a showcase for environmental sustainable urban development can take a starting point in one or more of following crucial issues:

- The fast growth rate in new residential settlements and private developers possible commitment to environmentally sound building principles and public authorities' necessarily matching taking over responsibility for providing more sustainable urban planning conditions including infrastructural improvements regarding energy supply, water supply, sanitation and waste disposal.
- High attraction value for industries due to cheap land rates and airport/ highway infrastructure and multinational industries' possible commitment to environmental management, cleaner production and sustainable urban development including energy supply efficiency and new clean energy sources.

- Old township values for cultural, social and quality of life aspects and municipal and commercial sector's possible commitment to strengthen attraction values including public health improvements regarding water, sanitation and traffic etc. which are issues of crucial importance to enable implementation of Agenda 21 actions.

First of all, it is important to underline that Gurgaon stakeholders from public and private sector are very well aware of many environmental problems and many possible solutions. The difficult part is how to make some of the good solutions into a reality for Gurgaon.

Secondly, there is no doubt that implementation of more environmental sustainable solutions for Gurgaon's further urban development has to be done in a very close integrated 3-way partnership between authorities, private developers and Gurgaon citizens.

Thirdly, a holistic approach has to be adopted to view Gurgaon as an inherent part of Greater Delhi including the 22 surrounding cities/ suburbs. The methodology adopted for the project should form a base for its possible replicability in some of the other suburbs around Delhi and lessons learned from other surrounding cities should also be included in Gurgaon Green City project.

7.0 Stakeholder interests

Throughout the feasibility study all stakeholders have shown very much interest in pushing forward the Gurgaon Green City project into the implementing phase.

Commissioner, Deputy Commissioner and HUDA Administrator have during rounds of meetings with UNDP & UNIDO involving national & international experts and Green City Denmark/ Green City India in June, October and November 2000, keenly recommended starting up of demonstration projects on the high priority issues of meeting basic needs of water supply, waste management and sanitation etc.

Similarly, high interests are expressed from central government representatives, National Capital Region Planning Board, Gurgaon Municipality, private developers and from NGO representatives in Gurgaon.

UNDP who has financed this feasibility study the project has seen this as a showcase and model for similar initiatives in other developing countries for improving urban sustainability.

8.0 Visions 2021 -- for Gurgaon Green City

The overall objective is to make Gurgaon a unique showcase of Sustainable Urban Management in National Capital Region of Delhi based on the Green City concept of close public/ private partnerships and broad stakeholder participation.

The objective of the project is thus to develop a holistic approach for planning and management of environmentally sound urban development and urban renewal integrating proposals and recommendations for land uses, land delivery, infrastructure systems, energy savings, solid waste, water resources and waste water in Gurgaon.

This is the overall objective to be dealt within master planning and management for the entire city as well as in local planning.

Gurgaon Green City will be a showcase of:

- Environmentally sustainable urban development and urban renewal.
- Proper waste collection and disposal systems.
- Ecological balanced water supply and consumption.
- Energy & environmental sustainable urban housing.
- General public's environmental awareness and behaviours.

These 5 issues are closely linked and interrelated around the process of providing future sustainable urban development in Gurgaon focusing on Quality of Life aspects and on reducing the growing problems of urban slum/ urban poor people.

Environmentally sustainable urban planning, development and renewal will ensure basically proper location of housing and optimal conditions for efficient infrastructures to provide energy, water, waste management facilities as well as transport and recreational facilities.

Basic importance is that general public's environmental awareness and behaviour will guide the demand for energy efficient housing, renewable energy supply and energy savings, water savings and reuse of water, source segregation of waste and recycling etc.

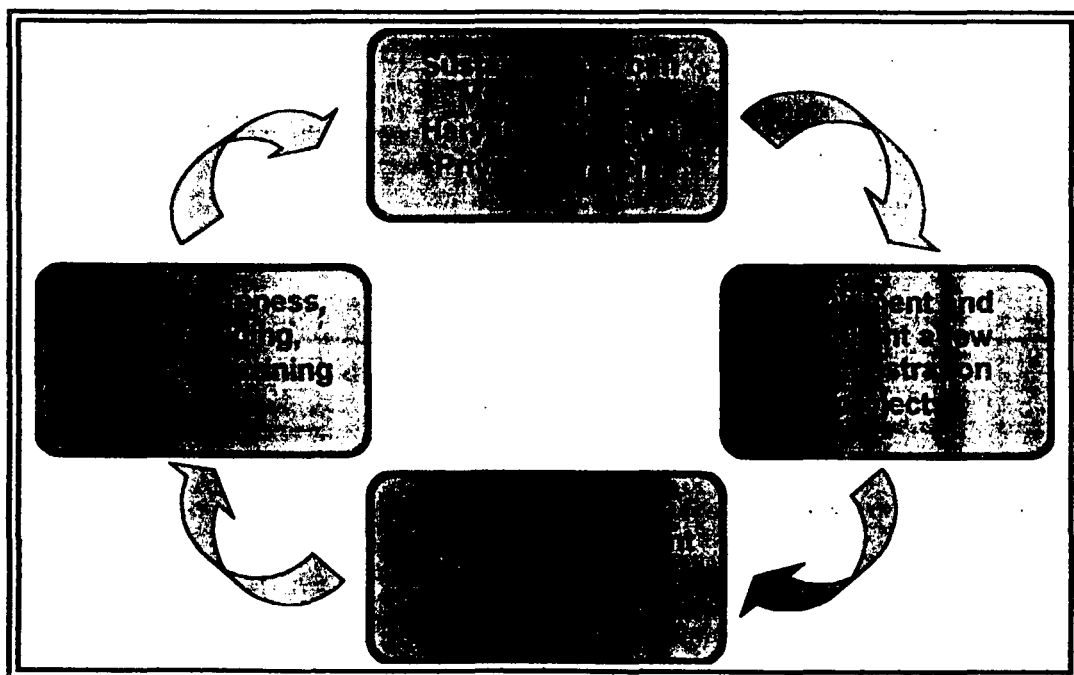
9.0 Strategy for Gurgaon Green City

To visualise a Green City approach in Gurgaon there is a long way to go and the many good ideas from initial findings, comments and proposals need to be processed into a clearly comprehensible and persistent Green City Action Plan. An Action Plan, which is created and approved amongst all Gurgaon Green City project stakeholders.

It is crucial to ensure conditions of commitment from all stakeholders and implementation of at least a few high priority demonstration projects to visualise the beginning of Gurgaon Green City.

The Green City strategy development is arising from linking 4 main conceptual parts and the model shown below illustrates an urban management process directed into attaining sustainability.

The Green City Model linking four main conceptual parts



1. The urban managers from politicians/ administrators/ private partners decide and initiate implementing of a demonstration project to visualise part of the Gurgaon Green City strategy.
2. Implementation of the demonstration project involving relevant Gurgaon stakeholders throughout the process of planning, construction and start up operation.
3. Monitoring of effects to provide data for information.
4. Information to participating stakeholders and general public, politicians, local administrators, public-private partners etc. to stimulate awareness, which is a crucial step to change attitudes into more sustainable behaviours.
5. Politicians, local administration departments, public-private partnerships etc. will use information from effects of demonstration projects and experienced reactions from stakeholders and general public etc. to adjust and expand Gurgaon Green City strategies for initiating further steps in a more sustainable direction.

10.0 Action Plan for Gurgaon Green City

Aiming at the overall objective the initial steps on the road to the Vision 2021 for Gurgaon Green City have been identified through the following workpackages/ tasks and demo projects:

Workpackage on Urban Planning:

UP1: Introduction and preparation of spatial/ socio-economic/ participatory planning

UP2: Implementing Geographical Information System (GIS) start-up phase

UP3: Test planning methodology on North Eastern urban fringe of Gurgaon

UP4: Local selected area for implementing demo project on integrated planning/ building

UP5: Urban renewal within Gurgaon Old Town slum area

Workpackage on Waste Management:

WM1: Local area demo project for door-to-door waste collection, composting etc.

WM2: Implementing of authorised/ controlling waste transportation system

WM3: Upgrading of landfilling and guidelines for new landfills

WM4: Public/ private partnership for Gurgaon Municipal Corporation waste management

WM5: Health Care Risk Waste

WM6: Biological treatment of organic waste in central treatment facility

Workpackage on Water Resources:

WR1: Regional catchment area water balance model and monitoring system

WR2: Public/ private partnership for water supply and wastewater management in Gurgaon Municipal Council.

WR3: Revised Water Resource Management Plan for Gurgaon.

WR4: Urban slum area demo project for proper water supply, sanitation, waste cleaning etc.

Workpackage on Energy Efficiency and Low-Energy Building:

LE1: Energy efficiency audit within energy production, distribution and consumption sectors

LE2: Energy saving initiatives and renewable energy sources to be introduced

LE3: Demo project to be implemented on low-energy buildings with a public/ private partnership

LE4: Revised low-energy building standards and building sector strategies for Gurgaon

Workpackage on Peoples Participation & Information:

PP1: Study tour to Denmark for key persons from Steering Committee and 5 Task Groups

PP2: Training and exchange programmes for key person from public sector/ private sector

PP3: Awareness campaigns to facilitate Gurgaon Green City project implementation

PP4: Targeted awareness actions for implementing the specific demo projects

PP5: Socio-economic study and implementing of database

Demo projects to be implemented and to be highlighted for Green City awareness building:

1. Urban slum area demo project for proper water supply, sanitation, waste cleaning etc.
2. Local area demo project for door-to-door waste collection, composting etc.
3. Demo project to be implemented on low-energy buildings with a public/ private partnership

11.0 Implementation of Gurgaon Green City Action Plan

Following in this chapter is a description of necessary work involved from the 5 Task Group components to realise Action Plan as shown above in 10.0 overview.

11.1 Budgeting assumptions

To give a rough estimate on the budget for the suggested Action Plan, an estimation of man-months (MM) for international expert/ consultant respectively and local assistance is mentioned in the following description for each workpackage and specific tasks. Technology costs and construction costs as well as operational costs can only be estimated very roughly on this study level, but will have to be elaborated within each of the suggested workpackages/ tasks as a part of the individual detailed project studies.

The budget fees for man months are based on a weighted average of the given fees for the different groups of involved consultants, staff members etc.

Following assumptions have been made for working out the budget:

- 1 MM equal 135 hours
- All fees are including overheads
- Exchange rate according to given spot rate May 2001
- 1 MM equals 8370 USD for international experts
- 1 MM equals 1350 USD for Indian experts

Fees for international experts:

The international experts to be involved will consist of consultants from private companies and consultants/ staff members from public organisations like counties and municipalities.

- Average fee for Danish consultants per hour equals **62 USD per hour, or 8370 USD per MM**

For the Indian inputs, three groups will be involved:

1. National experts

- Average fee per hour is **15 USD**, based on the official monthly average rate of 2000 USD used by UNDP in projects involving national experts

2. Indian consultants

- Average fee per hour is **15 USD**, based on the official monthly average rate of 2000 USD used by UNDP in projects involving national experts

3. Local staff in state and city Government:

- Net personal costs as basis for estimation of in kind contribution is **8 USD per hour**

To work out an Indian average fee per hour, following assumptions have been made based on the above:

- Average fee for Indian Consultants and National experts is 15 USD per hour, and it is assumed that 20% of the consultancy work will be done by National experts and 80% will be done by Indian consultants.
- Average fee for Indian inputs to project is 10 USD per hour i.e 1350 USD per MM, as it is assumed that 20% of the Indian input will be given externally (15 USD per hour) and the rest 80% will be given as in kind contribution by state/ local government own staff (calculation basis 8 USD per hour).

11.2 Urban Planning Task Group

Aim within 2-5 years: Integrated and holistic viewed urban planning structure for Gurgaon.

Master planning for urban development and urban renewal plays a crucial role aiming at Vision 2001 – Gurgaon Green City. As stated the overall objective is to introduce a holistic approach for planning and management of an environmentally sound city, a "recycling of the city" approach.

11.2.1 UP1: Introduction and preparation of spatial/ socio-economic/ participatory planning

As further stated this objective calls for a transformation of the traditional spatial oriented planning process into a new planning process combining spatial, socio-economic and participatory issues. The Masterplan for Gurgaon has to be restudied in this light.

The plan has to be restudied considering population forecasts and densities, the role of Gurgaon in the Delhi conurbation, townscape and landscape analysis, the urban fabric and land use recommendations, the growth pattern of the old town, the urban slums, the urban villages, private developments and HUDA developments etc., the proposals for green structures of the city incorporating areas for rain water harvesting, the planned urban infrastructure systems and services etc.

A draft EIA, Environmental Impact Assessment study, will be prepared analysing the present and future urban development of Gurgaon.

These spatial analyses will be confronted with socio-economic relations, financial and human resources in planning, management and development, real estate market analysis, as well as cultural/ social relations, employment and

incomes of the population. The spatial analysis should also be confronted with conceptual projections for the future of the entire urban area regarding water supply, energy management, waste management etc.

The means and organisation of people's participation in the process of preparing a review of the Masterplan for Gurgaon will be examined.

The output will be proposal for a new spatial, socio-economic and participatory planning methodology to be applied in the next revisions of the Masterplan.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff	2	8370	16740
Local staff and experts/consultants	6	1350	8100
Total			24840

11.2.2 UP2: Implementing Geographical Information System (GIS) start-up phase

During the feasibility study a proposal for starting up of GIS implementation in Gurgaon has been prepared and presented for urban planning task group members.

Increasingly, local administrative authorities worldwide are recognising the benefits of using Geographical Information Systems (GIS) for sustainable planning. GIS provides a vital tool for the analysis of spatial data particularly where it is necessary to model the interaction between several layers of spatial & socio-economic data and where the relationship between these layers can be quite complex and not easily apparent when studied in isolation.

The overall requirement is to produce/ formulate an easy-to-use software package with a GIS interface, which will allow any local or national administrative authority to identify and assess the strategies for sustainable development within the broad issues of urban development and associated management. The proposed study takes into consideration an area of 200 sq. km covering Gurgaon Town and its surroundings.

It would be possible to procure 1 metre resolution IKONOS satellite data, incorporating required attributes to prepare a comprehensive internet ready GIS in

about 5 months time. The GIS would make available land use approved by Gurgaon authority, land cover including soil condition, ground water prospects, population as per census of India and revenue information relating to plot number/ownership details etc.

The package includes required GIS software and training of core team in Gurgaon. The total cost for above is Rs. 6.70 million. (Equal 150,000 USD)

11.2.3 UP3: Test of planning methodology on North-Eastern urban fringe of Gurgaon

A pilot project will be prepared to demonstrate and test the new spatial, socio-economic and participatory planning methodology as suggested above. The areas of the North-Eastern boundaries of Gurgaon have been selected as the planning area.

The pilot project will be divided into two parts, the overall planning and management for the area (say 5 – 10 districts) and the detailed, local planning activities for a smaller part hereof as a stepping stone for the immediate implementation of the spatial, socio-economic and participatory proposals and recommendations.

The spatial planning exercises will include proposals and recommendations concerning:

- The future functions of the pilot planning area as integral part of Gurgaon City.
- The landscape in and around the planning area also defining the potentials for a green structure and for rainwater harvesting.
- The future townscape of the new city districts.
- The future urban structure, the urban fabric, the land and building uses.
- A green structure for parks (including the areas for rain water harvesting), greening of streets and squares, location of sports complex and play grounds etc.
- The urban services, schools and other cultural or social facilities.
- The urban infrastructures, the street network, water supply, sanitation and solid waste handling:

A special EIA analysis will be presented following the draft EIA analysis as carried out under UP1 above. The EIA will describe both the present and the future urban environmental profile of the development in the North-Eastern districts. Means to avoid or reduce environmental risks will be discussed.

An implementation programme will be prepared examining financial and human resources, legislation and administrative capacities to manage the development process. The organisation and tools of community participation will be proposed.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff	3	8370	25110
Local staff and experts/consultants	8	1350	10800
Total			35910

11.2.4 UP4: Local selected area for implementing demo project integrated planning/ building

The second part of the pilot project covers the preparation of a site plan for a smaller part of the pilot planning area described above in UP3.

The site plan will describe:

- The layout, the arrangement, the heights, the densities and uses of the future buildings in the area considering the landscape, the architecture and the climate for energy saving purposes.
- The layout and landscaping of streets, piazzas, walkways and outdoor spaces.
- Guidelines for energy saving design of the houses.
- Guidelines for water supply, sanitation and solid waste handling.

An implementation programme will be prepared as under UP3 part of the pilot project.

The output will be:

- The spatial, socio-economic and participatory planning and management methodology has been demonstrated, tested and possibly reviewed.
- An overall plan for the North-Eastern districts has been completed.

- A site plan has been prepared as a stepping stone for immediate implementation of the spatial, socio-economic and participatory proposals.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff	1	8370	8370
Local staff and experts/consultants	4	1350	5400
Total			13770

11.2.5 UP5: Urban renewal within Gurgaon Old Town slum area

Parts of the existing town plus the urban villages of Gurgaon and Jharsa will be analysed in detail to establish baseline information for planning and management of urban renewal following the same spatial, socio-economic methodology as introduced above. Such baseline information will include:

- A description of the said urban areas as part of Gurgaon City.
- Facts about the demography of the areas, the socio-economic relations, employment and income.
- The urban structures and landuses for housing, shops, workshops and other commercial activities, and urban services, physical and social.
- The road network, water supply systems, sanitation and solid waste handling.

Public participation is a must for a successful outcome of such a field survey. The output is: baseline information for the introduction of the spatial, socio-economic participatory planning and management concept in renewal of substantial parts of the city.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff	1	8370	8370
Local staff and experts/consultants and a number of architectural students.	3	1350	4050
Total			12420

Long-term activities

- To further implement GIS in the planning and management systems for relevant sectors.

- To review the Gurgaon Development Plan (Masterplan for Gurgaon Urban Area).
- To prepare other more detailed development plans as described under short-term activities UP3-UP4.
- To develop urban renewal plans for parts of Gurgaon Old Town and for the urban villages of Gurgaon and Jharsa.
- To prepare plans for other substantial parts of the city.

11.3 Waste Management Task Group

Aim within 2-5 years: Proper waste collection, transportation and disposal system covering basic services for total urban area.

In the Part II report, detailed suggestions as to storage, segregation, primary collection, street sweeping, litterbins, temporary storage depots, and transportation are given. We need to be aware of these ideas while planning the demonstration projects and other activities to be performed during the Green City Gurgaon project.

As to processing and disposal of the waste, it is important to start up the considerations of a new landfill strategy as suggested as a sub-component of the waste management strategy of the Green City Gurgaon project, the same is suggested for the feasibility study of treatment of biological waste.

The Part II of the report also includes description of Indian Case Studies, which are very interesting for European observers. It shows a potential in the Indian society to cope with the problems and come up with ideas and solutions for a proper waste management. It is important to look deeper into the findings of these Indian experiences to utilise the planning of the waste management component in the Gurgaon Green City concept.

11.3.1 WM1: Local area demo project for door-to-door waste collection, composting etc.

Demonstration projects will be ready for implementation in 4 different local areas (part of Old Town, HUDA sector 14, Gurgaon Village, Jharsa Village) to demonstrate 3-way segregation of waste into organic waste, recyclable waste and residual waste for landfilling by door-to-door collection, local composting plant and

local transfer station. Included in the activity is preparation of guidelines for proper establishing, operational procedures, and training of collection and operational staff.

The international expert/ consultant specialists will be involved to assist the local task group in designing the demonstration projects including assessment of site layouts, purchase or production of equipments and organising the activities including training activities. Training of trainers for the dissemination of the systems to cover the entire city will be part of the technical assistance.

Further the international expert/ consultant specialists will assist the task group in follow up and reporting the project findings.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff (Composting Specialist)	1.5	8370	12555
International expert/ consultant staff (Waste Collection/Training Specialist)	3	8370	25110
Local staff (Waste Collection/ Training Specialist)	6	1350	8100
Local staff (Composting Specialist)	3	1350	4050
Establishment of composting area including tools			20000
Land acquisition for composting and waste collection			20000
Site preparation for composting and waste collection			10000
Tools and equipment for segregation			20000
Total			119815

11.3.2 WM2: Implementing of authorised/ controlling waste transportation system

The transportation system from the local areas to the landfill site must be improved to secure that all waste to be landfilled will be transported to the municipal landfill and not just dumped illegally in the outskirts of or outside local area.

The means of this will be training and licensing of drivers as well as choice of the right equipment for collecting and transportation of the waste. The international expert/ consultant will advise the organisations responsible for waste transportation in outlining a transportation system covering the entire city. A test of the transportation system may be part of the above demonstration projects.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff (Waste Transportation /Training Specialist Waste)	1,5	8370	12555
Local staff (Waste Transportation /Training Specialist Waste)	3	1350	4050
Total			16605

11.3.3 WM3: Upgrading of landfilling and guidelines for new landfills

The immediate objective of this activity is to improve the existing landfill by upgrading the operational procedures, moving from open dumping to more controlled dumping and outlining procedures and measures to rehabilitate the environmental impact from the landfill, i.e. moving towards a so-called engineered landfill.

The development objective is to outline guidelines and standards to move even higher in the landfill hierarchy from engineered landfill to sanitary landfill. To meet this objective it is important to look into and discuss the landfill philosophy used today in Gurgaon and elsewhere in the region using the wastes to fill up low lying areas as site preparation for city development.

This means using areas close to inhabited areas for landfilling and that the filling height of the landfill being rather limited. The first issue results in risks of impacting the environment of adjacent residential areas, such as noise, dust, smell, vermin, pollution of drinking water sources, etc. The latter issue indicates that it is difficult to establish the landfill as a sanitary or even engineered landfill, as the establishment costs for such a landfill to a very high degree is dependent on the area occupied for landfilling. The bigger the filling height, i.e. the more waste per m² of the landfill the lower is the capital cost per ton of waste landfilled. The output of the activity will be:

- Improved operational procedures at the existing landfill.
- Outlined measures to take to reduce environmental impact from the existing landfill.
- Outlined strategy, guidelines and standards for the establishment of future landfills.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff (Landfill Specialist, Operations/ Design)	1.5	8370	12555
International expert/ consultant staff (Landfill Expert, Strategy/ Guidelines)	3	8370	25110
Local staff (Landfill Specialist, Operations/ Design)	3	1350	4050
Local staff (Landfill Expert, Strategy /Guidelines)	6	1350	8100
Total			49815

11.3.4 WM 4: Public/ private partnership for Waste Management in Gurgaon

This activity is aimed at clarifying legal barriers for an integrated waste management system covering the total urban area with special emphasis upon urban villages. Further standards/ regulations for the old town respectively new urban settlements will be outlined. The activity also includes the clarification of possible legal barriers for public-private partnerships in waste management.

Included in this task will be to look into the legal framework at central level regulating waste management activities including private participation in public services and suggesting areas where the legal framework needs to be complemented.

The output will be a report recommending areas of complementing legal framework and outlining the framework for local by-laws and regulations covering the different areas of the waste management system.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff (Municipal Legal, Administrative and Management Expert)	2	8370	16740
International expert/ consultant staff (Private Participation in Infrastructure Projects Specialist)	1	8370	8370
Local staff (Municipal Legal, Administrative and Management Expert)	4	1350	5400
Local staff (Private Participation in Infrastructure Projects Specialist)	2	1350	2700
Total			33210

11.3.5 WM5: Health Care Risk Waste

The objective of this activity is to outline and test a plan for phased establishment of an infectious waste segregation and collection system, including establishment of the basis for an environmental safe disposal method.

The activity will contain the following tasks:

- Outline procedures regarding waste handling, propose equipment and packaging materials to be used for the internal collection system at hospitals and clinics.
- Outline an external collection system including a special collection vehicle.
- Outline the concept for a fenced disposal site at the landfill site, using the trench method with daily coverage of the waste out of reach of scavengers.

As a demonstration project, it is further intended to:

- Establish and test the concept at selected departments at the hospital including external separate collection and intermediate disposal including training of operational staff.
- Outline a plan to extend the tested system to cover the entire hospital as well as other sources of health care risk waste in Gurgaon.

Finally it is the intention to evaluate the technical, environmental and economic consequences of introducing incineration as the treatment method. (Alternatively other treatment methods such as sterilisation, autoclaving, microwaving, and plasma arch incineration will be considered).

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff (Health Care Risk Waste Collection/ Training Specialist)	3	8370	25110
International expert/ consultant staff (Health Care Risk Waste Treatment Specialist)	1,5	8370	12555
Local staff (Health Care Risk Waste Collection/ Training Specialist)	6	1350	8100
Local staff (Health Care Risk Waste Treatment Specialist)	3	1350	4050
Total			49815

11.3.6 WM6: Biological treatment of organic waste in central treatment facility

Biological waste at the landfill is the source of production of methane gas, which is a very strong greenhouse gas. Further the organic waste is the source of producing leachate with a high BOD₅ content, which is a threat to drinking water sources.

To reduce the environmental impact from landfilled organic waste, a solution will be to introduce central biological treatment producing biogas and/ or compost. An option is to process the organic waste at the above local composting plants.

During this activity, feasibility analyses will be performed comparing central biogas processing with central composting as well as with the results of the local composting plants tested during the demonstration projects. The feasibility analyses will analyse the technical, environmental and economical consequences of the different treatment methods and recommend which solution to choose.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff (Biological Treatment Expert)	3	8370	25110
Local (Biological Treatment Expert)	6	1350	8100
Total			33210

11.4 Water Resources Task Group

Aim within 2-5 years: Well established water resource management system, water saving requirements integrated in building regulations and consumption pricing differentiated to benefit urban poor and to match the actual costs.

11.4.1 WR1: Regional catchment area water balance model – and monitoring system

Water quantity and quality is insufficient and new measures have to be taken to ensure that water is available in sufficient amount. Gurgaon cannot control the supply of surface water from outside the local catchment. Ground water is

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff	4	8370	33480
Local staff and experts/ consultants	8	1350	10800
Hardware/ software package			15000
Sampling, borings and analysis			30.000
Total			89,280

11.4.2 WR2: Public/ private partnership for water supply and wastewater management in Gurgaon

The public/ private corporation is suggested to be established covering the total urban area of Gurgaon as applied for within the new juridical borders of "Gurgaon Municipal Corporation".

Building of infrastructure must follow the expected high rate of development of human activity. Investments in water and wastewater facilities require that private capital is available since public funding is insufficient according to Sustainable Water Plan of India.

An improved service and maintenance will be more expensive and will exceed the existing rates for these services. Subsidised water supply must be limited to the poor people while more well off must pay for the cost of capital and service. The economic factor of water should be emphasised and water is suggested to be valued as the live giving element.

Private investors want to protect their investment in buildings and infrastructure, which can be done by a partnership in a public private corporation taking care of investment and operation. This new way of working together is suggested for initiation in the water sector where obvious common interests can facilitate the collaboration.

It is suggested that a Steering Committee will be assisted by international resource persons to build trust and results for this new way of working. Shareholders and stakeholders are suggested to be able to influence the public private corporation. Legal and institutional aspects are important since this initiative requires local prizing and local authority.

therefore a primary resource and drawback resource in case of problems with supply by canal.

Ground water is lost in the local catchment and measures to infiltrate rainwater must be implemented.

Natural infiltration is suggested to be a main recharging option together with recharge of storm water and rainwater from roofs of houses. National Indian expertise in rainwater harvesting and recharge is suggested to be a significant player in the water business together with international professionals.

A water model describing water situation in the catchment is suggested. It is a tool for evaluation of different scenarios.

Monitoring of quantity and quality of water in Gurgaon area is suggested to be included in a model for water availability in the larger region, which will guarantee that a regional approach is used and that agricultural irrigation is included

Water and wastewater monitoring will be made available to a more action-oriented management of the resources. Some bore holes may be closed due to low water quality.

Approach:

To ensure a full use of existing data and a realistic demand to a future monitoring programme, an identification on the weakest information will be carried out. This will further be used to make estimates on uncertainty in the conclusions and to make an optimal monitoring programme. "Mike Basin" model programme will be used as a tool for compilation of data and knowledge by:

- **Water availability analysis:** conjunctive surface and groundwater use, optimization thereof.
- **Infrastructure planning:** irrigation potential, reservoir performance, water supply capacity, wastewater treatment requirements.
- **Analysis of multisectoral demands:** domestic, industry, agriculture, hydropower, navigation, recreation, ecological, finding equitable trade-offs.
- **Ecosystem studies:** water quality, minimum discharge requirements, sustainable yield, effects of global change. Regulation: water rights, priorities, water quality compliance.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff	5	8370	41850
Local staff and experts/consultants	10	1350	13500
Total			55350

11.4.3 WR3: Revised Water Resource Management Plan for Gurgaon

The water and wastewater planning will be implemented together with new standards for payment of services, which take poor people into account. Payment is only partly subsidised for poor people. New regulation is necessary. Canal water from outside the region must be included in the planning. This includes the question of the guarantee for desired amount of surface water.

The wastewater quality is suggested to be high to ensure that all used water is treated and possibly recycled as irrigation water or secondary quality water for technical use. Storm water should also be of high quality since it then can be recharged to ground water.

The loss of water must be reduced concerning evaporation and leakage in the supply system. Food availability as well as social conscience and living conditions are issues that are suggested to be premises of the public/ private Corporation.

Rainwater infiltration in the region should be optimised. Rainwater from houses is one possibility but rehabilitation of old natural infiltration sites is a main issue. Storm water should be infiltrated also to maximise infiltration volume. Geology of the areas will be studied using data of existing borings. Satellite data from other studies may be available for identification.

The output is a map of suggested natural infiltration sites that can be used in choosing sites for implementing of 5-10 stormwater treatment and natural infiltration systems connected to buildings as well as to drainage system.

Wastewater reuse will be controlled to avoid spreading of diseases and to improve water availability for irrigation. Irrigation methods as well as leakage control of water supply pipes will be implemented. Activities, which affect the water quality, must be identified and controlled by the public private corporation.

Training of personal will be implemented, which will include the office and account system.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff	6	8370	50220
Local staff and experts/ consultants	12	1350	16200
Waste water reuse: Pumps and equipment			10000
Infiltration tests			2000
Implementation of an infiltration site			20000
Analysis			5000
Leakage tests			10000
Account system			10000
Total			123420

The output is an Indian Green City concept for water and wastewater management.

11.4.4 WR4: Urban slum area demo project for proper water supply, sanitation, waste cleaning etc.

To meet basic needs for water, proper sanitation, waste cleaning and health care in urban slum areas of Gurgaon, a demo project will be implemented also including urban poor in Gurgaon Village and Jharsa Village as well as informal settlements and floating population.

NGO's are in charge as being well experienced from implemented projects in other Indian cities.

Assumptions on budget

1. The renovation project comprises an older apartment house including 25 apartments.
2. The age and quality of the building makes it worth renovating.
3. Local labour as well as local materials will be used.
4. Technical consultancy from international specialists will include draft conception and project supervising.

5. The prices stated below include expenses for salaries and materials.

Estimated budget on renovation of an urban house in the Old Town, 25 apartments:	MM	Costs	Total in USD
International expert/ consultant staff	2	8370	16740
Local staff and experts/consultants	12	1350	16200
Draft conception			40000
Project supervising			15000
Construction, exterior			125000
Construction, indoor			140000
Electricity			60000
Heat			75000
Ventilation			40000
Water			65000
Drainage			30000
Outdoor areas			20000
Total			642940

Long-term activities

- Further implementation of water and wastewater facilities.
- The next phase is the fully implemented Green City strategy on water and wastewater. Estimation of resources required will have to be evaluated after implementation of subsequent included short-term actions.

11.5 Energy Efficiency and Low-Energy Building Task Group

Aim within 2-5 years: Having implemented demonstration projects for house-building with achieved considerable savings of energy and water in the households and having approved adherent building regulation to ensure systematically improved standards.

Frequent daily power cuts in Gurgaon is a serious threat to stabilise economic development and attraction value for next coming years. Energy demand is monthly raised by some 15-20 %, but the supply side can only expand some 5-7 %.

Compared to Western European standard energy efficiency within production, transmission and distribution of energy as well as even more within consumption is rather low. Transmission/ distribution loss is on the level of 20-25 %, where maybe 12-15 % is caused by illegal power thefts from the wires.

Haryana State produces 60% of own energy consumption, mainly from hydroelectric power and then also from thermal power. NCR is planning for more gasfired power stations.

Bridging the growing gap between demand and supply is as seen from a European viewpoint, a matter of combining improved efficiency in energy production, storage, transmission/ distribution and consumption with strong initiatives on energy savings, renewable energy sources and legislative work setting energy consumption standards for buildings, industrial production, traffic etc.

11.5.1 LE1: Energy efficiency audit within energy production, distribution and consumption sectors

Based on Western European energy efficiency standards an energy efficiency audit will be carried out comprising representative parts of Gurgaon energy supply production, storage, transmission and distribution systems including maintenance principles and financing/ administration.

Output will be the setting up of an action plan for improving energy efficiency from supply side including introduction of new supply principles as may be combined cooling/ power production, district cooling systems and renewable energy sources.

At consumption level an adherent energy efficiency audit will be carried out comprising of selected representatives from industrial sectors, commercial sectors, public institutions and residential areas.

Output will frame the basis for energy saving initiatives, consumer pricing/ administration initiatives etc.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff	2	8370	16740
Local staff and experts/ consultants	5	1350	6750
Total			23490

11.5.2 LE2: Energy saving initiatives and renewable energy sources to be introduced

Exchanging experiences on energy savings, low-energy building principles including energy supply partly based on renewables, for example roof integrated solar plants to produce hot water supply, energy audit principles and advantages etc.

Energy saving initiatives will be implemented or proposed to be implemented for the selected representatives from consumers of industrial sectors, commercial sectors, public institutions and residential areas participating during above described workpackage LE1.

Initiatives for promoting renewable energy sources for Gurgaon region will be formulated.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff	1,5	8370	12555
Local staff and experts/consultants	3	1350	4050
Total			16605

11.5.3 LE3: Demo project to be implemented on low-energy buildings in a public/ private partnership

Clarifying legal barriers for public/ private partnerships on building projects including all supply facilities for waste management, water supply, drainage & sanitation, energy supply etc. covering building projects in the total urban area, especially regarding urban villages and standards/ regulations for old town respective of new urban settlements.

Selection of an urban area for a demo project of low-energy buildings with a public/ private partnership (see urban planning task group)

Demo project area proposal including low-energy building standards, renewable energy by solar etc. integrated, proper waste collection system, greenings, water harvesting etc.

As a specific part, work out a draft proposal for demonstration project on roof integrated solar system for hot water supply covering a number of private

developer buildings as well as a number of public institutions and amongst others involving MNES programmes.

Assumptions on budget:

1. The demo project comprises a public/ private development including 50 apartments.
2. The price level is Western European/ Danish in case local delivery is questionable.
3. The estimate includes technology costs, but only the additional costs compared to a "standard construction" – and neither construction nor operational costs.

Estimated budget on environmentally friendly technology costs:	MM	Costs	Total in USD
International expert/ consultant staff	6	8370	50220
Local staff and experts/ consultants	12	1350	16200
Materials			
Constructions made of wood, tile, concrete and steel			0
PVC - and lead-free materials			0
Insulants of paper, perlite, flax and wool			0
Electricity			
Utilization of low-energy illuminants			6000
Living rooms facing southeast/ southwest			0
Establishment of a communal laundry			20000
Individual measurement of electric consumption			9000
Solar cell plant on the house end/roof			55000
Heat			
Heavy frontings for heat accumulation			0
Solar shield			0
Low-energy windows			15000
Solar collector for production of hot-water			45000
Individual measurement of heat consumption			8000
Ventilation			
Suction device from kitchen and bathroom			60000
Natural ventilation			20000

Water			
Water-saving mixing fittings	~ 0	~ 25,000	0
Water-saving lavatories			0
Collection of rainwater for toilet flush			25000
Individual measurement of consumption			8000
Outdoor areas			
Plantation of frontings and roofs			5000
Composting plant			5000
Render visible the rainwater			6000
Percolation of rainwater			7000
Environmental station for waste separation			9000
Total			369420

11.5.4 LE4: Revised low-energy building standards and building sector strategies for Gurgaon

Clarify the use of improved energy & environmental building construction standards, which has already been made mandatory in other Indian cities.

Clarify additional Danish/ European implemented improved standards.

Clarify existing building construction standards in Gurgaon.

Outlining suggestions for revision of building regulatives based on international and national experts' input and focusing on integration of old town, HUDA developments, private developments, industrial estates, urban villages and the informal squatting.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff	1,5	8370	12555
Local staff and experts/ consultants	3	1350	4050
Total			16605

11.6 Peoples Participation & Information Task Group

Aim within 2-5 years: A showcase for Peoples Participation and Awareness Campaigns concerning urban sustainability matters and well established hearing procedures etc. for involving the general public in urban environmental projects.

In Europe and Denmark the degree of success in a project like this one is directly proportional to the involvement of the local population.

It is our impression that in India it is even more important to ensure the peoples participation than elsewhere, because India apparently has a high degree of self-organisation and enterprising that is being displayed daily.

The background for this enthusiasm seems to be that the Indian community is based upon the initiative of the individual.

By involving the population, which will only require the joining with the relevant RWA's, ward representatives and NGO's in a sort of participatory organisation for the different elements of the project, a local anchoring process is ensured at the same time.

It is very important not to make the proportions boundless for the people involved, as focus is easily lost in relation to the daily life. These are experiences that we in Europe as well must remember if we want to have success in similar projects.

11.6.1 PP1: Study tour to Denmark for key persons of Steering Committee and 5 Task Groups

For Green City inspiration and for studying public/ private partnerships as well as getting started the working process of project implementation key persons from Steering Committee and the 5 Task Groups are suggested to participate in a study tour to Denmark.

Green City infrastructures for urban sustainability will be shown to illustrate main components regarding urban planning, waste management, water supply, waste water treatment, energy supply, low-energy building projects and renewable energy sources.

Legislative, administrative and financing framework will be given and special focus will be on the functioning of public/ private partnerships for waste management, energy supply, water supply and wastewater treatment.

Workshop will be carried out to introduce and achieve consensus for project implementation method, necessary training/ educational activities along with project implementation and a more detailed planning of specific tasks within each workpackage and each Task Group.

Estimated budget: (for 20 persons in 1½ week)	MM	Costs	Total in USD
International expert/ consultant staff	3	8370	25110
Local staff and experts/consultants	8	1350	10800
Travel – local bustransport (daily 475 USD)			5700
Travel Air ticket (each 1050 USD)			21000
Daily fees (each 31 USD)			7410
Accommodation costs (each 85 USD)			20400
Miscellaneous			650
Total			91070

11.6.2 PP2: Training – exchange programmes for public sector/ private sector key persons

Training sessions in Danish municipalities/ private companies and in Gurgaon.

For each Task Group an exchange programme is suggested to be defined and carried out by 2-3 key persons from each Task Group in co-operation with international expert/ consultant and Danish public/ private colleagues within urban planning, waste management, water supply, waste water treatment, energy supply etc.

Education, training and capacity building will arise during a 12 week training programme in Denmark followed by visits from Danish colleagues in Gurgaon during a 4 week local exchange/ training period.

Estimated budget: (for 12 persons 12 weeks in DK, and 6 persons in India each a week)	MM	Costs	Total in USD
International expert/ consultant staff	20	8370	167400
Travel air ticket to India (each 1050 USD)			6300
Subsidence in India (each 215 USD)			3360
Daily fees in India (each 31 USD)			9030
Local staff and experts/consultants	48	1350	64800
Travel – local bustransport in DK (daily 475 USD for 6 weeks)			16500
Travel Air ticket to DK (each 1050 USD)			12600
Daily fees in DK (each 31 USD)			31248
Accommodation costs in DK (each 85 USD)			85680
Miscellaneous			2000
Total			398918

11.6.3 PP3: Awareness campaigns to facilitate Gurgaon Green City project implementation

The starting point for preparing a preliminary information material concerning environmental awareness in general must naturally be the existing experiences from previous similar projects carried out in India or best of all in the Delhi region.

In light of the mentioned registration in the following task PP5 it will be possible to point out specific groups of people to give more goal oriented information, for instance school children, poor people in different types of areas and the groups of people that already work with different aspects of the environmental subjects. These groups should be given the highest priority considering their role as intermediaries and considering their number.

It should also in this connection be considered whether written material considering the widespread use of commercials in India is the right way to inform or maybe instead the spoken word seems to be the optimum way for some target groups. This is mostly concerning the less educated part of the population.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff	2	8370	16740
Local staff and experts/consultants incl. NGO's	10	1350	13500
Production and distribution of campaign material, workshops			30000
Total			60240

11.6.4 PP4: Targeted awareness actions for implementing the specific demo projects

The local information and communication about the Green City project implementation should address all the involved stakeholders besides the primary groups.

In light of experiences from similar projects in India the preparation of proper campaigns about the selected demonstration projects should be described. Hereby the first exercise will be the campaign to back up the project about waste handling in HUDA sector 14, Old Town, Gurgaon and Jharsa villages.

Schools are very good starting point for promoting Gurgaon Green City initiatives as an addition to the environmental education. It is evident to give this possibility to all schools in Gurgaon as a standard material.

Further establishing of user-groups among the inhabitants is known to be a very efficient way to involve people in Denmark. But there might be difficulties to consider because of differences in the political or religious etc. background among the Gurgaon population.

Involved Indian specialists in the Task Group will ensure proper approach to facilitate implementation of demonstration projects as future showcases of local environmental initiatives in Gurgaon.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff	1	8370	8370
Local staff and experts/consultants incl. NGO's	6	1350	8100
Production and distribution of campaign material, workshops			15000
Total			31470

11.6.5 PP5: Socio-economic study and implementing of database

It would be evident to compile a proper database with information to use both for preparing the information and communication material to be used in relation to implement Gurgaon Green City project. Besides the database could be used in relation to a later possibility for collection of fee for the use of water and energy as well as the opposite by public payment for welfare or likewise.

This database should be established stepwise by taking its starting point in the different types of urban areas/ populations in Gurgaon. The registration could be done in collaboration with the local architecture school or other local people. It would also be evident to make the registration as a part of the registration done on GIS (see work task UP2).

The registration could besides have great value for both social and cultural purposes. The involvement of both RWA's and NGO's are essential for the success of the registration.

The planning of the registration itself will be very complicated and especially if the purpose of the database should be other issues then only this project of updating and maintenance of the information's must be considered very carefully. Besides access and the group of users should be considered very well before taking off.

Estimated budget:	MM	Costs	Total in USD
International expert/ consultant staff	1	8370	8370
Local staff and experts/consultants and students' assistance	6	1350	8100
Total			16470

11.7 Total budget for activities suggested in Gurgaon Green City Action Plan

The total estimated budget for activities suggested in the action plan (excluding technology costs and construction costs for "standard construction" for demo LE3) is as follows:

Estimated budget (operational costs not included):	Total in USD
Workpackage on Urban Planning (including Demo UP4)	236940
Workpackage on Waste Management (including demo WM1)	302470
Workpackage on Water Resources (including demo WR4 urban slum renewal)	910990
Workpackage on Energy Efficiency and Low-Energy Building (including demo LE3)	426120
Workpackage on Peoples Participation & Information (including all training)	598168
Total estimated budget	2,474,688

11.8 Organising of Gurgaon Green City project implementation

During the feasibility study 5 Task Groups were established in August 2000 covering the main focus areas of Urban Planning, Waste Management, Water Resources, Energy Efficiency & Low-Energy Building and People's Participation & Information Strategy.

After task group meetings in November 2000 private developers and national experts were involved in discussing possible establishment of public/private partnerships for implementing Gurgaon Green City.

A very positive interest from both public authorities and private developers was expressed and the ideas of a "Special Purpose Vehicle" were outlined comprising partnerships between HUDA and private developers.

As a starting point it is recommended to establish such public/private partnership for a Steering Committee to be responsible for the 5 task groups hereby implementing the proposed short-term action plan for Gurgaon Green City.

This could later on develop into a new institutional framework for City Management – maybe starting on public/private partnership companies for:

- Low-energy urban housing including infrastructure services
- Waste management services
- Water supply & waste water treatment services
- Public transport

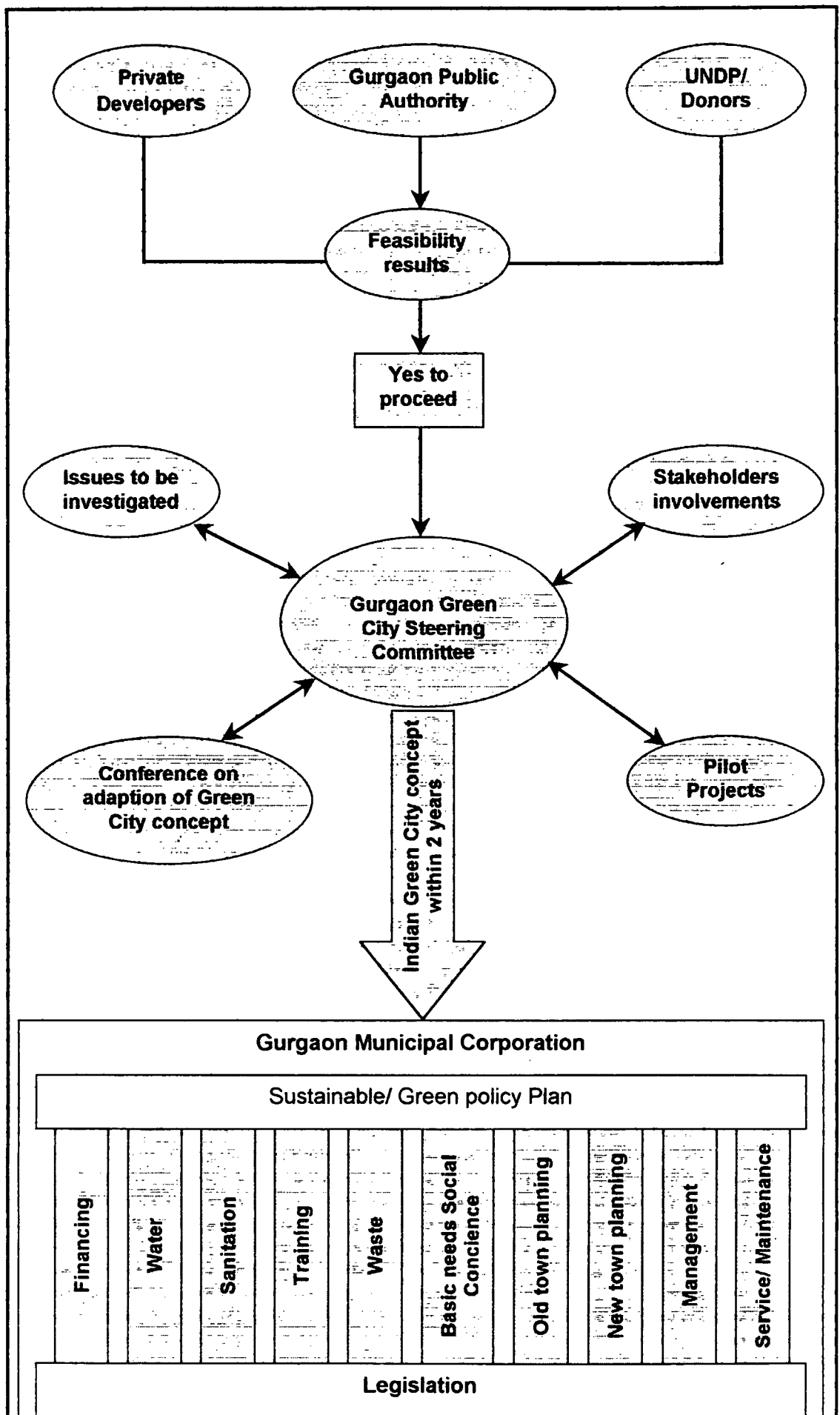
On next page an illustration is set up for linking the processes of project implementation.

11.9 Time schedule for Gurgaon Green City project implementation

The short-term activities described in this report are estimated for implementation during a period of 2-5 years depending on local Gurgaon stakeholder economic contributions and donor possibilities.

As shown on the illustration next page project partners can anyhow decide to start up establishing Steering Committee once feasibility study results and recommendations are approved.

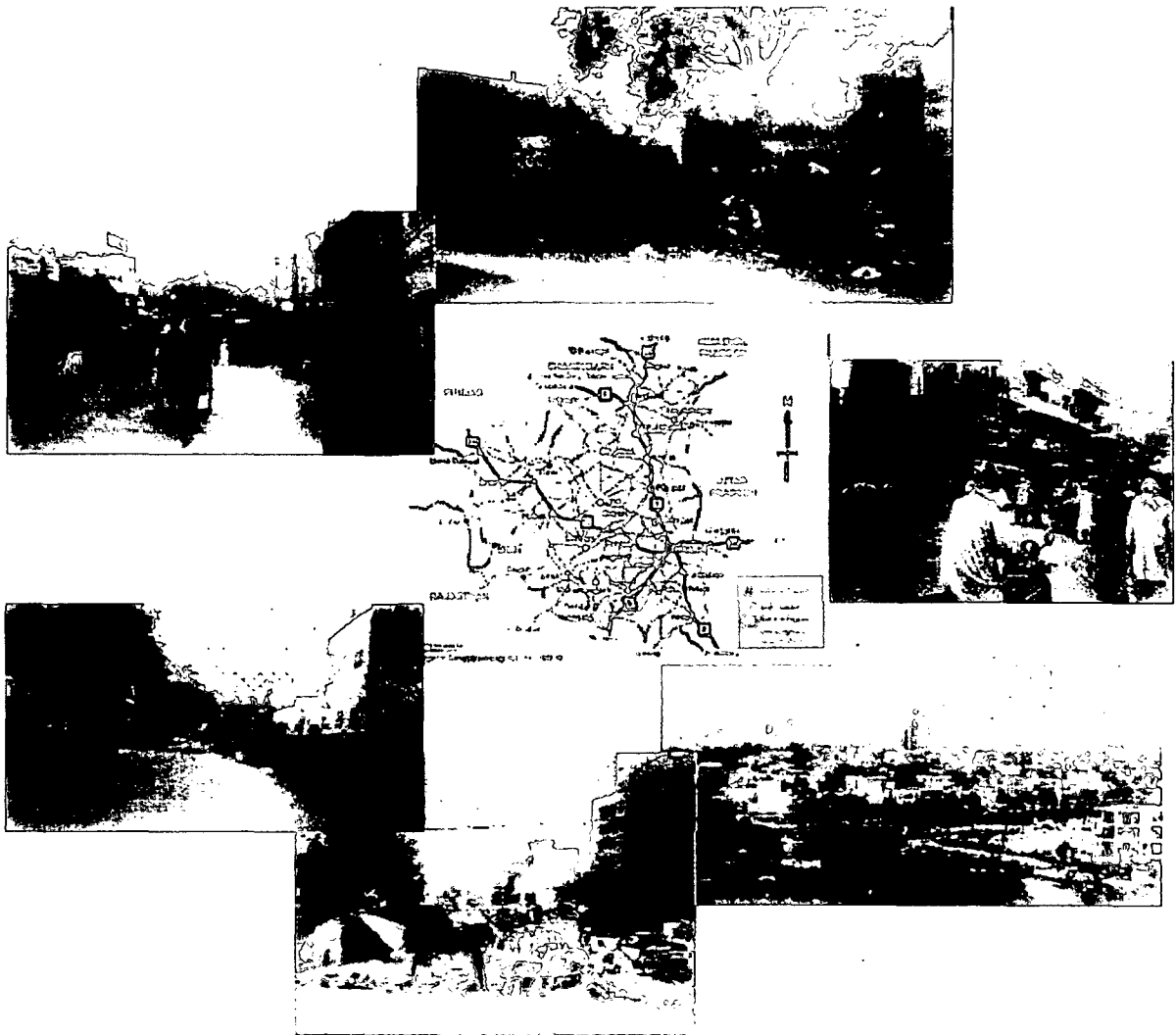
Then recommended workpackages can be prepared along with carrying out donor meetings, donor applications as well as meeting Haryana State and National Indian Governmental departments for clarifying financial contribution programmes.



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**Feasibility study
for
implementation of "Green City" concept
in Gurgaon City, Harayana State, India**

Part III



This feasibility study is co-financed by UNDP - and undertaken by UNIDO with technical assistance from Green City Denmark A/S in co-operation with Green City India Pvt. Ltd. including appointed national and international experts

May 2001

Preface

City dwellers face a wide range of environmental challenges: dirty air and water, dwindling open space, garbage, soot-spewing buses, traffic and the impacts of industry. No matter where they are, cities are the centers of art, culture, business, and government. Their vibrant energy makes them the pulse points of a nation. At the same time, cities are increasingly a nexus for environmental challenges.

The best ways to make cities work better for everybody, is likely to be a matter of major concern in the next century as problems in the cities grow exponentially. A major part of these problems will be environmental: designing effective land use; meeting the challenge of effective and environmentally friendly transportation; preserving open space; providing healthy air and water.

Looking at the present condition and due concern for the future of the Indian Cities, United Nations Development Programme (UNDP) funded the Feasibility Study to Implement "Green City" concept in Gurgaon. Gurgaon is an upcoming modern township near New Delhi located in the state of Haryana, India.

United Nations Industrial Development Organization (UNIDO), Austria, the implementing agency subcontracted the job of Feasibility Study to Green City Denmark A/S (GCD) based in Herning, Denmark. GCD has developed the "Green City" concept on the basis of "Agenda 21".

The Green City project team comprised of official from UNIDO Austria/ New Delhi, GCD along with five international experts and Green City India Pvt. Ltd. (GCI), the joint venture partner of GCD along with nine national experts.

The "Green City" vision incorporates the goal of a sustainable (enduring, adapting and improving), Dynamic (vibrant, progressive and participative) city.

It is also about changing people's thinking on issues, and looking for values that are compatible with sustainability. "Green City" concept encourages a cautious and long-term view on future development and present activity, and encourages community-led initiatives in the areas of economic and social

development, environmental protection, and community involvement in decision-making.

The feasibility study will provide support to the Indian authorities in planning to transform the city of Gurgaon in Haryana State into a modern Green City, to serve as a model for other parts of India. The model Green City will be an important contribution towards implementation of Agenda 21.

The Green City Team is thankful to UNDP for taking the initiative to fund the Feasibility Study and is highly indebted and thankful to the State Administration of Haryana, Local Administration of Gurgaon, Central Government Ministries like Ministry of Urban Development, Ministry of Environment and Forests, Ministry of Non-Conventional Energy Sources, Office of the Commissioner & Deputy Commissioner, Gurgaon, Haryana Urban Development Authority, Municipal Council of Gurgaon and various other stakeholders & Task Group members for their kind interest, encouragement, valuable observations & suggestions and inspiring deliberations in the course of the study.

Our acknowledgement would be incomplete without mentioning the efforts of all the National and International experts involved with this study.

May 2001

Green City Team

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Chapter 1

Introduction

On the recommendation from Government of India, Haryana State and Gurgaon Local Government - UNDP has given financial support to work out a feasibility study focusing on how to implement the "Green City" concept of urban sustainability into Gurgaon City.

The objective is to make Gurgaon a model Green City to act as a showcase for sustainable urban development for other Indian cities - including primarily the region around New Delhi, which comprises of some 22 "satellite" cities. All of them like Gurgaon are challenged by a very fast growth rate.

The purpose of the project is to support the Indian authorities in planning to transform the City of Gurgaon in Haryana State into a modern Green City, as a model for other parts of India.

The model Green City will be an important contribution towards implementation of Agenda 21.

This feasibility study report presents prioritisation of different measures necessary for transformation of Gurgaon into a Green City. Special attention has been drawn to income and employment generation through ecologically sustainable industrial expansion and to key issues related to clean and efficient energy and management of environmental problems.

The main areas of concern have been chosen after giving special attention to ecologically sustainable urban expansion and to key issues related to clean and efficient energy and management of environmental problems.

The results of the feasibility study will be disseminated in India and other developing countries in order to indicate how the Green City concept may be adapted to developing country conditions.

UNDP has appointed UNIDO as the implementing agency for this study with technical assistance from Green City Denmark A/S in co-operation with Green City India Pvt. Ltd.

1.1 "Agenda 21" - Rio De Janeiro Conference

In 1987, the Brundtland Commission produced a report entitled "Our Common Future". Five years later, in 1992, the United Nations Conference on Environment and Development (UNCED) brought 179 heads of governments together in Rio de Janeiro.

This conference focused world attention on critical issues of sustainability and natural resources, and mapped out a plan of action for future global partnership to achieve concrete goals.

"Agenda 21" was one of following five documents, which was the outcome of this conference:

- The Rio Declaration on Environment and Development
- A statement of principles to guide sustainable management of forests
- United Nations Framework Convention on Climate Change
- The Convention on Biological Diversity
- Agenda 21

Agenda 21 is the plan to implement the agreements of Rio conference.

It guides business and government policies into the 21st century. It identifies population, consumption and technology as the primary driving forces of environmental change and proposes what needs to be done to reduce wasteful and inefficient consumption patterns in some parts of the world while carefully managing natural resources.

All the world leaders attending the conference signed the declaration undertaking to achieve worldwide sustainable development. This is the declaration underlying Agenda 21: the action programme for the coming century.

Agenda 21 explains that population, consumption and technology are the primary driving forces of environmental change.

It lays out what needs to be done to reduce wasteful and inefficient consumption patterns in some parts of the world while encouraging increased but sustainable development in others.

It offers policies and programmes to achieve a sustainable balance between consumption, population and the Earth's life-supporting capacity. It describes some of technologies and techniques that need to be developed to provide for human needs while carefully managing natural resources.

Agenda 21 provides options for combating degradation of the land, air and water, conserving forests and the diversity of species of life. It deals with poverty and excessive consumption, health and education, cities and farmers.

There are roles for everyone: governments, business people, trade unions, scientists, teachers, indigenous people, women, youth and children. Agenda 21 does not shun business. ***It says that sustainable development is the way to reverse both poverty and environmental destruction.***

Accounting systems that measure the wealth of nations also need to count the full value of natural resources and the full cost of environmental degradation. The polluter should, in principle, bear the costs of pollution.

To reduce the risk of causing damage, environmental assessment should be carried out before starting projects that carry the risk of adverse impacts. Governments should reduce or eliminate subsidies that are not consistent with sustainable development.

A major theme of Agenda 21 is the need to eradicate poverty by giving poor people more access to the resources they need to live sustainably.

The developed nations also promised more funding to help other nations develop in ways that have lower environmental impacts. Beyond funding, nations need help in building the expertise - the capacity - to plan and carry out sustainable development decisions. This will require the transfer of information and skills.

Agenda 21 calls on governments to adopt national strategies for sustainable development. These should be developed with wide participation, including non-government organizations and the public.

Agenda 21 puts most of the responsibility for leading change on national governments, but says they need to work in a broad series of partnerships with international organizations, business, regional, state, provincial and local governments, non-governmental and citizens' groups.

As Agenda 21 says, only a global partnership will ensure that all nations will have a safer and more prosperous future.

Agenda 21 is the United Nations General Assembly's call for halting and reversing the effects of environmental degradation.

As one of the signatories of the resolutions regarding Agenda 21, India is committed to the implementation of Agenda 21.

1.2 Sustainable Urban Development

The concept of sustainable development has deep roots in the early 20th century theory of renewable resources management. Later advanced as a more fully integrated approach to conservation and development in the World Conservation Strategy (IUCN 1980), sustainable development has only recently been popularized by our Common Future, the 1987 report of the World Commission on Environment and Development (The Brundtland Commission).

The Brundtland Commission defined sustainable development as "development that meets the needs of the present with out compromising the ability of the future generations to meet their own needs (WCED 1987: 43).

The nature cannot indefinitely sustain accelerating human demands. The relationship between human activity and the Earth's resource base has reached a turning point. It has been increasingly recognized that environmental issues are an integral part of economic development that poverty is both a cause and effect of global environmental problems and that development is much more than economic growth.

Cities play a vital role in development and have become centers for social and economic progress. They absorb the growing populations of the cities, as well as the population that migrates to the cities. Hence, they have been centers of productivity and social advancement, although such activity has created other economic, social, environmental and even social equity problems.

The inefficiencies in the use of local resources lead to environmental degradation. They become a threat to the full realization of the socio-economic contribution which cities can make and threatens sustainable development.

The strategy for achieving sustainable development in the urban context should include important considerations pertaining to major issues like:

- Conservation of Resources
- Pollution Control
- Development of Indigenous Resources
- Ecofriendly Products
- Appropriate Technology
- Scientific research
- Socio-economic Gains
- Resource Mobilization
- Urban-rural Balanced Development
- Self-reliance
- Interdependence

Cities are a testimonial to human civilization and a well spring of opportunities. The city is also the place where compelling social issues such as poverty, homelessness, crime and unemployment takes on a dimension far bigger and more complex than ever seen before.

City is a place where most of the world's population lives and works; where most of the economic activity takes place; where the most population is generated; and where the most natural resources are consumed.

Sustainable development is thus the most pressing challenge facing humanity in the twenty-first century.

1.3 UNDP Habitat - UN Conference on Habitat

The Second UN Conference on Human Settlements Habitat II -The City Summit, held in Istanbul in 1996, was of the last in a cycle of major UN conferences that have shaped the global development agenda for the years to come.

The focus brought together the issues dealt with at earlier conferences as they relate to the pressing problem of the rapid urbanization of today's world. Those attending the conference included representatives from 171 governments and an unprecedented 8,000 people from 2,400 non-governmental organizations (who were allowed access, for the first time; to participate in deliberations as full partners).

They all focused their discussions on the principle themes of sustainable human settlement development in the urbanizing world with the provision of adequate shelter for all.

As a result, the Conference adopted The Habitat Agenda, *a plan that provides an effective tool for creating sustainable human settlements for the next generation with regard to broad-based sustainable development (i.e. the environment, human rights, social development, women, population, etc.) in the specific context of urbanization.*

The First UN Conference on Human Settlement in Vancouver '76, had sought to develop strategies to suppress the negative effects of rapid urbanization; while twenty years later half of the world's population resides in cities, with the majority living in poverty.

The UN Centre for Human Settlements (Habitat) was established in Nairobi in 1978 and serves as the nexus for human settlement development within the UN system and also as the Secretariat of both the Commissions on Human Settlements and Habitat II.

In 1988, the General Assembly adopted the Global Strategy for Shelter to the Year 2000, emphasizing an enabling approach where governments do not provide shelter itself, but a coordinating legal institution and regulatory environment to motivate people to provide and improve upon their own living conditions.

The Habitat II Conference would review and evaluate this Strategy and UN Centre being prompted by the Rio Summit in 1992 where it was made clear that 600 million people live in threatened housing conditions throughout the world.

During the conference the participants agreed to address many important issues concerning human settlements including: unsustainable consumption and production patterns, unsustainable population changes, homelessness, unemployment, lack of basic infrastructure and services, growing insecurity and violence, and increased vulnerability to disasters.

After discussion of the issues the Habitat Agenda was formulated as an acting guide towards achieving broad-based sustainable development of the world's cities, towns, and villages into the first two decades of the next century. Included within the Agenda are a statement of goals, commitments, and strategies for implementation.

The goals within the Agenda include poverty eradication, strengthening of family, partnership among countries, increased financial resources, etc. The commitments cover adequate shelter for all, sustainable settlements, gender equality, financing of settlements, international co-operation, and the assessment of progress.

The strategies emphasize that individuals, families, and communities must be enabled to improve their housing, and the government should promote better housing by prohibiting discrimination and ensuring legal security.

Habitat II offered a positive vision of sustainable human settlements where all have shelter, a healthy and safe environment in which to live with basic services provided.

1.4 "Green City" Concept

A Green City may be conceived of in many different ways depending on the requirements of the urban population and environment.

In general, it may be defined as a city where environmentally sustainable solutions have been found for all aspects of human activity, economic development and environmental management in the urban area. The aim is to achieve lasting harmony between man and nature and to protect the interests of future generations.

Green City Denmark is the pioneer of the concept of "Green City" or a Eco-friendly city and has developed environmentally sustainable solutions with respect to:

- Water supply and waste water treatment.
- Energy supply, energy savings and renewable energy development.
- Waste management, soil pollution and air pollution.
- Cleaner industrial technologies and environmental management.
- Agriculture and food industries.
- Building construction and urban ecology management.
- Urban traffic and transportation.

Adoption of "Green City" concept leads to many benefits and a few of the social and economic benefits are mentioned in **Table 1.1**.

The European Commission has launched a project under its Thermie Programme to support the European Green Cities project. This project involves 11 low-energy demonstration projects in 9 European Union countries (Austria, Belgium, Denmark, Finland, France, Greece, Italy, Spain and the United Kingdom). The main purpose is to initiate low energy and environmentally sound house building in the 11 cities. So far the project has covered a total of 645 dwellings.

There is now worldwide interest in the Green City concept. Municipal authorities in many developed and developing countries have initiated programmes to incorporate various aspects of the Green City model in their own urban planning.

Examples of this development can be found in countries such as: Bulgaria, China, Greece, Ireland, Malaysia, Russia, Spain and United Kingdom.

Parallel to this development is the European Commission's "Energie - Cités" Programme for urban energy planning covering such action areas as, the use of renewable resources, industrial scale combined heat and power generation, urban waste management, rational use of water, low energy consumption and waste water treatment.

Accordingly, applying the Green City concept to Gurgaon City in Haryana State will act as a model for other cities in India and India's response to the Agenda 21 implementation besides the various other projects and activities being taken by

the Central Government and respective state Governments on sustainable development.

Being a fast growing industrial township, Gurgaon offers a good mix of industrial and residential areas where the novel Green City concept can be successfully implemented in an integrated way.

1.5 Participating Agencies

This feasibility study has been funded by UNDP, who appointed UNIDO as the implementing agency for this study in technical assistance from Green City Denmark A/S and in co-operation with Green City India Pvt. Ltd.

As such an endeavour relating to Agenda 21 and Sustainable development calls for active participation and involvement of all, this study has been carried out with full support and co-operation extended by the Local Administration of Gurgaon, State Government of Haryana, involvement of the Resident Welfare Associations and various Non-Governmental Organisations working in Gurgaon.

Also a number of National and International experts specialising in Waste Management, Water Resource Management, Urban Planning, Energy Conservation and People's Participation have been associated with the project.

Details list of the National and International Experts associated with the project is given in Annexure 'A'.

In order to have grass root level action, Task Groups have been formed in the five core areas of Urban Planning, Waste Management, Water Resource Management, Energy Conservation and People's Participation. Each task group involves active participation of Deputy Commissioner – Gurgaon, Administrator – HUDA, other State/ Local Administrative Officers, National and International Experts and the Green City team. The list of the task group members associated with the project is given in Annexure 'B'.

1.6 Green City Denmark A/S

Green City Denmark was established in 1994 as a worldwide showcase of environmentally sound solutions within water supply, waste management, energy supply, traffic, building sector, industrial production and urban development etc.

Denmark has been at the environmental forefront since implementing the Environmental Protection Act in 1974 through a close public/private co-operation that has been continued and strengthened ever since.

The aim of Green City Denmark is to provide environmental inspiration and facilitate international co-operations to benefit environmentally sustainable development.

1.7 Green City India Pvt. Ltd.

Green City India Pvt. Ltd. (GCI) was formed in April 1998 as a joint venture between AG Consulting, an organization promoted by the present Managing Director of Green City India Pvt. Ltd. and Green City Denmark A/S, Denmark in 1998.

The basic aim of this Joint Venture is to facilitate and share the expertise gained in Denmark and other parts of the globe in the areas related to Environment and Energy with special focus on Green City Concept.

GCI also provides consultancy services of the transfer of environmentally safe, ecologically sound, globally proven technologies to India and to identify and facilitate environment related business activities.

GCI aims to provide the basic link for promoting business in environmental areas between the best technology/ equipment/ services providers overseas and public / private sectors in India.

1.8 Criteria for Selection of Gurgaon

The selection process for the relevant city for adoption of "Green City" Concept was based on the following aspects:-

1. A fast developing small to medium size upcoming township.
2. Strategic Location and close proximity to a main metropolitan city.
3. An ideal mix of residential, business and industrial activity.
4. A proactive local administration.
5. Political stability.
6. A mix of old and new urban areas.
7. Possibility to transform into a model visible showcase.

1.9 Development of Gurgaon - Green City Concept

A basic study which started with the initiative of AG Consulting in cooperation with Green City Denmark A/S in early 1997 for the selection of a city/ township for applying the Green City concept brought forward Gurgaon – a City in Haryana State to act as a model for other cities in India.

Being a fast growing industrial township, Gurgaon offers a good mix of industrial and residential areas where the novel Green City concept can be successfully implemented.

Gurgaon's important position on the industrial map of India and its close proximity to Delhi will make it an ideal showcase for the Haryana State as well as the whole of India.

Also the support, encouragement and acceptability of the Local State Government of Haryana to the very concept helped in deciding on adopting Gurgaon for implementation of the Green City Concept.

The development process started based on inspiration from Denmark and introduction of the concept to the Central/ State/ Local Government Authorities, where a number of presentations were made to various officials in Delhi, Gurgaon and Chandigarh during 1997 & 1998.

Presentations were preceded by a visit to Denmark, of the Central Government delegation headed by the Secretary, Ministry of Urban Development, to have a first hand view and experience of the Green City Concept in August/September 1997.

In October 1998, a Seminar on "Implementation of Agenda 21" was held in Gurgaon, Haryana. The seminar was organized by Green City Denmark A/S and Green City India Pvt. Ltd. in association with RIET Singapore and was attended by officials from Haryana State Government and Local Administration, and representatives of industry.

The objective of the Seminar was to create and strengthen environmental awareness and introduce discussion on key parameters and areas of concern for achieving sustainable development.

As an important component the Green City concept was introduced for discussion as a possible gateway to visible Agenda 21 actions in Indian cities.

The project was then presented to UNDP to seek financial support for the same.

In March 1999, UNDP hosted a follow-up meeting with the participation of UNIDO, Green City Denmark, Green City India and representatives from Haryana State and Gurgaon City.

This meeting focussed on the value and applicability of the introduction of the Green City concept to India in general and to Gurgaon City in particular. During this meeting agreement was reached on the development and implementation of this project.

The project finally took off in February 2000 with the funding possibility of UNDP for this Feasibility study and constitution of the team.

1.10 Scope and Objectives of Study

The overall objective of this study is to provide support to the Indian authorities in planning to transform the city of Gurgaon in Haryana State into a modern Green City, to serve as a model for other parts of India. The model Green City will be an important contribution towards implementation of Agenda 21.

Objective 1

To interact with and obtain advice from decision-makers at policy level and from various sectors of the society on the overall vision for the establishment of Gurgaon City as a model Green City.

Objective 2

To present the feasibility study for the transformation of Gurgaon City into a model Green City, to the Indian Government policy makers for decision and future action.

Objective 3

- a) To establish an action plan for implementing selected demonstration projects in Gurgaon as initial steps for its transformation into a Green City. These projects will serve as showcase for visitors from other Indian cities and from other developing countries.
- b) To disseminate the findings of the feasibility study for the Gurgaon Green City project to other parts of India and to other developing countries.

Scope of Study

The scope of study includes those core areas which require special attention such as energy conservation, solid waste management, waste supply, sanitation, urban planning, environmental education / people's participation.

The report gives special attention to issues of economic prosperity related to income and employment generation through ecologically sustainable industrial expansion in the urban area and focuses on key issues related to clean and efficient energy, and management of environmental problems, drawing lessons from the European Commission's European Green City project and Energie-Cités programme.

The study has been based primarily on secondary data sources, with questionnaire based primary surveys done in selected areas of concern.

Table 1.1

Social and Economic benefits of the "Green City" concept.

Social Benefits	Economic Benefits
➤ Cleaner Environment & its protection	➤ Foreign aid on environment
➤ Better hygiene & health	➤ Greater Industrialization
➤ Economic prosperity & job opportunities	➤ Foreign investments inflow ➤ Optimal utilization of resources
➤ Cheap availability of bye-products	➤ Reduced state spending
➤ Ecological balance	➤ Boost to tourism

Chapter 2

Gurgaon Urban Area Profile

The old name of this town Gurgaon, it is said, was *Guru Gram* and that means the village belonging to the teacher or the spiritual guide. Yudhishtira, the eldest of the Pandavas and the king of Indraprastha (ancient Delhi), it is believed, gave this *Gram* (village) as a gift to his *Guru* (teacher), Dronacharya, in whose memory a tank still exists on the West Side of the road to railway station.

The town of Gurgaon has been the headquarters of the Gurgaon district since 1816, and has exhibited spectacular and steady growth after the partition. Gurgaon started as a Notified Area Committee for the Hidayatpur Chhaoni estate in 1899-1900 which was however, abolished in the twenties.

The development of the town remained neglected throughout the British regime as compared to other district headquarters. It is only in the post-independence period that the town has witnessed tremendous growth due to various factors such as rehabilitation of displaced population from Pakistan, planned sectoral development by Haryana Urban Development Authority and rapid increase in the industrial activities along the Delhi - Jaipur road.

It was only in 1950 that class II Municipal Committee was set up for Gurgaon and in 1969 it was transmuted into the class I Municipal Committee.

2.1 Location

Gurgaon is located at 28° 53'N latitude and 75° 35'E longitude and is situated at a distance of 32 kilometers away from New Delhi, the capital of India. It lies at 229 meters above mean sea level. It is a District Headquarters and forms a part of the National Capital region.

Gurgaon is the southern most district of Haryana and is bounded by Delhi and Rohtak district in the North, Faridabad in the East, Alwar and Bharatpur (Rajasthan) in the South and Mohendragarh and Rohtak district in the West.

2.2 Topographic Features

Gurgaon district has considerable topographic diversity by a reversal of slope and variety of relief as compared to the normally level surface of the most areas in Haryana plains. The extension of Aravalli hills and presence of sand dune in Gurgaon district are an important part of the topography.

Gurgaon district is an area of confluence of Aravalli hills, Indo-Gangetic plains and Indian desert. The district has varied topography comprising low lying Khadar made of newer alluvium, upland plain made of alluvium, areas covered with sand-dunes, small valley, undulating lands and are encounters ridges, which are relics of old Aravalli mountain system.

Gurgaon town is situated over a plain, gently sloping towards the north with little undulation here and there. It is surrounded by agricultural lands, a part of which is being developed by Haryana Urban Development Authority for planned urban development.

2.3 Climate

The climate of the district is hot tropical to sub-tropical characterized by high temperature and moisture deficiency for most part of the year. The district is subjected to extremes of temperature, which shows great diurnal & seasonal variations.

The climate of the town like that of the district can be divided into following distinct seasons:

1. Winter season : Late November to February
2. Summer season : March to June
3. Rainy season : July to mid - September
4. Autumn : Mid September to late November

The climate, except during the monsoon, is characterized by the dryness in air. Hot summer, cool winter and unreliable rainfall are distinctive features of the climate. Dust storms during the summer are a common feature.

Summer season can also be termed as 'Hot dry season'. From the beginning of March, temperature starts rising. May and June are the hottest months. From April onwards, hot dust laden winds locally known as 'Loo' blow and the weather becomes unpleasant. The maximum temperature often goes upto 45 °C and sometimes higher than that also.

The winter season begins from late November and terminates in the end of February. Weather is marked by clear sky except a few showers from depressions. December & January are the coldest months. The mean daily maximum temperature in January is about 21 °C and the mean daily minimum is about 7 °C.

In the winter months, during cold waves, which affect the district in the wake of western disturbances passing across north India, minimum temperature may sometimes go down and frosts may occur. The minimum temperature has been recorded as low as 2.1 °C during January 1997 at Gurgaon.

Rainy season generally begins in the first week of July and continues to the middle of September. Sometimes monsoons reach in the last week of June, causing an appreciable drop in the day temperature and the weather becomes pleasant.

During the monsoon season, the sky is heavily clouded and the refreshing winds, which are laden with moisture, make the weather more fascinating and joy giving.

The dramatic departure of the monsoon is usually noticed in the first week of October. After the withdrawal of the monsoon, the day temperatures are more or less the same as in the monsoon months but the nights become progressively cooler.

After the middle of October, there is a fall in both day and night temperatures. The effect of cool breeze is not felt before the end of November. It is also called autumn. The days are also very comfortable in March and April.

Winds are generally very light, but gain force in the summer and monsoon seasons. It is subjected to high-velocity winds from March to August. The velocity of the wind varies throughout the year. The period from April to June has the highest incidence of dust storms and thunderstorms, some of these being very violent.

During the monsoon seasons winds are mostly from East or Southeast; while in the rest of the year, the winds are predominantly from West or Northwest tending to be more northerly in the afternoons. The mean wind velocity varies from 0.2 km/hr to 7.6 km/hr.

Mean relative humidity remains minimum during April to June. In these months' temperature and mean wind velocity remains highest. Mean relative humidity remains maximum during January due to low temperature. Mean wind velocity recorded at Gurgaon is given in the Table 2.1.

Southwest monsoons are the main source of rainfall. Rainy season starts from July and lasts upto September recording about 80% of the total rainfall. July and August are the rainiest months. Rainfall is uneven and erratic.

Good rainfall occurs once in four to five years. Some rainfall is also received during winter season from cyclonic disturbances originating from Arabian Sea.

The distribution of rainfall during different periods of 1988 to 1998 is given in Table 2.2 and the rainfall during different months for the period 1988 to 1998 is given in Table 2.3.

2.4 Vegetation

On account of pressure of population and extensive urban development very less has been left of the natural vegetation. Gurgaon town and its surrounding areas are relatively less wooded. The *Shisham* is found planted on both sides of the roads while *Kikar* has generally been found in the low-lying areas.

The forest department has also started planting Eucalyptus trees (the quick growing species) with the object of checking soil erosion as well as providing wood for various industrial and household purposes.

The area was rich in *Jand* in the past. Most of the *Jand* trees growing in private lands had been cut and sold by the owners before the consolidation of holdings. This took place in spite of its utilities such as fodder for cattle during lean periods, wood, manure by the leaf fall, shade in the fields, amelioration of heat and windbreak.

Moreover, it does not harm the field crops as it is a deep-rooted tree and derives its food from the region much below the root zone of the field crops. In the low-lying flooded tracts where the soil is sandy, *Khajur* grows abundantly, but the fruit is of inferior quality.

The names of some plants commonly found in Gurgaon town and its periphery are *Acacia nilotica* (*Kikar, Babul*), *Azadirachta indica* (*Neem*), *Bombax ceiba* (*Semul*), *Butea monosperma* (*Dhak*), *Capparis decidua* (*Karir*), *Capparis zeylanica* (*Hins*), *Cardia dichotoma* (*Lasura*), *Dalbergia sissoo* (*Shisham*), *Eucalyptus hybrid* (*Safeda*), *Ficus bengalensis* (*Barh/ Bargad*), *Ficus religiosa* (*Peepal*), *Ficus racemosa* (*Gular*), *Holoptelea integrifolia* (*Papri*), *Phoenix sylvestris* (*Khajur*), *Prosopis cineraria* (*Jand*), *Tamarindus indica* (*Imli*), *Zizyphus mauratiana* (*Beri/ Baer*) and *Zizyphus nummularia* (*Pala/ Jhar-Ber*).

Among the numerous other plants found in the region, the following deserve a mention:-

Tephrosia purpurea (*Bansa*) grows abundantly near the hills which is used in making the cylinders of temporary wells by weaving together its branches. *Leptadenia pyrotechnica* (*Khip*) grows on salt land and in the past used in salt-pans to quicken the crystallization of salt.

Chenopodium album (*Bathua*) and *Amaranthus graclis* (*Chaulai*) are common pot herbs, the former grows chiefly in irrigated lands. *Ipomoea canvea* (*Wilayat Akra*) is also grown along field boundaries to serve as hedge. It has also come up along some of the roads.

2.5 Demographic Pattern

The economic life of the town and its hinterland is an index of the economic well being of the people residing there. Gurgaon is the most important industrial and commercial town of the Gurgaon district.

It is the only town in the district, situated very near to the national capital city of New Delhi, through which all trade and commerce are channelized to the surrounding hinterland towns and villages.

The last two decades have witnessed continual and accelerated industrial progress with the expansion of infrastructural network and provision of attractive incentives including large flow of institutional credit to entrepreneurs.

The demographic profile of Gurgaon from 1971 to 1991 is given in **Table 2.4**.

Spread over an area of 15.33 sq. km the Gurgaon Town had a population of 121,486 and the Gurgaon urban area had a population of 135,884 spreading over an area of 24.13 sq. km according to the 1991 census. The population density of Gurgaon town, Gurgaon Urban area and Gurgaon district as per 1971-1991 census is given in **Figure 2.1**.

The population density shows that Gurgaon Town and Urban Area is a densely populated area compared to Gurgaon district. Though the variations in densities of population occur on account of topography, soils, land, occurrence of economic minerals, accessibility and other socio-economic factors, the most important factor for Gurgaon is close proximity to the National Capital, New Delhi and rapid industrial development.

As per Development Plan of Gurgaon published in January, 1996, the total urbanisable area including defence land (0.633 sq. km) works out to be 98.81 sq. km.

The Gurgaon Urban area is having a varying density from 100 PPA (24711 per sq. km) to 250 PPA (61777 per sq. km) for different areas and sectors.

The Gurgaon Urban area as per Development Plan published in 1996 includes a large number of villages. The details of the villages falling under Gurgaon Urban area including population, area as per 1991 census and the sectoral location is given in **Table 2.5**.

The total population of the rural villages within Gurgaon Urban area as per 1991 census is 86,123.

Due to rapid industrialization and development Gurgaon saw an abnormal growth rate during the period of 1991 and 2000.

The Current population (2000) of the municipal area as per estimation of the Municipal Council is given in **Table 2.6**.

The total population of the municipal area as per estimation of Gurgaon Municipal Council year 2000 is 210300.

Estimated population within the sectors developed by HUDA is around 100,000 and within the Private Colonizer area is about 50,000. These estimates are made on the basis of discussions with HUDA and District Town Planner. It is also a point to note that though the areas and colonies developed by Private Developers can accommodate a population of around 250,000 to 300,000 persons but the occupancy rate at present is only around 20%.

As per 1991 census the population of the villages falling within the urbanisable area was 86,123 persons. Taking a growth rate of 2% per year their present population (2000) is estimated to be 101,625 persons since a number of industrial workers have started residing within villages especially those, which are in close vicinity of the industrial areas.

Therefore, the total current population of Gurgaon Urban Area is estimated to be 461,925 persons.

The population of the Gurgaon Urban Area as per 1991 census was 135,884 excluding the rural villages. Therefore, the population of Gurgaon Urban area was (135,884 + 101,625) i.e. 237,509 persons minus population of Gurgaon

village (14,398), Bhimgarh (2,407) and Dundahera (6,767) as they are included in the population of Gurgaon Urban Area comes out to be 213,937 persons.

The population project of Gurgaon Urban Area for the year 2001, 2011 and 2021 is given in **Table 2.7**.

2.6 Air Quality Status

One of the prime environmental concerns today is that of the quality of air we breathe. With the spillage of Delhi's populations, shifting of large corporate houses & industries and growth of private developers in recent years - Gurgaon has experienced a deteriorating air quality. Since there are no large polluting industries in Gurgaon, the major source of air pollution is the increased vehicular traffic on the major routes of Delhi - Gurgaon roads.

The ambient air quality of Gurgaon is given in **Table 2.8**, the cumulative percentile distribution of SPM in **Table 2.9**, the cumulative percentile distribution of SO₂ in **Table 2.10**, the cumulative percentile distribution of NO₂ in **Table 2.11**, the industry wise emissions in Haryana sub-region of NCR in **Table 2.12** and cumulative point area and line source emissions of Gurgaon in **Table 2.13**.

2.7 Water Quality Status

Water being one of the important physical environments of man has a direct bearing on its health.

Gurgaon lacks abundance of underground potable water. Infact the fast pace of urbanization has evolved serious implication on Gurgaon's limited surface and ground water resources. Hence emphasis and efforts have to be made on planned utilization of waste resources in the entire area.

The ground water table in Gurgaon is depleting at a rate 0.8 to 1.0 meters per annum resulting in a lowering of water table by 16 meters in the last twenty years.

2.8 Soil Conditions

Gurgaon District: The Gurgaon district is occupied by Quaternary alluvium and pre-cambrian meta-sediments of Delhi system. The generalised formations are as follows:

System	Series	Stratigraphic Unit
Quaternary	Pleistocene and Recent	Wind blown dust Newer Alluvium Older Alluvium
Delhi	Ajabgarh (Pre-cambrian)	Slate, Phyllites and Quarzites
Delhi	Alwar (Pre-cambrian)	Quartzite, Mica schist and Pegmatite intrusions

The Gurgaon district has the distinction of having various types of soils right from clay to sand dune. The soil of the area varies from sandy loam to loam. In certain low-lying areas, the soil is clayey and saline. The former is dark coloured and is impure calcium carbonate, known as 'Kankar'. The newer alluvium, light coloured and poor in calcareous matter, is known as 'Chiknot' (clay loam). These may be grouped into three major categories, heavy or hard clay (Chinkot, Daker and Rahi) clay loam (Normot), sandy loam (Megda) and sandy (Bhood).

The Alluvia, newer and older, occur extensively in the area. They comprise silt, sand, gravel, clay and kankar. The older alluvium occurs extensively in the area west of Sohna ridge. The area east of this ridge is occupied by newer alluvium. Besides these, sand dunes also occur. The geomorphic unit has unconsolidated formations which form porous media and offer good ground water prospects.

The unconsolidated alluvium forms the principal aquifer. Water occurs both under water table conditions and under confined conditions at deeper levels. The water table contours generally follow the surface topography.

The Hydrogeomorphology of the district shows structural ridges / structural hills representing these ridges. The rocks constituting the ridges are consolidated, fissured media, often discontinuous. These geomorphic units have poor to moderate ground water prospects.

Figure 2.1

Population Density of Gurgaon Town, Gurgaon Urban Area and Gurgaon District as per 1971 - 1991 Census

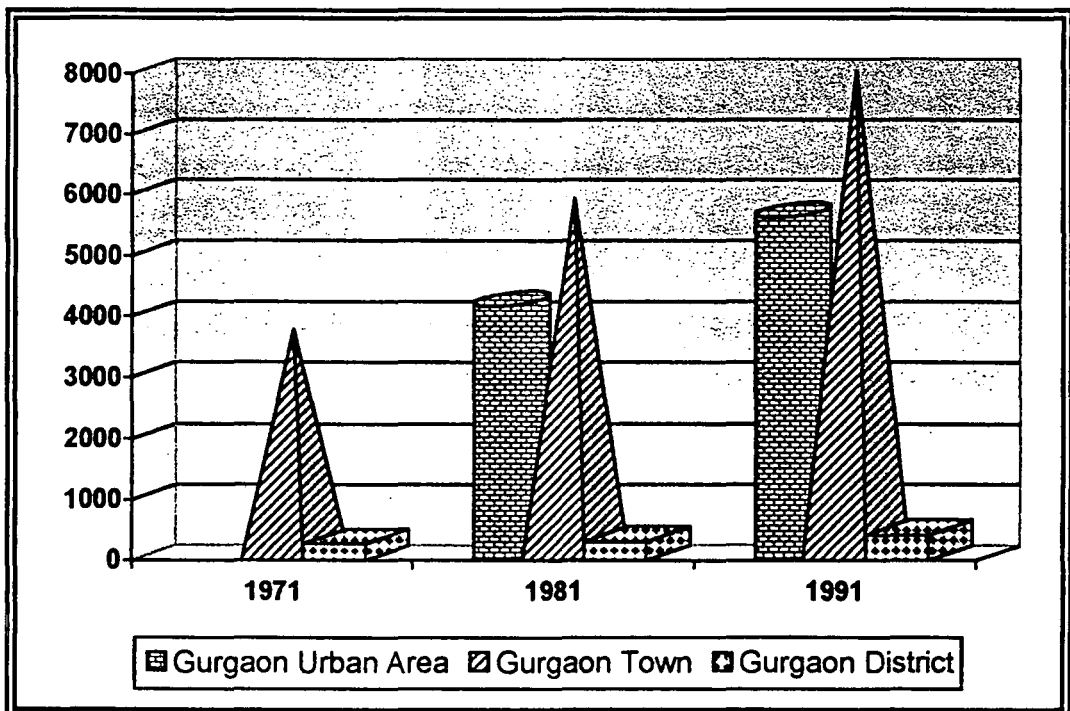


Table 2.1

Mean Wind Velocity of Gurgaon

Month	Mean wind velocity Km/hr
January	3.7
February	4.5
March	5.5
April	5.8
May	6.7
June	7.6
July	6.3
August	3.9
September	4.3
October	3.6
November	3.2
December	3.2

Source: District Forest Office, Aravalli Project, Gurgaon

Table 2.2

Distribution of Rainfall (in mm) during Different Periods of 1988-98

Period	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	Avg
June - Sept.	632.1	212.4	498.5	373.7	318.1	532.4	575.2	885.2	503.5	338	349	521.8
Oct. - Feb.	10.8	28.2	136.9	26.1	47.5	14.6	27.2	71.7	39	108.3	84.8	59.5
Mar. - May	32.6	11.1	44.6	24.6	3.6	5.8	11.1	16.6	4.4	79.6	9.65	24.4
Total	675.5	251.7	680	424.4	369.2	553.1	613.5	973.5	547.2	525.9	443.5	605.7

Source: District Forest Office, Aravalli Project, Gurgaon

Table 2.3

Rainfall (in mm) during Different Months for the Period 1988-98

Month	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	Avg
January	0.7	12.3	0	0	24.9	0.5	23.8	49.7	10.4	5.5	0	12.8
February	9	0	87.6	15.2	16.5	14.1	3.4	21.9	5.3	0.3	8.8	18.2
March	29.7	11.1	0	0	1	2.6	0	11.8	1.9	16.4	7.2	8.2
April	1.6	0	8	13.3	1	0.4	6	4.8		27	0.15	6.2
May	1.3	0	36.6	11.3	1.6	2.8	5.1	0	2.8	36.2	2.3	10.0
June	80.1	5.1	24	35.7	9.5	21.9		44.4	71.3	65.5	34.5	46.0
July	170.3	59.6	186.9	72.9	116.9	342.1	341.1	126.3	79.7	84.8	90	167.1
August	265.2	127.7	56.8	241.7	166.8	41.8	151.4	431	235.7	165.6	88.5	197.2
September	116.5	20	230.8	23.4	24.9	126.9	14.6	283.5	116.8	22.1	136	111.5
October	0	0	0.3	0	0	0	0	0	23.3	55.4	76	15.5
November	0	7.9	25.2	0	6.1	0	0	0	0	13.5	0	5.2
December	1.1	8	23.8	10.9	0	0	0	0.1	0	33.6	0	7.8
Total	675.5	251.7	680	424.4	369.2	553.1	613.5	973.5	547.2	525.9	443.5	605.7

Source: District Forest Office, Aravalli Project, Gurgaon

Table 2.4

Demographic Profile of Gurgaon (1971-1991)

Area	Gurgaon district			Gurgaon town			Gurgaon urban area		
	1971	1981	1991	1971	1981	1991	1971	1981	1991
Population	1707369	849598	1146090	57151	89115	121486	--	100877	135884
Males	917766	451861	612620	30481	--	64006	--	--	71639
Females	789603	397737	533470	26270	--	57480	--	--	64245
Sex ratio	860	880	870	875	870	898	--	869	896
Households	276664	126947	170390	10801	16116	22239	--	17958	24680
Population density	278	313	415	3680	5813	7925	--	4181	5631
Growth rate in %	--	50.23	34.89	--	55.9	36.3	--	76.5	34.7
Area (km ²)	6146.0	2716.0	2760	15.33	15.33	15.33	--	24.13	24.13
Literate	480013	299279	469895	34423		86899	--		95618
Literacy Rates in %	28.1	35.2	40.9	60.23	67.14	74.86	--		70.3
Scheduled caste	276162	120681	155720	4421		9715	--	11118	12681
Scheduled tribe	23	0	--	0			--	0	-
Main workers	445948	236136	318088	14568		35597	--		-
Marginal workers	-	32893	49355	-		41	--		41
Non-workers	1261421	580569	778647	42583		85848	--		96694
Workers	445948	269029	367443	14568		35638	--		39190
% Workers to the total population	26.1	31.66	32.06	25.4	27.12	39.9	--		28.87
% Non-workers to the total population	73.9	68.34	67.9	74.6		70.7	--		71.15

Source: Census Handbook-1991, Haryana

Table 2.5

Rural Population, Area and Sectoral Location of the Villages within Gurgaon Urban Area

Sl. No.	Village	Area Sq. Km	Population	No. of households	Density	Sectoral Location
1.	Mohammadpur Jharsa	2.95	1890	241	641	36
2.	Khandsa	6.46	4634	761	717	37
3.	Narsinghpur	1.97	1448	181	735	36
4.	Kadipur	2.40	3310	651	1379	10-A
5.	Tikri	2.48	701	105	283	48
6.	Ghasola	1.59	359	64	226	49
7.	Bhimgarh		2407			3
8.	Choama Khera	7.41	1605	344	217	1
9.	Carterpuri	5.17	2602	394	503	23-A
10.	Mulahera	2.72	3589	848	1320	22
11.	Gurgaon village		14398			6
12.	Naharpur	1.14	1586	266	1391	33
13.	Sukhrauli	4.78	5538	1114	1159	17
14.	Sirhole	3.23	2638	348	817	18
15.	Dundahera		6767			21
16.	Islampur	2.59	2436	333	941	38
17.	Jharsa	9.99	8480	1289	849	39
18.	Silokhera	2.74	1986	428	725	30
19.	Chakarpur	6.01	2525	393	420	28
20.	Sikanderpur	2.61	2772	632	1062	25-A
21.	Nathupur	5.65	3508	479	621	24
22.	Kanhai	3.55	2995	480	844	45
23.	Samaspur	1.65	946	147	573	51
24.	Wazirabad	13.1	5670	848	433	52
25.	Tigra	2.49	1333	164	535	57

Source: Census Handbook-1991, Haryana and Haryana Urban Development Authority, Gurgaon

Table 2.6

Ward-wise Current Population of Gurgaon Municipal Area

Ward	Population	No. of Houses	Area
1	9000	1638	Himgarh Kheri, Ashok Vihar, Dayanand Colony, Ashok Puri, Mahavir Pura
2	7800	946	Adarsh Nagar, Mainwali Colony, Acharya Puri, Sanjay Colony, Gopal Nagar, Purani Najafgarh Road
3	8000	2437	Rajeev Nagar, Delhi Road
4	6000	1846	Prem Nagar, Rajeev Nagar, Delhi Road
5	7000	1552	Sector 14, Industrial Area, Mehrauli Road, Mahavir Chauk, DLF Colony
6	10000	1663	Nahar Colony, Vidyut Board Colony, Police Line, Civil Hospital Colony, Patel Nagar, Housing Board, Jharsa Road
7	7500	703	Jacub Pura, Roshan Pura, Sadar Bazar, Jama Masjid
8	7000	886	Subhash Nagar, Indrapuri, Jacub Pura
9	7500	715	Indrapuri, Subhash Nagar, Sainik Mahulla
10	6000	1124	Bhim Nagar Camp
11	8000		Ratan Garden, Shivpuri, Sector 7, Sector 4
12	8500	1086	New Colony, Krishna Colony
13	6000	941	Pratap Nagar, Arjun Nagar, Nehru Line, Vijay Nagar
14	6500	911	Arjun Nagar
15	9000	634	Nai Basti, Arjun Nagar, Ram Nagar
16	6500	665	Nai Basti, Meat Market, Jail Road, Prem Nagar
17	8000	889	Civil Lines, Friends Colony, New Court, Shivaji Nagar
18	6000	988	Shivaji Nagar
19	5000	777	Om Nagar, Shanti Nagar
20	4000	664	Om Nagar, Raj Nagar, Anaj Mandi
21	5000		Gandhi Nagar, Shivaji Park, Heera Nagar
22	6000		Heera Nagar, Lakshmi Garden
23	7000	935	Lakshmi Nagar, Charat Barla
24	8000	871	Arjun Nagar, Nai Abadi, Veer Nagar, Shakti Nagar, Charmalla, Lakshmi Garden
25	5500	971	Baldev Nagar, Amar Colony, Feroz Colony, Shakti Nagar, Veer Nagar, Shamshanghat

Contd.... Table 2.6

Warc	Population	No. of Houses	Area
26	6500	1782	Madan Puri
27	6000	1036	Jyoti Park, New Jyoti Park, Sector 7
28	5000	1000	Krishna Colony, Sector 7, Parts of Sector 4
29	7000	1153	Sector 4, Laksham Vihar, Surat Nagar, Daulatabad Road
30	5000		Rajendra Park, Vishnu Garden, Police Chauki
31	6000	5227	Awadh Puri, Anand Garden, Railway Station
Total	210300		

Source: Gurgaon Municipal Council, Year 2000

Table 2.7

**Population Projection of Gurgaon Urban Area for
the Year 2001, 2011 & 2021**

Year	Population	Increase in population	% Increase in population	Population Project		Average
				Arithmetical Increase	Geometric Increase	
1991	213937					
2000	461925	247988	115.92			
Per Year Increase		27554	12.88			
2001				494093	521421	507757
2011				815773	1116380	966076
2021				1127453	1711340	1419396

Table 2.8**Ambient Air Quality of Gurgaon Town**

Sl. No.	Location of Sampling Point	SPM ($\mu\text{g}/\text{m}^3$)	SO ₂ ($\mu\text{g}/\text{m}^3$)	NO _x ($\mu\text{g}/\text{m}^3$)
1.	ADC Complex, Vikas Sadan, Gurgaon	185	12	10
2.	Sohna-Alwar Road, near Sohna Bus Stand, Gurgaon	534	18	12
3.	Mehrauli Road, IDC, Gurgaon	485	24	16
4.	Udyog Vihar, Gurgaon	336	18	12
5.	Railway Road, Gurgaon	540	20	14
6.	Market, near Main Post Office, Gurgaon	725	24	16
7.	Maruti Udyog Limited, Gurgaon	143 (Avg.)	-	-

Source: State Pollution Control Board - Gurgaon, 2000)

Table 2.9

Cumulative Percentile Distribution of SPM

Sl. No	Station	Max	Min	Avg	SD	Percentile					
						10	25	50	80	95	98
1.	IDC	728	76	356	146	196	243	330	468	590	672
2.	Ind. Estate	545	27	268	136	53	161	263	370	457	506
3.	St. C. College	2045	146	721	537	171	286	596	1044	1821	1973
4.	Sector 17	1184	148	444	274	178	205	325	656	914	1073

Source: Carrying Capacity Study of NCR Region, NEERI, Nagpur

Table 2.10

Cumulative Percentile Distribution of SO₂

Sl No	Station	Max	Min	Avg	SD	Percentile					
						10	25	50	80	95	98
1.	IDC	220	6	35	50	6	6	12	59	118	172
2.	Ind. Estate	86	6	29	26	6	9	16	51	79	83
3.	St. C. College	93	6	24	21	6	6	18	40	51	72
4.	Sector 17	54	6	18	14	6	6	11	31	44	51

Source: Carrying Capacity Study of NCR Region, NEERI, Nagpur

Table 2.11

Cumulative Percentile Distribution of NO₂

Sl. No.	Station	Max	Min	Avg.	SD	Percentile					
						10	25	50	80	95	98
1.	IDC	46	3	11	12	3	3	4	16	35	40
2.	Ind. Estate	59	3	15	16	3	3	6	22	49	56
3.	St. C. College	40	3	12	9	3	3	11	16	29	36
4.	Sector 17	86	3	14	20	3	3	6	17	51	72

Source: Carrying Capacity Study of NCR Region, NEERI, Nagpur

Table 2.12**Industry-wise Emissions in Haryana Sub-region of NCR**

Type of Industry	Total Emissions (g/s)				
	SPM	SO ₂	NO _x	CO	HC
Chemical	0.133	2.63	0.28	0.04	0.0009
Food/Beverages	80.77	20.36	4.63	0.9	0.38
Drugs/Pharmaceutical	0.04	2.20	0.19	2.02	0.004
Dyeing/Textile	0.69	0.59	0.11	3.12	0.69
Ceramic/Refractory	0.50	3.39	0.42	2.21	0.49
Foundry (Ferrous)	0.05	4.52	0.64	0.14	0.02
Total	82.28	115.97	6.27	6.43	1.58

Source: Carrying Capacity Study of NCR Region, NEERI, Nagpur

Table 2.13






















Cumulative Point, Area and Line Source Emissions

Source of Pollutant	Emissions (g/s)				
	SPM	SO ₂	NO _x	CO	HC
Point	82.28	115.97	6.27	6.43	1.58
Area	412.01	207.16	49.73	424.65	203.31
Line	4.27	2.26	16.71	94.22	54.87
Total	498.56	325.39	72.71	525.30	259.76

Source: Carrying Capacity Study of NCR Region, NEERI, Nagpur

MAP 2.1 : GURGAON: FINAL DEVELOPMENT PLAN FOR CONTROLLED AREA I TO IV



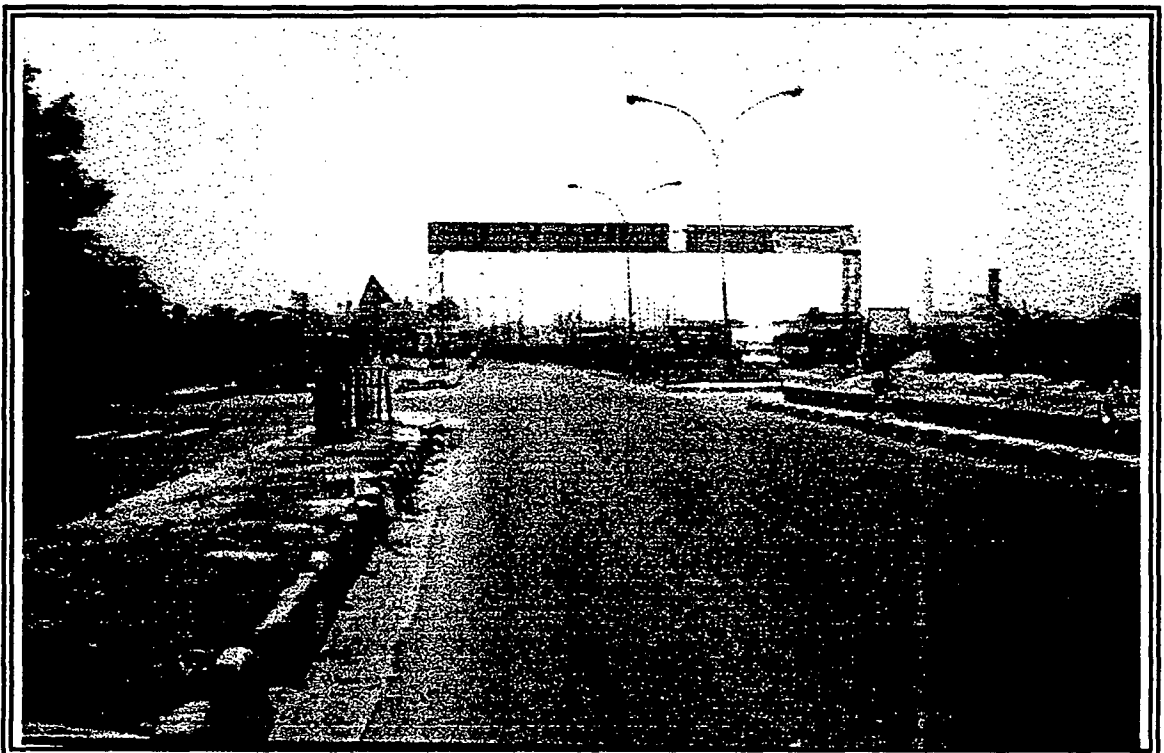
 State Boundary	 Residential/ GH / Plotted	 Public and Semi Public Use
 Controlled Area Boundary	 Existing Town	 Open Spaces
 Municipal Limit	 Village	 Agricultural Zone
 Major Road	 Commercial	 Forest Land
 Other Roads	 Industrial	 Special Zone
 Village road/ Village	 Transport and Communication	 Nallah/ Water Bodies
 Railway Line	 Public Utilities	 Non-Conforming Use

**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**



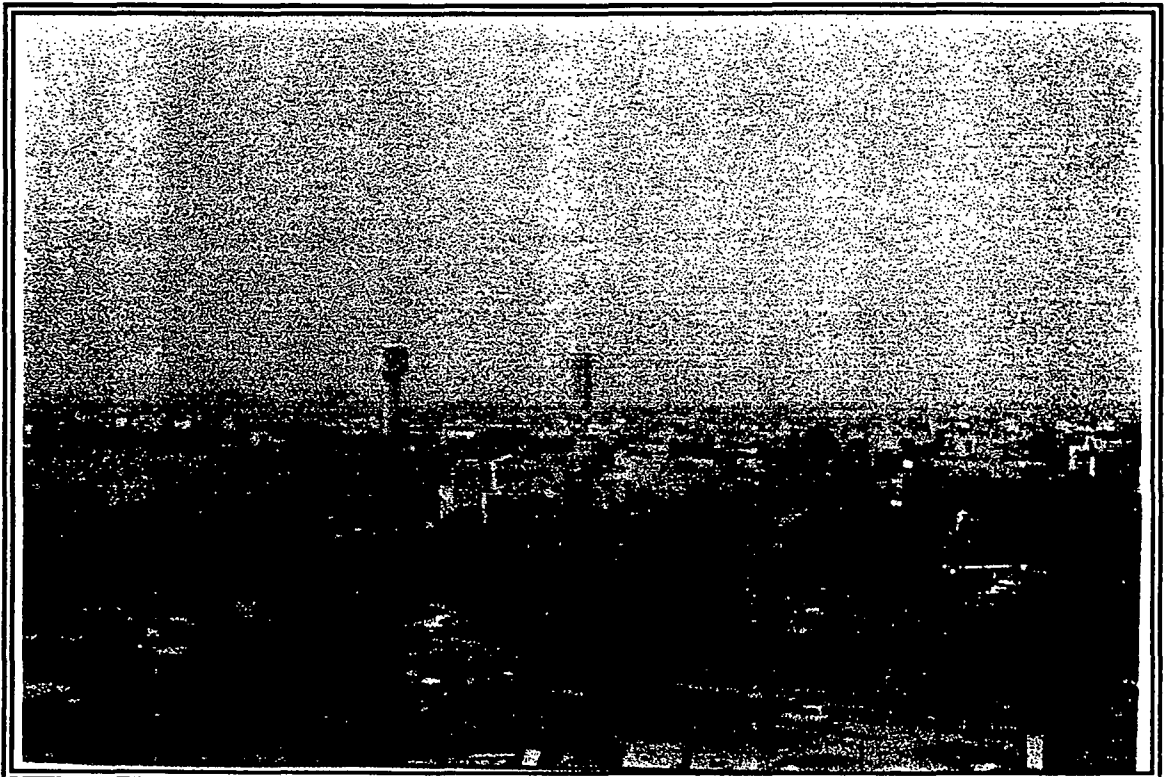
Map No.





"HARYANA WELCOMES YOU"

Entry to Gurgaon from New Delhi



"GURGAON - AN OVERVIEW"

Chapter 3

Urban Planning

India, with its accelerated pace of urbanization has exhibited a steep rise in its urban population of nearly ten fold between the period 1901-1991, wherein the number of urban settlements have also doubled.

The rapid concentration process of population in the larger urban centres reveal that the metropolitan cities accommodate one- third of the urban population, and are presently confronting complex environmental problems, leading to high-risks environment in the form of deteriorating natural systems and socio-economic conditions.

It has been estimated that the urban population in India would contribute to 33 percent by 2001 indicating a significant increase of 7 percent within a short span of ten years.

Infact it has been viewed that the mega cities of Delhi, Calcutta, Mumbai and Chennai account for nearly one-fourth of the total urban population of the country and are struggling to maintain satisfactory levels of urban infrastructural services.

The problems of ineffective and insufficient infrastructural provision and mass exodus of rural counterparts to the cities, has been steadily upsurging, exacerbating the impact of rapid urban growth on quality of life and productivity.

Further severe concerns emerge from inadequate urban services due to inadequate finance and ineffective governance which has aggravated the problems, environmental decay, proliferation of slums, urban poverty severely impinging on the sustained growth of the urban area. It is hence imperative to have improved urban infrastructure for enhancing urban productivity and sustainability.

Delhi with its teeming and overflowing population poses a serious threat to environmental sustainability and is at the brink of an environmental disaster. Infact of

the seven metropolitan cities, Delhi's population shows no signs of stabilizing, and has already spilled over its boundaries with increasing magnitude, which implies that, the day is not far away when the city may trigger a catastrophic environmental decay by exploding into an orgy of waste and destruction.

Gurgaon, a satellite town of the National Capital region also confronts complex urban environmental problems having strong linkages with Delhi. Hence the concept of Green City –an oxymoronic term has been visualized for Gurgaon as it is one of the fast growing town of the NCR within proximal distance to Delhi and is facing the brunt of its growth.

The green city concept is not a grand ivory tower vision, it's just a survival kit for the booming urban centres of the 21st century. Infact this model city would envisage energy efficient development providing clean and pollution free surroundings and conservation of natural resources for higher quality of living.

The rapid pace of urbanization and industrialization has been very overwhelming during the past decade in Gurgaon. It has experienced massive growth, due to the spillover of Delhi's ever increasing population on one hand and the advent of the private sector organizations and developers on the other, whereby leading to transmogrification of the entire urban landscape of Gurgaon.

Gurgaon can be broadly classified under two distinct sections namely the HUDA area and the old town area (municipal area limit). The area under HUDA can be further subdivided into the private colonizer area, HUDA sectors, industrial area and the urban villages.

The Old town and the HUDA area exhibits distinctive characteristics, wherein the old town has a high population density with narrow and congested lanes, crowded market area and bus stand at the very heart of the town.

The HUDA area on the other hand comprises the sectors maintained by them, which are planned localities, the private colonizers area or the licensed colonies on the other hand have modern high rise buildings and apartments with conscious efforts of landscaping and planning being effectively done.

The urban villages and the unauthorized colonies situated admist the Private Colonizers area also form one of the vital components of the region, giving rise to multi-facet problems of diverse socio-economic implications. The industrial

area within the HUDA area and Udyog Vihar under HSIDC accommodates a large variety of industrial units.

3.1 Growths and Expansion of Gurgaon

3.1.1 Changing Urban Landscape

Before 1980

Gurgaon deriving its name from the Gurugram village is emerging as one of the prime urban centre of the National Capital Region. The town of Gurgaon has been the administrative headquarters since 1816, and has exhibited spectacular and steady growth after the partition.

Gurgaon started, as a notified area committee for the Hidyatpur Chhauni estate in 1899-1900, which was abolished in the twenties and in 1950 the class II Municipal Committee was set up for Gurgaon. Later, in 1969 Gurgaon was transmuted into the class I Municipal Committee.

However the main reasons for the growth of Gurgaon can be attributed to the Haryana Urban Development Authority, which opened the doors for private sector development and investments to take place in Gurgaon, attracting people mainly from Delhi to settle here.

The Haryana Development and Regulation of Urban Areas Act (1975) encouraged participation by private developers under which the private developer could obtain licenses to acquire, develop, and dispose land.

The objective of this act was to provide developed land and housing at a faster pace and to channelise non-government resources towards the enhancement of the urban area. It was envisaged that by the involvement of the private sector, urban development would take place in a planned and systematic manner and would also accelerate urbanization in the long run.

The formal private sector urban development in Gurgaon dates back to 1966, by the Urban Estates Department, Haryana, for developing residential sectors of 4 and 7. The industrial estates of sector 18 and residential sectors of 14 and 17 were developed in 1971 and 1973 -1975 respectively.

The spatial distribution of the development during this period engulfs the entire town boundary and the areas north and northeastern side to it.

1980-1990

The establishment of Maruti Udyog Ltd., a car manufacturing company, in early eighties and the initiation of its Joint Ventures in mid-eighties like Mark Auto Limited, Jay Bharat, Bharat Seats, Machino Plast, Caparo Maruti and Krishna Maruti Limited marked a new era of industrialization in Gurgaon.

Further the private developers having already embarked on developing residential colonies added a new dimension to the pattern of urban growth in Gurgaon. The urban development strategy involved acquisition of land by HUDA and development under two heads:

- Development of sectors under HUDA, which are maintained by HUDA
- Development of colonies by the Private colonizers under the licenses issued by HUDA.

The two-way mechanism by which development of Gurgaon is being governed is through the control device used by the state government on the urban expansion on one hand and learning from the professional experiences of the private colonizers on the other.

The new ideas and concepts by the private colonizers in the area of town planning and architecture have been very commendable and praiseworthy in Gurgaon.

The residential development in this period mainly incorporated sectors 15, 31, 32A, 45, 46, 28, 27, 43, 26, 23, 22, 21, 3 and 9. The spatial distribution of development during this period took place on the northern side of the Defence area, southwestern and southeastern side of the town. Further the growth also took place in dispersed fashion as and when the colonies were set up.

1990 onwards

The development of Gurgaon in 1990's reflects that the upsurge of private developers, Corporate Houses, Multi-Nationals and related activities have contributed significantly in changing the total urban scenario of the region.

The trend in the 1990's exhibits a faster pace of population concentration as well as increased number of floating population in Gurgaon. There has also been a shift of working population from Delhi to Gurgaon in order to reduce work place distance and for a better living environment.

The planned growth of the Colonies, Industrial Areas, Clubs, Recreational Areas, Golf courses etc reveal that Gurgaon can be compared to any modern cities of today.

The spatial distribution of the area developed during this period includes the sectors 9, 9A, 10, 15/I, II, 37/I, III, 38, 39, 40, 45 and 46. The main development took place on the southeastern, southwestern and in various pockets developed by the colonizers.

The growth and development of Gurgaon from year 1980 to 2000 is given in Table 3.1.

In spite of proliferation of innovative approaches to develop Gurgaon in a systematic and co-ordinated manner, the seriousness of urban problems due to sudden population rise has been accelerating and threatening the urban-environmental issue of the region.

The shifting of multi-nationals, corporate business houses, private developers colonies etc to Gurgaon in the 1990's have opened the doors for urbanization in a large way. This in turn requires a strong infrastructure support system to sustain the sudden growth on one hand and seek alternative measures to integrate the diverse components of the urban area like the old town, urban villages and unauthorized colonies into one single entity on the other hand.

3.1.2 Advent & Growth of Private Developers

Gurgaon can be characterized as one of the fast growing urban centers in the NCR due to the emergence of large-scale private development taking place at a rapid pace.

Though the growth of private developers in the initial years was very sluggish with less habitation and utilization of services in their colonies being slow, the pace of development in Gurgaon triggered off in the mid-seventies wherein the town witnessed total change in the urban scenario. The reasons being:

- The constitution of Haryana Urban Development Authority (HUDA) in 1977 gave boost to urban development and expansion in Haryana, which was reflected in Gurgaon too.
- The mid-seventies witnessed change in the conditions of land market, which was favourable for Gurgaon's development.
- Enactment of the Urban Land Ceiling Act of 1976 placed restriction on the maximum size of plots in Delhi and this with the policy of auctioning residential plots on Delhi gave private sector urban development in Gurgaon a tremendous boost.
- The affordable land prices in Gurgaon in comparison to the high land values in Delhi attracted investment from people in this sector.
- Gurgaon's location at the threshold of South Delhi and access on the National Highway 8 (Delhi - Jaipur road) formed an added attraction for the people of Delhi to shift here. Further, the close proximity to Indira Gandhi international Airport and efficient road and railway network brought about the trend of shifting of the high Tech and High value projects and the large Corporate houses in the recent years, giving impetus to Gurgaon's development.
- The absence of large-scale polluting industries in comparison to Faridabad encouraged people to choose Gurgaon as an alternative place to live.
- The land scarcity in Delhi led to fast development of land by the private developers in Gurgaon. This has made private sector urban developments in Gurgaon of prime importance in the development scenario.

3.1.3 Gurgaon's Office Market

The opportunity to create Gurgaon as an office center arose because of the extreme shortage of space in Delhi in the early and mid 1990's and the problem of developing large new buildings arising out of the Urban Ceiling and Regulation Act.

Being in Haryana, beyond the boundaries of Delhi, the Urban Land ceiling and Regulation Act does not apply. Gurgaon had plenty of land, and is only 20 to 30 minutes drive to the airport and the executive residential districts of South Delhi. The opportunity was grasped by far sighted developers.

Indeed, Gurgaon Urban Area has achieved that vital ingredient which every new property location needs – credibility. It would be easy to characterize the emergence of Gurgaon as a prime office location as a bold grand plan, but the reality is a little prosaic.

Gurgaon originally made its name as a modern employment area in the context of manufacturing, most notably the Maruti complex at the Udyog Vihar, which was set up in early 1980's.

Since 1996, Gurgaon has been and continues to be conspicuously successful in attracting major office operations of household name multinationals. Major arrivals include:

- Pepsi – moved from Connaught Place to DLF Corporate Park in 1997.
- Coca Cola - moved from Nehru Place to Enkay Towers in 1997, but will move on again to Unitech Signature Towers in 2000.
- British Telecom – moved from Connaught Place.
- Flour Daniel - set up its main Indian office at DLF Corporate Park in 1997.
- GE Capital – moved from New Friends colony to DLF Corporate Park in 1997.
- CI, Dunpont Far East, SmithKline Beecham and British Airways have relocated from inner city to Gurgaon.
- Gillette would be establishing their head office in Global Business Park, moving out from Delhi.

The places such as Connaught Place, Nehru Place, New Friends Colony are located in New Delhi and places such as Enkay Towers, Unitech Signature Towers, DLF Corporate Park and Global Business Park are located in Gurgaon.

The DLF Corporate Park formula is simple and effective and readily replicable, and would be instantly recognizable in suburban or out of town business park location in Europe or in the USA.

It is quite evident from the style of later developments that this formula is being replicated many times over, by almost all developers. The continuing demand for cheap, high quality International configuration, office space can be primarily attributed to two major sources.

1. The corporations relocating from the inner city, in a bid to lower their real estate costs and consolidate operations in one building- example of which include ICI, Dunpont, Pepsi, British Airways, et al.
2. The other includes the business organizations seeking office space in proximity to their manufacturing or logistics operations as well as firms like GE Capital International Services setting up large back office remote processing centers.

Although, Gurgaon as whole can be considered as an acceptable location, it has yet to be seen which location within Gurgaon would emerge on top. Further, Gurgaon has an excellent future as an office location for World class companies, both multinationals and increasingly Indian, but again the future for office developers is not clear-cut. Despite the orderly business park image and a master plan, the commercial and (indeed the residential) developments in Gurgaon are spread over a very wide area, in an apparently random manner. For example, a two mile of rough road from DLF Corporate Park to Unitech Signature Towers. The five star Bristol Hotel has not created for itself a distinct location. Extensive areas of scrubland typically surround the new developments.

Town and Country Planning Office with a view to have a planned development in Gurgaon, has been laying down rules and regulations on land development, Building By-laws etc for achieving balanced development. On the other hand viewing Gurgaon within the framework of a larger plan and introducing the concept of balanced development the National Capital Region Plan was envisaged.

3.1.4 Municipal and HUDA Area

Gurgaon can be broadly divided into two zones – the old town and the HUDA area and the segmentation of these two are indeed very sharp, manifesting in increasing gaps in the level of quality of urban amenities.

An overview (Figure 3.1) of these two areas throws light on the existing disparities and discrepancies in their level of infrastructural and socio-economic development.

3.1.4.1 Profile of Gurgaon Municipal Area

Gurgaon town covered an area of 15.33 sq. km till 1991 wherein an additional area of 1.17 sq. km was added in the year 1994-95. The old town area has been divided into 31 wards for administrative purpose, wherein each ward comprises few colonies within it. The municipal town had 22 wards in 1981, 21 wards in 1991, and 10 wards were added in 1994-95.

The analysis of the demographic and socio-economic characteristics of Gurgaon town reflects on the spatio-temporal variations existing within the various areas of the town, and can be viewed in the following section.

The census analysis of demographic profile of the Gurgaon town covers the aspects of population growth, population distribution and sex ratio. The social components include the literacy pattern, distribution of scheduled caste and tribes, whereas the economic characteristics reveal the workforce composition, nine fold industrial classification and non-workers.

The existing socio- economic infrastructural condition of municipal limit determines the development status of the town as well as the distribution pattern of the existing amenities within the town.

i. Ward-wise demographic characteristics of Gurgaon town 1981-2000

The demographic characteristics of the town reveal that the town has more or less same distribution pattern of population with few high and low pocket areas. The categorization of population distribution into high, medium and low has

been done so as to assess the trend and growth of population in various areas of the town.

The population distribution of the areas has been done by taking into account their contribution to the total population of the town. The town can be divided into three zones of low, medium and high distribution with low accounting between 1.00 - 3.5 percent to the total population, the medium ranging between 3.5 - 6.00 and high accounting for above 6 percent.

The population distribution pattern as suggested in the **Table 3.2** reveals that in 1981, the densely populated pockets were that of ward 18 and 2 contributing to 7.74% and 7.63% the total population. The less population concentration were in the wards of 22, 19 and 5 contributing to 3.3%, 3.34% and 3.44% respectively.

In 1991 the high pockets were that of wards 21(8.80%), 18 (10.4%), 9 (3.97%) and 2 (11.57%) and 1(6.32%). This reveal that wards 18 and 2 accounts for high population concentration, with the former being in proximity to Khandsa road and the latter situated near the bus stand and railway depot, of the town.

The recent survey by the Municipal council in the year 2000 reveals that the town exhibits a uniform population distribution pattern of percentage contribution in the various wards. The wards with high concentration are that of 15 (4.28%), 6 (4.76%) and 16 (4.28%). On the whole the town has reached its brink where further population expansion needs to be checked.

The distribution of residential households **Table 3.3** also signifies the population concentration in the various areas in the town. The ward-wise distribution of residential households with their percentage contribution to the total households of town can be broadly divided into three categories of low, medium and high with percentage contributing from 1.0 - 3.5 in the low category, 3.5 - 6.00 in medium and above 6 percent in the high category.

The spatial distribution of the residential households **Table 3.4** shows more or less similar pattern as in the case of population distribution **Table 3.5** in the years 1981 and 1991. The wards of 18 and 2 have higher percentage of households in comparison to the other wards of the town, with the ward no 9 being an additional entity in 1991, contributing the maximum share of 15.4 % to the total residential household of Gurgaon.

The Municipal survey report 2000 highlights that wards of 3 & 31 have highest range of households accounting for 7.16% and 15.36% to the total residential household of Gurgaon respectively. The maximum share of wards however lies in the lower category showing an overall even distribution pattern.

The temporal analysis of the rise in the residential households and population ward-wise highlights that there has been a general shift from concentration on selected pockets in 1981 to uniform distribution of population and household distribution in the year 2000. This indicates that all the areas in the town have grown in significant magnitude.

II. Economic Profile of Gurgaon Town - 1991

Occupational structure

The economic characteristics of an area play a determining role in the overall development of the region. In Gurgaon, the maximum share of population is in the tertiary sector (72.6%) followed by secondary (25.7%) and primary sector (1.7%). The functional classification of Gurgaon can be designated as a service town.

The ward-wise distribution of occupational structure Table 3.6 and Figure 3.2 in Gurgaon exhibits that the wards with maximum share of tertiary activities are in 16(83.1%), 8(80.3%), 19(80.3%) and 3(80.3) having more than 80% share in this sector.

The secondary sector has a maximum share in the wards of 18(31.6%), 6(35.4%), 21(33%) & 2(32.1%) accounting for more than 30% of the workers involved in industrial activities.

The primary sector however has a very less role to play in the Gurgaon with wards of 1(4.0%) and 2(4.1%) contributing to maximum percentage share.

Ward-wise Industrial classification of the workers - Gurgaon town - 1991

The nine-fold classification of the industrial workers in Gurgaon reveal that the maximum share is in the service sector accounting for 40.4 percent followed by trade and commerce sector 24.9 percent and industrial sector 21.5 percent. The least share of workers is in that of areas of mining followed by cultivators and agricultural labourers.

The ward-wise distribution of the nine fold classification workers reveals that other services with respect to economic activities such as community, social and personal etc services and activities account for the highest share with five wards contributing more than 40 percent. Whereas the least share of workers are there in the mining & Quarrying, agricultural labourers, cultivators and livestock, forestry, fishing and allied activities.

The second highest contribution is that of trade and commerce with maximum share in ward 4 contributing to 33 percent of the total workers in the respective ward. Infact industrial sector also has a significant contribution in the various wards of the town especially household industry.

The proposed plan of the NCR 2001A.D highlights on aspect of shifting the function of Gurgaon from service town to industrial sector by the boosting industrial growth in the urban area. The industrial sector would then account for 40 percent followed by service sector-22 percent, trade and commerce 16 percent and construction 10 percent.

Ward-wise Workers and Non workers - Gurgaon town - 1991

The distribution of workers and non-workers in the various wards of Gurgaon shows that the percentage of workers ranges from 25 percent to 33 percent. There are twelve wards that have workforce percentage more than 30 percent. The Regional Plan of NCR has estimated that the workforce by 2001AD will account to 35percent.

The non-workers contribute between 67 percent to 75 percent in the various wards of the town consisting of people mainly engaged in household duties, student, retired person or rentier beggars, etc. or engaged in non productive economic activity. The distribution of workers and non-workers for Gurgaon Town is given in Figure 3.3.

III. Spatial distribution of social composition in Gurgaon

The social characteristics of Gurgaon reflect on the existing socio-economic structure, pattern and inequity within the city. The inappropriate priorities, inadequate institutions, insufficient service delivery mechanism and lack of awareness amongst the people are the main impediments in achieving sustainable development in this area.

The spatial distribution of SC/ST population, literacy rate and Below Poverty Line People provides an insight into the social characteristics of Gurgaon. The categorization of the percentage contribution of SC/ ST/ OBCs to the total population of their respective wards have been under two broad percentage heads i.e. between 10 - 20 percent and 20 - 30 percent.

Ward-wise distribution of Scheduled caste and Scheduled tribe / Other backward class population

The spatial distribution of the SC population in 1991, revealed that maximum number of people were in the category less than 10 percent and the total percentage of SC population in Gurgaon accounted for 8 percent of the total population.

The municipal survey of the town in 1997-98 highlighted that the percentage contribution of SCs to the total population of the town was 13.8 percent. The wards with high percentage of SC/ST & OBCs contributing between 20-30 percent contained slums within them.

Incase of Scheduled caste distribution, the wards with 20 and above percent SC population were that of ward number 21, (Heeranagar slum) 17 and 9. The percentage contribution within 10-20 percent was that of wards 3, (Rajiv Nagar Slum & Delhi road) and 26 (parts of Baldev Nagar, Firoze colony and Veer Nagar slum).

The ward-wise distribution of scheduled tribe and Other Backward class also exhibits a similar pattern. Infact there were wards where Scheduled tribe contributed more then 40 percent like wards of 3 (Rajiv Nagar Slum & Delhi road), 5 (Mahavir Colony), 21(Gandhi Nagar & Heera Nagar) and 22 (Heera Nagar slum).

The average Scheduled tribe and other backward class contribution to the total population in Gurgaon in 1997-98 were estimated to be around 20.8 percent. This denotes that a significant proportion of population is dominated by them and needs to be kept in mind while initiating any development policies in this area.

The wardwise distribution of Scheduled Caste, Scheduled Tribe in Gurgaon Town is given in Table 3.7 and Figure 3.4.

In addition to the above the Below Poverty Line population ward wise also depicts the spatial inequity and area of low - income pockets within the town. The

wards of 3 (Rajiv Nagar Slum & Delhi road), 1 (Dayanand Colony & Mahavir pura), 9 (Bhim Nagar), 14 and 26 (parts of Baldev Nagar, Firoze colony and Veer Nagar slum) have more than 200 households.

Though it is difficult to assess and link the distribution of SC/ST, OBCs and BPL and slums within each other, but nevertheless a broad socio-economic pattern of the town emerges from the above.

Wardwise percentage distribution of Scheduled Caste/ Scheduled Tribe and Below Poverty line population in Gurgaon Town is given in Table 3.8 and Figure 3.5.

Ward-wise distribution of Literacy Pattern

To have an overall view of the social profile of the town aspects like literacy rates have been also been analyzed. The ward wise literacy rates in Gurgaon reveal that the ward of 1, 2, 6, 7, 15, 18, 20, 21 account for literacy rates between 60-70 percent whereas the rest of the wards account for more than 70 percent literacy.

This reflects that there are 8 wards with 60-70 percent literacy rate whereas 13 wards have more than 70 percent literacy level. On the whole the average literacy rate of the town is 71.5 percent suggesting that Gurgaon town has a high average literacy rate in comparison to the District average of only 49 percent.

The ward-wise socio-economic component of the town provides a comprehensive picture of the existing inequity within the town.

The literacy pattern of Gurgaon Town - 1991 is given in Table 3.9.

IV. Urban Slums

The increasing magnitude of slums and squatter settlements in the city has often been treated as a mere symptom of housing problem of urban poor and remains unattended and ignored. Thus the main thrust of the slums of Gurgaon should aim at people's participation that would sustain social economic and environment support structures for reconstruction and revitalization of society and aiming for a sustainable future.

Amongst all the class I towns of Haryana, Gurgaon is the only town where more than 1/3 of its population resides in slums.

The contribution of slum population to the total population of Gurgaon Town - 1991 is given in Table 3.10.

The Municipal survey of 1998 highlights that there are 14 slums in Gurgaon with its population accounting for 18 percent to the total population of the town. However, DUDA has identified 8 other slums that encompass areas within the town as well as to HUDA areas. Hence taking the slum population as estimated by Municipal Council & DUDA, the percentage of slum population in town accounts for 28 percent. Though this reveals a decline from the 1991 figures but nevertheless the percentage slum population is quite high.

Distribution of slum colonies identified under municipal council and DUDA -1997-98 is given in Table 3.11.

An overview of the socio-economic characteristics of the slum population in few identified colonies would bring out the basic existing structure within all of them. The socio-economic background of identified 8 slum colonies by DUDA outlines:

Firoze Gandhi Colony

The Firoze Gandhi Colony has maximum people working as labourers on construction sites and factories as well as in service sectors. They are a migrant population largely from other parts of Haryana and have recently settled here for owning a shelter and earning their livelihood. Forty percent of the population is Scheduled Caste, 22 percent Scheduled Tribe and 28 percent other backward castes. The literacy level in this slum would account for 40 percent.

Subhash Nagar

Majority of the people in this slum is dominated by Hindus wherein 42.8 percent belong to the backward class followed by scheduled caste (28.9 percent). The literacy level in this colony is 80 percent, which is quite high in comparison to other slums. The economic condition is also comparatively better than the Firoze Gandhi Colony, with workers engaged in construction or as factory labourers. They are also migrant population from other parts of Haryana as well as parts of Delhi, U.P and Rajasthan.

Bhim Nagar Colony

The majority of people in this slum are dominated by Hindus, which account for 90 percent of the total population. The literacy level of the slum is 49 percent whereas the occupational structure reveals that people are engaged as labourers (42.9 percent) and as sweepers (28.5 percent). Majority of people in Bhim Nagar colony have migrated from various parts of Haryana and are settled here for the past fifteen years.

Veer Nagar Colony

The slum of Veer Nagar has a sizeable proportion of Hindi speaking population along with Rajasthani, Harynavi, Marathi, and Kannada languages. They all belong to Hindu religion with 61 percent dominance of scheduled caste and 22 percent of the scheduled tribe. The SCs comprise of Balmiki and Nayaks, and STs are of mainly Banjaras. The literacy level of this slum is very low accounting for only 28 percent and the population is mostly self-employed. They are migrant population from Haryana, Delhi, Punjab, U.P, Rajasthan Maharashtra and Kamataka.

Katchi Colony

The slum of Katchi colony is dominated by scheduled caste population particularly Balmiki caste wherein two-third of the population is illiterate and has migrated from other parts of Haryana itself. The economic structure highlights that, majority of them are construction workers and wage employed. Since this is an unauthorized colony, pucca structures are not prevalent.

Idgah Colony 1 & 2

Hindus dominate these slums with prominence of schedule caste of Balmiki sub-caste and literacy level of only 30 percent. The occupational structure of the colony reveals that 70 percent of the people are engaged as sweepers in Government services and others are labourers.

Mahavirpura

The slum is dominated by Hindus and scheduled caste population. The sex ratio is 7:3 and literacy level is around 68 percent. The economic status of the colony shows that 40 percent are self employed others in wage employment

respectively and have migrated from Haryana followed by Delhi, Rajasthan U.P and Punjab.

Bhimgarh Kheri

The slum being located near the railway station belongs to Hindus wherein most of the population is illiterate. Occupation wise majority is self employed followed by wage employment and sweepers in Government service (Municipal Committee). The migrant population is similar to that of Mahavirpura and the main reason for migration is due to better employment opportunities in this area.

The slums identified by the Municipal Committee also reveal a similar socio-economic profile with dominance of scheduled caste in the colonies of Delhi Road (41.8 percent), Mahavirpura (62.2 percent), Dhanak Basti (83.8 percent) and Gandhi Nagar (41.1 percent) and scheduled tribe in the colonies of Manohar Nagar (41 percent) Laxman Vihar (30.5 percent) so on. The economic structures of these slums are also similar to the ones elucidated earlier.

Hence the comprehensive analysis of the Municipal town under its two broad heads of the ward wise details and slum profile gives the background of the existing socio-economic status. The steady deterioration in the quality of infrastructure within the slums, occasioned by increasing urbanisation has had adverse effects on the poor and pose a serious challenge to the policy makers and inspire them to develop multi pronged interventions for their development.

3.1.4.2 Profile of HUDA Area

With the enactment of Haryana Development and Regulation of Urban areas in 1975 and having the distinction of being the first of its kind by involving private sector in acquisition, development and disposal of land, HUDA was set up in 1977 marking the transformation of the urban landscape of Gurgaon.

The controlled area envisaged for Gurgaon along with the final development Plan for the urbanizable limit was published in 1996 outlining the various zones for development for Gurgaon UA. The HUDA area can be broadly divided into four sections:

- I. HUDA Sectors**
- II. Colonizers area**
- III. Urban Villages**
- IV. Industrial Area**

I. HUDA Sectors

HUDA initiated its development process by acquiring land from the farmers ranging from Rs 1.50 (1966) to Rs 20 (1986) per square yard. The earliest acquisition of land was done in 1965-66 for a part of sector 4. This sector being located towards north west and adjacent to the town was acquired for Rs 193.5 per acres against a compensation of Rs 1.38 million, at the rate of Rs 1.50 per square yard.

Later as the development process gained momentum the land rates increased from Rs 20 per acre (1977) to Rs 0.1 million per acre in 1986. However the rates were paid by the government depending on the categorization of land and location.

The HUDA sectors are developed on modern lines with a network of wide sector roads. In residential sectors minimum 45 percent of area under a particular use is kept for parks, open spaces, road and community buildings including community centres, dispensaries, schools crèches etc. as per the norms adopted by HUDA. The details of the sector under HUDA area are given in **Table 3.12**.

The total urbanizable area under each HUDA sector as provided in the development plan accounts for 2407.73 hectares and the actual area developed by HUDA accounts for 67.4 percent of the total urbanizable area.

II. The Private Colonizers Area

The Haryana Development and Regulation envisaged that by involvement of private sector, the urban development would become much faster and better planned due to availability of more financial resources. Under this policy, land for urban development was frozen and no individual could execute development works without acquiring license from HUDA.

Since 1981, the issue of license has encouraged private urban development and building construction under the act of 1975. The act provided as

already mentioned above regulatory controls to protect the interests of the plot holders and the government at every stage wherein no development could be done without issue of license.

While granting the license the state government in 1982 imposed certain additional condition for providing greater benefits to the members of Economically weaker section and low-income group of society. The stipulations included 20 percent plots to be allotted to such persons on such terms and conditions as the state government might direct. Another 25 percent of the plots to be developed on no profit no loss basis. The colonizers were free to dispose off the balance 55 percent of their land for general public.

Initially 1466 hectares of land in Gurgaon, situated close to Delhi was given under private development, this development started in 1982. Gurgaon with large tract of undeveloped land offered great potential of land and housing market where most of big colonizers of Delhi concentrated their energies and resources.

The Haryana mode of land development, with particular reference to Gurgaon offered a good case study of involvement of public and private sector in urban development, especially when the central government contemplated to involve the participation of private builders and developers by amending land policies and acts on the line of Haryana Development and Regulation of Urban Area Act in 1975.

The Overview of the Private Developers in Gurgaon is given in Table 3.13 and Figure 3.6.

The distribution of licensed colonies amongst the various colonizers in Gurgaon reflects that the main ones in this area are that of DLF followed by Ansals and Unitech contributing to 38.4 percent, 27.5 percent and 15 percent respectively. These colonizers have also undertaken work for the EWS as per the HUDA norms and have executed development works in the villages engulfed by them.

The main colonizers, DLF, Ansals and Unitech are contributing to 80 percent of development in the colonizer area. The internal infrastructural development is the responsibility of the colonizers, while the external development is carried out by HUDA out of the funds collected as external development charges collected from the private developers.

The main problems of the colonizers, however is the difficult procedure in procurement of land from the Panchayats and unwilling parties forming major

impediments in the continuity of the development process. The villages that are surrounded by the developers are given in Table 3.14.

III. Urban Villages

The final development plan accounts for 25 villages that are distributed all over the HUDA area and are encompassed by the private colonizers in many cases.

Though they are known as villages, but most of them have been fully urbanized (urban village) with very few people engaged in primary sector activities. Though the Lal Dora (built up) area has not increased but the pressure of population on land has been increasingly immense.

The urban villages in Gurgaon have given rise to peculiar phenomena, as their characteristics have drastically changed due to the advent of private developers and development taking place at rapid pace around them.

The detail of these villages along with their sectoral location provides a comprehensive picture of their spatial distribution in the urban area of Gurgaon.

The Gurgaon Urban area as per Development Plan published in 1996 includes a large number of villages. The details of the villages falling under Gurgaon Urban area including population, area as per 1991 census and the sectoral location is given in Table 3.15.

IV. Industrial Area

The industrial sector occupies an important position in Gurgaon's economy and plays a pivotal role in its rapid economic development. Gurgaon being situated at the periphery of Delhi and proximity to Indira Gandhi Airport has experienced a spurt of industrial activities. With the establishment of Maruti industry, the advent of other modern industries has taken place from mid eighties in Gurgaon. The main industrial areas within Gurgaon UA are Udyog Vihar under HSIDC and HUDA industrial estate.

The Development Plan have earmarked an exclusive area for industrial activities with development of industries taking place in the sectors of 18, 19 and 20 near Delhi border, sector 3A, 37A, 60 and 62 along the railway line and sector 34, 35, 36 and 37 along Delhi Jaipur road.

The State Government through department of Industries along with agencies HSIDC and HUDA has already done work in the field-creating infrastructure for setting up of industries in the district. They have established various industrial development areas as developed plots and sheds.

HSIDC has also been planning to carve out phase VII on the National Highway-8 for further strengthening the industrial infrastructure in Gurgaon. The details of the various industrial development areas as developed plots and sheds are given in Table 3.16 and 3.17.

The distribution of large and medium scale industries in Gurgaon UA reflects that the maximum percentage share is in the Engineering sector followed by IT industry, Plastic and Rubber products and Food processing. The textile industries also have a significant role in Gurgaon whereas the least contribution in industrial sector is that of leather goods.

The distribution of large and medium scale industries in Gurgaon is given in Table 3.18 and Figure 3.7.

Apart from the above- mentioned industries located in the Urban Area the Municipal town also has a significant proportion of industries within it. It can be viewed that the maximum number of industries are in ward 4 followed be ward 31, 5 and 3.

The wardwise distribution of industries in Gurgaon Town 1998-99 is given in Table 3.19.

3.2 Urban Infrastructure - Gurgaon Urban Area

The urban services provided under the master infrastructural plan by HUDA encompasses the urbanizable area of Gurgaon (covering a part of the town area also). The status of existing urban infrastructural facilities under HUDA's Master infrastructural plan includes the following services:

- Drinking water supply
- Sewerage System
- Storm water Drainage
- Roads and Bridges
- Street Lighting
- Horticulture and Arbosculture
- Community Buildings –External & Internal
- MTC of roads for 5 years
- MTC of PH services for 5 years
- Resurfacing of roads after 5 years
- MTC of street light and energy charges for 5 years
- Fire services

I. Master Water & Sewerage System

To supply water to higher altitude areas, the intermittent station is functional. There is 1 Pump House, 1 clear water tank of 1.25 million gallons capacity and 3 pumping stations (60 meter head and 200 LPS discharge each), which have been installed under this scheme. The areas to be served across National Highway include sectors of 29, 30, 41, 27, 28, 25, 18, 19, 20, 24, 26, 26A, 42, 43, 53, 54 & 55-56.

As per the topography of Gurgaon, the sewerage system has been divided into four zones. The slope of the urban area is towards the western side and the Najafgarh drain is available at a distance of 6 Kms from Gurgaon. The sewerage of the entire area will be collected near sector 4, near Delhi-Rewari Railway Line and be treated by the Sewerage Treatment Plant. Presently, the 32 MLD Sewerage

Treatment Plant constructed under the Yamuna Action Plan is functional and, the 68 MLD under the HUDA area is near completion.

II. Master Storm water Drainage Scheme

Gurgaon situated at the tail of the Aravalli hills has a natural gradient from the northeast direction to southwest direction. Previously the storm water from the Aravalli hills and from the catchment area of Gurgaon flowed through the natural creeks and surface drains existing in the area with ultimate disposal to the Najafgarh drain. Due to urbanization, the storm drains for drainage have been channelised into seven zones. Master Storm Drain for rainfall intensity of 1/10" per hour with its ultimate disposal into the Najafgarh drain. The S.W Box Drain Work completed is 13 Kms, SW Box Drain work in progress is 7 kms and the open drain is 5 kms. The catchment area of the Gurgaon is 17900 acres and the catchment discharge proposed to be carried out by each of the drain include the following:

- Drain 1 2895 acres
- Drain 2 5291 acres
- Drain 3 3271 acres
- Drain 4 2573 acres
- Drain 5 871 acres
- Drain 6 866 acres
- Drain 7 1140 acres

Potential area for water harvesting

The eastern side of the Gurgaon UA has a natural drainage system, with undulating topography and well-defined creeks carrying floodwater from the nearby hilly catchment.

There were two bundhs constructed earlier at Chakarpur and Wazirabad for flood protection and water conservation, but with rapid pace of urbanization these bundhs have given rise to complex environmental problems due to massive construction taking place around these areas. One of the upstream bundhs of Wazirabad for sector 27, 26A, 42, 43, 53, 54, 55 and 56 was required to channelise the storm water flow of the existing well defined creeks so as to protect these sectors from flash floods of the hilly catchment.

However, in recent years the area identified as the potential water harvesting zone in Gurgaon is the northern and the eastern areas covering the DLF area, Sushant Lok and villages of Chakarpur, Sikanderpur and Nathupur. The sectors suitable for water harvesting area thus include - sector number 55, 56, 54, 53, 42, 43, 27, 28, 25, 24, 25 A, 25 & 26.

III. Master Road & Street Lighting Works

Gurgaon has a network of master roads i.e. V2 roads (60 meter R.O.W) and V3 roads (30 meter R.O.W) of 151.05 kms, of which the existing PWD (B&R) roads is 41.80 kms. (37 kms-V3 roads + 4.8 kms-V2 roads. The total network of HUDA roads is 109.25 kms of which V3 roads are 73.57 kms and V2 roads are 35.68 kms. The detailed status of the V3 and V2 roads include:

V2 roads (60 kms wide R.O.W)

Existing P.W.D.(B&R) –Gurgaon Sohna road	4.80 kms
Total length of HUDA roads	35.68 kms
Length of construction roads with dual carriage way	9.5 kms
Length of constructed roads with single carriage way	11.49 kms
Length of balance roads to be constructed	14.76 kms

V3 roads (30 meter R.O.W)

Total length	110.57 kms
Existing PWD (B&R) roads	37,00 kms
Length of HUDA roads	73.57 kms
Length of constructed roads	42.11 kms
Length of balance roads to be constructed	31.46 kms

The street lighting network is about 151.05 kms i.e. V2 roads is 40.48 kms and V3 roads is 110.57 kms of which the existing PWD (B&R) roads forms part of master roads is 41.80kms(37 km-V3 type & 4.80Km V2 type).

IV. Master Horticulture

Master Horticulture provides planting of trees along the roadsides, green belt and open spaces, besides development of green belt along National Highway-8 and along roads 60 meter and 30 meter wide. Provisions have been made for planting four rows of plants along the 60 and 30-meter wide roads. The first two rows are to be shady with beautiful foliage and other two rows are ornamental with colorful flowers and good canopy. There is also provision for development of parks, open spaces and green belts of about 363 hectares under this scheme.

Development of Leisure valley parks include a park with an area of 25 acres, developed with water body, fountain and rose garden in sector 29 –city centre-Gurgaon. HUDA has also developed a nursery for sale of plants and shrubs to public and a Model Park for children.

As per Master Plan total project cost of the work is Rs. 125 million including the maintenance costs for five years. The following items have been taken up in the estimate:

A) Road Side Plantation

There is provision of 432 Km. roadside plantations with 35490 ornamental cum shady trees to be planted on all the master road i.e. on 60 M. wide road & 30 M wide roads. Plants shall be planted at distances of 10 m to 12 m.

B) Provision of Mild Steel Tree Guards

Good quality of Tree-guards made of mild steel shall be provided around all the trees to protect them from stray cattle.

C) Plantation of Shrubs

Planting of about 85870 flowering shrubs has been provided for under the Master Horticulture scheme. Two shrubs shall be planted between one tree. These shrubs shall act as groundcover as well as make the berms beautiful with their multicolour flowers.

D) Development of Green Belts

In the Master Horticulture Scheme, there is 353 acres area of Green Belt, which is to be developed with parks and thick plantation. About 100 Acre area from this green belt shall be developed as park fenced with Toe Wall with Jali wire fencing and others Land Scape features such as foot path shelters, Fountains, Water Falls, Lily Pools shall also be installed to add to the aesthetic beauty.

E) Thick Plantation in the Green Belt

There is provision of 56820 nos. plants to be planted in the Green Belt provided along 60 M. road as well as 30 M. road in various parts of the town.

Details of Green Belt with parks/thick plantation in Gurgaon Urban Area are given in Table 3.20.

V. Construction of Community Buildings

HUDA has already constructed various types of buildings – 7 community center, 2 police stations, 9 Police posts, 1 higher secondary school, 9 primary schools, 1 dispensary, 1 Fire station, Club building, 5 cresches, 1 Restaurant and shopping complex and 2 Commercial Complex Buildings. Besides these, there are few others that have also been proposed for the future.

The distribution of social and economic infrastructural facilities in Gurgaon as envisaged in the master plan by taking into account its standards and norms are given in Table 3.21.

The distribution of existing and proposed public convenience system in Gurgaon has been given in Table 3.22.

Gurgaon town has 35583 residential buildings and 8127 shops / institutional buildings as per the Municipal survey of 1999. There are 341 industries, 42 big markets, 11 small markets 10 hotels & 134 big and small restaurants in Gurgaon Town and 42 hospitals including nursing homes/ dispensaries and 71 schools/ colleges in the entire Gurgaon UA.

3.3 Existing Landuse - 2001

3.3.1 National Capital Region Plan (1981 – 2001)

The adoption of the regional approach towards addressing the problems of Delhi arose at the time when the master plan of Delhi – 1962 was being framed. The master plan recommended that Delhi should not be treated in isolation but all the plans of future growth should be prepared in conjunction with the master plans of the entire region.

The reason being that all the units of the region are connected with the metropolis by the way of providing daily services and consumer products and form an integral part of it. The master plan had also suggested the constitution of a statutory body for the National Capital Region, wherein in 1985, the National Capital Regional Planning Board was set up with the first statutory Regional Plan –2001.

There are three distinct policy zones in the National Capital Region- the Delhi Union Territory, the Delhi Metropolitan area (DMA) excluding Delhi and the area beyond Delhi Metropolitan area. The interaction and interdependence of Delhi with the adjoining DMA towns has intensively increased in the recent years.

The services of Delhi like economic, social and job opportunities are served by the floating population from the DMA towns. However the prime objective of the DMA towns in the Regional Plan is to decongest Delhi and contain its population within the manageable limits.

Gurgaon being one of the most important DMA towns of National Capital Region exhibits tremendous potential for growth and development. Infact it has one of the highest average annual growth rate of population of 29.95 percent as estimated by the NCR plan for the period 1981-2001 AD.

The DMA towns under National Capital Region, its population (1981 & 2001) and annual growth rate are given in Table 3.23 and Figure 3.8.

The urban area of Gurgaon has been envisaged to incorporate large scale residential as well as industrial activities within its arena. Infact the land requirement for urban development in Gurgaon as estimated by the National Capital Region Plan-2001 reflects that an additional land of 31.87 sq. km will be required to accommodate 700 thousand population which is the second highest amidst the other six DMA towns after NOIDA.

The land requirement for urban development of Gurgaon by the year 2001 is given in **Table 3.24**.

Gurgaon aims to play an important economic base for decongesting Delhi as suggested by the Regional Plan. The projected participation rate of Gurgaon will be about 35 percent by 2001.

The major proportion of the workers would be in the sector of industries followed by services. The primary sector would account for the least share by 2001.

The employment structure in DMA town of Gurgaon is given in **Table 3.25** and **Figure 3.9**.

The Regional Plan, after evaluating various alternative scenarios for development, perceived that in order to save the overflowing population of Delhi, it is necessary to moderate growth in the areas around it.

At the same time, it is also recognized that any additional population in the DMA towns, will not to any extent moderate or reduce the problems of Delhi as their interdependence is intensive and necessary mutual.

The preliminary studies clearly concluded that economic activity with potential for large-scale employment should necessarily be located outside the DMA, preferably at the distance, which discourages daily interaction with Delhi. This further reflects that DMA towns have a significant relationship with Delhi and have potential for solving the over-congestion problem of Delhi.

3.3.2 Gurgaon Urban Area - 2001

The main development agencies in Gurgaon are Haryana Urban Development Authority (HUDA), Haryana State Industrial Development Corporation (HSIDC), Haryana Housing Board and State Government Departments like Public Works Department, etc. These agencies are prime movers for enhancing and promoting development in Gurgaon and have played an effective role in the overall progress for the same.

With an endeavor to achieve a holistic, balanced and integrated blue print for Gurgaon, the Development Plan-2001, was conceived. This Plan underwent many alterations and revisions from time to time incorporating the changing needs and demands of the region, before its was finally published in 1982.

Infact, the formulation of the Development Plan for Gurgaon dates back to 1971, which estimated a population of 125 thousand by the year 1991. This plan was further revised in 1977, with a projected population of 225 thousand by the year 2000.

Later on, keeping in view the physical sprawl of the region and regularizing the haphazard development at the fringes, Haryana Government Gazette Notifications was published on February 1980 and June 1981, extending the controlled area limits of the plan. Finally the Development plan was published visualizing a population of 1 million by the year 2001.

The Basic Concept of the Development Plan was to articulately design the landscape of Gurgaon with provisions of various landuses to be done in conscious manner. Thus the approach adopted was to concentrate the residential sectors in the southeastern, western and eastern side and near the industrial area for reducing the work place distance.

The industrial sectors were carved out along the National Highway for easy accessibility, effective communication and for a faster economic development. The commercial activities forming the main hub of a region, the heart of the plan was conceived to accommodate this landuse having easy accessibility to all the parts.

The parks and open spaces were also earmarked around the ammunition depot on the northern side, along roadsides and areas earmarked within individual sectors. Hence the Town & Country Planning Office envisaged an ambitious plan for Gurgaon that would be able to sustain and accommodate the rising population in this region comfortably.

The percentage of residential zone (63.7 percent) contributes to maximum share followed by industrial (13.65 percent), Transportation (6.73 percent) and Defence land (6.4 percent).

The area under Special zone accounts for least share. The area under the village and the municipal town has not been included in the Landuse, which accounts for 2.75 sq. km and 4.06 sq. km respectively.

The quantitative estimation of the area under each use helps in obtaining a fair idea of the landuse pattern of Gurgaon UA. The eight-fold classification of the major landuses in the plan elucidates their utility and significance in the process of balanced and compatible urban development for Gurgaon. These include:

Residential Use

The residential areas have been designed for accommodating the rapidly increasing population in Gurgaon. Further, few of the residential areas have been carved out near the industrial zone so as to maintain minimum work place distance.

The density near the industrial areas has been estimated as 150 persons per hectare, whereas the other areas have an estimated density of 100 persons per hectare. The residential zone hence forms the major landuse in the plan, for which adequate provisions have been made to accommodate Gurgaon's rising population with ease.

Industrial Use

Gurgaon emerging as one of the nodal centers for industrial activity, a major segment of land under this use has been earmarked for industrial development. The industrial zone concentrates along the major transport corridors for easy accessibility and increased efficiency of goods movement.

Commercial Use

As commercial activities form one of the vital components for a growing urban center like Gurgaon, the central location has been designated for this use, having linkages to all corners of the region. The 'city center' of Gurgaon would meet the needs of its district population as well as cater to the city's population.

Transport and communication

To streamline the local as well as the thorough traffic, the existing Delhi-Jaipur highway has been linked with the 60-meter wide road upto Delhi, with provisions of a green belt. Two more roads have also been proposed on eastern side for smooth connection between commercial, institutions, wholesale market areas etc.

Public and semi public uses

This use includes the institutional area that has been conceived to accommodate the increased resident population who would have their work place here in the following years to come.

Open Spaces

A 200-meter wide area has been demarcated around the ammunition depot and ordered to be kept free from urbanization under the provision of the Works and Defence Act 1903. The Delhi Jaipur highway, railway and Badshahpur nallah south of Gurgaon has also been designated as the green belt.

Agricultural Zone

Though a sizeable area within the plan has been designated as agricultural use, but it would not eliminate development such as extension of existing villages, provision of allied services etc. within the region.

Special Zone

This zone would encompass areas for recreation, entertainment, commercial group housing and institutional uses.

The spatial pattern development in Gurgaon indicates a wide spectrum of variations in landuses, each depicting its distinct identity in the overall framework of the plan.

Along with the Development plan, the legal sanctity to the proposals regarding landuses has been given effect, by laying down Zoning Regulations, which form a part of the Development Plan. These regulations govern the change in landuse and the standards for development.

They also elaborately detail out the allied and ancillary uses that are permitted in the major landuses and stipulate that all development and changes of landuses shall be in accordance with the details shown in the sector plans for each sectors to guide the development and enforce proper control.

The existing landuse pattern of Gurgaon urban area is given in Table 3.26 and Figure 3.10.

Though the Development Plan 2001 for Gurgaon envisaged a gigantic vision, there have been few areas that need attention and more emphasis while planning:

- The published Final Development Plan for the controlled area I-IV was designed with an estimated population of 1 million for 2001. Meanwhile the controlled area V-VI around Gurgaon were also declared under section 4(i) of the Act no 41 of

1963 vide Haryana Govt. Gazette Notification in 1995, in continuity of the controlled area I-IV earlier declared. But till date no Development Plan for these areas V-VI have been published.

- The proposed open spaces in Gurgaon were estimated as 8.50 sq. km in 1983 Draft Plan prepared by Town and Country Planning Office, which contemplated setting up of playgrounds, parks green belts, crematoria etc, wherein only 3.63 sq. km of land was finally approved in the Final Development Plan.
- Though the Agricultural zone is supposed to be east of the railway line, but along the line, a number of unauthorized colonies have sprung up in blatant violation of Punjab Scheduled Roads Act and Urban Area Act.
- A glaring example of encroachment has taken place over the years in the prohibited areas around the ammunition depot. Whereas the depot requires having an open area of 900 meters surrounding it under the provision of the Works of Defence Act -1903 but there have been several constructions within its domain like colony of New Palam Vihar and others violating the regulations.
- Though Gurgaon town constitutes a small proportion of the entire plan, its mention has been omitted in the entire exercise.
- The Final development plan proposes a unidirectional growth for Gurgaon, which is only towards the southern side between Sohna and Gurgaon Jaipur road as well as in the Gurgaon Pataudi section. Hence the southern section needs connectivity and easy accessibility.
- The Development Plan needs to have an integrated and holistic approach for counteracting the problems of the municipal town as well as the HUDA area. The plan cannot view the problems of the HUDA area in isolation, hence along with the proposed development for the urban area of Gurgaon, emphasis has to be laid on the changing dimension of the town's demographic and socio-economic profile.
- The Development Plan needs to envisage an approach, which would lead to balanced development of the town as well as the HUDA areas.
- Land grabbing, encroachment and degradation have assumed an alarming proportion in Gurgaon that needs to be curbed by various measures adopted in the Development plan as well as adherence of the same.

With all its weaknesses and shortcomings the Development Plan of 2001 has laid a positive path for growth of Gurgaon by integrating all the landuses in a compatible and conscious manner. It has also paved the path for setting of multinationals and other nonpolluting industries that would boost the economy of Gurgaon in the coming years.

The Haryana Urban Development Authority has acquired and developed around 9995.4 acres of land constituting 33 sectors designated for different landuses, which are under different stages of planning process. The sectors are developed on modern lines with network of wide sector roads.

The standard and norms of HUDA include that in the residential sectors, minimum 45% of the area has to be kept under parks, open spaces, schools, dispensaries, crèches, police posts, post office, electric sub station etc.

The higher order facilities have to be provided for an estimated population of 100 thousand persons including the provision of colleges, hospitals, police stations, telephone exchange, and fire stations.

3.4 Proposed Landuse Plan - 2021

3.4.1 National Capital Region Plan (2001 – 2021)

The Regional Plan 2001-2021 for the National Capital Region is still under preparation and visualizes to incorporate strategies that would lead to effective urban management and sustainable urban development for the entire region.

The Plan would emphasize on implementing counter magnet approach for the achievement of planned decentralization and enabling wider dispersal of population and activities.

Based on these concepts the Regional Plan of NCR with special focus to Gurgaon is trying to perceive on the following issues, which would aid in balanced development:

- The communication revolution in the present decade illustrates that there has been a trend of shifting Corporate offices from Delhi to Gurgaon for favourable reasons and is likely to gain momentum in the following years. The rising industrial activities in IMT, Manesar would further contribute to an increased

growth rate in Gurgaon. Hence an estimated population of 2 million has been proposed for the year 2021 after having viewed the present and past trends.

- The possibilities of urban extension as under the Final Development Plan suggest unidirectional growth for Gurgaon. Further the connecting roads of Faridabad and Sohna terminates abruptly which should be connected to the NH-8, to make it by-pass for the traffic coming from Jaipur and going towards Sohna, Faridabad and Delhi.
- The proposed expressway connecting Delhi with its NCR towns would be passing Gurgaon at two locations – Gwal Pahari on Faridabad road and Dundahera on NH-8. Since its not feasible to have outer periphery roads that could connect the Expressway at the point of village Dunadahera, the proposed roads between Gurgaon-Faridabad and Gurgaon-Sohna road need to be extended upto NH-8. This would further deflect the traffic from Jaipur and the proposed urbanizable area to by-pass the existing town without merging with intra-city traffic.
- The controlled area V and VI would be included in the Plan for 2021 which would be a new addition to the previous plan.
- The land proposed for institutional use has already been more or less planned, developed and earmarked for various offices and no major chunk of institutional land is available within the published plan to be used for setting up major institutes. Therefore an exclusive sector for use of major institutions is proposed in the additional area proposed for urbanization.
- The Transport Nagar under sector 33 would not be very feasible to develop under the scale given in the development plan and only a limited area would be assigned to develop a mini transport Nagar. For this a full-fledged sector has to be designated to develop the transport Nagar and the ancillary facilities.
- An exclusive sector has to be earmarked for warehousing and storage as in the coming years the demand for storage facilities would rise tremendously.

Apart from the above-mentioned factors that are under consideration for preparation of the proposed Development plan-2021, it has been further decided that the extents of the NCR should be increased.

The National capital Regional Planning Board in July 2000 cleared the proposal to expand the limit of National Capital Region by including an additional limit of 38401 square kilometres area into it.

Though the Haryana sub-region was reluctant for inclusion of its area, but nevertheless the proposal was passed aiming for significant development for the period 2021.

The Regional Plan focuses for equitable development by introducing strategies at regional and interregional level for reducing disparity and increasing the quality of life.

The performance of each state within the NCR is of critical importance in effectively managing urban growth. While the access to basic infrastructure, shelter and employment depends, as much on private initiatives and enterprises, there are critically affected areas that require public sector policies and functions that only government can perform.

Thus the challenge is to combine the resources from both sectors and integrating policies for development in the NCR.

The joint mode of development adopted in Gurgaon has played a crucial role in transforming its urban landscape. It has also been realized that an integrated and holistic approach is required for coming out with realistic solution to the emerging urban-environmental problems in Gurgaon. This could be done by blending spatial and economic planning along with people's participation in the entire urban planning exercise.

There needs to be a shift from the traditional approach of planning to more realistic planning by incorporating views of community at large as well as having close Public – Private partnership in confronting the urban environmental challenges.

We are hence faced with the challenge of coping with our urban future, which has to be met by all – government, private sector, NGO community and the people, by working collaboratively to overcome the obstacles that we face in our everyday attempts to create a better urban environment.

3.4.2 Gurgaon Development Plan – 2021

With only a year behind the expiry of the Development Plan of the year 2001, efforts are being made to introduce the proposed Landuse Plan for the year 2021. Though this plan is still under preparation, the main components of this plan can be assessed at the backdrop of the existing Plan 2001 on one hand and the rapid expansion of Gurgaon with its emerging issues on the other hand.

The few vital constituents that have been visualized for the plan incorporates:

- By year 2016, there would be considerable enhancement in the economic activity of the Urban Area with the working population accounting upto 40 percent in relation to the total population.
- Gurgaon being one of the DMA towns, the impact of Delhi as the economic nerve center for the National Capital Region would influence the diversification of the workforce into varied sectors.
- The residential sectors have been planned keeping in view the factors like topography of land, close proximity to National Capital Region and having harmonious work plan relationship.
- The density of the new sectors being 100 PPA would have more space for socio-economic and recreational facilities and will in the long run enhance the standard of living of the region.
- The areas along Haryana – Delhi border on the southeast of realigned NH8 has been proposed to develop as forest zone for social forestry. The area south west of the urbanizable limit has been proposed as recreational/ cultural zone to cater to the recreational requirements of the region.
- The Transport Nagar has been earmarked on the NH-8 that could be easily accessible from the industrial and whole sale, commercial areas.
- The proposal of converting the existing meter gauge railway line into Broad Gauge in conformity with National Capital Region Plan wherein boosting the economic development of the region.
- The strengthening of the infrastructural facilities for the rising industrial complexes at Razka Meo and Dharuhera would require facilities from Gurgaon.

The proposed Landuse for Gurgaon has been conceptualized with a view to accommodate the rapidly changing urban scenario and the existing issues prevailing in the region.

The eight major Landuse include:

Residential

As envisaged by NCR, the residential development would be done in two phases for the projected population of 1.5 million by the year 2016. In the first phase (by year 2001), the residential development of 34.50 sq. km would be done accommodating population of 700 thousand and the remaining area of 11.95 sq. km would be reserved for the second phase for the balance population of 800 thousand.

Industrial

To meet the growing demand for the industrial activities in Gurgaon, 16.40 sq. km of land has been earmarked for it, extending to the sectors of 18, 19 and 20 near Delhi border, 3A, 37A, 60 and 62 along the Railway line and sector 34, 35, 36 and 37 along Delhi-Jaipur road. These sectors would be reserved for pollution free and electronic industries. Gurgaon would hence be characterized as an administrative and institutional town at the backdrop of an industrial base.

Commercial

Besides sector 29, being the hub of commercial activities, two district centers have also been provided in the sectors 23A and 46 in form of linear commercial strips along the main arteries. The ware housing facilities has been provided along with the industrial area in sector 37A and 48. The detailing of these commercial activities would be dove tailed with the blending of activities for recreation and institutions to give a character to the town for future development.

Transport and communication

Two major arteries have been proposed in the north south and the east west direction of the existing town marked as V2, with a width of 100 meters having green belts along its side. The artery of the east west of the town will adhere to the regional proposal of the NCR town linking Gurgaon with Faridabad and Rohtak via Jhajjar. Along the NH-8 and the proposed 100-meter (V2) road linking Faridabad Gurgaon, Jaipur and Rohtak, the sectors of 33 and 34 would develop the Transport Nagar.

In order to link the proposed town with the railway station, a V³ road plan along the sector 13, through the restricted area has been envisaged.

Public and Semi Public use

The sector 32 and 44 in form of linear strips along the V² arteries of the Development plan has been proposed for the public and semi-public purpose. In addition two sectors of 49 and 50 have also been provided for institutions.

Open Spaces

The open spaces have been proposed in form of green belts along the major arteries of the UA and in providing a buffer zone between the roads and surrounding areas. Infact the open areas have also been proposed along the bunds for ground water recharging.

The southern zone of the urbanizable area has been proposed as major recreational zone with sport facilities of Golf, Swimming Pools, Drive-in Theatre, Velodrome, Gymnasium Indoor stadium etc. The north south V² road terminates here, wherein cultural and regional recreational centers have been proposed for local and regional use.

Public Utilities

The area of 55 hectares has been reserved for public utilities, which includes canal based water works on Sultanpur road, disposal works at sector 9A, area across the railway line and the electric grid station near village Badshahpur.

Reserved Area

The area around the 1000 yards of the ammunition depot has been earmarked as reserved area where no construction can take place without the prior permission of the Government.

The proposed landuse for the year 2021 is given in Table 3.27 and Figure 3.11.

3.5 Critical Appraisal of Urban Planning Issues in Gurgaon

The rapid pace of urbanisation in Gurgaon calls for an urgent need for a long-term perspective planning in creating a strong infrastructural base for its rising population.

The urban-environmental issues in Gurgaon if not addressed and managed today, the stress on infrastructural provision will be reflected by the year 2010 AD when the construction of houses and colonies will be at their completion stage.

The plethora of plans and policies, for sustainable urban development process in Gurgaon has assumed prime importance. Though there have been conscious efforts from the HUDA to encourage the private developers to acquire land within the planned area – develop and sell it in the open market, the few issues that still require urgent attention include:

- The development plan for Gurgaon should also be supported by a detailed infrastructural plan, which would be able to incorporate the growing demands of the area. One such apathy can be viewed in case of Solid waste management system of Gurgaon. When the development plan was made few vital issues were not envisaged like – earmarking area for solid waste disposal, cremation grounds and so on.
- The need to shift from the traditional approach of planning to more participatory and realistic planning is what one requires in today's era. The participatory planning approach would cater to the needs and aspirations of the people and have realistic base for policy intervention in Gurgaon.
- The inclusion of the green concept while planning for the region forms an important element, which seems missing in various plans of today. Though there has been mention of developing this concept but little has been done in this regard.
- Gurgaon exhibits varied development patterns in terms of modern high rise buildings, predominance of urban villages, slum colonies and the old town area. A number of slums have made their appearance due to growth of employment potentials in Gurgaon and viewing the experiences in Delhi reveal that the villages within the Urban Area tend to become repository of the poor and also acquire slum like character if not planned now.

- In terms of infrastructural conditions in Gurgaon, apart from the main road network most of the other roads are still being constructed. The master water supply scheme, storm-water and sewerage system is still being laid down. A large proportion of the Gurgaon's population is still using ground water and as a result the ground water is becoming brackish due to over exploitation.
- Gurgaon poses an attractive land market for the investors/developers wherein a large proportion of the flats, which are being built by the developers, are kept vacant and speculation on the land is considered. The other serious question that arises in Gurgaon is that of affordability of these flats/houses/colonies developed by the Private Colonizers. The local people of Gurgaon find it difficult to afford these houses and most of these flats/ houses are owned by people residing in Delhi.
- The dramatic ground water lowering in Gurgaon poses a serious threat in future, with the depth of water lowering upto 40 meters in the central area and 30 meters in the adjoining areas.
- The resource potentials and carrying capacity of the region needs to be assessed and incorporated in the plan, whereby giving the details of the existing situation and future projections. The inclusion of low energy buildings and newer techniques to conserve energy must be incorporated in the plan.
- The growth of informal sectors, unauthorized colonies and urban villages along with the high-rise private developer buildings focuses on complex socio-economic disparities and lack of integrated planning in Gurgaon.
- One of the major connectivity from south Delhi to Gurgaon (Mehrauli – Gurgaon road) the 21-km Delhi-Gurgaon stretch handles over 0.2 million passenger car units daily against its capacity of 40,000 PCUs, traffic on Mehrauli-Gurgaon has been fast attaining dangerous proportions.
- The traffic jams at Sikanderpur village and the narrow culvert / bridge in the adjoining area (near DLF Corporate Park) endures immense traffic pressure. Gurgaon being one of the most upcoming DMA Towns of the NCR has been facing immense vehicular pressure on the National Highway-8 in recent years.
- The need to introduce intra city public transportation system and strengthen inter city transport system is of critical importance in Gurgaon.

- Though there have been proposals for widening the NH-8, there are other considerations that also need to be kept in mind like that of road accidents, proper roundabouts to be laid where smaller roads bisect NH-8 (Sukhrali, Jharsa and Maruti Joint Ventures).
- Gurgaon experiences scattered development and hence infrastructural investment becomes a gigantic task. There is a need to focus on a phase wise development in Gurgaon.
- The old town of Gurgaon having narrow roads / lanes and heavy traffic leads to bottlenecks and congestion in the central area of the town. Hence serious thought has to be given to constitute an urban renewable plan for Gurgaon and integrating it with the newer areas.
- The existence of two authorities viz. HUDA and the Municipal Committee and their attempt to achieve sustained urban development for Gurgaon, has given rise to discrepancies and deadlocks within their areas of jurisdiction.
- Further the financial strain of the Committee also adds on to the apathy. Thus transforming Gurgaon into the Municipal Corporation with one single authority would solve many vital issues and avoid confusion.

Hence the comprehensive profile of the region by identifying the major issues provides imperatives for devising planning inputs in formulation of concrete plan for the region.

3.6 Suggested Action Plan

The final Development Plan for Gurgaon published in 1996 envisages a population of one million by 2001AD, covering an area of 10562 hectares. Gurgaon with its accelerated pace of development is considered as an urban extension of Delhi and has been accommodating its over spilling population.

However keeping in view the physical sprawl of the region and developing Gurgaon in a systematic manner, HUDA encouraged the private developers to acquire land within the planned area – develop and sell it in the open market.

As a result, these developments are at much higher density than stipulated in the development plan. It also appears from the current pattern of development that

Gurgaon will accommodate 4 to 5 million population by 2021 AD, against the envisaged target of 2 million.

The urban environmental issues in Gurgaon if not addressed and managed today, the stress on infrastructural provision will be reflected by the year 2010 AD when the construction of houses and colonies will be at their completion stage.

With the plethora of plans and policies the joint mode of development adopted in Gurgaon has played a crucial role in transforming its urban landscape. Despite conscious efforts being made by TCPO, HUDA, and HSIDC and others to develop Gurgaon in a sustained manner, the city has been growing disproportionately giving rise to complex urban environmental issues.

The basic concept for visualizing Gurgaon, as a green city for tomorrow would be to adopt a holistic and integrated approach to counteract the multi-facet problem of socio-economic dimensions and urban infrastructural issues in the future years.

Hence the need to shift from the traditional approach of spatial planning to spatio-economic & participatory planning is what one requires in today's era.

Planning Paradigms

In order to make Gurgaon into a green city, the action plans have been broadly divided into short term & long term plans along with regulatory measures. Further the action plan focuses in the areas of Landuse/ Environmental issues and Urban Infrastructural Management & others.

A. LANDUSE / ENVIRONMENT

Though the Final Development plan for Gurgaon envisages a gigantic vision for 2021 AD, the suggested measures for strengthening the Landuse/Environment issues would be:

Short term

- The assessment of likely population base, assuming it to be high, needs to be given some spatial definition, because spatial distribution of activities and population commensurate with environmental carrying capacity is crucial to

Green City Concept. There is a need for assessment of land and environmental resources vis a vis population and activities.

- To formulate a comprehensive Development Plan for Gurgaon by incorporating details of the existing socio-economic components and infrastructural demands with future projections for the entire urban area (water supply, energy management, waste management, so on).
- The Green City of Gurgaon need not be considered as a "stand alone" example. It should be considered as a city in the regional framework of other cities including Delhi. Growing cities in the vicinity have tendencies to coalesce into space continuum defeating the purpose of Green sustainable cities unless they all follow similar development paradigms. Spatial Development control policies, based on environmental sustainability on a regional basis is a sine a qua non, for success of Green City concept. There is a need to carry out a regional study.
- Master Plans tend to be based on fixed horizons of time with deterministic land use designations. This has failed to provide environmentally sustainable development mainly because of its inflexibility, and incapability to monitor and adapt to changing needs. A city to remain Green needs to be adaptable and responsive to changing socio-economic realities. The portions of the planned city, which are still unbuilt need to be replanned accommodating this postulate.
- Gurgaon Master plan needs to be reviewed by re- examining the population density in all the blocks of the urban area.
- To have a separate urban development body for framing detailed layout plans and regulations for Gurgaon Urban area
- To make an inventory of the layout plans in a comprehensive and composite manner by examining the areas where development /onsite development has been committed and the areas where development is still coming up. Then restructure the plans in such a way so that the object of Green City is achieved.
- The Development Plan needs to highlight on the growth pattern of the old town, Urban Slums, Urban Villages, Private Developers, HUDA sectors & industrial / Institutional areas and emphasize the definite role each would play in the future years. The future character of the town also needs to be defined.
- Provisions need to be made for the allocation of sites for disposal of solid waste, cremation ground, leisure activities so on.

- The need for identifying the physical growth & direction of the city and also to come up with plan wherein each sector would emerge as a self-sustaining unit by themselves.
- The need for carrying out an Environmental Impact Assessment and detailing of the various environmental issues, emerging by 2021 AD, keeping in view the urban development taking place in Gurgaon.
- To incorporate extensive tree plantation in linear pattern along roadsides and maintenance of greenery in the eastern part of the Gurgaon UA and also within the town area.
- The areas traditionally used for water harvesting should be kept out of purview of building development and may be developed as major open space structure to accommodate technologies of sewerage and ground water recharging facilities.
- The northern and eastern region of Gurgaon, having natural drainage and suitable contours for water conservation can be considered a good site for the above.
- The villages, which are engulfed by urbanization, they need greater attention. Delhi's experience should be fully learnt and repeat prevented. Therefore, a detailed study of existing villages needs to be carried out, so that they get integrated into the emerging urban fabric. Villages beyond the urban area, tend to be repositories of the poor, and unwanted uses. Since they are not in the purview of urban authorities, they become slums. A city cannot remain green in an otherwise black belt. This aspect should also be considered in planning.
- Browning of the Green Belt is a known phenomenon, and has been successful in defeating the purpose of a sustainable environment friendly city. The methodology of managing these Green Belts is crucial to the Green City Concept.

Long term

- To Introduce GIS application for mapping and formulating the sectoral & areal plans for Gurgaon Urban Area.
- To develop an urban renewable plan for the old town of Gurgaon.

- To have a revival and rejuvenating plan for the selected ponds in Gurgaon (at Sukhrali & Dronacharya college)
- The essentiality of incorporating the green city concept in Gurgaon, viewing the unbalanced pattern of growth it exhibits.
- Encourage wastewater and recycled water for maintenance of green covers in Gurgaon

Regulatory Measures

- The need for proper enforcement of Haryana Regulation Act-1977/79 by strictly abiding to its building rules/ regulations (setbacks, FAR so on)
- To make water-harvesting methods mandatory for public, semi public and residential buildings.
- To adopt and encourage sustainable pattern of building designs for energy efficient and water conservation methods for building plans.
- To define the responsibilities of various departments and make them accountable for their work.
- The construction of sewerage lines and pipelines to be laid on the extreme side of the roads to avoid cutting of roads for further broadening and encroachment.
- Introduction of strict regulatory measures to curb land grabbing and encroachment and to install sign boards in each vacant land denoting the owner of the land.
- Speculation on Land and development needs to be assessed. Specified time frame may be given to the owners for constructing houses so as to avoid and disproportionate pattern of growth and encroachment.
- Installation of separate pipelines for raw water connection and drinking water connection in the building plans.
- The land development and real estate development licenses must contain:
 - Obligations for provision of water, power and transport.
 - Promoter's interests must be permanent and not allowed to 'sell and scoot'.

- Parks and leisure venues must be included in the licensee's obligations
- The no objection certificate/ occupation certificate to be given to the owners on the account of fulfilling the following criteria:
 - Having basement parking for public / semi public buildings.
 - Construction waste to be removed to the dumping sites
 - Facades / fire fighting mechanisms
 - Having specified percentage of green areas in institutional/ Office complexes and industries.

B. URBAN INFRASTRUCTURE

1) Traffic Management

Short term

- To strengthen the existing infrastructure of Gurgaon railway-station & make it broad gauge. Also increase the frequency of trains on the Delhi-Gurgaon route.
- The urgent need to widen as well as strengthen the Delhi-Gurgaon connecting roads (Mehrauli Road, NH-8; RITES have undertaken the project of widening of National Highway)
- The need to observe special timings and restrictions of heavy vehicles in selected (busy) inner roads of Gurgaon town
- To maintain proper hierarchy of roads - viz. to avoid having direct approach of inner roads/ lanes to NH-8. The maintenance of proper roundabouts where smaller roads bisect NH-8. (Sukhrali, Jharsa & Maruti Udyog)
- The essentiality of widening /strengthening the Sikandarpur bridge/ culvert near the DLF Corporate Park, as it happens to be the only connecting road from Mehrauli / South Delhi to Gurgaon.

- To have a detailed feasibility study for assessing the traffic pressure, parking facilities and traffic movement at the backdrop of rapid private sector development taking place in Gurgaon.

Long term

- A city to remain Green needs to conform to permitted levels of pollution. One of the major sources of pollution is automobile traffic, due to the volume, and lack of dispersal. The answer is to reduce volume of traffic by providing mass rapid transit facilities. The mass rapid transit system to cater to entire town whereby minimising the use of cars/ private vehicles. Similarly the technology of MRTS needs to be carefully considered while integrating it into the NCR plan.
- The distribution of all social and economic facilities/amenities to locate at the node of MRTS. The defined may run from the Railway station to the City Centre having maximum coverage.
- The National Highway-8 cutting through the city needs to be realigned with alternative routes given. The alternative arrangement for diverting the traffic from National Highway –8 for avoiding traffic pressure and congestion may be:
 - Propose a By-Pass from Sohna – Faridabad – Delhi without merging with the city traffic (As per the proposed plan-2021 AD).
 - The proposed Expressway of the NCR must integrate Gurgaon's traffic system in such a manner so as to reduce the pressure on road traffic.
- To identify no traffic zone in the congested market / bus stand of the town.

II) Special Purpose Vehicle – Institutional framework for City Management

To initiate private sector participation in urban development was an original idea in the Gurgaon Development, but the infrastructure development being HUDA's obligation distorted the provision of services in due course of time.

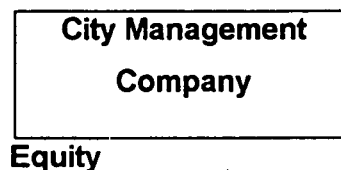
It is hence necessary that an implementation model – *Special Purpose Vehicle* is created in which the principal players, put in the requisite equity and a management team, vested with the responsibility of creating, renewing and sustaining municipal level services is carried out.

Short term & Long term

- The following will be the core areas of activity of this *Special Purpose Vehicle*.
 - Urban infrastructure and municipal services - financial management and planning
 - Project development and management – Privatization and its mandate and philosophy would be on a continual basis.
 - Create single/multi special purpose vehicles for implementation
 - Create suitable sub structures for maintenance and sustainability.
 - Follow the methodology of demand analysis and economic viability.
- The 12th schedule of the 74th amendment to the constitution of India outlines 18 important responsibilities for the urban local bodies. Similarly in Gurgaon also, added emphasis in the city's managerial responsibilities has to be defined, the governing philosophy has to be commercialisation of services and these would include the following:
 - Local authority must start publishing data of costs and services to residents.
 - Advertise that user pays and abuser pays penalty.
 - Prioritise infrastructure project formulation.
 - Raise resources through debt.

- The creation of Institutional Framework for urban infrastructural management and implementation of projects. Create city Management Company through state participation and private developers with a mix of debt and equity

HUDA DLF UNITECH ANSALS & OTHERS



- Article of Association and object clauses would be:
 - Creation and management of infrastructure
 - Contracting services
 - Creating sub-companies
- Create tariff structure for services with the commercial user paying higher levels.
- Create legal framework and developing capacity:
 - Create regulatory authority for fixing tariffs and ensuring quality of service.
 - If government or the state agency is a provider of services, it should be clearly within the jurisdiction of the regulator.
 - Recognise BOO & BOT as modes of building infrastructure.
 - Prescribe a techno-financial and a techno-legal regime.
 - Urban local bodies need to have intrinsic human resources for taking the responsibility of improved city management.
- Project issues and framework must involve:
 - a) City management group to get the commitment of the stakeholders in infrastructure:
 - b) Detailed work on the following range of issues like –financial evaluation of costs and prices, legal framework, engineers to assess the existing system and so on.

- The need to delineate its role to manage:
 - Maintenance of internal roads
 - Maintenance, operations and replacement of street and traffic lights
 - Regulate every inch of public space in the HUDA areas and levy charges.
 - Prepare a feasibility study for setting up and distribution of power supply to cater to:
 - Residential areas
 - Commercial areas
- This company will survey the entire area and form sub companies for management of civic amenities in their area of operation as viable units.
- HUDA to concern itself with trunk infrastructure including toll roads.
- HUDA to earmark areas for landfill sites and prepare waste management options.
- The company will be responsible for weekly/fortnightly surveys of vacant areas to detect encroachments and evacuate the same.
- HUDA and Municipality to prepare notices of their properties and bring them to public notice, at every three months/ six months period.
- HUDA / Municipality/ SPV to restructure the water and tax tariffs for commercial residents.
- Municipality to unbundle services for cleaning, sweeping services street wise to cooperatives after doing a cost benefit analysis of in-house activities.
- Municipality to link up with NGOs in health and education through which the informal sector or marginalised communities can be given access to services
- Municipality areas to link up with entrepreneurs to build and operate public facilities coupled with commercial concessions.
- HUDA and municipality to open public offices in every two kilometer area for public interface and grant of licenses, clearances, payment of taxes etc. activities which can be decentralized.

III. Others

- Open spaces and plantations are not only spaces for recreation, they need to be considered as part of city infrastructure in terms of lung spaces, pollution abetter, treatment of waste and wastewater, recharging of ground water etc. The standards of open space worked out on the basis of sports and recreational facilities needs to be re-examined.
- The maintenance of existing public conveniences and construction of more for better health and hygiene.
- Overall philosophy of resource generated must be spent on sustaining the framework of the city.
- Work towards preparing a policy and regulatory framework keeping in view realistic performance of obligations and accelerate the development of the city centers so that the livability index is continually rising.

In an imperfect world there will always be imperfect cities but the search for sustainable development must go on.

Figure 3.1

Overview of Gurgaon Urban Area

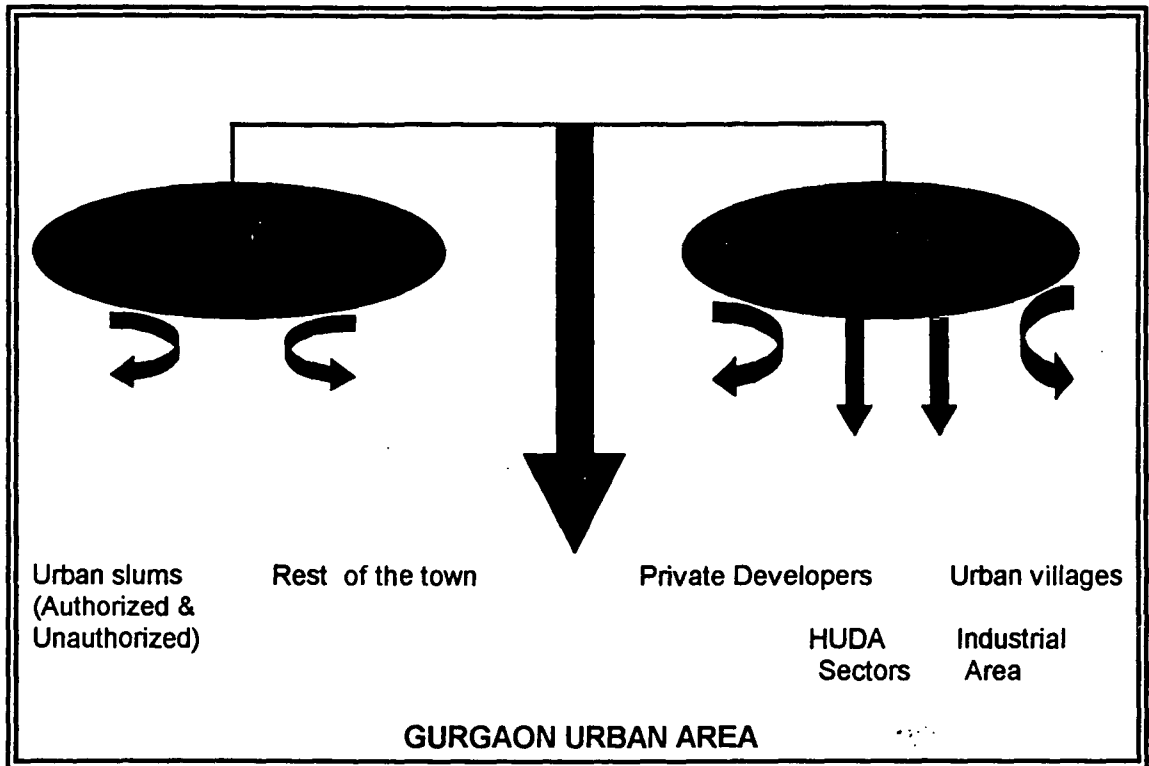


Figure 3.2

Wardwise distribution of Primary, Secondary and Tertiary Workers -1991

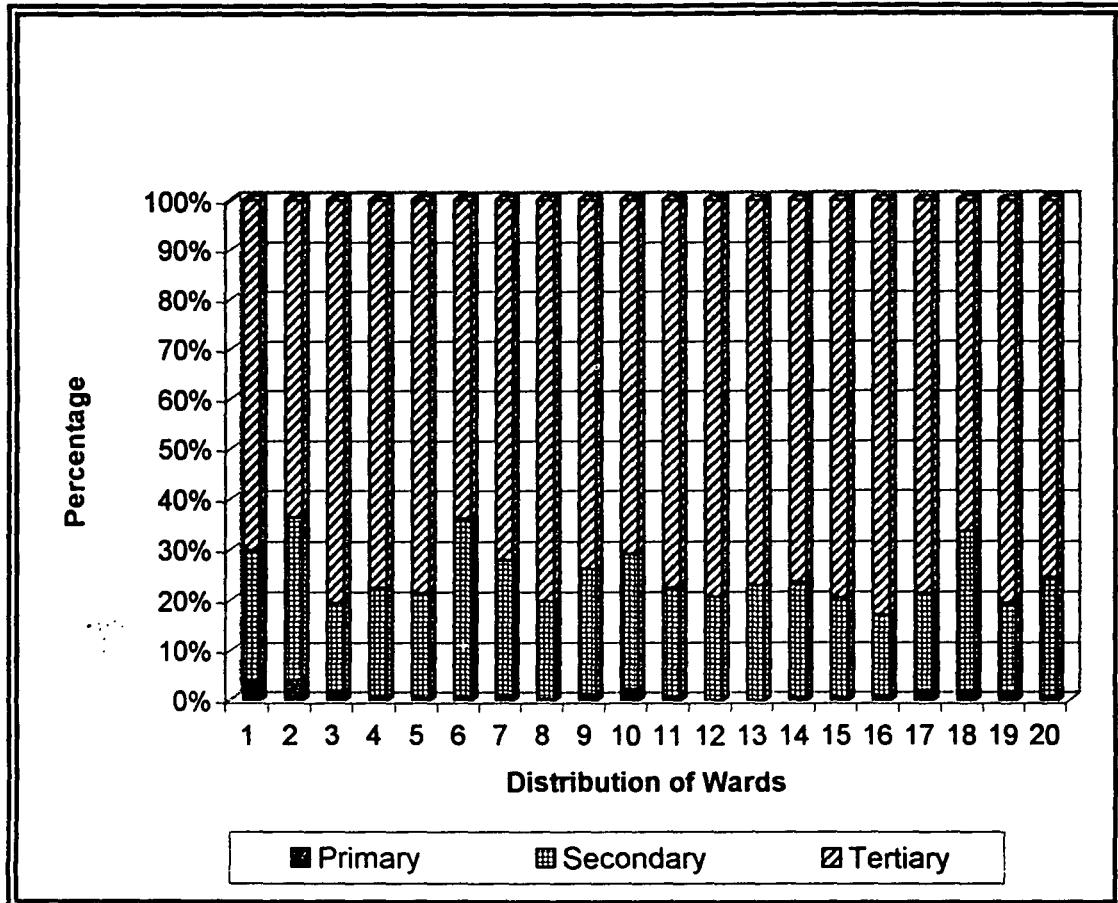


Figure 3.3

Distribution of Workers and Non-Workers in Gurgaon Town - 1991

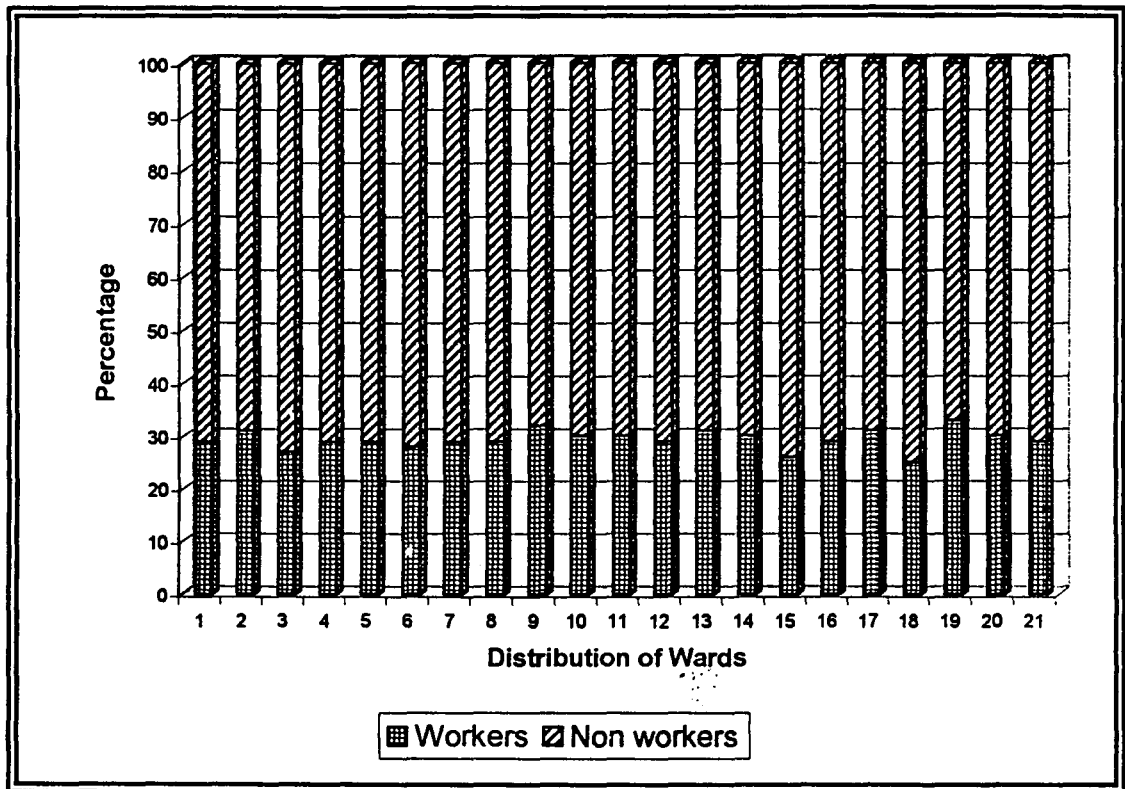


Figure 3.4

Distribution of Scheduled Caste (1991-98) & Scheduled Tribe (1998)

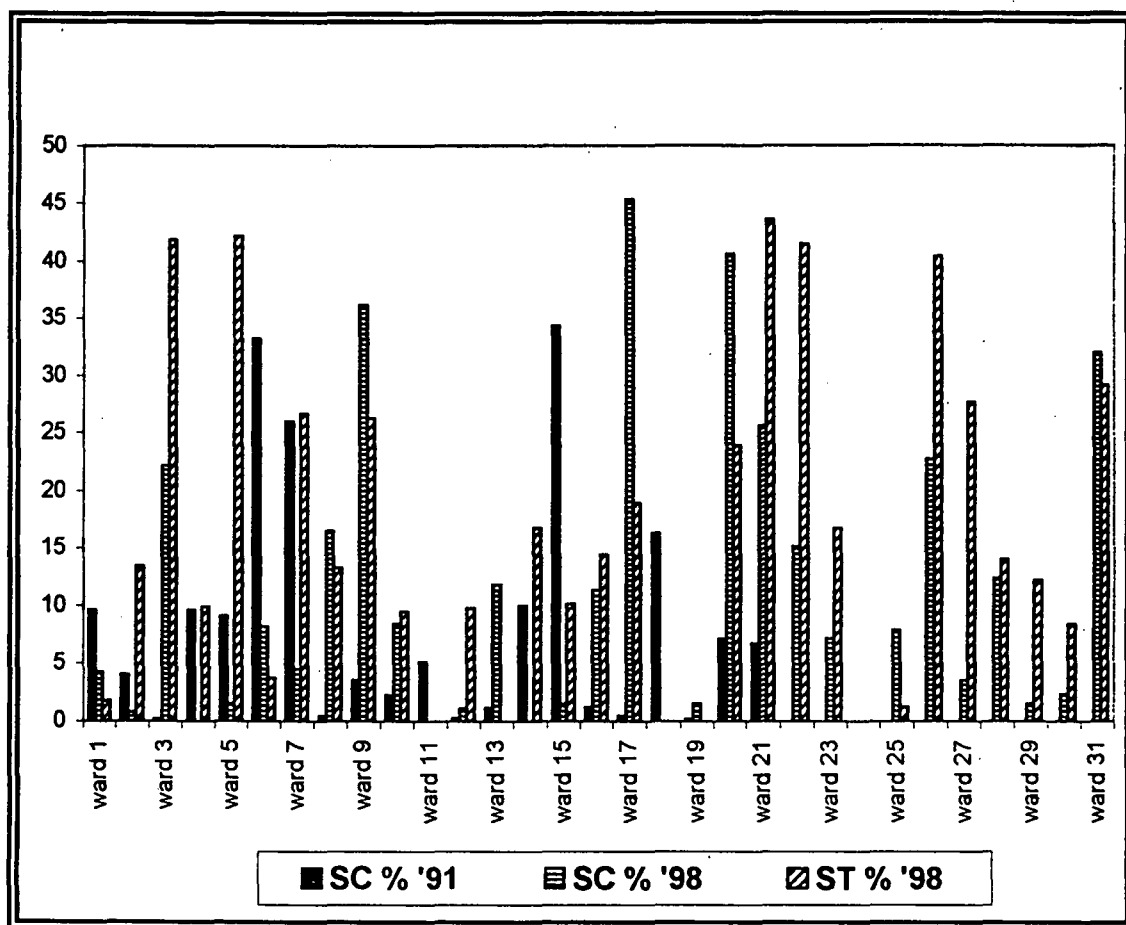


Figure 3.5

Wardwise Distribution of Below Poverty Line Population - 1998

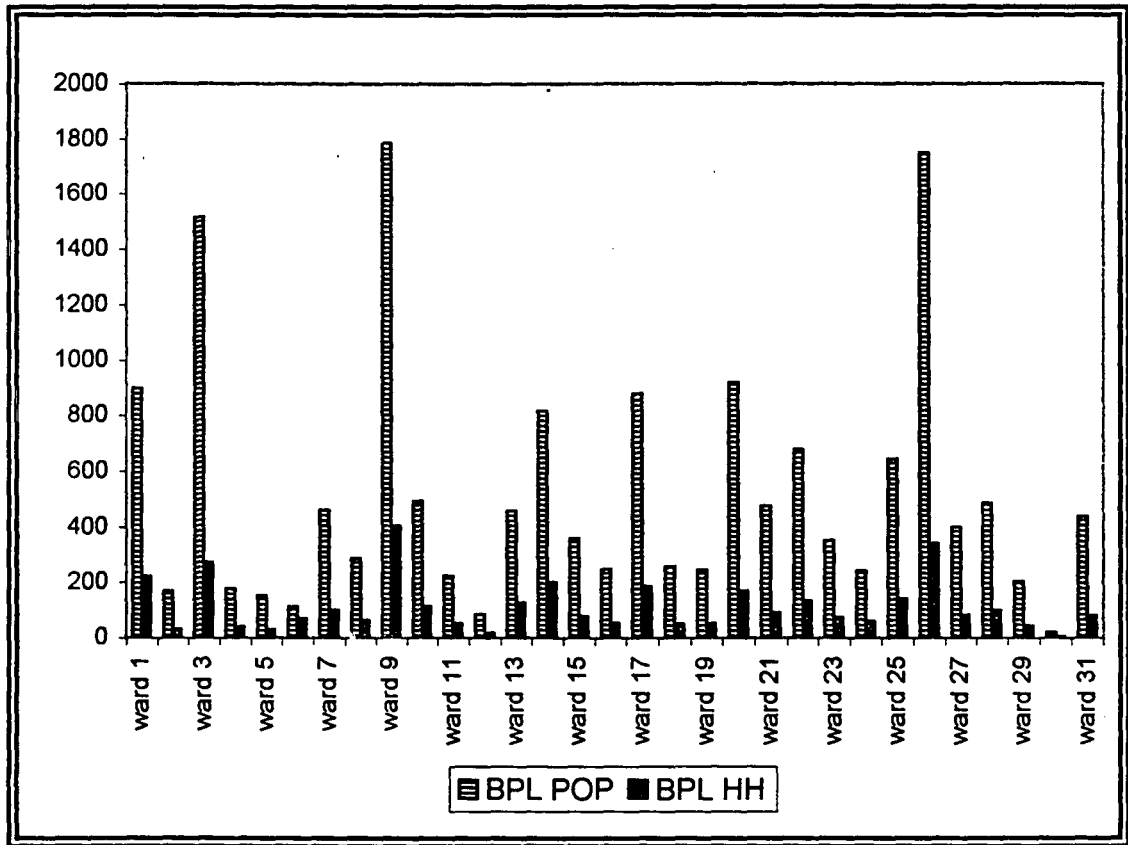


Figure 3.6

Overview of the Private Developers in Gurgaon

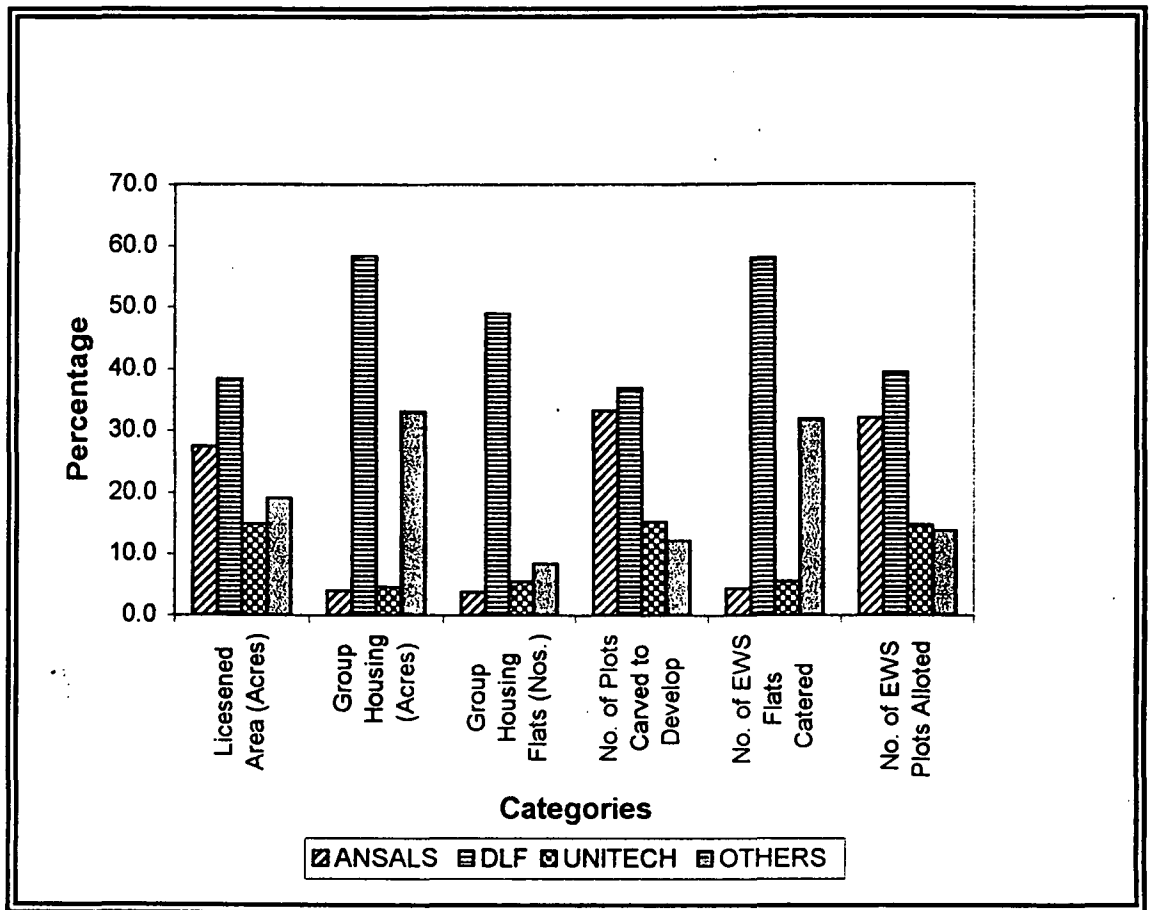


Figure 3.7

Distribution of large and medium scale industries by type

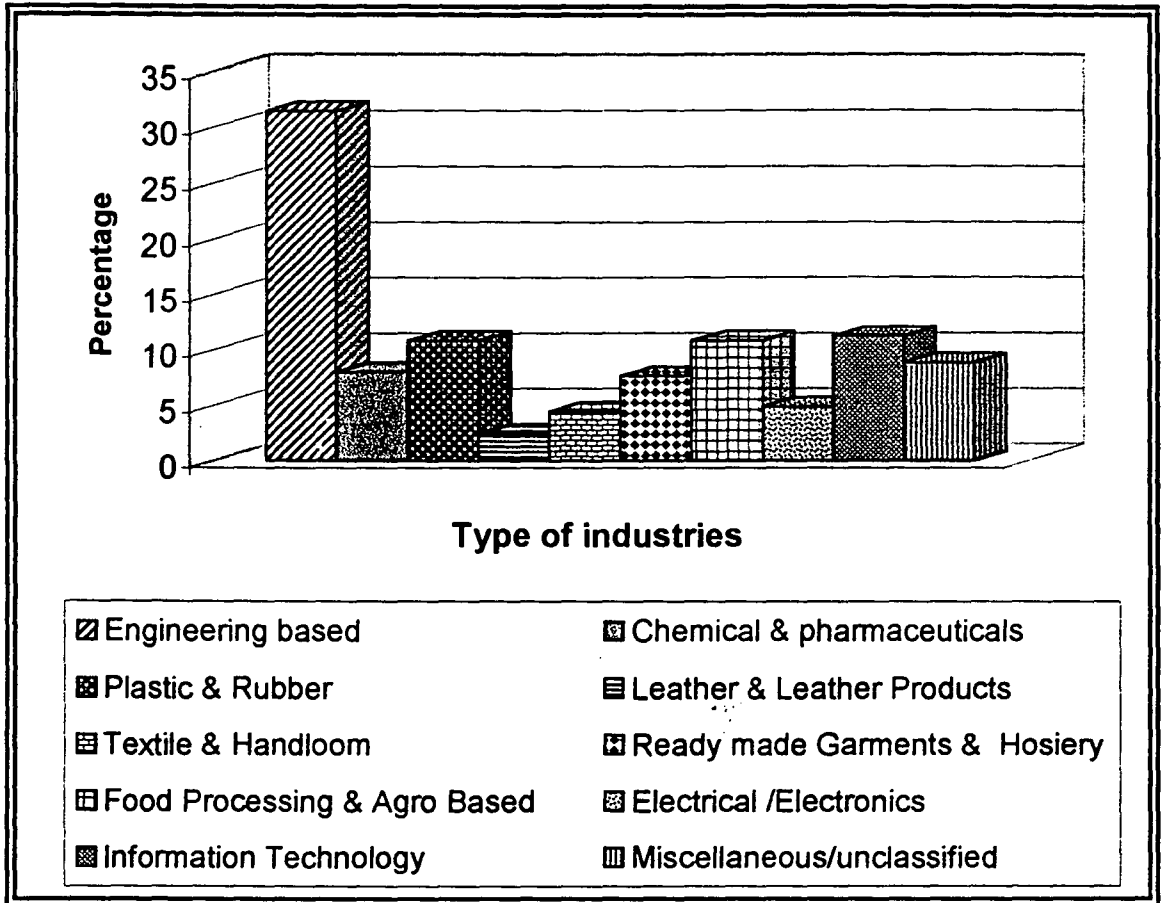


Figure 3.8

Population Growth (1981 - 2001)

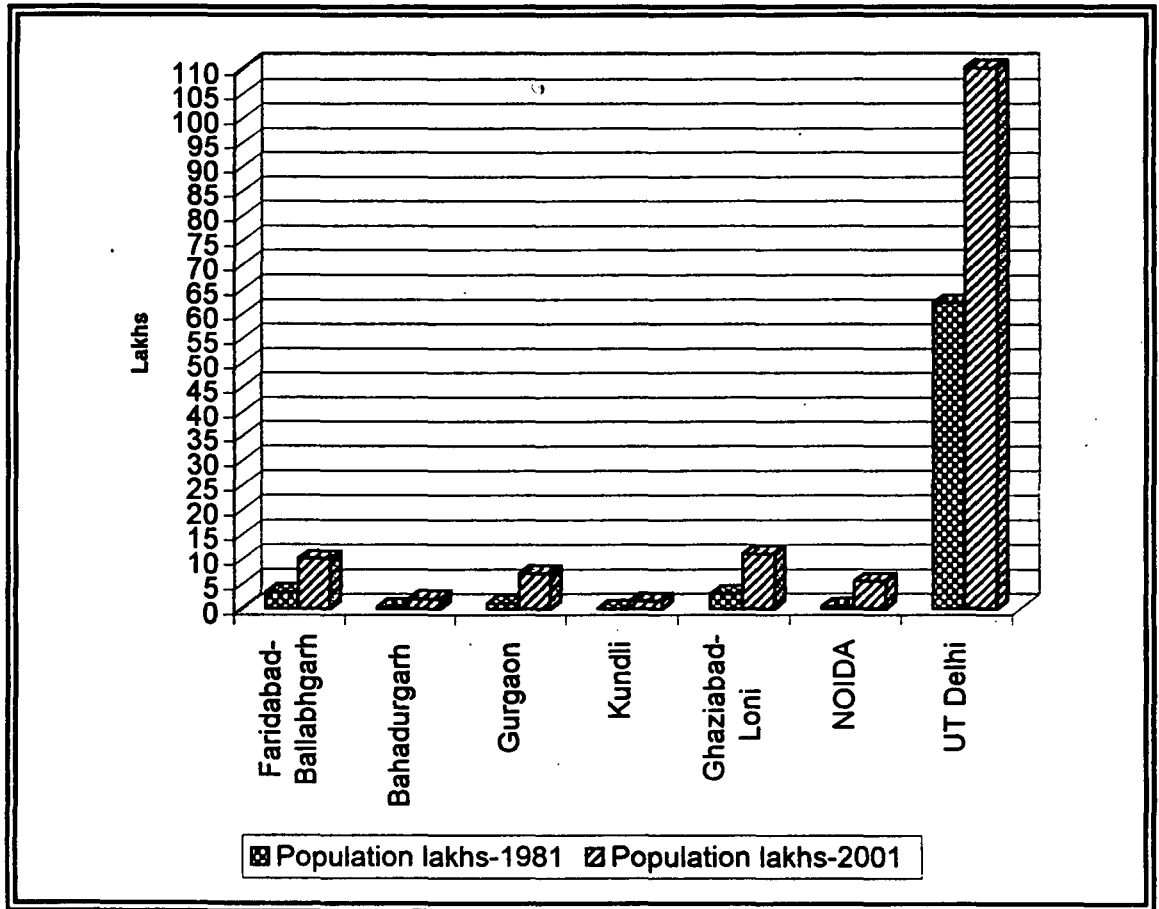


Figure 3.9

Employment Structure in DMA towns of NCR - Year 2001

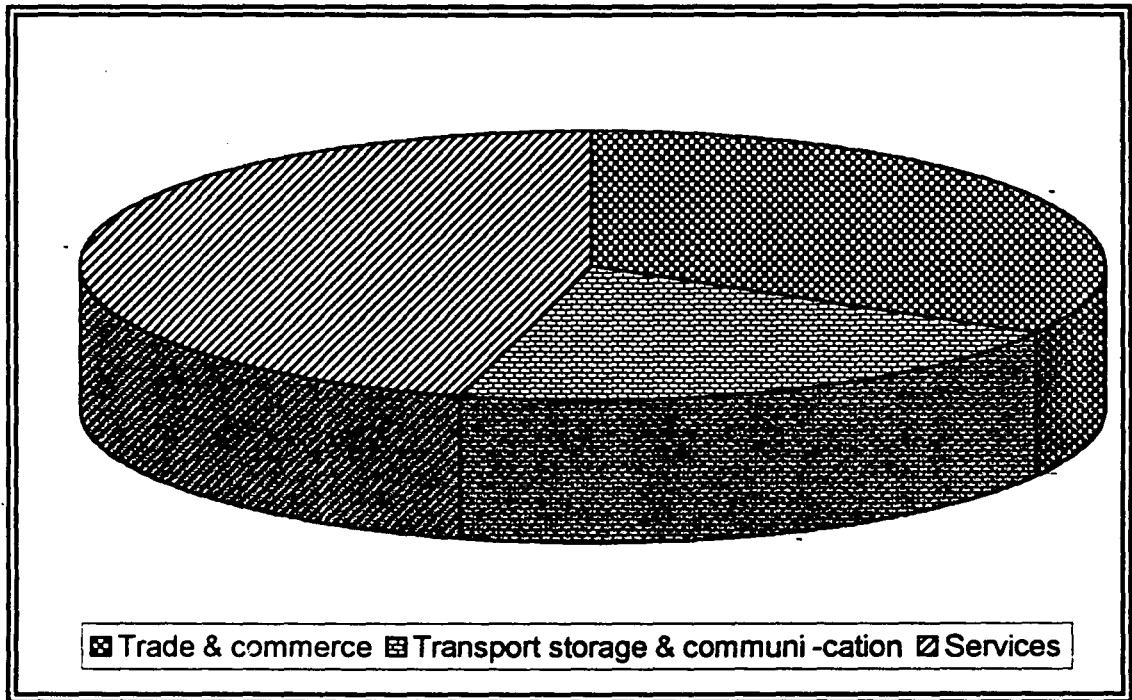


Figure 3.10

Existing Landuse of Gurgaon UA - Year 2001

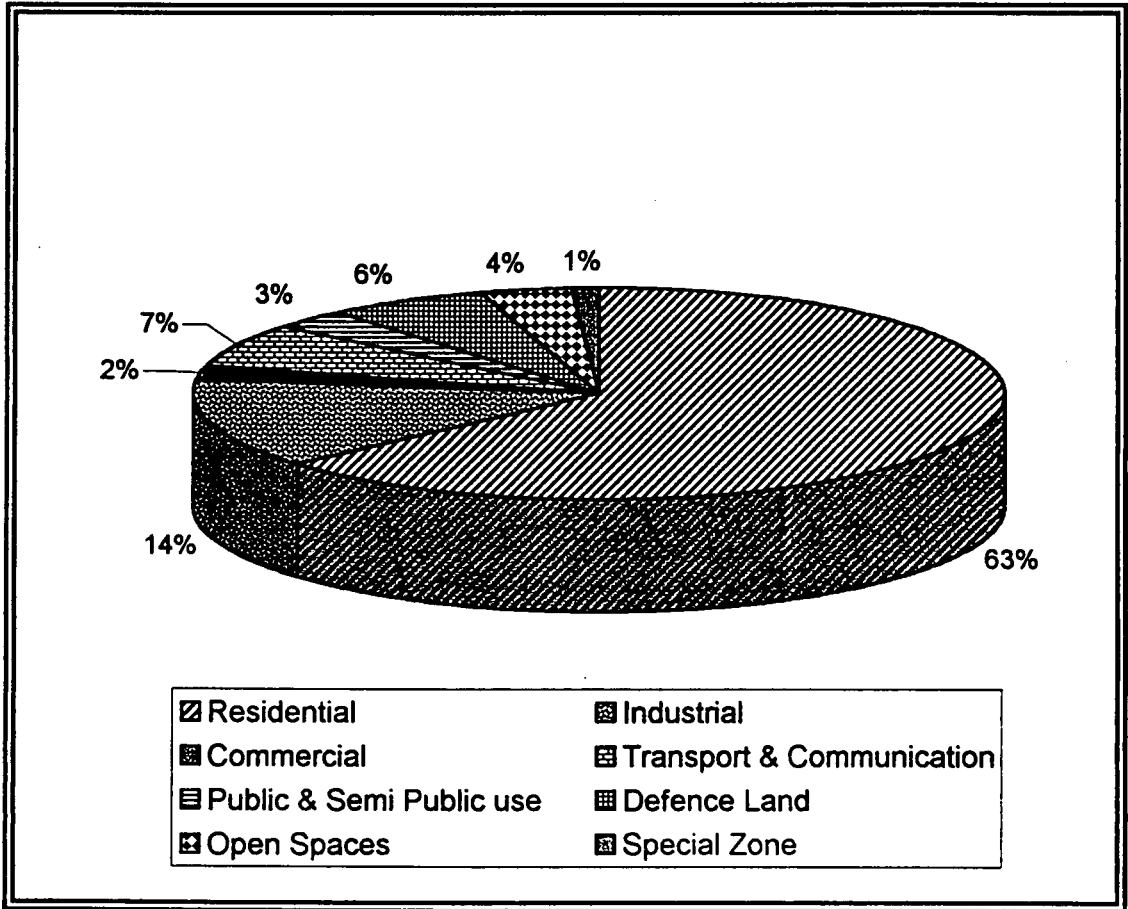


Figure 3.11

Proposed Landuse for Gurgaon UA - 2021

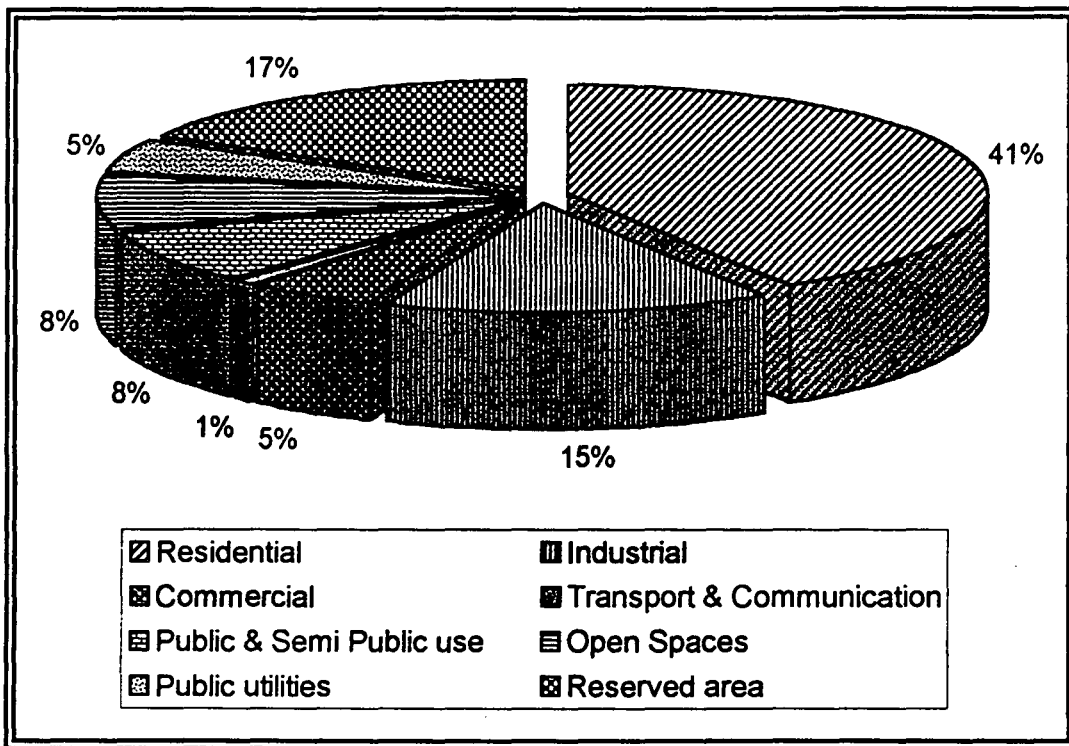


Table 3.1

Growth and Development of Gurgaon – 1980-2000

Development 1980 till date	Spatial distribution of development	Land acquisition for development under various sectors
Before 1980	Entire town boundary and the areas north and northeast to it.	4, 7, 14, 17, 18 (part of it)
1980-1990	The northern side of the Defence area, south -western and south-eastern side of the town. Further the growth also took place in dispersed fashion as and when the colonies were set up.	1, 2, 3, 7extension, 10A, 21, 22, 23, 23A, 31-32P, 30, 41, 42, 18
1990 onwards	South-eastern, south western and in isolated pockets developed by the private colonizers	5, 3 & 6 part, 9, 9A, 10, 5/I, II, 37/I, III, 38, 39, 40, 45, 46, 44, 55, 56, 23part

Source: Haryana Urban Development Authority, Gurgaon

Table 3.2

Ward-wise Spatial Distribution of Population – Gurgaon Town 1981-2000

% Contribution to total population	1981	1991	2000
	Ward no	Ward no	Ward no
1.00 – 3.5	22,19 & 5	3, 5, 6, 8, 11, 12, 13, 14, 15, 19 & 20	4, 5, 13, 14, 16, 18, 19, 20, 21, 22, 23, 8, 10, 25, 26, 27, 28, 29, 30 & 31
3.5 – 6.00	1, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 20 & 21	16,17,10,7&4	16, 14, 11, 10, 9, 7, 6, 1, 2 & 3
Above 6.00	18 & 2	21,18, 9, 2 & 1	—

Source: Census 1981, 1991 & Gurgaon Municipal Council

Table 3.3

Ward-wise Spatial Distribution of Residential Households – Gurgaon Town 1981-2000

% Contribution to total residential households	1981	1991	2000
	Ward no	Ward no	Ward no
1.00 – 3.5	5, 6, 19	3, 4, 5, 6, 8, 11, 12, 13, 14, 15	2, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 23, 24, 25, 27, 28 & 29
3.5 – 6.00	1, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 20, 22, 3	7, 10, 16, 17,	26, 4, 5, 6 & 1
Above 6.00	21, 18 & 2	21, 18, 9, 2, 1	3 & 31

Source: Census 1981, 1991 & Gurgaon Municipal council

Table 3.4

Ward-wise Spatial Distribution of Residential Households – Gurgaon Town 1981-2000

WARD	HH '81	% Contribution	HH '91	% Contribution	HH '00	% Contribution
1	768	4.77	1389	6.26	1638	4.81
2	1399	8.68	2893	13.04	946	2.78
3	568	3.52	425	1.92	2437	7.16
4	646	4.01	736	3.32	1846	5.42
5	496	3.08	434	1.96	1552	4.56
6	534	3.31	468	2.11	1663	4.89
7	727	4.51	805	3.63	703	2.07
8	678	4.21	575	2.59	886	2.60
9	691	4.29	3417	15.40	715	2.10
10	781	4.85	990	4.46	1124	3.30
11	659	4.09	605	2.73	NA	NA
12	689	4.28	685	3.09	1086	3.19
13	649	4.03	626	2.82	941	2.76
14	577	3.58	514	2.32	911	2.68
15	634	3.93	467	2.11	634	1.86
16	808	5.01	889	4.01	665	1.95
17	760	4.72	830	3.74	889	2.61
18	1273	7.90	2277	10.26	988	2.90
19	557	3.46	493	2.22	777	2.28
20	681	4.23	744	3.35	664	1.95
21	951	5.90	1921	8.66	NA	NA
22	590	3.66	NA		NA	NA
23	16116		22183		935	2.75
24					871	2.56
25					971	2.85
26					1782	5.24
27					1036	3.04
28					1000	2.94
29					1153	3.39
30					NA	NA
31					5227	15.36
					34040	

Source: census 1981,1991 & Gurgaon Municipal council

Table 3.5

Ward-wise Population Distribution – Gurgaon Town 1981-2000

WARD	POP '81	% OF TOTAL POP.	POP '91	% OF TOTAL POP.	POP '00	% OF TOTAL POP.
1	4861	5.45	7673	6.32	9000	4.28
2	6801	7.63	14056	11.57	7800	3.71
3	3296	3.70	2646	2.18	8000	3.80
4	4028	4.52	4628	3.81	6000	2.85
5	3064	3.44	2926	2.41	7000	3.33
6	3402	3.82	3067	2.52	10000	4.76
7	3978	4.46	4511	3.71	7500	3.57
8	3564	4.00	3091	2.54	7000	3.33
9	3528	3.96	16973	13.97	7500	3.57
10	3990	4.48	5230	4.31	6000	2.85
11	3740	4.20	3502	2.88	8000	3.80
12	3675	4.12	3251	2.68	8500	4.04
13	3621	4.06	3455	2.84	6000	2.85
14	3234	3.63	3162	2.60	6500	3.09
15	3730	4.19	3158	2.60	9000	4.28
16	4554	5.11	5108	4.20	6500	3.09
17	4256	4.78	4657	3.83	8000	3.80
18	6894	7.74	12646	10.41	6000	2.85
19	2973	3.34	2886	2.38	5000	2.38
20	3771	4.23	4169	3.43	4000	1.90
21	5215	5.85	10691	8.80	5000	2.38
22	2940	3.30	NA		6000	2.85
23					7000	3.33
24					8000	3.80
25					5500	2.62
26					6500	3.09
27					6000	2.85
28					5000	2.38
29					7000	3.33
30					5000	2.38
31					6000	2.85
Total	89115	100	121486	100	210300	100

Source: census 1981,1991 & Gurgaon Municipal council

Table 3.6

Ward-wise Distribution of Occupational Structure of Gurgaon Town

Ward no	Sex ratio	Primary	Secondary	Tertiary	Workers	Non workers
	'000	%	%	%	%	%
1.	868	4.0	25.8	70.2	29	71
2.	886	4.1	32.1	63.7	31	69
3.	840	1.7	17.7	80.6	27	73
4.	933	0.5	21.9	77.6	29	71
5.	931	0.4	20.9	78.7	29	71
6.	911	0.5	35.4	64.1	28	72
7.	898	1.1	26.7	72.2	29	71
8.	963	0.2	19.5	80.3	29	71
9.	906	1.2	24.9	73.9	32	68
10.	921	2.2	26.8	71.0	30	70
11.	927	0.7	21.7	77.6	30	70
12.	934	0.0	20.7	79.3	29	71
13.	887	0.0	22.8	77.2	31	69
14.	881	0.4	23.1	76.5	30	70
15.	948	0.4	20.0	79.6	26	74
16.	889	0.9	16.1	83.1	29	71
17.	951	2.0	19.3	78.8	31	69
18.	864	2.0	31.6	66.4	25	75
19.	909	1.5	17.9	80.6	33	67
20.	916	0.6	23.8	75.6	30	70
21.	869	1.2	33.1	65.8	29	71

Source: Census Handbook – 1991

Table 3.7

Ward-wise Distribution of Scheduled Caste, Scheduled Tribe in Gurgaon Town

Wards % Contribution	Scheduled Caste		Scheduled Tribe /OBCs
	1991	1998	1998
Below 10 %	1, 2, 3, 4, 5, 8, 10, 9, 11, 12, 13, 16, 17, 19, 20, 21	1, 2, 5, 6, 7, 10, 11, 12, 14, 15, 18, 19, 23, 25, 27, 28, 29, 30	1, 4, 6, 10, 11, 12, 13, 18, 24, 25, 30
10-20 %	14 & 18	3 & 26	17, 15, 23, 28, 8, 14, 12 & 16
20 % and above	6, 7 & 15	31, 20, 17, 9, 21	3, 5, 7, 9, 20, 21, 22, 27, 31, 26 & 2

Source: Municipal Council & Census, 1991

Table 3.8

Ward-wise Percentage Distribution of Scheduled Caste/ Scheduled Tribe and Below Poverty Line Population in Gurgaon Town

	SC % 91	SC %98	ST %98	BPL HH	BPL POP
ward 1	9.6	4.2	1.7	223	898
ward 2	4	0.7	13.4	31	167
ward 3	0.2	22.2	41.8	272	1515
ward 4	9.6		9.9	39	178
ward 5	9.1	1.5	42.2	30	153
ward 6	33.2	8.2	3.7	72	114
ward 7	26	4.5	26.7	102	460
ward 8	0.4	16.5	13.3	64	286
ward 9	3.5	36.2	26.3	403	1786
ward 10	2.2	8.5	9.5	113	494
ward 11	5.1	0.004	0.006	53	225
ward 12	0.3	1.05	9.8	17	85
ward 13	1.1	11.8	0.004	127	457
ward 14	10	0.002	16.8	201	818
ward 15	34.4	1.5	10.2	79	358
ward 16	1.2	11.4	14.5	52	249
ward 17	0.4	45.4	18.9	187	881
ward 18	16.3	0.005	0.006	50	258
ward 19	0.2	1.5		51	246
ward 20	7.1	40.6	23.9	170	921
ward 21	6.7	25.7	43.6	93	478
ward 22		15.1	41.5	134	681
ward 23		7.2	16.7	74	353
ward 24			0.003	59	242
ward 25		7.9	1.2	141	644
ward 26		22.8	40.4	339	1749
ward 27		3.5	27.7	80	398
ward 28		12.4	14.08	100	487
ward 29		1.5	12.2	42	204
ward 30		2.3	8.4	5	19
ward 31		32	29.2	80	437
		13.8	20.08	3483	16241

Source: District Urban Development Authority, 1998 and Census - 1991

Table 3.9

Literacy Pattern of Gurgaon Town - 1991

Literacy rates (%)	Ward wise Spatial distribution of literacy pattern
60 -70	1, 2, 6, 7, 15, 18, 20 & 21
70 – 80	3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 16, 17 &19

Source: Census 1991

Table 3.10

Contribution of Slum Population to the Total Population of Gurgaon – 1991

	Population	Slum population	Percentage Contribution	Area (sq. km)	Density (per sq. km)
GURGAON	121486	42854	35.27	13.22	3241

Table 3.11

Distribution of Slum Colonies Identified under Municipal Council and DUDA -1997-98

A. SLUM COLONIES - MUNICIPAL COUNCIL					
Slum colonies	Area	H.H	SC%	Total population	Density
▪ Area between Delhi -Najafgarh	35	406	41.8	2030	58.0
▪ Sanjay Colony	15	85	35.2	425	28.3
▪ Mahavir Colony	20	285	62.2	1325	66.3
▪ Daya Nand Colony	22	150	13.3	750	34.1
▪ Bhim Garh Kheri	30	350	40	1750	58.3
▪ Jyoti Park	40	600	11.2	3110	77.8
▪ Dhanak Basti	10	680	83.8	620	62.0
▪ Krishna Colony	20	486	14.5	2400	120.0
▪ Manohar Nagar	18	366	24.5	1830	101.7
▪ Baldev Nagar	15	320	25	1600	106.7
▪ OM Nagar	40	1140	21.9	5700	142.5
▪ Gandhi Nagar	50	880	41.1	3400	68.0
▪ Hira Nagar	30	930	35.4	4650	155.0
▪ Laxman Nagar	25	360	36.1	1800	72.0
B. SLUM COLONIES - DUDA					
▪ Idgaha Balmiki Basti	6	374		943	157.2
▪ BhimNagar	5	493		1903	380.6
▪ Firoze Gandhi Colony 1	22.23	1310		4988	224.4
▪ Veer Nagar	4	934		3509	877.3
▪ Katchi Colony Khandsa	14.2	275		943	66.4
▪ Firoze Gandhi Colony 2	3	213		1193	397.7
▪ Rajiv Nagar Jhuggi Basti	6	215		1075	179.2
▪ Nai Basti	6	360		1825	304.2
TOTAL	436.43	11212	-	50214	115.05

Source: District Urban Development Authority and Municipal Council Gurgaon - 1998

Table 3.12

Details of Sectors under HUDA Area

(Area in Hectares)

Sector no.	Total Urbanizable area	% Contribution of total urbanizable area	Area under the survey	Area developed by HUDA	% Share of area developed by HUDA to total HUDA area
3	355.65	2.9	190	18	0.22
4	269	2.2	302	302	3.61
5	118	1.0	140	140	1.67
6	69	0.6	69	46	0.55
7	104	0.8	104	104	1.24
8	350	2.8	350	225	2.69
9	244	2.0	200	200	2.39
9	390	3.1	390	183	2.19
10	308	2.5	308	243	2.90
12	54	0.4	63	46	0.55
14	387	3.1	190	169	2.02
15 I&II	368	3.0	368	224	2.68
16	258	2.1	160	40	0.48
17	225	1.8	225	225	2.69
18	720	5.8	984	764	9.13
19	171	1.4	171	104	1.24
20	366	2.9	366	60	0.72
21	239	1.9	239	199	2.38
22	210	1.7	210	164	1.96
23	662	5.3	662	600	7.17
29	480	3.9	480	480	5.74
30	225	1.8	225	32	0.38
31&32	280	2.3	280	265	3.17
32	212.08	1.7	167	161	1.92
33	332	2.7	332	270	3.23
34	385	3.1	385	100	1.20
37	548	4.4	548	325	3.88
38	313	2.5	329	288	3.44
39	344	2.8	344	155	1.85
40	200	1.6	200	135	1.61

Contd. Table 3.12

Sector no	Total Urbanizable area	% Contribution of total urbanizable area	Area under the survey	Area developed by HUDA	% Share of area developed by HUDA to total HUDA area
41	221	1.8	221	8	0.10
43	453	3.7	634	90	1.08
44	218	1.8	181	181	2.16
45	295	2.4	295	200	2.39
46	380	3.1	380	317	3.79
47	442	3.6		178	2.13
48	490	3.9	490	430	5.14
50	532	4.3		245	2.93
55	190	1.5	611	450	5.38
	12407.73	100	11793	8366	100.00

Source: TCPO Office, Gurgaon

Table 3.13

Overview of the Private Developers in Gurgaon

	Ansals	%	DLF	%	Unitech	%	Others	%	Total
Licensed Area (Acres)	1650	27.5	2304	38.4	897	14.95	1149	19.15	6000
Group Housing Acres	40	4.0	584	58.3	46	4.6	332	33.1	1002
Group Housing Flats (No.)	2201	3.7	29200	48.9	3317	5.6	5000	8.4	59718
No Of Plots Carved To Develop	13580	33.2	15100	36.9	6260	15.3	5000	12.2	40940
No of EWS Flats Catered	394	4.4	5153	58.0	501	5.6	2830	31.9	8878
No of EWS Plots Allotted	2791	32.1	3434	39.4	1281	14.7	1200	13.8	8705

Source: DLF, Ansals, Unitech & TCPO

Table 3.14

Villages under the Private Colonizer Area

Villages	Private Developers	Colonies
Choma Khera	Ansal	Palam Vihar
Ghatta	Ansal	Sushant Lok
Nathupur	DLF	Qutub Enclave
Sikanderpur	DLF	Qutub Enclave
Chakkarpur	DLF	Qutub Enclave
Silokhera	Unitech	South City
Samaspur	Sheetal Enterprises	Sheetal Enclave

Source: HUDA, 2000

Table 3.15

Rural Population, area and Sectoral Location of the Villages within Gurgaon Urban Area

Sl. No.	Village	Area Sq. Km	Population	No. of households	Density	Sectoral Location
1.	Mohammadpur Jharsa	2.95	1890	241	641	36
2.	Khandsa	6.46	4634	761	717	37
3.	Narsinghpur	1.97	1448	181	735	36
4.	Kadipur	2.40	3310	651	1379	10
5.	Tikri	2.48	701	105	283	48
6.	Ghasola	1.59	359	64	226	49
7.	Bhimgarh		2407			3
8.	Choama Khera	7.41	1605	344	217	1
9.	Carterpuri	5.17	2602	394	503	23A
10.	Mulahera	2.72	3589	848	1320	22
11.	Gurgaon		14398			6
12.	Naharpur	1.14	1586	266	1391	33
13.	Sukhrauli	4.78	5538	1114	1159	17
14.	Sirhole	3.23	2638	348	817	18
15.	Dundahera		6767			21
16.	Islampur	2.59	2436	333	941	38
17.	Jharsa	9.99	8480	1289	849	39
18.	Silokhera	2.74	1986	428	725	41
19.	Chakarpur	6.01	2525	393	420	28
20.	Sikanderpur	2.61	2772	632	1062	26
21.	Nathupur	5.65	3508	479	621	24
22.	Kanhai	3.55	2995	480	844	45
23.	Samaspur	1.65	946	147	573	51
24.	Wazirabad	13.1	5670	848	433	52
25.	Tigra	2.49	1333	164	535	57
26.	Jiwanwali					30

Source: Census - 1991

Table 3.16

The Industrial Area of Udyog Vihar under HSIDC

Phase I – V, Udyog Vihar	1430 plots
Phase-VI, Udyog Vihar	312 plots
Phase V, Udyog Vihar	118 sheds
Phase VI Udyog Vihar	45 sheds

Source: HSIDC, Gurgaon

Table 3.17

The Industrial Area under HUDA

Sector-18 Gurgaon (Software)	30 plots
Electronic city	30 plots
Sector 34	72 plots
Pace City	146 plots

Source: District Industry Centre, Gurgaon

Table 3.18

The Distribution of Large and Medium Scale Industries in Gurgaon

Type of Industry	Distribution of large and Medium scale Industries in Gurgaon UA			
	No of units	% Share to total	Investment (Rs- million)	Employment
Engineering based	79	31.5	31776.3	22197
Chemicals and pharmaceuticals	20	8.0	944	1833
Plastic & Rubber	27	10.8	4683.3	1648
Leather & Leather Products	6	2.4	414.5	1131
Textile & Handloom	11	4.4	1047.8	1394
Ready made Garments & Hosiery	19	7.6	1342	2548
Food Processing & Agro Based	27	10.8	1052	2516
Electrical /Electronics	12	4.8	506	1286
Information Technology	28	11.2	140	3500
Miscellaneous/unclassified	22	8.8	1834.1	1947
	251	100	43740	40000

Source: District Industry Centre, Gurgaon - 2000

Table 3.19

Ward-wise Distribution of Industries in Gurgaon Town 1998-99

Ward No	No. of Units
ward 1	15
ward 2	10
ward 3	17
ward 4	112
ward 5	23
ward 6	5
ward 7	5
ward 8	5
ward 9	7
ward 10	3
ward 11	5
ward 12	7
ward 13	2
ward 14	2
ward 15	2
ward 16	4
ward 17	
ward 18	7
ward 19	8
ward 20	3
ward 21	5
ward 22	3
ward 23	2
ward 24	4
ward 25	7
ward 26	10
ward 27	5
ward 28	7
ward 29	2
ward 30	2
ward 31	52
	341

Source: Municipal Committee - 1999

Table 3.20

Detail of Green Belt with Park / Thick Plantation

Sector No.	Green Belt as Park with Final Grassing & Plant	Green Belt with Plantation & Rough Grassing along 30 & 60 M Wide Road	Green Belt with Thick Plantation	Total	Toe Wall Jali Wire Fencing	
	(in Acres)				(Rmt.)	(Area)
4	-	10.00	-	10.00	-	-
7	-	5.00	-	5.00	-	-
10-A	1.50	2.00	-	3.50	500	2.00
14	10.00	15.00	-	25.00	2000	20.00
15-I	20.00	-	-	20.00	2000	20.00
15-II	20.00	-	-	20.00	2500	20.00
16	-	-	15.00	15.00	1500	15.00
17	10.00	12.00	-	22.00	2000	10.00
18	-	8.00	20.00	28.00	800	5.00
21	-	2.50	-	2.50	-	-
22	2.50	5.00	2.50	10.00	400	2.50
23	2.50	5.00	5.00	12.50	200	2.00
26-A	-	5.00	-	5.00	-	-
27	-	5.00	-	5.00	-	-
28	-	2.00	-	2.00	-	-
29	20.00	8.00	-	28.00	3000	20.00
30	-	6.00	-	6.00	-	-
31	20.00	5.00	-	25.00	2000	20.00
32	2.00	5.00	1.00	8.00	1000	4.00
34	-	2.00	2.00	4.00	600	2.00
37-I	1.50	0.50	-	2.00	400	1.50

Contd. Table 3.20

Sector No.	Green Belt as Park with Fine Grassing & Plant	Green Belt with Plantation & Rough Grassing along 30 & 60 M Wide Road	Green Belt with Thick Plantation	Total	Toe Wall Jail Wire Fencing	
	(In Acres)				(Mt.)	(Area)
39	-	5.00	-	5.00	-	-
40	-	5.00	-	5.00	-	-
46	-	2.00	-	2.00	-	-
55	-	2.50	-	2.50	-	-
56	-	2.50	-	2.50	-	-
38	2.50	6.00	-	8.50	800	2.50

Source: Horticulture Department, Govt. of Haryana

Table 3.21

Distribution of social and economic facilities in Gurgaon

Sector No.	Nursery School	Primary School	High School	College	Crèche	Health Centre/ Dispensary	Hospital	Club/ Community Centre
4&7	2	5	2		1	1		1
5 PART	6	3	1			2		1
3&6								
9	6	4	1	1	1	1		1
9-A	6	3	1		1	1	1	2
10	6	3	1		1		1	1
10-A	2	2	1		1			1
12-A		1						
14	1	1	1			1		1
15-I	1	2						1
15-II			1					
17	1	3				1		1
21		2				2		1
22		1	1					1
23&23A	4	2	2	1	1	2	1	1
29								1
30	NOT YET PLANNED							
31&32-A	1	3	1		1	1	1	1
41 PART								
32(INST)								1
38	5	4	1		2	1		1
39	5	2	1		1	1		2
40	6	3	1		1	1		1
43 PART	2	3						1
44				1			1	
45	10	5	2		2	2		1
46	15	8	2		2	2		2
47	NOT YET PLANNED							
55&56	6	4	3	1	1	2	1	2
	3	4	3	1		1		
TOTAL	85	64	21	4	16	21	5	26

Contd. Table 3.21

Sector No.	Police Station	Police Post	Fire Station	Dharamshala / Social / Charitable	Nursing Home	Clinic	Petrol Pump	Religious	Telephone Exchange	Electric Sub Station
4&7		1		3				5		
5 PART		1					1			
3&6										
9		1	1		2	3		2		
9-A		1			2	3		1		1
10		1			3	4		1		
10-A		1	1	1		4		3		
12-A						2			1	
14		1								
15-I					3	6				
15-II	1			1	3	7	1	2		
17		1					1	2		
21					1			3		
22	1	1						1		
23&23A		1	1		2	8		3	1	1
29	1		1	1			2		1	
30	NOT YET PLANNED									
31&32-A		1		1	1	4	1	4		
41 PART										
32(INST)										
38	1				2	5		2		1
39		1			5		1	2	1	
40					2	2		1		
43 PART										
44	1			4						1
45		1			4			2	1	1
46		1			4	3		3		
47	NOT YET PLANNED									
55&56	1	1		1	4			4	1	1
					2					
TOTAL	6	15	4	12	38	51	7	42	5	

Source: TCPO office, Gurgaon

Table 3.22

Existing Public Convenience in Gurgaon

	Existing Location	Status of the Toilets	Proposed Location (suggested by SI)	Suggestions for new Toilet Complexes
Urinals in Gurgaon MC	<ul style="list-style-type: none"> - Near the Civil Hospital gate - Post office crossing - Near Fountain crossing of Mahavir Park (Delhi Rd) - Sohna crossing - New Railway road on Dronacharya College gate - New Colony Turn near Triangular Park - In New Colony Market - Basai Road besides Vitalu Hotel - Khandsa Road near Raghu gas - Behind post office next to Gandhi Tea Stall - In the street of the bus stand - Bhim Nagar village near Guest house - On Khandsa road in front of S.D school - Vir Nagar Leprosy Basti 	<ul style="list-style-type: none"> - Lack of maintenance - Lack of water supply for all purposes - Lack of toilet seats in the complexes. - Need for working sewerage/electricity & water connections. - The bad conditions of the toilets have discouraged people from using them. 	<ul style="list-style-type: none"> - Near Jackampura Higher Secondary school - Behind old Veterinary Hospital <p style="text-align: center;">Proposed Location (suggested by GTA)</p> <ul style="list-style-type: none"> - Public toilet near DSD college - Near Senior Secondary School, Gurgaon - In main city - Sohna Addia Chowk - Post office chowk - Behind post office - Din Dayal Upadhaya Market 	<ul style="list-style-type: none"> - To have paid toilet system in the town area - 6 complexes - To have unpaid toilet system in the slum area- 15-16 - To have 20-30 years leasehold system for toilet complexes - The unpaid toilet complexes could be run through concessions/ advertisements so on - To explore funding from the Municipality through their State/ Central funds for Sanitation - To Explore ideas and from YAP/ HEDA/ MNES so on.
Sulabh toilets	<ul style="list-style-type: none"> Vegetable Market Vir Nagar new settlement Ashok Puri At the bus stand 			

Source: Municipal Council, Gurgaon

Table 3.23

**DMA Towns under National Capital Region, its Population (1981 & 2001)
and Annual Growth Rate**

DMA towns	Population in '000 (1981)	Population in '000 (2001)	Average annual growth rate 1981-2001
Faridabad - Ballabhgarh	3.31	10	33.5
Bahadurgarh	0.37	2	8.15
Gurgaon	1.01	7	29.95
Kundli	-	1.5	-
Ghaziabad-Loni	2.97	11	40.15
NOIDA	0.42	5.5	25.4
UT Delhi	62.2	110	
Total	69.9	147	

Source: National Capital Region planning Board

Table 3.24

Land Requirement for Urban Development by 2001

Town	1981			2001		
	Area Sq. km	Population ('000)	Density per sq. km	Assigned population ('000)	Total land requirement (sq. km)	Addl. land requirement (sq. km)
Gurgaon	24.13	101	4186	700	1.25	31.87

Source: National Capital Region Planning Board, New Delhi

Table 3.25

Employment Structure in DMA Town of Gurgaon – 2001

TOWN	Proposed participa- tion ratio	Primary	Industry	Construc- tion	Trade & Commercial	Transport & Communi- cation	Services
GURGAON	35	2.0	40.0	10.0	16.0	10.0	22.0

Source: National Capital Region Planning Board, New Delhi

Table 3.26

The Existing Landuse Pattern of Gurgaon Urban Area – 2001

Landuse	Area (sq. km)	Percentage	Spatial distribution
Residential	62.43	63.7	Eastern, South eastern & south western side
Industrial	13.49	13.65	Northern & Southern side along NH8
Commercial	2.20	2.22	Central part - Sector 29
Transport & Communication	6.65	6.73	NH8 widening, two more proposed on the eastern side
Public & Semi Public use	3.02	3.05	South western side adjoining NH8
Defence Land	6.33	6.4	Northern side of the town
Open Spaces	3.63	3.67	Area surrounding the ammunition depot, along NH8, railway line and southern side – Badshahpur nallah
Special Zone	1.06	1.07	Concentrated mainly on the northern side.
Total	98.81	100	

Source: Development Plan-2001, Town & Country Planning Office- Gurgaon

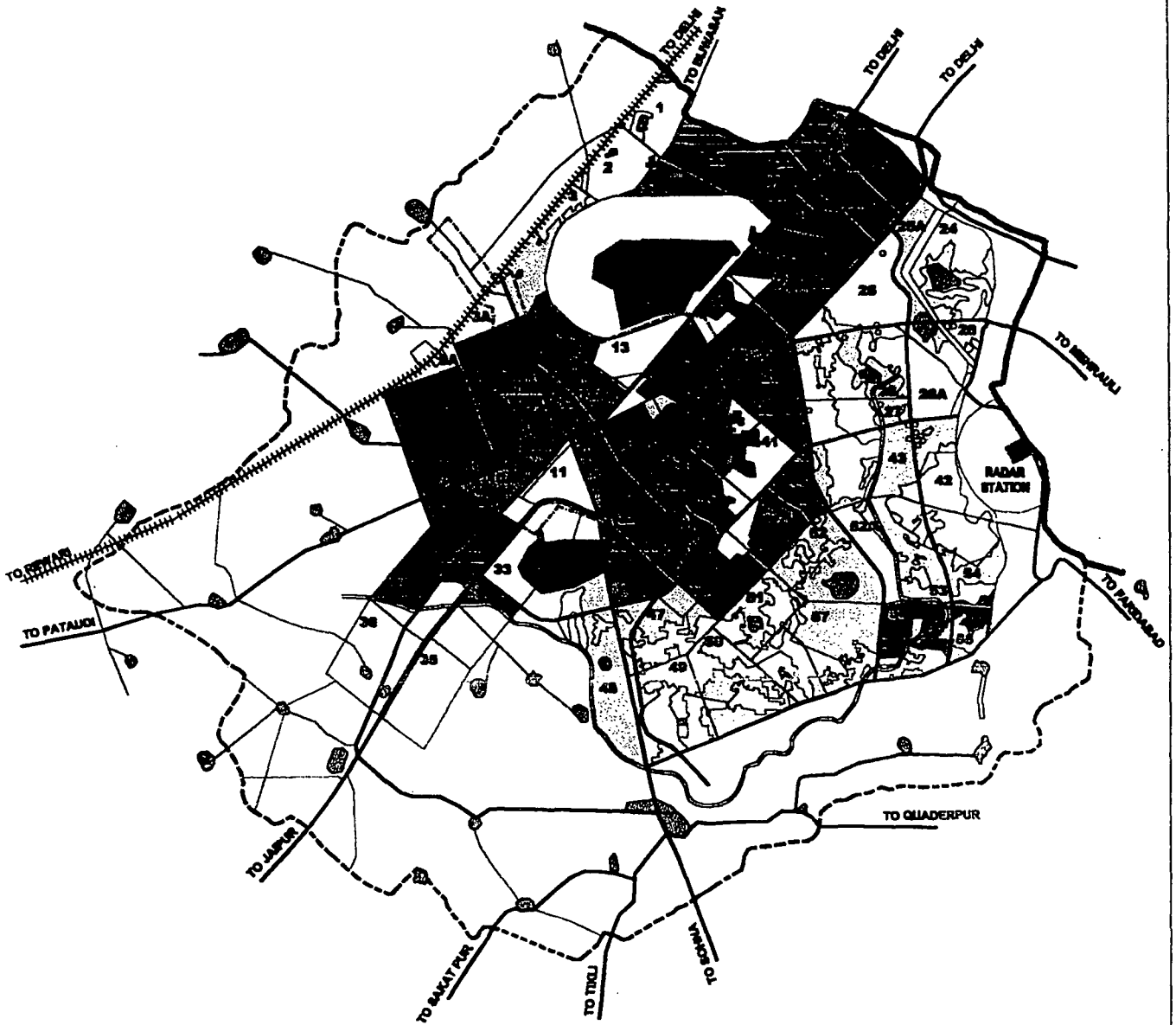
Table 3.27
Proposed Landuse for the Year 2021

Landuse	Area (sq. km)	Percentage	Spatial distribution
Residential	46.45	43.14	Eastern, South eastern & south western side
Industrial	16.40	15.23	Northern & Southern side along NH8
Commercial	5.95	5.52	Central part - Sector 29
Transport & Communication	1.45	1.34	NH8 widening, two more proposed on the eastern side
Public & Semi Public use	8.85	8.22	South western side adjoining NH8
Open Spaces	9.25	8.59	Area surrounding the ammunition depot, along NH8, railway line and southern side – Badshahpur nallah
Public utilities	5.5	5.1	Concentrated mainly on the northern side.
Reserved area	18.75	17.41	Northern side of the town
Total	107.65	100	

Source: Town & Country Planning Office, Gurgaon

(Note: The Reserve area includes area under Existing Town and area under Defence land)

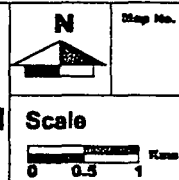
MAP 3.1 : GURGAON: MODE OF DEVELOPMENT



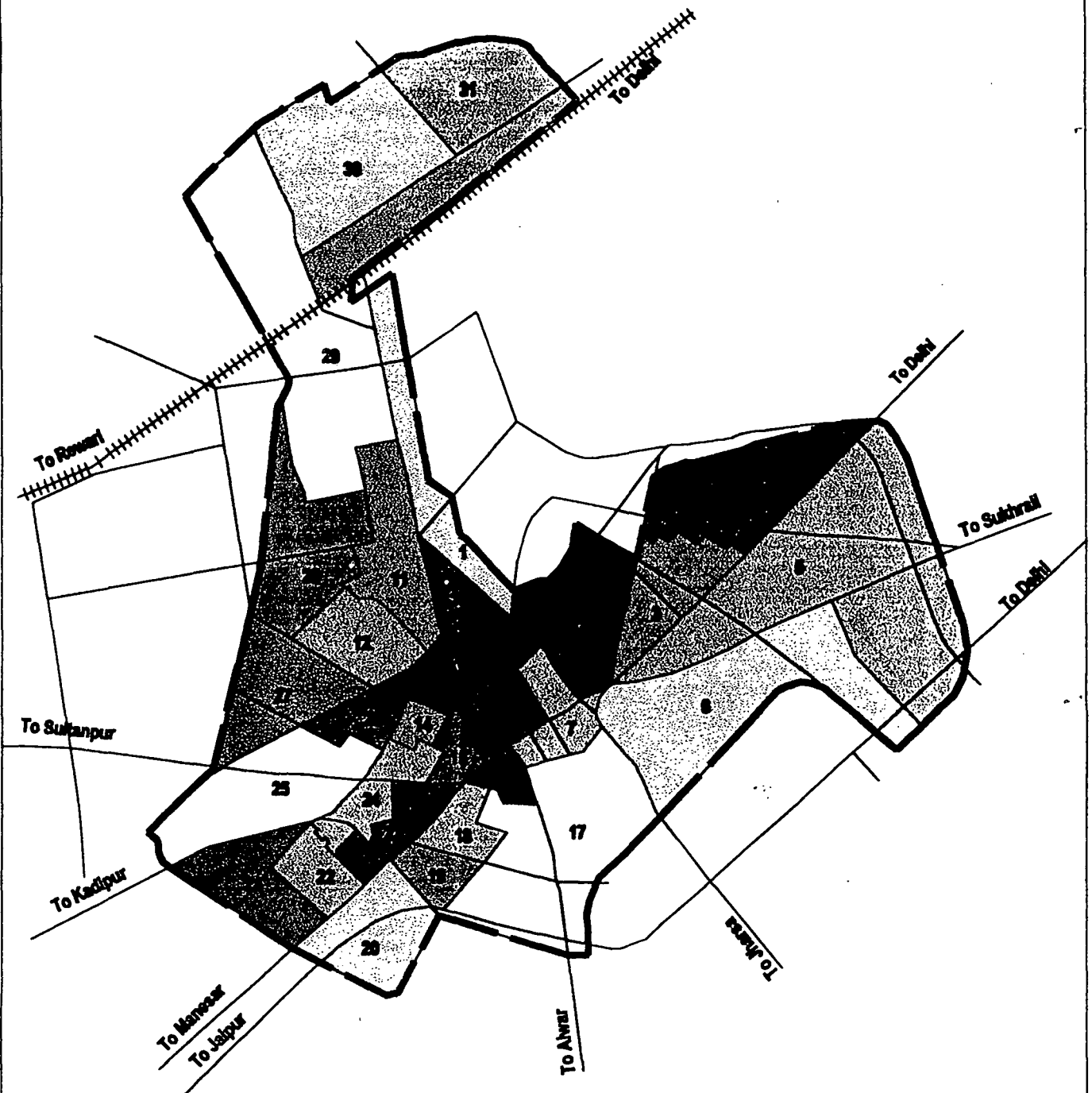
LEGEND

- | | | | |
|--|--------------------------|--|---|
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| | Controlled Area Boundary | | Area Under Development by HUDA |
| | Municipal Limit | | Defence Land |
| | Major Road | | Industrial Area Developed by HSIDC |
| | Other Roads | | Area Under Licensed Colonies/ Group Housing |
| | Village road/ Village | | Area Notified Under Section 4 |
| | Railway Line | | Area Under Existing Town/ Villages |





**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**






MAP 3.2 : DISTRIBUTION OF WARDS - GURGAON TOWN



LEGEND

-  Municipal Boundary
-  Ward Boundary
-  Major Road
-  Railway Line

**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**

N 	Map No.	
Scale 		



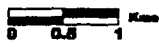
MAP 3.3 : AREA UNDER PRIVATE COLONIZERS



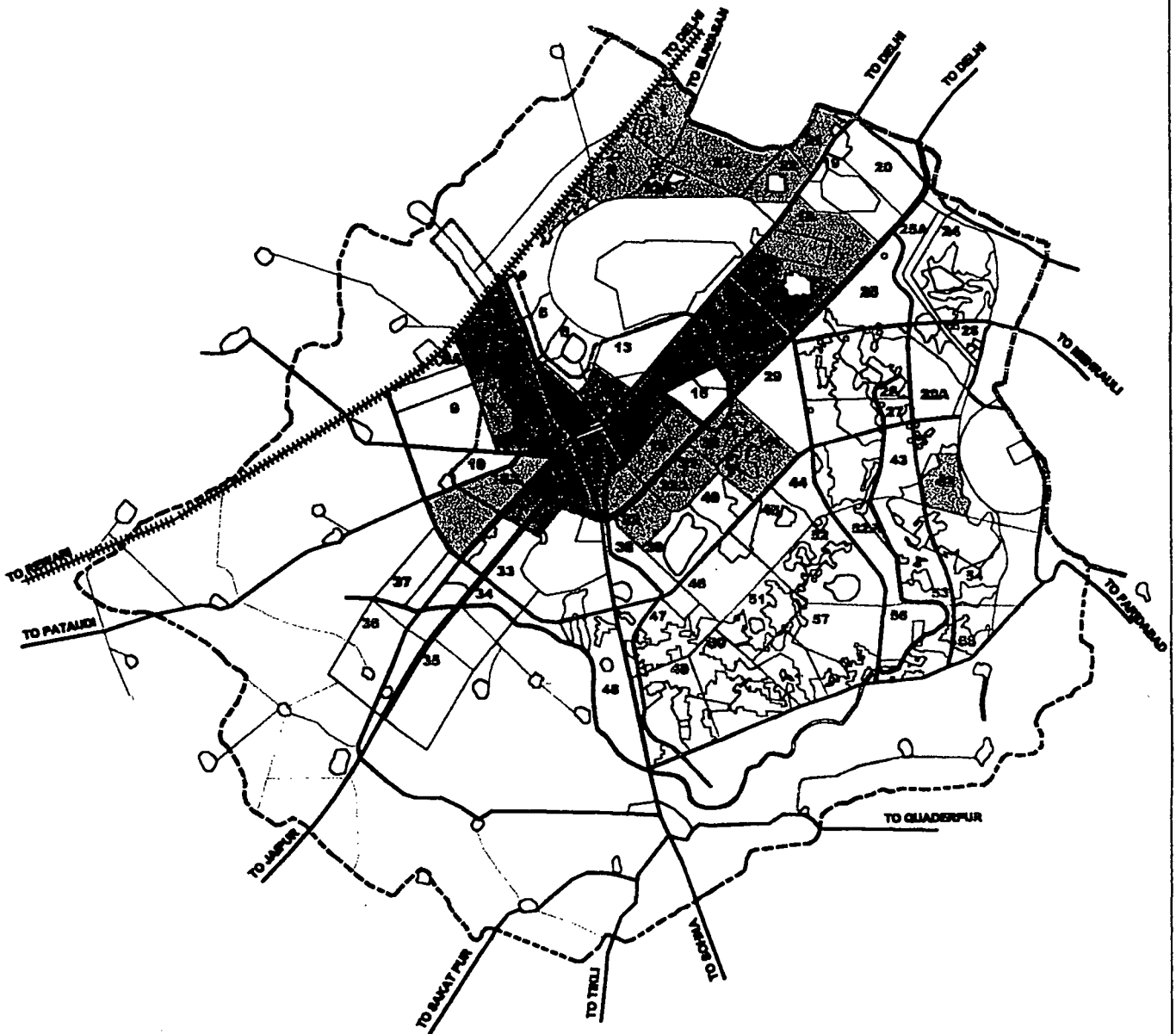
LEGEND

-  State Boundary
-  Controlled Area Boundary
-  Municipal Limit
-  Major Road
-  Other Roads
-  Village road/ Village
-  Railway Line
-  Area Under Licensed Colonizers

**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**

 N	Map No.	
Scale 		

MAP 3.5 : GROWTH OF RESIDENTIAL COLONIES



LEGEND

- | | | | |
|--|--------------------------|--|--------------|
| | State Boundary | | Before 1980 |
| | Controlled Area Boundary | | 1980 - 1990 |
| | Municipal Limit | | 1990 Onwards |
| | Major Road | | |
| | Other Roads | | |
| | Village road/ Village | | |
| | Railway Line | | |

FEASIBILITY STUDY IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON











N 	Map No.	
Scale 		

GREEN CITY INDIA




MAP 3.6 : PLANNING CONCEPT FOR GURGAON UA



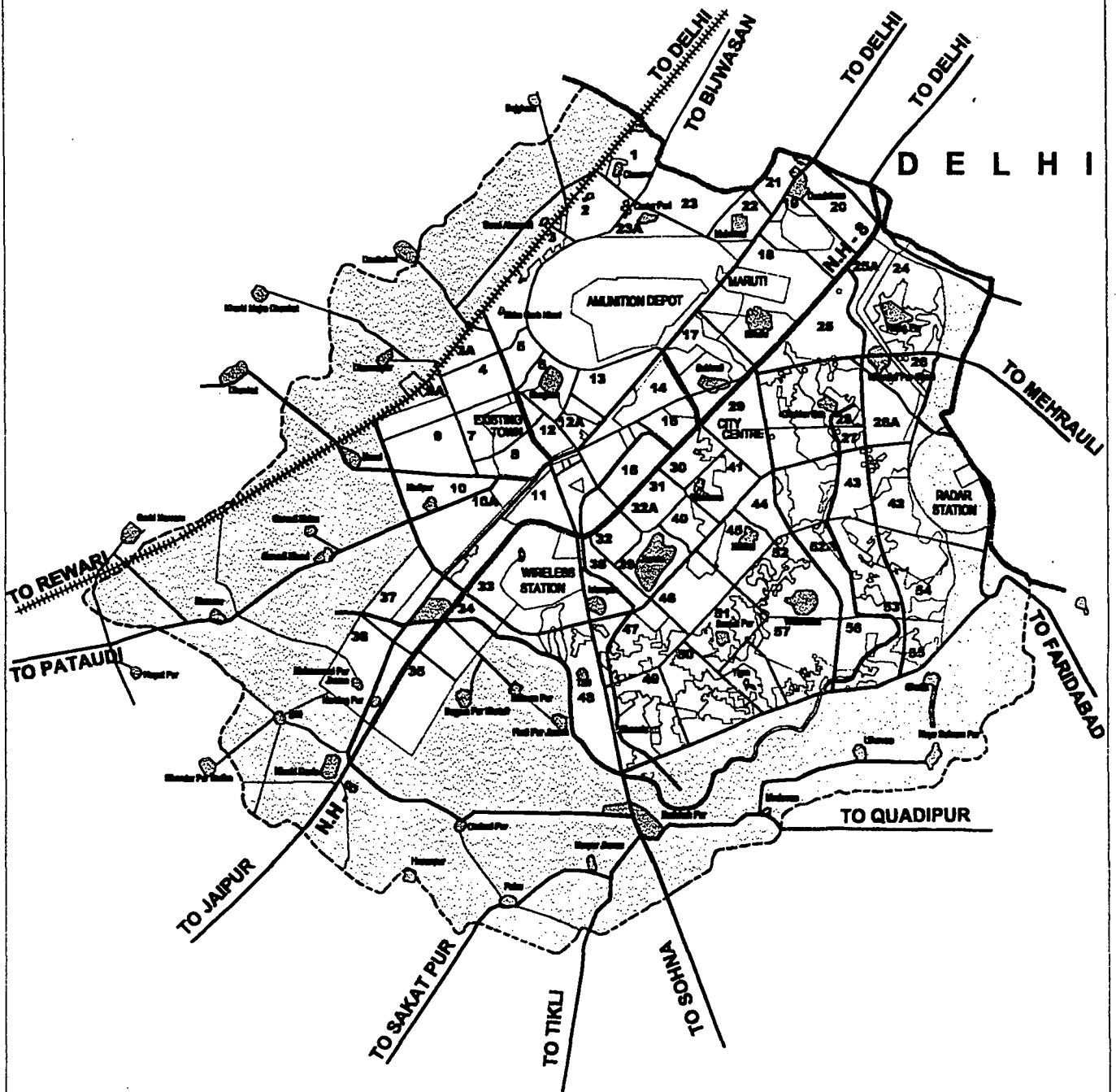
LEGEND

- | | |
|--|---|
|  State Boundary |  Landscaped area |
|  Controlled Area Boundary |  M.R.T.S Routes |
|  Municipal Limit |  Ponds to be Developed |
|  Major Road | |
|  Other Roads | |
|  Village road/ Village | |
|  Railway Line | |









FEASIBILITY STUDY IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON

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GREEN CITY INDIA		




MAP 3.7 : ROAD NETWORK & LINKAGES



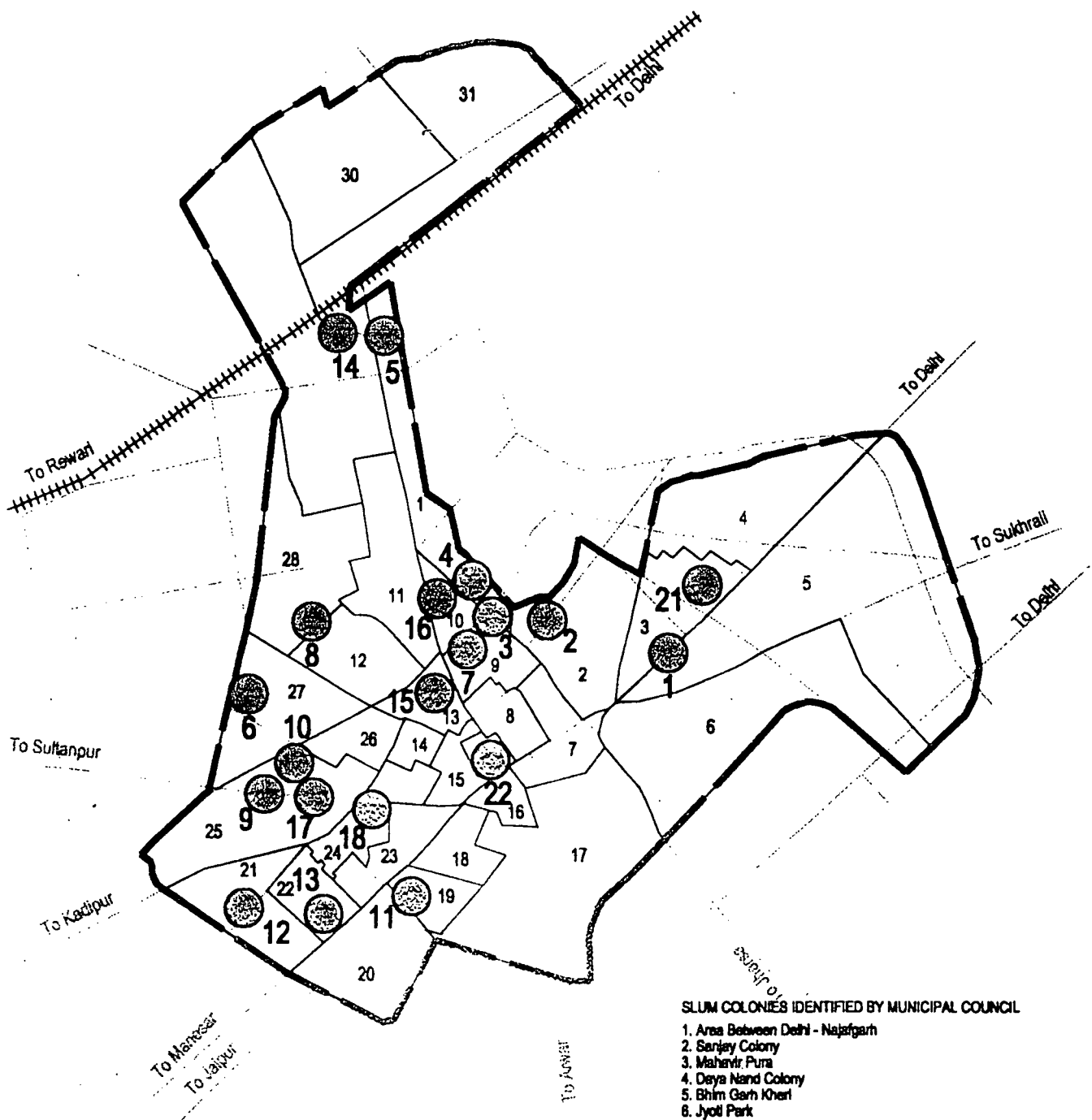
LEGEND

- | | |
|--|--|
|  State Boundary |  Gurgaon Urban Area |
|  Controlled Area Boundary |  Agricultural Area |
|  Major Road |  Villages |
|  Other Roads | |
|  Village Road | |
|  Railway Line | |





**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**

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MAP 3.8 : DISTRIBUTION OF SLUM COLONIES IDENTIFIED UNDER MUNICIPAL COUNCIL AND DUDA (1997 - 1998)



LEGEND

-  Municipal Boundary
-  Ward Boundary
-  Major Road
-  Railway Line


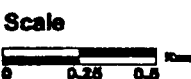

SLUM COLONIES IDENTIFIED BY MUNICIPAL COUNCIL

1. Area Between Delhi - Najafgarh
2. Sanjay Colony
3. Mahavir Pura
4. Daya Nand Colony
5. Bhim Garh Kheri
6. Jyoti Park
7. Dhanak Bhasi
8. Krishna Colony
9. Manohar Nagar
10. Baldev Nagar
11. OM Nagar
12. Gandhi Nagar
13. Hira Nagar
14. Laxman Vihar

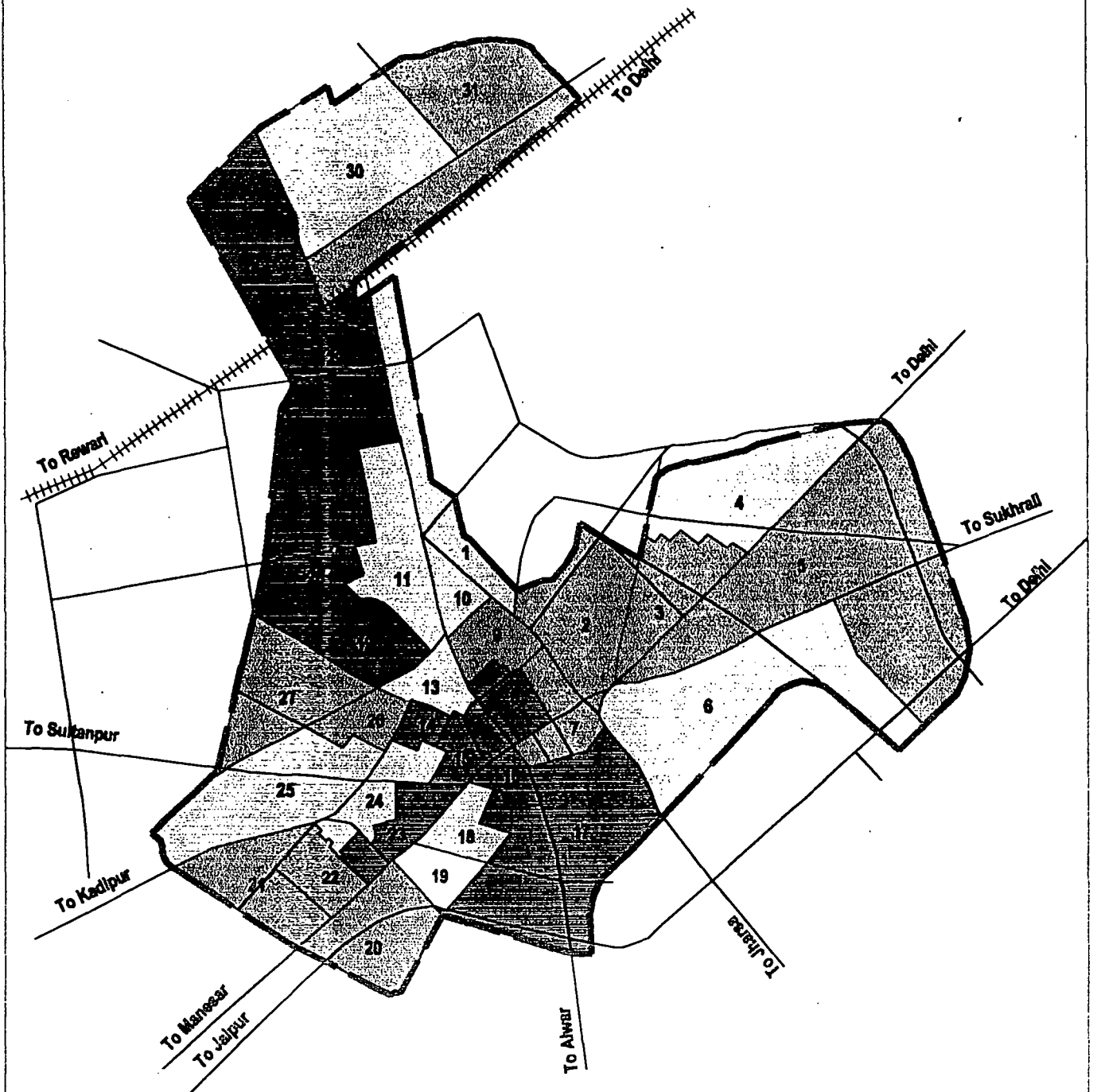
SLUM COLONIES IDENTIFIED BY DUDA

15. Idgaha Balmid Basti
16. Bhim Nagar
17. Firoza Gandhi Colony
18. Veer Nagar
19. Katchi Colony Khandasa
20. Firoza Gandhi Colony
21. Rajiv Nagar Jhuggi Basti
22. Nai Basti





**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**

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Scale 	
 GREEN CITY INDIA	




MAP 3.9 : GURGOAN TOWN - WARDWISE DISTRIBUTION OF SCHEDULED TRIBE/ OBCs - 1998



LEGEND

-  Municipal Boundary
-  Ward Boundary
-  Major Road
-  Railway Line

% Contribution to Total S.C. Population

-  Below 10 percent
-  10 to 20 percent
-  Above 20 percent


**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**

N

Map No.

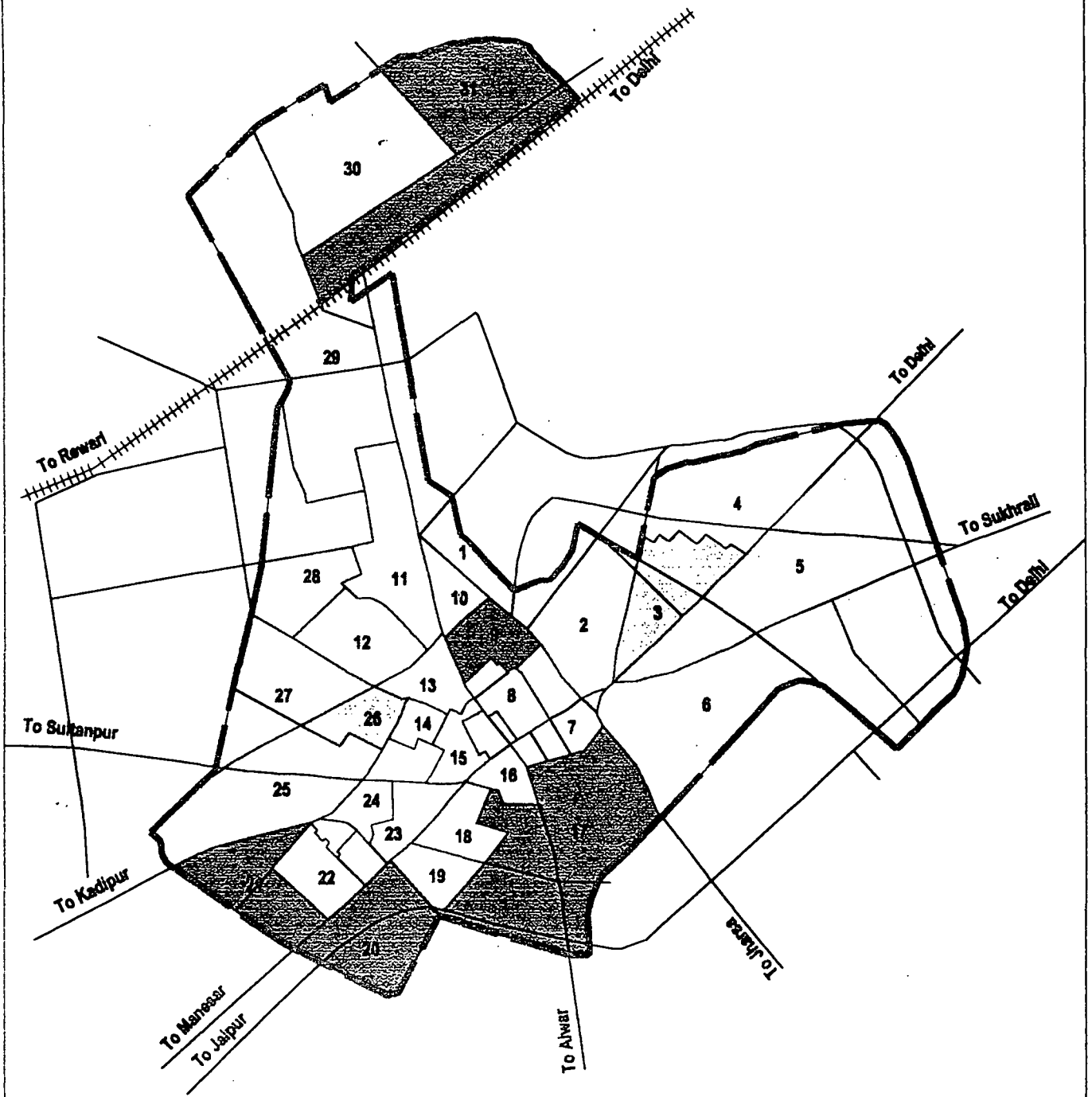
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





GREEN CITY INDIA




MAP 3.10 : GURGOAN TOWN - WARDWISE DISTRIBUTION OF SCHEDULED CASTE - 1998



LEGEND

-  Municipal Boundary
-  Ward Boundary
-  Major Road
-  Railway Line

% Contribution to Total S.C. Population

-  Below 10 percent
-  10 to 20 percent
-  Above 20 percent

**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**

N

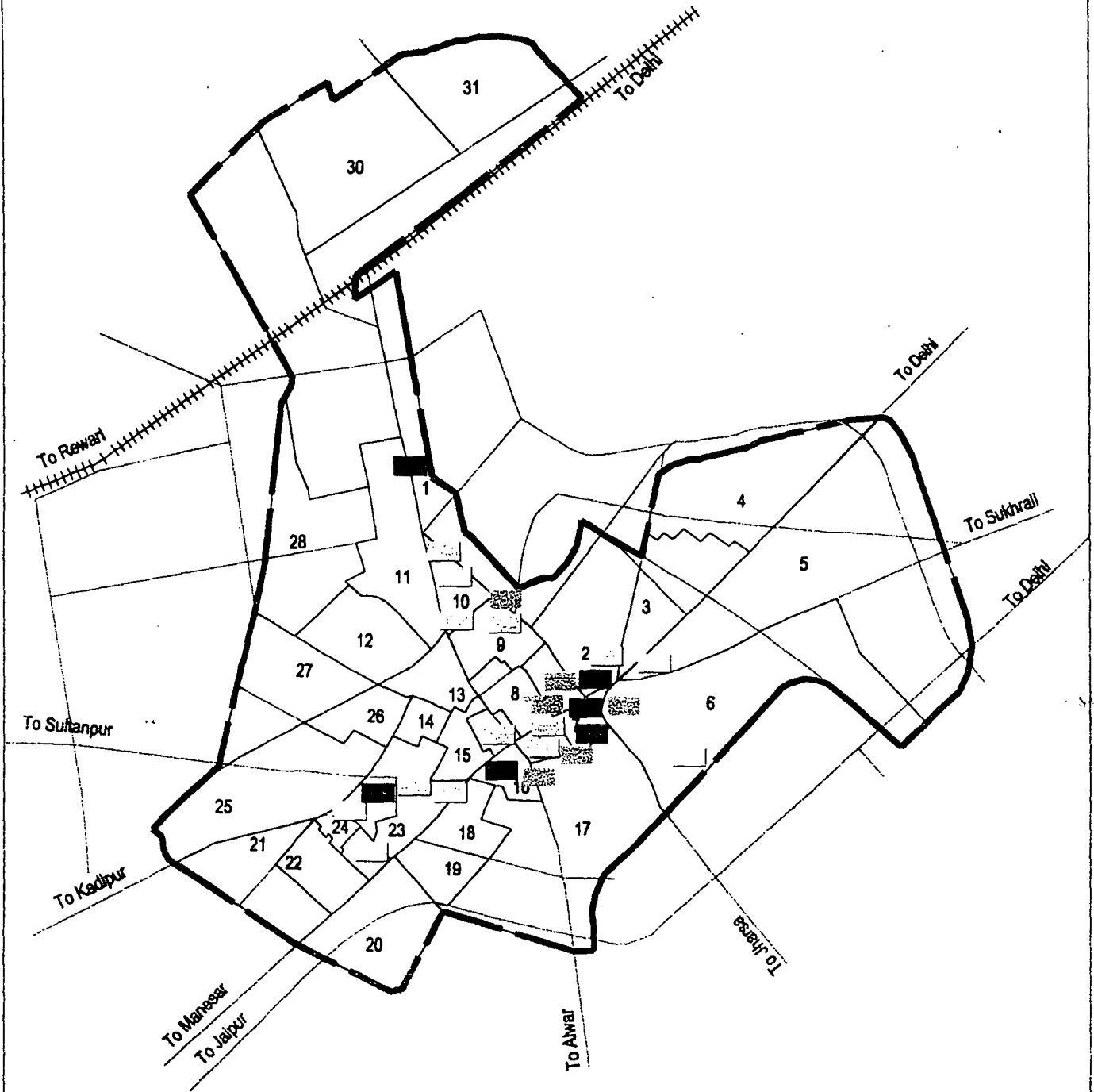
Map No.

Scale

0 0.25 0.5 Km



MAP 3.11 : EXISTING AND PROPOSED TOILET FACILITIES IN GURGAON



LEGEND

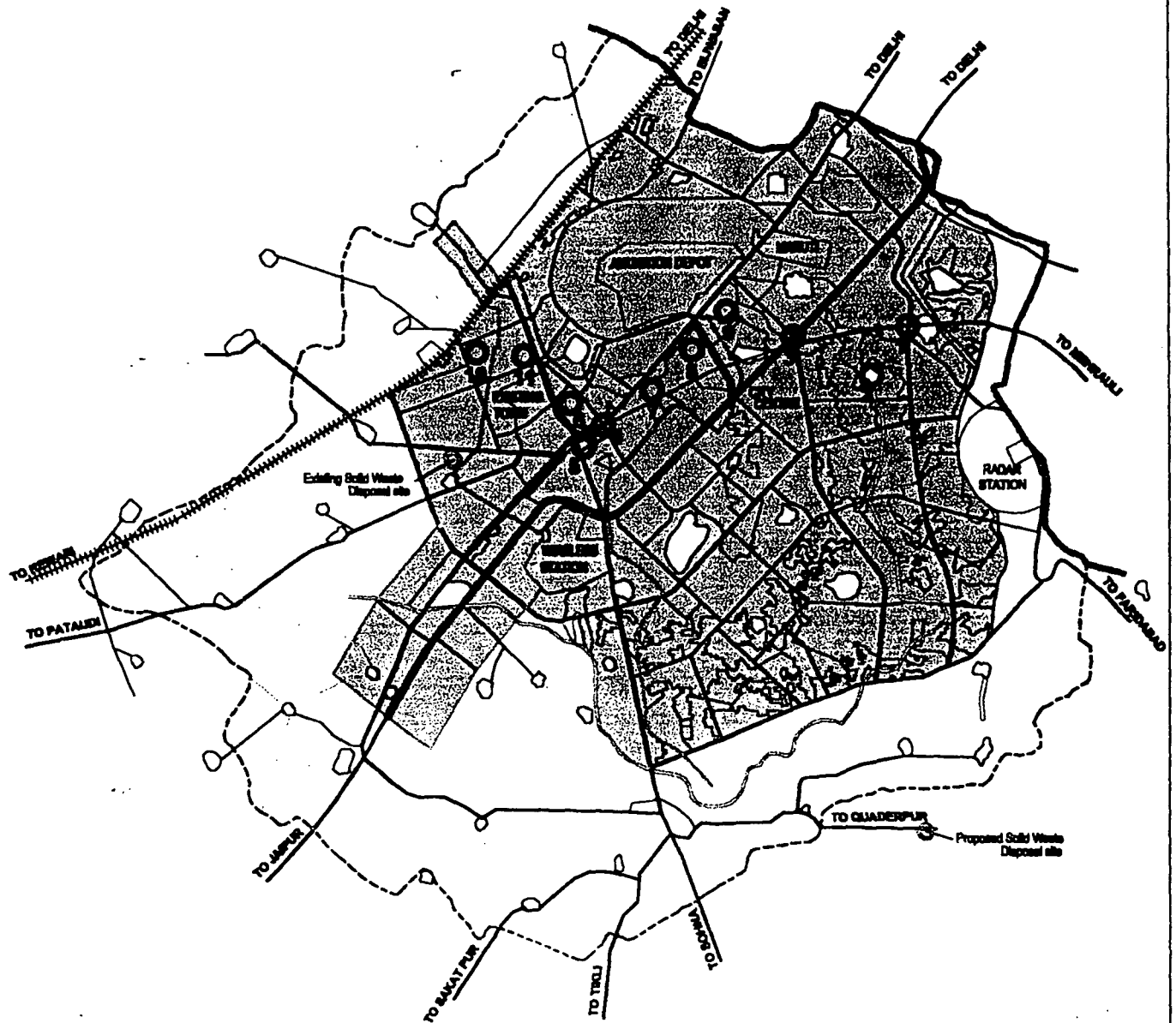
- Municipal Boundary
- Ward Boundary
- Major Road
- Railway Line

- List of Existing Urinals in Gurgaon Municipal Area
- Existing Public Toilet Complexes, Built & Operated by Sulabh
- Toilet Complexes that are Required as Suggested by the Sanitary Inspector
- Toilet Complexes that are Required as Suggested by the Gurgaon Traders' Association

FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON

N 	Map No.	
Scale 0 0.25 0.5 Km		

MAP 3.12 : PROPOSED SITES FOR ULTRA MODERN TOILETS AT GURGAON



○ Proposed Ultra Modern Toilet Sites

LEGEND

- State Boundary
- Controlled Area Boundary
- Municipal Limit
- Major Road
- Other Roads
- Village road/ Village
- Railway Line

SITE NO. LOCATION

- 1 Sikandarpur Chowk
- 2 Rao Shyamal market, Chakdarpur
- 3 IFFCO Chowk, NH-8
- 4 Fountain Chowk, Zila Police Line
- 5 Nehru Market, Badar Bazar Chowk
- 6 Sector - 12 Market, Near Telephone Exchange
- 7 Sector - 14 Market
- 8 Sector - 14 Main Road, Opp. Shyam Garments
- 9 Sector - 17 Market
- 10 Sector - 4 Market
- 11 Sector - 4 Near Gurunank Market

**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**

N

Map No.

Scale

GREEN CITY INDIA



"GURGAON SKYLINE"

A view from top



" A MODERN CREATION "

A DLF Building

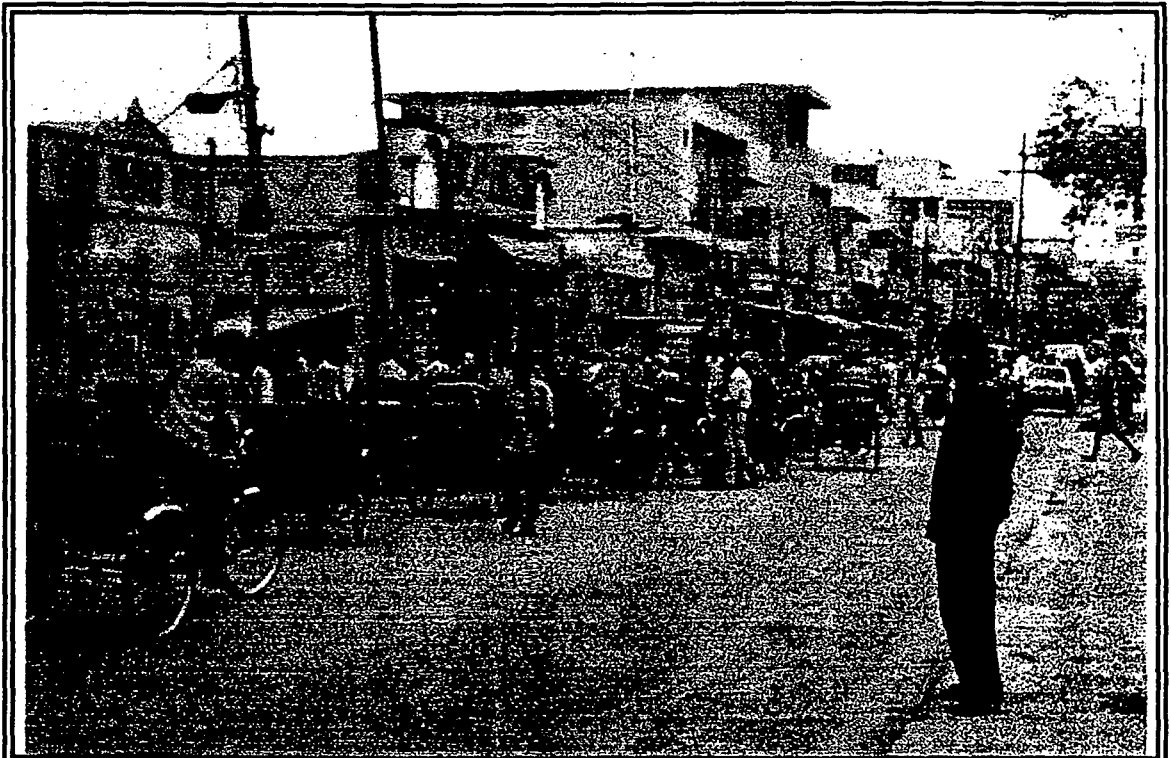


"A BUSY MARKET PLACE"



"BEVERLY PARK"

Residential Area developed by Private Developers



"LOCAL TRANSPORTATION"

Rickshaws in the middle of Gurgaon Town

Chapter 4

Waste Management

In recent years there has been growing concern about a variety of problems associated with garbage management. Most urban authorities are unable to collect, transport and adequately dispose the increasing quantities of waste that is generated in our cities and towns.

Accumulations of waste breed a variety of disease vectors while random dumping of solid waste poses a great threat to the environment in the form of air, soil and water pollution.

Rapid urbanization has led to the deterioration in the physical environment and quality of life in urban areas caused by widening gap between demand and supply of essential services and infrastructure all over India.

Today's economy in the society is characterized by production of high volume of waste. Disposal of large volume of waste poses the difficulties of disposal sites, location and adoption of methods that are economical.

In most cities it is observed that nearly half of the solid waste remains unattended. Landfill sites and garbage dumps are overflowing. The present solid waste management system has several problems.

Gurgaon today has started facing the brunt of high growth rate and the inadequacies in the availability of basic amenities. This is showing visible signs of deterioration and may result in becoming an urban slum, if proper and comprehensive action plan, to tackle one of the worst problems facing the Indian cities of solid waste management is not drawn up. The existing solid waste management and disposal system being followed has a number of problems.

The problems of solid waste disposal have become very acute in rapidly growing towns, because of limited disposal facilities. Such a situation can be viewed in Gurgaon too, where problems of solid waste management are assuming serious proportions due to increasing population and urbanization.

At present, the solid waste is being dumped in haphazard manner in various parts of the urban area, thereby causing not only an impact on the environment but also serious health hazards.

The various sources of solid waste in Gurgaon Urban area are waste from residential/ household, commercial & institutional areas, hospitals, markets, industries and construction debris. The main source of solid waste is the domestic or household waste.

The various sources solid wastes and its main contents are given in Table 4.1.

4.1 Waste Quantity and Characteristics

The quantity of MSW generated depends upon the number of factors such as food habits, standard of living, degree of commercial and industrial activities, climatic conditions, etc.

Out of the MSW generated at source a part of it including plastics, paper, metal and other recyclable items, is reclaimed by the waste pickers during different stages of collection, transportation and at disposal site.

The quantity is known to vary seasonally. During monsoon due to high moisture content the quantity of MSW increases. During festive seasons also the amount of refuse generated shows an increase.

The average per capita waste generation is about 410 gm/capita/day; the total municipal waste generated in Gurgaon Urban Area is given in Table 4.2.

Quantity

There is no documentation available regarding past trend of increase in per capita MSW generation in Gurgaon Town. However, NEERI based on their studies has suggested an increase of 1.33% per annum in per capita waste generation for Indian cities. Details of total population, per capita waste generation and future quantity of MSW generation for Gurgaon Town under the municipal limit is given in Table 4.3.

Characteristics

Knowledge of physical as well chemical characteristics of MSW is very important for effective and economical planning of collection, transportation, treatment and disposal system.

The municipal solid waste of Gurgaon is characterized by high sand, grit and ash content. The calorific value is a little higher compared to other towns of similar demographic characteristics, and the moisture content is also high.

The MSW generated has sufficient compostable matter, wood, rubber, cloth and plastic content. Metal and glass content is negligible in the MSW but has a good NPK value and C/N ratio. The MSW is neither acidic nor basic as shown by the pH value. Compostable matter has high volatile substance and organic carbon.

The physical characteristics of municipal solid waste in Gurgaon are given in Table 4.4 and the percentage distribution of the physical characters is given in Figure 4.1.

The chemical characteristics of Gurgaon municipal waste are given in Table 4.5.

The pH of MSW is an indication of its age. The pH of fresh waste is around seven (7), which becomes acidic due to decomposition of the organic portion. If the material is already stabilized, it gives an alkaline pH. The pH of MSW in Gurgaon shows a normal pH of about 7.07.

The gross calorific value of the MSW is analyzed to be 960 Kcal/kg. Calorific value of the refuse is important when the MSW is to be incinerated. It gives an indication that whether any auxiliary fuel is required to be blended with the MSW or not.

The rate of bio-degradation/ methane generation depends on the percentage of volatile matter. In Gurgaon the average percentage of volatile matter is about 29.7% of the total waste generated.

The nitrogen, Phosphorous, Potassium (N, P and K) values and the carbon content in the MSW gives an idea about the fertility of organic manure produced from the waste. C/N ratio of the waste indicates the rate of decomposition of waste. This value is important while selecting appropriate technology for treatment of solid waste. N, P, K values are 0.012%, 0.011% and 0.047% respectively on average basis for Gurgaon's municipal solid waste.

The commercial complexes (offices, shops, etc.) contribute roughly 4 to 5 TPD of solid waste. The characteristics of the waste generated from the commercial complexes are given in **Table 4.6**.

Hotels and Restaurants contribute roughly around 5 to 7 TPD of solid waste. The characteristics of the waste generated from the commercial complexes are given in **Table 4.7**.

Vegetable and fruit markets contribute roughly 2 to 3 TPD of solid waste. High organic and soil content having sufficient vegetable and fruit waste characterize the vegetable market waste.

The calorific value of vegetable market waste is very high. The waste also has a high NPK value and C/N ratio. The typical characteristics of the vegetable market waste are given in **Table 4.8**.

4.2 Waste Management in Gurgaon

Three separate and individual bodies having their respective zone of management, manage the municipal solid waste in Gurgaon urban area. The institutional arrangement for municipal solid waste management in Gurgaon Urban Area is given in **Table 4.9**.

- Municipal Council is responsible for collection and disposal of solid waste generated in the Gurgaon Town.
- HUDA manages the collection and disposal of solid waste generated in the HUDA sectors.
- Private developers have their own solid waste collection and disposal mechanism for their colonies.

4.2.1 Waste Management - Municipal Area

The Sanitary wing of the Gurgaon Municipal Council is directly responsible for the municipal solid waste management. The work is executed under the overall supervision of the Chief Sanitary Inspector, who carries out the work through Sanitary Inspectors, Sanitary Supervisors, Safai Darogas and Safai Karmacharies.

The organizational structure of the solid waste management department of Gurgaon Municipal Council is shown in the **Figure 4.2**.

In the existing organizational setup there is 1 Chief Sanitary Inspector, 2 Sanitary Inspectors, 2 Sanitary Supervisors, 8 Safai Darogas and 467 Safai Karmacharies. Safai Karmacharis carry out the work of road cleaning, collection and transportation of waste to community bins and to disposal sites.

The existing manpower deployment for the solid waste management in Gurgaon Municipal area is given in the **Table 4.10**.

The Gurgaon Municipal Council does not have any workshop and no manpower deployed for maintenance and repairs of vehicles used for transporting the waste. The work of repair and maintenance is done from a private workshop.

I. Collection System

Sweeping: The Safai Karmacharies sweep the roads using long handled broom and collect the sweepings at suitable locations on the roadside. Each Safai Karmachari is provided with a broom, basket and a spade for sweeping and transferring the waste.

Their working hours are 6.30 to 11.30 a.m. in the morning and 2.00 to 5.00 p.m. in the afternoon for six days a week. A sweeper serves a population ratio of about 500 people and cleans a road length of about 400 meters a day.

The waste thus collected is transferred to a wheelbarrow with the help of a spade and then taken to the nearest community bin or a collection point for further transportation to the disposal site. The number of Safai Karamcharis appointed for a certain area depends upon the size of that area.

The amount of waste generated in congested lanes and in the market area is comparatively more, so number of Safai karamcharis appointed in this area are also more than other places.

The detail figures of road cleaned in Gurgaon Municipal area is given in **Table 4.11**.

Collection: Presently "community bin system" for collection of MSW is being adopted in Gurgaon Municipal Area. MSW generated at individual premises is removed initially by the owner or his employee.

In some parts of the town there is door-to-door collection system. The MSW is either deposited in a community bin or at an open place from where it is put into the community bin by Safai Karmacharies.

Due to shortage of community bins, there are a number of places throughout the city where people collect and deposit the solid waste on open ground. Safai Karmacharies also dumps the waste collected from sweepings at such places.

Community Bins: Presently the community bins that are used for collection and storage of MSW can be divided into two broad categories as:

Stationary Bins: Generally known as 'dust bins', they are made with bricks masonry walls and are open without lids. MSW collected at these bins are loaded into Tractor Trolleys manually by Safai Karmacharies.

Portable Bins: Refuse Collector bins (R. C. Bins) are the portable bins. These bins are lifted mechanically by the lifting arrangement provided with the transportation vehicles, unloaded and kept back in their place.

The existing waste collection system in Gurgaon Municipal area is shown in the **Figure 4.3**.

Presently there are 57 bins including 5 refuse collector (R.C.) bins distributed into 31 wards. Each bin caters to around 700 property units or 4000 people. Each bin is placed at an average distance of 300-400 yards.

The wardwise distribution of dustbins and refuse collector bins is given in **Table 4.12**.

The location of dustbins or MSW collection points in Gurgaon Municipal Area is given in **Table 4.13**.

II. Transportation System

MSW collected in the community bins and at other places is presently transported to the dumping site in different vehicles such as Refuse Collector, Tractor Trolley and Truck. The detailed description of the vehicles used, capacity and number of trips per day is given in the **Table 4.14**.

About 70-75% of the waste generated in the town is transported to the dumping site leaving a backlog of 25-30%. There are about 500 persons directly involved in collection and disposal of waste and spend an annual expenditure of over Rs. 20 million on the same, which works out an average cost of Rs. 500 per ton of waste.

Some financial figures regarding the cost of transportation, collection, disposal of Gurgaon Municipal Council is given in the **Table 4.15**.

No major safety measures have been adopted either at the primary collection, loading, transportation or final dumping operations of MSW. Insecticides are not sprayed on the garbage collected to eliminate foul smell and keep the area insect free.

The Safai karmacharies are not provided with basic amenities like mask, gloves, shoes, etc. and due to unhygienic working conditions they are exposed to diseases such as Tuberculosis, Cholera, etc.

The unscientific collection of garbage in open collection points and the dumping site at sector 10, Basai Road is leading to pollution of ground water as well as the surrounding environment.

The transportation of MSW is done in open vehicles, which leads to spillage of garbage on the roads while transporting. The uncollected garbage blocks the open storm water drains and leads to mosquito breeding and malaria.

4.2.2 Waste Management - HUDA Sectors

HUDA is responsible for the waste management of the 16 sectors that are under its domain. It is mainly responsible for collection of the waste from the community bins.

The community bins are placed at certain specified locations in the sectors. On an average there are about 6 bins in each sector. The bins are placed at a distance of about 250m from each other. They have a capacity of 1.5 cubic meter.

There are about 100 bins altogether in the HUDA sectors. The waste that is collected from the households is thrown into the bins. These bins are emptied every alternate day. In sector 14, there is only one bin placed at the market place.

HUDA is not responsible for house-to-house collection of the waste. It is only responsible for the collection of the waste from the community bin and transporting it to the disposal site.

HUDA has also appointed sweepers who are responsible for cleaning and sweeping the roads. They have also appointed some private contractors who are responsible for the waste management in certain areas.

The private contractors in turn have employed sweepers for this purpose. There are 300 sweepers employed for the waste management in the HUDA sectors, out of which 55 belong to HUDA and the rest are appointed by the contractors.

The sweepers collect the waste from the surrounding area and throw them into the bins. Thus the solid waste that is collected mainly comprises of household waste and the street sweepings. Sometimes the hospital waste is also dumped into these bins.

The detailed description of the vehicles used, capacity and number of trips per day is given in the **Table 4.16**.

HUDA has three refuse collectors for transportation of waste. Since alternate day waste removal is practiced, hence they are responsible to cover 8 sectors in each day.

It is estimated that the amount of waste that is disposed in each day is about 78-80 tonnes. During the transportation of the waste the refuse collectors are not covered as a result of which spillage occurs.

The sweepers have been provided with a uniform, but they have not been provided with a safety kit comprising of mask, gloves and shoes. Therefore no safety measures are adopted either at loading, transportation or final disposal of the solid waste.

4.2.3 Waste Management - Private Developers

As per the data collected during the primary survey it is observed that the private developers have their own system of waste handling. They have appointed private contractors in their area.

These contractors employ sweepers who work for 8 hours in a day. They are responsible to collect the waste from each of the houses. The residents collect the waste in plastic bags and keep it outside their houses, from where the sweepers collect it regularly in hand carts, open cycle carts or moveable trolleys.

The waste thus collected is disposed in any open land or dumping yards outside the private developer area. The disposal site is an unauthorized disposal site and not designated for dumping of waste. But since HUDA has not provided any land for waste disposal, this kind of unauthorized dumping is practiced.

In some places the dump is occasionally serviced but in certain cases no such servicing is done, and the waste thus thrown there remains accumulated over a long period of time.

The accumulated waste affects the air quality of the surrounding area and creates an unhealthy atmosphere for the people residing close by. Apart from this the

leachate from the waste might also affect the ground water quality, as there is no provision to control the leachate in these dumping sites.

The waste from the houses is directly sent to the disposal site, as there is no collection point at the intermediate stage. It has been estimated that the amount of waste generated from each of the houses generally ranges between 2-4 KGs.

Apart from house to house collection the private developers are also responsible for maintenance of roads, parks and gardens in that area. The sweepers do not take any safety measures or precautions during handling of the waste. They are not aware of the hazardous effects of toxic waste handling.

Waste management at Ansals, Unitech - South City I and DLF is given in Table 4.17, 4.18 and 4.19 respectively.

4.2.4 Waste Management - Hospital Waste

Hospital waste comprises of waste generated from hospitals, medical institutions, nursing homes and other medical facilities. It has always been considered as health hazard in view of the inherent potential for dissemination of infection.

In the recent year's wider variety of potentially hazardous ingredients including antibiotics, cytotoxic drugs, corrosive chemicals and radioactive substances have become a part of the hospital waste, which could endanger human life.

In Gurgaon there is only one government hospital and the others are private owned. There are about 42 nursing homes/hospitals in Gurgaon as per the information obtained from the Municipal Council.

As per the sample survey that has been conducted for the study it has been observed that maximum number of hospitals are found around Sector 14, on the New Railway Road and the Old Railway Road area.

The details of the survey results are given in Table 4.20. It is estimated that the total hospital waste generated in the Gurgaon Urban Area is approximately 500 kg per day.

Majority of the patients belong to the middle and low-income group. Also on the basis of the survey we can conclude that maximum number of people are

affected during the monsoon season rather than in summer or winter. Most commonly found diseases are water and air borne.

More than 85% of the hospital waste is non-hazardous, about 10% is infectious and 5% is non-infectious but hazardous. The quantum of waste generated varies depending upon the type of health problem, the type of care provided and the hospital practices.

It is estimated that the amount of solid waste generated per patient per day ranges between 1 – 2 kg. There is no standardized system of segregating hazardous waste from non-hazardous waste in majority of the hospitals. Mixing of hazardous with non-hazardous component results in increased quantity of hazardous wastes that require safe disposal.

From the information that has been collected from the various nursing homes and hospitals during the primary survey, it is observed that no proper record is maintained about the treatment and quantum of waste generated from them.

As there is no well-established system of segregating hazardous from non-hazardous waste in most hospitals, there are no clear-cut guidelines on source segregation of hazardous waste from non-hazardous waste. Technical problems of the poor segregation of hazardous wastes at source might also be due to the lack of awareness or due to the low education of personnel in charge.

In most cases the waste generated in the hospital is collected in plastic bags or drums. Generally there is no direct handling of the waste by the sweepers, still as a precautionary measure, they do not use any gloves while collecting the waste. The waste thus collected is disposed off in the Municipal bins.

In some places partial segregation is practiced – the glass bottles are collected separately and sold to the kabadiwalas, so that they can be further reused. The needles of the used plastic syringes are cut with a cutter and then they are disposed separately. The used cotton and bandages are collected and burnt so that it does not cause any sort of infection.

It is observed that nursing homes and other private hospitals discard their waste into the community bins or open collection points in nearby areas, thereby mixing it with Municipal solid waste.

In some hospitals the waste that is collected is taken in trolleys, and dumped in open land. This practice is very likely to result in the contamination of the entire MSW at collection points as well as at the disposal sites.

In certain cases the used needles are destroyed by shredders and dumped in open lands and the remaining hospital waste is carried away by sweepers and dumped in the Municipal bins. The bins are not generally covered and remain exposed to the surrounding.

In very few instances it is noted that categorized segregation of the waste is carried out at the initial stage. The plastic packets that are generated are collected for disposal but the bio-hazardous materials are autoclaved and chemically treated in some chemical solutions in order to disinfect them. After being disinfected they are burnt and disposed.

4.2.5 Waste Management - Household Waste

The type of waste that is generated from the household mainly comprises of kitchen waste including vegetable remains, paper, and plastics and occasionally glasses, tins etc.

Though the household waste is either dumped on open roadside or in bins but in some parts of the city mainly in the HUDA sectors and the Private Colonies there is door to door collection of household waste.

The Resident Welfare Association or the RWA mainly activates the door-to-door collection system. The RWAs collect a fixed sum of money from the residents of the area and in turn take care of the maintenance and also the waste management of the area.

As per the data collected during primary survey of the RWAs it is observed that in most cases house-to-house waste collection system is practiced. The private contractors generally collect the waste that is generated from the houses. They have appointed sweepers who are responsible for collection of waste from each of the houses.

The number of sweepers also varies depending upon the size of the respective area. They work for 8 hours during the day. The sweepers collect the

waste everyday from the doorstep of each household, either in handcarts or in rickshaws.

The waste generated from each house is collected in plastic packets by the household members, which are kept outside the house. Some people collect the waste in buckets. These buckets are then emptied into the handcarts of the sweepers when they come for collection.

Recycling of waste is currently not practiced within the households. In the houses segregation of waste is also not done. All the waste is gathered and stored in a plastic bag or a bucket or a small waste bin to be disposed. Amount of waste generated from each household range between 1 – 5 kg per day.

There is no community bin or an authorized garbage dump for dumping of the waste. The sweepers collect the waste and dump them in any empty land or open space outside the community. The capacity of this garbage dump is not sufficient and there is no system of cleaning the dump.

Hence there is no intermediate collection point between the collection and final disposal. As a result of this method of disposal the area within the colony remains clean, but the unauthorized dumping of waste affects the people residing in the surrounding area.

Some of the wastes which remains on the roads like pieces of paper and roadside litters including plastics, paper, metals and other recyclable items are reclaimed by the rag pickers. The rag pickers do not take any safety measures because they are not aware of the hazards that may arise due to handling of wastes.

On the basis of the survey it can be concluded that the collection of waste from the houses is carried out systematically on a daily basis but since no designated land has been provided by HUDA for the waste disposal which is very essential, hence unauthorized dumping is practiced. Also adequate number of sweepers and gardeners are not present for the proper maintenance of the roads and gardens.

4.2.6 Waste Management – Market Waste

In Gurgaon there are two registered licensed markets, one is located at Khandsa Road and the other is in the Town area. Besides the above two there are other small markets located in the HUDA sectors and the private colonies and in small pockets in the city.

At Khandsa Road, the market area comprises of 53 shops. Amount of the waste generated from each shop per day is approximately 10 - 15 kg. So the total amount of waste generated in the Khandsa Road market area ranges between 600 kg to 1 tonne per day.

The market waste mainly comprises of vegetable wastes, plastics, paper and grass. The amount of waste also varies with the different seasons, maximum being in the monsoon.

Generally street sweeping of the Market area is done in two sessions in a day, once at 10.00 a.m. in the morning and again at 4.00 p.m. in the afternoon. The waste that is disposed from each shop is kept accumulated outside the shop.

The sweepers appointed by the Market Committee collect the waste in handcarts from each shop. Here the cleaning is done with a short handled or long handled broom. While sweeping, initially they make small heaps of waste on the street and then load this waste into their handcarts.

The waste collected is disposed in an empty land within the Market premises. The disposal site has an area of approximately 1361 square yards. The waste disposed in this site is burnt from time to time in order to make the area empty for future disposal. The area where the waste is disposed is not designated for waste disposal, but since it is an empty land it is used for the purpose.

The waste that is generated in the other market areas is collected similarly in heaps at particular points or in bins by the sweepers. Then from there the waste is loaded in the tractor trolleys, which carry it to the Basai Road area, where it is disposed.

Since substantial quantity of waste is generated in this area, a tractor trolley is kept here only for the disposal of the market waste. The tractor generally carries out three trips per day.

The organizational structure of Gurgaon Market committee is given in Figure 4.4.

4.2.7 Waste Management – Rural Villages

There are about 44 villages in and around Gurgaon. The type of waste generated mainly comprises of household garbage, rubbish, street sweeping, demolition debris, sanitation residues and hospital solid waste if any.

The quantity and contents vary according to the socio-economic and cultural habits of the people, density of population and extent of commercial activity. In most of the villages it has been observed that maximum amount of the waste that is generated remains unattended.

This give rise to insanitary conditions especially in the densely populated villages, which in turn results in an increase in morbidity especially due to microbial and parasitic infections. So at present waste management is a major problem in the villages of Gurgaon, which should be mitigated in order to improve the condition of the villagers.

On the basis of the primary survey conducted it can be concluded that the waste is very poorly managed in the villages. No proper attention is paid for maintaining a clean and healthy environment.

In some villages it is observed that a partial attempt is made for management of the waste. The waste is collected from each household everyday at 7.30 a.m. by the sweepers employed by the Panchayat . These sweepers also remove the waste from the roads, but eventually dump the waste in any empty land outside the village.

There are unauthorized dumping sites as no site is been provided for the waste disposal. There are no community bins placed at any point. Hence there is no system of collection of the waste at the intermediate stage. The waste is transferred directly from the houses to the disposal site.

In most of the villages it is observed that no proper measures are adopted for waste management. The members of the household throw the waste directly on to the road, because there is no proper place for the waste disposal. No sweepers

are appointed for the maintenance of the roads, hence the waste thrown, gets accumulated on the road and is partly carried away by the wind.

Sometimes when the waste gets piled up for a long period of time, then the Panchayat appoints sweepers to remove the waste and clean the roads.

So the sweepers collect the waste from the roads and throw it in any open land outside the village. As the HUDA sectors have developed all around the villages, there is not even much empty land left for dumping of the waste.

In certain areas the sewerage system is very poor because the pipelines laid down are narrow as a result of which the sewer lines get choked, thereby resulting in the stagnation of waste water which gives rise to a foul smell and creates an unhealthy environment in that area.

4.2.8 Waste Management - Slum Area

Garbage disposal facilities are virtually non-existent in the slum areas of Gurgaon. There is no proper system of waste management. It is indeed surprising to know that in the slum areas no community bins are available for the disposal of the waste, nor the sweepers are employed for the purpose.

All the households are reported to be disposing off the garbage, outside in the open land. The people collect the waste and throw it in any open land outside their houses. Hence the question of maintenance does not arise in this case.

The authorities have shown less concern about the dismal situation of the garbage disposal, which is evident from the fact that they have not provided any garbage storage arrangement or any site for waste disposal. These situations lead to the spread of diseases and gives rise to a very unhealthy environment.

Disposal of garbage is thus one of the major problems faced by the slum dwellers as with an increase in population the garbage generation has increased substantially.

Though it is difficult to say that the urban local bodies are ill equipped to cope with this increasing pressure it is certain that there is lack of will on their part to discharge their obligation in this respect. Thus the waste handling system is extremely poor in the slums and there is an urgent need to implement proper measures to improve this condition.

4.2.9 Waste Management - Industrial Waste

Industrial waste can be hazardous or non-hazardous depending upon the industry. Hazardous and non-hazardous solid wastes generated from large industries can be identified and their safe disposal can be ensured. However there are several problems in identification, segregation and safe disposal of waste generated by large units.

By far the largest proportion of industrial waste consists of rubbish from production processes, office waste, and possibly garbage from the worker canteen.

The rubbish includes floor sweepings, rags, discarded cardboard and wooden packaging materials, broken glass, metal offcuts etc.

Manual handling of industrial waste is the usual practice in Gurgaon. Waste is shovelled by hand into the storage containers and people handling the waste do not even wear gloves and do so.

Generally the industries in Gurgaon are non-polluting industries, hence the waste generated from them are not hazardous. The waste is not thrown in a haphazard manner. The solid waste that is generated is collected by the sweepers and disposed in the bins that are placed at certain points in close proximity to the industries.

4.2.10 Waste Management - Disposal of Waste

Solid waste generated at Gurgaon Town is currently disposed off (crude dumping) at a low-lying area located in Sector 10, Basai Road, which is about 3 - 4 km from the city centre. The approximate area of the disposal site is about 4 - 5 hectare. It is observed that transportation vehicles carrying MSW unload the waste haphazardly at the dumping site.

The site is in close proximity of the existing town and is located within the urbanisable area and falls under the residential sector - 10. The site is not fenced, there are no arrangements for lighting and drinking water. Leachate control, collection and treatment system has not been planned for this site.

Effects on ground water quality due to leachate from the dump could only be a speculation, as the ground water quality is not monitored in the vicinity. The waste pickers have made temporary huts near the dump and earn their living from the waste.

HUDA disposes off the waste generated in its sector at Basai Road and also in the depressed lands in Sector 5 & 22.

The disposal sites are not at all serviced. They are only meant for dumping the waste, but are not at all maintained.

The Private Developers dump the waste in the low-lying land and empty plots in its own area, or in some dumping yards outside that area. There is no proper site designated for the purpose, as a result of that, unauthorized dumping of waste is practiced.

Keeping in view of the above and with the increase in population and waste quantity, the following sites have been identified by the District Town Planning Department for waste disposal.

- i) **Village Ghata:** Although the said site, is a 10 - 15 feet low-lying area from the surrounding region and is in close proximity to the proposed periphery road connecting Faridabad - Sohna roads, but the downward slope at the site is quite gradual and its total area is under agricultural use and perhaps falls within drainage line of rainy water from the surrounding hilly region. And hence, dumping of solid waste at the site may pollute the water down stream. Further it may also disturb the aesthetic environment to be visible from surrounding high rise buildings coming up in sectors - 55, 56, 57, etc.
- ii) **Hilly Tracks under village Sakatpur:** A huge area of around 1000 acres with undulating topography spreaded along hilly tracks is available which can be used for dumping the solid waste, but the site is quite off from the present urbanisable limits.
- iii) **Village Quadarpur:** A site of about 150 acres under village Panchayat of Quadarpur, is depression along the hilly tracks and also is in the close proximity of periphery road connecting Faridabad and Sohna road. The area available is quite adequate and dumping of solid waste can act as land reclamation measures for future.

4.3 Suggested Action Plan

4.3.1 Initial Findings / Observations

The initial findings and observations of the waste management of Gurgaon Urban Area are as under:

- No segregation at source of disposal.
- Priority area of problem expressed at every level of interaction.
- Expectation of problem solving by the Government Authorities and "citizens right" of getting rid of waste by throwing on roads/streets/public places.
- People spending very nominal almost negligible amount to get rid of waste.
- Garbage being dumped in haphazard and inefficient way.
- Newly developed areas like DLF phase I also have started experiencing garbage being dumped by roadside.
- Overflowing and open garbage bins.
- Stray Animals like cows, pigs and dogs in large numbers at all dumping bin locations adding problem of spillage on roads.
- Garbage being dumped on road sides even without bin locations.
- Large quantity of plastic being mixed with wastes.
- Absence of vigilance and check on disposal.
- No strict check on Hazardous waste mixing with Municipal waste.
- No safety measures are adopted either at primary collection, loading and final disposal.
- No safety clothing and accessories provided to Municipal cleaning workers.
- Transportation of solid waste is done in open vehicles causing spillage.
- Uncollected garbage finds its way in open storm water drains causing blockage and health problems.

- No insecticides are used on storage and collection bins leading to foul smell and breeding of Mosquitoes.
- The private parties involved in waste collection in the HUDA sectors, instead of disposing the waste in the dumping site they dump it in the low-lying areas nearby.
- Very crude dumping method at low-lying land site of 4-5 acres on Basai Road located within urban area of sector 10.
- Dumping site open to human access and no regulated entry restrictions.
- Inadequate Capital, Human, and Financial resources

4.3.2 Suggested Action Plan

A. Storage of waste at Source

It is essential to keep the streets and the public places clean at all times of the day. This is possible only if waste producers co-operate and effectively participate in the waste management efforts of the local body. If people keep on throwing wastes on the streets indiscriminately, the local body cannot keep the city clean in spite of its best efforts. People, therefore, have to form a habit of storing the waste at source in their personal/ public bins and discharge the waste into the municipal system only, at specified times.

Objective:

- No waste shall be thrown on the streets, footpaths, open spaces, drains or water bodies
- Waste shall be stored at source of waste generation in two bins/ bags, one for food waste/ biodegradable waste and another for recyclable waste. (See Table 4.21)
- Waste such as used batteries, containers for chemicals & pesticides, discarded medicines and other toxic or hazardous household waste

(see Table 4.22), if and when produced, should be kept separately from the above two streams of waste.

Action Plan

The following measures to be taken by Gurgaon Authorities to meet the above expectations.

I. Household - All households to be directed:

- Not to throw waste in their neighbourhood/ streets/ open spaces/ vacant plots/ drains
- They shall (a) keep the food waste/ bio-degradable as and when generated, in any type of waste container preferably with a cover, and (b) keep dry/ recyclable wastes preferably in bags or sacks
- Use of a metal or plastic container with lid is advised for storage of food/ biodegradable/ wet waste. A container of 15 liter capacity for a family of 5 members would be adequate.
- Keep domestic hazardous waste as listed in Table 4.22 separately
- Private society, association of flats/ multistoried buildings, etc., shall provide two-community bin for storage of wet domestic waste and recyclable waste, to facilitate collection of such waste by the local body from designated spot.
- In slums/ villages, storage of waste at source to be the system and where house – to house collection is not possible suitable sized community bins ranging from 40 to 100 liter, to be placed at convenient location directing the residents to put their waste only an hour before clearance each day.

II. Shops/ Offices/ Institutions/ Workshops etc

- Shops, offices, institutions to be refrained from throwing their solid waste/ sweepings etc. on the footpaths, streets, and open spaces.
- Waste to be kept on-site as and when generated in suitable container until the time of doorstep collection
- They shall keep hazardous waste as listed in Table 4.22 separately
- Multistorey buildings and commercial complexes to provide liftable community bins matching with the collection & transportation system of the Gurgaon local body and directing them to transfer the waste into the community bin before the prescribed time on a day to day basis.

III. Hotels and Restaurants

- Hotels and restaurants to be refrained from throwing their dry and wet solid waste/ sweepings on the footpaths, streets, and open spaces or drains.
- They should also be asked to refrain from disposing their waste into municipal street bins or containers.
- They shall store their waste on-site in sturdy containers of not more than 100 liter capacity having appropriate handle or handles on the top or side and rim at the bottom for ease of emptying
- They shall keep hazardous waste listed in Table 4.22 separately.

IV. Vegetable/ Fruit Markets

- The market associations to be directed to provide containers matching the transportation of the local body.
- The shopkeepers to be directed that they shall not dispose of waste in front of their shop/ establishment or anywhere on the street or in open spaces and instead shall deposit their waste as and when generated into the container that is provided for storage of waste in the market.

V. Street Food Vendors

- All street food vendors to be directed not to throw any waste on the street or pavement. They must keep bins or bags for the storage of waste that they generate during their activity.

VI. Marriage halls/ Community Halls, etc.

- Suitable containers with lid matching the primary collection or transportation system of the Gurgaon local body to be provided by these establishments at their own cost. The site of the placement of these containers to be finalized in consultation with Gurgaon Local Body to facilitate easy collection of waste.

VII. Hospitals/ Nursing homes/ Pathological Lab

- These establishments to be refrained from throwing any biomedical waste on the streets or open spaces, as well as into the municipal dustbins or the domestic waste collection sites.
- They shall also to be refrained from throwing any ordinary solid waste on the footpaths, streets or open spaces.

- They shall keep colour-coded bins or bags as per directions of the Govt. of India, Ministry of Environment Bio-medical waste (Management & Handling) Rules 1998. Also another container with lid, for storage of food waste and other wastes fit to be disposed of into the municipal domestic waste stream shall be provided.

VIII. Construction & Demolition wastes

- No person shall dispose of construction waste or debris on the streets, public space, footpath or pavement.
- Construction waste shall be stored until removed only within the premises of the building, or in containers where such facility of renting out containers is available. In exceptional cases where storage of construction waste within the premises is not possible, the waste producer to take prior permission of the local authority for temporary storage of such waste and having obtained and paid for such permission, may store such waste in such a way that it does not hamper the traffic and it does not spread and block drains.

IX. Garden Waste

- Large public parks & gardens and private gardens to as far as possible compost and re-use all plant waste on-site.

B. Segregation of Recyclable waste

It is essential to save the recyclable waste material from going to the main waste stream and getting disposed off at the landfill. Salvaging it at source for recycling could make profitable use of such material. This will save resources and also save the cost and efforts to dispose off such waste. This can be done by keeping recyclable waste material separate from food wastes, in a separate bag or a

bin at the source of waste generation. The two-bin system for storage of waste should be adopted at homes, shops and establishments where the domestic food waste (cooked and uncooked) goes into the Municipal system and recyclable waste can be handed over to the waste collectors (rag pickers) at the door step.

Objective:

- Households, shops and establishments not to mix recyclable waste with domestic food/ biodegradable waste and instead keep recyclable/ non-biodegradable wastes in separate bin or bag at source of waste generation.

Action Plan

The following measures to be taken up by the Gurgaon Authorities towards segregation of recyclable waste:

- To mobilize NGOs or co-operatives to employ rag pickers and train them to collect recyclable clean material from the households instead of picking up soiled and contaminated waste from streets, bins or disposal sites. This will reduce the financial cost for transporting such waste by the local authority.
- Actively associate RWAs, Trade & Industry associations, NGOs in creating awareness among the people to segregate recyclable material at source and hand it over to the designated waste collector (former rag picker).
- The waste collectors to be provided with an identity card so that they may have acceptability in the society.

C. Primary collection of Waste

It is necessary to provide a daily service to all households, shops and establishments for the collection of putrescible organic/ food/ biodegradable waste from the doorstep because of the hot climatic conditions in the country. This service must be regular and reliable. Recyclable material can be collected at longer regular intervals as may be convenient to the waste producer and the waste collectors, as this waste does not normally decay and need not be collected daily. Domestic hazardous waste is produced occasionally and so such waste need not be collected from the doorstep. People to be advised or directed to put such waste in special bins kept in each sector.

Objectives:

- Domestic, trade and institutional food/ biodegradable waste shall be collected from the doorstep or from the community bin on a daily basis.
- Recyclable waste material / non-biodegradable waste other than toxic and hazardous waste shall be collected from the source of the waste generation at a given frequency of time say twice a week.
- Domestic hazardous/ toxic waste material shown in Table 4.22 shall be deposited by the waste producers in special bins, to be provided by local authority in various parts of the city.

Action Plan

The Gurgaon Local body to arrange for primary collection of waste stored at various sources of waste generation by adopting the following methods:

- Doorstep waste collection through containerized handcarts/ tricycles having non-conventional horns with active community participation.
- Collection through community bins from private societies, multi-storied buildings, and commercial complexes.

- Doorstep or lane-wise collection of waste from slums/ villages or collection from community bins provided.
- The local body to provide special bins one in each sector for disposal of domestic hazardous wastes.

Modus Operandi

I. Door step collection through containerized handcarts with bells/ whistles

- Each sweeper to be given a handcart having detachable containers (preferably 4-6) of 30 to 40 liter capacity
- A bell to be attached to the handcart or a whistle to be provided to the sweeper
- Each sweeper to be given a fixed area or beat for sweeping plus a fixed number or stretch of houses for collection of waste
- In congested or thickly populated areas, 300 running metres of road length and the adjoining houses may be given to each sweeper, whereas in less congested areas 500 running metres of the road length with the adjoining houses to be allotted to the sweeper. In low-density area even 750 running metres of road length and houses can be given. Normally 150 to 250 houses coupled with the above road length is taken as a yardstick for allotment of work to individual sweepers.
- The sweeper should ring the bell or blow whistle announcing his arrival and people to be directed that on hearing the bell/ whistle they should put their domestic biodegradable waste into the handcart or handover the waste to the sweeper.
- The sweeper to also sweep the road and clean the drains along with collection of waste.
- The resident, on account of their non-availability at home when the sweeper arrives in the area, they are to directed to leave the domestic

waste in bins/ bags just outside the house on the streets enabling the sweeper to pick up the waste.

- No sweeper to be directed to do house to house collection by asking for waste at doorsteps, as this will affect their energy and productivity.

II. Collection of waste from societies/ Complexes

- No sweepers to be provided by the local body in these areas. The private societies to deploy private sweepers for house-to-house collection.
- To be made compulsory for private societies/ complexes/ multi storied buildings to keep community bins or containers to store dry and wet waste separately.
- The design of the community bins to be as per the transport facilities of the local body.
- Bins to be placed at an easily approachable location for easy collection by the local body staff.
- The local body to arrange collection of waste from these community bins/ containers through handcarts, tricycles or pick-up vans on a daily basis.
- The local authority to make it obligatory for the societies and complexes to identify an appropriate site within their premises for keeping such bin/ container for the storage of waste.

III. Collection of Waste from Slums/ Villages

- Waste from slums/ villages to be collected by bell ringing/ whistle system along the main access lanes.
- Residents should bring their wastes from their houses to the handcarts.
- Where residents prefer community bins, biodegradable waste to be dumped in the bins only an hour or two before the time of clearance.

IV. Collection of duly segregated recyclable/ non-biodegradable waste from households

- NGOs to be activated to organize rag pickers and train them. This will improve their quality of life and reduce their health risks.
- Waste collectors to be allotted lanes and by-lanes comprising of 150 to 250 houses for doorstep collection of recyclables.
- Waste collectors to be provided with identity cards for increasing their acceptability in society
- Waste collectors to collect waste from households in a given frequency of time (say twice a week)
- Waste collectors to be provided bags and tools for collection of recyclables by the local body or the NGOs.
- The local body to inform the people of the arrangements made by the NGOs.

V. Collection of waste from Shops and Establishments

Shops and establishments normally open after 9 or 10 am. These timings do not synchronize with the usual work schedule of the sweepers. Under this situation the following suggestions to be adopted:

- Sweepers to only carry out the work of street sweeping
- Shop-keepers to keep waste in two bins - one for bio-degradable and one for non-biodegradable
- Waste collectors (rag pickers) to be organized to collect recyclable waste from the shops soon after they open, as most of such waste is recyclable. Deposit the organic waste collected in the community bin placed at a convenient location to be collected by the local body staffs.
- The associations of markets, shops and establishments to organize this service with the help of rag pickers in their market.
- Doorstep collection service from shops and establishment can also be provided by the Gurgaon Local Body or may be contracted out on 'full cost-recovery' basis.

VI. Collection of bio-medical waste

The collection of bio-medical waste should be done in accordance with the directions contained in the Govt. of India, Ministry of Environment Notification dated 20th July 1998. The liability for the disposal of bio-medical waste is now on the waste producer. Therefore, the local body as such is not liable to provide any service. However, if the Gurgaon Local Authority desires to help the hospitals, nursing homes and other health care establishments in the matter of handling and disposal of bio medical waste, it may assist them on full cost recovery basis and extend a helping hand without taking over any legal responsibility as under:

- Hospitals and nursing homes to be divided into convenient groups and routes to be mapped for door to door collection from hospitals.

- The hospitals to be directed to keep sealed bags at one safe place to be handed over to collection staff.
- The municipality to provided the services of primary collection and transportation on full cost recovery basis to the hospitals.

VII. Collection of Hotel and Restaurant Waste

- The hotels and restaurants to make their own arrangements for waste storage in two-bin system, one for organic waste and the other for recyclable waste.
- The Gurgaon Local body to extend help in primary collection of such waste by deploying its own manpower and machinery for door step collection on full-cost-recovery basis.
- Charges of collection of hotel waste to depend upon the quantity of waste to be picked from the hotels and restaurants and frequency of collection required.
- A survey of the waste generation of the hotels/ restaurants may be made before the collection rates are introduced and notified

VIII. Collection of vegetable, fruit market wastes

- The wastes should be removed on a daily basis by the Gurgaon local body or through a contractor on full cost recovery basis.

IX. Collection of construction and demolition waste

- The Gurgaon authority to prescribe rates per ton for the collection, transportation and disposal of construction waste and debris and notify the same to the people.

- Every person who is likely to produce construction waste to be required to deposit with the Local body an approximate amount in advance at the rates prescribed by the local body from time to time, for the removal and disposal of construction waste from his premises. Such amount to be deposited at the time when the building permission is sought and in cases where such permission is not required, at any time before such waste is produced.
- The charges for removal of construction waste to be doubled for those who failed to deposit the amount in advance.
- To facilitate the collection of small quantities of construction and demolition waste generated in the city, suitable sites to be identified in various parts of the city and notify people to deposit small quantities of construction and demolition waste. Containers could be provided at such locations and small collection charge levied for receiving such waste at such sites and for its onward transportation.

D. Sweeping of streets and public places

Daily sweeping of public streets is essential where there is habitation close by. Isolated pockets or roads with little or no habitation around do not require daily cleaning but at the same time they cannot be ignored. A schedule of street cleaning to be prepared, prioritizing the roads requiring daily cleaning and the ones, which, need to be cleaned periodically.

Objective:

- All public roads, streets, lanes and by-lanes having habitation or commercial activity on one or both sides of the street shall be cleaned on daily basis assigning clearly demarcated area to each sweeper and street sweepings shall be in the container placed at the temporary waste storage depot.

Action Plan

The following measures may be taken to ensure regular sweeping of streets and public places:

I. Street sweeping to be done on a daily basis

- Sweeping of public roads, streets, lanes, and by-lanes to be done daily if there is habitation and commercial activity on one or both sides of the street.
- A list of such roads and streets together with their length to be prepared and a program for their daily cleaning to be worked out by the local body keeping in view the norms of work (yardstick) prescribed.
- Roads and streets with no cluster habitation which do not require daily cleaning to be put in a separate group and may be taken up for need based cleaning on alternate days, twice a week, once a week or occasionally.
- A timetable to be prepared for cleaning of open public spaces daily or periodically to ensure that they do not become dump yards and remain clean.

II. All solid waste management services to be provided daily including on Sundays and Public Holidays

The generation of waste is a continuous process. As waste is produced each day, collection, transportation and disposal of waste is required to be done daily. There can be no holiday in street sweeping, primary collection, transportation, processing and disposal of waste. Therefore to reorganize the work schedule the following suggestions are made:

- The sweepers and other staff engaged in collection, transportation and disposal of waste as well as supervision of sanitation services to be given their statutory weekly off by rotation instead of giving them off

on Sunday, by dividing the staff into seven groups and each group getting a weekly off on one of the days of the week.

- The staff to be compensated for working on a public holiday by giving additional earned leaves in lieu of the public holiday, or additional salary/ allowance as deemed proper.

III. Prevent burning of waste by sweepers and the public

- Prevent burning of tree leaves and other waste by sweepers on the roadside and direct sweepers to take waste to communal waste storage bins/ sites only.
- Where open spaces are available nearby, the leaves could be rapidly composted and used locally as organic manure for roadside plantation.

IV. Tools to be given to Sweepers

The following recommendations to be considered by the Gurgaon Authority

Brooms

- Instead of using short handled brooms, which require bending of the body while at work and causes fatigue and back pain, the work force to be encouraged to use long handled brooms.
- One long handled broom per month is considered adequate for street sweeping.

Metal Tray and Metal Plate

Each sweeper engaged in street sweeping should be given a metal tray and a metal plate for facilitating easy transfer of street sweeping from the streets to the handcart.

Hand-Carts/ Tricycles

- Each sweeper engaged in street sweeping to be given a handcart having 4 to 6 containers or a tricycle having 8 or more containers of 30 to 40 liters capacity.
- The containers should be detachable to facilitate the direct transfer of street sweepings and household waste from the container into the communal waste storage bins.
- The handcart to have at least 3 wheels with sealed ball bearings so that it can be used efficiently.

V. Norms of work for street sweepers

- Sweepers to be assigned fixed individual beats (specific areas) according to the density of the area to be swept. The following guidelines are suggested:
 - High-density area: 250 to 350 running meters of road length
 - Medium density area: 400 to 600 running meters of road length
 - Low-density area: 650 to 750 running meters of road length
- The sweepers to sweep the roads and footpaths in the area allotted to them as well as collect the domestic wastes in their handcart/ tricycle from all households, shops and establishments situated along the stretch of road/ street allotted to them.
- The above sweeping norms are for cleaning the streets in the first 4 hours of the working day.
- The next 4 hours, the sweepers to be assigned for cleaning the streets in the slums/ villages to ensure hygienic conditions, cleaning surface drains, open spaces, etc.

VI. Working hours

- The work of sweeping and collection of waste to start as early as possible in the morning so that the city looks clean before the roads and streets get busy.
- Instead of having two shifts, the morning and the afternoon, continuous working hours for the sweepers is recommended with a half an hour break, as most of the sweepers remain absent from the afternoon shift.

VI. Cleaning of Surface Drains

- Action to ensure that sweepers and citizens do not dispose of any waste into drains
- The sweepers to be provided with necessary tools like seamless handcart and shovel for cleaning the drains
- Waste removed from drain not to be allowed to remain outside the drain for long, for drying.
- The waste/ wet silt to be deposited directly into seamless handcart as soon as it is removed and if that is not possible or found difficult, the silt may be allowed to dry for 4 hours outside the drain before transporting the semi-solid silt for disposal.

E. Provision of Litterbins

For keeping the streets clean it is necessary to provide facilities of litter bins all over the city so that people can deposit the litter in hand into such bins while on the move and keep the streets litter free.

Objective:

- Adequate numbers of litterbins shall be placed in Gurgaon Urban Area at Railway Station, Bus Stations, Market Places, Parks and Gardens and important commercial streets and public places.

Action Plan

The following suggestions to be taken by the Gurgaon Authority:

- Litter bins to be provided at railway stations, bus stations, in all market places, places where people gather or wait in queues and on important roads at reasonable distances ranging from 25 to 250 meters depending upon the location.
- The removal of waste from these bins to be done by the "pin-point" beat sweepers during their street cleaning operations.
- The wastes form the liter bins to be directly transferred into the handcart of the sweeper.
- Such facilities can be created at no cost to the Gurgaon Authority by involving the private sector and giving them advertisement rights on the bins for a specified period or by allowing them to put their name on the bins as a sponsor.
- Litter bins to be placed in posh as well as poor areas (slums/ villages).

F. Temporary waste storage depots

The solid waste collected from the doorstep or from the community bin by the primary collection system has to be unloaded and stored at a convenient place for its onward transportation in a cost-effective manner. Temporary storage depots are, therefore, required to be created at suitable locations in lieu of open waste storage sites, masonry or such other bins.

Objective:

- All open waste storage sites should be abolished expeditiously and all dustbins made of cement and masonry construction should be replaced in a phased manner by parked vehicles for temporary storage of waste through containerized handcarts/ tricycles from door steps and from the community bins for onward transportation of waste in cost effective manner

Action Plan

- Where the bell ringing/ whistle system is adopted the transport vehicle to come at a particular place and at a particular time, where the sweeper will be directed to reach with their handcarts.
- The sweepers will unload the waste collected directly from their containers to the transport vehicle
- The vehicle then moves on to the next site until filled to capacity.
- In other areas, the present refuse collector container used by the Municipality and HUDA to be placed at short distances depending on the load of garbage to be received in the container from that area. However all the containers to be provided with lids.
- The container to be placed on cement concrete.
- The flooring to be flush with the border of the road to maintain hygienic conditions and facilitates transfer of waste from handcart/ tricycle into the container.

- A catch pit to be provided to collect the storm water and finally connecting the sewerage system/ storm water drains.

G. Transportation of waste

The system of transportation should be such that it can be easily maintained in the city department or through private garages and the system should match with the system adopted for storage of waste at the dustbin site. Manual loading should be discouraged and phased out expeditiously and replaced by direct lifting of containers.

Objective:

- Transport of waste to be done regularly to ensure that the containers/ trolleys and dustbins sites are cleared before they start overflowing. The frequency of transportation shall be arranged accordingly.
- The system of transportation of waste must synchronize with bulk storage of waste at the temporary waste storage depots.
- Multiple and manual handling of waste to be avoided.

Action Plan

The following measures to be taken to meet the above objectives:

I. Frequency of collection and routing of vehicle

The transportation of waste from the temporary waste storage depots/ sites to be planned in accordance with frequency of containers becoming full. The locations where the containers are placed to be grouped into three categories as under:

- Containers which are required to be cleared more than once a day
- Containers which are required to be cleared once a day

- Containers to be cleared on alternate days

Depending upon when the containers need to be cleared, the route for lifting the container may be worked avoiding unnecessary movement of the vehicle.

II. Type of vehicles to be used

- At places where the R. C. bins are placed, the refuse collector machine owned by the Gurgaon authorities to be utilized. However, the vehicles should be without compaction facility, and should have top or back loading facility.
- The existing tractor trolleys and hydraulic tipping trailers to be used for collecting the waste where the bell ringing/ whistle system of primary waste collection system is adopted.

III. Transportation of bio-medical waste

- The transportation of bio-medical waste has to be arranged by the waste producers or their associations. The instructions contained in the Biomedical Waste (Management and Handling) Rules 1998 to be followed.
- One separate closed vehicle to be deployed for transportation
- The local body can also arrange for transportation of bio-medical waste on full cost recovery basis.

IV. Transportation of waste from hotels & restaurants

- The hotels and restaurants waste to be collected once or twice daily depending upon the quantum of waste generated by them by the Gurgaon Authority on full cost recovery basis.

- Doorstep collection system to be introduced for collection of such wastes.
- Either refuse collector or hydraulic tippers with closed body to be used for transportation.

V. Transportation of construction waste and debris

- Hydraulic tippers to be deployed for transfer of construction waste and debris

H. Processing and Disposal of waste

The following criteria to be adopted when selecting waste processing and disposal technologies:

- Indian experience or proven foreign technology suitable under Indian conditions.
- Capital investments required
- Requirement of land, water and power
- Recurring expenditure
- Economy of operation
- Manpower needs
- Level of skill required
- The capability of Gurgaon authority to manage such facility departmentally or through private sector participation
- Scale of operation
- Environment impact of such technology

- Process aesthetics
- Cost of end products
- Compatibility of cycle of nature

The various technology options available for processing waste is as under:

I. Sanitary Landfilling with gas recovery option

The landfill gas technology can very effectively be utilized for disposing MSW of Gurgaon, which has relatively high organic content. In this technology landfill site acts as a bioreactor in which gas is generated by decomposition of organic matter.

It has been estimated that over a period of 10 years one tonne of MSW can produce gas more than 100 times its own volume. The gas consists of about 40 to 50% of methane and 50 to 60% of carbon dioxide. The gas is extracted through gas wells via a network of perforated plastic tubes laid within the waste. From the wells, it is taken to a filter, compressor, monitoring units and the gas can be utilized for electricity generation.

II. Composting

Composting is a slow natural process in which mixed bacteria, fungi, insects and worms consume plant and animal wastes and convert them slowly to a soil like substances very beneficial to plant growth. Compost provides energy, minerals, nutrients and micronutrients, useful microbes and water retaining humus to soil.

Composting can be done by aerobic and anaerobic processes. The aerobic windrow process can now be completed in 45-60 days, on any scale, even with mixed non-toxic wastes, by repeated turning and aeration.

The open windrow type of composting is preferred in Gurgaon having high ambient temperature. The other factors affecting the system approach are cost of labour, energy, land and socio-culture attitudes of the community.

The waste would be kept in pre-fermentation yard for 21 days and turning of windrow to be carried out mechanically using a front-end loader at suitable time intervals to keep the process aerobic. Suitable drainage arrangement would be provided in the windrowing area. Arrangement for spraying water on the windrows to maintain required moisture content of the waste also to be made.

The compost plant to have the following components:

- **Weighbridge**
- **Pre-fermentation windrows** (approximately 2.7 m wide at bottom and 1.5 m height. Length of windrows to be such that one day's MSW would make one row)
- **Picking belt** - To be used to transfer the waste from windrow to a hopper using hydraulically operated tractor-trailer loaded with the help of front-end loader. From this hopper the waste would move on a picking belt moving on pulleys. Speed reduction gear assembly that is provided with the driving unit control speed of the belt. Stone plastics, rubber, leather, glass and metals are removed on this belt.
- **Air Classifier** - The picking belt would unload the waste into an air classifier through a hopper where inorganic portion would be separated from the organic matter.
- **Screen** - The separated organic matter would be screened. The coarse material retained above the screen would go to the size reduction unit and the fines would go for windrowing in the maturation yard.
- **Maturation yard** - Optimum moisture would be maintained in the windrows by spraying water and turning the windrows using front-end loader to carry out aeration. Maturation would be carried out for four weeks. The matured compost to be screened and the fine, tested for its fertilizing value. Nitrogen, phosphorous and Potassium may be added to keep their desired level.

Approximate analysis of the cost of the plant, operating cost (per annum) and economic viability of the composting technology is given in Table 4.23, Table 4.24 and Table 4.25 taking plant capacity @ 100 tonne per day (300 days/ year): 30,000 tonne MSW per year

III. Biomethanation

It is one of the most innovative techniques for treating MSW in which resource recovery is in the form of biogas and organic manure. The biogas can be used for power generation whereas the sludge from treatment plant is used as organic manure. Economic recovery in the form of biogas and organic manure provides good prospects for self-sustainability of the treatment plant. The process takes place in close reactors and thus reduces environmental pollution. High organic content in the waste from Gurgaon favours use of this technology.

IV. Incineration

Incineration technology is used for energy recovery from MSW, and it achieves maximum volume reduction. This is a thermal process for burning the waste at a very high temperature. Incineration requires high caloric value waste, which can burn without any external fuel. The calorific value of waste in Gurgaon is 960 kCal/kg, which is very low. The system of incineration is therefore not suitable for Gurgaon.

I. Legal Measures

I. Duty of occupiers of premises to store solid waste at source of generation

It shall be incumbent on the occupiers of all premises to keep two receptacles, one for the storage of food/organic/bio-degradable waste and another for recyclables and other types of solid wastes generated at the said premises. The domestic hazardous waste shown in table 4.22 shall however be kept separately in a suitable container as and when such waste is generated.

II. Duty of occupier not to mix recyclable / non-biodegradable waste and domestic hazardous waste with food waste etc.

It shall be incumbent on the occupier of any premises to ensure that the recyclable wastes as well as domestic hazardous waste generated at the said premises does not get mixed with the food/biodegradable waste and that they are stored separately.

III. Duty of Societies/Associations/Management to provide community bins

It shall be incumbent on the management of Co-operative Societies, Associations, Residential and Commercial Complexes, Institutional buildings, markets and the like to provide community bin/bins of appropriate size as may be prescribed by Gurgaon Authority, for the temporary collection of waste other than recyclable waste, to be stored at their premises for its primary collection by the municipal authorities. A separate community bin may also be provided for the storage of recyclable waste where door-to-door collection of recyclable waste is not practiced.

IV. Receptacles to be kept in good repair

Receptacles shall at all times be kept in good condition and shall be provided in such number and places as may be considered adequate and appropriate to contain the waste produced by the citizens supposed to be served by the community bins.

V. Duty of occupiers to deposit solid waste in community bins

It shall be incumbent on occupiers of all premises for whom community bins have been provided, to cause all segregated domestic waste, trade waste, institutional waste from their respective premises to be deposited in the appropriate community bins.

VI. Duty of occupier of households / shops/ establishment to hand over the recyclable material / non-bio-degradable waste to the waste collectors

It shall be incumbent on households / shops / establishments to hand over their segregated recyclable waste / Non-bio-degradable waste to waste collectors from time to time. Such waste shall not be disposed of on the street or in municipal bins or open spaces along with the organic/food/bio-degradable waste.

VII. Prohibition against littering the street and deposit of solid waste

No person shall litter public streets or public places or deposit or cause or permit to be deposited or thrown upon or along any public street, public place, land belonging to the local body or any unoccupied land or on the bank of a water body any solid waste except in the receptacles.

VIII. Prohibition against deposition of building rubbish

No person shall deposit or cause permit to be deposited any building rubbish in or along any street, public place or open land except at a place designated for the purpose or in conformity with conditions laid down by the Gurgaon Authority.

IX. Prohibition against flow of filthy matters on public places

No owner or occupier of any building or land, shall allow any filthy matter to flow, soak or be thrown therefrom, or keep or suffer to be kept therein or thereupon, anything which is or can become a nuisance to any person, or negligently suffer any receptacle or place for deposit of filthy matter or rubbish on his premises to be in such a state as to be offensive or injurious to health.

X. Prohibition on disposal of carcasses etc.

No person shall deposit or otherwise dispose of the carcasses or parts of any dead animal at a place not provided or appointed for this purpose.

XI. Punishment for littering on streets and depositing or throwing any solid waste in contravention of the provisions of this

Whosoever litters the street / or public places or deposits or throws or causes or permits to be deposited or thrown any solid waste or construction debris at any place in contravention of the provisions of this Act or permits the flow of any filthy matters from his premises shall be punished on the spot with a fine not less than Rs. 50/- as may be prescribed by the Gurgaon Authority. Such spot fines may be collected by officers authorized by the Municipal Corporation/Municipality, not below the rank of sanitary inspector. The amount of fine imposed shall be recoverable as arrears of property taxes. The amount of fine shall be kept higher for repeat offences.

4.4 Case Study

The Work of Exnora in Chennai

Exnora International was formed in 1989. The adverse effects of the deteriorating environment on health and hygiene and the apathy of the common man towards these issues were a challenge that the Exnorans were ready to tackle. The basic premise with which Exnora began its operations was that community participation at all levels of functioning was essential to make their work a success. Therefore they welcomed constructive ideas from all quarters. Thus was born the notion of Excellent, Novel and Radical ideas to help transform the city's environment.

To begin with Exnora concentrated its efforts on Solid Waste Management, as this issue required urgent attention. The reason for this being that the average garbage collection at Chennai is 2,500 to 3,000 tonnes per day and the civic agencies on an average spend 10 to 20% of their budget especially on solid waste management which works out to about Rs 60 to Rs 80 per capita per year.

In spite of this large expenditure the citizens of Chennai have nevertheless had to face the garbage menace. But occasionally governmental bodies did evolve new methods to try and control the problem.

The Corporation of Chennai evolved the system of hydrocontainers for containerized handling of garbage on Kamaraj Avenue in Adyar. These hydrocontainers were made available at the end of every street so that garbage could be dumped into it directly and not strewn in and around dustbins. From here the containers would be hauled on to corporation trucks and taken to dumping sites. Unfortunately this experiment did not meet with initial success as residents found it inconvenient to carry garbage from their houses up to the end of the street for disposal.

It was here that Exnora stepped in to provide workable alternative. They introduced the concept of the **street beautifier** to collect the garbage from individual households. This street beautifier was a former ragpicker who used to rummage through the dustbins to collect raw materials, which he would sell, to recycling agents.

Exnora was able to provide employment opportunities and dignity of labour to the ragpicker by providing him with a specially designed tricycle to collect

the garbage from the different households in a particular street. The ragpickers collect the garbage from the households from 8.00 a.m. onwards and subsequently sweep the streets everyday. They delivered the garbage to the transfer points wherefrom the Corporation will take it to the dumping sites.

The success of this endeavour resulted in the birth of the concept of the civic Exnora in India of which around 900 are in Chennai.

Besides this, Exnora's first efforts also clearly illustrated that the co-operation of the public is absolutely essential for bringing about change at any level and that it is possible to work hand in hand with both government bodies and the ragpickers towards creating a clean environment.

During 1996-1998, Exnora has expanded its activities from mere garbage collection to a complete waste management mechanism through waste recycling.

The system of **vermi composting** of degradable garbage at household levels was introduced during 1995-96. Community vermi composting of the organic waste in residential colonies is carried out in large compost units on a vacant plot of the Municipal Corporation of Chennai.

This practice has been replicated in Cochin with the local Municipal Corporation building compost stations for every one of the 100 wards and the project "Clean Cochin Tomorrow" is being implemented to meet the objective of Zero Garbage. Active participation of the people and ward councillors is a hallmark of this project.

Exnora has taken up resource generation activities by collecting pure organic garbage from market complexes. On an average, 100 metric tonnes of garbage, generated from the market area are being transferred to the nearby garbage transfer stations.

Exnora, with assistance from New College, Chennai, is using cost-effective technology to compost this organic waste into bio manure. This experiment is being replicated in Thiruverkadu within the state using municipal vacant plots.

This experiment in Thiruverkadu has already shown practical and economic replicability. Large-scale organic wastes are collected from market complexes, large restaurants, huge parks etc. within the city. This practice is being

scaled up and replicated at the Park Sheraton Hotel and in the adjoining neighbourhood of the Boat Club in Chennai.

Another important development of this practice is that the Chennai Metropolitan Sewerage Board has been approached to take the help of the sewerage treatment plant for using the bio waste slurry as microbial inoculum in order to compost a substantial portion of the 100 tonnes a day output of organic garbage in the market complex.

Since 1996, micro-entrepreneurial activity has also been started in Periyar Nagar, Chennai, along with waste management activity. The street beautifiers segregate the waste and take it to vermi compost units or municipal dumping yards.

Non-degradable wastes are taken to the colonies for further processing. The wastes are disposed of to unorganized recyclers at the rates applicable to specific grades, thus leading to income generating activities.

Organizations like Rotary International Foundation and the Central Institute of Plastic Engineering Technology are involved with Exnora for setting up such treatment plants with tremendous potential for sustainability and replicability in other low income group areas.

The concept of zero garbage has been propagated in all districts in Tamil Nadu and also in the southern states of Kerala, Karnataka and Andhra Pradesh. In these states the practice of waste management has been started replicating the Exnora model.

The Exnora example in Chennai has been replicated and scaled up elsewhere. This practice is emulated in other cities and towns in Tamil Nadu and also in Bangalore, Pune and Vijayawada. An active student Exnoran in Chennai initiated Exnora activities in the University of Rochester, New York.

Exnora has been successful in introducing the concept of **reduce, reuse and recycle** amongst the public. Nearly 30 to 40 % of perishable organic waste and the balance of inorganic waste generated from our garbage can be recycled.

The street beautifier is trained to segregate the waste at the source itself and can gain additional income by selling the inorganic waste like plastic, paper, glass and metal scraps to recycling agents.

The innovative vermi composting technology helps to produce excellent manure from our organic wastes at the household level itself with minimum investment and maximum benefits. In fact more people have been motivated to start this process in their backyards.

Exnora is exploring the possibilities of using this technology as an income-generating cottage industry in the lower income areas of Chennai. This method is also being propagated in other cities, towns and villages of Tamil Nadu and in other states in India.

Figure 4.1

Percentage Distribution of the Physical Characters of Municipal Waste.

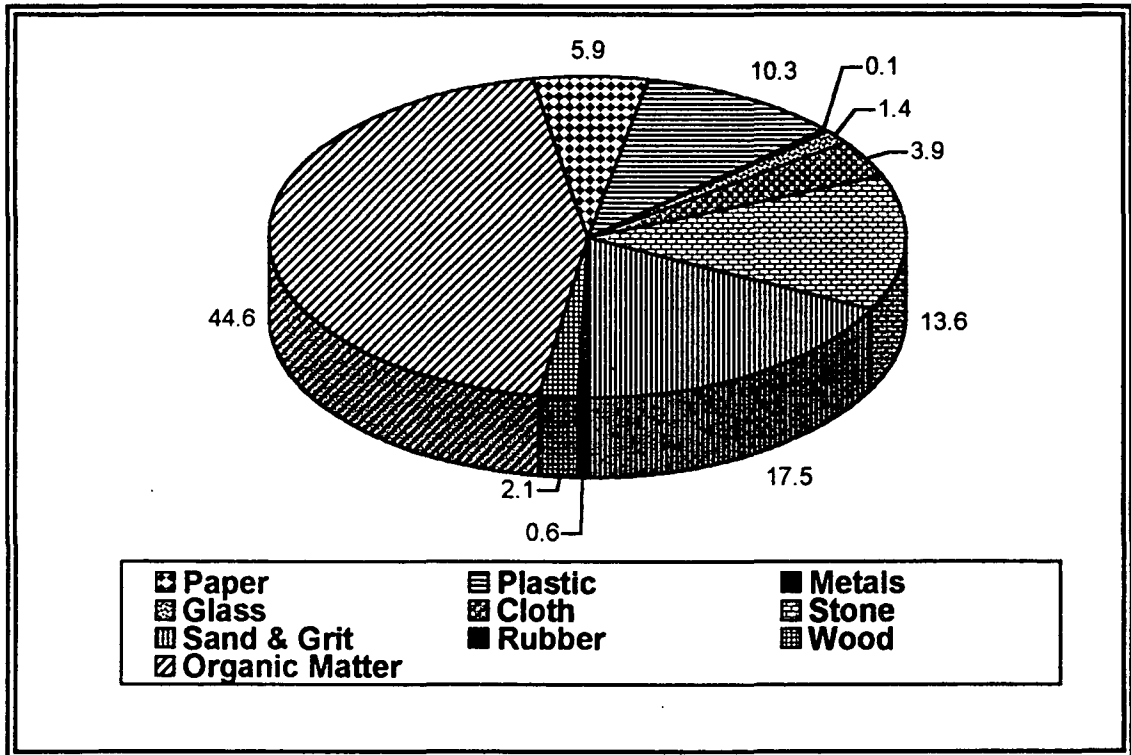


Figure 4.2

Organizational structure of solid waste management department of Gurgaon Municipal Council

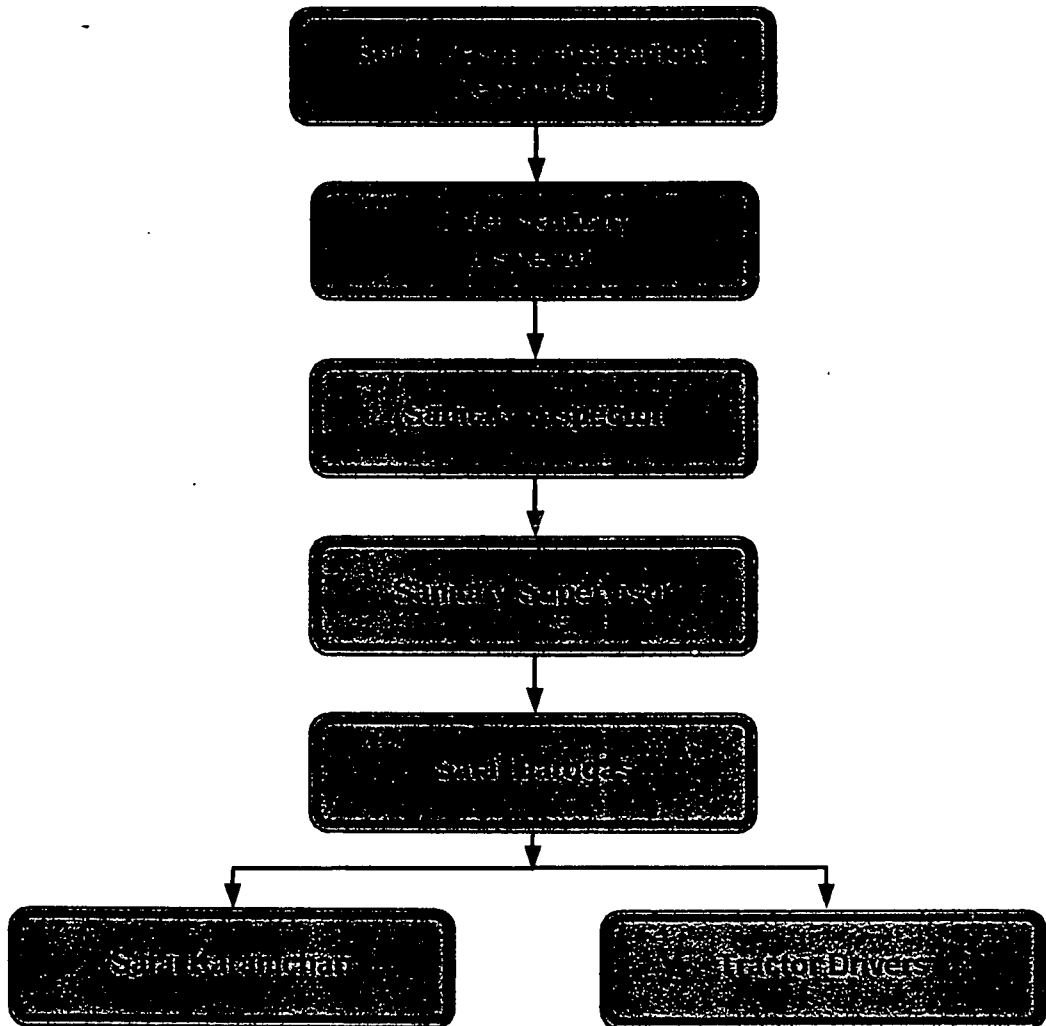


Figure 4.3

Existing waste collection system in Gurgaon Municipal area.

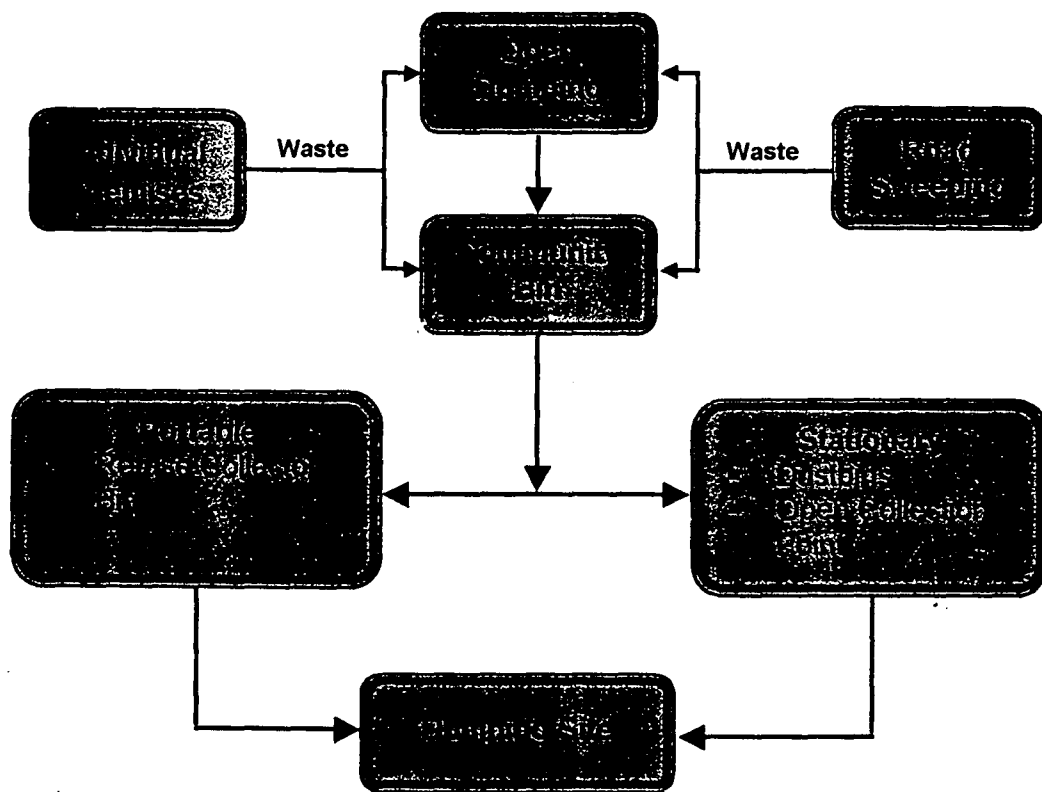


Figure 4.4

Organizational Structure of the Gurgaon Market Committee

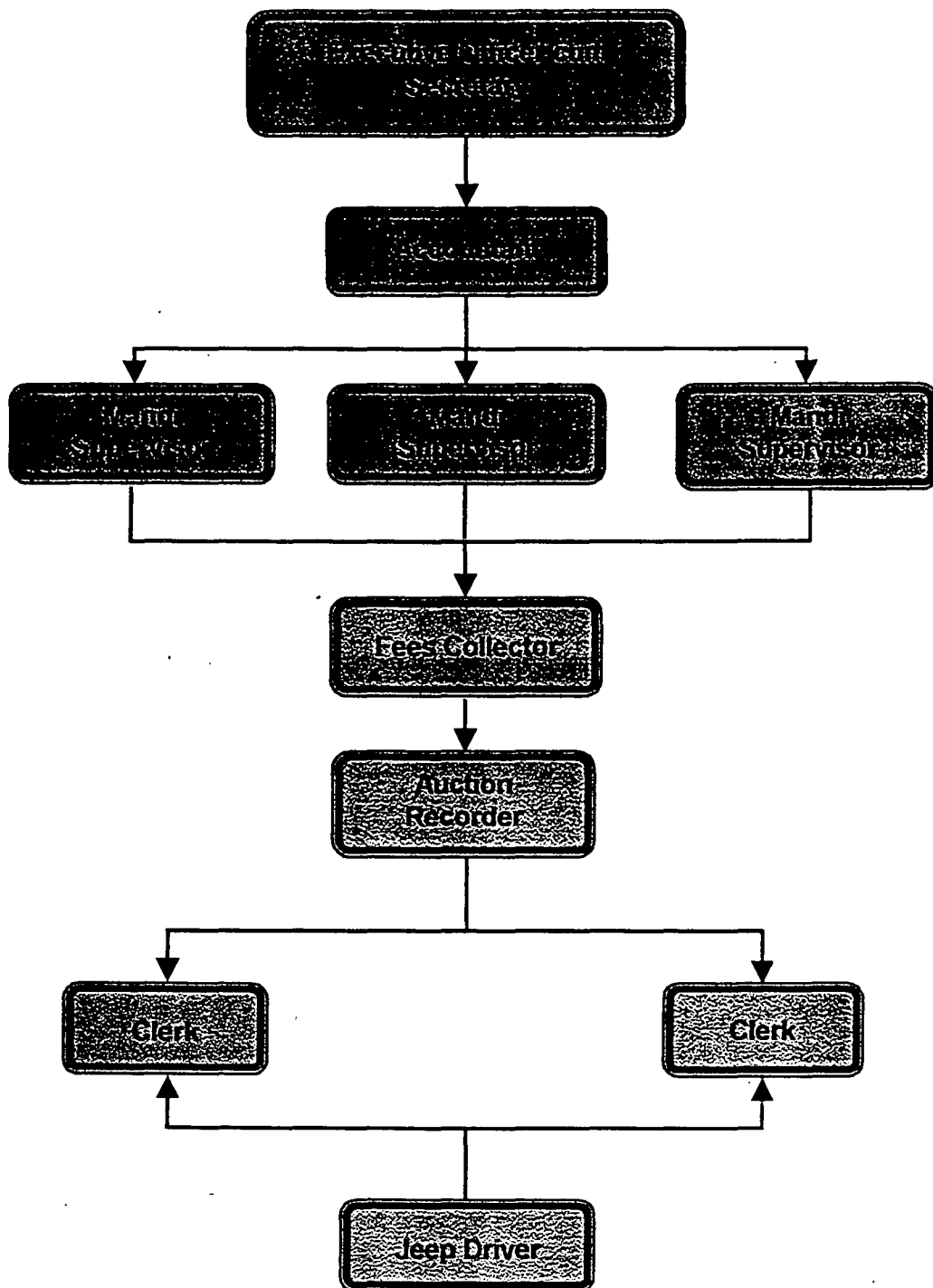


Table 4.1

Sources of Solid Wastes and its Main Contents

Source	Main Contents
Household waste	Kitchen & food waste, vegetable waste, paper, plastic, wood, etc.
Commercial & Institutional waste	Paper, plastics, construction material
Hospital waste	Plastic, syringes, blood, bandage & cotton, etc.
Market waste	Vegetable waste
Construction waste	Bricks, sand & grit, earth
Industrial waste	

Source: Gurgaon Municipal Council and Haryana Urban Development Agency, Gurgaon

Table 4.2

Quantity of Municipal Solid Waste Generated in Gurgaon Urban Area

Particulars	Population	Per capita generation (gm/capita/day)	Total (TPD)
Municipal Area	210300	410	87
HUDA sectors	100000	410	41
Private Developers	50000	410	21
Villages	101625	410	42
Others - Market, Hospital, industries			15
Total			206

Table 4.3

Projection of Municipal Solid Waste Generated in Gurgaon Urban Area

Year	Total Population	Per capita generation (gm/capita/day)	MSW generation (tonne/day)
2000	461925	410	191
2001	507757	416	212
2011	966076	472	455
2021	1419396	535	760

Table 4.4

Physical Characteristics of Gurgaon Municipal Waste

Particulars	Value	
	Weight (gm)	Percentage
Paper	850	5.9
Plastic	1500	10.3
Metals	10	0.1
Glass	205	1.4
Cloth	560	3.9
Stone	1980	13.6
Sand & grit	2545	17.5
Rubber	90	0.6
Wood	300	2.1
Leather	--	--
Wax	--	--
Organic matter	6485	44.6

Source: Detailed Project Report for Municipal Solid Waste Management of Gurgaon City, Sycorn Projects Consultants Pvt. Ltd., New Delhi

Table 4.5

Chemical Characteristics of Gurgaon Municipal Waste

Particulars		
	Value	Dry weight basis
Free moisture	63.0 %	
Dry matter	37.0 %	
Volatile substance	11.0 %	29.7
Ash content	26.0 %	70.0
Organic carbon		13.3
Nitrogen		0.012
Phosphorus		0.011
Potassium		0.047
pH	7.07	

Source: Detailed Project Report for Municipal Solid Waste Management of Gurgaon City, Sycom Projects Consultants Pvt. Ltd., New Delhi

Table 4.6

Characteristics of Waste Generated from Commercial Complexes

Particulars	Value
Paper	42.0 %
Plastic	15.0 %
Glass	2.7 %
Staples, Pins and other metallic substances	9.3 %
Cloth	1.0 %
Sand & grit	11.0 %
Organic Matter	19.0 %
Free moisture	38.2 %
pH	7.21 %
Calorific value	2000 Kcal/kg.

Source: Detailed Project Report for Municipal Solid Waste Management of Gurgaon City, Sycom Projects Consultants Pvt. Ltd., New Delhi

Table 4.7

Characteristics of Waste Generated from Hotels and Restaurants

Particulars	Value
Paper	3.7%
Plastic	3.4%
Glass	8.0%
Cloth	2.5%
Stones	1.3%
Metals	0.5%
Sand & grit	25%
Vegetable & Organic Matter	45.6%
Free moisture	43.65%
pH	7.91
Calorific value	1500 Kcal/kg.

Source: Detailed Project Report for Municipal Solid Waste Management of Gurgaon City, Sycom Projects Consultants Pvt. Ltd., New Delhi

Table 4.8

Characteristics of Waste Generated from Vegetable and Fruit Markets

Particulars	Value (dry weight basis)
Physical Characteristics	
Leaves	1.98%
Vegetable & fruit wastes	19.76%
Hay & Straw	2.96%
Organics	25.69
Fine organics & soil	31.62
Paper	6.92
Plastics	1.98
Rags	5.93
Wooden matter	--
Glass	--
Bones	--
Stone, bricks, etc.	3.16
Chemical Characteristics	
Organic matter	50.0%
Carbon	27.78%
Total Nitrogen	0.68%
C/N ratio	42.74
Phosphorous as P ₂ O ₅	0.43%
Potassium as K ₂ O	0.51%
Calorific value	2791.5 Kcal/kg

Source: Detailed Project Report for Municipal Solid Waste Management of Gurgaon City, Sycom Projects Consultants Pvt. Ltd., New Delhi

Table 4.9

Institutional Arrangement for Municipal Solid Waste Management in Gurgaon Urban Area

	Zones	Agency Responsible
a)	Municipal Limit of Gurgaon (Gurgaon Town)	Municipal Council
b)	HUDA sectors of Gurgaon Urban Area	HUDA
c)	Private Developers	Own

Source: Gurgaon Municipal Council and Haryana Urban Development Authority, Gurgaon

Table 4.10

Existing Manpower Deployment for Solid Waste Management in Gurgaon Municipal Area

Sl. No	Name of the Official	Numbers
1.	Chief Sanitary Inspector	1
2.	Sanitary Inspectors	2
3.	Sanitary Supervisors	2
5.	Sanitary Darogas	8
6.	Safai Karmacharies (Street Sweeping)	360
7.	Safai Karmacharies (Drain Cleaning)	70
8.	Safai Karmacharies (Cleaning toilets)	5
9.	Safai Karmacharies (collection of construction waste)	15
10.	Safai Karmacharies (for waste transportation, loading, unloading)	30-35
11.	Tractor Drivers - Waste transportation	4

Source: Gurgaon Municipal Council

Table 4.11

Details of Road Cleaned in Gurgaon Municipal Area

Cleaning of Roads	Kilometers
Length of the road cleaned daily	12-14
Length of the road cleaned on alternate days	4-5
Length of road cleaned twice a week	2-3
Length of road cleaned occasionally	4-5

Source: Gurgaon Municipal Council

Table 4.12

Ward-wise Distribution of Dustbins and R. C. Bins

Ward No	Area Under Each Ward	R.C. Bins/ Dustbins
1	Bhimgarh Kheri, Ashok Vihar, Dayanand Colony, Ashok Puri, Mahavir Pura	1
2	Adarsh Nagar, Miawali Colony, Acharya Puri, Sanjay Colony, Gopal Nagar, Purani Najafgarh Road	2
3	Rajeev Nagar, Delhi Road	4
4	Prem Nagar, Rajeev Nagar, Delhi Road	4
5	Mehrauli, Mahavir Chauk, DLF Colony,	4
6	Nahar Colony, Vidyut Board Colony, Police Line, Civil Hospital Colony, Patel Nagar, Housing Board, Jharsa Road	3
7	Jaikampura, Roshanpura, Sadar Bazar, Jama Masjid	1
8	Subhas Nagar, Indrapuri, Jaikampura	2
9	Indrapuri, Subhas Nagar, Sainik Mahulla	3
10	Bhim Nagar Camp	3
11	Ratan Garden, Shivpuri, Sector 7, Sector 4	1
12	New Colony, Krishna Colony	7
13	Pratap Nagar, Arjun Nagar, Nehru Line, Vijay Nagar	1
14	Arjun Nagar	2
15	Nai Basti, Arjun Nagar, Ram Nagar	1
16	Nai Basti, Meat Market, Jail Road, Prem Nagar	1
17	Civil Lines, Friends Colony, New Court, Shivaji Nagar	2
18	Shivaji Nagar	4
19	Om Nagar, Shanti Nagar	2
20	Om Nagar, Raj Nagar, Anaj Mandi	1
21	Gandhi Nagar, Shivaji Park, Heera Nagar	2
22	Heera Nagar, Lakshmi Garden	1
23	Lakshmi Garden, Charat Barla	1
24	Arjun Nagar, Nai Abadi, Veer Nagar, Shakti Nagar, Charmalla, Lakshmi Garden	2
25	Baldev Nagar, Amar Colony, Feroz Colony, Shakti Nagar, Veer Nagar, Shamshanghat	1
26	Madanpuri	1
27	Jyoti Park, New Jyoti Park, Sector 7	1
28	Krishna Colony, Sector 7, Parts of Sector 4	1
29	Sector 4, Lakshman Vihar, Surat Nagar, Daulatabad Road	1
30	Rajendra Park, Vishnu Garden, Police Chauki	1
31	Awadh Puri, Anand Garden, Railway Station	1

Source: Gurgaon Municipal Council

Table 4.13**Location of the Dustbins / MSW Collection Points in Gurgaon Municipal Area**

Sl. No.	Location
1	Kabir Bhawan Chowk
2	Sohna Chowk
3	Near Nehru Stadium
4	Near PWD Quarters
5	Officers Colony No. 3
6	Opposite Pushpanjali Hospital
7	Near Dhronacharya park
8	Electricity Board Colony, Jharsa road
9	New Shama restaurant
10	Opposite Municipal Council Office
11	Civil Hospital
12	Electricity Board Colony, Mehrauli Road
13	Industrial area
14	Opposite Saraswati Hospital
15	DLF Colony
16	Prem Nagar
17	Opposite Tonga Stand, New Railway Road
18	Dronacharya college gate, New Railway Road
19	Bhim Nagar, New Railway Road
20	Opposite Dayanand Colony
21	Ellora factory, New Railway Road, Opposite Bhim Nagar
22	Gaba Road, New Colony
23	Opposite Sector 4
24	Colony Roundabout, Opposite Balmiki Basti
25	Colony Roundabout, Opposite Triangular Park
26	New Colony opposite State Bank
27	Shyam Vatika, opposite New Colony
28	Behind Dr. Soota's Clinic
29	Dusshera Ground, New Colony
30	Krishna Colony
31	New Colony, Opposite Gurudwara
32	Subhash Nagar (Ramlila Maidan)
33	Behind Dr. Lal's Clinic, Subhash Nagar
34	Mission School wall
35	Meat Market

Contd... Table 4.13

Sl. No.	Location
36	Subzi Mandi
37	Shivaji Nagar, Near Jindal Furniture
38	Behind Dr. Pasrcha's Clinic
39	4/8 Marla, Near Community Hall
40	4/8 Marla, Near R.K. Tent House
41	Om Nagar Gali No.2
42	Om Nagar Gali No.4
43	Rajnagar Main Road
44	Prem Nagar
45	Nai Basti, Near Kali Basti
46	Arjun Nagar Near Gurudwara
47	Near Cremation Ground, Arjun Nagar
48	Madan Puri Main Road
49	DAV School, Khandsa Road
50	Shivpuri, Ramlila Maidan
51	Bhim Nagar, Main Road
52	Mianwali Colony
53	Housing Board
54	Patel Nagar, Opposite Old Octroi Office
55	Officers Colony No.1
56	Behind Deputy Commissioner's Residence
57	Mianwali Colony, Near the park

Source: Gurgaon Municipal Council

Table 4.14

Type of Vehicles used, Capacity and Number of Trips per day for Waste Transportation by Gurgaon Municipal Council

Type of Vehicle	Nos.	Capacity per vehicle (tonnes)	No. of trips	Waste disposed (tonnes)
Refuse collector	1	18	3	54
Truck	1	8	—	Not functional
Tractor Trolley	4	4	3	48
Total				102

Source: Gurgaon Municipal Council

Table 4.15

**Cost of Transportation, Collection and Disposal of Solid Waste for
Gurgaon Municipal Council**

Particulars	Cost (Rs.)
Waste collection per day per tonne	375
Waste transportation cost per day per tonne	380
Waste disposal cost per tonne per day	362

Source: Gurgaon Municipal Council

Table 4.16

Type of Vehicles used, Capacity and Number of Trips per day for Waste Transportation by HUDA

Type of Vehicle	Nos	Capacity per vehicle (tonnes)	No. of trips	Waste disposed (tonnes)
Refuse collector	1	6	3	18
Refuse collector	2	10	3	60
Total				78

Source: Haryana Urban Development Authority, Gurgaon

Table 4.17

Waste Management at Ansals

Particulars	Sushant Lok I	Sushant Lok II	Sushant Lok III	Palam Vihar
Transportation	Moveable trolleys	Moveable trolleys	Moveable trolleys	Moveable trolleys
Method of disposal	Moveable trolleys	Moveable trolleys	Moveable trolleys	Moveable trolleys
Number of moveable trolleys	10	-	-	10
Number of bins	-	4	3	-
Disposal sites	Dumping yards	Dumping yards	Dumping yards	Dumping yards

Source: Ansals

Table 4.18

Waste Management at Unitech - South City I

Particulars	Description
Number of bins	23
Mode of transportation	Cycle Rickshaw
Number of trips per day	8
Disposal site	Present disposal is done within the colony by land filling
Future Proposal	When the population increases, HUDA shall have to install a treatment plant

Source: Unitech

Table 4.19

Waste Management at DLF – Qutub Enclave Phase I, II, III, IV, Silver Oak Apartments, Beverly Park I & II, RP I & II and Heritage City

Particulars	Phase I	Phase II	Phase III	Phase IV	SOA	BP - I & II	RP - I & II, HC
Method of collection/ disposal	Door to door collection by rickshaw and disposal by tractor trolley						
No. of rickshaw/ tractor trolley	4 + 1	4 + 1	4 + 1	2 + 1	1	1 + 1	1 + 1
No. of bins	Nil	Nil	Nil	Nil	10	Nil	Nil
Waste collected per household	1 kg	1 kg	1 kg	1 kg	1 kg	1 kg	1 kg
Transportation	Rickshaw and tractor trolley						
Disposal sites distance	Within phase 2 km	Within phase 2.5 km	Within phase 3 km	Within phase 1.5 km	2 km		
No. of trips	2	2	2	2	2	2	2

Source: DLF

Table 4.20

Results of Hospitals surveyed in Gurgaon

Hospitals/Nursing Homes	No. of Beds	Amount of Waste Generated Per Person Per Day	Amount of Waste Generated Per Day
Goel Nursing Home	1 to 15	0.5 - 1 kg	Not available
Arora Mother & Child	1 to 15	0.5 - 1 kg	8 to 10 kg
Batra Maternity Clinic & Nursing Home	5	10 to 15 gms	500 gms to 1 kg
Malik Nursing Home	1 to 15	0.5 - 1 kg	2 to 3 kg
Mahajan Nursing Home	1 to 15	0.5 - 1 kg	5 kg
Kharbanda Nursing Home	15	1 kg	40 kg
Kamla Memorial Hospital	5	0.5 - 1 kg	2 to 5 kg
Bansal Nursing Home	Not available	Not available	Not available
Kanshiram Medical Services	1 to 15	0.5 - 1 kg	5 - 6 kg
Sethi Hospital	15 to 30	Not available	Not available
Nangia Hospital	15	Not available	1 kg
East West Medical Centre & Hospital	15 to 30	0.01 kg	1 kg
Chiranjiv Hospital	1 to 15	0.5 - 1 kg	7 to 8 kg
Umkal Hospital	45 and above	0.5 kg	20 kg
Thakral Nursing Home	1 to 15	Not available	Not available
Saraswati Hospital	15 to 30	2 kg	20 kg
Aryan Hospital	15 to 30	1 to 2 kg	40 kg
Premnath Hospital	1 to 15	Not available	1 kg
Mathur Maternity & Child Care	1 to 15	0.5 kg	5 to 10 kg

Contd. Table 4.20

Hospitals/Nursing Homes	No. of Beds	Amount of Waste Generated Per Person Per Day	Amount of Waste Generated Per Day
Lall Nursing & Maternity Home	20	1 to 2 kg	45 kg
Madan Hospital	15 to 30	0.5 kg	5 kg
Bhatnagar Hospital	10	1 to 2 kg	10 to 12 kg
Sheetla Hospital	45 and above	0.5 kg	8 to 10 kg
Albega Hospital	1 to 15	0.1 kg	5 kg
Parasher Hospital	1 to 15	0.5 kg	5 to 6 kg
<p>Approx. total HOSPITAL WASTE generated in Gurgaon Urban Area is around 500 kg per day</p> <p>TYPE OF WASTE GENERATED: Plastics, Plastic / Glass Syringes, Paper, Cotton, Bandages, Needles, Chemicals, Medicines, Other bio-medical wastes.</p>			

Table 4.21

Type of wastes to be put in the bins meant for food wastes & biodegradable wastes

- Food wastes of all kinds, cooked and uncooked, including eggshells, and bones
- Flower and fruits waste including juice peels and house plant waste
- House sweeping (not garden sweepings or yard waste)
- Sanitary towels
- Disposable diapers and incontinence pads
- Ashes

Types of Recyclable wastes to be kept for collection by informal sector

- Paper and plastic, all kinds
- Cardboard and cartons
- Containers of all kinds excluding those containing hazardous materials
- Packaging of all kinds
- Glass, all kinds
- Metals, all kinds
- Rags, rubber, wood
- Foils, wrapping, pouches, sachets and tetrapaks (rinsed)
- Cassettes, computer diskettes, printer cartridges and electronic parts
- Discarded clothing, furniture and equipment

Source: Solid Waste Management in Class I Cities in India, Supreme Court Report '99

Table 4.22

List of Domestic Hazardous Waste

- Aerosol cans
- Batteries from flashlights and button cells
- Bleaches and household kitchen and drain cleaning agents
- Car batteries, oil filters and car care products and consumables
- Chemicals and solvents and their empty containers
- Cosmetic items, chemical based
- Injection needles and syringes after destroying them both
- Insecticides and their empty containers
- Light bulbs, tube-lights and compact fluorescent lamps (CFL)
- Medicines discarded
- Paints, oils, lubricants, glues, thinners and their empty containers
- Pesticides and herbicides and their empty containers
- Photographic chemicals
- Styrofoam and soft foam packaging from new equipment
- Thermometers and mercury containing products

Source: Solid Waste Management in Class I Cities in India, Supreme Court Report '99

Table 4.23

Capital Cost of Compost Plant (100 TPD)

Description		Cost (million Rs.)
Land	20,000 sq. meter	--
Civil Works	Office building and repair shed 200 sq. meter @ Rs. 5000 per sq. m	1.00
	Weighbridge and gate structure	0.20
	Storage shed 1500 sq. m @ Rs. 2500 per sq. m	3.75
	Parking shed 60 sq. m @ Rs. 2500 per sq. m	0.15
	Boundary wall and gate office	1.00
	Internal roads, water supply, lighting arrangements and other infrastructural works	2.00
Equipment and machinery	Front end loader 1 no. @ Rs. 11,00,000 per no.	1.10
	Tractor trolley 2 no. @ Rs. 5,00,000 per no.	1.00
	Weighbridge 1 no. @ Rs. 5,00,000 per no.	0.50
	Screen, conveyor belts for separation and grinding unit etc.	5.00
Total		15.70

Table 4.24

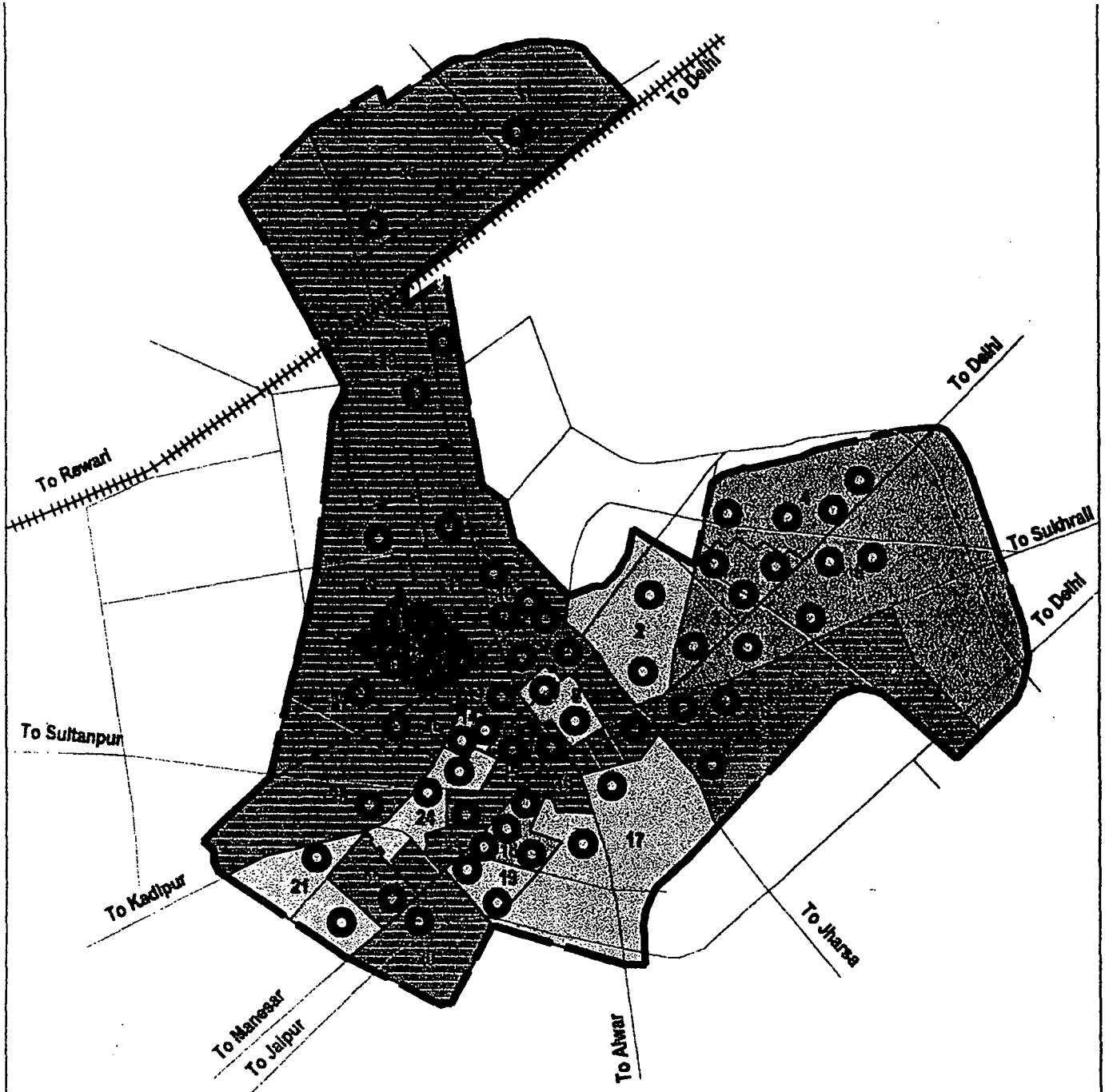
Operating Cost (per annum) of 100 TPD Compost Plant

Description		Cost: (million Rs.)
Land Lease	@ Rs. 1.50 per sq. m per annum	0.03
Amortization	@ 8% of the cost of civil works and 10% of the cost of equipment and machinery	1.41
Maintenance charges	@ 2% of civil works and 5% of plant and machinery	0.54
Fuel Charges	For running equipment and machinery	0.50
Power charges	@ 5 kWh per tonne of MSW @ Rs. 2.25 per kWh	0.34
Water charges	@ 500 liter per tonne @ Rs. 4 per kilo liter	0.06
Manpower		2.00
Cost of additives	@ Rs. 100 per tonne of organic manure	1.05
Total		5.93

Table 4.25

Economic Viability of Composting Technology (100 TPD)




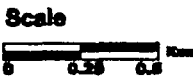
A.	General Features	
	Plant Capacity (100 x 300 tonnes/ year)	30,000
	Capital Cost (lac Rs.)	157.00
	Land Requirement (Sq. M)	20,000
	Production of Organic manure (tonnes/year) @ 35% of the plant capacity	10,500
B.	Annual Expenditure	
	Variable cost of production (Lac Rs.)	59.28
	Interest on capital cost @ 0.75% per annum (soft loan)	1.18
	Cost of marketing @ Rs 30 per tonne of manure	3.15
C.	Annual Recovery	
	Sale of Organic Manure @ Rs. 700 per tonne	73.50
D.	Yearly Profit margin (million Rs.)	
		0.99



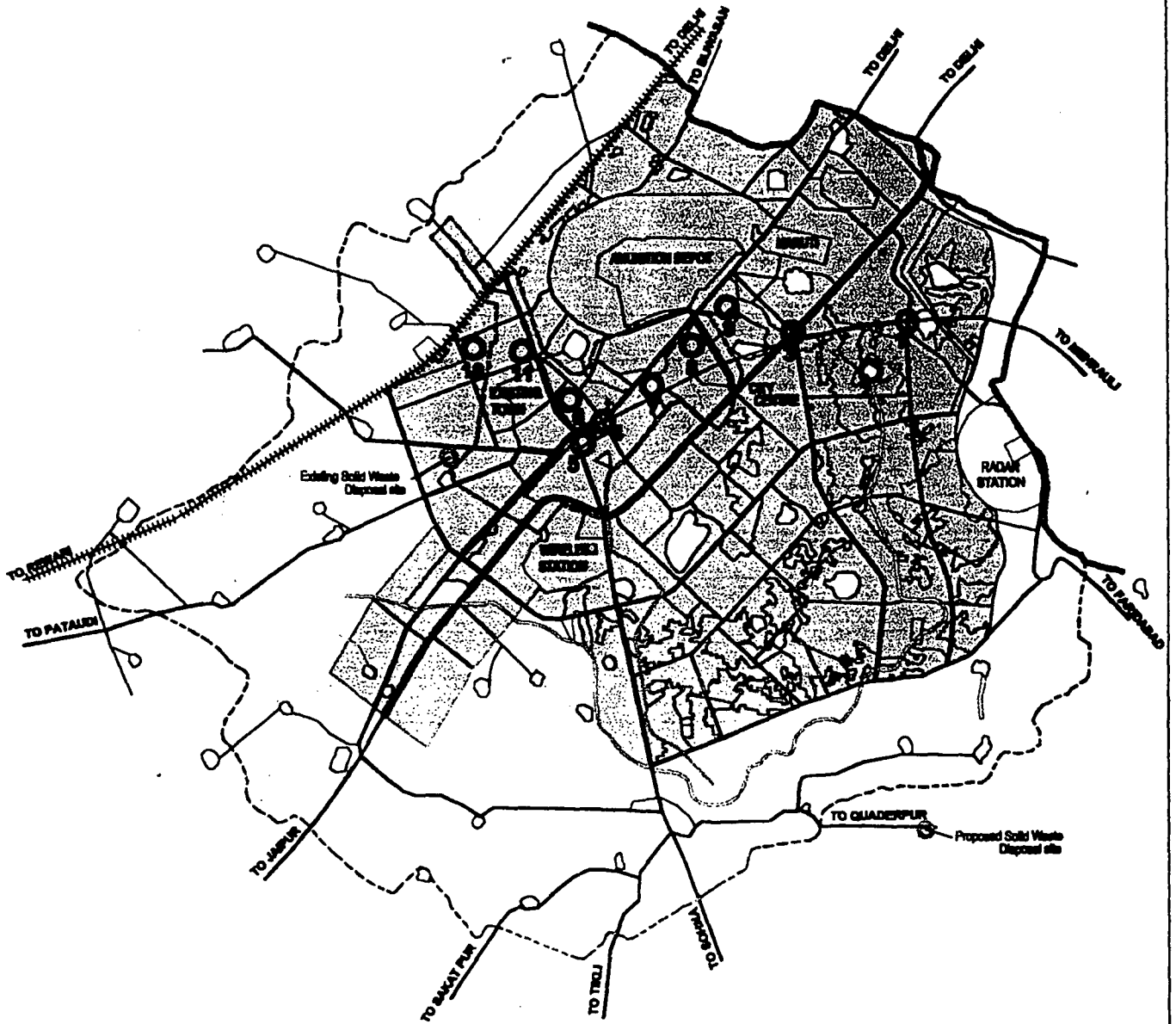
LEGEND

-  Municipal Boundary
-  Ward Boundary
-  Major Road
-  Railway Line
-  Bins








**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**

 N	 Map No.	
Scale 		

MAP 4.2 : SOLID WASTE DISPOSAL SITES



LEGEND


-  State Boundary
-  Controlled Area Boundary
-  Municipal Limit
-  Major Road
-  Other Roads
-  Village road/ Village
-  Railway Line

 Solid Waste Disposal Sites

SITE NO. LOCATION


- 1 Sikandarpur Chowk
- 2 Rao Shyamal market, Chakdarpur
- 3 IFFCO Chowk, NH-8
- 4 Fountain Chowk, Zila Police Line
- 5 Nehru Market, Badar Bazar Chowk
- 6 Sector - 12 Market, Near Telephone Exchange
- 7 Sector - 14 Market
- 8 Sector - 14 Main Road, Opp. Shyam Garments
- 9 Sector - 17 Market
- 10 Sector - 4 Market
- 11 Sector - 4 Near Gurunank Market

**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**



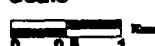
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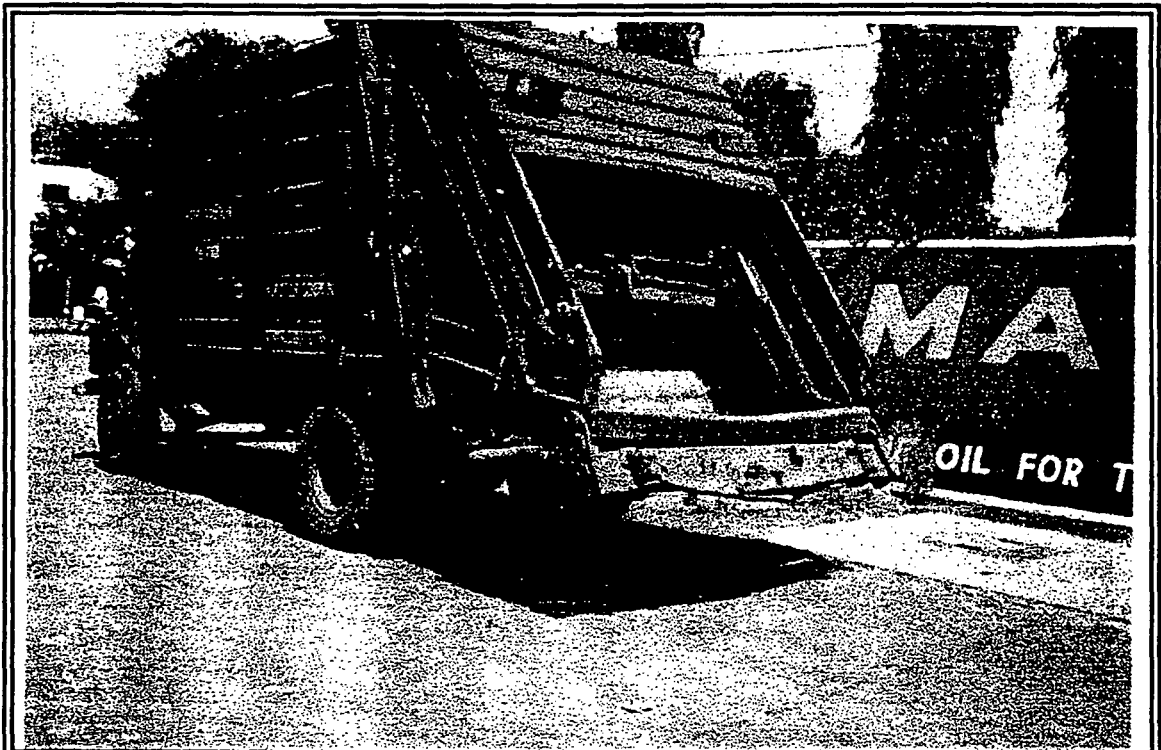
Map No.



GREEN CITY INDIA

Scale





"A REFUSE COLLECTOR"

Refuse Collector used for waste transportation



"NEIGHBOUR'S PROBLEM"

A major garbage dump right next to a multinational company



"MAN. ANIMAL & GARBAGE"

The landfill site at Basai Road



"OVERFLOWING GARBAGE BINS"

Garbage storage bins in the middle of the market



"ROAD SIDE DUMPING"

DLF Phase II



"THE RECYCLING MARKET"

A waste recycling market next to Basai Road landfill site



"FEAST TIME"

Pigs feasting on an open garbage bin

Chapter 5

Water and Wastewater Management

Water is certainly the prime element of environmental concern, and its sources are not only getting depleted in many urban areas, but also polluted. The water supply, originating from surface or ground sources, is further endangered by over-exploitation and sometimes even unchecked wastage, and massive water losses due to technical weakness in the distribution system.

Water supply by state level agencies that has been largely subsidized, and due to the absence of proper pricing policies and cost recovery, is becoming an unsustainable basic service. Additionally, even the aspect of water conservation and re-use or recycling is not being encouraged.

Safe water supply and Sanitation are vital for protecting the environment, improving health and alleviating poverty, which greatly affect the quality of life. Disease, drudgery and millions of deaths every year are directly attributable to lack of essential services.

Water being the single most essential component of the physical infrastructure for improved quality of life, demands urgent attention in Gurgaon. The rapid development process and expansion of economic activities during the last decade has led to tremendous demand of water for diverse usage in the entire urban area.

Since water supply forms the basic need for human sustenance and is one of the most critical environmental concerns, its effective management for

ensuring adequate supply of potable water in terms of reliability, quantity and quality would be of the fundamental goal of planned development in Gurgaon.

Sources of Water

With the absence of a river system or any other natural surface water body, Gurgaon has been depending heavily on its underground water sources for domestic, industrial and commercial usage. This in turn has led to serious implications on the rapid lowering of the water table and emerging issues of water salinity and brackishness.

The water resources in the study area can be broadly classified into:

- a) **Surface water:** The main sources of surface water can be attributed to the Western Yamuna canal originating from Sonapat.

The project for bringing the canal water from Sonapat was initiated by HUDA, wherein the water after filtration is being supplied to Gurgaon.

- b) **Underground Water:** The underground water comprises mainly of Tubewells and percolation wells, which is then boosted through various means to serve the Gurgaon town and forms a major component of municipal water supply.

With the existing disparities in the municipal water supply, and the increasing gap in water supply, the augmentation of canal water by HUDA has been the major element of support for bridging the water supply gaps in the town.

Initial Water Supply

The piped water supply in Gurgaon was introduced in 1965. Prior to 1965, the dependency on water was mainly on the open wells, handpumps and ponds.

The first piped water scheme in Gurgaon was introduced in 1960, envisaged to provide drinking water from two tubewells and was completed in 1967. In 1969, efforts were made to augment the water supply, but it was in 1971, that the major water supply scheme was sanctioned costing Rs. 11.19 million. This scheme envisaged drilling of tubewells in the vicinity of village Badshahpur at a distance of 8

Km from mains (waterline) into the underground tanks, from where the water was boosted into the then prevailing system.

In the areas covered by HUDA, water supply was introduced in 1974 in sectors 4 & 7 and in 1978 in sector 14. The water supply system in these three planned sectors was based on 20 tubewells, 2 clear water tanks and 3 overhead service reservoirs.

The initial water supply schemes in Gurgaon are given in **Table 5.1**.

5.1 Water Quantity and Characteristics

The water quality also forms one of the most essential criteria's for achieving better health and hygiene for the community. It has been seen that maximum illness amongst the people is due to consumption of poor water quality. Hence water quality along with water quantity plays a significant role in sustainable urban society.

Incidences of high levels of fluorides have been recorded at few locations where fluoride values exceeded 1.5 mg/l as shown in **Table 5.2**. Water sources at Gurgaon and Badashahpur show moderate to high conductivity values, which attribute to salinity problem in that area.

From the data for heavy metals (**Table 5.3**) manganese and iron concentrations are found in between permissible and excessive limits in some of the collected samples.

The **Table 5.4** reflects on the actions taken by the Public Health and Engineering Department for assessing and monitoring the water supply in the town.

5.2 Present Scenario

Institutional Arrangements

Two dominant authorities primarily execute the water supply in the Gurgaon Urban Area, one being the Public Health Engineering Department (PHED), which was initially under the Municipal Council but is now an independent unit under the State Public Health Department. Its main function is of operating and maintaining the water supply system in the Gurgaon Municipal Area.

The second agency responsible for water supply in the urban area beyond the municipal limit of Gurgaon town is the Haryana Urban Development Authority (HUDA). They also provide assistance to the Public Health Engineering Department by supplying water from the western Yamuna canal.

The institutional arrangement for water supply in Gurgaon Urban Area is given in **Table 5.5**.

Existing Water Supply Status

The water supply of Gurgaon under the two authorities viz. Public Health Division and Haryana Urban Development Authority can be viewed differently in terms of their jurisdiction and coverage.

5.2.1 Municipal Water Supply System

In 1981 the water supply of the town under the Public Health Engineering Department was based on 27 Tubewells and 5 percolation wells, of which 7 were functioning from the Badshahpur village.

The water from these Tubewells was directly fed to the main water works located at Jharsa bund, through rising mains. Further the water of the Tubewells was collected in the under ground tanks from where it was boosted into the overhead service reservoirs with help of 4 boosting pumps.

As on today the water supply of Gurgaon town is based on tubewells drilled at Gurgaon and village Badshapur. The average discharge of the tubewells is

about 3000 GPH (gallons per hour), which is very less. The spring level is at 30 meter.

The present municipal water supply system as compared to 1981 is given in **Table 5.6**.

In 1999, there were 44 main Tubewells and approximately 123 Tubewells in all that catered to the Gurgaon town. The well water was treated with chlorine at the rate of 0.2 parts per million gallons. The main cast iron conduit with internal diameter of 30 cm, decreased as the length of the pipe moved away from the reservoir. The total length of the water pipeline had increased to 106 km in 1999 from 67 km in 1981.

In addition to the Tubewells, overhead and underground tanks, the Public Health Engineering Department also draws water from the Western Yamuna canal, a project that was initiated by HUDA.

The various water supply systems adopted for the water supply in the town between 1981-1999 has been highlighted in **Figure 5.1**.

It is very essential to analyze and comprehend the spatial distribution of the existing main Tubewells in the town from where the water is regularly drawn to cater to the town's need. The spatial distribution of the wells in Gurgaon is given in **Table 5.7**.

The spatial distribution of the Tubewells in the town along with the details of the existing underground and overhead tanks provide an insight into the prevailing water supply system by the Public Health Division. These tanks are aided by four boosters situated at Main water works, Jacobpura, Mainwali colony and New Township for water supply to the town.

The temporal analysis of the water supply systems within the town also highlights and gives an overall picture of the water supply augmentation initiatives taken by the Department between the period 1981 to 1999 to meet the water demand of the area.

The water supply augmentation initiatives taken by the department between the period 1981 to 1999 is given in **Table 5.8**.

The water supply status in the Gurgaon town under the Municipal Water supply scheme exhibits discrepancies in the meeting the requirements of the town. Since the water supply of Gurgaon town is based primarily on Tubewells, this source of water is no longer sufficient and reliable due to less discharge and deep spring level. The discharge of existing tubewells is decreasing day by day and the spring level is going down at an alarming rate of 0.8 to 1 meter/ year.

Hence to combat these issues and problems in the area, a project has been launched for water augmentation with the help of HUDA, to suffice the water demands of the town. This ongoing project mainly aims at taking water from canal water from HUDA.

The town is served by intermittent water supply with 3hrs daily, distributed during mornings and evenings.

The existing municipal water supply status of Gurgaon town is summarized in Table 5.9.

5.2.2 HUDA Water Supply System

In 1974, HUDA initiated its water supply scheme in its area, which covered the sector 4 and 7. It further extended its domain to sector 14 in 1978. The water supply system in these three planned sectors was based on 20 tubewells, two clear water tanks with a storage capacity of 0.9 million liters and three overhead service reservoirs with a storage capacity of 0.455 million liters each.

The urban areas which were already developed by HUDA i.e. sector 4 & 7, 14, 17, etc., were being given the water supply from local tubewells. These tubewells are basically the shallow tubewells upto a varying depth of 150 to 250 feet depending upon the strata and quality of ground water. The discharge of these tubewells is varying from 3000 to 5000 gallons per hour and during summer season it further goes down.

Due to this depleting source of tubewells, HUDA has sought to an alternative source of water arrangement for its areas by embarking on a massive Master Water Supply project. Under this project raw water is procured through a new 69 km canal known as Gurgaon Water Supply (GWS) channel, exclusively for water supply to Gurgaon Urban Area from the Western Jamuna Canal (WJC) system,

having a headwork at village Kakroi near Kharkhoda district Sonapat. Though the major source of water supply under HUDA depends on WJC, it also has Tubewells catering to some of the sectors maintained by it.

The final capacity of canal works out to be 100 cusec at tail to meet water supply demand of Gurgaon after taking into all evaporation and seepage losses.

The Master water supply Scheme has been divided into four phases, for a total provision of 100 MGD capacity of water supply, wherein by 2001, 60 percent of its work will get executed for the entire Gurgaon Urban Area. Further there are three distinct water supply zones under this scheme embracing areas of the Gurgaon town, HUDA sectors, industrial and commercial establishments, defense land, Private colonizers area and villages.

The water supply norms taken into account for the formulation of the Master Water Supply scheme in Gurgaon is given in Table 5.10.

The water supply norms for domestic purposes are same as in case of other towns though the norms for NCR town provides for 70 gallons per capita per day. The irrigation requirement has been taken as 4000 gallons per acre against a normal figure of 5400 gallons per acre because of restricted canal water supply.

The proposed scheme has been designed for a population of 1.63 million by the year 2011 and the total water supply demand of Gurgaon Urban Area has been taken at 100 MGD. However by 2001 A.D, HUDA has envisaged an estimated designed population of 1 million, which would be catered by its 60 MGD capacity system, which is still under construction.

The proposed HUDA Master Water Supply Scheme is given in Table 5.11.

The phase wise implementation plan and existing status of the Master Water Supply scheme is given in Table 5.12.

The Master Water Supply scheme is divided into three distinct zones for water distribution. The areas covered and the population to be served under each zone are given in Table 5.13, 5.14 and 5.15.

The total daily water requirement for each zone under Master Water Supply scheme is given in Figure 5.2.

The water distribution under various usages in each zone in the Master Water Supply scheme is given in the Table 5.16 and Figure 5.3.

5.2.3 Water Tariff and Usage

Municipal Water Tariff

The water tariffs have been worked out on the basis of the consumption of water by various users and categorically rates have been fixed for unmetered and metered water supply.

The water charges for unmetered water supply is given in Table 5.17 and of metered water supply is given in Table 5.18.

The water connection fee is charged @ Rs. 300/- and the rate of bulk water supply is @ Rs. 2.00 per kiloliter.

The above rates are in effect from 27 July 1994 along with the following notifications:

- a) No new connections of ferrule size above 10mm to be sanctioned and the existing consumers with higher ferrule size be informed of the changed rate along with an option to get the connections reduced to lower ferrule size of 10mm.
- b) Electric pumps installed direct on the supply lines should in no case, be allowed to continue and should be immediately removed and water supply disconnected.

Wherever the electric pumps installed directly on the water supply lines are detected, penalty at a rate of Rs. 1200 by the way of the post misuse should be levied on the beneficiary who should also be charged penal charges at the rate of Rs.100/- per month in addition to the usual water charges till the pump is removed.

- c) The procedure for reconnection of water meter in such houses will be decided separately.

- d) No flat rate for commercial and industrial establishment is prescribed but such premises must have a good quality water meter as prescribed by the Public Health Engineering Department and the charges based on the actual consumption shall be levied. It should be ensured that water meters in those establishments are working in proper order.

The trend of water charges on metered water supply in Gurgaon town is given in Table 5.19.

Before July 27, 1994, for unmetered connections, flat rates were charged at the rate of Rs. 15 per month for 1/2" and 3/4" connection and Rs. 12 per month for 1/4" and 3/8" connection for the first tap and Rs. 3 per month for the subsequent taps.

The water charges in the Gurgaon town were estimated by the rate of consumption of 1000 liters of water by the type of establishment. It can be seen that the domestic water rates are lower than the commercial and industrial categories in the years prior to 1994 as well as in 2000.

The trend of metered and unmetered water supply in Gurgaon town is given in Table 5.20.

The water connection with regards to metered supply in domestic sector accounts for 15250 connections whereas the unmetered connections are 89 in number. On the whole domestic consumption accounts for maximum connections followed by industrial and commercial respectively. It can be also viewed that there has been a considerable increase in the water connections in the industrial and commercial sectors, revealing the growth of industrialization in the town.

The water consumption under the various sectors would provide a base for assessing the augmentation of water supply systems under the various categories and the water tariff being imposed accordingly.

It has to be also comprehended that the water charges have to laid in such a way that it does not affect the common people at large, because water happens to be the main essential sustaining element of the nature which should be accessible to all.

It has been viewed that domestic sector accounts for highest consumption and the water tariff paid by them is lowest, as there is wide disparities existing

amongst the entire population structure. The domestic consumption is followed by industrial and commercial sectors.

The **Figure 5.4** elaborates the percentage of water usage amongst the various sectors.

HUDA Water Tariff

HUDA has almost the same structure of water tariff as that of the Public Health Engineering Department. The water charges have been calculated at the rate of consumption of 1000 liters of water by the type of establishment. It can be seen that the domestic water rates are lower than the commercial and industrial categories.

The existing water tariffs under HUDA water supply system are given in **Table 5.21**.

The percentage of water distribution under various usages in the Master Water Supply scheme is given in **Figure 5.5**.

5.3 Suggested Action Plan

5.3.1 Initial Findings / Observations

The initial findings and observations are as under:

- Dramatic ground water lowering at the rate of 3.3 metres annually reaching upto 40 metres in the central areas.
- No restriction on the limit for extraction of ground water by various users.
- Rising Issues of water salinity and brackishness due to excessive withdrawal of ground water (especially in central areas)
- Municipal water supply solely depends on the underground water sources.
- Huge Water distribution losses due to installations of motors directly on the main HUDA water line
- The water quality of the town is poor and does not conform to the water quality standards.
- Limited Municipal water supply hours and disparities in the distribution system.
- The absence of any synchronized water supply plan of entire Gurgaon.
- Lack of Inter agency co-ordination giving rises to complex inter related problems of water supply system in Gurgaon.
- Lack of cost recovery mechanism by the Public Health Department.
- Lack of public awareness regarding issues of water wastage, conservation, water harvesting etc.
- Undefined and intermittent power cuts hamper the filtration and distribution of water.
- Absence of strict regulatory measures to curb water thefts and water wastage.

5.3.2 Suggested Action Plan

Since safe and adequate water supply forms a vital ingredient for the very human existence, its effective management in Gurgaon calls for urgent attention. The following suggested initial proposals for combating the problems of water supply in Gurgaon would highlight on the core areas where action is required.

Short Term Measures

- Increased public participation and mobilization of public opinion for water conservation strategies by involving local professionals, educationists, RWAs and NGOs in various localities through simple demonstration projects.
- Gender involvement in water conservation strategies especially in the slums.

Regulatory Measures

- To set up regulatory measures to speculate a specified limit of extraction of ground water in Gurgaon from the existing tubewells and banning any new tubewells.
- Introduction of strict laws and fine system for water thefts like - illegal installation of motors on the main HUDA water pipeline.
- Provisions for Fire fighting measures in the multistoried buildings as well as norms for the provision of underground storage of water as a fire-fighting device.
- Formulating definite role for both PHED and HUDA regarding water supply system and strengthen institutional partnerships by maintaining checks and balances for the entire water supply mechanism in Gurgaon.
- Water harvesting techniques to be made mandatory for all institutional and industrial buildings and introduction of simple water harvesting techniques in colonies and other areas.

- Introduction of differential water charges, based on income strata, water usage, quantity used firstly in the newer colonies and then its extension to the other areas as well.
- The industrial and institutional water charges need to be increased so as to cater the poorer section at lower water tariff rates.
- Introduction of 100 % metering of water, with water connection charges to be increased marginally every year so that the residents of Private colonies, Institution and industries do not feel the pinch of increase.

Long term measures

- Water quality assessment laboratory to be introduced with the help of the private sector.
- Installation of separate pipelines for khara pani and sweet water as practiced in the Arunachal Building, Delhi.
- Revival of old ponds and rainwater harvesting at location given in the Urban Planning Action Plan.
- Assessing the WTP of the people in the town and introducing privatization of water distribution system accordingly.
- Setting up of water quality monitoring stations at various vulnerable locations in the urban area.
- Public private partnership for contracting water supply and maintenance in the town.

5.3.3 Rain Water Harvesting

In scientific terms, water harvesting refers to collection and storage of rainwater and also other activities aimed at harvesting surface and groundwater, prevention of losses through evaporation and seepage and all other hydrological studies and engineering interventions, aimed at conservation and efficient utilization of the limited water endowment of physiographic unit such as water shed.

In general water harvesting is the activity of direct collection of rainwater. The rainwater collected can be stored for direct use or can be recharged into the groundwater.

How much water can be harvested?

The total amount of water that is received in the form of rainfall over an area is called the *rainwater endowment* of that area. Out of this, the amount that can be effectively harvested is called the *water harvesting potential*.

$$\text{Water Harvesting Potential} = \text{Rainfall (mm)} \times \text{Collection efficiency}$$

The *collection efficiency* accounts for the fact that all the rainwater falling over an area cannot be effectively harvested, because of evaporation, spillage, etc. Factors like runoff coefficient and the first-flush wastage are taken into account when estimating the collection efficiency.

Runoff Coefficient and First-Flush Device

Runoff coefficient is the factor, which accounts for the fact that all the rainfall falling on a catchment cannot be collected. Some rainfall will be lost from the catchment by evaporation and retention on the surface itself.

A first-flush device is a valve or a simple device, which is used to ensure that runoff from the first spell of rain, is flushed out and does not enter the system. This needs to be done since the first spell of rain carries with it relatively larger

amount of pollutants from the air and the catchment surface. The runoff coefficients for various surfaces are given in Table 5.22.

The following is an illustrative theoretical calculation that highlights the enormous potential for rainwater harvesting. The same procedure can be applied to get the potential for any plot of land or rooftop area, using rainfall data for that area.

Considering a building with a flat terrace area of 100 sq. m. the average annual rainfall in Gurgaon is approximately 605.7 mm. In simple terms, this means that if the terrace floor is assumed to be impermeable, and all the rain that falls on it is retained without evaporation, then, in one year, there will be rainwater on the terrace floor to a height of 605.7 mm.

Area of plot	= 100 sq. m.
Height of rainfall	= 0.6057 m (605.7 mm)
Volume of rainfall over the plot	= Area of plot x Height of rainfall = 100 sq. m. x 0.6057 m = 60.57 cu. M (60,570 litres)
Assuming that only 60% of the total rainfall is effectively harvested,	
Volume of water harvested	= 36,342 litres (60,570 litres x 0.6)

This volume is about twice the annual drinking water requirement of a five-member family. The average daily drinking water requirement per person is 10 litres.

The case of Gurgaon

Gurgaon has an annual average rainfall of 605.7 mm. However, recharge to groundwater is limited because of decreasing availability of permeable soil surfaces due to existence of roads and buildings.

As a result of poor recharge and heavy extraction of groundwater, ground water in Gurgaon has declined as much as 16 metres in the past 20 years at an annual rate of 0.8 metres per year.

Groundwater can be a sustainable source of water only if it is ensured that the amount of water withdrawn from the groundwater aquifers is compensated by recharging an equal amount of rainwater into the ground. Water harvesting provides the means to recharge the groundwater, thereby maintaining the balanced situation of the resource.

Rainwater harvesting has a huge potential in Gurgaon. The illustrative calculation for water harvesting potential for a single building can also be adapted to the Gurgaon Urban area as a whole.

With an area 100 sq. km., the rainwater harvesting potential of Gurgaon comes to be about 60 billion litres annually. This is equal to about 220 days of water requirement of the proposed HUDA Master Water Supply Scheme to supply 60 MGD of water by the year 2001.

Eighty per cent of the annual rainfall is received in the period between June to September and the rainwater therefore has to be harvested during this short period.

Elements of a typical water harvesting system

1. Catchments

The catchment of a water harvesting system is the surface, which receives directly and contributes the water to the system. It can be paved area like a terrace or courtyard of a building, or an unpaved area like a lawn or open ground. Temporary structures like sloping sheds can also act as catchments.

2. Conduits

Conduits are the pipelines or drains that carry the rainwater from the catchment or rooftop to the harvesting system. Conduits may be of any material like polyvinylchloride (PVC), asbestos or galvanized iron (GI), materials that are commonly available.

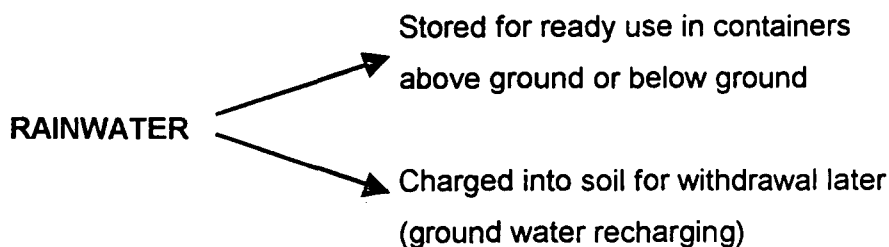
3. Storage facility

Rainwater can be stored in any commonly used storage containers like RCC, masonry or plastic water tanks. Some maintenance measures like cleaning and disinfection are required to ensure the quality of water stored in the container.

Alternative for storing, rainwater may be charged into the groundwater aquifers. This can be done through any suitable structures like dugwells, borewells, recharge trenches and recharge pits.

Methods of harvesting water

Broadly, rainwater can be harvested for two purposes:



Part 1: Storing rainwater for direct use

Rooftop harvesting has been prescribed, practiced since ages, and even today it is practiced in many places throughout India. In some cases, the rooftop harvesting system is adopted, using a split pipe or bamboo directing runoff from the roof into an oil drum placed near the roof. In Ahmedabad, which has a climate similar to that of Gurgaon, traditional rainwater harvesting tanks, which store drinking water, can be seen even today in some old houses.

Generally, runoff from only paved surfaces is used for storing, since it is relatively free of bacteriological contamination. Drainpipes that collect water from the catchment (rooftop) are diverted to the storage container. To prevent leaves and debris from entering the system, mesh filters should be provided at the mouth of the drainpipe. Further, a first-flush device should be provided in the conduit before it

connects to the storage container. If the stored water is to be used for drinking purposes, a sand filter should also be provided.

An underground RCC/ masonry tank can also be used for storage of the rainwater. The tank can be installed inside the basement of a building or outside the building. Pre-fabricated tanks such as PVC can be installed above the ground. Each tank must have an overflow system for situations when excess water enters the tank. The overflow can be connected to the drainage system.

Design of storage tank

The quantity of water stored in a water harvesting system depends on the size of the catchment area and the size of the storage tank. The storage tank has to be designed according to the water requirements, rainfall and catchment availability.

Design parameters for storage tanks:

- Average annual rainfall
- Size of catchment
- Drinking water requirement

Suppose the tank has to be designed for meeting drinking water requirement of a 5-member family living in a building with a rooftop area of 100 sq. m. Average annual rainfall in Gurgaon is 605.7 mm. Drinking water requirement per person (drinking and cooking) is 10 litres.

The maximum amount of rainfall that can be harvested from the rooftop:

Following details are available:

Area of the catchment (A) = 100 sq. m.

Average annual rainfall (R) = 605.7 mm

Runoff coefficient (C) = 0.85

Annual water harvesting potential from 100 sq. m. roof

$$= A \times R \times C$$

$$= 100 \times 0.6057 \times 0.85$$

$$= 51 \text{ cu. m. (51,000 litres)}$$

The tank capacity has to be designed for the dry period, i.e. the period between the two consecutive rainy seasons. With a monsoon extending over four months, the dry season is of 245 days.

Drinking water requirement for the family (dry season)

$$= 245 \times 5 \times 10$$

$$= 12,250 \text{ litres}$$

As a safety factor, the tank should be built 20 percent larger than required, i.e., 14,700 litres. This tank can meet the basic drinking water requirement of a five-member family for the dry period.

Part II: Recharging groundwater aquifers

Various kinds of recharge structures are possible which can ensure that rainwater percolates in the ground instead of draining away from the surface. While some structures promote the percolation of water through soil strata at shallower depth (e.g., recharge trenches, permeable pavements), others conduct water to greater depths from where it joins the groundwater (e.g. recharge well)

At many locations, existing features like wells, pits and tanks can be modified to be used as recharge structures, eliminating the need to construct any structures fresh.

A few commonly used recharging methods are explained here. Innumerable innovations and combinations of these methods are possible.

a) Borewells/ Dugwells

Rainwater that is collected on the rooftop of the building is diverted by drainpipes to a settlement or filtration tanks, from which it flows into the recharge well (borewell or dugwell).

If a borewell is used for recharging, then the casing (outer pipe) of the borewell should preferably be a slotted or perforated pipe so that more surface area

is available for the water to percolate. Developing a borewell would increase its recharging capacity (*developing* is the process where water or air is forced into the well under pressure to loosen the soil strata surrounding the bore to make it more permeable).

If a dugwell is used for recharging, the well lining should have openings (weep-holes) at regular intervals to allow seepage of water through the sides. Dugwells should be covered to prevent mosquito breeding and entry of leaves and debris. The bottom of recharge dugwells should be desilted annually to maintain the intake capacity.

Precautions should be taken to ensure that physical matter in the runoff like silt and floating debris do not enter the well since it may cause clogging of the recharge structure. It is preferred that the dugwell or borewell used for recharging be shallower than the water table. This ensures that the water recharged through this well has a sufficient thickness of soils medium through which it has to pass before it joins the groundwater. Any old well, which has become defunct, can be used for recharging, since the depth of such wells is above the water level.

Settlement Tank

Settlement tanks are used to remove silt and other floating impurities from rainwater. A settlement tank is like an ordinary storage container having provisions for inflow (bringing water from the catchment), outflow (carrying water to the recharge well) and overflow. A settlement tank can have an unpaved bottom surface to allow standing water to percolate into the soil.

Apart from removing silt from the water, the desilting chamber acts like a buffer in the system. In case of excess rainfall, the rate of recharge, especially of borewells, may not match the rate of rainfall. In such situations, the desilting chamber holds the excess amount of water till it is soaked up by the recharge.

Design parameters for settlement tank

For designing the optimum capacity of the tank, following aspects have to be considered:

1. Size of the catchment
2. Intensity of rainfall
3. Rate of recharge

Since the desilting tank also acts as buffer tank, it is designed such that it can retain a certain amount of rainfall, since the rate of recharge may not be comparable with the rate of runoff. The capacity of the tank should be enough to retain the runoff occurring from conditions of peak rainfall density.

In Gurgaon, say the peak hourly rainfall is 90 mm. The rate of recharge in comparison to runoff is a critical factor. However, since accurate recharge rates are not available without detailed hydrogeological studies, the rates have to be assumed. The capacity of recharge tank is designed to retain runoff from the last 15 minutes rainfall of peak intensity. (For Gurgaon, 22.5 mm/hr, say 25 mm).

Suppose the following data is available:

Area of rooftop catchment (A)	= 100 sq. m.
Peak rainfall in 15 minutes (r)	= 25 mm (0.025 m)
Runoff coefficient (C)	= 0.85

$$\begin{aligned}\text{Then the capacity of the desilting tank} &= A \times r \times C \\ &= 100 \times 0.025 \times 0.85 \\ &= 2.125 \text{ cu. m. (2,125 litres)}\end{aligned}$$

Any container with adequate capacity of storage can be used as a settlement tank. Generally, masonry or concrete underground tanks are preferred since they do not occupy any surface area. Old tanks can be modified to be used as settlement tanks. For overground tanks, pre-fabricated PVC or Ferro cement tanks can be used. Pre-fabricated tanks are easier to install, compared to masonry and concrete tanks.

b) Recharge pits

A recharge pit is a pit 1.5 m to 3 m wide and 2 m to 3 m deep. The excavated pit is lined with a brick/ stonewall with openings (weep-holes) at regular intervals. The top area of the pit can be covered with a perforated cover.

The method of designing a recharge pit is similar to that for a settlement tank.

c) Soakaways

A soakaway is a bored hole of up to 30 cm diameter drilled in the ground to a depth of 3 to 10 m. The soakaway can be drilled in the ground with a manual auger unless hard rock is found at a shallow depth. The borehole can be left unlined if a stable soil formation like clay is present. In such a case, the soakaway may be filled up with a filter media like brickbats. In the case of unstable formations like sand, the soakaway should be lined with a PVC or MS pipe to prevent collapse of the vertical side. The pipe may be slotted/ perforated to promote percolation through sides.

A small sump is built at the top end of the soakaway where some amount of runoff can be retained before it infiltrates through the soakaway. Since the sump also acts like a buffer in the system, it has to be designed on the basis of expected runoff as described for settlement tanks.

d) Recharge trenches

Recharging through recharge trenches, recharge pits and soakaways is simpler compared to recharge through wells. Fewer precautions have to be taken to maintain the quality of the rainfall runoff. For these types of structures, there is no restriction on the type of catchment from which water is to be harvested, i.e. both paved and unpaved catchments can be tapped.

A recharge trench is simply a continuous trench excavated in the ground and refilled with porous media like pebbles, boulders or brickbats. A recharge trench

can be 0.5 m to 1 m wide and 1 m to 1.5 m deep. The length of the recharge trench is decided as per the amount of runoff expected. The recharge trench should be periodically cleaned of accumulated debris to maintain the intake capacity.

In terms of recharge rates, recharge trenches are relatively less effective since soil strata at depth of about 1.5 m is less permeable.

Design of a recharge trench

The methodology of design of a recharge trench is similar to that for designing settling tank. The difference is that the water holding capacity of a recharge trench is less than its gross volume because it is filled with porous material. A factor of loose density (voids ratio) of the media has to be applied to the equation.

Using the same method as used for design of settlement tank:

Area of rooftop catchment (A)	= 100 sq. m.
Peak rainfall in 15 minutes (r)	= 25 mm (0.025 m)
Runoff coefficient (C)	= 0.85
Voids ratio (D)	= 0.5 (assumed)

$$\begin{aligned}\text{Required capacity of recharge trench} &= (A \times r \times C) / D \\ &= (100 \times 0.025 \times 0.85) / 0.5 \\ &= 4.25 \text{ cu. m. (4,250 litres)}\end{aligned}$$

The void ratio of the filler material varies with the kind of material used, but for commonly used materials like brickbats, pebbles and gravel, a voids ratio of 0.5 may be assumed.

In designing the recharge trench, the length of the trench is an important factor. Once the required capacity is calculated as illustrated above, length can be calculated by considering a fixed depth and width.

e) **Permeable Surfaces**

Unpaved surfaces have greater capacity of retaining rainwater on the surface. A patch of grass would retain a large proportion of the rainwater falling on it, yielding only 10 - 15 percent as runoff. A considerable amount of water retained on such a surface will naturally percolate in the ground. Such surfaces contribute to the natural recharge of groundwater.

If paving of ground surfaces is unavoidable, one may use pavements, which retain rainwater and allow it to percolate into the ground.

Cost of water harvesting

Typically, installing a water harvesting system in a building would cost between Rs 2,000 to 30,000 for buildings of about 300 sq.m. It is difficult to make an exact estimate of cost because it varies widely depending on the availability of existing structures like wells and tanks that can be modified to be used for water harvesting.

The cost estimate mentioned above is for an existing building. The costs would be comparatively less if the system were incorporated during the construction of the building itself.

Some basic rates of construction activities and materials have been given in Table 5.23, which may be helpful in calculating the total cost of a structure. The list is not comprehensive and contains only important activities meant to provide a rough estimate of the cost.

Fig. 5.1

Water Supply Systems in Gurgaon - (1981-1999)

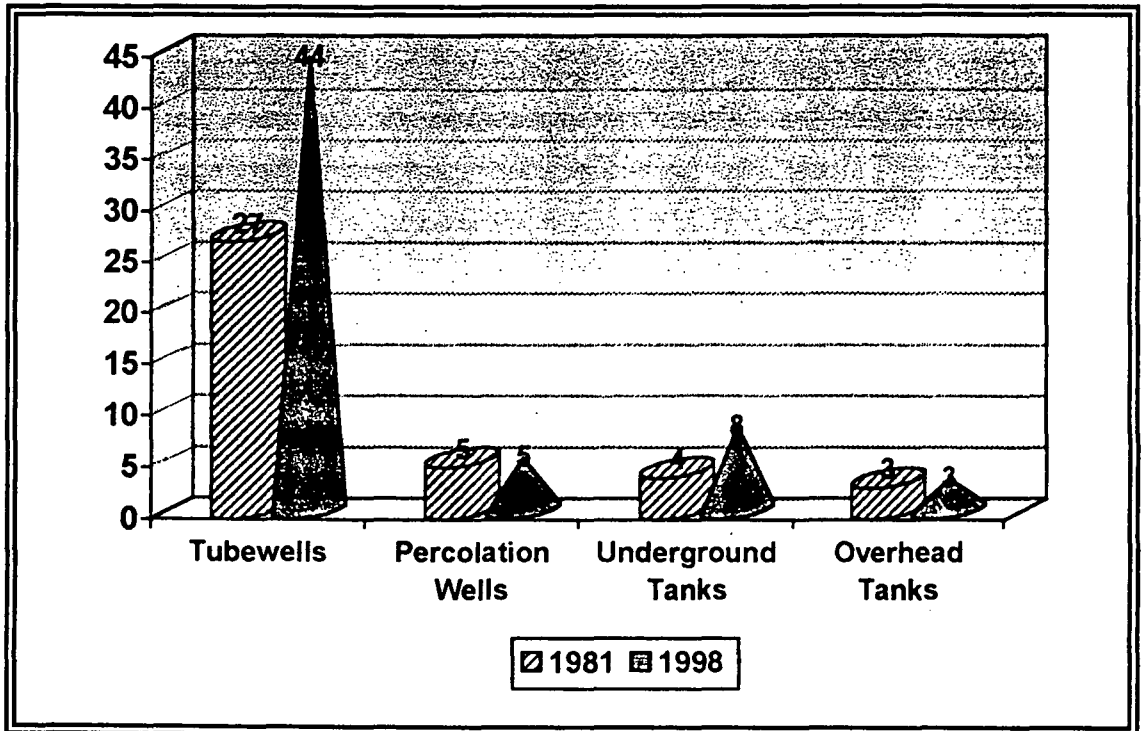


Fig. 5.2

Total Daily Water Requirement for each Water Supply Zones under Master Water Supply Scheme

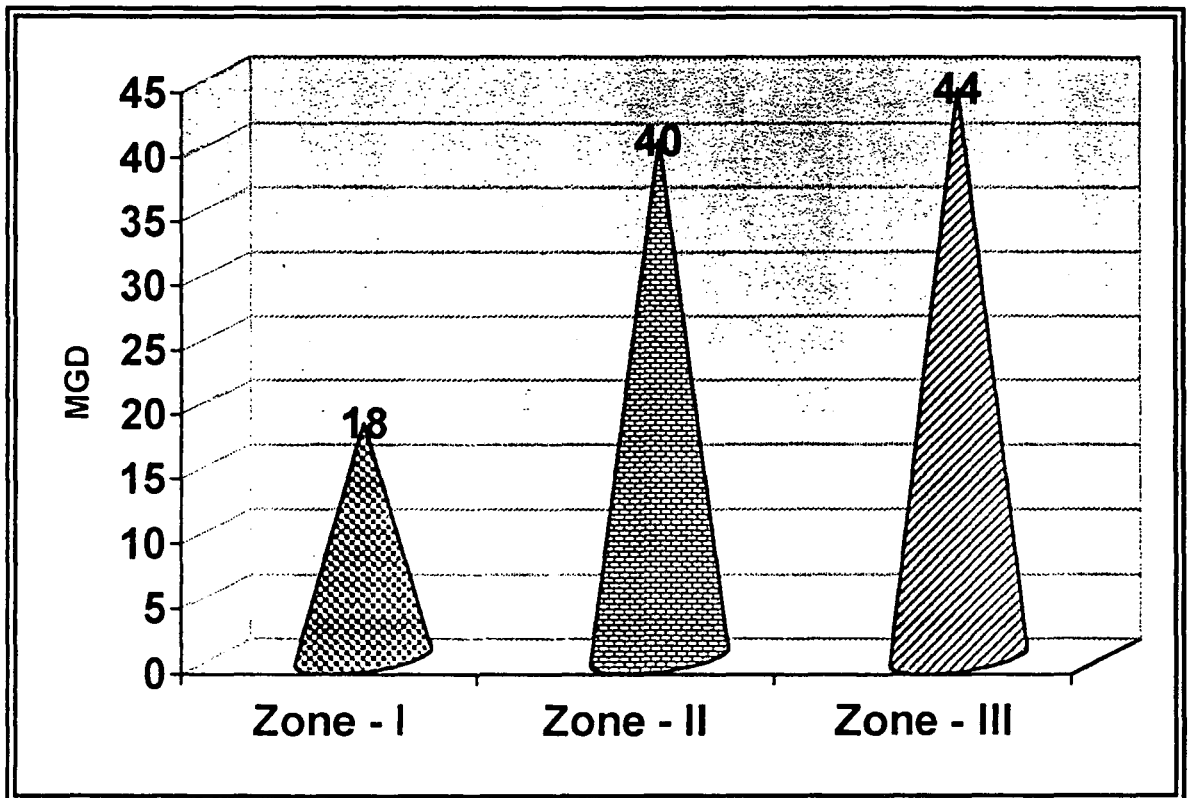


Fig. 5.3

Water Distribution under various usages in each Zone in the Master Water Supply Scheme

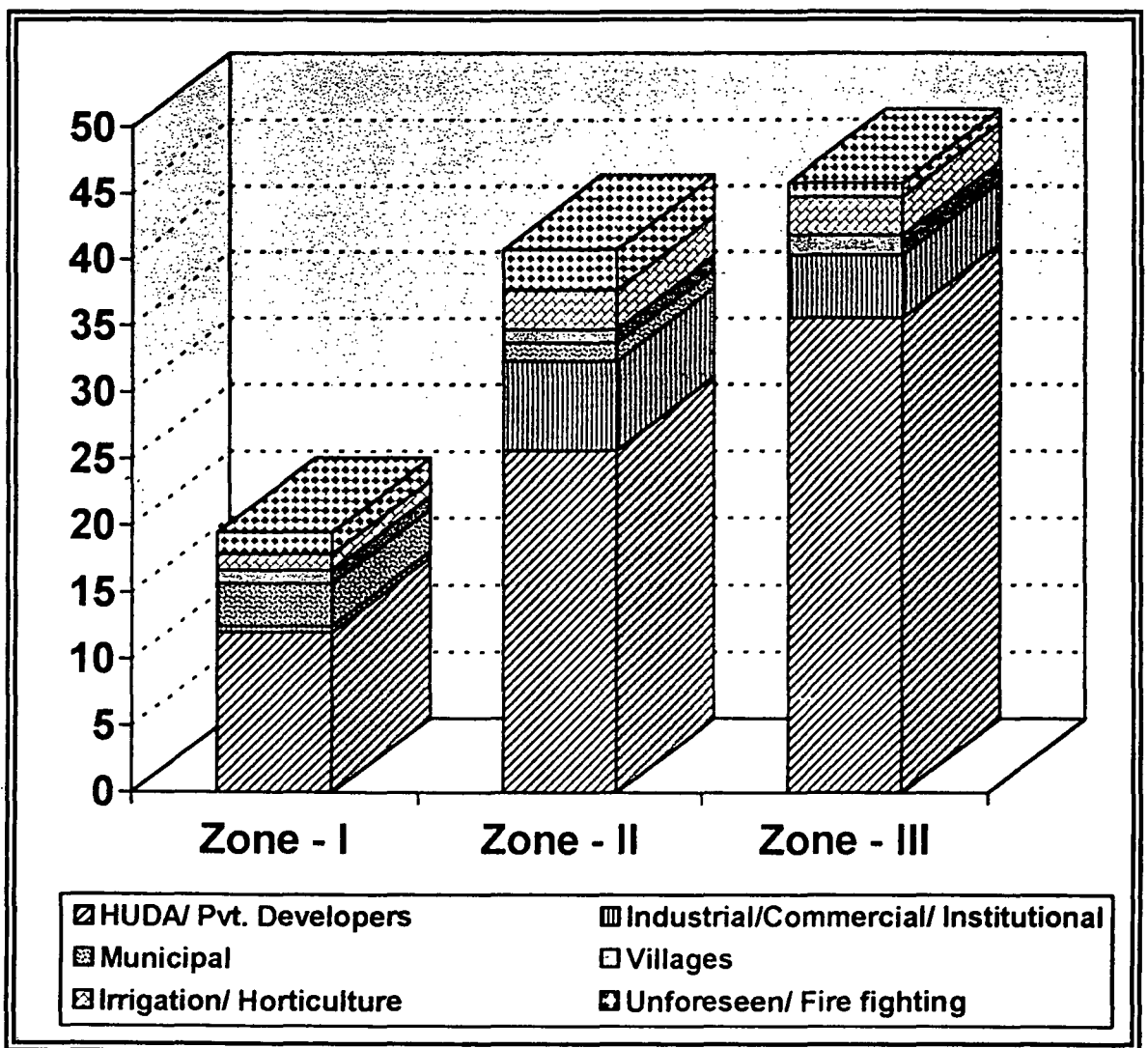


Fig. 5.4

Percentage of Water usage among various Sectors

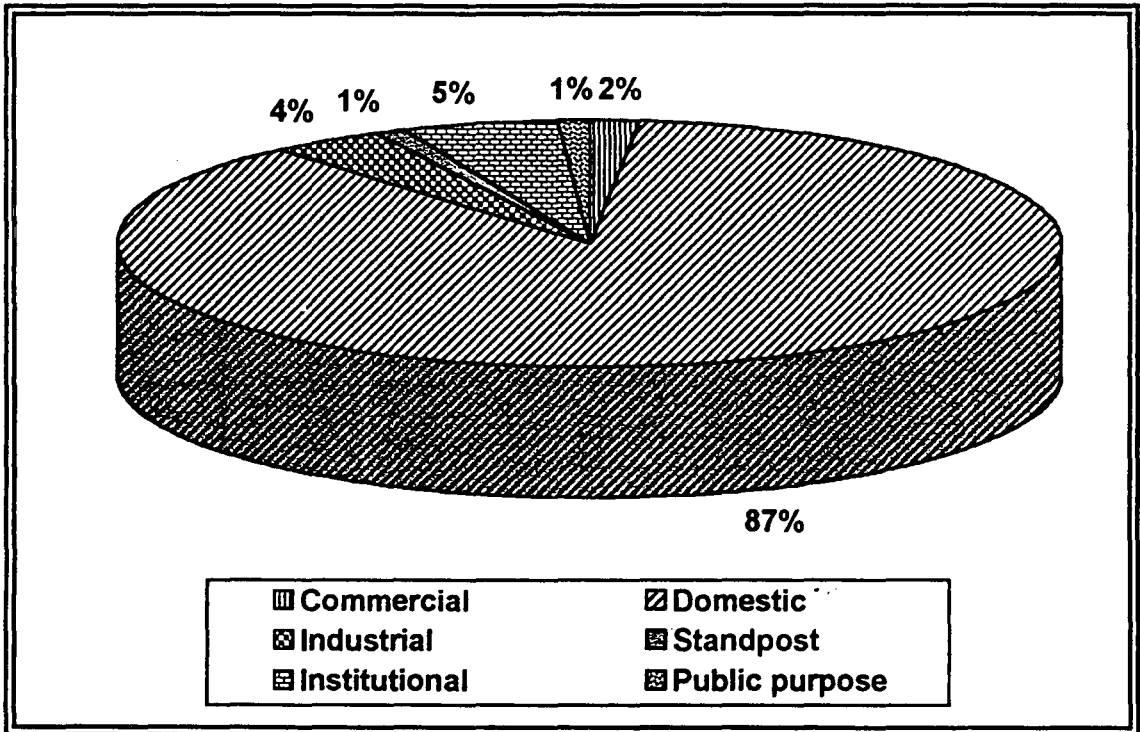


Fig. 5.5

Percentage of Water Distribution under various usages in the Master Water Supply Scheme

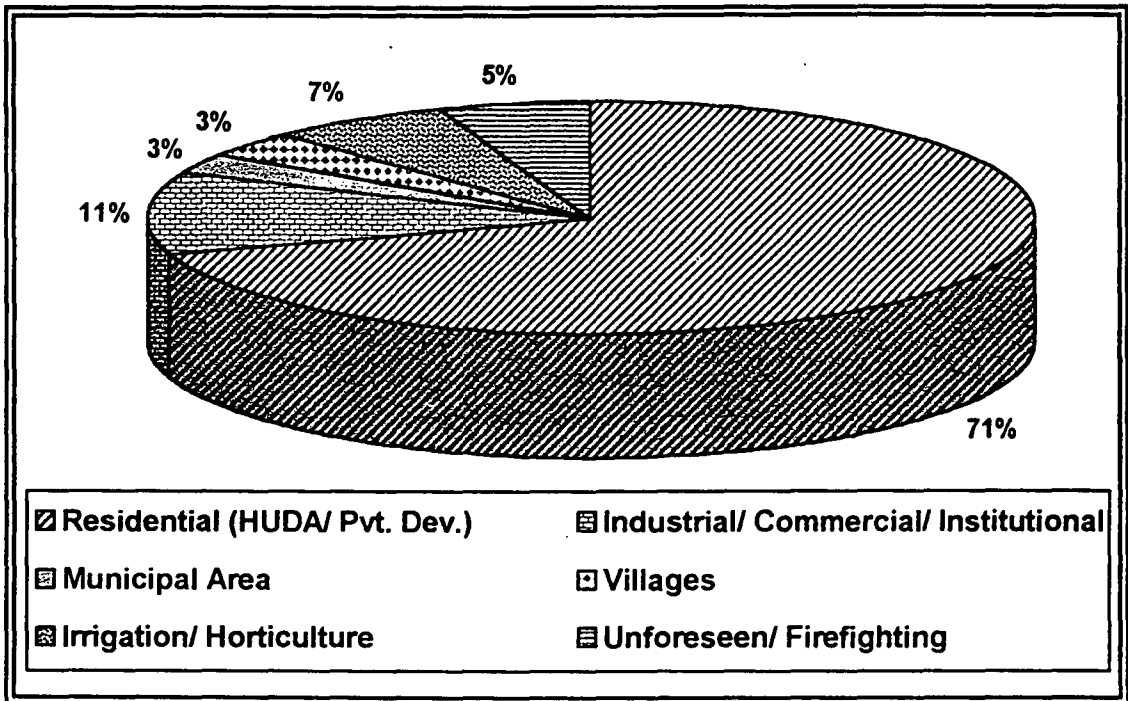


Table 5.1

Initial Water Supply Schemes in Gurgaon

Initial Water supply Scheme: in Gurgaon	Cost Estimation (Rs. Million)	Coverage	Purpose
1960 (completed in 1967)	1.03	Parts of Jacobpura, Roshanpura, Civil Lines, Barafkhana, Holi Ground, and Ramlila ground.	Provide drinking water supply from two tube wells
1969	10	Municipal Town limit	Augment water supply in the town
1971	11.19	Municipal Town limit	Augment water supply in the town
1974	--	Sectors 4 & 7	Provide drinking water supply
1978	--	Sector 14	Provide drinking water supply

Source: Town Survey Report - Gurgaon, 1981, Directorate of Census Operations, Haryana

Table 5.2

Ground Water Quality in Gurgaon District - Physico-chemical

Source	pH	Conduc- tivity µS/cm	Total Alkalinity as CaCO ₃	Total Hardness as CaCO ₃	Calcium Hardness as CaCO ₃	Magnesium Hardness as CaCO ₃	Calcium as Ca	Magnesium as Mg	Sodium as Na	Pota- ssium as K	Chlo- rides as Cl	Sul- phates as SO ₄	Nitrates as N	Flu- oride as F
Gurgaon (Tubewell)	7.6	1300	404	188	88	100	35	24	345	3	176	125	7.3	0.1
Gurgaon (Tube Well)	7.6	960	426	104	48	56	19	14	200	3	100	70	4.5	0.1
Badshahpur (Tube Well No. 11)	7.7	2200	306	312	152	160	61	39	285	2	294	210	4.3	0.1
Badshahpur (Tube Well No. 10)	7.2	3000	266	688	376	312	150	76	280	4	444	400	1.2	0.1

Source: Carrying Capacity Study of NCR, NEERI, Nagpur

Table 5.3

Ground Water Quality in Gurgaon District - Heavy Metals

Source	Cr	Cu	Ni	Cd	Pb	Mn	Fe	Zn
Gurgaon (Tube Well)	0.054	ND	0.030	ND	ND	0.059	0.080	0.327
Gurgaon (Tube Well)	0.067	0.014	0.015	ND	0.041	0.54	0.295	0.101
Badshahpur (Tube Well No. 11)	0.037	ND	0.016	ND	0.027	0.021	ND	0.016
Badshahpur (Tube Well No. 10)	0.026	0.004	0.019	ND	ND	0.071	0.335	0.312

Source: Carrying Capacity Study of NCR, NEERI, Nagpur

Table 5.4

Steps taken by PHED for Water Quality Monitoring

Type of treatment provided	Chlorine
Agency responsible for water quality monitoring	Public Health Engineering
Periodical monitoring of water	--
At treatment plant	Daily
At distribution Network	Weekly
Whether laboratory facility are adequate	Yes

Source: Public Health Engineering Department, Gurgaon

Table 5.5

Institutional Arrangement for Water Supply in Gurgaon Urban Area

Responsible Institution for Water Supply	Coverage	Water Sources
1. Public Health Engineering Department (PHED)	Municipal Limit of Gurgaon Town	Tube wells & canal water from HUDA
2. Haryana Urban Development Authority (HUDA)	HUDA sectors, Private Developers colonies	70 km western Yamuna Canal & Tubewells

Source: Public Health Department & HUDA

Table 5.6

Municipal Water Supply Systems 1981-1999

WATER SUPPLY SYSTEMS	1981	1999
TUBEWELLS	27	44
PERCOLATION WELLS	5	5
UNDER GROUND TANK	4	8
OVERHEAD TANKS	3	3

Source: Town Survey Report - Gurgaon, 1981 & PHED Dept., Gurgaon

Table 5.7

Spatial Distribution of Wells in Gurgaon Town

Sl. No.	Location	Sl. No.	Location
1	Shivpuri	2	Bhim Nagar No. 1
3	Bhim Nagar No. 2	4	Tubewell No. 5 New Colony
5	Tubewell No. 8 New Colony	6	Madanpuri No. 1
7	Madanpuri no.2	8	Jyoti Park
9	Om Nagar	10	Shanti Nagar
11	Subash Nagar	12	Arjun Nagar no. 1
13	Arjun Nagar no. 2	14	Arjun Nagar no. 3
15	D.L.F No. 1	16	D.L.F No. 2
17	D.L.F No. 3	18	Ram Nagar
19	Partap Nagar	20	Jacubpura No. 1
21	Jacubpura No.2	22	Industrial Estate No. 1
23	Industrial Estate No. 2	24	Industrial Estate No. 3
25	Vyapar Sadan	26	Patel Nagar No. 1
27	Patel Nagar no. 2	28	Housing board
29	Tubewell No. 7 near Jharsa Bandh	30	Tubewell No. 6 near Jharsa Bandh
31	Tubewell ki	32	Tubewell kirti Nagar
33	Tubewell No1 at main water works	34	Tubewell no. 2 at Main water Works
35	Tubewell. No. 4 Jharsa Bandh	36	Tubewell No. 9 near Mini Sectt.
37	Tubewell No. 1 Shivaji Nagar	38	Tubewell No.2 Shivaji Nagar
39	Tubewell No. 3 Shivaji Nagar	40	Tubewell No. 4 Shivaji Nagar
41	Tubewell at 4 & 8 Marla	42	Tubewell Laxmi Garden
43	Tubewell Om Nagar	44	Tubewell Shanti Nagar

Source: PHED, Gurgaon

Table 5.8

Water Supply Augmentation Initiatives by PHED

Particulars	Capacity (1981) Million Liters	Capacity (1998) Million Liters
UNDERGROUND TANKS		
UGT 1 - Main Water Works	2.275	2.275
UGT 2 - New Township	0.91	0.91
UGT 3 - Jacobpura	0.455	0.455
UGT 4 - Mainwali Colony	0.228	0.228
UGT 5 (NTS)		0.455
UGT 6 (NTS)		2.275
UGT 7 (NTS)		0.228
Total	3.868	6.826
OVERHEAD TANKS		
OHSR 1 - Main Water Works	0.455	0.455
OHSR 2 - Main Water Works	0.228	0.288
OHSR 3 - New Township Water Works	0.136	0.136
Total	0.819	0.819
BOOSTING PUMPS		
BP 1 - Main Water Works	100 H.P	100 H.P
BP 2 - Jacobpura	55 H.P	55 H.P
BP 3 - Mainwali Colony	30 H.P	30 H.P
BP 4 - New Township	30 H.P	30 H.P

Source: Town Survey Report - Gurgaon, 1981 & PHED Dept, Gurgaon

Table 5.9

Existing Municipal Water Supply Status

Particulars	Status
Source of water supply	Ground water sources - Tubewells
Agency Responsible for water supply	Public Health Engineering Dept.
Water supply norms	180 lpcd
Present Status	116 lpcd
Target aim to achieve	135 lpcd
Water required	28.5 MLD
Water supplied	18 MLD
Water supply gaps	9.5 MLD
Water supply zones	4

Source: Public Health Engineering Department

Table 5.10

Water Supply Norms for Formulation of Master Water Supply Scheme

Sl. No.	Particulars	Unit
1.	Domestic purpose	45 gallons/ head / day
2.	Industrial & commercial purpose	2500 gallons/ acre/ day
3.	Irrigation requirements	4000 gallons/ acre/ day

Source: Haryana Urban Development Authority, Gurgaon

Table 5.11

HUDA Master Water Supply Scheme

Particulars	Figures
Designed population (Year 2001)	1 million
Water supply (proposed by the year 2001)	60 MGD
Designed population (Year 2011)	1.63 million
Water supply (proposed by the year 2011)	100 MGD
Water supply zones	Three
Distribution losses	10 –12 percent
Length of distribution mains	110 km
Water supply scheme implementation phases	Four

Source: Haryana Urban Development Authority, Gurgaon

Table 5.12

Phase Wise Implementation Plan and Existing Status of Master Water Supply Scheme

Phase	Plan
Phase - I	20 MGD & 50 km distribution line
Phase - II	20 MGD & 60 km distribution line
Phase - III	20 MGD
Phase - IV	40 MGD

Source: Haryana Urban Development Authority, Gurgaon

Table 5.13

Areas Covered under Water Supply Zone - I

Sl. No	Type	Sectors/ villages	Area (acres)	Populatio Density	Population	
A.	Residential Area a) Developed by HUDA	4	300	113	33900	
		5, 3(P) 6(P)	184.01	98	18033	
		7	50	113	5650	
		7 Extn.	54.34	145	7879	
		9	286	98	28028	
		9A	201	118	23718	
		10	183.68	76	13958	
		12A, 6(P) & 13(P)	103.74	79	8195	
		14	168.95	86	14529	
		23 & 23A	600	96	57600	
		b) Licenced area/ Private Developers	1	294	80	23520
			2	319	80	25520
			3	85	80	6800
		B.	Industrial/Commercial / Institutional	3A	148	--
23 & 23A	42			--	--	
C.	Municipal Area	--	--	--	70000	
D.	Villages	Kadipur			3310	
		Gurgaon village			14398	
		Cartarpuri			2602	
		Choma			1605	
		Bhimgarh Kheri			2407	
		Dundahera			6767	

Source: Haryana Urban Development Authority, Gurgaon

Table 5.14

Areas Covered under Water Supply Zone - II

Sl. No	Type	Sectors/ villages	Area (acres)	Population Density	Population
A.	Residential Area a) Developed by HUDA	10A	243.80	127	30962
		39	144.70	93	13457
		40	135	120	16200
		31 & 31A	259	98	25382
		15 - I, II & 16P	324	76	24624
		17	225	96	21600
		22	163	90	14670
		21	199	104	20696
		42 -	200	116.72	23344
		-	222	116	25752
	43 -	310	88.68	27491	
	-	300	100	30000	
	b) Licenced area/ Private Developers	25 & 25A	553	116.72	64546
		28 -	31	250	7750
		-	13	151	1963
		-	193.16	116.72	22545
		-	96.80	80	7744
		24 -	584	116.72	68164
		-	22.30	177	3947
		26 & 26A	434	116.72	50656
30		200	88.68	17736	
41		284.05	88.68	25190	
27	310	80	24800		
B.	Industrial/ Commercial/ Institutional	33	103	--	--
		32	148	--	--
		18	887	--	--
		19	208	--	--
		20	333	--	--
		29	370	--	--
		Maruti Udyog Ltd.	--	--	--
C.	Municipal Area	--	--	--	30000
D.	Villages	Basai			3387
		Gadoli			--
		Naarpur			--
		Khandsa			4634
		Mohammadpur			1890
		Narsinghpur			1448
		Jharsa			8480
		Silokhra			1986
		Sarhol			2638
		Chakarpur			2525
		Sikanderpur			3772
Nathupur			3508		

Source: Haryana Urban Development Authority, Gurgaon

Table 5.15

Areas Covered under Water Supply Zone - III

Sl. No	Type	Sectors/ villages	Area (acres)	Population Density	Population
A.	Residential Area	38A	151	100	15100
		48 & 48A -	72.89	400	29156
		-	491.10	100	49100
		47 -	13	400	5200
		-	165.49	98	16218
		-	258	100	25800
		49 -	22.82	400	9128
		-	426.10	250	106525
		-	50	100	5000
		50 -	218.40	88.68	19368
		-	327.60	100	32760
		46 -	15	88.68	1330
		-	368	105	38640
		54 -	360	116.72	42019
		-	156	116	18096
		51	304	119	36176
		45 -	10	88.68	887
		-	361	86	31046
		52 & 52A -	25	250	6250
		-	484	100	48400
57 -	409	250	102250		
-	578	100	57800		
55 & 56 -	200	250	50000		
-	410	116	47560		
B.	Industrial/ Commercial/ Institutional	34	334	--	--
		35	400	--	--
		36	507	--	--
		37	553	--	--
		38	99	--	--
C.	Villages	Islampur			2436
		Tikri			701
		Ghasula			359
		Shamshpur			946
		Tigra			1333
		Kanahi			2995
		Wazirabad			5670

Source: Haryana Urban Development Authority, Gurgaon

Table 5.16**Water Distribution under various usages in each Zone in the Master Water Supply Scheme**

Particulars	Zone - I	Zone - II	Zone - III	Total
	MGD	MGD	MGD	MGD
Residential - HUDA/ Pvt. Developers	12.03	25.62	35.59	72.74
Industrial/ Commercial/ Institutional	0.48	6.74	4.73	11.95
Municipal Area	3.15	1.35	0	3.00
Villages	1.00	1.00	1.50	3.5
Irrigation/ Horticulture	1.21	3.00	2.95	7.16
Unforeseen/ Fire Fighting	1.63	3.07	1.0	5.7
Total	19.5	40.78	45.77	106.05
Less yield from tubewells	1.55	1.39	1.5	4.44
Grand Total	17.95	39.39	44.27	101.61

Source: Haryana Urban Development Authority, Gurgaon

Table 5.17

Water Charges - Unmetered Supply

Sl. No	Categories	Rate (Rs. Per month)
a)	Flat rate for water connection having one tap with ferrule connection upto 10mm.	25
b)	Flat rate for water connection having more than one tap with ferrule connection upto 10mm.	40
c)	Flat rate for water connection with ferrule size upto 12mm. (any number of taps)	100
d)	Flat rate for water connection with ferrule size upto 15mm. (any number of taps)	125
e)	Flat rate for water connection with ferrule size upto 20mm. (any number of taps)	150
f)	Flat rate for water connection with ferrule size above 20mm. (any number of taps)	200

Source: PHED Department, Gurgaon

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Water Distribution under various usages in each Zone in the Master Water Supply Scheme

Particulars	Zone - I MGD	Zone - II MGD	Zone - III MGD	Total MGD
Residential - HUDA/ Pvt. Developers	12.03	25.62	35.59	72.74
Industrial/ Commercial/ Institutional	0.48	6.74	4.73	11.95
Municipal Area	3.15	1.35	0	3.00
Villages	1.00	1.00	1.50	3.5
Irrigation/ Horticulture	1.21	3.00	2.95	7.16
Unforeseen/ Fire Fighting	1.63	3.07	1.0	5.7
Total	19.5	40.78	45.77	106.05
Less yield from tubewells	1.55	1.39	1.5	4.44
Grand Total	17.95	39.39	44.27	101.61

Source: Haryana Urban Development Authority, Gurgaon

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c)	Flat rate for water connection with ferrule size upto 12mm. (any number of taps)	100
d)	Flat rate for water connection with ferrule size upto 15mm. (any number of taps)	125
e)	Flat rate for water connection with ferrule size upto 20mm. (any number of taps)	150
f)	Flat rate for water connection with ferrule size above 20mm. (any number of taps)	200

Source: PHED Department, Gurgaon

Table 5.18

Water Charges - Metered Supply

Sl. No	Categories	Rate (Rs. Per Kilo liter)
a)	Domestic water supply	1.00
b)	Commercial water supply	2.00
c)	Industrial water supply	2.50

Source: PHED Department, Gurgaon

Table 5.19

Trend of Water Charges on Metered Water Supply in Gurgaon Town

Categories	Rate per kilo liter Before 27/7/94	Rate per kilo liter Year 2000
Domestic water Supply	0.35 paise	Rs. 1.00
Commercial water supply	0.60 paise	Rs. 2.00
Industrial water supply	0.80 paise	Rs. 2.50

Source: Town Survey Report - Gurgaon, 1981 & PHED Department, Gurgaon

Table 5.20

Trend of Metered and Unmetered Water Supply in Gurgaon Town

Type of establishment	1981			1999		
	Metered	Unmetered	Total	Metered	Unmetered	Total
Domestic	8588	54	8642	15250	89	15339
Commercial and Industrial	414	-	414	489	-	489
Public water taps	-	-	232	NA	NA	NA
Total	9288	54	9288	15739	89	15828
Standpost						200

Source: PHED, Gurgaon

Table 5.21

The Existing Water Tariffs under HUDA Water Supply System

Categories	Rate per kilo liter
Domestic water Supply	Re 1
Commercial water supply	Rs. 2 per kilo liter
Industrial water supply	Rs. 2.50 per kilo liter
Rate of bulk water purchase	Rs 3.5 per kilo liter

Source: Haryana Urban Development Authority, Gurgaon

Table 5.22

Runoff Coefficients for various surfaces

Type of Catchment	Coefficients
Roof Catchments	
- Tiles	0.8 - 0.9
- Corrugated metal sheets	0.7 - 0.9
Ground Surface coverings	
- Concrete	0.6 - 0.8
- Brick pavement	0.5 - 0.6
Untreated ground catchments	
- Soil on slopes less than 10 per cent	0.0 - 0.3
- Rocky natural catchments	0.2 - 0.5

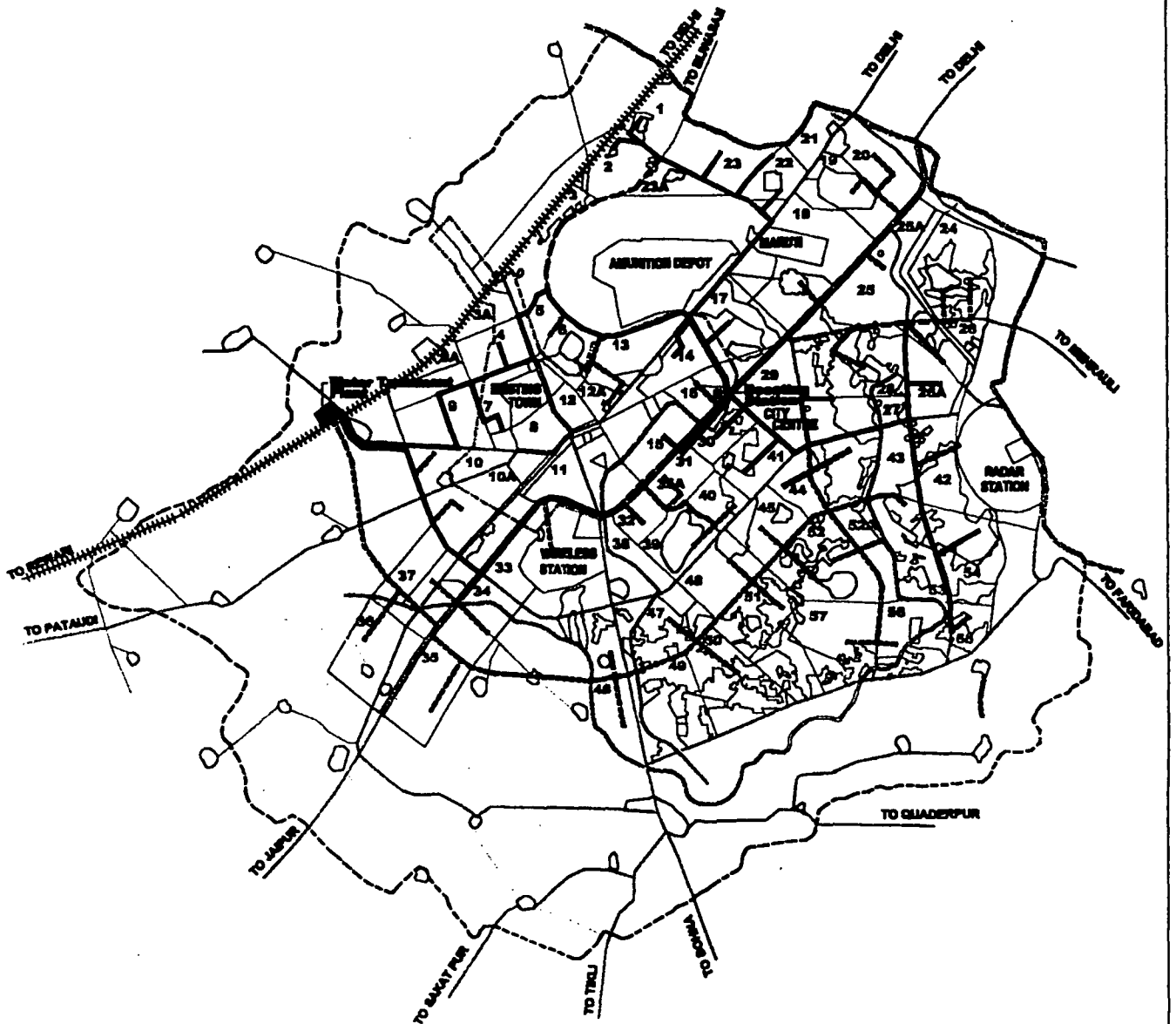
Source: Water Harvesting Manual for Urban Cities, Centre for Science and Environment, New Delhi

Table 5.23

Approximate costs of common items or work in water harvesting

Activity	Unit	Rate (Rs.)
Excavation in soils	Cu. m.	65.00
Excavation in rock	Cu. m	110.00
Brickwork with cement mortar (1:6)	Cu. m	1190.00
Plain cement concrete (1:3:6)	Cu. m.	1300.00
Reinforced cement concrete (1:2:4)	Cu. m	1740.00
Centering and shuttering	Sq. m.	90.00
GI piping		
100 mm diameter	Metre	375.00
150 mm diameter	Metre	590.00
PVC piping for rainwater pipes		
110 mm diameter	Metre	165.00
200 mm diameter	Metre	275.00
Making shallow soakaway in soft soil (with 150 mm diameter PVC casing)	Metre	300.00
Making deep recharge borewell using mechanical rotary drilling	Metre	1300.00

Source: Water Harvesting Manual for Urban Cities, Centre for Science and Environment, New Delhi



LEGEND

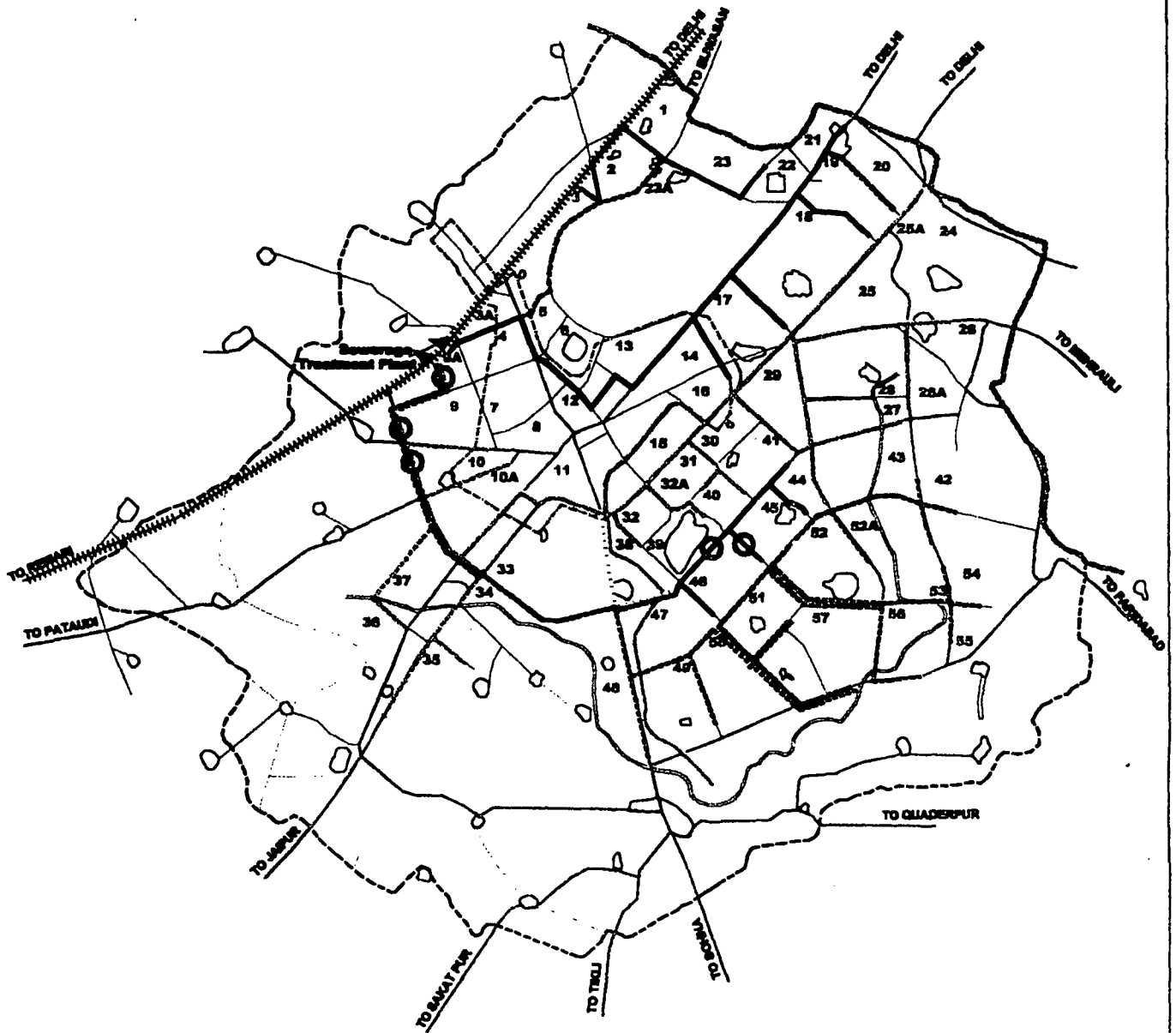
- State Boundary
- Controlled Area Boundary
- Municipal Limit
- Major Road
- Other Roads
- Village road/ Village
- Railway Line

- Water Supply Line Distribution Zone - I
- Water Supply Line Distribution Zone - II
- Water Supply Line Distribution Zone - III

Laid	In Progress	Yet to be laid

**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**

N 	Map No.	
Scale 		



LEGEND

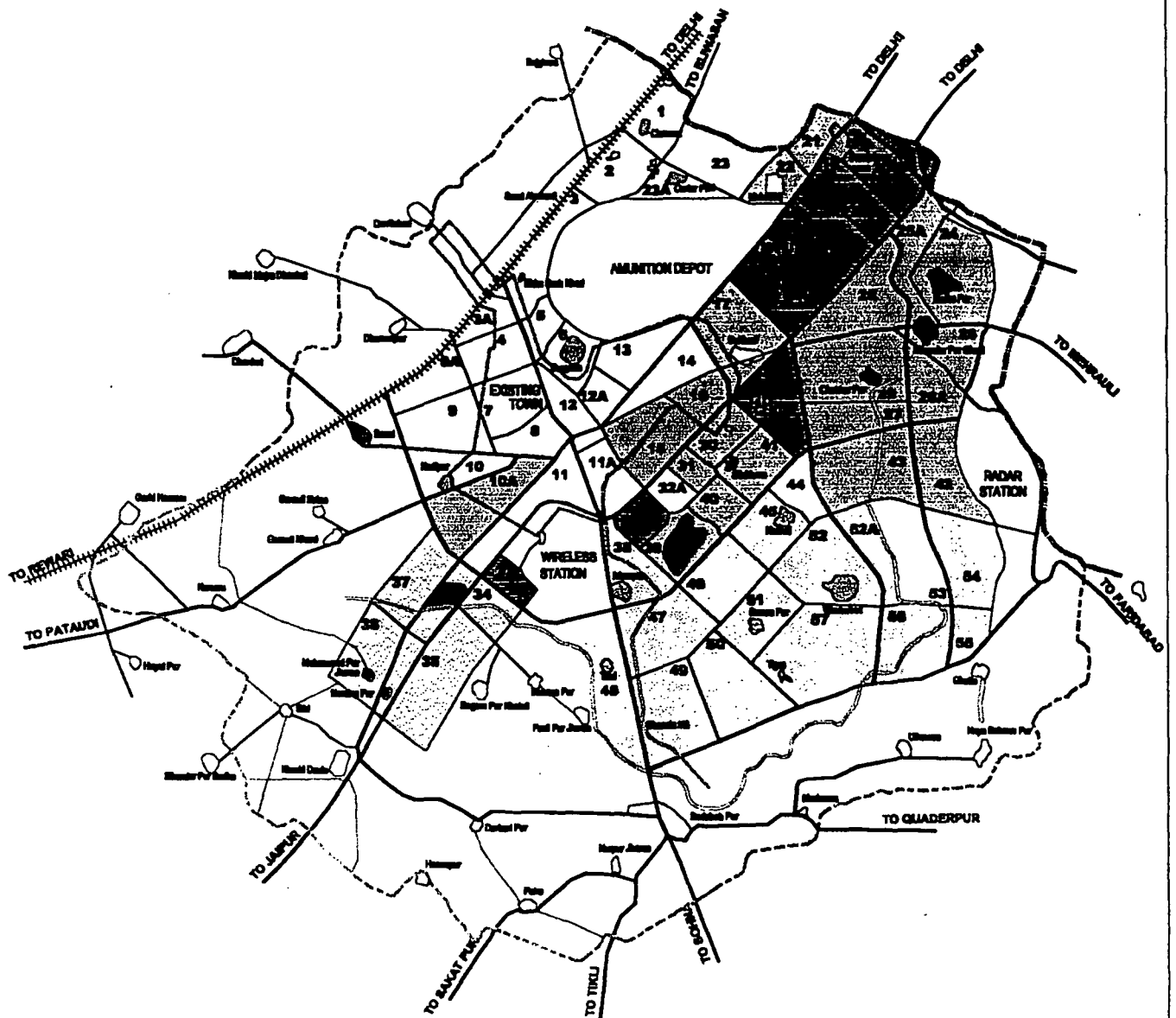
- State Boundary
- Controlled Area Boundary
- Municipal Limit
- Major Road
- Other Roads
- Village road/ Village
- Railway Line

- | Laid | Yet to be laid | |
|------|----------------|--|
| | | Trunk Sewer No. I |
| | | Trunk Sewer No. II |
| | | Trunk Sewer No. III |
| | | Trunk Sewer No. IV |
| | | Area under Litigation |
| | | Proposed Sewer Pipe / CBD to be laid during the year 1999 - 2000 |
| | | Proposed Sewer Pipe / RCC Pipe Line to be laid during the year 2000 - 2001 |
| | | Proposed Sewer Pipe / RCC Pipe Line to be laid during the year 2001 - 2002 |
| | | Proposed Sewer Pipe / RCC Pipe Line to be laid during the year 2002 - 2003 |

**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**

N 	Map No.	
Scale 		

GREEN CITY INDIA

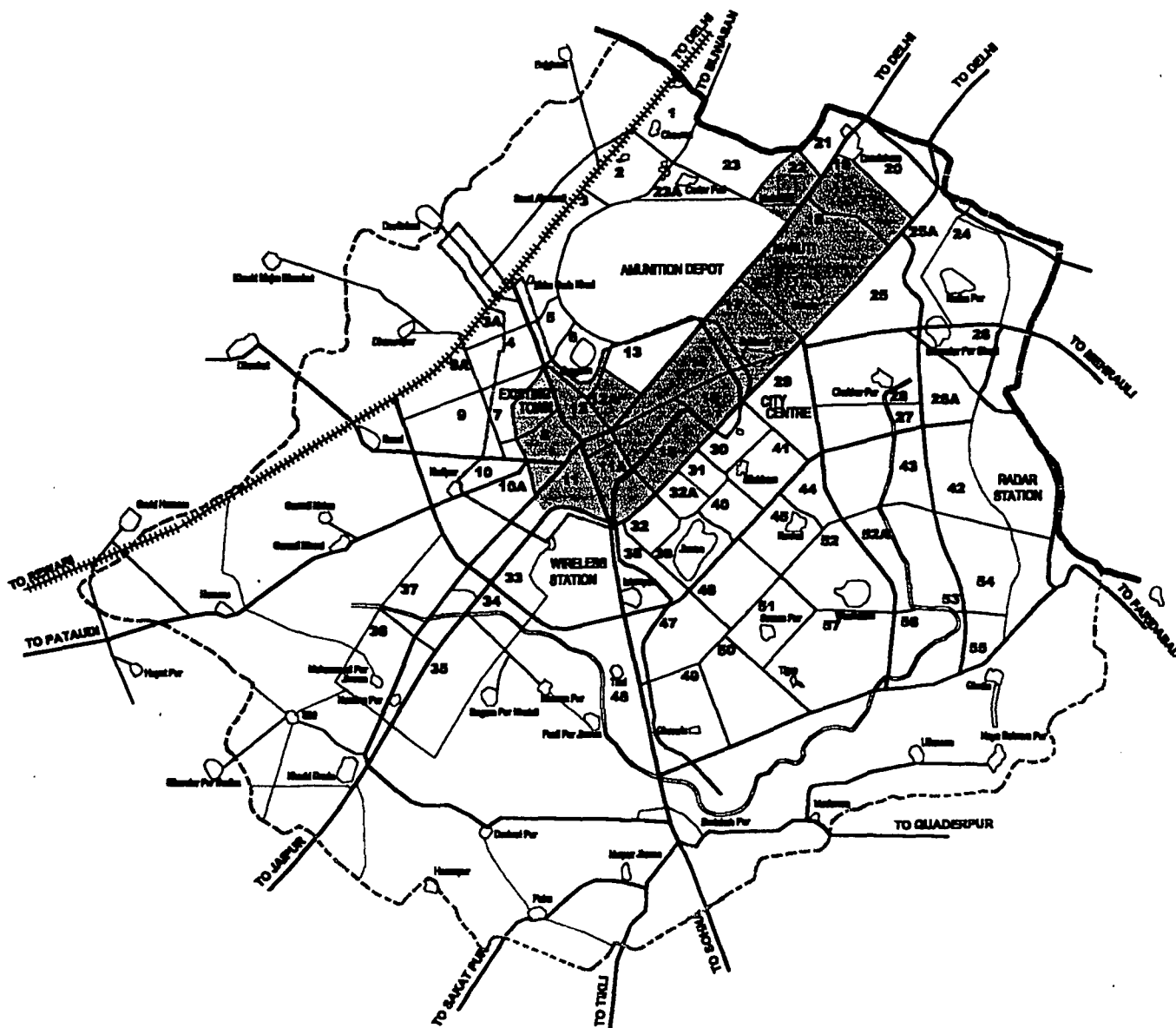


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







- | | | | | |
|--------------------------|-------------|-------------------|---|--|
| State Boundary | Residential | Golf Course/Hotel | Villages | Area covered under Water Supply Zone - I |
| Controlled Area Boundary | Park | Industrial | Area covered under Water Supply Zone - II | Area covered under Water Supply Zone - III |
| Municipal Limit | Open Space | Commercial | | |
| Major Road | | | | |
| Other Roads | | | | |
| Village road/ Village | | | | |
| Railway Line | | | | |

**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**




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Scale 		
GREEN CITY INDIA		



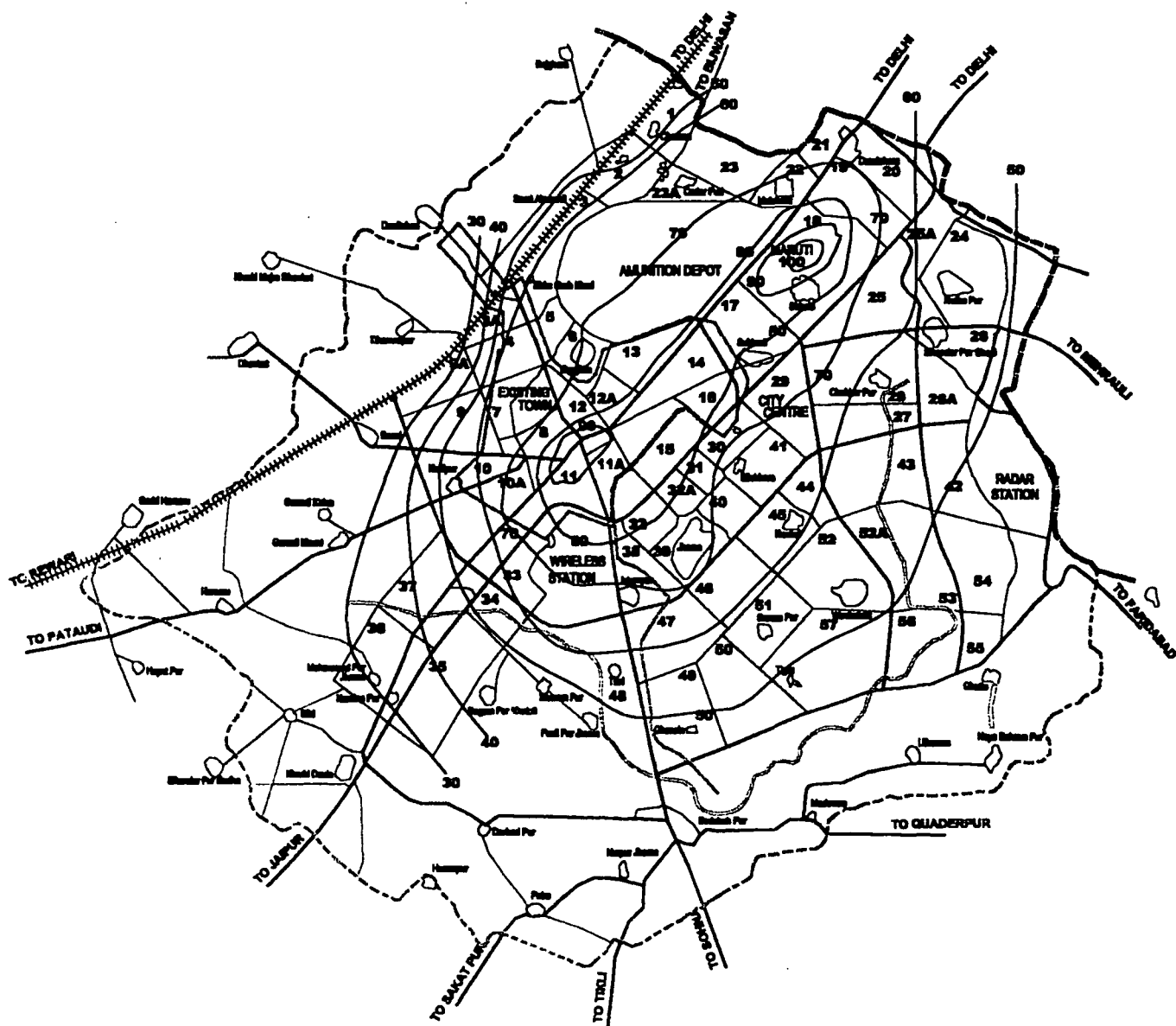
LEGEND

-  State Boundary
-  Controlled Area Boundary
-  Municipal Limit
-  Major Road
-  Other Roads
-  Village road/ Village
-  Railway Line
-  Critical Area








**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**

N 	Map No.	
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0 0.5 1 Km		




GREEN CITY INDIA

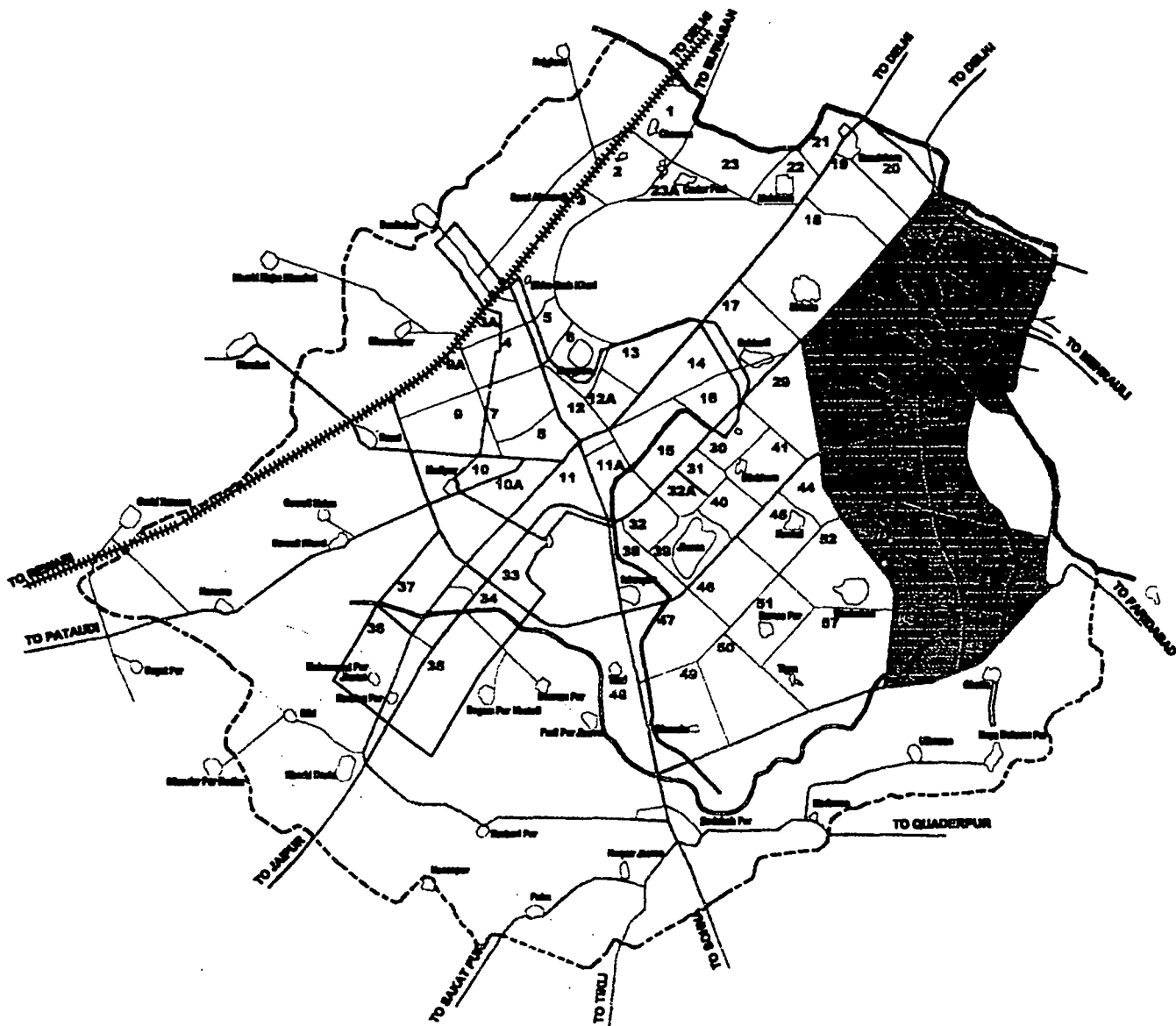


LEGEND

-  State Boundary
-  Controlled Area Boundary
-  Municipal Limit
-  Major Road
-  Other Roads
-  Village road/ Village
-  Railway Line

**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**

 N	Map No.	 GREEN CITY INDIA
Scale  0 0.5 1 Km		



LEGEND

- State Boundary
- Controlled Area Boundary
- Municipal Limit
- Major Road
- Other Roads
- Village road/ Village
- Railway Line
- Area Suitable for Water Harvesting

**FEASIBILITY STUDY
IMPLEMENTATION OF GREEN CITY CONCEPT IN GURGAON**

 N	Map No.	
Scale 		
GREEN CITY INDIA		



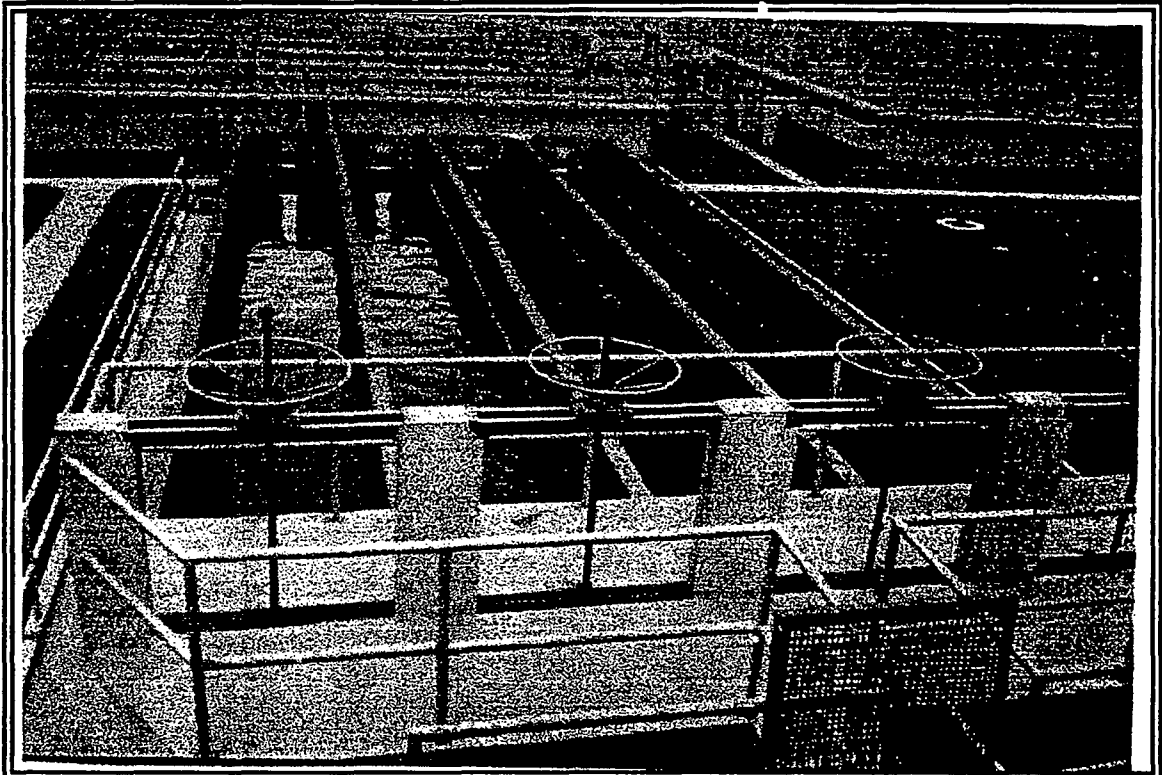
"POLLUTED SURROUNDINGS"

A polluted water body next to a residential area



"OPEN SEWER"

An open sewerage near the railway station



"SEWAGE TREATMENT PLANT"

A 30 MLD Sewage Treatment Plant under PHED at Gurgaon

Chapter 6

Energy Management & Low Energy Building

Energy is an essential ingredient in development and modernization and electricity, one of the most important forms of energy. It is indispensable for any development whether industry or agriculture, and for improving the living standards of the people. It is the driving force for industry, agriculture and modern life in general.

Demand for electricity in India has assumed a steady rise of about 8% per annum as depicted in the energy reports of the planning commission for the Five - Year Plans. With the liberalized economic and industrialization policy of the Indian Government taking effect, installation of new power plants have been identified as one of the priority sector industries and a massive power development programme has been conceived to cope up with the projected demand.

6.1 Energy Availability in Gurgaon

The Ministry of Defence, Government of India, established its thermal powerhouse at Gurgaon in 1946. Electricity to general public for domestic and commercial purposes was supplied from this station. It stopped supply to the general public in 1955, when the town started receiving electricity from Bhakra Beas Management Board.

Agencies for supply of electricity to the town were Haryana State Electricity Board and Bhakra Beas Management Board. The distribution of electricity and realization of dues from the residents was the responsibility of Haryana State Electricity Board. The town had two sub-stations, viz. 66 KV sub-station and 33 KV sub-station, having 5 transformers and 17 feeders to cater to the load of Gurgaon Town.

Haryana Vidyut Prasaran Nigam (HVPN), a power distributing company and Haryana Power Generation Corporation (HPGC), a power generating company was constituted by the Government of Haryana in 1999 with the view to augment the power distribution and generation network in Haryana.

Haryana Vidyut Prasaran Nigam is responsible for buying power from Haryana Power Generation Corporation and various IPPs in Haryana, importing power from central power utilities, regional projects, other State Electricity Boards or other sources.

Gurgaon, which lies in the Delhi Metropolitan Area of the National Capital Region (NCR), falls in the Northern Power Zone. NCR has in operation six power generating stations – five thermals and one gas fired.

Three power generating stations lies in the Haryana portion of the NCR, two run by the Haryana Power Generation Corporation and one by the National Thermal Power Corporation (NTPC).

Haryana region of the NCR, in addition to receiving power from its own generating station receives power from Bhakra Nangal Complex, Dehar and Pong powerhouses under Bhakra Beas Management Board (BBMB), Bairasiul Hydel Station and I. P. Station (Delhi) to meet its demand.

The main sources of power in Haryana are Hydel power and Thermal power. Haryana produces nearly 60% of its own electricity and the rest 40% of purchased from the other states.

The power from the hydel started in 1971 and has shown a substantial improvement since than. The hydel power has become the leading source of power generation since 1997 and has surpassed the energy generated by the thermal sources. Lately some private investors have also set up low capacity power generating units.

Currently, Haryana Vidyut Prasaran Nigam is getting power at 16 paise per unit from the Bhakra Nangal Complex, which is the cheapest and at Rs. 2.20 per unit from Uri hydel project.

Besides the above mentioned sources, there are two private sector power generating units in Gurgaon.

1. 25 MW Fuel Oil based power generating unit owned by Magnum Company located at Sikanderpur is the first private investment in power sector at Gurgaon. It started its operation in November 1998. Haryana Vidyut Prasaran Nigam buys the electricity produced at the rate of Rs. 2.40 per unit.
2. A gas turbine based power plant owned by Maruti Udyog Limited built for the internal consumption of the company. In case of emergency, HSEB purchases the surplus power from Maruti Udyog Limited if available at a rate of Rs. 1.50 per unit.

6.2 Energy Consumption

The power consumption in Gurgaon for the year 1996/97 and 1997/98 is given in **Table 6.1**.

The category wise number of power connection is given in **Table 6.2**.

The above load is catered through a chain of 66 KV Sub station located in different areas. Gurgaon is supplied power through various lines, as such there is no independent source of generation, which is exclusively for Gurgaon's load.

The data on the existing Sub-stations in Gurgaon is given in **Table 6.3**,

The data on the existing 220/66/33 KV lines in Gurgaon is given in **Table 6.4**.

Gurgaon in all has seven KV lines, which are supplying power to the Gurgaon City. Out of the seven KV lines five KV lines are being fed by the power supplied from Haryana while the other two are being fed by the line from Delhi feeder lines.

The details of electricity lines in Gurgaon are given in **Table 6.5**.

Gurgaon has a high transmission and distribution losses, almost to a tune of 22.5 %. The overall transmission and distribution losses of the Haryana state is to a tune of 33.5% of which 23% are due to power thefts.

The power demand is rising at a rate of 15 - 20% per month. The supply is only increasing at the rate of 5 - 7%. This implies that Gurgaon has to either produce more electricity on its own or ask for more allocation of power from the state or depend on the neighboring states for more power in the near future.

The electricity connections released in Gurgaon in the 1999-2000 are given in **Table 6.6**.

Every month nearly 15 - 20 connections are released in Gurgaon in the commercial and the industrial sector and nearly 300 connections are released in the general sector, which comprise of domestic and other sectors. The trend shows that this is a high rate of growth and to keep up with the rising demand more electricity is needed for future requirements.

The electricity supply to different sectors of usage is given in **Table 6.7**.

The per unit rate of power differs from one category to another, the power for agricultural sector is highly subsidized and is placed between 41 - 53 paise per unit. On the other hand the power rate for the industrial and commercial sector is Rs. 4.13. The rate for the domestic sector varies from Rs. 2.04 to 3.19 per unit.

The electricity tariff prevalent in the Haryana State is given in **Table 6.8**.

The per unit rates of power is different from one category to another because the government fixes the rate in each category depending upon the affordability of the particular category. The agriculture sector is highly subsidized because the Haryana state is an Agrarian state and therefore the government gives a lot of incentives in that sector.

The NCR plan suggests to look into the possibility of power generation through gas fired turbines to cater to the rising needs of power in the national capital region. The technology is available indigenously and is of relatively non-polluting in nature.

A lot of power is being lost in the network so the NCR plan suggests to achieve optimum transmission and distribution in the grid so that the losses can be minimised and the power lost may be used in a substantial manner.

The NCR suggests a coordinating body to be set up mainly to arrange and distribute power if additional power is made available from the central state sources for the NCR.

The electricity forecast-2001 of the Haryana sub-region of the NCR is given in the Table 6.9.

6.3 Energy Conservation and Augmentation

The initial findings and observations are under:

- The mother system in Gurgaon is old and a lot of money is needed for renovation to make the supply proper.
- The transmission and the distribution losses in the grid are of the tune of 20-25% and so a lot of power is being lost.
- The Haryana state electricity board is not able to collect the bills on a regular basis and because of this every year the enterprise loses a lot of money due to non-payment of bills and the defaulting amount is on the rise every year by 12 - 15%.
- In the recent years the energy supply has not kept pace with the growth of the industrial sector.
- The Plant Load factor is below 50% against the National average of 63%.
- Low voltage supply
- Defective meters
- The energy supply is only increasing at a rate of 5-7%.
- Lack of renewable energy sources

The following are the plans of the electricity department for augmentation of power supply in Gurgaon.

1. 66 KV sub station in sector 55-56
2. 32 KV sub station in sector 33-34. Initially in Phase I –1x 16 KV to be set up.
3. 32 KV sub station in sector 45-46. Initially in Phase I X16 KV to be set up.
4. 32 KV sub station in sector 9 A. Initially in Phase I 1x16 KV to be set up.
5. 220 KV at Sikanderpur/Chakarpur transmission line.
6. All 16MVA will be connected to 32 MVA by the year 2005 A.D.

6.4 Low Energy Building Concept

A rough capital cost estimates for renovation of urban houses in the Old Town of Gurgaon incorporating Low Energy Building concept prepared by the Danish expertise is given below:

Assumption

1. The renovation project comprises an older apartment including 25 apartments.
2. The age and quality of the building makes it worth renovating.
3. Exchange rate: USD ~ DKK 8.1
4. Local labour as well as local materials will be used.
5. Technical consultancy from Danish specialists will include draft conception and project supervising.
6. The prices stated below include expenses for salaries and materials.

Particulars	Costs in USD
Draft conception	40,000
Project supervising	15,000
Construction, exterior	125,000
Construction, indoor	140,000
Electricity	60,000
Heat	75,000
Ventilation	40,000
Water	65,000
Drainage	30,000
Outdoor areas	20,000
Total estimates for 25 apartments	610,000

6.5 Suggested Action Plan

Firstly, society must come to structure itself so that fundamental inefficiencies are eradicated.

Secondly, considerable energy can be saved through a mixture of conservation and improved efficiencies in the end-use. A curb on wasteful consumption, the use of proper insulation, the matching of supply and demand can make considerable impact on energy demands.

Thirdly, renewable and as far as possible non-fuel sources of energy need to be developed and deployed. The technologies already exist for extracting wind, wave, hydro and solar energies need to be adapted.

The more efficient use of energy is not a penurious option: on the contrary energy conservation can be a boost to the economy by reducing energy costs and even more importantly the costs of pollution and the consequences of the greenhouse effect.

Among the range of approaches available, no single approach will be adequate to address all the questions associated with policies and technologies.

I. ***Near-term objectives***

- 1) Promotion of conservation as well as the efficient production, conservation and utilization of energy
- 2) Promotion of the market penetration of non-fossil and low carbon-emitting energy sources
- 3) Enhancement of cooperation to improve the efficiency and emission characteristics of energy systems
- 4) Enhancement of R & D for conservation, efficiency improvements and options to limit emissions

II. ***Long-term objectives***

Short-term options

(1) *Improvement of energy efficiency and conservation*

A. Energy consumption side

- Industrial sector

Example: Improvement of energy use in manufacturing process

- Residential and commercial sector

Example: Energy conservation in home use equipment

- Transportation sector

Example: Improvement of energy use in automobiles.

- Improved recycling of materials

- Others

- B. Energy conversion side
 - Power generation sector
Example: Combined-cycle power generation
 - Transmission sector
Example: Power transmission with high voltage
 - Energy storage and production
 - Natural gas use and transmission
 - Others

(2) *Introduction of no or less greenhouse gas emission energy*

- A. Non-greenhouse gas emission energy
 - Geothermal energy
 - Wind power
 - Solar thermal power
 - Photovoltaic

- B. Less greenhouse gas energy
 - Natural gas
 - Biomass from plantations

- C. Greenhouse gas removal
 - Tree plantations
 - Others

(3) *Promotion measures for items (1) and (2) above*

A. Promotion of research and development

Examples: R & D for improvement of energy efficiency; R & D for no or less carbon dioxide emission energy.

B. Promotion of technology transfer

Example: Tax incentives and financial aid for investment in energy conservation and alternative energy.

C. Public acceptance

D. International cooperation

Examples: Technology assistance for developing countries; financial support for developing countries; framework for international cooperation.

E. Other means

- Taxes, fees, regulations, standards, education, cooperation, new institutions, removal of barriers

Options for next phase study

1. *Improvement of energy efficiency*

A. Energy consumption side

- Industrial sector
- Residential and commercial sector
- Transportation sector

Example: Effective transportation system such as a linear motor car

B. Energy conversion side

- Power generation sector
- Transmission sector

2. *Development of new energy*

- Advanced renewable energy

Example: Photovoltaic power generation of ultra efficiency

3. *Development of technology for reduction of greenhouse gases such as carbon dioxide*

- Separation, collection and disposal of carbon dioxide from emission gas
- Fixation of carbon dioxide from the air
- Redesign of process to produce products other than carbon dioxide
- Development of industrial uses of carbon dioxide
- Others

4. *"Structural" changes*

- Substitution of new materials
- Heat island mitigation
- Development of new carbon sinks
- Intermodal transportation shifts

5. *Advanced energy storage*

Examples of the Potential for Improved Energy Efficiency are given in **Table 6.10.**

Reduction of energy waste can be achieved through a balanced combination of regulatory, technological and economic measures.

Several specific proposals such as the following have been elaborated by competent bodies, both governmental and non-governmental:

- 1) Raise car and truck fuel economy standards, in combination with the development of efficient and comfortable public transport systems, which could reduce reliance on privately, operated vehicles.
- 2) Reform utility regulation to promote and bring about efficient use of energy.
- 3) Establish and promote energy efficiency codes for commercial and residential buildings.
- 4) Generously expand funding for research, development, and promotion of energy efficiency, along with educational programmes and labelling schemes that encourage consumers to make more pro-environmental energy choices.

It is inevitable that the changes in energy production and consumption modes required will be dynamically related to changes in lifestyles, economic principles and financial instruments.

Table 6.1

Power Consumption in Gurgaon - 1996/97 & 1997/98

(Million Units)

Consumers	1996/97	1997/98
Commercial	290.5	358.22
Industrial	1999.8	2270.27
Domestic	1295.07	1548.48
Public Works	42.88	54.48
Railways	N.A	N.A
Others	2028.35	2147.96
Total	5656.60	6379.41

Source: Electricity Board, Gurgaon

Table 6.2

Category wise number of power connection

Category	No. of Connections
Industrial	2505
Commercial	7671
Domestic	35349
Others	3530
Total	49055

Source: Electricity Board, Gurgaon

Table 6.3
Data for Existing Sub-Stations

S.No.	Name of Sub-station	Capacity of Power Transformers
1.	22 KV Badshahpur	2x100 MVA 220/ 66 KV 45x60 MVA 220/66 KV
	66 KV Badshahpur	1x16 MVA 66/11 KV 1x8 MVA, 3 MVA 33/11 KV
2.	66 KV Mehrauli Road	2 x 16 MVA 66/ 11 KV 1x8 MVA 66/33 KV 1x6 MVA, 3 MVA 33/11 KV 1x12.5 MVA 33/11 KV
3.	66 KV Maruti	1x16 MVA 66/ 11 KV 1x12.5 MVA, 66/11KV
4.	66 KV Dundahera	2 x 12.5/16 MVA, 66/11KV
5.	66 KV Sector- 34 A Gurgaon	2 x 12.5/16 MVA, 66/11KV
6.	66 KV DLF Gurgaon	2x16 MVA 66/11 KV
7.	66 KV Sector- 10 A Gurgaon	2x16 MVA 66/11KV

Source: Haryana Vidyut Prasaram Nigam, Gurgaon

Table 6.4

Data for 220/66/33 KV Line

S.No	Lines	Length:km	Size of cond.
1	220 KV D/C Line Samaypur to Badshahpur	25,000	0.4 sq. inch ACSR
2	66 KV D/C Line Badshahpur to Gurgaon	9,000	0.15 sq. inch ACSR
3	66 KVS/C Line Gurgaon to Maruti	6,210	0.15 sq. inch ACSR
4	66 KV S/C Line Gurgaon – Maruti line to PH 18 Tcc off Dundahera	2,800	0.15 sq. inch ACSR
5	66 KV D/C Line Delhi to Gurgaon	34,000	0.15 sq. inch ACSR
6	33 KV S/C Line Delhi to Gurgaon	34,500	0.075 + Copper
7	Tec off Gurgaon – Pataudi Line to Sector 10 A		0.15 sq. inch ACSR

Source: Haryana State Electricity Board, Gurgaon

Table 6.5

Details of Electricity lines in Gurgaon

Particulars	Details
Low transmission lines	892 kms
High transmission Lines	267. 5 kms
Rise in demand every year	15-20%
Supply increases	5-7%
Transformers	950

Source: HVPN, Gurgaon

Table 6.6

Connection released 1999-2000

Month	General sector	Industrial & Commercial Sector	Others
4/99	428	35	
5/99	345	20	
6/99	357	18	2
7/99	456	18	
8/99	396	15	
9/99	392	8	
10/99	483	24	1
11/99	334	26	5
12/99	299	21	

Source: Haryana Vidyut Prasaram Nigam, Gurgaon

Table 6.7

Electricity supply to different sectors

Category	Jnit billec (Rs. Mill.)	SOP Rs. Million	Other items (Rs. Mil.)	Total (Rs. million)	Per unit charges (Rs.)
High power	17.76	74.79	0.38	75.17	4.21
Medium power	6.58	26.19	0.14	26.33	3.98
Agricultural power medium	6.35	3.11	0.31	3.42	0.49
Agricultural power low	10.86	4.24	-	4.24	0.66
Domestic supply	21.59	53.27	0.69	53.97	2.47
Non domestic supply	3.85	14.43	0.17	14.60	3.47
Local supply	1.52	5.64	0.02	5.66	3.71
Street light	0.36	1.42	0.03	1.44	-
Free power	0.18	-	-	-	-
Public works	1.71	7.28	0.68	7.36	4.24
Others	0.03	0.06	0.66	-	2.27
Total	70.83	190.45	2.51	192.23	2.83

Source: Haryana Vidyut Prasaran Nigam, Gurgaon, (Month 8/99)

Table 6.8

Electricity tariff in Haryana

Type	Per unit charge
Industrial	Rs. 4.13
Domestic	Rs. 2.04 & 3.19
Commercial	Rs. 4.13
Public utilities	Rs. 4.13
Agriculture	41 paise meter supply & 53 paise flat rate

Table 6.9

Electricity forecast - 2001 of the Haryana Sub-region of the NCR
Energy in MU/ Load in MW

Area	1989-90		1994-95		1999-2000		2000-2001	
	ER	PL	ER	PL	ER	PL	ER	PL
Haryana sub-region	4046	825	6401	1305	10128	2065	18024	3678

ER : Energy requirement

PL : Peak Load

Source : National Capital Region Growth & Development, NCRPB

Table 6.10

Examples of the Potential for Improved Energy Efficiency

Energy use	Current intensity	Potential intensity	Savings (per cent)
Commercial lighting	8.0 kWh/ft ² /yr	1.5 kWh/ft ² /yr	81
Frost-free refrigerator	1100 kWh/yr	200 kWh/yr	82
Electric water heating	4500 kWh/yr	1000 kWh/yr	78
Windows in commercial buildings	70,000 Btu/ft ² /yr	20,000 Btu/ft ² /yr	71
Windows in residential buildings	35 million Btu/yr	14 million Btu/yr	60
Car/light truck	420 gal/yr	210 gal/yr	50

Source: *Industry and Environment, UNEP*

Chapter 7

People's Participation & Information Strategy

India with its ongoing development and ever growing population is at the brink of an environmental disaster. With the rapid onset of industrialization and an unexpected increase in urbanization; the degradation of environment is increasing at an alarming rate. People are experiencing shortage of water, suffocating air, dirty surroundings, unhealthy atmosphere, various diseases and yet not realizing that the main culprit causing this disaster is they themselves.

The emissions of harmful and noxious gases from the industries as well as from the automobiles; are directly or indirectly leading to the rise in temperature of the earth, thereby badly affecting the fertility of the land; change of a productive area into desert is the eventual consequence. The rapid growth of industries though providing humans with the increased job opportunities; but on the other hand the waste from the industries which are being dumped as such without any treatment into the nearby rivers is not only polluting the water bodies but also the indirectly affecting the soil quality in the adjoining areas.

The increase in urbanization is giving rise to a number of problems related to management of the solid waste, access to safe and clean drinking water, drainage and sanitation, transport availability, traffic problem, etc. All these lead to the deterioration of the environment. A well managed and healthy environment is built on the solid foundation of effective planning and good city governance providing sustainable environmental services.

Experience has indicated that scientific work in laboratories like bringing out data on the quality of the environment serves very little purpose in comparison to education in terms of people's awareness and community participation.

Gurgaon is a fast developing city and has a mix of the old and the new areas having a population of around 3,00,000 and estimated to be 1 million by year 2010.

The old part of the city has already borne the brunt of increased population, increased traffic, water pollution, air pollution, congestion etc. The newer areas are being developed beautifully, but if not taken care of properly, will also be ruined. Therefore it is imperative to make sure that the people in the old as well as the new township are not only aware of the environmental degradation they cause, but also are motivated to mitigate the negative effects of their activities. It is important for the people in newly developed areas of Gurgaon to preserve the natural resources that they have and help the community in the other parts, to revive a cleaner greener city. This will enable them to have a better future and a healthy environment to live in.

Gurgaon has become a polluted city, while at the same time it has high levels of income in the Indian context. To politicians and residents alike, the existing situation is dismal. To restructure the existing situation the participation of all is necessary. The purpose of the participation is to:

- Bring about a change in the way "Gurgaon" responds to its development and related environmental impacts;
- Inspire and galvanize people into action; and
- To make Gurgaon an internationally competitive and productive city.

11 Participation & Information Strategy

The Participation & Information Strategy is about letting consumers (people themselves) participate with the planning, implementation, and operation & maintenance of services.

- It is about working with consumers and their associations, where they are: i.e. where they generate waste, consume water, consume energy, etc. When one removes consumers from their setting to “workshops”, one rarifies the problem such that only “discussion” takes place & effective solutions are harder to find.
- The strategy is based on a realistic assessment of what consumers & service providers want from PIS, and how can it really play an effective role in the project.
- What the consumers and service providers generally want from the project is:
 - **Planning**
 - Information on key ingredients of the project at the time of its design.
 - Their opinions solicited & considered.
 - Feedback on the final design of the project.
 - **Implementation**
 - Information & specific consultation about planned interventions.
 - **Operation & Maintenance (O&M)**
 - Information on key aspects of O&M of infrastructure & services immediately relevant to them.
 - An effective design for their participation in monitoring.
 - **More Planning**
 - A design for dialogue on further interventions that are required (i.e. more planning)

7.2 Environment Awareness and Education

Awareness among the people about the environment is a dire necessity of the recent times. People must be made aware of how the environment has been polluted, the extent to which it has been so far and the dangers of further degradation of the environment due to human activities.

The people must be educated about their important role in checking environmental pollution and the ways and means available to them to do so.

In the implementation of the Green City concept, the following agencies can play an important role-

- 1) Government agencies
- 2) Non - govt. organizations
- 3) Masses

In order to succeed, all levels and sections of the Gurgaon Community should and must, cooperate and make a positive contribution to the environment of the city. At present, administrative control of the institutions and authorities responsible for the governance of Gurgaon is split between central and state government.

The results of the existing multiplicity of policy-making authorities and lack of an orderly line of control are very visible. The present system of governance is failing to meet the demands of the vast majority of the citizens. The multiplicity of policy-making authorities and field agencies and a complexity of governance are given in Table 7.1.

It is clear that the dominant factors are on a fast track of deterioration and therefore a radical change is required. We need to think of the unthinkable.

"Thinking the unthinkable" for eg. A reduction in the influence of urban development and poverty alleviation coupled with a total rethink of the size and future role of HUDA and Municipality, and adopting policies which:

- Optimizes existing assets and financial flows;
- Create a "climate of opportunity", which will allow the energy of the people to be spent in helping themselves;

- Confine government agencies to doing those things which "people" cannot do themselves;
- Involve "people" at all levels of the planning and decision making process;
- Introduce flexibility, transparency and accountability into the political and bureaucratic structure.

The active participation of the people is a pre-requisite to make the project more successful. Involvement of the people should be encouraged through the interaction with the RWAs/ societies, Sudhar Sabhas/ societies, of each locality if any.

Thus the RWAs/ NGOs can play a major role in motivating the people and in educating and spreading awareness among them about the necessity of improving and maintaining the environment and their active participation in each and every core area viz.

- Urban Planning
- Waste Management
- Water and Wastewater Management
- Energy Conservation & Low Energy Building

Development of Community Awareness and Trust in the Government

At the present time the poor and unserved communities are exploited and used as political pawns. Despite promises and well-meaning policies, little has been achieved. As things stand, the number of people living in the unserved settlements is growing. They will be silent sufferers forever.

Public awareness and trust in the government is a must and what it requires is that:

- Everyone should be included, i.e. politicians, bureaucrats, planners and engineers etc. and the public should understand their role in the development process; and
- Promises will be kept

Since situations are dynamic and actors on the scene are also changing, it is always necessary to pause and look back and adjust the steps in order to attain the desired goal. Intermediate monitoring and evaluations can indicate whether the progresses have both been on the right track or changes are necessary.

7.3 Present Scenario

7.3.1 Self-Help Initiatives by the People of Gurgaon

The self-help initiatives taken by the people of Gurgaon in the sectors of concern to the project are worthy of replication, expansion and upgradation to enhance a better standard of living.

- RWAs in private developer's area & HUDA colonies have managed to incorporate door-to-door waste collection systems. Recyclable materials are picked out by the collectors from this waste and the rest is disposed off at unauthorized sites.
- Some RWAs have tried to spread awareness amongst their members to reduce use of plastic bags.
- A resident of Charmarla, a colony in Gurgaon Town has ensured that the municipal sweeper collects the waste from door to door since the last 7 years. The municipality is now planning to expand this model.
- Recently, Delhi commuters association filed an interim application in the Supreme Court seeking the plying of inter-state buses from Gurgaon on the routes as fixed on Dec 31 1997.

7.3.2 Self-Help Initiatives by the Gurgaon Administration

The initiatives taken by the Gurgaon Administration are:

- Water experts in the Irrigation Department are thinking of water harvesting initiatives throughout Gurgaon district.
- The Administration is examining ways to increase local revenue to help meet deficits in various areas.
- HUDA has a Master Plan for a green Gurgaon.
- Some industries are reported to have implemented water-harvesting schemes on their premises.
- The Deputy Commissioner's office appears to be easily accessible to all stakeholders in Gurgaon.
- The Haryana Government has initiated computerization of all land-records, including in Gurgaon district.

7.3.3 Self-Help Initiatives by the Non-Government Sector

We also know of the following initiatives taken by the non-government sector in the areas of concern to the project:

- TERI has built an energy efficient building (zero dependence on power grid though it is a large facility) at Gwal Pahari where non-conventional energy systems are being used.
- Gurgaonharyana.com, a website for Gurgaon has spearheaded a communication campaign against the use of plastic bags: they have information up on their site. They have gone and talked to several schools, in individual classes, then organized door-to-door awareness campaign in a few colonies. They also distributed cloth bags free of cost to the households of Sushant Lok to reduce the use of plastics bags.
- The Jackampura bazar trader's association has built a urinal & drinking water facility in their bazar and maintains it well. They have proposed to the Traffic Police & Municipality that proper traffic routing & parking system needs to be operated for the bazar. They have

developed detailed suggestions to this effect and are pursuing with the Traffic Police & Municipality.

- The principal of a senior secondary school is liaising with Yamuna Action Plan, Traders' Association of Jackampura and the Municipality to have a public toilet built for shoppers & workers who otherwise ease themselves around the walls of the school. She has also had several trees planted in the school.
- The apex Traders Association is concerned about the loss of tree cover in Gurgaon Town. It has proposed to the Municipality & Traffic Police to develop central verges on all roads and plant trees on them. Trees on side verges die for various reasons.
- Development Alternatives is doing environmental awareness activities with two schools.
- The Ansals have implemented water-harvesting structures in some of their buildings. Other builders are planning to follow suit.
- CONSERVE is initiating interaction with RWAs to increase their self-help capacity on several issues.
- Major housing & commercial centres have, of course been developed by licenses of HUDA. Some builders have, however, developed housing colonies on unauthorized land as well.
- Some of the licensed builders have done good landscaping & tree-plantation work in their areas.

The profiles of the NGOs working in Gurgaon are given in Table 7.2.

Suggestions provided by the NGOs for improving the conditions

I. Energy Conservation

Proper power supply should be implemented and certain campaigns should be conducted by the NGOs to motivate the people to save electricity. People should be encouraged to use non-conventional energy sources. Energy conservation can also be implemented by car pooling, construction of good roads, and by prevention of excess use of electricity.

II. Solid Waste management

Solid waste management is a major problem in Gurgaon, which should be taken care of.

The waste management system is extremely poor or rather lacking in the slum areas, so frequent waste collection strategies should be carried out in order to improve the condition of the slums and make it more eco-friendly.

Proper solid waste management strategies should be adopted and implemented for the development of a clean and healthy environment. People should also be made aware of the necessities of maintaining a clean and green environment and should be trained accordingly to maintain such a situation.

III. Water Supply:

In most areas the water supply system has improved. In the developed areas, it is more or less proper and adequate to meet the needs of the people. But the condition in the slum areas is very poor. The water supply in the slum areas needs to be improved by installation of proper pipelines. This will at least enable them to get adequate water to cater for their bare necessities.

IV. Drainage and Sanitation

According to some, drainage and sanitation problems have reduced in comparison to what it was earlier. It is more or less adequate as per the requirement of the people is concerned. But according to the others, drainage & sanitation is a major problem, which should be brought into the knowledge of the people for further improvement. It needs to be further improved with the help of government interventions.

V. Environmental Education

In order to make the people environmentally conscious, environmental education is a must and thus it should be promoted among them by distribution of pamphlets by the NGOs and other social organizations. Environmental education should be incorporated as a part of the annual curriculum to make the people aware

of the beneficial aspects of the environment. It should be encouraged among the schools, RWAs and Multinationals.

VI. Industrial and Vehicular Pollution

Industrial and vehicular pollution can be mitigated by widening of the roads in the inner part of the city and also by checking the pollution level of the vehicles. It should be checked and kept in control so that it does not exceed its limit and cause air pollution.

VII. Transport and Traffic

Public transport system is a major problem and needs to be improved. Privatization of the local transport will help to improve the transport facilities of the people. Traffic police should be more helpful and co-operative with the local people.

7.3.4 Self-Help Initiatives by the Resident Welfare Association

The RWA's are responsible for the maintenance and security of the colonies. A membership fee is charged by these associations/ housing societies, ranging from Rs. 250/- to Rs. 500/- monthly or Rs. 45/- to Rs. 500 annually or Rs. 600/- to Rs. 1500/- as a life time membership.

All the Resident Welfare Associations in Gurgaon have not been very active in initiating activities to create awareness on environmental issues, but some of them have initiated a few activities like:

- Tree plantation and celebration of "Van Mahotsav" in Sector 15
- Extra Curricular activities like essay competition and skit on environmental issues organized for the children by the RWA of Sushant Lok which was sponsored by gurgaonharyana.com.
- The ladies of Sushant Lok are also involved in a campaign to ban or at least mitigate the use of plastic bags.

The profiles of the various RWAs in Gurgaon are given in Table 7.3 and their activities are given in Table 7.4.

Suggestions given by the RWAs for improving the conditions

As a result of the interactions with the NGOs & RWAs it is understood that at present the drinking water that is supplied by Municipality, HUDA, or other private colonizers is found to be satisfactory except at Rail Vihar. They pointed out that the need of the drinking water in the Rail Vihar is fulfilled by the tubewells present there, as they are not getting the required quantity of drinking water from HUDA.

The position of electricity is stated to be satisfactory except for the period of breakdown.

Almost all the RWAs of remote sectors and colonies complained for the lack of public transport i.e. poor intra-transport facilities. People travel within the city either on the auto-rickshaws, hand driven rickshaws or by private vehicles. All these things give rise to the problem of traffic jams and commotion in the congested areas, and above all it affects the air quality in the surrounding environment.

Various RWAs brought into our notice that no attention is given to the management of the solid waste. The garbage collected from the different localities is dumped into the empty plots and barren lands. The waste that is collected from one sector is disposed in an empty plot in another sector, thus affecting the cleanliness of that area. Because of the open dumping, cattle and cows are often seen feeding on the garbage. These unhygienic conditions not only lead to the spread of communicable diseases in humans but also affect the animals feeding on the garbage.

It has been noticed that in the sectors/areas that are recently being developed by HUDA or Ansals; the drainage is not yet connected to the mainline and at times the residents do have to face the problem of choking of the sewers especially during the rainy seasons. Sometimes the sewage also accumulates on the road and gives rise to some foul smell. The sectors/areas are Sec. 21,22 (A), 23, 15 - I & II, Palam Vihar, Sushant Lok.

The RWAs are mainly concerned to safeguard their interests with the Municipal Committee, HUDA & about the maintenance and development of their respective areas.

According to them awareness regarding the environment is a must and all of them suggested that Environmental Science should be introduced as a compulsory subject in the annual curriculum of the educational institutions. On the basis of the discussion with the RWAs it is concluded that according to them planting

trees and promoting greenary could check the degradation of the environment to some extent.

This awareness regarding tree planting should be spread among the masses and campaigns should be conducted to ban the use of the plastic bags. Some of them also emphasized upon the need of spreading awareness among the educated class of people, as they are also responsible for polluting the environment inspite of knowing that the adverse effects may lead to the depletion of the environment.

They also suggested that through implementation of strict rules and laws one could keep a check on the culprits.

Regarding pollution from the industries they suggested that the various industries should be made to use various primary and secondary methods of waste treatment that are available at present, so that the emission from these industries can be treated and they do not affect the surrounding environment.

In order to cope up with the traffic problem in the city of Gurgaon they suggested that construction of fly-over and widening of the roads are the two options that can be considered.

The views of the various RWAs are given in Table 7.5.

7.3.5 Existing Condition in the Villages

In Gurgaon there are about 44 villages. Availability of water is more or less adequate to meet the needs of the people in the villages. The water is obtained from the tubewells, which are provided either by HUDA or by the Public Health Engineering department.

In some villages it has been so observed that overflow of the water leads to water logging in the surrounding areas. This overflow occurs due to the availability of water for 24 hours. The quality of water received by the villages, which are in close proximity to the industries, is quite poor. As the wastewater generated from the industries is discharged in the adjoining area, which in turn affects the ground water quality.

The waste management system is very poor. There is no mechanism of waste collection and disposal. The members of the household collect the waste and

throw it any open land outside the house. Some people even throw the waste directly on the roads. House to house system of waste collection is not practiced.

There are no appointed sweepers who can collect the waste from the houses. When the waste that is disposed in a particular place gets accumulated over a long period of time, then the Panchayat appoints some sweepers to clean that area. The sweepers collect the waste from there and throw it in any open land outside the village.

As the HUDA sectors have developed all around the villages, there is not even much empty land for dumping of the waste. HUDA has also not provided any dumpsite for dumping the waste of the villages. Thus disposal of waste is a major problem.

The sewerage system in the villages is not much developed. In some places, HUDA has laid pipelines but operation has not yet started. In certain areas the sewerage system is very poor because the pipelines laid down are narrow as a result of which the sewer lines often get choked, thereby resulting in the stagnation of waste water which gives rise to a foul smell and creates an unhealthy atmosphere in that area. Leakage in the pipes is a common feature.

As a result of this, the wastewater leaks all over in the surrounding area, thus giving rise to very unhygienic conditions. In some areas wastewater does not have a proper outlet as a result of which it remains stagnant in a place for a long time.

7.3.6 Existing Condition in the Slums

The electricity supply is available in almost all the slum areas. One of the most critical problems in the slums is lack of proper water supply facilities. Slum units do not have individual water taps, therefore the dwellers are dependent on community sources, such as community taps/connections, hand pumps, shallow tube wells etc., which are installed at a fair distance from the dwelling units.

The water supply in the community taps/connections is available for about a maximum of 5-6 hours per day. The quality of potable water is in accordance with the standards.

Sanitation facilities, which include toilet, drainage and garbage disposal is highly inadequate in the slums.

By type of toilet facilities an overwhelming majority of households use open air. The seriousness of the sanitation problem can be gauged by the percentage of sample households using open spaces for personal sanitation.

Garbage disposal is another major problem that are currently being faced by the slum dwellers. Such facilities are virtually non-existent in the slum areas of Gurgaon. No community bins are available for the disposal of the garbage and nor any sweepers are employed for the purpose.

It is only self-help that is practiced. It is mostly observed that all the households dispose their waste outside in the open area. Thus the question of maintenance does not arise. The physical condition of waste disposal is poor and unhygienic.

The provision of health care facilities available in the slums of Gurgaon City is hardly adequate to meet the requirements of the dwellers. The study reveals that it is only private clinic/service and private doctors who provide health care services. No medical facilities are provided to the slum dwellers by the government.

7.4 Suggested Action Plan

To implement the awareness programme successfully in Gurgaon it needs to be nurtured primarily by local environmental organizations and schools along with residential and industrial welfare associations and most importantly with the rural poor in the following way:

- The entire residential & working population of the Gurgaon Urban area would be the target audience for the public service messages required to be communicated for the different sectors. The target audience can be divided in two broad groups: households and institutions. In households, the women should be focussed on. They can in turn educate the rest of the household.

In institutions, the decision-making body should be focussed, and left to inform the rest of their group as per their requirement.

- Direct contact may be the most cost-effective way of reaching the target audience. Meetings of women at the RWA level may be considered backed by the messages on a mass media. In case of the

institutions, again a meeting with the decision-making group, backed by a follow-up brochure from the Administration, may be the best strategy.

- Effective ways must be found to make the net accessible to all sections of the population, including institutions, RWAs and other such bodies. The private sector has a key role to play here as vendors and loan providers for equipment, and to run the cyber cafes.

Regardless of the specific strategies in each sector, there are some fundamental messages that we are all clear should be internalized by the consumer. For example that he should:

- Accept responsibility for improving environmental conditions in his lane/colony
- Work out a rational strategy to take small, incremental steps towards this goal
- Associate with others in his lane / colony to work in a synergistic way to increase benefits, i.e. establish and work through associations
- Dialogue appropriately with service providers to increase the environmental benefits from their services

Specific strategies within each sector will be added to the above. Presently, the following core ideas can be incorporated:

- Nurturing trees on road-sides, parks, schools and other institutional areas
- Introduction of rain water harvesting in colonies, institutions, homes and offices – catching rain water where it falls for direct use, or for percolation into ground aquifers
- Utilizing the biodegradable wastes from the colonies, institutions, homes and offices – and using the compost as manure
- Consider what it costs to produce & distribute power, both in financial & environmental terms

Involvement of the educational institutions in spreading environmental awareness

Educational institutions play a major role in spreading awareness as it is observed that children grasp the things as it is told to them and they should be trained in such a manner so that they can take up the responsibility tomorrow. The students should be made aware of the benefits of the environment and hence should be aware of the proper utilization of the natural resources.

Environmental science is being taught as an elective subject / program / activity in order to promote awareness among them from childhood.

It is noticed that the educational institutions in Gurgaon with the guidance & the technical help from a Delhi based NGO, DA (Developmental Alternatives) is running an environmental awareness program as a part of their annual curriculum.

The schools currently associated with DA are-

- Salwan Public School, Sec-15 II
- Shri Ram Public School, DLF Phase III

The schedule includes activities like:

- a) Motivating and involving the school children in assessing the water and air quality on a seasonal basis by simple water and air tests with the help of easy to handle kits
- b) Children are encouraged to participate in the campaigns, rallies, skits, street plays related to environmental awareness
- c) Promoting activities like tree plantation by children and care of the planted tree by the children themselves is integrated as the work experience or house activity.
- d) Social service is also promoted through the activity of regular visit of the school children to nearby orphanage so as to induce the habit of caring and sharing among the little ones.
- e) Promoting campaigns with the school children for recycling paper, practicing vermi-composting against use of polythene bags. The children are also taught the procedure of soap manufacture.

Modes of Communication

Effective ways have to be found to reach these messages to all stakeholders of the Gurgaon Urban Area. The following ways are suggested:

1. The television watching, radio listening, and newspaper/magazine/newsletter/web reading habits of the GUA population will be assessed to work out a cost effective mix of media to be used for the messages to be delivered to the public. Based on the media-mix to be used, an appropriate budget must be set aside for this purpose.

A social advertising agency needs to be contracted for devising such a communication campaign. The entire residential and working population of the Gurgaon Urban area would be the target audience.

2. All Administration staff & other service providers who have any role to play at all in public dealing will be coached and invited to own these messages as their own. The staff as well as their organization must act as vehicle for the communication of these messages in their dealings with the public.

Additionally the general stand-offish attitude of public servants as "go speak to someone else about your problem", must undergo a change. They must learn to be responsive to the public.

The Administration management on its part must design systems to treat the consumer with respect, as a purchaser of its services, not as a victim with no choice – for that time is surely on its way out.

3. The maximum possible information about services and the Administration must be available in the public domain, as specified in the IT policy of Haryana. Obviously the simplest way to do this is to put up the information on web sites and publicize their URLs. Additionally the information must be available in the local language i.e. hindi.

4. Parallely, all other possible means should be adopted to inform the consumer and keep him updated. For example, all bills and any other communication going out from the administration should have its back printed with information on that service. All offices/public-dealing spaces of the administration must have all relevant information on well-lit notice boards for the benefit of the public.

Improving the Administration – Public Interface

1. All public dealing spaces of the Administration must be designed, with due respect towards the consumer i.e. appropriate seating arrangement so people do not have to stand for hours, adequate lighting and ventilation, toilets and drinking water should be provided.
2. The administration must evolve an effective complaint-tracking and redressal system. Lip service has always been paid to this need, but it has rarely been met. No sustainable improvements to services are possible unless the administration evolves effective mechanisms for this. Implementation of IT policy can contribute hugely to this.
3. At present holding camps at ward or sector level; periodic meetings between associations and the administration; monitoring visits by senior officials to different areas; and inviting comments at the time of framing new policies or laws; are some of the ways adopted for public participation. These ways have been found to be effective. Some other possible ways are:
 - Consult the concerned association before finalizing a new scheme for their area.
 - Pay attention when they bring to notice a serious lacunae in the contractor's or other executing body's way of working.
 - Firmly link monitoring of Operation and Maintenance of commissioned services to comments by Consumer Associations. This can include obtaining signatures of one of the Association's office-bearers on regular monitoring formats.
 - Reward Associations or groups of citizens who are taking initiatives to better services or provide some of their own -

normally, the Administration ignores or punishes such efforts, rarely working in tandem with them!

- Having relevant Government databases available on computers, and then on web sites, will also go a long way in enabling effective public participation, especially when cyber-cafes are widely available, and the relevant content is in Hindi.

4. All Government staff in departments of relevance to the project, who have a supervisory / public dealing role, need to be trained. It will be best to collaborate with existing institutions that train various levels of government staff: the Local Self-Government Training Institute, DUDA, and others. The focus of the training to be provided needs to be:

- Many cities have begun to manage their financial position much better than they used to: 90-100% property tax collection, regular updating of records, finding some more sources of revenue generation, rational cost-cutting in various ways, slowly computerizing all data bases used by the local body / Administration. This can also be applied in Gurgaon.
- It is imperative to re-design service delivery with the consumer at its centre. The days of monopolies, government or otherwise, are over in this era of rising consumer expectations and liberalization. All service delivery organizations will eventually need to compete for the customer's favour or fold-up. Other government sectors have also made this transition. Telephone services are a case in point.

Specific Participation & Information Strategy for each sector

Some specific PIS strategies for the different sector that seem to require people's participation are:

- **Using mass-media:** Points such as 'Informed understanding of the problems and of workable solutions', 'Advertise that user pays and abuser pays penalty', 'Public relations to assess and educate public about the process (privatization of city management and services) & 'Legal measures and practices applicable to occupiers', require a wide-ranging dialogue between public members which can best be done through the print & web media.

Apart from independent writing that the media may do, their need to be 'response columns' in all popular print & web media with letters from the public with the response of the Administration. The Administration also needs to run a programme each on television & radio, in which it communicates with the Gurgaon populace, including answering phone-in questions.

- **Study-visits:** In regard to 'make water-harvesting methods mandatory' & 'encourage sustainable pattern of building designs for energy efficient and water conservation methods', management of public & semi-public organizations, RWAs, Traders' & Industrial Associations in Gurgaon should be taken on a 'see-for yourself' tour of nearby water-harvesting structures and any waste-water treatment & energy-efficiency examples in building design.

Similar study visits may also be conducted to tubewells and pumping houses, water treatment facilities, sewerage treatment plants, power generation & distribution facilities, etc., so that they understand better and appreciate the investment and operating costs of running these services.

- **Direct contact:** For 'Legal measures and practices applicable to occupiers', direct contact meetings may be coordinated by a Social Advertising Agency with housewives all across Gurgaon Urban Area, on public service messages, and similar meetings can also be held with decision-making bodies of all institutions.

- **Improve the Public-Administration interface:** The Public-Administration interface has to be improved in various ways for 'Legal measures and practices applicable to occupiers', including linking and monitoring of O&M of commissioned services to comments by the Consumers' Associations, and an effective complaints redressal system should also be in practice.
- **Government data-bases to be available on web-sites:** In regards to 'Open public offices in every two kilometer area for public interface', having relevant Government data-bases available on computers, and then on web-sites, will go a long way in enabling effective public participation, especially when cyber-cafes are widely available, and the relevant content should be in Hindi.
- **Training for service providers:** In regard to 'Initiating few awareness programmes for sweepers' & 'Legal measures and practices applicable to occupiers of all Premises, Societies / Associations / Management', the SWM staff are the best communication vehicle for the latter messages.

Both senior officials & junior staff need training in the new system of SWM, and to emphasize that change in present level of service, the service delivery has to be re-designed with the consumer at its centre. Where the public is concerned, the best communication of all is visible changes in service, i.e. the sweeper on his beat, ready with his handcart & whistle, inviting people to put wastes directly into his vehicle.

- **Surveys required for PIS:** The PIS for the project will require a baseline survey to determine current levels of parameters that are important. A yearly / twice yearly survey should follow through the life of the project to monitor any progress or lack thereof for these parameters, so that adequate measures can be taken accordingly.

Comments

In order to empower the communities with an ability to know the quality of their surroundings and to enable them to make the right choices and decisions in the interests of the larger community and instill a sense of responsibility in every individual, it is important to educate them with respect to the environmental issues and the right practices to combat them.

It is the people who can shape their future by choosing appropriate alternatives, policies and institutions through a sense of collective responsibility. This would lead to develop efficiency in use of the resources and poor people's access to natural resources, besides minimizing the damage to the environment.

As observed from the study conducted there are certain initiatives that have been taken to bring about awareness among the people and motivate the children to do something about it. But a major effort needs to be put in to motivate the community at large, to spread awareness and take corrective steps for a cleaner, greener future. If a stepwise plan is drawn and followed, existing environmental problems can be brought in the forefront and every individual can be made to realize the magnitude of the problems, so that he can also take up adequate steps to mitigate them.

I. Urban Planning:

The following points needs to be amendable for devising a PIS for:

- Implementation models for power, civic services and waste management & 'Informed understanding of the problems and of workable solutions'

Consumers in various categories should be educated on problems with services & workable solutions. They should be asked what models they prefer. This discussion may be difficult to organize except through the media: newspapers & web sites could be asked to run articles on successful implementation models elsewhere in the country.

- Municipality to link up with NGOs in health and education through which the informal sector or marginalised communities can be given access to services.

- Local authority must start publishing data of costs and services to residents – This can be done on as many web-sites as possible, but also in the print media. These could also be released as advertisements or better still as part of response columns. The TV and Radio programmes as has been mentioned earlier.
- Advertise that user pays and abuser pays penalty – The general population has not accepted the reality of pressure on power and water supply resources, and the costs associated with delivering them to the users.

They need to appreciate this in order to be ready to pay for use and penalty for abuse. Local schools and colleges, RWAs & other Associations can be encouraged to conduct visits with the co-operation of the Administration, to tubewells and pumping houses, water treatment facilities, sewerage treatment plants, power generation and distribution facilities, etc., in order to better appreciate the investment and operating costs of running these services. The media would also be encouraged to do comparative stories on this.

- Public relations to assess & educate public about the process (privatization of city management and services) especially labour unions, consumer organizations, private enterprises & user groups and how to seek co-operation of the stakeholders – The focus here needs to be on successful examples of privatization of city management and services. Projections of likely scenarios in Gurgaon can be done through print media, website, television and radio.
- To make water-harvesting methods mandatory in public and semi-public building plans and to adopt and encourage sustainable patterns of building designs for energy efficient and water conservation methods – Management of public and semi-public organizations in Gurgaon should be taken on a 'see-for-yourself' tour of nearby water-harvesting structures. RWAs, traders and industrial associations too should be taken on such tours.

The lead for organizing these tours needs to be taken by the Irrigation Department as well as the Deputy Commissioner's office. Similar tours need to be organized also for any wastewater treatment & energy-efficiency examples in building design.

- HUDA and Municipality to open public offices in every two kilometer area for public interface and grant of licenses, clearances, payment of taxes etc. activities which can be decentralized.

II. Waste Management

The following points seem immediately amendable for devising PIS for:

- Initiating few awareness programmes for rag-pickers and the sweepers in order to motivate them – There is need for screening of the municipal staff for training them so that they can handle the waste in a more systematic way. Some examples of such activities being performed in other places can be shown to them, so that they can have a vivid idea of what needs to be done.
- Legal measures and practices applicable to occupiers of all premises, Societies/ Associations/ Managements – Occupiers of all premises in Gurgaon have to be informed of their legal obligations and practices required in regard to waste management.

The best route to do that is by the Municipal staff themselves, including the sweepers. The local body employs a large number of solid waste management staff. Their work takes them to the streets and in front of all premises of the city. They will also be the persons to monitor compliance.

Therefore, they are the best means of communicating to the users. For this purpose proper training needs to be provided to them as well as to their senior officials. The training should include a new solid waste management system that change is possible in present level of service and re-designing of service delivery with the consumer at its centre.

III. Water Resources:

The following points seem immediately amendable for devising PIS for:

- Increased public participation and mobilization of public opinion for water conservation strategies by involving local professionals, educationists, RWAs and NGOs in various localities through simple demonstration projects and gender involvement water conservation strategies especially in the slums.
- People should understand that water harvesting techniques should be made mandatory for all institutional and industrial buildings and introduction of simple water harvesting techniques in colonies and other areas is a must to minimize the rate of ground water depletion.

IV. Energy Management

The following points seem immediately amendable for devising PIS for:

- The Haryana State electricity board is not able to collect the bills on a regular basis and because of this every year the enterprise loses a lot of money due to non-payment of bills. Newspapers have also reported the mayhem created by various groups of consumers in cities & rural areas of Haryana when the electricity undertaking tried to recover arrears or contemplate changes in its way of functioning, etc. It is obvious that consumers need to be informed of what it takes to produce and distribute power, and how they are only short changing themselves by not paying adequately.

7.4.1 Case Studies

1. Statement of Community Policing of Solid Waste

CONSERVE in association with the Delhi government and United Nations Development Program (UNDP) launched Community Policing of Solid Waste Program. The aim was to bring about larger awareness among the RWA's and to mobilize them to participate in managing the waste they generate, thus fostering the birth and development of a consciousness about the need and importance of proper SWM practices.

Some very pertinent views from the RWA's emerged regarding the activities that RWA's might engage in, which require serious consideration. The RWA's agreed to launch a solid waste literacy campaign, social mobilization to encourage households to segregate waste and work towards legal empowerment. Some RWA's are understanding the need to segregate the waste at source and have made attempts to look into the alternatives of managing waste like composting or landscape an area which could have become waste dump area.

2. Communities and Bio – Medical Waste

The study on community and bio – medical waste was organized by CONSERVE in association with Deputy Commissioner, Municipal Corporation of Delhi. The motto was to look into the hazards caused by bio-medical waste and its devastating effects on the environment and the people.

The interactive session brought to light the problems faced by the sanitary inspectors and their team of workers and how proper dissemination of waste could prevent the deterioration of the environment. The sanitation inspectors incharge of the MCD bins were really not aware of how they could address the medical waste problem

3. Promoting local dialogue to educate communities

CONSERVE agrees completely with the need for Reforms. Its philosophy is that, for regulatory reforms to be successful in India, they need to be holistic and not compartmentalized. The reform process should be rooted in the existing socio-

economic milieu and should cover and benefit the entire society, especially the underprivileged. If this vital sector of the underprivileged were ignored, there would never be sufficient political will to carry forward or implement the reform process in "spirit".

CONSERVE educates the communities on the benefits of the reform process as to minimize the political backlash, therefore also encourages adoption of policies that provide for in-built, short term and medium term benefits, so that the reform process delivers actual perceivable benefits.

4. Environment Awareness Program with School Community

Students are the future citizens and are well aware of the environment. CONSERVE's school program brings about an interaction with administrators, teachers and all concerned in the school community to take appropriate measures for zero waste concept, run an energy audit to understand the billing system and to develop ideas of implementing the retrofit plan. The ideas and also the know how of composting, recycling of paper and water harvesting plans are engrained in their minds at a young age.

5. Community Policing of Electricity & Water

CONSERVE launched this program to sensitize the community on the need for water conservation and electricity. During the campaign it was found that most of the communities feel handicapped when it comes to understanding policy issues, technologies available and networking with each other. The program created the sense of social responsibility in conserving scarce natural resources among the community members and motivated to participate in all kind of improvement activities at benefiting community.

Objectives:

- Persuade and motivate community participation
- Enhance awareness and educate the community on rational use of water & electricity

- Access the needs of the local community in terms of energy efficient materials and water management equipment through door-to-door survey of the selected locality and neighboring areas.

6. Exnora International

Exnora International was formed in 1989. The adverse effects of the deteriorating environment on health and hygiene and the apathy of the common man towards these issues were a challenge that the Exnorans were ready to tackle.

The basic premise with which Exnora began its operations was that community participation at all levels of functioning was essential to make their work a success. Therefore they welcomed constructive ideas from all quarters. Thus was born the notion of Excellent, Novel and Radical ideas to help transform the city's environment.

Exnora's first efforts also clearly illustrated that the cooperation of the public is absolutely essential for bringing about change at any level and that is possible to work hand in hand with governmental bodies and the ragpickers towards creating a clean environment.

The principle of community participation has spread through the Civic Exnora movement. On an average each Civic Exnora comprises 75 to 100 families. Each Civic Exnora is formed as an independent association of local residents and has its own committee of a president, vice-president, secretary, joint secretary and treasurer.

Each Civic Exnora is affiliated to the parent body, Exnora International. Each household has to contribute from Rs 10 to Rs 25 per month towards payment of salary for the street beautifier, which ranges from Rs 700 to Rs 1,000 per month, for maintenance of tricycle and for the purchase of required materials for garbage collection.

The Civic Exnoras operate not only in the middle, upper middle class and posh localities but also in the slum areas in the city. The latter have been provided with free tricycles for garbage collection and the initiative of the local youth has been enlisted to maintain a clean environment.

At their annual activities fair called Community Fair, Exnora has been able to enlist many youngsters to participate in community service and be involved in developmental activities.

Exnora has been successful in inculcating a sense of community participation and creating awareness about the beneficial aspects of preventive environmental protection amongst the common people of the city.

Exnora has been able to create a more active sense of community participation amongst the slum-dwellers and also arouse their interest in environmental issues, starting with their immediate environment. They have now begun to take interest in solving other problems like water supply, drainage etc.

One of the slum settlements along the banks of the Adyar river used to face a perennial problem of flooding from the river during each monsoon. The slum-dweller members of the Chinnamalai Civic Exnora have found a permanent solution to their problem through their own initiative.

They arranged with the property dealers in that area to provide their debris free of cost which they transported in 400 lorryloads to the site of their problem. During the course of three months the people of this area --- men, women and children --actively participated in physically lifting this collected debris to construct bunds around the point where the flooding occurred. They worked everyday from 6 to 9 in the evenings to finish this construction of the bunds.

Table 7.1

Multiplicity of policy-making authorities and field agencies and a complexity of governance

ISSUE	CONCERNED AGENCIES	RESULTS
Provision of serviced plots for housing to accommodate growth	HUDA, HSIDC, Haryana Housing Board, State Govt. Depts. Like Public works Dept., Town and Country Planning Office	Lack of enough houses/ plots, growth of unauthorized colonies, growth of JJ cluster, spread out colonies with problems in infrastructure provisions.
Transportation	PWD, DTC, Haryana Transport, private sector	Lack of adequate mass transportation capacity and routes, resulting in growth of personalized vehicles with resultant problems of traffic congestion, air and noise pollution.
Environmental Pollution	Pollution Board, Dept. of environment, municipal council, transport operators, water board, power sector	Land, water, air and noise pollution, environmental health problems, etc.
Improving habitat for urban poor	Municipality, HUDA, dept. of urban development, other public agencies owning land like railways;	Slum upgradation or relocation program cannot pick up momentum.

Table 7.2

Profile of Non Governmental Organizations in Gurgaon

Sl. No.	Name of the Organization	Work area	Area undertaken for work
1.	Adarsh Mahila Vikas Sadan	Women welfare	Pataudi Chowk
2.	Rural Child & Women Research & Development Institute	Child & women welfare	
3.	SNS Foundation	Child welfare	Slums
4.	Khushbu Welfare Society	Physically handicapped	Gurgaon & Rewari
5.	Joint Assistance Centre	Disasters	
6.	All India Women Conference	Women welfare	Tikri village
8.	Society For Development of Rural areas		
9.	Gurgaonharyana.com society	Environment education	

Contd. Table 7.2

Sl. No.	Name of the Organization	Organization funding their work	Work accomplished so far in Gurgaon	Problems faced by them so far
1.	SNS Foundation	Government aided	<ul style="list-style-type: none"> - Slum improvement project - Environmental education to slum dwellers - Urban base services to poor 	Less funds are provided by the Government
2.	All India Women Conference	Government aided, local donors	<ul style="list-style-type: none"> - Introducing smokeless chulhas in 7 villages - Planting 2000 trees in Tikri - Promoting non – formal education & cresh 	Government intervention
3.	Adarsh Mahila Vikas Sadan & Anandi Seva Sadan Education Society	Government aided	<ul style="list-style-type: none"> - Running TV repairing training centres - Conducting awareness camps 	
4.	Khushbu welfare society	Government aided, local donors	<ul style="list-style-type: none"> - OPD - Running vocational training centers (above 18) - Establishment of rehabilitation center in Rewari 	Delayed release of grants by the Government

Source: Sample Survey

Table 7.3

Profile of the registered RWAs

Sl. No.	RWA	Location	No. of members in the working committee	No. of houses in the area	No. of houses affiliated to the association	Membership charges
1.	Heritage City	Heritage City	5	150	150	Rs.600/-
2.	Sec-22 & 23 (A)	Sec-22 & 23(A)	10	350	100	Rs.10/- p.m.
3.	Sec-21	Sec-21	6+10	250	200	Rs.100/- annually
4.	Old DLF	Old DLF Colony	7	124	50	Rs.120/- annually
5.	Sec-7	Sec-7	30	750	350	Rs.30/- p.m.
6.	Palam Vihar	Palam Vihar	6			
7.	Surya Vihar	Surya Vihar	14	600	400	Rs.100/- annually
8.	Sec-14	Sec-14	15	1150	950	Rs.100/-
9.	DLF Phase III	DLF Phase III	30	2000	1700	Rs.300/ p.a. Rs.1600/- life-time membership
10.	Sec-17B	Sec-17B	8+5	300	300	Rs.250/- life-time Membership
11.	Sec-4	Sec-4	10	2500	1900	Rs.50/ p.a. Rs.250/- Lifetime membership

Contd. Table 7.3

Sl. No.	RWA	Location	No. of members in the working committee	No. of houses in the area	No. of houses affiliated to the association	Membership charges
12.	Hope Apartment	Sec-15 II	5	170	170	Rs.500/- p.m.
13.	Sec-17 C	Sec-17 C	7	350	350	Rs.45/ p.a.
14.	Sec-17 A	Sec-17A	14	318	318	Rs.200/-p.m
15.	DLF	DLF Phase IV	30	50	50	Rs.1500/- Membership charges Rs.180/ p.a.
16.	Sec-5	Sec-5	6+9	200	140	Rs.500/- Life-time membership
17.	Sec-31	Sec-31	9	200+	48	Rs.100/- membership
18.	Sec-15I	Sec-15 I	12	200	155	Rs.100/p.m. Rs.1000/- life time membership
19.	Sec-15 II	Sec-15 II	4	1000	125	Rs.100/- Membership Rs.20/- p.m.
20.	Sec -7 Housing Board	Sec-7 Housing Board	18	485	485	Rs.100/- Annually
21.	Sec- 31 & 32 A	Sec- 31 & 32 A Housing Board	7+5	300	300	No charges
22.	Park View Apartment	Sec-15II	5	36	36	Rs.350/p.m.

Contd. Table 7.3

Sl. No.	RWA	Location	No. of members in the working committee	No. of houses in the area	No. of houses affiliated to the association	Membership charges
23.	Vijay Rattan Vihar	Sec-15 II	5	371	371	Rs.250/p.m.
24.	Rail Vihar	Sec-15 II	16	500	500	Rs.50/-p.m. Rs.500/ Life time membership
25.	Housing board	Housing Board, Sec-17	6	400	250	Rs600/- life time membership
26.	Jal Vayu Vihar	Sec-31	15	640	640	Rs.300/- p.m.
27.	Sec-7	Sec-7 Ext	12	877	877	Rs.50/ p.a.
28.	Sushant Lok	C-Block, Sushant Lok	11+ 30	700	360	Rs.120/- annually

Source: Sample Survey

Table 7.4

Activities and remarks of the RWAs

Sl. No.	RWAs	Method of waste collection, transport & disposal	Drainage & Sanitation	Water supply	Electricity availability
1.	Heritage City	<ul style="list-style-type: none"> - Door to door method of collection of garbage by the hired contractors - They dump it on the left out plots 	Drainage & sanitation is good	Water is available all the time	The hours of availability are not fixed
2.	Sec-22 & 23 A	<ul style="list-style-type: none"> - Garbage is disposed in the bins kept at selected places within the colony - From there it is transported in covered rickshaws & is burnt thereafter 	Drainage is often a problem as the drainage line from the sector is not connected to the main line	5-6 hrs/day	The duration is not fixed
3.	Sec-21	<ul style="list-style-type: none"> - Door to door method of garbage collection - The waste is transported in covered rickshaws & is dumped on the left out plots 	Drainage is not satisfactory as it is not connected to the main line	6-8 hrs/day	Electricity availability is satisfactory except for the major fallout
4.	Old DLF	<ul style="list-style-type: none"> - Garbage collected at the selected places is transported across the colony in covered rickshaws & is burnt after that 	Drainage facility is satisfactory	Water supply duration is not fixed	Power supply is poor

Contd. Table 7.4

Sl. No.	RWAs	Method of waste collection, transport & disposal	Drainage & Sanitation	Water supply	Electricity availability
5.	Sec-7	<ul style="list-style-type: none"> - Door to door collection of waste is carried out by jamadaars - The waste is transported in covered rickshaws and is eventually burnt 	Drainage needs to be improved	4 hrs/day	Hours of electricity availability are not fixed
6.	Palam Vihar	<ul style="list-style-type: none"> - Door to door waste collection method is practiced - The waste is then dumped on the left out plots outside the colony 	Drainage is often a problem as it is not connected to the main line	4 hrs /day	Electricity availability is satisfactory except for the major fallouts
7.	Surya Vihar	<ul style="list-style-type: none"> - Door to door mode of garbage collection 	Drainage and sanitation is very good	Water is available all the time	Power is available all the time
8.	Sec-14	<ul style="list-style-type: none"> - Door to door mode of garbage collection by the private sweepers charging Rs.30p.m. - An agency of Chandigarh has been hired for the cleaning and maintenance of roads by HUDA - Garbage so collected is transported in refuse collectors of HUDA - It is then dumped on the bare ground 	Drainage and sanitation is good	2 hrs /day	20 hrs /day

Contd. Table 7.4

Sl. No.	RWAs	Method of waste collection, transport & disposal	Drainage & Sanitation	Water supply	Electricity availability
9.	DLF Phase III	<ul style="list-style-type: none"> - Door to door collection of waste by the private contractors - The waste thus collected is transported in covered rickshaws and dumped into the wasteland 	Drainage is not connected to the main line	4-5 hrs/day	Electricity availability is satisfactory
10.	Sec-17 B	<ul style="list-style-type: none"> - Door to door mode of garbage collection - The waste collected is transported to a suitable place where it is burnt 	Drainage system is not proper	3-4 hrs /day	Major breaks are often a problem
11.	Sec-4	<ul style="list-style-type: none"> - Garbage is collected in bins kept at various places and is burnt after that 	Drainage system is still working although it is 25 years old	4 hrs/day	Electricity all the time except for the major fall outs
12.	Hope Apartments	<ul style="list-style-type: none"> - Garbage is collected in bins kept at various places - Waste collected is transported in covered rickshaws and is dumped at left out plots 	Drainage and sanitation is very good in the colony	5-6 hrs /day	At times it is a major problem
13.	Sec-17 C	<ul style="list-style-type: none"> - Door to door mode of garbage collection by the private sweepers charging Rs15/p.m - The waste thus collected is burnt 	Water supply is not good	The duration of electricity availability is not fixed	

Contd. Table7.4

Sl. No.	RWAs	Method of waste collection, transport & disposal	Drainage & Sanitation	Water supply	Electricity availability
14.	Sec-17 A	<ul style="list-style-type: none"> - Door to door collection of garbage - Waste is transported in covered rickshaws and burnt subsequently 	Drainage is satisfactory	3-4 hrs/day	
15.	DLF Phase IV	<ul style="list-style-type: none"> - Door to door method of garbage collection - it is not regular and the collected garbage is dumped on the bare land 	Drainage is not to the standard	2-3 hrs/day	Electricity availability duration is not fixed
16.	Sec-31	<ul style="list-style-type: none"> - Door to door mode of garbage collection by the individual employed for the same purpose - The waste is eventually burnt 	Drainage system is not proper	Hours of water supply are not fixed	Electricity is available but the voltage at times is not good
17.	Sec-5	<ul style="list-style-type: none"> - Door to door method of garbage collection - It is transported in covered rickshaws 	Drainage from the sector is not connected to the main line	2-3 hrs /day	Hours of electricity availability are not fixed
18.	Sec-15 I	<ul style="list-style-type: none"> - No means of garbage collection - The residents dump it on the left out plots 	Proper drainage is lacking	4 hrs/day	Condition is very bad

Contd. Table 7.4

Sl. No.	RWAs	Method of waste collection, transport & disposal	Drainage & Sanitation	Water supply	Electricity availability
19.	Sec-15 II	<ul style="list-style-type: none"> - Door to door collection of garbage by the jamadaars - They carry it outside the colony in covered rickshaws and dump the waste on the land allotted by the Municipality 	Drainage from the sector is not connected to the main line	2 hrs /day	The duration of availability is not fixed
20.	H.B, Sec-7	<ul style="list-style-type: none"> - No means of garbage collection 	Drainage is not proper in the locality	4-5 hrs /day	-
21.	H.BSec-31	<ul style="list-style-type: none"> - Door to door garbage collection - The collected garbage is disposed on the left out plots 	Drainage and sanitation needs to be improved	5-6 hrs/day	The availability is not satisfactory
22.	Park View Apartments	<ul style="list-style-type: none"> - Door to door garbage collection - The collected garbage is disposed on the land allotted by the Municipality 	Drainage and sanitation is satisfactory in the colony	6-7 hrs/day	Electricity is available all the time except for the load shedding
23.	Vijay Rattan Vihar	<ul style="list-style-type: none"> - Door to door collection of garbage - The collected waste is disposed on the left out plots 	Drainage needs to be improved	2 hrs /day	Power supply is not good

Contd. Table 7.4

Sl. No.	RWAs	Method of waste collection, transport & disposal	Drainage & Sanitation	Water supply	Electricity availability
24.	Rail Vihar	<ul style="list-style-type: none"> - Door to door collection of garbage - The collected garbage is directly dumped into the dump-yard 	Drainage system should be improved	1-2 hrs/day	
25.	H.BSec-17	<ul style="list-style-type: none"> - Door to door collection of waste is practiced - The collected waste is disposed on left out plots 	Drainage system is satisfactory	3-4 hrs/day	Power supply is not satisfactory
26.	Jal Vayu Vihar	<ul style="list-style-type: none"> - Door to door collection of garbage - It is transported across the colony in covered trolleys 	Drainage and sanitation is satisfactory	6 hrs /day	The duration of electricity availability is not fixed
27.	Sushant Lok	<ul style="list-style-type: none"> - Door to door collection of the garbage - The collected waste is either burnt or is dumped on the left out plots 	Drainage system is not satisfactory as it is not connected to the main line	3-4 hrs /day	Power supply is not satisfactory
28.	Sec -7 Extension	<ul style="list-style-type: none"> - The garbage is collected from the bins kept at selected places - The collected waste is then burnt 	Drainage is satisfactory	4 hrs/day	Power supply is not sufficient

Source: Sample Survey

Table 7.5

Views of various NGOs

RWA	Energy conservation	Solid waste Management	Water supply	Drainage & sanitation	Environment Education	Industrial & vehicular pollution	Transport & traffic
Heritage city	Frequent power cuts occur, so power supply needs to improve	No authorized dump for waste disposal	No problem	No problem	Encourage planting of trees and Ban the use of plastic bags		Roads should be widened for the increasing traffic
Sec -22 & 23 A			Improved	Improved	Should be given to the children to make them environment conscious		State transport should provide the local transport
Sec-21		Disposal of solid waste should be taken care of	Improved	Improved	Has been implemented to promote awareness		Local transport
Old DLF	Prevent unnecessary use of energy sources	<ul style="list-style-type: none"> - Waste management system needs to be improved - Sweepers should be appointed for maintenance of roads - Proper site should be provided for waste disposal 	Overhead tanks need to be installed in order to get adequate supply of water	Proper	Is necessary to make the people environment conscious	-	Needs to be improved

Contd. Table 7.5

RWA	Energy conservation	Solid waste Management	Water supply	Drainage & sanitation	Environment Education	Industrial & vehicular pollution	Transport & traffic
Sec-4	<ul style="list-style-type: none"> - Electricity distribution should be equal & appropriate - Meters should be accessible to the users 	<ul style="list-style-type: none"> - Burning of garbage should be avoided - Proper waste management strategy should be adopted 	Improved	Proper	Is a must for all	Checked	Local public transport
Sec-17 C	The power supply is very erratic and irregular	Requirement of proper dumping sites for garbage disposal	Water conservation should be practiced	Proper	Is a must to promote awareness among the people		Local transport facilities should improve
Sec-17 A	Restricted energy consumption	An authorized garbage dump is required for proper waste disposal	Lack of adequate place for executing such plans	Proper	<ul style="list-style-type: none"> - Is the dire necessity to bring awareness among the people - People should be more co-operative 		Transport
DLF Phase IV			Improved	Improved	Planting trees		Transport
Sec-31	NCES should be used	Proper waste management strategies should be implemented	Potable water of quality	Proper drainage	Is a must		

Contd. Table 7.5

RWA	Energy conservation	Solid waste Management	Water supply	Drainage & sanitation	Environment Education	Industrial & vehicular pollution	Transport & traffic
Sec-7			Improved	Proper	Should be given to all		
Palam Vihar	<ul style="list-style-type: none"> - NCES should be implemented - Use of excess lights should be prevented - Energy saving lights should be used 	Proper waste Management strategy should be promoted		Proper	Is necessary to bring awareness among the people	Should be checked to prevent air pollution	Local transport
DLF Phase III	Methods of energy conservation to be imposed by HSEB	Garbage collection system should improve	Improved	Proper	More stress to be given	No problem	Attention needs to be given
Sec-17 B	Use of electricity and energy in a self-disciplined way		Improved	Proper	Must begin from schools, colleges & homes	Noise pollution needs to be checked	

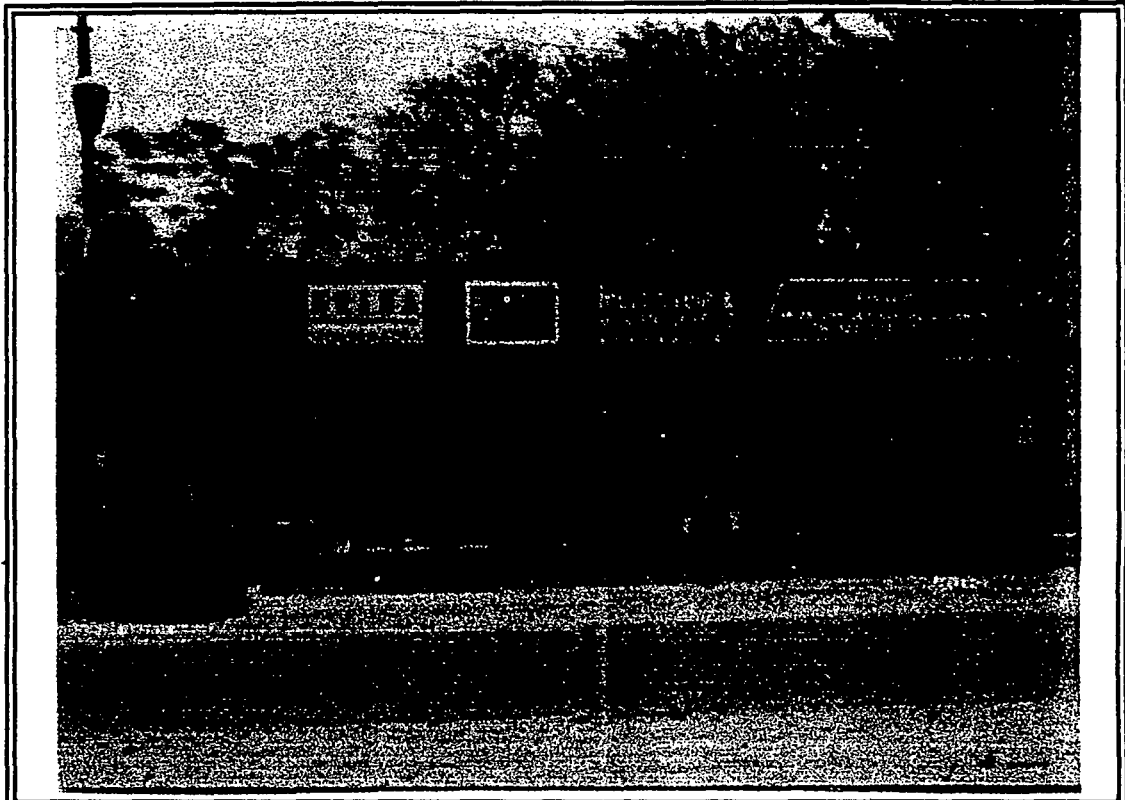
Contd. Table 7.5

RWA	Energy conservation	Solid waste Management	Water supply	Drainage & sanitation	Environment Education	Industrial & vehicular pollution	Transport & traffic
Sec-15 I	Solar energy project can be started	Some NGOs should come up to initiate the process		Improved rain water drainage & sanitation	Should be there in schools	Should be checked	Public transport
Sec-15 II	Check on energy consumption	Implemented	Improved	Proper	Educating masses		Public transport
H.B. Sec-7		Should be there	Improved	Proper	Should be there & to be initiated from the primary levels		Transport facility
Park View Apartments	<ul style="list-style-type: none"> - NCES should be harnessed - Use of energy saving lights - Restricted use of extra lights and street lights 	Method of dumping of the waste needs to be improved	Economic use of water by the residents	Storm water drainage	Is a must for children		Local transport
Vijay Rattan Vihar		Should be there	Water quality assessment should be there	Should be there	Is a must		

Contd. Table 7.5

RWA	Energy conservation	Solid waste Management	Water supply	Drainage & sanitation	Environment Education	Industrial & vehicular pollution	Transport & traffic
Rail Vihar	Switching off the lights which we can live without		More regular	Improved			Local transport
Jal Vayu Vihar	NCES should be harnessed	Solid waste should be used for producing energy			Made use in our daily lives		Local transport, roads widened, traffic police more service oriented
Sec-7 Extn.				Storm water drainage			Local transport
Sushant Lok	Voltage fluctuation problems need to be improved	No authorized dump is provided for waste disposal	Improved	Improved	Should be promoted among the people of all spheres	Checked	Needs to be improved

Source: Sample Survey .



"AWARENESS DRIVE"

An effort of Municipal Council, Gurgaon to reduce the usage of plastic bags

Annexure

NATIONAL EXPERTS						
NAME	ORGANISATION	DESIGNATION	CONTACT DETAILS			
			ADDRESS	TEL.	FAX	EMAIL
1. Gurgaon Green City Urban Planning Strategy						
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2. Mr. R. Liberhan	India Habitat Center	Director	Core 5A, 6 th Floor, India Habitat Centre, Lodi Road, New Delhi - 110003	+91-11-4682000	+91-11-4682010	ihc@vsni.com
2. Gurgaon Green City Waste Management Strategy						
1. Dr. Dilip Biswas	Central Pollution Control Board	Chairman	Parivesh Bhavan, East, Arjun Nagar, New Delhi	+91-11-2227233	+91-11-2223311	cpcb@sansad.nic.in
2. Dr. R. Sarin	National Environmental Engineering & Research Institute	Dy. Director & Head	NEERI, Nehru Marg, Nagpur - 440 020	+91-712-225640	+91-712-222725	drsarin@nagpur.dot.net.in

Annexure – A, contd.

NATIONAL EXPERTS						
NAME	ORGANISATION	DESIGNATION	CONTACT DETAILS			
			ADDRESS	TEL.	FAX	EMAIL
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4. Gurgaon Green City Water Resources Strategy						
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5. Gurgaon Green City People's Participation Strategy						
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Annexure – A, contd.

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Annexure – A, contd.

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Annexure – A, contd.

INTERNATIONAL EXPERTS						
NAME	ORGANISATION	DESIGNATION	CONTACT DETAILS			
			ADDRESS	TEL.	FAX	EMAIL
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5. Gurgaon Green City People's Participation Strategy						
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Annexure – B

TASK GROUP MEMBERS

CATEGORIES	TASK GROUP MEMBERS		CONTACT DETAILS				
	NAME	DESIGNATION	ADDRESS	TELEPHONE OFFICE	TELEPHONE RESI.	FAX	EMAIL
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Co-convener	Mr. A. Agarwal, IAS	Administrator, HUDA, Gurgaon	HUDA Building, Sec.14, Gurg.	916321650		916313211	
State / Local Administration	Dr. N. K. Jain	Civil Surgeon, Gurgaon	Civil Lines, Gurgaon	916322412	916321702		
	Mr. S. S. Kapoor	Superintendent of Police, Gurgaon	Gurgaon Range, Gurgaon	916320221	916331800	916320221	
	Mr. P. Kumra	S. E., HUDA, Gurgaon	HUDA Building, Sec.14, Gurg.	916323881	9812024462	916323211	
	Mr. Y. Mathur	S. E., Public Health, Gurgaon	PHE Department, Gurgaon	916320988	916320928		
	Mr. Kamlesh Gupta	District Town Planner, Gurgaon	TCPO office, HUDA Building, Sec.14, Gurg.	916320573	916307754		
	Mr. S. N. S. Sidhu	Executive Officer, M. C., Gurgaon	Municipal Council, Opp. Civil Hospital, Gurgaon	916333751	--	--	
	Ms. Madhu Pradeep	D. T. P., HUDA, Gurgaon	HUDA Building, Sec.14, Gurg.	--	--	--	

Annexure – B, contd.

CATEGORIES	TASK GROUP MEMBERS		ADDRESS	CONTACT DETAILS			
	NAME	DESIGNATION		TELEPHONE OFFICE	RESI	FAX	EMAIL
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Annexure – B, contd.

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Co-convener	--	Sub Divisional Officer, Gurgaon					
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Annexure – B, contd.

CATEGORIES	TASK GROUP MEMBERS		CONTACT DETAILS				
	NAME	DESIGNATION	ADDRESS	TELEPHONE		FAX	EMAIL
				OFFICE	RESI.		
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	Mr. R.N. Malik	G. M. (HSIDC), Gurgaon					
	Mr. Kamlesh Gupta	District Town Planner, Gurgaon	TCPO office, HUDA Building, Sec.14, Gurg.	916320573	916307754		
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Annexure – B, contd.

CATEGORIES	TASK GROUP MEMBERS		CONTACT DETAILS				
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				OFFICE	RESI.		
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State/ Local Administration	Mr. V. K. Gupta	S. E., HUDA, Gurgaon	HUDA Building, Sec.14, Gurg.	916323881	916323561	916323211	
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	Mr. A.K. Kalra	S. E., Irrigation, Gurgaon					
	Mr. R.N. Malik	G. M., HSIDC, Gurgaon					
	Mr. K. S. Joshan	G. M. (Industries), Gurgaon		916324040	916381400	91632266	
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	Mrs. Madhu Pradeep	D. T. P., HUDA, Gurgaon	HUDA Building, Sec.14, Gurg.				
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CATEGORIES	TASK GROUP MEMBERS			CONTACT DETAILS			
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Others		Private Developers Industrial Organizations					

Annexure – B, contd.

CATEGORIES	TASK GROUP MEMBERS		ADDRESS	CONTACT DETAILS		
	NAME	DESIGNATION		TELEPHONE OFFICE	RESI.	FAX
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Co-Convener	Ms. Nirja Shekhar	Additional Deputy Commissioner	Vikas Sadan, Near New Court, Gurgaon	9163323363	916320715	916322211
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	Mr. P. Kumra	S. E., HUDA, Gurgaon	HUDA Building, Sec. 14, Gurg.	916323881	916323561	916323211
	Mr. Sunil Singla	XEN, Housing Board, Gurgaon	Saraswati Vihar, Gurgaon	916355186		
	Mr. R. S. Malik	S. E., HVPN, Gurgaon				
	Mr. S. N. S. Sidhu	Executive Officer, M. C., Gurgaon	Municipal Council, Opp. Civil	916333751		
	Mr. T. Aneja	S. E., PWD (B&R), Gurgaon	PWD (B&R) Colony, Civil Lines, Gurgaon	916321494	916322122	
	Mr. Y. Mathur	S. E., Public Health, Gurgaon	PHE Department, Gurgaon	916320988	916320928	
	Mr. A. K. Narang	XEN, PWD, Electrical Branch		916320874	916311694	
	Mr. K. S. Joshan	G. M. (Industries), Gurgaon		916324040	916381400	91632266

Annexure – B, contd.

CATEGORIES	TASK GROUP MEMBERS		ADDRESS	CONTACT DETAILS			
	NAME	DESIGNATION		TELEPHONE		FAX	EMAIL
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International Expert	Mr. R. N. Malik	G. M., HSIDC, Gurgaon	Arhus, Denmark				
National Expert	Mr. Peter Ejsing	Sales Manager, Carl Bro	Nehru Marg, Nagpur 440 020	0712- 225640	220605	222725/ 231529	
Green City Denmark	Dr. R. Sarin	Dy. Director & Head, NEERI	Gl. Kongevej 1, 4. DK-1610 Kobenhaven V	+45- 33268982		drsarin@nagpur. r.dot.net.in	
	Mr. Jens Frenndrup	Technical Director				jf@greencity.dk	
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Green City India	Mr. Mainak Hazra	Assistant Manager Projects	N 4, Green Park Extension, II nd Floor, New Delhi	6164496/97		mainak@green cityindia.com	
Others		Private Developers Industrial Organizations					

Annexure – B, contd.

CATEGORIES	TASK GROUP MEMBERS		ADDRESS	CONTACT DETAILS			
	NAME	DESIGNATION		TELEPHONE OFFICE	RESID	FAX	EMAIL
5. People Participation Strategy							
State/ Local Administration	Mr. A.K.Singh, IAS	Deputy Commissioner	Civil Lines, Gurgaon	9163033333		9163033333	
	Mr. A. Agarwal, IAS	Administrator, HUDA, Gurgaon	HUDA Building, Sec.14, Gurg.	916321650		916313211	
	Mr. Bhrampakash	Chairman, M. C., Gurgaon	Municipal Council, Opp. Civil Hospital, Gurgaon	916333751			
	Ms. Neerja Shekhar	Additional D. C. - Gurgaon	Vikas Sadan, Gurgaon	916332363	916320715	916322211	
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	Mr. Kamlesh Gupta	District Town Planner, Gurgaon	TCPO office, HUDA Building, Sec.14, Gurg.	916320573	916307754		
International Expert	Ms. Madhu Pradeep	D. T. P., HUDA, Gurgaon	HUDA Building, Sec.14, Gurg.				
	Mr. S. N. S. Sidhu	Executive Officer, M. C., Gurgaon	Municipal Council, Opp. Civil	916333751			
	Ms. Anette Ransby Sejersen	Engineer	Municipality of Frederiksberg				

Annexure – B, contd.

CATEGORIES	TASK GROUP MEMBERS		CONTACT DETAILS				
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	Mr. Satish Girotra	Principal Correspondent - India Weekly - London	702, Adishwar, 34, Feroz Shah Rd, New Delhi	3739239		3714605	girotra@nde.vsnl.net.in
	Ms. Anjana Mehta	Sociologist	E-264, Mayur Vihar – II, New Delhi - 110091	2475603		2732773	anjraman@vsnl.com
	Mr. Abhay Chawla	CEO, gurgaonharyana.com	607, Sector 4, Gurgaon	916391091			candfp@vsnl.com
	Ms. Jyoti Kanwer		87, Bhakhtawer Singh Block, Asiad Village. New Delhi	6491175			jyoti19792000@yahoo.com
Green City Denmark	Mr. Jens Frendrup	Technical Director	Gl. Kongevej 1, 4. DK-1610 Kobenhaven V	+45- 33268982			jf@greencity.dk
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Annexure – B, contd.

CATEGORIES	TASK GROUP MEMBERS		CONTACT DETAILS				
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Abbreviations

Avg.	Average
BBMB	Bhakra Beas Management Board
BOO	Built Own Operation
BOT	Built Own Transfer
BPL	Below Poverty Level
BPL HH	BPL House holds
BPL POP	BPL Population
C/N	Carbon/Nitrogen
CaCO₃	Calcium Carbonate
CO	Carbon Monoxide
CONSERVE	Conservation Of Nature And Sustenance Of Environmental Resource Via Energy Efficiency
CPCB	Central Pollution Control Board
DA	Development Alternatives
DMA	Delhi Metropolitan Area
DTC	Delhi Transport Corporation
DTP	District Town Planner
DUDA	District Urban Development Authority
EWS	Economical Weaker Section
GCI	Green City India Pvt. Ltd.
GI	Galvanised Iron
GM	General Manager
GPH	Gallons Per Hour

GUA	Gurgaon Urban Area
GWS	Gurgaon Water Supply Channel
HC	Hydro Carbon
HEDA	Haryana Energy Development Agency
HH	Households
HPGC	Haryana Power Generation Corporation
HSEB	Haryana State Electricity Board
HSIDC	Haryana State Industrial Development Corporation
HUDA	Haryana Urban Development Authority
HVPN	Haryana Vidyut Prasaran Nigam
IT	Information Technology
IUCN	International Union for The Conservation of Nature
lpcd	Litre per capita per day
LPS	Litres Per Second
MC	Municipal Council
MCD	Municipal Corporation Of Delhi
MGD	Million Gallons Per Day
MLD	Million Litres Per Day
MNES	Ministry of Non-Conventional Energy Sources
MRTS	Mass Rapid Transport System
MSW	Municipal Solid Waste
NCR	National Capital Region
NEERI	National Environmental Engineering Research Institute
NGO	Non-Government Organization
NH – 8	National Highway – 8
NO₂	Nitrogen Dioxide

NPK	Nitrogen, Phosphorus, Potassium
NTPC	National Thermal Power corporation
O & M	Operation & Maintenance
OBC	Other Backward Class
PHED	Public Health Engineering Department
PIS	Public Information Strategy
POP	Population
PPA	Person Per Acre
PVC	Poly Vinyl Chloride
PWD (B&R)	Public Works Department (Bridge & Road)
RC Bins	Refuse Collector Bins
RIET	Regional Institute Of Environmental Technology
RITES	Rail India Technical & Economic Services
RWA	Resident Welfare Association
SC	Schedule Caste
SE	Superintendent Engineer
SO₂	Sulphur Dioxide
SPM	Suspended Particulate Matter
SPV	Special Purpose Vehicle
ST	Schedule Tribe
SWM	Solid Waste Management
TCPO	Town & Country Planning Office
TERI	Tata Energy Research Institute
TPD	Tonnes Per Day
UA	Urban Area
UN	United Nations

UNCED	United Nations Conference on Environment & Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
WJC	Western Jamuna Canal
YAP	Yamuna Action Plan

Bibliography

1. Manual on Municipal Solid Waste Management (First Edition) – Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban Development, Government of India, New Delhi, May 2000
2. Solid Waste Management in Class I Cities In India – Report of the Committee constituted by The Hon. Supreme Court of India, March '99
3. Urban Solid Waste Management in India, Planning Commission, Government of India, 1995
4. Detailed Project Report For Municipal Solid Waste Management (MSW) of Gurgaon City for Gurgaon Municipal Council – Sycom Projects Consultants Pvt. Ltd., May 1998
5. Census of India 1991, Haryana State District Profile 1991
6. Development of Yamuna River Front, Special Projects Cell, Delhi Development Authority
7. Ministry of Environment & Forests, Government of India, National River Conservation Directorate – Yamuna Action Plan, Progress Monitoring Report for the month of May 1999
8. Survey of the Environment '97 & 2000 – The Hindu
9. Treatment techniques for safe drinking water, Central Ground Water Board, Ministry of Water Resources, Government of India
10. Research Report – The Impact of Environmental Improvement Case Study, Surat by Sanjib Sarma and Hitesh Vidya
11. DTUDP, Decentralized Training for Urban Development Project – Human Settlement Management Institute
12. Women and the Commons – Towards Sustainability in the Haryana Aravallis, J. K. Rawat & Harvinder Bedi, Aravalli Project, Forest Department, Government of Haryana, 1996

13. Fuelwood Crisis in the Aravallis: Need for Production and Conservation, Aravalli Project, Forest Department, Government of Haryana, 1995
14. Strategies For Institution Building For Management of Common Property Resources, Aravalli Project, Haryana Forest Department, 1997
15. Aravalli File – News & Views, M. D. Sinha, I. F. S., Publicity & Extension Division, Aravalli Project, Haryana Forest Department, October 1999
16. Development Alternatives (1995) - Energy in Construction Sectors: A case study for India Times
17. Development Alternatives (1995) – Sustainable Building Material Production: Towards an Implementation Strategy, New Delhi, August
18. Industry and Environment, UNEP
19. Joint Management of Common Lands: The Aravalli Experience, Aravalli Project, Forest Department, Government of Haryana, 1994
20. Indian Environmental Legislation, Guide for Industry and Business – Environment Management Division, Confederation of Indian Industry, May, 1996
21. Socio-economic Environmental Assessment TFL Babrala Project, Phase I – The Neighbourhood, Environment Systems, Development Alternatives, March 1998
22. Evaluation Study on The Quality of Benefits Accrued Under the Urban Basic Services For The Poor (UBSP) Programme in Haryana (Gurgaon City) – Office of the Project Director, NRY & Secretary, State Urban Development Society, and Government of Haryana, Chandigarh, 1997
23. Statistical Abstract of Haryana 1998-99 – Economic and Statistical Organization, Planning Department, Government of Haryana, 2000
24. Gurgaon, The City of the Future, Published by: Industrial Assistance Group, Government of Haryana in collaboration with Haryana Urban Development Authority
25. Census of India 1981, Series – 6, Haryana, Part X – B, Town Survey Report – Gurgaon
26. Manual For Rainwater Harvesting In Urban Areas – Centre For Science And Environment, 2000.