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**THE ROLE OF
URBAN AND PERI-URBAN AGRICULTURE
IN METROPOLITAN CITY MANAGEMENT
IN THE DEVELOPING COUNTRIES**

A Case Study of Delhi

**National Institute of Urban Affairs
New Delhi
February 2000**

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PREFACE

Rapid urbanisation is creating a great demand for service, employment and food in the cities that is stimulating urban agriculture. Given a broad definition of the concept, urban agriculture is not just crop cultivation. It includes horticulture, pisciculture, livestock rearing, dairying, food processing and vending, floriculture and the production of exotic varieties of food, flowers and vegetables. It has been observed that the larger the population, the more varied are the food requirements and the more expansive is urban agriculture. What attracts such activities to a city is a ready market: both consumer, as well as of labour.

Urban agriculture begins by using the marginal lands within a city and then spreads to the periphery. The magnitude of the spread depends upon the size of the city and the demand for food. It is, however, influenced by transportation and communications. In fact, certain types of urban agricultural activities are more suited to peri-urban areas that have mixed land-use and less population concentration, especially those that are harmful for congested areas within cities.

Though conceptually incompatible, as urban is opposed to rural, the benefits of urban agriculture appear to be many; though with some restraint on the use of land, which within a city is highly priced and should, therefore, be sparingly used. Urban agriculture helps to enhance food security by producing more food and by providing more income to buy food, it generates employment, especially for the uneducated poor migrants who take to urban agriculture as a temporary solution to unemployment in the initial years of urban living, thereby assisting in poverty alleviation. The latter also leads to social improvements accruing from economic welfare.

Besides the socio-economic benefits, urban agriculture also contributes to environmental improvement within cities, such as: solid, liquid and gaseous waste assimilation, conservation of water, prevention of pollution, improved aesthetics, etc. all of which lead to an improved quality of life. It also helps the municipality and other management agencies to cut down on the costs of maintenance, even while improving the environment. In effect, good environmental management saves on costs of pollution control and the negative impacts of a degraded environment.

The study has tried to understand the concept and characteristics of urban agriculture, reviewed the policies that might influence such developments, studied the importance given to urban

agriculture in both city development and urban environmental management and estimated its potential role in sustainable urban development. Finally, the study has tried to analyse the contribution of urban agriculture in the National Capital of Delhi. The study has been divided into three sections. The first section deals with the concept and the phenomenon of urban agriculture, browsing through different case studies. The second section probes into the planning and policy provisions made by the Government of India regarding this new idea. The third section is a cursory review of urban agriculture of Delhi.

Difficulties arose in accurately estimating the contribution of urban agriculture to city management, as there are no systematic and formal records of urban agricultural practices and the entire process is new and informal and has not yet been seriously included into the planning process. Hence, often surrogate variables had to be used to assess the environmental status. Besides, time and budget restrictions would not have permitted for more in-depth analysis. To that extent this study is more exploratory, with the need for accurate estimations of the contributions of urban agriculture to the different aspects of city development and management, that needs to be considered and debated in urban policy planning. Many of the assessments are, therefore, notional derivations from the wide literature survey done on the strategies adopted so far and an assessment of the secondary data available.

The study has grown from an earlier research collaboration which NIUA had with The Imperial College of Science, Technology and Medicine, London, with DFID funding, on "the impacts and policy implications of air pollution on urban and peri-urban areas in developing countries". The study has been done under the supervision of Dr. Madhusree Mazumdar, Senior Research Officer at NIUA, with assistance from Virni Agarwal, S.P. Tyagi, Sangeeta Vijn, Indu Senan, Ajay Kashyap and H.P. Pandey.

We are grateful to Mr. Kalyan Biswas, ex-Principal Secretary, Environment, Government of West Bengal for his valuable comments on this report.



Vinod Tewari
Director

New Delhi: February 2000

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List of Abbreviations

CPCB	Central Pollution Control Board
DDA	Delhi Development Authority
DMA	Delhi Metropolitan Area
DOE	Department of Environment
DUT	Delhi Union Territory
EIA	Environmental Impact Assessment
EMP	Environment Management Plan
FAO	Food and Agricultural Organisation of the United Nations
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
HACCP	Hazard Analysis Critical Control Points
HUDCO	Housing and Urban Development Corporation
IDRC	International Development Research Centre
MCD	Municipal Corporation of Delhi
NAFED	National Agriculture Cooperative Marketing Federation of India
NDRI	National Dairy Research Institute
NO _x	Nitrogen Oxides
S & T	Science and Technology
UA	Urban Agriculture
UNCED	United Nations Conference on Environment and Development
UNCHS	United Nations Centre for Human Settlements
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Education Fund
USAID	United States Agency for International Development
VOC	Volatile Organic Compounds
WB	World Bank

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SECTION I

Chapter I

INTRODUCTION

The process of urbanisation brings along with it a series of changes, both within and around a city, that initiate consequential developments. In the case of metropolitan city growth, there is a fast intrusion of urban activities into the agricultural landscape of the peri-urban areas, from the spill over of the expanding city population caused by rapid urbanisation, that changes the occupational structure and the landuse pattern of the urban fringe, creating both positive and negative impacts on agricultural practices. While the physical expansion of the city reduces the proportion of land under traditional agriculture and the grain crops, population growth enlarges the urban market, which gives a boost to the production of horticultural and other perishable food products as an economic activity in the peri-urban areas, to benefit from the proximity to the city's market.

Within the city, urban growth generates a wide range of employment that helps in improving the urban economy. But it also brings along with it physical congestion that manifests in the form of housing shortages, overuse of utilities and a pressure on the infrastructure. Unless resources are augmented and the utility networks reinforced, this increase in population tends to reduce the per capita provision of services like water supply or garbage collection, leading to lack of sanitation and an increase in pollution, causing public health problems. In the case of transportation, an increase in the number of motor vehicles, without widening of roads, creates traffic congestion and air pollution, creating further deterioration in the quality of life, especially when municipalities suffering from financial constraints are unable to upgrade and maintain the infrastructural support system of the city. As the city becomes congested, the open "lung" spaces are devoured by more buildings and non-agricultural activities to contain the ever expanding population, which tends to eliminate the greenery/vegetation that contributes to the assimilative capacity, thereby reducing the city's capacity to absorb waste.

In India, this deterioration in the quality of urban life is further accentuated by a continuous influx of uneducated and unskilled migrants (in search of employment) from the rural areas, who add to the

woes of urban settlements by putting more pressure on the urban system through their informal existence and employment that avoids taxation and thereby their contribution to the city's maintenance revenue. However, some of these unemployed migrants with agricultural backgrounds take to urban agriculture (UA) by cultivating the marginal/unused lands within the city while awaiting regular employment and until such time till they acquire the technical skills of non-agricultural jobs. It has been observed that this process of income generation not only helps the low-income groups to earn a living, it also assists households to enhance food security, either through increased income, or through additional nutrition derived directly from the use of the produce. Moreover, UA helps cities to improve their aesthetics and the waste assimilative capacity, both of which are highly valuable for a good quality of life, as it can countercheck some of the negative impacts of urbanisation.

In fact, in the present day context of increasing urban poverty and pollution caused by rapid urbanisation, UA can be considered as a beneficial aid for city management in several ways: like growing more food for the ever expanding urban market, solving some of the unemployment/poverty problems by supplementing household income and/or food, and by improving the environment through a natural process of assimilation by using solid and liquid waste generated within a city to grow trees and plants (that are being depleted because of urban development), which in turn helps to assimilate gaseous waste. It is expected that all such measures will contribute to poverty alleviation, better socio-economic development and improved environment within the city. A parallel phenomenon that is growing along with the cultivation of horticultural products in and around cities is the home processing and street vending of food as an income earning activity, and is, therefore, included in UA.

A positive aspect of UA is that it generally uses the marginal lands available within cities, which would otherwise remain unutilised or underutilised, for growing crops; though, for other kinds of UA, like urban forestry or gardens and parks, specific landuse is maintained. A common observation is that crop cultivation within cities is mostly informal, thereby indicating its exclusion from the planning process. Also, cultivation of crops is often a temporary arrangement made to utilise vacant lands waiting to be developed. But in the peripheral areas such activities are generally formal and are carried out at competitive land rents. However, it is to be remembered that land rents in the urban

fringes are normally much lower than those of the city centre. Therefore, even though agriculture is considered to be incompatible in an urban context, horticulture, floriculture, pisciculture, poultry, dairying and other types of livestock rearing and food processing is gaining grounds in and around cities to cater to the expanding urban market. So much so, that UA is now being considered as a business proposition for the city and the urban population.

The Habitat II Conference of 1996 recognised urban agriculture as a realistic and desirable landuse option in urban areas and as an integral part of the urban system. Urban agriculture was acknowledged for its potential role in increasing food security, employment and income generation, poverty alleviation, community resource development and conservation, waste management and environmental sustainability. The World Food Summit (FAO: 1996) had also recommended the inclusion of urban agriculture as a component in the food and nutrition policies. It is estimated that by the year 2005, 25-30 per cent of the world food production will be from urban areas, including nearly half of all vegetables, fish, meat and dairy products that are consumed in cities (Jac Smit : 1996).

India is self-sufficient in terms of food grain production in the country as a whole (Times of India : February 1999). But the World Bank reports that pockets of urban concentrations suffer from calorie deficiency more than their rural counterparts. In fact, urban dwellers pay much more for their food than the rural people. A very large proportion of the income of the urban poor is spent on food. The UNICEF tells us that one-sixth of the world population suffers from inadequate diet. The UNCHS projects that between 1990 and 2020, urban population will increase from 45 per cent to 65 per cent (Jac Smit:1996) of the total world population. There is, therefore, a growing consciousness to utilise the marginal lands within cities and in the peri-urban areas that otherwise lie fallow, to augment household income and nutrition by promoting urban agriculture, especially the highly priced and/or perishable products that can be cultivated intensively in small plots of land.

There is also a belief that there can be a major reduction in the cost of food production from the savings on refrigeration and trucking, which is not required if perishable food is grown within short distances from the consumers. In fact, less number of trucks may also mean a saving of energy and a

reduction in air pollution from motor vehicles. Besides, less number of vehicles would also mean less pressure on the city's infrastructure and maintenance costs.

Therefore, the positive externalities arising from UA are the improvement in the air assimilative capacity, the use of recycled bio-degradable waste that helps in reducing the solid waste management cost and at the same time helps in enriching the soil, the use of liquid waste after an initial treatment, economic use of valuable under-utilised urban land, and the enhancing of the aesthetics of open areas used as lung spaces within cities. Hence, metropolitan cities of developing countries, in their quest for management solutions, are looking upon urban and peri-urban agriculture as a panacea for many of their urban ills. As the renowned ecologist and visionary Lewis Mumford had once said, “ the most important public task, around every growing urban center, and far beyond, is to preserve permanent open areas, capable of being maintained for agriculture, horticulture and related rural industries”. His vision was that such areas would bring succor to the urban dwellers living in cramped conditions within cities. He also thought that such areas would prevent the coalescence of one urban unit with another (Mumford: 1986).

However, what may be good for a particular sector, need not necessarily benefit all aspects of development. Urban land, because of its well-developed infrastructure, is very highly priced. The reason as to why urban development is concentrated in limited space is because of the exorbitant price of land and the economies of scale. To use such land for agriculture (which usually requires large stretches of land) may not be economical. Besides, agriculture in the true occupational sense is opposed to urban, and vice versa. Therefore, economic valuation of agricultural productivity vis-a-vis other urban activities with their employment and production capacity should be compared, if agriculture is to be promoted within or around cities. The overall experience is that landuse development follows the law of demand and supply that takes into account the market price of land; though often in city planning, decisions cannot be left totally to market conditions.

Again, the negative effects arising from urbanisation within a city like the impact of urban pollution, especially of air, water and soil contamination on the crops from waste can be harmful for agriculture. For example, congested living can affect crops badly through vehicular and other atmospheric pollution, as conversion of VOCs and NO_x (see List of Abbreviations) into ozone,

especially in the tropical countries with bright sunlight, is harmful for the crops and their productivity (UNEP & WHO:1992). Ozone is formed in the lower atmosphere that damages crops specially in the peri-urban areas of metropolises because of vehicular pollution and waste disposal. Besides, megacities like Delhi also create "heat islands" which lead to ozone formation because of high energy dissipation from traffic and the production and use of organic chemicals, natural gas, crude oil, etc. Therefore large cities create a dilemma with congestion causing air pollution that reduces food productivity and thereby food security, especially when there is a dire need for it.

Similarly, if polluted waste water is used without treatment for agriculture, it may be harmful for crops and human beings if it enters the food chain or gets absorbed into the water cycle. Soil conditions too deteriorate because of air pollution and contamination from water, or from chemical emissions by industries, or from chemical fertilisers used for agriculture, sometimes giving a fillip to pest formation.

However, if the negative impacts can be avoided or minimized through conscious efforts, the positive externalities associated with urban and peri-urban agriculture may still help in improving the quality of life, with employment and income from crop production adding to the household and the city's income. Urban agriculture, therefore, has manifold utilities and benefits: such as enhancing food security, increasing air and waste assimilative capacity, solving solid/liquid waste management problems, generating employment for the poor/marginal workers, increasing the city's income, improving the city's aesthetics and often providing recreational opportunities. Hence urban agriculture, of late, is being recommended as a good management practice for cities, to bring about social and economic change and physical environmental improvements. In a country like India where almost 60 per cent of the population live in large cities (of more than one lakh population) and about 30-40 per cent in city slums, UA can assume importance as a catalyst for environmental improvement, employment generation, and poverty alleviation.

But it is to be remembered that UA is transient in character as it is practised mostly on marginal/underutilised/transitional lands. Therefore, urban developments can obliterate such agriculture both within the city, as well as in the peri-urban areas. On the periphery of the city, UA can be pushed farther away from the centre of the city because of urban expansion. Therefore, what

is more important in city management is the phenomenon of UA, rather than its spatial ramifications. For neither can city limits remain constant, nor can UA be restrained by spatial determinism. What needs to be emphasised about UA is that as a concept it is very different from the traditional crop cultivation, even though it is developing as an economic activity.

At a time when sustainable development is a global quest, city improvement through agriculture can be of additional help for attaining sustainability. It is being increasingly recognised that economic development has to be balanced by social development. Both stand to gain in urban agriculture, which improves income and promotes community resource development. However, it is to be noted that no city can be self-sufficient in food in absolute terms, as cities are concentrations of non-agricultural economic activities and therefore, depend on rural agricultural productivity for sustenance. At the same time, no agriculture can survive without an urban market.

This study will examine the newly found role of urban agriculture in city management, pertaining to landuse planning, aesthetics, employment generation, the socio-economic change, etc. that has come up with rapid urbanisation. The study will also discuss the possible contributions of UA in reducing the problems of poverty alleviation, food security and waste assimilation and try to identify the stakeholders involved in promoting UA and city management.

Chapter II

STUDY OBJECTIVES AND METHODOLOGY

Study Objectives:

Although only sporadic efforts were made in the past to introduce agriculture in cities to enhance food security, the consideration that UA can be used as a component of planning is gaining grounds. Experience shows that UA has actually evolved to cope with rapid urbanisation and is, therefore, a consequence of it. Thus the phenomenon of UA as an aid for city management is a fairly new concept in India. However, both, practice and research of UA, are still in their nascent stages of development and need to be explored and understood.

This study will try to find out the benefits of using UA in city planning and management. To do so, concepts will have to be understood and past practices studied to ensure the validity of using such a phenomenon. In order to find out the credibility of using such a practice for city management, the status of UA in Delhi will be studied vis-a-vis the process of urbanisation, so as to assess the current position of UA in metropolitan city development.

Since the concept has gained grounds after the recent consciousness on environmental improvement, it has not yet been practiced very widely. This study is, therefore, going to be more exploratory than analytical. The main aim of this study will be to find out whether UA can really help in city management; and if so, to which extent? For a deeper understanding of the concept of UA, the strategies adopted in the other countries will serve as examples to estimate its role in city management.

The main objectives of the study will be:

- To understand the concept of urban and peri-urban agriculture.
- To study the role of peri-urban areas in city development.

- To examine the process of urban agriculture and document illustrative cases to highlight strategies adopted for city management.
- To examine the role of urban and peri-urban agriculture in city management.
- To review the government policies that are likely to influence urban agriculture in India.
- To review the National Five-Year Plans to find out the government's approach to urban agriculture in India; and finally,
- To study the status of urban agriculture in Delhi, in an attempt to assess the usefulness of UA as a component of city management for sustainable development.

Methodology

The study will be divided into three parts. Part I of the report will examine the concepts and strategies of urban and peri-urban agriculture and the role and contribution of the urban fringe in city development. This will be followed by a discussion of the possible role of UA in city management.

Part II of the study will review the policies and plans relating to or influencing urban environment in general and urban agriculture in particular in India, or the local level provisions made for it. For the purpose the study will scan the Environment Conservation Policy, the Landuse Policy, the Siting of Industries, the Pollution Abatement Policy and the National Five-year Plans, in an attempt to establish a position for urban agriculture in city development.

Part III of the study will examine the status of urban and peri-urban agriculture in Delhi by studying the available data and information on Delhi, including the Master Plan and other published research papers to analyse the influence of urbanisation on UA with regard to employment, food production and waste assimilation, in order to assess the role of UA in city management.

Chapter III

THE PERI-URBAN BELT AND CITY DEVELOPMENT

The peri-urban zone or the rural-urban fringe is the area of mixed landuse and diverse economic activities immediately adjacent to the city, with characteristics of both the rural and the urban. It has strong interactions with the city in terms of daily commuting and exchange of goods and services. Peri-urban areas display a strong metropolitan/urban influence on its physical, occupational and demographic structure. Usually located outside the municipal corporation limits, it is a zone of transition at the edge of the city where because of urban growth pressures from the city there is a continuous intrusion of urban development into rural areas (both in the agricultural lands, as well as the habitats). With scope for further growth, because of its developing nature, peri-urban areas inculcate a certain amount of flexibility in their structure that can be moulded to suit developmental activities.

The uncertainties in the peri-urban areas are caused mainly by the lack of urban services, a not so well developed landuse and an indefinite employment pattern. However, these areas are highly dynamic and if monitored well, can grow into efficient and attractive suburban zones. Unfortunately, the peri-urban areas of Indian cities are often chaotic, as agricultural land is not systematically converted into urban land. Frequently, agricultural land along the city limits is left fallow for speculation. Experience shows that when agricultural land is not cultivated for a long time, it contracts all the ills of urban pollution. To add to it, the misuse of landuse like setting up of brick kilns for construction and more development, or the motor repair centres, or siting small scale industries using toxic chemicals along the city's periphery, makes it unfit for agriculture. Subsequently, as population increases and land values rise because of greater demands, this land is drawn into the city limits as "urbanisable", so that the city can expand beyond its physical limits to accommodate more people and activities. It has been observed that farmers hold on to peripheral agricultural land until the price of the land becomes more than the income from agricultural productivity, after which it is sold for urban use.

The growth and extent of peri-urban areas depend on the rate of urban growth and the size of the city. The more the pressure of population, the greater is the need for city expansion and infrastructure development, and the faster is the fringe area formation. Conversion of rural land to urban is usually influenced by scarcity of serviced land, high land values within the city limits, speculative land and/or the housing market, lower land values on the fringes, and the absence of building regulations outside the city limits of which people take advantage. Being outside the city's administrative area, physical planning is not extended to the peri-urban zone. Therefore, the growth of any peri-urban area is haphazard, until such time till it is drawn into the city's jurisdiction and provided the support of planned development, giving way to new peri-urban formations. However, in Development Plans, peri-urban areas are often designated for special activities.

The rural-urban fringe is a concept (recent in India) that has emerged with the advent of the motor vehicles. In the olden times, city limits were clearly defined by walls, moats or other protective structures. The fringe areas in those days were outside the city walls. Today not only have these physical barriers been removed, the invention of the motor vehicle and the rapid transit system have made the rural-urban fringe a common feature of urban growth. The transformation, however, is gradual, with a distance decay function, displaying more urban developments closer to the city than farther away (Dwivedi:1992). As demands on land by a large population are more than those by a small population, metropolitan cities not only have larger peri-urban belts around them, but these belts also have diverse activities therein. The range of activities depends on two factors - the increase in the communication facilities/skills and the size of the population. For, the larger the population, the more varied are the activities; and the more efficient the communication facilities, the farther can urban activities travel.

The predominant features of the rural-urban fringe are the presence of industries, landfill sites for solid wastes that pollute the city, cremation grounds, cemetery and/or activities that are socially morbid, activities that require plenty of space such as the airports, railway sidings/yards, warehouses, recreational activities in large open spaces (catering to the urban population), institutions needing large campuses, suburban high income housing and/or resettlement colonies of the low income population of the city. Along with all such urban features can be found plots of

agricultural land and clusters of farmhouses of the agriculture labour that ultimately deteriorate into slums.

In a developing country like India, housing in the peri-urban areas focuses on two extreme requirements: the shelter needs of the priced-out population of the city, and/or the expensive farmhouses that take advantage of the cheap land available in a city's periphery, along with an efficient commuting system in order to interact with the city centre. In city fringes, where the landuse pattern is systematically laid out, industrial townships to house workers close to their place of work can also be found adjacent to the industries located in the city's periphery.

A feature that has come up with the growth of metropolitan cities and expanding peri-urban areas, is the development of transitional agricultural activities like poultry, dairying, floriculture and market gardening to cater to the urban market. These can be intensely produced on small plots of land within a limited time frame. Besides, since the demand for such perishable products are high, these agricultural activities are more conveniently practiced in peri-urban locations, as closeness to the city can reduce trucking and refrigeration and thereby the cost. Peri-urban agricultural activities generally provide employment to three sections of the city's population: the native agriculturists who once lived in or adjacent to the city and are now being pushed away from the city because of landuse incompatibility and environmental problems (as in the case of dairying); the rural to urban migrants who take to transitional agriculture in the periphery in the absence of permanent employment and housing within the city; and for those who consider horticulture, pisciculture, floriculture, etc. as a business proposition to cater to the growing urban market, by producing highly perishable and rare products like mushrooms, flowers, milk (and butter, cheese, ice cream, etc. from it), green vegetables, poultry, etc. These are also the highly priced food products that have better prospects in an urban market because of the high purchasing power of the city population and on account of the changing food habits. It is to be noted that peri-urban horticulture/agriculture has the characteristics of rural farming, with an added advantage of being exposed to a very strong (urban) market.

It has been observed that the Master Plans of cities (like Delhi or say Varanasi) often make provisions for such activities (as mentioned above) in the peripheral zones of cities. In the Master Plans of Delhi and Varanasi (to cite examples) there are provisions for farmhouse development on

large plots of peripheral land (of one acre plots in Use Zone A.1 in Delhi) that work as a buffer zone between the city and the other towns, or between the city and the typical agricultural fields. The Master Plan of Delhi also proposes a system of linked open spaces and district parks, to be interconnected by green linkages penetrating even through residential areas within the city. The zoning regulations of Delhi have also permitted the development of non-commercial farms, agricultural gardens, nurseries and green houses in residential zones. An agricultural green belt has been proposed around the city, with permission for horticulture, dairy, poultry, farming, milk chilling centres, farmhouses, etc. In Use Zone A.2, which is more rural, all the above mentioned uses are also permitted. The Master Plan of Varanasi has also proposed similar "agricultural" activities in its Use Zones A.1 and A.2 circumventing the city.

Irrespective of the details, the very concept of rural-urban fringe means the co-existence of rural and urban features, with agriculture and industry juxtaposed on the city's periphery of partially integrated and mixed land use, supported by an urban way of life and rural-urban interaction. Peri-urban belts are thus areas of perpetual conversion from rural to urban. Any peri-urban area is, therefore, more dynamic than the city. Of course, the latter has a more stable structure and employment pattern. The conversion of land and the economic activities within a peri-urban area is often guided by the policy regulations of planned development and city planning. The changes that occur are from agricultural to industrial and then to tertiary activities; that is, from green to brown (in the environmental management parlance).

The peri-urban belt acts as a common ground for both the urban and the rural developments. However, with the progressive urban development and the receding agriculture, the role of the zone is to absorb and assimilate the spillover from the city. This alters the rural characteristics, where very often agriculture starts catering to the immediate needs of the city (as mentioned above) and not to the overall grain/cereal production of the nation.

The rural-urban fringe is also considered to be an area that can be polluted easily; for industries that would otherwise spoil the quality of life of the inner city are shunted into the periphery, away from the wealthy sections of the city, to prevent the risk of pollution affecting the health of the majority of the urban population within the municipal limits. So is it with the solid waste dumps and the landfill

sites. Given the nature of activities and land use, the peri-urban area is a zone where pollution would otherwise be more, but for the less intense use of land because of incomplete developments interspersed with agriculture that keep the pollution levels low. In fact, conditions within a peri-urban area are influenced by the policy decisions taken on industrial location, pollution abatement, transportation developments such as the building of highways and metro bypasses, development of housing, resettlement colonies, location of specific activities and any other planned urban expansion.

Thus peri-urban areas harbour both positive and negative impacts of city growth. While increasing food requirements because of rapid urbanisation has introduced the cultivation of highly priced perishable products in the city fringes, generating special types of employment in urban agriculture; environmental management policies and practices have pushed out the polluting industries from the main city to the periphery. Residential attractions for the periphery are also dichotomous: with a juxtaposition of the rich and the priced out city population, both enjoying the benefits of the peri-urban zone in their own way.

Chapter IV

URBAN AND PERI-URBAN AGRICULTURE

Definition and Concept

By definition, urban and peri-urban agriculture is food and fuel grown in and around cities (where land is meant for non-agricultural activities) directly for the urban market. It means growing crops, raising livestock or otherwise harvesting of edible produce (for humans and animals) in urban spaces, or areas adjacent to it, for sale within the city. It also includes cultivation of crops and animal husbandry on roadsides, along railroads, in gardens, backyards of houses, on roof tops, within utilities rights of way, in vacant plots of industrial estates, on the grounds of large institutions and along rivers (often using recycled urban solid and liquid organic wastes as resources); aquaculture in tanks, ponds and rivers; orchards and vineyards and street trees and even floriculture, food processing and food vending within the confines of the city or in the periphery.

Urban agriculture normally produces goods for the daily urban market. It does not specialize in cereal crops. But that does not mean that UA does not cultivate grain crops at all. For instance, fields of mustard, wheat and millets are visible on the floodplain of the river Yamuna in Delhi, though water melons, flowers, spinach and vegetables are more common. These vegetables are sold in the informal "farmer's markets", close to their areas of cultivation. UA is typically intensive cultivation of high yielding crops, producing 3 to 15 times as much per hectare than by common rural methods, dominated by vegetable crops. It is considered to be more organic and sustainable than rural agriculture for two reasons: first, because the urban waste which is used as fertiliser is more abundant than rural waste and second because the urban farmer's labour intensive methods use less land and water per unit of production than when agriculture is carried out as an industry (Jac Smit: 1996).

The scale of urban agricultural production in the world is far above common perceptions. It was estimated that in 1993 between 15 to 20% of the world's food was produced in the urban areas (Jac Smit: 1996). The project, "Cities Feeding People" (1991) cites how Chinese cities are self-sufficient in perishable food crops and how UA is spreading in Asia. Ganapathy (1983) mentions

that only 6 sq.meters of area can produce all vegetables needed for a family of four. Other studies also indicate nutritional self-reliance.

Besides promoting market gardening, livestock production and aquaculture that augment the food supply of a city, urban agriculture (which includes the growing of trees) can also contribute to the quality of the urban environment as an excellent assimilator of solid, liquid and gaseous waste. It can even help to reduce the cost of waste processing through the use of recycled solid and liquid organic waste that not only helps to fertilise UA, but is a good management practice that can augment the cost of waste processing and disposing by the municipality, through the sale of manure to the city farmers. City management, therefore, has the twin benefits of fertiliser production and cost reduction from the use of city waste for UA. Urban Development Authorities that undertake avenue plantations, development and maintenance of parks, institutional areas and green belts, nursery raising, etc. to improve the city's environment, assimilative capacity and aesthetics, can also make use of such benefits to reduce the overall cost of city maintenance.

Practising UA is also a very efficient way of managing land. It utilises "idle" space under public possession or not suited for building; lands that can have an interim use while awaiting the assigned development within a city or in the periphery and community lands and household yards that can be utilised for vegetation (often as a pastime or for aesthetics), thus bringing value to the otherwise unused land, even if it is of a temporary nature, thereby contributing to the city's economy. By doing so, UA reduces the public costs of land maintenance and simultaneously yields benefits from the productive use of land.

UA can also help to conserve energy by shortening the distance between the points of production and consumption, and saving in storage and transport losses. This beneficial role of UA in reducing pollution and cost of city management, is being increasingly accepted as an effective urban management process.

Almost 50-60% of the household income is spent on basic food and drink by the low income group (Jac Smit: 1996). Being the largest component of household expenditure, any saving on food expenditure translates into significant addition to the family income, which is then available for non-

food purchases. Moreover, as mentioned above, urban production of food brings down the cost of food by saving on transport, storage and expenses on middlemen (which is part of the marketing structure). It also improves the accessibility of food for the urban poor. This is a very positive aspect of UA as it helps to contribute to the nutrition intake of the poor and avoid health problems through improved diet, even while "adding value to the local environment". In this context, it also serves as a social safety-net for the poorer sections of the society.

Urban agriculture also helps in employing marginal workers, especially the rural to urban migrants, who come to the city with no other skills than their agricultural expertise. Therefore, until such time they acquire technical skills for non-agricultural jobs, urban agriculture is often considered to be a panacea for the marginal workers and the rural migrants (who come to the city in search of employment). It also generates employment in food processing and business in perishable products, thereby improving the city's economy.

Therefore, even though agriculture and urbanisation are seen as typically conflicting activities, UA is increasingly being recognised as a realistic and desirable landuse option in urban areas and as an integral part of the urban system. Hence, interest in UA is growing very fast. There are numerous examples of urban farming throughout the world, in countries like the US, Canada, China (with roughly 40 per cent of the urban jobs in agriculture), Hong Kong, Singapore, Papua New Guinea, Zambia, Kenya, Mozambique (the capital Maputo has 30 per cent in UA),etc. which testify the benefits derived from UA. In Berlin as many as 50,000 persons rent land to produce crops. In Dar es Salaam 68 per cent of the city workers produced food in 1988. The common belief is that the future of UA is in Asia. Rightly so, as urbanisation is more rapid in the Asian countries today, than in the West (Internet Information: 1998).

Development of UA

The 1970s noticed an increase in farming in the cities (Jac Smit: 1996). The most typical activity in those days was home and school gardens. The UNICEF, FAO and many aid organisations supported community gardens, with the prime objective of improving the family diet. Unfortunately, most of these programmes failed because of local preferences and priorities.

In the 1980s a crucial role was played by the "Food Energy Nexus" project of the United Nations University. Papers were written on the status of food and energy production within and near towns, revealing UA as a global phenomenon. The IDRC engaged in a large number of studies using waste as a resource for UA, urban food distribution systems and food security. The USAID supported the Street Food Project, emphasising the importance of locally produced informal marketing of food products. The FAO was also actively promoting UA. Various agencies started funding UA projects, such as the Asian Development Bank, African Development Bank, Inter American Foundation, Overseas Development Agency, Oxfam, etc. UNDP too started the Healthy Cities project, integrating some aspects of UA, which is still continuing.

The 1990s began with the UNDP's "Urban Agriculture Initiative", which was carried out with the support of IDRC, UNICEF, WB, GTZ and CARE. The UNICEF also supported a number of studies in UA for women and children. The World Bank undertook a major study on UA in Sub-Saharan Africa and commissioned a regional study on vegetable production for sustainable cities. In 1992 the UNDP established the Urban Agriculture Advisory Committee, which in the following year led to the establishment of the Support Group on Urban Agriculture (SGUA) with the participation of various agencies and stakeholders.

Participants of the 1996 SGUA meeting decided to establish a Global Facility on Urban Agriculture (GFUA), which aims to stimulate activities in UA by national and local governments, NGOs, and agencies for international and bilateral development cooperation, and the direct involvement of local stakeholders (urban farmers, neighbourhood organisations, small entrepreneurs, etc.). The GFUA seeks to counteract roadblocks to UA and intends to actively support innovative action and research.

The Agenda 21 of the Rio Conference also emphasised the need for innovative and integrated strategies in urban landuse planning that took into account environmental and social issues and employment for the urban poor, especially small scale food production and food processing. Agenda 21 also recommended more funds for innovative research in re-cycling and re-use of urban waste, all of which are very conducive for UA.

Habitat II talked of labour intensive production (including UA) and creating access to land for the poor (1996). As mentioned earlier, Habitat II acknowledged UA as an integral part of the urban system. It considered the potential role of UA in increasing food security, employment and income generation, poverty alleviation and community resource development and waste management. The World Food Summit organised by FAO (1996) emphasised the different approaches required for food security for the urban poor.

UA is gaining importance today in the context of "sustainable habitat" and "ecological cities". In developing countries UA is considered as a panacea for employment creation and food security. However, the main constraints of UA are the biases city planners and policy makers have, imposing legal restrictions on the use of land and water bodies within and around cities for UA. Planners attach a higher value to urban land supporting housing and industries, than agriculture would give. In a city, every bit of land is intensely used for non-agricultural activities.

In European countries like Holland and UK, UA has always been an element of urban planning, although mainly with a narrow conception: home gardening. Of late, UA is being considered in a much wider context. The concept of "local initiatives" emerging from the Rio Conference, stimulated many countries to promote UA for multifunctional use of urban spaces, combining recreational, productive and environmental functions. UA is also being suggested to strengthen rural-urban linkages, of which UA could be a part. Also, the economic role of green spaces within cities is now being valued much more after the UNCED conference of 1992.

In Eastern Europe the spontaneous development of UA is dramatic since the collapse of the collective doctrine. Where the formal sector production is stagnating and incomes of urban people are declining, the interest in urban farming activities is booming in a large number of countries and cities. As in the developing countries, UA is considered here for employment substitution in the absence of organised sector jobs (Internet: 1998).

Therefore, an overall experience is that UA in the developed countries is being favoured for its multiple use of urban space and because of the possibility of decentralisation of urban waste management, whereby waste can be turned into resource at the local level. In the North UA is also

given importance for conserving energy and preventing pollution. In developing countries UA is prized for generating employment, supplementing household income and contributing to food nutrition and easy accessibility of food for the poor. Here waste assimilation and pollution control is only an externality. Hence UA is being encouraged in the South as an economic activity, much more than in the North.

Selected Strategies of Urban Agriculture

Reproduced below are a few case studies, mostly from South and South East Asia, which gives credence to the importance of urban agriculture. These cases have been specially selected to understand the significance of UA in the Indian context, where cities face similar socio-economic and management issues because of rapid urbanisation.

Lea (UNICEF: 1984)

The city of Lea in Papua New Guinea, in the sixties and seventies, experienced rapid urban and population growth that resulted in widespread destruction of forest land surrounding the city. The sudden increase in the population also brought about heavy dependence on imported food supplies that led to unemployment, malnutrition and a massive increase of solid waste.

The Lea City Council (formulated in 1977) decided to combat these problems. In order to increase the food and fuel consumption it sought assistance from the national government and international agencies to form a comprehensive plan focussing on:

- a) allotment gardens
- b) composting agro-forestry
- c) regulation of food imports.

Allotment gardens were constructed on city lands and assigned to low income residents by the city government. The crops were fertilized with locally produced compost. Technical assistance was provided by the city horticultural staff in crop selection, planting techniques, etc.

Compost production is a method to recycle solid wastes for nutrients that can be applied in allotment

gardens, so that the amount of wastes at landfill sites can be reduced. After non-biodegradable objects like glass, metal etc. are removed, urban-derived solid wastes are combined with manure and composted. The final product is fertilizer, which is used for the city gardens and the surplus is sold to commercial farmers outside Lea. During the first two years of the programme, 1,500 tons of compost were produced. Eventually 11,000 tons of compost will be produced per year, thereby reducing the amount of solid wastes by 10 per cent.

Lea's urban food and fuel programme is a comprehensive urban agricultural strategy which is being practised very extensively all over the world. Such improvements in urban agriculture also help in reducing or eliminating pollution by utilising urban waste, which in turn takes care of public health.

Shanghai (Yeung:1985)

Shanghai has systematised food production within its city region by expanding its boundaries by almost ten folds in 1958. A unified, coordinated regional food system has superseded a fragmented, individual decision (UNICEF: 1984). The control of production, distribution and marketing of food has been transferred from diverse operating units to the Shanghai Municipal Government. All growing and marketing of food followed centrally planned agricultural policies for the area, involving officials at the city, country and farm levels. Shanghai has recently allowed communes and production teams to transport and sell their produce directly within certain intra-city areal boundaries. Cross-province companies have been established to facilitate the flow of agricultural goods to the city and industrial goods to the countryside.

Another factor accounting for enhanced agricultural productivity is modernisation of farming achieved via mechanisation, electrification, water conservancy work and large scale provision of modern inputs. A direct outcome of these improvements in farming practices is the intensification of cropping patterns. In Shanghai, the city is bifurcated into inner and outer zones. The inner zone (10 kms. from the city centre) produces 76% of the vegetables consumed in the city.

By introducing the above mentioned strategy, the Chinese concept of urban self-sufficiency in food has, by and large, been translated into reality. Shanghai is self-sufficient in vegetables, most of the grains, pork, poultry and other foods. In fact, it exports surplus grains and vegetables.

Hong Kong (Yeung: 1985)

The city produces about 45% of its fresh vegetables, 15% of the pigs and 68% of the live chicken in 10% of its total area. Vegetable growing and fish ponds occupied 31.1% and 18.20% respectively, of all the agricultural land use in 1979. Over 60 kinds of vegetables are grown in Hong Kong. Paddy cultivation has dwindled to insignificance because of its relative unprofitability and rural-urban migration. Pond-fish culture (important source of food in Hong Kong) is being taken up for urban development. There is also intensive livestock farming in Hong Kong. Wastes from food processing plants are fed to pigs.

Singapore (Yeung: 1985)

Singapore grows 25 per cent of its vegetables consumed by the population. The city-state is self-sufficient in pork and poultry, and has a surplus of eggs and chicken for exports. The city also has a thriving specialised industry of orchids (primarily for exports). In the face of rapid urban and industrial growth, agriculture has had to make significant adjustments. The first has been the loss of agricultural land. There was a resettlement programme for the farmers between 1957-75. The need was felt for a major realignment in case agriculture was to remain as a viable economic sector, against the background of rapid urban-industrial growth. The government policy towards agriculture in Singapore is based on three objectives: (i) a high degree of self-sufficiency, (2) no subsidies, and (3) development of large-scale, modern and fully commercial type of farming business.

Pig farming is a leading agricultural activity. Next in importance is the production of poultry and eggs. But while pig farming is reducing, the other two are expanding. Since the area under such farming is not increasing, this is an indication of technological progress. Vegetable production also remains stable despite a decline in the farm area. High yields are maintained through higher intensity of land use, by adopting multi-cropping methods, hydroponics, and short-growing varieties. Specialised and intensive farming schemes are also developed, for orchids, aquarium fish, mushrooms. The key to Singapore's agricultural activities is economical and rational use of limited land resources. Urban agriculture in Singapore is a model of maximisation of economic returns through selective emphasis, with central planning policy interventions.

Metro Manila (Yeung: 1985)

In Manila three major measures with respect to urban agriculture are worth mentioning: (i) stimulating food production for the nutritionally at risk, as mentioned in the Five Year Philippine Development Plan (1983-87), including the poor in Metro Manila; (ii) government encouraging food production within urban areas - providing "home garden" around new low-income housing and multi-storey housing estates of Metro-Manila; and (iii) encouraging agriculture within the city by promoting unused and idle land within the centre of Metro Manila (declaration issued by President Marcos) or with the landowner's consent, giving people the right to cultivate land in the owner's absence. The same rule applied to public land adjoining streets or highways.

The programme of "community garden" of Barrio Matalahib in Quezon city within Metro Manila is notable for its success lessons. Starting on a disputed land, it produced crops of mustard, sweet potato, greens, kangkong, egg-plants and other leafy vegetables, meeting 80% of the need of 400 families of Barrio Matalahib. Squatters produced their own food. The lesson is clear: given land, organisation and official blessings, the poor would seize any opportunity to grow their own food; and they usually excel at it. This experiment can be seen as a panacea to solve social problems.

Urban Horticulture in Dar es Salaam Inner City (Howorth: 1995)

Dar es Salaam has a high population density with relatively low income. The city is unplanned, with shortage of space and basic resources. The purchased inputs are low because money security is low. Horticulture is carried out mainly for supplementing the diet, with any excess produce being sold locally within the community rather than the market e.g. in the town/area of Vingunguti, farming is mostly done by women who use traditionally constructed local shallow wells to water their plots of 10 sq.meters, while the fertiliser comes from home produced compost from their household waste and from goat manure from the local slaughterhouses. These are mixed with ash and applied to agricultural plots that grow tomatoes, eggplant and spinach. About half of this produce is sold to neighbours, whereas the other half satisfies domestic needs. This strategy is a good example of how low income group citizens have sustained agriculture within their limited means and resources at the local neighbourhood level despite shortage of space.

Internet Information (Jac Smit : 1996)

Some internet information from GFUA describing the importance of UA is given below:

- Ms Luna in *Valparizo* raises one-third of her family's nutritional needs during the year. This one-third includes two-thirds of their protein and micronutrient requirements. On a recent study tour to 20 countries for the UNDP, the author discovered that there are hundreds of millions of Ms Lunas in Asia, Africa, Europe and North America, as well as in Latin America.
- Nine out of ten families in *Nairobi*, who have access to land, are food producers.
- In a somewhat richer country like in Russia, two out of three families in *Greater Moscow* raise food. In recent years, the people of Russia have experienced severe basic food shortages. The main function of the Rooftop Gardening Program in St. Petersburg was to conduct research and development of garden techniques.
- In wealthy countries, like in *USA*, 16 million families in urban and suburban census tracts raise vegetables, that is almost one-in-three of all American urban families.
- In *Los Angeles, California*, the Top Vegetable Family Farm located under the electricity pylons owned by Edison Utility is a thriving commercial success. In purity tests, their produce was far superior to the vegetables available at the supermarkets.
- In *Istanbul* UA is widespread. It is practiced by people from a wide variety of socio-demographic backgrounds. However, availability of a reliable supply of water is a major constraint. UA of Istanbul displays a wide variety of opportunities, resources and skills. Economically it ranges from household gardens to commercial greenhouses, from harvesting for household consumption to harvesting for sale.
- In the *Middle East*, aridity is the single greatest factor affecting UA, where evaporation exceeds precipitation. Hence, the linking of UA to wastewater reuse is vital in the Middle

East. Aridity affects the type of crops that are grown. Some crops show greater productivity in limited land and are more suited for UA, having higher potential for the adoption of intensive, commercialised techniques, less susceptibility to contamination from polluted soil, air, or irrigation water and the ability to fulfil multiple purposes: for example, the fruit bearing trees of the arid-region such as figs, dates, mulberries, olives, etc. which can also act as ornamental trees in urban areas.

- In *Mongolia* in 1990/91, 850 families grew vegetables in the city. In 1992 a program to improve food/nutrition was started by the order of the National Development Board, which is part of the Prime Minister's Office, giving special emphasis to vegetable production in urbanised areas. The year 1993 was proclaimed the "Food Year in Mongolia". In 1994 the Agricultural Consultancy Exhibition, based in Ulan Bator was started as a one-stop extension service centre for gardeners to learn about UA and to buy seeds/seedlings, fertilizers and tools for their gardens.

A project, "Model Ger Area" ("ger" is a felt-covered traditional nomadic dwelling) was started in the suburbs of the city in 1994. Ten poor families were given support. In 1996 the programme was expanded to ten different ger micro-districts. Teachers working in the programme were selected from gardening experts living in these places, each having his own plot of cultivated land. The responsibilities of the teachers were:

- they must grow plants on their own premises;
- they must organise training classes and allow visitors to come to see their garden;
- they must teach ten of the poorest families in their area who want to start a garden;
- they must distribute and sell seeds/seedlings, fertilizers, tools and educational materials.

The milk production waste from small dairy stables in the east of *Mexico City* is used to grow an edible plant called *Napal*, which is native to Mexico.

The Indian Experience

Urban Agriculture in India is practised by various actors with different intents. The garbage farms of Kolkata and the vegetable plots on narrow strips of land along the railway lines in Mumbai are developed by growers and slum dwellers for commercial purposes. For the fisheries of Kolkata the sewage lagoons satisfy one third of the city's market demand for fish. In India most of the small scale dairy enterprises and poultry units are developed in and around the cities. Again, organisations like the COCO in Bangalore and Mother Dairy in Delhi, collect and market the products through consumer outlets. Moreover, individual households also grow vegetables, fruits, trees and flowers in backyard gardens and/or roof tops for home consumption.

Port Gardens, Mumbai (C. Pye-Smith: 1994)

The 37 acres Mahim Nature Park was a treeless garbage dump, with sprawling slums on one side and a polluted creek on the other. Today it is an oasis of green resource providing education to children and students. When the local authority called for ideas to develop this part of the city in 1977, the World Wildlife Fund for Nature (WWF) promoted an ambitious scheme which would tackle pollution in Mahim Creek, clean up the garbage dump and create a much needed green lung.

This Park has been designed as an outdoor laboratory with trails which traverse a broad spectrum of habitats: which are microcosms of the ones found in the state of Maharashtra. The garbage has been leveled, covered with topsoil, contoured and planted with trees and shrubs (some 12,000 in all) which 60 species of birds have made their home. For administrative purposes, Mahim Nature Park has initiated partnerships of individuals, governments, organisations and businesses.

Ahmedabad (Jac Smit: 1996)

This city decided to cut costs of management by allowing urban families to farm in the "green" belt. The programme has been successful in raising food security, employment, reducing the municipal budget and greening the city.

Kolkata Wetlands (IWMED: 1996)

The East Kolkata wetlands are the results of intricate drainage patterns over the moribund delta.

Physiographically the region lies between the River Hooghly in the west and the River Bidyadhari to the east. In 1930, when River Bidyadhari was declared dead by the Irrigation Department of the Government of Bengal, a storm water flow (SWF) channel was excavated. Later on, to facilitate efficient drainage, a dry weather flow (DWF) canal was laid parallel to the SWF channel. This change in the drainage layout resulted in the development of a changed eco-system linked with the environment of the city of Kolkata.

The entire domestic sewage of the city (estimated to be 680 million litres/day) runs through a system of principal and ancillary channels passing through the East Kolkata wetlands. These flows are utilised in the sewage treated fisheries for pisciculture as nutrients and the wetlands purify the sewage water through a natural process of oxidation, radiation, biological breakdown of organic waste and pisciculture. The tropical climate with moderately high temperature and abundant solar radiation and the shallow depth of water have facilitated the evolution of this unique ecosystem. This complete ecological process has been understood by the local fishermen very well, to generate resources and employment.

The practice of farming on garbage dumps dates back to the 1870s. The garbage dumps in Dhapa cover 800 acres. This unique system of garbage dumping by leaving long strips of water bodies in between two dumping grounds has helped to irrigate the crops and vegetables with sewage water. There are 2,490 farm plots. At present the Kolkata Municipal Corporation owns 350 acres of Dhapa. This area grows paddy, maize and all kinds of vegetables. The fish produced meets one third of Kolkata's requirements.

This is a unique cost-effective system of sewage and garbage disposal. Though Kolkata's location was the least likely place for a metropolis, the proximity of the wetlands came to the rescue of the city's environment. The city grew as a metropolis without any sewage treatment plant and all its sewage was drained through the wetlands where the garbage was dumped.

East Kolkata wetlands are peri-urban in location. Their functional use has developed them into a unique man-made ecosystem. The area is identified with waste recycling practices that not only provide fish, vegetables and crops throughout the year, but also support low-cost urban sanitation.

The spill basin helps to reduce water-logging in the city. However, East Kolkata wetlands are being threatened by the continuous expansion of the city. The wetlands also provide employment to a large section of the society.

Technology Development

Urban agriculture practised wisely can give a boost to public health concerns. Particular to this is the use of recycled urban waste as agricultural inputs, especially where water is scarce. Efforts are normally made to use waste water after minimum treatment, to prevent the spread of diseases. Biological wastes can be used for small farms and thereby maintained with low investment and operating costs. Chinese cities are the best examples of very productive urban waste recycle technology for agriculture. This technology is being practised in the cities of Hong Kong, Singapore and others. Sewage can also be recycled for purposes of aquaculture. A good example from India is Kolkata, where in the wetlands fish is raised using self-purified sewage (Ghosh and Furedy: 1983). Human waste used for renewing the fertility of vegetable farms in Kolkata, is also an age-old practice in China.

Hydroponics, a relatively new farming technique is yet another method being practised in land-scarce cities like Hong Kong and Singapore. It involves scientifically controlled mixtures of plant nutrients and water to be supplied to vegetables and fruits as per requirements. By this method multiple tiers of vegetables and fruits can be grown on the same amount of land, with manifold increase in the production levels.

Another farming technique increasingly used in Chinese cities, following established practice in Japan and Korea, is the use of vinyl plastic covers and structures to protect early spring plantings against late frost. This method also helps to control plant diseases, and is especially employed for growing frost vulnerable crops such as tomatoes and lettuce.

Israel and Jordan have developed techniques for controlled watering in greenhouses and outdoors. Israel, Tunisia and Morocco are experimenting with the recycling of used water. The Arabian Peninsula is trying to promote desalination of sea water and the use of halophytic crops.

Religion influences UA by guiding the production of certain food items. For example, rearing of pigs or goats, which is helpful for the consumption of organic waste, is often prohibited by a few religions. There are also some gender based socio-spatial issues of UA, especially in the Islamic countries, which influences technology and the growing of crops.

Finally, some factors like application of fertilizers, adoption of high yielding varieties and a more reliable and adequate supply of water will also materially increase production.

The Relevance

Historical development of UA reveals that this practice is a global phenomenon, which started long back in almost every country (eg. in China in the 1870s) to supplement family diet and which was basically a concept of poverty alleviation. But over the years the focus has widened to include many environmental and socio-economic issues of urban management like energy conservation, pollution control, waste assimilation, landuse planning, food security, employment generation and so on. Thus the primary focus on poverty alleviation and health care extended to physical, economic, social and environmental upgradation. However, since the inclusion of UA in the planning process of India is still uncommon, the main driving force behind the development of UA is the market value of agricultural products and its income earning capacity. The other benefits arising from UA are externalities from which a city benefits when UA is practiced for income support. However, an element of planning can be traced in the local governments trying to promote tree plantation or the development of greenery in and around cities, to maintain lung space. This aspect of UA does not generate income for the city directly, but often helps in contributing towards poverty alleviation when the upkeep of such areas are leased out, like in maintaining parks or collecting the fruits of roadside trees to be sold by individuals. However, by doing so, the city saves on the maintenance cost of such public property. In some cases this leasing even creates regular employment. Besides, planting of trees helps in pollution control and waste assimilation, which is why they are grown.

The two dominant planning issues emerging out of UA debates are:

- Who benefits from UA as (i) a source of food security, (ii) as an urban industry, (iii) as a landuse option, (iv) as a method of waste management, (v) as a devise for pollution control

and (vi) as an environmental intervention? and

- How significant are these benefits? To which extent does it contribute to city development and management?

As a newly found development planning element (as adopted from the Habitat II and the Rio conference), many management issues come up while promoting UA. For example:

- Whose responsibility is urban agriculture? How can the issue be dealt with at the local level? Should it be the concern of the Agriculture Department, or must it be administered by the local government?
- Do all stakeholders/beneficiaries contribute towards UA?
- Is UA allocated development funds?
- It is envisaged that UA benefits different sectors of development (economic, social, environmental): hence, who should integrate the operations and how?
- What kind of institutional arrangements exist for monitoring the nature and magnitude of UA?
- UA is considered to promote a social safety network for the poor. What kind of management does it entail?
- To which extent should benefits from urban agricultural policy be balanced against the constraints of other land use options?
- To which extent can urban agriculture solve solid, liquid and gaseous waste management problems? Is it a good way of taking care of the city's sewage, garbage, or air pollution?

However the benefits that will accrue, if UA is contemplated as an important social, economic and environmental management intervention that will help the city economically and uplift the poor socially, are as follows:

- UA makes efficient economic use of underutilised and unproductive space or "idle" lands, thereby adding more value to it.
- UA improves urban physical environment/aesthetics by adding more vegetation/greenery in and around cities. It also improves the bio-diversity.

- UA adds to the city's income by giving employment to the poor.
- UA enhances food security by making high value nutritive food more accessible to the poor.
- UA uses municipal solid waste in farming, thereby enriching degraded soils and protecting the environment by reducing the use of chemical fertilizers.
- UA digests waste and helps in controlling pathogen pollution and health problems by converting organic solid waste and waste water into resources and using them for vegetation, crop production, fish and livestock raising.
- By using waste water, urban agriculture reduces the pressure on the use of groundwater and potable water.
- UA is often useful in town planning for enhancing the waste assimilative capacity. For example, one sugar maple along a roadway removes in one growing season 60mg of cadmium, 140mg of chromium, 820mg of nickel and 5200mg of lead from the environment. In fact UA can use pollution resistant species of vegetation to improve the air and the soil quality. Besides, there is 7db noise reduction per 100 ft. of forest due to trees reflecting and absorbing sound energy.
- UA provides good lung space, while being productive. Stressed individuals recuperate faster when viewing tree filled images. Thus, UA benefits human health and welfare.
- UA can recycle waste water and thereby solve sanitation problems.
- UA slows down public health deterioration.
- UA supplies fresh food to the city market.
- UA reduces transportation and refrigeration costs and pollution.
- UA benefits the small producer.
- Farming brings a community together and promotes association with nature despite its urban location.
- UA influences the micro-climate by reducing the temperature. The city is greener and cooler with UA, which adds value to the local environment.

There are, of course, a few problems that plague urban agriculture. For example:

- Since agriculture in an urban setting is a non-compatible landuse (as it is considered to be

rural), economists treat agriculture within a city as an externality. As a result, investments in urban agriculture are low and given less importance.

- Land within a city is highly priced; hence agriculture within a city is done only on marginal lands, as according to city planning criteria agriculture is not intensive use of land. Therefore use of land for urban agriculture is of low value vis-a-vis housing and industries. City planners are, therefore, averse to UA.
- Expansion of the city into the fringe farmlands make peri-urban agriculture an ephemeral economic activity. It is, therefore, not very reliable. It is only a temporary utilisation of land, and a temporary solution to economic problems.
- Proportion of workers employed in agriculture within or near a city is less.
- With industries located outside cities, peri-urban areas have air pollution from industries (for example, Delhi's industrial location policy is to remove noxious industries from within the city). This is harmful for vegetation and crop growth. Also cultivation along roads suffer from vehicular pollution, leading to heavy metal contamination.
- Severe air pollution within a city from motor vehicles and industries leads to poor land and crop quality and incidence of pests.
- Ozone formation from air pollution in and around cities affects agriculture negatively.
- Use of chemical fertilizers and pesticides can contaminate the soil and thereby the underground water through the leachate process. In India groundwater is often used in cities without adequate treatment, to supplement the municipal water in case of shortages. Under the circumstances, it proves to be harmful.
- UA leads to accumulation of organic waste, when plants lose value after the crop harvest.
- UA along river banks and slopes can cause soil erosion (from tilling of the soil) and siltation of streams.
- Information on urban agriculture within cities is incomplete.
- Water supply for urban agriculture is limited.
- Because of its ephemeral nature, UA is pursued in an uncoordinated and piecemeal fashion, and hence cannot be made very economical. There is no allocation of funds for its development.
- UA adds to the informal economy, which is considered to be weak or accommodative urban planning. It indicates a failure of the formal urban economy's performance.

- There are no clear cut regulations/policies for UA in a majority of the countries. It has no formal and/or legal recognition, which is why UA represents unplanned cultivation in the open areas of the cities.

Planning Issues

With lessons derived from debates on UA and the strategies followed in the different countries, certain planning issues are raised, which when resolved, will help city management. For example:

- What should be the nature and extent of UA to be carried out within cities?
- How much land should be given over to UA? What should be the quality of the land which can be spared for UA?
- Does UA really maximise returns from land?
- Does the transformation of rural land into urban, in the city's periphery, affect rural agricultural productivity?
- UA indulges in promoting the informal sector, which is harmful for the city's revenue.
- What is the extent of succour brought to the poor in terms of income or food security?
- FAO(1996) estimates that by the year 2005, 25-30% of the world's food production will be from urban areas. Judging by such estimates, how dependable is urban agriculture for attaining self-sufficiency in food for cities, especially when it is of a transient nature.
- Is UA significant enough to influence food import regulations?
- Should sale of products be restricted to the city only, as per the definition of UA?
- Does UA actually reduce the cost of waste management or land management?
- Does UA help in reducing food prices by saving on fuel, refrigeration and transportation, or is it a myth?
- Is UA a good substitute for other urban jobs?
- Should UA produce more than what the city requires? For any excess production might lead to exporting food, which will incur transportation, fuel and refrigeration expenditure and thereby nullify the benefits of having UA to save on such expenditures.
- If UA is practiced only on marginal lands by marginal workers, then UA assumes a social role. But if UA has to compete with other industrial categories, then cost-benefit will have to be calculated to estimate the economic benefits.

Much of the benefits from UA will depend upon the strategies adopted for environment management. If UA is to be used as an instrument of planning, UA will have to evolve methods and practices conducive to city management and to improve the quality of life for the citizens. However, the anticipated benefits from UA are still required to be proved in India. Therefore, our major tasks will be to find out:

- How to reduce pollution through UA?
- How to reduce the cost of waste management with the help of UA?
- How to reduce the cost of public land administration by practising UA?
- How to reduce poverty by promoting UA?
- How to increase income from UA?
- Do contributions from UA affect/benefit the city's economy?
- How to improve food security in cities?
- How to enhance aesthetics within cities?
- How to use UA for recreation?
- How to integrate the community with the help of UA?
- How to use UA for socio-economic development?
- How to use UA to regulate food imports?
- How to develop urban self-sufficiency in food? And finally,
- How to attain sustainability with the help of UA?

All these will mean that a series of action plans will have to be formulated to make UA an instrument for urban environmental management. Only then will we be able to measure the benefits derived from it.

Chapter V
THE ROLE OF URBAN AGRICULTURE IN CITY MANAGEMENT
FOR SUSTIANABLE DEVELOPMENT

Examination of the definition, concept, characteristics, practices and the possible benefits of UA lead to envisaging a multi-dimensional role of UA in city management. However, its potential to improve the city's economy and environment, as also the socio-economic status of the citizens because of employment in UA and better access to food and nutrition and thereby a good quality of life, is intimately connected to the process and extent of urbanisation and its impacts and the methods used for city management. Effective practice of UA will depend upon factors like the nature of city growth and administration, Plan-provisions for urban expansions that influence land use and activity zones, the institutional support available, the city's economy including the extent of poverty and unemployment, the quantity and quality of infrastructure support, and so on. To consider all these, a systematic approach will have to be adopted to integrate them into an efficient city management plan, including an environment management system. The different sectors of development that can be promoted by UA are:

- Food security
- Poverty alleviation
- Employment
- Economic development
- Community participation and social upliftment
- Land use planning and land regeneration
- Assimilation of solid, liquid and gaseous waste
- Environmental change, including microclimate
- Aesthetics and recreation

Each of these aspects will be discussed in this chapter, to assess the ability of UA to contribute to city management and human welfare.

Food Security

As a city grows in size and the need for food (in terms of quantity and variety) increases, UA can help in providing specific kinds of food that can be conveniently grown in and around the city. The two advantages of UA are an abundant supply of labour which can be found in a city and a ready urban market. Usually the types of food that are grown near cities are the easily perishable and highly priced varieties, to be bought by the urban market which has a better purchasing power than its rural counterpart. When food is produced close to cities, it can save on the costs of trucking and refrigeration by taking advantage of the proximity to the consumers for safe delivery. By doing so, it helps in conserving energy and preventing vehicular pollution. It has been generally observed that items like meat, fish and milk products that are highly perishable, benefit from being produced close to the market.

Metropolitan cities tend to diversify needs because of their large population base and exposure to a variety of cultures. This phenomenon follows the simple demand-supply logistics that help in determining the nature of UA. Some of these foodstuffs are of high value, from which farmers can earn large profits. The demand for special food items in metropolitan cities is changing the pattern of agriculture in and around them. For example, the cultivation of mushrooms and broccoli is gaining grounds in the Indian metropolitan cities, to cater to a newly created market by the diverse culinary arts that have invaded these cities. Because of the many cultures that are congregating in cities, food habits have got diversified, giving rise to a wide market. So far in India, mushrooms were considered to be ethnic and were grown mostly locally by native communities who had knowledge about its cultivation. Thus consumption was limited to a few communities and its production was restricted in space to just a few locations. But today, mushrooms have become very popular in large cities and are also easily available.

Similarly, the development of poultry and piggery for the production of chicken and pork has become very common. Statistics indicate (in the case of Delhi) a rise in the development of poultry (Table: 41) with urbanisation (the cause could be a rise in the population, as well as a diversification of food habits). However, it has been found that though a large number of poultries are registered, some still remain unregistered. There is a large supply of chicken in the informal markets of the city, of which no records are kept. Some of the smaller poultries are often informally tended by self-

employed persons. There are also instances of farmers switching over from food crops to even fodder crops that are required to maintain the livestock in the urban areas. This could be to support dairying or meat production.

Another example of how the urban market generates certain types of rural activities can be witnessed while assessing the demand-supply of milk production and distribution. The formal sources of public production and distribution of milk in the national capital are the Delhi Milk Scheme and the Mother Dairy, that meet only 40 percent of Delhi's demand for milk (discussion with agency personnel). It is, therefore, inevitable that the rest of the demand will have to be met by the private sector, some of which come from the formal sources of the neighbouring states, while the rest come from informal sources of the local or peri-urban farmers of which no records are maintained. However, this informal source is an effective generator of employment for the city dwellers.

A logical phenomenon is that the demand for any food item increases with population expansion. With large concentrations of population, cities form lucrative markets for farmers and traders. India is self sufficient in terms of food grains that are generally grown in the rural areas. Moreover, such items can be easily transported from long distances into the urban market, without the risk of any damage. Difficulty arises in transporting vegetables and other highly perishable products from long distances. The prices of such foodstuffs rise because of trucking and transportation. Producing such food items, close to or within cities, can avoid the cost of transportation and thereby reduce its price in the market. A positive externality arising from this, as mentioned earlier, is a reduction in air pollution with less number of trucks coming into the city.

There are different ways of looking at this market expansion. First, there is the need for more food that aims at higher production. This is purely a business proposition that improves the city's economy by generating more trade and commerce and providing more employment to the ever expanding population. It obviously indicates that urbanisation generates both employment and business, which helps to stabilise the economy. UA can, therefore, enhance the scope to improve the economic base of the city, leading to sustainability and often to self-sufficiency in food. As

explained in the section on UA strategies, many cities of the far east and south-east are moving towards such self-sufficiency, like in Hong Kong and Singapore.

Secondly, food security for the poor is a very important factor of socio-economic development. As mentioned earlier, about sixty percent of the incomes of the urban poor are spent on food. If UA can supplement income with home grown food for the low income communities, a fair amount of money will be released for other uses. As explained in the introductory chapter, many marginal workers earn a living from UA until they get regular jobs. UA can, therefore, be a very good source of food and income for them. In fact, many of them continue with UA to augment their income even after getting regular employment. Under the circumstances, UA often becomes recreational.

The third type of benefit from UA comes with the technical specialisation that are mostly available in cities. Therefore, certain types of agricultural practices can only be had in and around cities, like the food processing industry that also has a ready market in the city.

UA can, therefore, help in supplying food to urban dwellers in many ways: (i) as income to buy food (perhaps of better quality and quantity), (ii) provide more nutrition from the direct use of UA products, (iii) provide highly perishable foodstuffs that are also highly priced, and (iv) offer a range of exotic food products that have developed with modernisation.

Poverty Alleviation

Another way of looking at UA is that it provides employment to the not so well educated poor, especially those that migrate from the rural areas with very little technical skills other than a knowledge of agriculture. In India where rural to urban migration in search of jobs is a common practice, UA is a standby until such labour force gets absorbed into the formal job market. Very often they move from one informal job to another. It has been observed that agriculture is considered to be a temporary solution because of its low value in the job market, where skilled jobs are better paid. The value estimation is done in the context of the fact that agriculture is generally not permitted in land that is put to urban use. Therefore cultivation of crops is transitional and impermanent and is not considered as a stable job opportunity and a permanent source of income. However, it certainly covers a risk for the poor. But, UA has always been considered by economists

as an externality. Therefore not much attention is given or investments made for agriculture within a city by the planning/development authorities.

An analysis of the proportion of those employed in agricultural activities within DUT (details given in section III) indicates a rise in agriculture labour with time, even though the overall proportion of the labour force in this industrial category is low. The census figures of Delhi also point out to a rise in women cultivators indicating new practices being developed for agriculture and animal husbandry, like mushroom cultivation, farming of vegetables, poultry, piggery, etc. all of which are permitted to be done in the peri-urban zone of the city, as referred to in the Master Plan. Besides, the farmhouses in the periphery of the city also grow exotic flowers for the international market (digressing from the definition of UA). Hence UA seems to be a lucrative business.

For the poor marginal workers UA supplements their income from other lowly paid jobs. UA is a relief for this section of the society as it increases their food security.

Employment

As the market for food expands, the scope for employment is bound to rise. The issue here is whether employment in the food industry should be included in UA. If the term UA is used in a broad sense, then food processing within the city can be considered as UA (as discussed in the Introduction). However, even if only the growing of food products is considered to be UA, employment in UA will still indicate a rise over the years because of the sheer need to provide more for a growing population.

The growing of food crops within the city by the poor and the marginal workers add to the job opportunities of the poor, who do not have to invest on land as UA is carried out mostly on marginal lands or as a transitional occupation. Also, in many cities in India, where fruit trees or cash crops are grown on public land, like the "jamun" or the "semur" trees in New Delhi, they are leased out to individuals by the city government during the harvesting season, who also maintain the trees. This

then becomes a source of earning/employment for the poor. The maintenance of parks and urban forests often provide regular employment to many.

UA is considered as a business proposition for a growing market. Especially when large investments are necessary, it is the rich who invest in UA as a business. Often these cultivators recruit labour to carry out UA, thereby employing the poor. There are ways of interpreting this situation: either that the poor has taken to agriculture in the marginal land, or that the growing agriculture business is employing more people, including the poor. In both the cases opportunities come up for the poor. As mentioned earlier, UA generates employment mainly for three segments of the population: the rural-urban migrants who only have experience of cultivation; those agriculturists who once lived in the periphery of the city that has been now added to the city with areal and population expansion, for whom agriculture has been the main occupation; and those who take to agriculture as a business with the growing urban market. Thus UA can provide employment to both the rich and the poor. Census figures reveal that there is an increase in the proportion of agriculture labour in Delhi, over the years. So for all practical purposes, UA does generate employment opportunities, especially for the poor.

Economic Development

Though agriculture is a contradiction to urban, producing food within the city is supposed to improve the food security situation, so that cities can become more self-sufficient. This does not mean that food cannot be obtained from distant sources. Ideally, if a city is able to supply large proportions of its needs in vegetables, fruits, livestock and fish (that is, those food items which are perishable) from within its own precincts, it develops a capacity to conserve energy by shortening the distance between the points of production and consumption, saves on storage and transport losses, avoids pollution from vehicular movement (that otherwise leads to health and crop losses) and promotes employment and thereby economic self-sufficiency. The additional urban production improves the accessibility to food or income for the poor urban families and often brings down the costs of food. As mentioned before, saving on food expenditures translate into a significant portion of the family income becoming available for other non-food expenditures. Urban agriculture can not only reduce dependency on inputs from outside the city, but also generate more efficient use of

resource flows within the city, and bring about reduction and re-use of waste flows (water and biodegradable solid waste) whenever possible.

As mentioned by Yeung (1985), food for a city has to be purposefully planned and certain policy options should be exercised in view of an ever-growing urban population and their food requirements. Lessons for food production within cities can be taken from Chinese policy goals where:

- integration of funding and management is planned among agriculture, industry, and commercial enterprises;
- productivity is improved through integrated movements in educational, scientific and technical skills; and
- reduction in the gap between the city and the countryside, and between industry and agriculture is considered during "food planning" for the city; and
- urban agriculture is considered to be a part of the overall urban development.

This approach ascertains the role of the state in developing UA. It promotes research and controls countervailing market forces. Institutions like producers' cooperatives, neighborhood associations, citizens groups and voluntary organisations are promoted; and measures such as incentives, subsidies and tax rebates are used to promote urban agriculture. It can be suggested that some of the development assistance with respect to agriculture and related fields can also be spent in the urban areas (Yeung: 1985).

Besides self-sustainability of cities in terms of food security and providing low cost food to urban dwellers, other economic factors that support the growth of urban agriculture include: proximity to markets and consumers, efficient use of land and urban solid waste and waste water, management of animal waste, reduction of public costs for land maintenance or municipal services and employment generation for the poor and/or the marginal workers. All these measures save on costs of maintenance in some form or the other. In fact, UA has already been acknowledged for its potential

role in increasing food security, employment and income generation and environmental sustainability in Habitat II at Istanbul in June 1996. In urban areas, the increase in need with a growing population helps to create more jobs and business, both of which contribute to the economy of the city.

Community Participation and Social Upliftment

Urban and peri-urban agriculture can earn a living or supplement the regular income of those practising it even when farming is only part of their economic activities. This role can be particularly important when farming is practised for subsistence and when it is essential for the very survival of the people concerned, as is shown in the case of Dar es Salaam. This city has a high population density with relatively low income. The city is unplanned, with shortage of space and basic resources. The purchased inputs are low because money security is low. Hence in Vingunguti, an area in Dar es Salaam, horticulture is carried out mainly to supplement the diet, with any excess produce being sold locally within the community rather than the market. Farming here is mostly done by women who use a traditionally constructed local shallow well to water their 10 sq. meter plots, while their fertiliser comes from home produced compost from their household waste and from goat manure from the local slaughterhouses. These are mixed with ash and applied to agricultural plots that grow tomatoes, eggplant and spinach. About half of this produce is sold to neighbours, whereas the other half satisfies domestic needs (Howorth: 1995). Such a strategy is a good example of how low income group citizens have sustained themselves through urban agriculture within their limited means and resources at the local neighbourhood level, despite shortage of space. It is also a very good example of how UA can promote community participation and social upliftment in city management.

In Delhi, UA is bringing about a structural change in the traditional agricultural areas. The SEEDS report and the primary surveys done for this study indicate that members of many erstwhile cultivator families are moving over to non-agricultural jobs. However, agriculture is still retained and their income is supplemented by UA. In fact, this pattern can also be found even among the poor who cultivate marginal lands despite being employed in the informal sector.

It has been observed that in cities, which otherwise inculcate heterogeneity, farming helps in

community development by organising homogeneous groups. Besides, farming is a good exercise and is beneficial for physical and mental health (Joe Howe & Paul Wheeler: 1999). Farming also supplements the diet and therefore fosters socio-economic upliftment.

Landuse Planning and Land Regeneration

Urban agriculture per se is a paradoxical phenomenon; for conceptually agriculture is the prerogative of the rural areas, and its inclusion in the urban development plans is considered to be backward (Yeung:1985). Hence, practically all development assistance for agriculture and forest in India is confined to rural programmes. Thus urban agriculture is deprived of any plan support, even though within a city the maintenance of parks and roadside trees is the responsibility of the horticulture department of the municipality or that of the development authority. Urban agriculture, therefore, is considered to be an incompatible landuse, unless used as buffer zones between built areas for assimilation of pollution, especially in the form of lung spaces. Norms are generally set by planners regarding the density and the nature of use of land and pollution within a city is closely linked to the land use. However, within the city urban forests are said to "absorb" pollution much better than agricultural/horticultural crops. Hence, its promotion within the city needs proper examination of land values and benefits, for economic viability.

In the framework of the Sixth Five-Year Plan in India, a mention has been made of the cultivation of marginal lands, without specifying rural-urban locations. Land within a city is highly priced. Therefore, unless agricultural productivity is equivalent to industrial productivity, or certain social expenditures, urban agriculture will not be cost-effective. Often social costs of ignoring environmental requirements may have dire consequences that will entail larger costs than what was avoided. For example, if lung spaces are not maintained, congestion might cause infection from respiratory diseases for which the government may have to pay a larger price in terms of medical relief. Hence social and health problems should be weighed before a choice is made to build urban land very closely.

Besides urban agriculture is often uneconomical in the context of the city where land is used much more intensively, unless unproductive or underutilised land is used. For example, urban farming in Penang has come into conflict with the demands of other land users. Even though market gardening

is carried out within the city, there is a progressive shrinkage of the agricultural land because of industrial development. A series of confrontations between farmers and developers lead to problems of landowners and communities. This is the kind of dilemma being faced by Asian cities in the legal claims to redevelopment at the expense of urban agriculture (Tan:1983).

In Delhi (Section III, Table: 26) land is increasingly being transferred over the years to non-agricultural uses. There is also a massive rise in the cultivable waste land. Added to this, a decline in the total crop area and the net sown area gives a very clear picture of the lack of importance given to UA by the planning authorities. Hence there is a need for policies to be changed to promote UA if the city is to benefit from it. This is the scenario in Delhi even after the floodplains of the Yamuna are utilised practically all the year round.

In India, a city is administered/governed by the municipality. Though often Central/State laws and rules/regulations are used to administer a city, the ultimate task rests with the local government. The municipal enactment in India generally contains provisions for exercising control over the development of land, its sub-division and tenure (for orderly growth of cities), supply of potable water, maintenance of the water mains, drainage and sewerage works, laying and maintenance of public parks, gardens and natural recreation grounds, upkeep of plants and trees on roadside, and prevention, protection and guidance of dangerous trades and practices that pollute air, land and water that harm citizens. Apart from the obligatory functions, environmental protection is also taken care of under many of the Municipal Acts. But there is no mention of the cultivation of crops, though very often marginal lands are leased out by the municipality for urban agriculture.

Normally the land that is used for agriculture is either marginal or transitional, in the sense that land which is earmarked for some other use can be used for agriculture while in waiting. This would mean that agriculture in such land would be ephemeral. However, the positive aspect of using "land in waiting" would be to save on the cost of maintenance and at the same time earn a fee by leasing out temporarily. This would certainly help the landowner. Marginal lands too, if put to use without harming anybody or any activity, can be beneficial for the city and the people using the land, as productivity of the land increases.

There are, of course, some negative aspects of urban agriculture, such as chances of pollution from fertilizers, liquid, and solid waste, etc. Besides, if urban land, which is highly priced, is not used judiciously, it will lead to less productivity and an economic loss. However, urban agriculture is increasingly being recognised as a desirable land use option in urban areas and an integral part of the urban system.

Assimilation of solid, liquid and gaseous waste

As cities grow, chances of environmental deterioration rise with population congestion. In the metropolitan cities of India there is a virtual breakdown of the infrastructure system because of the overuse of utilities without augmenting them with population expansion. As a result, pollution is rampant. In Delhi the MCD collects only 70 per cent of the municipal waste. Water is in short supply in practically every residential area of Delhi where the supply lasts for only four hours twice a day. The city being spread over a very large area, a large number of vehicles are added every year. All these put together lead to heavy pollution. In Delhi pollution from motor vehicles contributes about 67 per cent of the total air pollution.

UA contributes towards improving the air quality of a city by enhancing its assimilative capacity through city/social forestry and/or by developing other green spaces that would act as lung spaces for congested conditions/areas. A study by CPCB explains how "jamun" trees are good assimilators of lead from the air (CPCB: 1984). The recent inclusion of a list of trees, in the revised Master Plan of Delhi, to be appropriately grown in the different parts of the city based on soil and climatic conditions, indicates the recognition by city planners of the importance of trees in enhancing the assimilative capacity of air.

A major negative externality avoided by UA within the city includes the pollution created by trucks carrying agricultural products into the city from distant rural areas. However, a word of caution on the ill effects of pollution on the crops and the food chain would help promoters of urban agriculture to pursue their activities with caution.

Mention has also been made earlier of the benefits of waste disposal, both solid and liquid, with agriculture using the biodegradable municipal waste as manure and water for irrigation. This will not

only reduce the cost of waste management, but will also help in reducing pollution from such waste. Fertilizers made from city waste is a resource for agriculture, which brings down the expenses on manure.

Liquid waste can also be very effectively used to save on water for irrigation, where water shortage is a major failure in the provision of urban services. If waste water is used after an initial treatment, it can reduce the cost of waste water disposal as well as the cost of irrigating crops. In many south-east Asian countries the practice of using waste for UA has brought in good results.

As mentioned earlier, if UA is practised wisely, it gives a boost to public health concerns. The example of Kolkata's wetlands is a case in point, where UA prevents endemic environmental problems, as well as helps the municipality to manage sanitation through natural processes. At the same time it produces about one-third of the fish requirements of the city, which promotes business.

Environmental Change, including Microclimate

Since UA helps in digesting waste, environmental conditions are bound to improve. UA contributes to environmental change in several ways. By encouraging the use of partially processed solid and liquid biodegradable waste and by assimilating air pollution, UA takes care of public health concerns. Besides, by providing employment, it improves the socio-economic conditions of the poor, that lead to the enhancing of the purchasing power and thereby the quality of life.

UA also provides recreation and healthy life with gardening as an exercise. City aesthetics improve with tree plantation and landscaping. Besides, cultivation of crops add to the biodiversity, which has positive impact on the health of citizens. As mentioned earlier, convalescing patients recuperate faster in greener surroundings.

Trees and greenery absorb temperature and noise and reduce wind velocities by acting as a screen. The microclimate of areas within cities is influenced by existing vegetation. The vegetation in any area absorbs moisture and lowers the heat, often resulting into rainfall.

Thus environmental changes from UA are of many kinds: of improving aesthetics, giving

employment and improving socio-economic status, providing recreation like physical exercises or parks and playgrounds for games or relaxation, provide food nutrition, digest waste, reduce pollution, influence the climate and so on, all of which contributes to changing the physical, social and economic environment.

Aesthetics and Recreation

UA includes all kinds of agricultural activities. While animal husbandry is not a very congenial activity within a congested city, cultivation of crops and growing of trees is very pleasing for the city's environment. UA includes parks and gardens that add beauty to a city. Home gardening is also recreational and pleasant for the households. Urban forestry, created to promote lung space, also has recreational value.

Landscaping and gardening of public spaces is also very pleasing. It could be done within institutional campuses, in residential neighbourhoods, along roads and open spaces for beautification. The city government also undertakes the planting of trees or development of gardens, which also forms part of UA. Thus UA can beautify a city, as well as contribute to recreational facilities. As mentioned above, UA by itself can also be developed into a recreational activity, which would take care of an individual's health. A common example of it is the allotment gardens of U.K. and U.S.A.

The Stakeholders

The role of any agent/component cannot be assessed without understanding the involvement of the stakeholders in the process of development. In India, any development normally includes many agencies of management and administration. In fact, overlapping and duplication of work is a much repeated accusation for urban management, where because of the enormity of the task, a range of organisations are set up to take care of different aspects of development. Often the duties of these organisations are not very well defined, to avoid duplication and conflicts. Hence, it is important to clarify the role of the various agencies and the stakeholders in attempting to understand what the management process would culminate to be, in the development and practice of UA. Placed below is a table giving the details of the involvement of the different stakeholders in UA, to ruminate over the existing status to assist future decisions.

Table 1
Stakeholders for UA

Role in City Management	Actors	Beneficiaries
Food Security	Poor citizens, Farmers (in agriculture & allied activities), neighbourhood organisations, small entrepreneurs	Entrepreneurs, Traders, Employees, Consumers (especially low income groups), the State
Poverty Alleviation	Poor Migrants, Marginal Workers, Farmers, Unemployed	the Poor, City, State
Employment	Farmers, Providers, Entrepreneurs, Traders, Food Industries	Poor, Unemployed, City, State
Assimilation of Waste	Municipality, Pollution Control Boards, Department of Industries, Farmers	Municipality, Farmers, Citizens
Landuse Planning	Town Planning, Development Agencies	City Managers, Residents
Economic Development	Business(producers, retailers, wholesalers), Farmers	Low Income Groups, City, State
Social Change	Farmers, Unemployed, Poor Migrants	Communities, Local Government
Aesthetics	City Planners, Households, Municipality, Institutions	City Managers, Citizens

For any policy change to take place, all the above mentioned actors will have to be involved. Besides, beneficiaries too need to understand their role in supporting UA. For ultimately it is the community/ actors who will have to support any new process that is being introduced, if they are to benefit from it.

SECTION II

Even though agriculture within a city was practised in the past and market gardening had been contributing to the food security of the urban poor, UA as a contributor to urban environmental planning and management is a fairly new concept. This aspect of UA was not considered for city development, until environmental deterioration became a problem for the city managers. The idea germinated when because of the rapid population growth, development could not keep pace with the population expansion, resulting into an overuse of resources that lowered the quality of life. Past agricultural practices were carried out only on the vacant lots of the much less congested cities than what is found today. Present day UA is trying to produce more food within the city, even when there is a shortage of space, by introducing new techniques of intensive agriculture such as hydroponics, rooftop gardening and so on, which are all space saving measures. In fact, a desperate attempt is being made to increase food supply in order to improve food security for the growing population. The strategies used are those of agribusiness, employing the urban poor and waste digestion that would alleviate poverty and improve the assimilative capacity of the natural resources within the city, like air, water and land. In fact, UA is being increasingly looked upon as a promoter of food security and as a support for environmental management. There is, therefore, a structural change in the role of UA in city management between those of the past and the present.

As is the practice, plans and policies are mostly framed when the need arises to resolve problems or monitor growth and development. Hence with the change in the problems and the diversification of needs, new policies and different dimensions of planning are being adopted. Policies regarding urban development in India have focused mostly on the growth of the urban population and their overall distribution, rather than on efficient functioning of cities, which in turn would foster economic development. Considering that 50-60% of the GDP is contributed by cities, issues regarding city management are grossly neglected, except for sectors like housing, water supply and sanitation. But even these components of development have not reached sufficiency. Except for a few ad hoc urban development programmes, an integrated system of settlement planning was never envisaged in India that would take care of all aspects of development, including migration and environment. However, while formulating the City Master Plans, landuse zones were often formed and lung spaces were demarcated in residential areas to take care of environmental concerns. But on

many occasions implementation was not carried out seriously, especially with the rising urban land rents that gave reason to encroach upon lung spaces to cope with the increasing demand for land for housing and other urban activities.

Environmental planning in India was introduced as late as in the Sixth Five-Year Plan. Here too, the focus revolved around conservation of environment rather than protection from pollution, except for the location of industries (details are given in the section on industrial location). But in the first industrial location policy, industries were dispersed into the backward areas for purposes of economic development and not so much to control pollution. Protection from pollution came as an externality, with backward areas being less congested and therefore causing lesser harm through pollution. However, it is to be noted that poverty in India is as much a generator of environmental pollution, as waste generated from the use of resources. Underdevelopment by itself is a cause for pollution. A common complaint has been the inadequate attention given to environmental planning and management, as indicated by the plan allocation of funds for the improvement and protection of the environment. For example, the Plan allocation for environment in the current year is Rs. 850 crores, which is just 0.72 per cent of the total annual budget of Rs. 1,17,334 crores (Ministry of Finance). Moreover, the Comptroller and Auditor General of India has pointed out to the slackness in the implementation of schemes by MOEF in the past three years, as a result of which the percentage of unspent revenues has risen from 6 per cent to 26 per cent between 1996-97 to 1998-99 (The Times of India), giving enough scope for future governmental restraints on budgetary allocations. The reasons for this inefficiency range from the non-approval of posts to the slow implementation of the schemes. This pattern of expenditure is regrettable, as it counters the planners' perpetual complain of lack of funds for development. Again, even though monitoring and control of pollution have been taken up by the Pollution Control Boards, much remains to be done. Besides, these Boards are the agencies of the central or the state governments. The municipalities' role in controlling pollution is almost non-existent. A common belief is that if municipalities were to perform their task of sanitizing the city seriously, plenty of pollution could be avoided. Similarly, if the overuse of infrastructure like the water supply, sewerage, etc. could be withheld, pollution can be prevented. The hurdles in the task of sanitizing cities lie with the archaic laws and the age-old methods of execution that slow down implementation. With the increasing magnitude of the task

and recent technological changes, new methods can be evolved to improve the quality of life with the help of UA.

As has been seen, UA can play a considerably important role in city management and socio-economic development. But such initiatives will have to be supported by plan allocation of funds and policy formulations, both of which require long and intensive debates to justify their presence. Hence it will be wise to find out how far the existing plans and policies can help to promote/support UA for city management.

This section of the study will examine the policies and the plans formulated by the Government of India, in order to find out the efforts being made to incorporate environmental planning and management, to protect and conserve the environment and prevent deterioration resulting from rapid urbanisation and development that often leads to overuse of resources and shortage of infrastructure. Chapter VI will review the policies that have the possibility of impacting on urban and peri-urban agriculture. The policies reviewed will be those of locating industries, the use of land, pollution abatement and the conservation of environment. Chapter VII will study the Five-Year plans with regard to environment and urban development. The responsibility of the municipality towards the protection of urban environment will also be discussed.

Chapter VI

POLICY REVIEWS

The aim of this chapter will be to find out the measures that have been taken by the Government of India so far, through policy formulations, to protect the environment and to find out if urban agriculture can be incorporated in the planning and management of cities.

Policy for Siting of Industries

A common outcome of industrialisation and urbanisation is the deterioration of air, water and land in and around cities, unless adequate technological precautions are taken to prevent environmental pollution and degradation. The earlier policies of locating industries in India have not been very effective in reducing environmental pollution hazards. The two major steps that were taken, vide the Policy Statement of July 1980, were: (1) to set up industries in the economically backward areas, and (2) to locate industries outside metropolitan cities of more than 5 lakh population. The overall focus was on the level of economic development, with help extended to backward areas, districts and states. Thus the precaution taken against pollution was basically an externality following from the dispersal of industries into the less developed areas to promote economic development and not from direct prevention of pollution. The method adopted was to give location-specific monetary incentives that were determined by economic progress and not just by maintaining good environmental standards. The only concern shown towards the preservation of ecological balance and the improvement of the living conditions of the urban centres was by deciding to site industries outside the metropolitan cities. This regulation was operated by the Department of Industries and not by the local government which normally looks after the city's maintenance. Hence, in effect, the city's concern for a pollution free environment was absent. The policy also did not address issues regarding the setting up of industries in the environmentally sensitive areas. However, it is to be remembered that the Ministry of Environment and Forests was only set up in 1985 and the focus on environmental improvement was considered in right earnest much later.

In the New Industrial Policy of 1991, the city size limit restricting industrial location has been raised up to 10 lakh (or one million) population. Besides, no industry is to be located within 25 kms. of the periphery of any Standard Urban Area, as defined by the 1991 Census. However, if the industrial units were to be located in an area designated as "industrial area" by the concerned state government before July 25, 1991, this restriction on location would not apply.

The location of industrial projects is supposed to be further regulated by the local zoning and the land use regulations, as well as by the environmental legislation. Various state governments have issued land use by-laws restricting the setting up of certain industries in specific areas in their respective territories. Similarly, many government departments have enacted laws restricting the setting up of industries in specified locations. For example, the Government of the National Capital Territory (NCT) of Delhi has recommended a ban on the setting up of large and medium scale projects in the NCT. Again, the Government of Maharashtra has divided Metropolitan Bombay into three zones, specifying categories of industries that can be set up in these zones.

The most recent precautionary measure taken to protect environment is the recently introduced Environmental Impact Assessment (EIA) that has been made mandatory for large development/industrial projects, in January 1994. In India, an EIA procedure includes the formulation of a detailed Environmental Management Plan for monitoring and maintenance, along with the action plans for the development of the projects. However, the most concerted effort made so far by the MOEF, to ward off pollution, has been to constitute a team comprising of (i) the Chairman of CPCB, (ii) a Joint Secretary of the Department of Industrial Development, and (iii) a Director of the Department of Environment, to formulate comprehensive guidelines for locating industries, taking care of environmental features such as flora, fauna, air, water, land, human settlements and so on. These guidelines have been brought out by the MOEF, in collaboration with the Department of Industrial Development. The MOEF guidelines demand that the licensing of industries will require clearance from the Central/State Air and Water Pollution Control Boards, to prevent air, water, and soil pollution by industries. But a drawback of this arrangement is that it does not take into account the cumulative impacts of clusters of small industries, which in the long run can damage the environment significantly. However, to give a concrete shape to this caution, the Department of Industries has notified a group of 20 industries that are required to follow certain

stipulated procedures. Site approval for environmental precaution is done by the MOEF, or any nodal agency set up for the purpose.

The guidelines specify the areas to be avoided (which includes distances from specific sensitive areas), siting conditions that will take care of forests, agricultural lands, formation of green belts around industries, provision of adequate space for solid waste management and so on. Moreover, the Environmental Impact Assessments are required to take care of certain natural and man-made elements and issues such as:

- meteorology and air quality
- hydrology and water quality
- site and surroundings
- occupational safety and health
- effluents (solid, liquid and air)
- handling/transportation of raw materials
- impact on sensitive targets
- measure/control of equipment
- vegetal cover
- transportation system
- disaster planning
- environmental management
- energy use, etc.

Moreover, the management plans are expected to promote resource conservation and pollution abatement.

It can, therefore, be clearly seen that the attitude of the Industrial Policy towards conservation and protection of environment and agricultural land is changing with the newly found consciousness for clean environment. While the previous policy focused only on development, the recently modified policy highlights precautions to be taken to minimise environmental pollution. It also focuses on the conservation of agricultural land; though it does not specify the nature of agriculture. Even then, the

siting of industries in the periphery of cities does influence urban agriculture in the peri -urban areas. However, their removal from within the city is a positive step towards promoting a cleaner environment, that would also cause less harm to UA, which at present is already being threatened by vehicular pollution in today's world of automation.

An issue to be raised here is the physical expansion of the city with urbanisation, which stretches urban landuse into the periphery, to include agricultural land that is devoured not only by the industries and the associated urban developments, but are also polluted by them. Hence, even though industrial siting takes care of preserving natural resources, including good agricultural land, especially in the periphery, it cannot prevent urban expansion into the rural areas, as urbanisation has an inherent quality of acting as a catalyst for growth. Therefore, despite all precautionary measures taken to preserve agriculture, some amount of damage is inevitable if the process of urbanisation is to continue. Alternately, it can select the so-called "urbanisable land" for city development, which is not always available for various reasons. Therefore, at best, a compromise can be made between urbanisation and industrialisation with the help of technology, to protect vegetation or UA in and around the cities.

Land Use policy

Several attempts have been made to formulate a land use policy for India, without success.

In 1983, the Ministry of Agriculture set up a two-tier Central body, namely, the National Land Board and the National Land Resources Conservation and Development Commission to serve as a policy planning, coordinating and monitoring agency for issues concerning land resource management of the country. In 1985, the National Land Board was reconstituted by the Ministry of Environment and Forests as the National Land Use and Wastelands Development Council (NLWC) under the chairmanship of the Prime Minister, with the state Chief Ministers and the Deputy Chairman of the Planning Commission as members. Two Boards were set up under the NLWC:

- 1) The National Land Use and Conservation Board-NLCB (in the Ministry of Agriculture);
- 2) The National Wastelands Development Board-NWDB (in the Ministry of Environment and Forests).

The NLCB, which started functioning in 1883-84, had the following objectives:

- Formulate a National Policy and Perspective Plan, taking into account land use and soil factors.
- Review implementation of the existing conservation schemes and development of land resources.
- Review soil survey proposals and general assessment of land resources.
- Consider measures for ensuring that good agricultural land is not indiscriminately diverted for non-agricultural purposes.
- Act in collaboration with NWDB in matters of common interest.

The NLCB prepared a National Land Use Policy Outline of 19 points, for an action programme.

These were:

- Creation and revitalisation of state level Land use Boards.
- Formulation of Land Use Policy through stakeholder participation.
- Restructuring of Urban Policy to ensure that highly productive land is not taken away. Besides, town planning should provide for green belts.
- Launching of national awareness campaigns to understand the need for an integrated land use policy.
- Reviewing of cropping pattern to derive maximum benefit from soil and water conditions.
- To create a good data-base from land and soil surveys.
- Penalise any interference with land resources and their productivity.
- Control problems of water logging, salinity and alkalinity.
- Review management of Command Areas in order to prevent the collapse of the irrigation system because of siltation.
- Adoption of the moisture conserving technologies.
- Formulation of special programmes of conservation and afforestation in the desert areas to prevent water and soil erosion.
- Control shifting cultivation.

- Integration of land use planning with rural employment programmes, to help loans and subsidies that are allocated to be more productive.
- To protect the rights of tribals and the poor through legal and administrative structures.
- Promote stall -feeding of animals.
- Launch special Fodder Development Programme along with Livestock Development Programme. The aim should be to limit livestock to economically productive stock.
- Locate plantations for commercial and industrial needs away from habitats.
- Withdraw subsidies for forest raw materials in order to promote afforestation.
- Use packaging materials that would not deplete the forest.

The NWDB, on the other hand, was established to develop the country's wastelands through massive afforestation programmes, with people's participation. It was accorded a high priority by including it in the 20-point programme of the government. Emphasis was placed on:

- ecological crisis caused by deforestation and land degradation;
- socio-economic crisis created by acute shortage of fuel and fodder; and
- making afforestation a people's movement.

The main functions of the Board were to be:

- i) To formulate within the National Policy, a Perspective Plan and Programme for the management of wastelands.
- ii) To identify the wastelands in the country.
- iii) To promote, encourage and finance development of wastelands through active participation of NGOs and the public, including the landless.
- iv) To collaborate with the Central and State governments, NGOs, etc. to raise funds and other inputs for wasteland development.
- v) To create a reliable data base on wastelands.
- vi) To interact with the financial institutions, for the funding of the wastelands.
- vii) To create general awareness for wasteland development, through the education system.
- viii) To act in collaboration with NLCB in matters of common interest.

The activities, however, remained disjointed. It could never be synthesized to develop a cohesive landuse policy. An attempt was made once again in 1988, to promote a Land Use Policy with minor modifications of the previous formulations. But, as the situation stands today, there is no Land Use Policy in India. Though many of the objectives developed by the NLCB could be extremely beneficial for UA.

Pollution Abatement Policy

The policy on the prevention of pollution and the protection of the environment (1992) is a very comprehensive document on the tasks to be undertaken for the purpose. The complex nature of environmental management is very well understood and presented. The focus is on the implementation of the objectives mentioned below; and the emphasis is on long-term planning and protection of the poor, as pollution affects the poor the most.

The document begins by identifying the problems and highlighting the objectives that need to be achieved. The suggestion is to use a mix of instruments: legislation, regulations, fiscal incentives,

voluntary agreements, educational programmes and information campaigns, to attain the goals. The problems that are identified by source and medium are:

- Water Pollution:
- traditional organic waste(large in volume)
 - industrial waste(concentrated pollution)
 - chemicals from fertilisers and pesticides
 - silt from degraded catchment

(In the larger cities very little of the waste water generated is collected and only about one-fourth of that which is collected is treated.)

- Air Pollution:
- high level of SPM
 - Nox is on the increase because of added vehicular emissions

- Chemical Industries:
- pollute atmosphere, soil and water

- Industrial Areas:
- effect on local health
 - impact on nature
 - social and economic functions of the environment

- Human Activities:
- influence the composition of the atmosphere

In formulating the policy, the conflicting role of science and technology is recognised. While scientific knowledge helps to control pollution, it also works as a catalyst in the indiscriminate use of resources. When the pressure from such use is further enhanced by population increase, depletion of natural resources becomes inevitable. This not only aggravates the situation; it causes irreparable loss. Therefore, technology has to be used very cautiously in seeking a higher quality of life. Hence the government will have to ensure that in all aspects of development, policies should be based on a set of principles that will harmonise economic development and environmental effects. In this context the Statement on Pollution Abatement complements the Forest Policy Statement.

The main focus of the policy is to integrate environmental considerations into decision-making at all levels. In order to achieve this goal, the following steps have been suggested:

- Prevent pollution at source
- Encourage, develop and apply the best available technology
- Ensure the polluter pays for pollution and control management
- Focus protection on heavily polluted areas and river stretches
- Involve the community in decision-making.

As understood, it is not enough to merely have laws. There should be popular support and consultation with the implementers of those laws. What is required is a comprehensive approach, linking environment to economic aspects of development, emphasising promotion of technology for

purposes of prevention and/or reduction of pollution. All this needs to be done by involving the community.

An important focus area of the policy is the critically polluted zones. In these areas, the cumulative effects of various types of pollutants will be taken into account. To do so, the following actions will have to be taken:

- Strategies will have to be evolved to prevent/reduce air, land, water, and groundwater pollution;
- Location specific standards will have to be developed for stringent environment quality objectives;
- Match waste generators with waste buyers;
- Setup industrial estates in rural areas with pollution abatement measures; and
- Include pollution abatement as an essential component of infrastructure development.

It is observed that an increase in waste water because of population expansion is creating more pollution. To treat such sewage water, biological waste water treatment has been suggested, as conventional treatment plants are costly. Also, resource recovery technologies that are socially and economically acceptable, should be introduced.

The policy also mentions that no mining activities should be carried out in ecologically fragile areas. Mining plans should be accompanied by EMPs and time-bound reclamation programmes for controlling environmental damage and reforestation of the mining areas.

The policy suggests that plenty of assistance should be given for adoption of clean technologies by small-scale industries. Since small-scale industries are very important in a developing country like India, combined facilities for treatment of effluents and solid waste has been recommended in these

areas. However, the large and medium scale industries will remain totally responsible for the control of their pollution.

The policy claims that standards will have to be revised. The existing ones are based on the pollutants in the effluents and the emissions. Norms will have to be revised to lay down mass-based standards, which will set specific limits to encourage minimisation of waste, promote recycling and reuse of materials, as well as conservation of natural resources, particularly water. Since standards will be related to source, application of best available technology will be encouraged for industrial processing. Standards will not merely be regulatory, but will indirectly indicate technological upgradation to be made. This will help in resource conservation and prevention of pollution. New units will have to conform to stricter standards, especially vehicular emissions. This should be promoted by improved technology. Environmental impacts should be assessed in relation to different levels of production. Chemicals will be reviewed according to the level of risk, and where safer alternatives have already been found, restrictions will be imposed on the use of the older materials. Regulations for liability and compensation for damages will supplement standards to promote greater care and caution, particularly in the management of hazardous waste and remedial action in case of contamination of soil and groundwater.

While regulatory measures remain essential for environmental management, fiscal measures should also be introduced. The focus in determining pricing will depend upon the costs of using the environmental and natural resources. The expectation is that market-oriented price mechanisms will influence the behaviour in using natural resources. People should be made aware of the cost of using limited natural resources. There are several fiscal incentives for the installation of pollution control equipment and shifting of polluting industries from congested areas. Policies to remove excise and customs duties on eco-friendly products will also be introduced, or those goods that use abatement measures in their production.

Efforts will also have to be made to introduce economic instruments to encourage a shift from curative to preventive measures, internalise the cost of pollution and conserve resources, particularly water. Effluent charges should be determined by the cost of treatment of pollution. High effluent charge will compel the treatment of polluted effluents. Revenues from economic instruments will be

used for enforcement of pollution abatement, installation of collective treatment facilities, encourage research and promote new investments. To deal with the pollution problems, a mix of regulatory and economic measures will be adopted. The choice of economic instruments will depend upon the ease with which effluent releases can be measured, as well as the prospective changes in the technology and the market structures.

Control of pollution comes under different departments. Hence there should be integration among the sectoral ministries, state governments, local bodies and agencies responsible for planning and implementation of development projects. In fact, local authorities should play a very important role in pollution abatement. Steps should be taken to strengthen governmental and institutional structures dealing with environmental management, especially sectors like energy, industry, water resources, transport, and agriculture.

Emphasis should also be laid on non-point pollution from pesticides, insecticides, fertilisers, etc. A long-term policy for the use of environmentally acceptable pesticides will be prepared, particularly the non-persistent and biodegradable ones, together with the phasing out of toxic and persistent ones in consultation with the ministries. An administrative structure would be evolved for implementation.

The policy admits that conservation of forest and vegetal cover is essential to control pollution, as these have assimilative capacity. In fact, planting of more trees would enhance the assimilative capacity. Hence forest and vegetal cover should be restored and enhanced wherever possible: like hill slopes, catchment areas, arid tracts, urban centres, industrial establishments, etc. It is also necessary to encourage planting of trees along rail lines, roadsides, canals and any unutilised land owned by institutions, corporate and public sectors and so on. These would directly promote UA.

A system of Environmental Audit should be introduced for local bodies, statutory authorities and public limited companies by requiring them to prepare an annual environmental statement to evaluate the effects of policies, operations and activities on the environment, particularly compliance with standards and generation and recycling of wastes. An integrated overview of

the organisational structure for decentralised impact assessment and environmental law enforcement should be taken, based on cooperation with the local authorities.

Emphasis will also be laid on the collection and integration of environmental, economic and health data to determine the status of the environment and to develop indicators for monitoring the effects of pollution. For the purpose, information systems will be set up. Greater emphasis will also be placed on promoting environment friendly goods. Consumer organizations would be involved in testing and dissemination of information relating to such products.

Emphasis will also have to be laid on community participation by encouraging the NGOs to supplement the regulatory system. Greater efforts should be made to educate the community and to bring awareness of the benefits of a clean environment, the health risks and dangers of degradation, and the real cost of resources. Since environment affects all, it should be an obligation of all professional and non-governmental organisations to train and build awareness on environmental planning and management.

The National Conservation Strategy and the Policy Statement on Environment and Development

The National Conservation Strategy and the Policy Statement on Environment and Development (1992) are a set of guidelines to help weave environmental considerations into the fabric of the national life and the development process. It reorients existing policies and actions in unison with the environmental perspective.

The document classifies pollution into two major categories: one caused by development, and the other as a consequence of poverty and paucity of resources. The two are evidently connected with the overuse of resources leading to shortages. Given the rapid population increase and the addition in the future to the already existing mass, the policy also foresees a scenario of food crisis leading to under-nutrition among the people. Hence, unless the country is in a position to improve upon crop and animal productivity on a continuing basis, development is bound to suffer. Along with an increase in food production, access to food will have to be ensured through opportunities for productive employment.

The document enlists the actions which are being taken at present with regard to air, water, land, soil, wild life, etc. and describes the on-going environmental assessment programmes that are already in practice. The primary purpose of the strategy and the policy statement is to reinforce the traditional ethos and to build up a conservation method that will use the best available technology making frugal and efficient use of resources. The main focus for the future will be on sustainable and equitable use of resources, prevention and control pollution, restoration and protection of the ecosystem, preservation of man-made and natural heritage, conservation of biological diversity and the genepool and protection of scenic landscapes and wild life.

The instruments of actions, to address the above agenda, will be to carry out Environmental Impact Assessments for large developments, ensure environmental clearance, incorporate environmental safeguards and protection measures, encourage research and better technologies, bring about environmental awareness, elicit community participation, aim at moderation of processes to recycle waste and conserve use, develop appropriate organisational structures and promote effective implementation. In this, population control has been considered to be a priority area for action to make all other measures effective. It has been observed that even the best of methods will fail under adverse demographic pressures.

Though the policy has not directly mentioned the role of UA, its concern for food security and population increase relates intimately to issues raised for UA. Hence, even though no special attention has been given to urban agriculture per se, there is enough evidence of support for UA in the detailed steps to be taken for preserving the atmosphere, such as raising green belts with pollution tolerant species, both within and outside the city, planting of shade giving and fruit bearing trees along the roadside, or in public places that eases pollution, in and around cities and the provision for parks, lakes, botanical gardens, etc. to improve the assimilative capacity of the city. There is also an emphasis to encourage urban forestry. There is a mention of the local people having a stake in continuing the productivity of the common lands and conserving the degraded forests, without any suggestion of employing the urban poor.

The policy also has a strong focus on controlling industrial pollution, which is not related specifically to urban. However, it can be derived that since most of the industries are either located in the peri-urban areas or within cities, the regulatory measures will influence other urban activities. There is also a mention in the transportation section on enforcement of smoke emission standards for vehicular exhausts, both at the manufacturer and the user levels that may have beneficial effects on UA.

In management strategies, the role of community participation and those of women have been emphasised. There is also a very strong focus on partnerships between the Central and the state governments.

The Relevance

It is seen that all the policies reviewed in this report can help UA in some form or the other. While the Pollution Abatement Policy and the National Conservation Strategy and the Policy on Environment and Development directly address UA to increase the natural assimilation capacities, the Siting of Industries focus on the prevention of pollution in and around cities. Protection of peripheral areas from pollution is an indirect help to UA. It is found that pollution, especially from automobiles, give rise to ozone formation in the periphery, which is harmful for peri-urban agriculture. Again, the proposed landuse development objectives of the NLCB can help to protect the soil, take care of the cropping pattern, control water logging and salinity and thereby help UA immensely within cities if a well meaning landuse policy can be framed. Actually solutions for developing UA lies in the attitude towards this concept and help can be drawn from the policies depending upon the manner in which these policies are interpreted. Of course, a lot will depend on the policy to be formulated for promoting UA. City planners will, therefore, have to decide whether UA should be actively used as a component of planning instead of the passive role it plays today.

Chapter VII

PLAN FOCUS ON ENVIRONMENT

Even though India has been a pioneer in recognizing the importance of environment through Article 48A of its Constitution that provides for the protection and improvement of environment, the focus in the initial years was restricted only to safeguarding forests and wildlife. The real concern for environment, as it is understood today, started effectively from the Sixth Five-Year Plan (1980-85) when major environmental issues such as monitoring of renewable resources to sustain economic development, lack of consideration of the costs of environmental degradation at the policy planning level, quick profit for entrepreneurs even if it leads to destruction of the resource base and so on began to question the mind of the planners. The Sixth Plan realised that given the existing environmental conditions, there is a need for a bold new approach to development, which will be based on techno-environmental and socio-economic evaluation of each development project.

Prior to the Sixth Plan, environmental degradation caused from waste generated from the use of resources or lack of development was looked after by the public health engineering department that took charge of the water supply and sanitation of cities. Therefore, this aspect of development was monitored by the department of urban development. In the National Plans, attention was paid to urban development from Fourth Five-Year Plan onwards. The areas of urban interest those days were on housing, water supply and sanitation, which if provided would prevent the environment from deterioration, while failure to do so would lead to environmental pollution. It is often said that if the local government were to perform its duties well, cities would be saved from many pollution hazards.

The Sixth Plan also proposed to improve agriculture, including horticulture in and around cities, from the angle of building up a National Food Security System. There was a focus on public policy measures that would stimulate production by small and marginal farmers. The Plan mentioned that the aim of land use planning should be to optimise the opportunities of gainful employment. It was proposed to introduce a systems approach to agricultural production, conservation, consumption and trade. There was also a thought about the development of meat processing industries and improvement of slaughterhouses in the major cities. The proposal was to set up a separate

organisation for promoting and regulating domestic production. There was also a concern of the cultivation of the marginal lands. But whether the marginal lands in and around cities should be cultivated, was not singularly specified. The matter was dealt as a sectoral issue and not as a panacea to urban problems.

From the environment protection angle, focus was laid on deterioration resulting from poverty and the negative effects of development. Efforts were, therefore, directed towards improvements in human settlements, especially to improve the quality of life of slums that are strained by inadequate utilities, initiate development control measures like EIA, introduce protective legislation and organisations, conserve the biosphere reserves/marine eco-systems and set up implementation support systems/agencies. It was during the Sixth Plan that the Department of Environment (DOE) was constituted.

This interest in "ecology and environment" continued in the Seventh Plan; and as the focus became sharper and clearer, it envisaged the formulation of a National Conservation Strategy, some environmental protection guidelines, the prevention of pollution of all natural elements like air, water, land and so on. The Seventh Plan also suggested the setting up of environmental monitoring centres to study the impacts on living resources. It also focussed on the stabilisation of human and livestock population and an emphasis was laid on public participation.

In the Eighth Plan more attention was paid to air and water pollution. Decentralisation and community participation was once again emphasised, as also the need for scientific understanding. However, even though the Eighth Plan focussed on the protection of the natural environment and regeneration and restoration of degraded ecosystems, and the monitoring of the state of environment, it is only very recently that a comprehensive Environment Action Plan was initiated (1993). This "plan" is yet to be supported by a "policy".

The Ninth Plan focused on macro-economic stability that would create a sound environment. But urban environment was not given as much emphasis as expected. A common complaint by planners is that environment in general, has not been given enough attention in the Ninth Plan, especially after the hype created about environmental improvement by the world conventions. Hence it appears

that to take up UA as a component of city management, urban environment will have to be considered more seriously. Given below are detailed reviews of the Plan emphasis on environment.

Environment in the Sixth Plan: 1980 - 85

The Sixth Plan considered environment as a "crucial guiding dimension" for plans and programmes in each sector, with the desire to see development proceed along rational and sustainable lines. It, therefore, called for a clear understanding of environmental protection. Environmental problems were classified under two broad heads:

- (a) those arising from conditions of poverty and under-development; and
- (b) those arising as negative effects of the very process of development.

The first category has to do with the impact on the health and its integration with the natural resources (such as land, soil, water, air, forests, wildlife, etc.) as a result of poverty and inadequate availability. The second category has to do with the unintended negative side effects of efforts to achieve rapid economic growth and development. The latter would be concerned with the distortions imposed on national resources from poorly planned development of projects and programmes, as well as lack of attention because of commercial and vested interests. The concern over the loss of natural resources and the disappearing of species and ecosystems under relentless pressures of an exploding population necessitates the preservation of the biodiversity (especially genetic resources and natural ecosystems), to ensure optimum use of our biological wealth for the future welfare of our people.

Environmental pollution on the other hand (from water, air, land, noise, radiation and odour) is caused by an inadequate perception of the potential hazards from such pollution. Hence to counter such trends, there is need for environmental education, as well as precautions to be taken to control pollution. The fact that the cost of degradation has never been assessed was taken note of: for land, soil, water, forests, other natural resources. Economically degradation has two kinds of cost implications: first, of overuse (leading to wastage) of scarce resources and second, of regenerating or improving what has been spoiled.

The other thrust area for environmental management in the Sixth Plan was that of human settlements: both rural and urban. Since rural lifestyles have close links with nature and its resources, protection of resources from overuse and misuse (especially because of poverty) becomes essential. In urban areas, growth of slums because of migration indicates a pressure on land, with indiscriminate mixture of landuses resulting in a steady deterioration of the already strained urban utilities and thereby the environment. As these trends are bound to intensify with population expansion, leading to further lowering of the living standards, "vigorous and coordinated steps are required for environmentally sound planning and development of human settlements". So far, attempts at environmental improvements have been disjointed and piecemeal.

Development control measures such as EIA (to assess impact of projects) have also been recommended. Along with safeguards, systematic monitoring of the effectiveness of projects has been proposed.

There is need for new legislation to take into account special problems arising from rapid economic development with social justice. The Plan has also recognised the need for a fresh and comprehensive look at the administrative and legislative aspects of environmental protection. For the purpose, the government had constituted a High Powered Committee under the chairmanship of the Deputy Chairman of the Planning Commission, which recommended the formation of a Ministry at the Centre. The functions of the Department of Environment were identified as:

- a "nodal" agency for environmental protection and eco-development in the country;
- carrying out environmental appraisal of development projects through ministries/agencies, directly and/or indirectly;
- administrative responsibility for
 - pollution monitoring and regulation
 - conservation of critical eco-systems designated as Biosphere Reserves
 - conservation of marine eco-systems.

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**THE ROLE OF
URBAN AND PERI-URBAN AGRICULTURE
IN METROPOLITAN CITY MANAGEMENT
IN THE DEVELOPING COUNTRIES**

A Case Study of Delhi

**National Institute of Urban Affairs
New Delhi
February 2000**

These "nodal" functions were over and above the direct responsibilities of the DOE. The main role of the DOE was to play an important coordinating role for environment related programmes in all sectors, which would be implemented by the ministries/agencies.

The programmes proposed in the field were :

- environmental research and development
- adoption of environmental impact assessment
- monitoring of environmental quality
- setting up of environmental information systems
- promoting documentation and publication of reports, research monographs, case studies, etc. as information for the general public
- public awareness programmes
- stimulate public participation and formal education
- set up institutions for environmental management
- promote field action programmes
- repair fragile eco-systems
- strengthen the capabilities of the state governments in carrying out environmental planning, protection and review
- set up rural and regional environmental centres for solving problems and to coordinate functions
- Biosphere Reserve programmes
- monitoring and conservation of marine eco-systems
- inventory of ecological resources

As an initial attempt to deal with a new sector of development, the Sixth Plan encompassed practically all aspects of environmental management. The net result was that focus on the two broad

heads of environmental problems (as mentioned earlier) remained diluted. However, its concern for UA came as a part of agricultural development and not as an element of urban environment.

Environment in the Seventh Plan: 1985-90

The basic approach of the Seventh Plan was on sustainable development in harmony with environment. Environment being all pervasive, success would lie in involving "the entire population at all levels... official and voluntary agencies must work together to create the needed awareness."

The term "environment management" was defined as : environmental planning, protection, monitoring, assessment, research, education, conservation and sustainable use of resources. The Plan highlights that from the early seventies India has played a significant role at international forums in delineating and articulating the relevance of environmental concerns in the context of economic development. There has been, over the last decade, a progressive strengthening of official involvement in environmental management in India, with increased scientific, technical, administrative and legislative backup at the Central and State levels.

The Seventh Plan reviewed the progress on the efforts made in environmental management, in the following manner:

- The Government of India set up the Department of Environment in the Sixth Plan. The states and the UTs were also asked to set up similar structures, which many states did. Besides, many other ministries/departments incorporated environmental considerations in their major development programmes.
- A countrywide rapid inventory on pollution from large and medium industries had been prepared.
- A programme on Control of Pollution at Source had been initiated.
- Minimal National Standards were set.
- Pollution control equipment was installed in about 30% of the large and medium industries.
- A network of 120 monitoring stations to check water pollution were created.

- Zoning and classification of all the 14 inter-state rivers were completed to provide a basis for water quality management.
- Basin-wise inventory for Yamuna and Ganga had been prepared to assess pollution load.
- Project Tiger was evolved.
- Establishment and development of the Wild Life Institute received an impetus. A 12-point strategy was adopted by India for Wild Life protection.
- Forest Survey of India has been preparing a national vegetation map, using remote sensing and ground survey method.
- Preparatory work for Biosphere Reserve was done.
- Environmental monitoring centres were established in Calcutta and Madras to study the impact on living resources of developmental activities such as hydro-electric and irrigation projects.
- Botanical and Zoological Surveys were oriented with better science and technology (S&T) inputs for holistic ecosystem management.
- Some major field action projects on eco-development were framed, and task forces constituted.
- Research projects (400) were sanctioned.
- Environmental Information System (ENVIS) was started.
- Programmes on environmental education, training and awareness were launched.
- Workshops, seminars, World Environment Day were organised. The first National Environmental Congress and the first National Conference of Legislators on Environment were also held.

For purposes of environmental planning, the following issues and responsibilities were enumerated:

- that environment includes living and non-living resources;
- that environment today is under severe threat of population pressure, poverty, misuse of natural resources;
- stabilisation of human and livestock population is crucial;
- environmental precautions to be taken while promoting developmental activities;

- primary responsibility for environment should rest with sectoral authorities, to take care of concerns in policies, plans, programmes, projects, legislations, etc.;
- environmental considerations should be of prime importance in development;
- Ministries/departments should serve as catalysts to promote environmentally sound national development through efficient management, provision of information, technical expertise, research and administration;
- that ultimate responsibility rests with the implementing agencies of development programmes;
- that environmental planning/protection/improvement requires a coordinated approach, active participation of all segments of society and political leadership.

The basic guidelines for implementation were:

- that environmental issues have no administrative, socio-cultural or political boundaries. Therefore, the initiatives for tackling environmental issues must emerge from official as well as non-official agencies and individuals, operating at different levels. Success in achieving environmentally sound development will depend greatly on the extent of cooperation that can be achieved between governments (Central, State, Local), their subsidiary agencies, voluntary groups, financial institutions, corporate groups in the public and private sectors, educational and research bodies, professional societies, religious and cultural institutions, etc.;
- that the Seventh Plan programmes will attempt to remove some of the weaknesses in the existing environmental planning system. However, given the close link between different subject areas relating to environment, it is difficult to assign absolute priorities in order of importance;
- for a variety of basic economic activities, high priority should be given to the management of natural resources. But water and land should get the maximum importance. However, purposeful environmental management is possible only when there is a control on livestock and population. These come under different authorities than natural resources. Therefore, each agency/institution should formulate their own priorities for action, based on direct responsibilities and capabilities;

- high priority should also be given to environmental problems of human settlements, especially with regard to potable water supply, waterborne diseases, slums and the like.

The management goals enumerated were:

- institutionalising the process of integrating environmental management and development;
- inducing organisations at the Central, State and Local levels to incorporate environmental safeguards in their plans and programmes;
- securing greater public participation in environmental management;
- establishing a strong scientific and technical base for environmental research and development, demonstration and extension activities;
- strengthening mechanisms for ensuring corrective action with regard to environmental degradation that has already taken place;
- the approach for management should be multidisciplinary.

In the initial years of the Sixth Plan nucleating activities were performed. These activities received greater impetus in the Seventh Plan. The major programmes were:

- Pollution monitoring and control: to be spearheaded by the Central Board for the Prevention and Control of Water Pollution, the basic task being: tackling air pollution, assessment and control of coastal pollution, development of professional expertise and trained manpower, development of cost-effective technologies for air and water pollution control, strengthening of institutional R&D support for pollution monitoring and control. Regional organisations were set up under the Central Board to take care of far flung UTs that are directly under the Centre. These were already set up during the Sixth Plan.
- Development of infrastructure and manpower for pollution control.
- Strengthening of the National River Water Quality Monitoring stations and increasing their number.

- Control of pollution at source, setting of standards-Minimal National Standards, establishment of Ambient Air Quality Network, Stack monitoring and Auto-exhaust monitoring.
- Study opportunities for cost-effective recovery of valuable by-products from pollution effluents and scale up relevant technologies for waste recycling.
- Strengthening of Madras Zoological Survey, Marine Biological stations, etc. Have collaborative programmes with appropriate institutions.
- Control of Hazardous Substances. The objective was to bring out comprehensive legislation.
- Prevention of pollution of the Ganga. Modernise and augment sewerage treatment plants.
- Building up of nationwide expertise on Environmental Impact Assessment of major development projects.
- Conservation of natural living resources; strengthening of Botanical and Zoological Surveys.
- Eco-development: restoration of the already degraded environment - mined area rehabilitation, fragile eco-systems, demonstration projects.
- Media development for awareness building and dissemination.
- Promote environmental management institutes.
- Promote environmental research.
- Promote environmental education, training and awareness.
- Develop environmental information systems.
- Coordinate and liase with the government.
- Formulate environmental policy and law. Coordinate and cooperate with international agencies.
- Strengthen organisational structures.

- to decentralise control over nature and natural resources;
- to formulate a national policy for environment and an appropriate legal and institutional framework in support of the policy;
- to ensure coordinated governmental action in conserving nature and sustainable use of natural resources;
- to make individuals and institutions more accountable to the people for their actions related to environment and the ecosystems;
- to monitor the state of the environment.

These tasks are not independent of each other but are complementary and sometimes overlapping. Many of them are already being performed by the Central and the State governments. However, more efforts were to be made.

The Eighth Plan also elaborated on the “protection strategy” to be used for environment. The primary task of the government was to protect natural ecosystems. Comprehensive strategies of protection had to be used for different areas, geographical regions, and ecological and social systems. Areas need to be classified not only according to ecological characteristics, including fragility, but also in terms of the types and the severity of the threats.

Broadly the threats are of three kinds: pollution, overuse and destruction. Strategies to cope with these threats could be preventive or regulatory. The strategy for prevention consists of raising public awareness, strict enforcement of law, statutory assessment of environmental impact of projects. The strategy of regulation is best applicable where projects have already come up, which requires:

- identifying the sources of pollution, including domestic and agricultural sources and suggesting measures to be taken;
- strengthening the functions of the Central and the State Pollution Control Boards;
- formulation of comprehensive and realistic standards for assessing the damage;
- making industries realise the cost of polluting the environment;

In the planning for environment, the Seventh Plan for the first time had a direct focus on the environmental improvement of the human settlements, keeping in mind health standards that are related to environmental resources like water, air, vegetation and the like. Hence a link seems to be emerging between human and natural environment that is necessary to improve urban environmental management.

Environment in the Eighth Plan: 1992-97

The scenario of environment and forests continued to cause concern. Destruction and degradation of forests were causing soil erosion and water problems/shortages. An estimated 6,000 million tonnes of top soil were flowing into the sea every year. Loss of top soil, vegetation cover, unregulated surface run off with poor recharge of aquifers seriously affect the society, especially the poor tribal, who depend completely on natural resources. Degradation of nature impoverish the rural poor as well. Much of the water and air resources continued to be polluted, affecting human health. Besides traditional domestic pollutants, there was also contamination by chemicals, heavy metals and other toxic substances thrown into rivers and the sea due to careless industrial and agricultural practices. Unplanned industrial growth and urbanisation were also increasing the pollution levels, which was damaging the life support system for the next generation, and threatening economic and social progress.

The causes of environmental degradation were many. On the one hand underdevelopment caused squalor and degraded the environment. On the other hand, development caused pollution from mismanagement. Therefore, the need to remove poverty, generate employment, raise the level of education and increase the awareness of the people to protect the environment were gradually crystallizing as the essential elements of planning.

The major tasks for the Eighth Plan were, therefore, considered to be:

- to protect natural environment;
- to regenerate and restore degraded ecosystems to increase their productivity;
- to develop and share an understanding of nature and natural processes;

- public participation and involvement of the NGOs;
- encouraging public vigilance;
- decentralising regulatory functions of the government, with training and equipment to be provided to the communities.

The Plan was to strengthen national parks and sanctuaries; and lay stress on eco-development. Much importance was given to regeneration and restoration of degraded ecosystems. The National Wastelands Development Board had included regeneration of degraded forest land as part of its objectives and given a special thrust to promotion of integrated wasteland development. The Eighth Plan also decided to convert the Ganga Action Plan into a National River Action Plan and establish common effluent treatment plants that will treat wastes from small and medium industries.

Decentralisation, in the form of transfer of control from the government to the people collectively was envisaged, for which local institutions had to be strengthened. This development would require to be priority based. Besides, information should also be made available to the people. Also, scientific understanding should be promoted. Research and training should be done as much as possible through already established organisations and institutions.

The Plan stressed on the need to formulate a National Policy on Environment with regard to natural resources and as per society's needs, in consultation with the people. The requirement was to focus on the weaker sections of the society such as the tribal, the nomads, the children, the women, etc. The emphasis was on coordination in government action. Plans and programmes were to be integrated. Efforts to internalise costs and benefits into the calculus of viability was suggested. Suitable methods were asked to be devised for accountability. A "business as usual" approach was to be avoided. A continuous system of monitoring was considered to be very important. It was thought that all this should be the responsibility of the government departments.

A review of the Seventh Plan's performance was also done during the Eighth Plan. This was with respect to Forest and Wildlife Policy and planning and environmental concerns. A National Forest Policy (1988) was formulated. Besides, a modern Forest Fire Project, assisted by UNDP

was implemented in Uttar Pradesh and Maharashtra. Plenty of forest research was also promoted.

Systematic efforts to integrate planning and environment into all the key socio-economic sectors, which began during the Sixth Plan, continued. As a result of sustained endeavour, environmental planning was included in all the major sectors of development like industry, science and technology, agriculture, energy and education.

In addition to the national level bodies like the Ministry of Environment and Forests, the Planning Commission has set up several expert groups/committees to formulate long-term sectoral policies like:

- Two expert groups on industries under the chairmanship of a member of the Planning Commission;
- An expert group to formulate policies for integrated development of the Himalayan Region under a member of the Planning Commission;
- A Standing Committee under the Deputy-Chairman of the Planning Commission for expeditious clearing of the pending projects;
- The Island Development Authority has been reconstituted. The Steering Committee of the Island Development Authority has been replaced by a new Standing Committee under the chairmanship of the Deputy Chairman of the Planning Commission.

Environmental issues such as the depletion of the ozone layer, greenhouse gases and climate change, bio-diversity and the role of the forest, etc. were taken care of in the international fora.

The basic policies and supporting legal structures devised by the end of the Eighth Plan period were:

- National Forest Policy, 1988
- Draft Policy Statement for Abatement of Pollution, 1991
- The Forest (Conservation) Act, 1980, and amended in 1988

- National Wildlife Action Plan
- Draft National Conservation Strategy and Policy Statement on Environment and Development
- Environment Protection Act of 1986
- Water (Prevention and Control of Pollution) Act of 1974, and amended in 1988
- Air (Prevention and Control of Pollution) Act of 1981, and amended in 1987.

By the time the Eighth Plan was formulated, a clear need emerged to develop a National Environment Policy, with particular attention to poverty alleviation, community participation and cost-benefit analysis of the impacts of development on the environment. However, even though several resolutions were made, a national policy still remains to be finalised.

Environment in the Ninth Plan: 1997-2002

The strategy for the Ninth Plan is based on the belief that macro-economic stability is fundamental not only for economic growth, but also for sound environmental management. However, even though the issue of empowering people for participation in management has been included in the Plan document, urban areas that are concentrations of people, have not been specifically focused for urban environmental management. Although all the different aspects of environment development have been considered as sectors of development that are worth paying attention, like control of pollution from industries, national river conservation programme, promotion of forestry and biodiversity, or even employment for the urban poor while planning for cities, the sectors' involvement in promoting urban agriculture has not been emphasised. As a result, the integration of urban environment with city planning and management has not yet evolved into a definite strategy, even after the Seventy-fourth Amendment of the Indian Constitution has declared it as an important task in the planning of cities. It is, therefore, clear that urban agriculture still does not have the Plan support, as a solution to many urban problems related to environment. However, if bits and pieces of all the provisions made in the Plan for the management of environment is to be collectively used, UA could be considered as a significant contributor to urban management.

In the section on agriculture in the Plan document, there is a focus on horticulture and market gardening, without any spatial reference to areas where it can be practised. Similarly, there are references to animal husbandry and dairying, without mentioning their benefits to city areas. There is also a section on agricultural employment focusing on reduction in rural poverty. Therefore, an emphasis is awaited to include urban agriculture as a tool for urban environmental management, poverty alleviation and food security.

Urban Environmental Planning

In the urban arena, public health, water supply, housing, etc. have formed part of the country's national programmes since the inception of planning. But the interdependence of living things and the natural elements such as air, land, water, etc. was only thought of during the Fourth Five-Year Plan(1968-73). Thus the need for harmonious development of environment and ecology, along with urban utilities and economic development, did not come at the onset of the planning period.

In the first three five-year plans the concern was more on housing. The objective in the First Plan (1951-55) was to provide low-income housing. But in the urgency to build houses, environmental conditions were neglected, although it was recognised that water supply was even otherwise poor. In the hurry to cope with housing shortages, ill-ventilated and dingy dwellings were built that led to further distress through overcrowding. Because of congested development of houses, water supply, drainage and lighting facilities were further strained, thereby lowering the quality of life.

In the Second Plan (1956-60) the focus was on industrial and on low-income housing. But it was soon realised that such shortages were the outcome of wider problems of planning. Therefore, attention was paid to urban development in relation to the regions surrounding cities. It was also realised that a clear conception of the economic development of the region should be had to plan for cities.

To the objectives of the previous Plans were added slum clearance, plantation labour housing and land acquisition and development for the basic success of the housing programmes in the Third Plan (1961-65). Concerted efforts were also made to prepare Master Plans and Regional Development Plans of metropolitan and industrial cities and for resource regions. The focus on resources was not

yet seen from the sustainable development angle. The emphasis those days was more in terms of providing adequate resources.

Even though 272 urban water supply and sanitation schemes were sanctioned during the First Plan, 227 in the Second Plan, and 529 in the Third Plan, special attention was given to water supply and sanitation only during the Fourth Plan (1966-70). Efforts were made to clear the backlog as 52 percent of the urban population were still without adequate water supply and 72 percent without sewerage. The realisation that the problems in the metropolitan cities were acute made planners think of tackling the issue from a regional perspective. It was therefore felt that Regional Water Supply and Sewerage Boards were needed. The emphasis was on combining water supply with sewerage schemes.

The consciousness of streams being polluted by industrial waste came during the Fourth Plan. To prevent the rivers from getting polluted (as these were the major sources of drinking water) the Health Ministry prepared a draft legislation. It was felt that an early enactment and enforcement of legislation by the different states was necessary for the preservation of public health.

In the Fifth Plan (1974-79) emphasis was laid on completing the spill over from the schemes introduced in the earlier Plans. The Fifth Plan itself was to cover 520 towns with water supply, and 84 towns with sewerage. The Plan outlay (of Rs. 539.17 crore) was designed to be supported by the Integrated Urban Development Scheme of the Centre in cities of national importance. The revised Fifth Plan provided an outlay of Rs. 10.27 crore for supporting training programmes for Public Health Engineering (for personnel and for mechanical composting). A provision was also made to convert dry latrines into sanitary toilets.

The Sixth Plan focused on small and medium towns over and above the continuation of the provision for the larger cities, especially in the congested areas populated by low income groups and the economically weaker sections. However, there were constraints of resources because of an emphasis on the supply to rural areas. Therefore, the augmentation and improvement of the water supply facilities (also for the small and medium towns) had to be continued in the Seventh Plan (1985-90). By the end of the Sixth Plan 81 percent of the country's urban population was covered by

water supply, and 33 percent with sanitation facilities. A thrust was given to the adoption of low-cost sanitation. International leverage (from UNDP) was used for the purpose. Central assistance was also provided for low-cost sanitation through the IDSMT Programme. HUDCO had also agreed to assist in the financing of low-cost sanitation.

Since water supply and sewerage are capital-intensive infrastructures, where local government financing is not enough, a proposal was given in the Seventh Plan for setting up a National Urban Infrastructure Development Finance Corporation to supplement local government financing. Provision was also made to promote research, training and information systems. For strengthening of monitoring and development of management Rs.1 crore was provided.

The Eighth Plan (1992-97) envisaged 100 percent coverage. The norms and standards recommended were:

- 125 lpcd for piped water and underground sewerage
- 70 lpcd for piped water supply, without sewerage
- 40 lpcd for spot sources

The aim was to:

- provide a special thrust to drinking water for small towns
- convert dry latrines into sanitary toilets
- cover outskirts or fringe of cities with low-cost sanitation and "pay and use" system
- evolve and execute financially viable sewerage schemes in big cities, with thrust on recycling of treated effluents for horticulture, irrigation and non-domestic purpose
- create scientific and effective mechanism for collection, transportation and disposal of solid waste (with restructured schemes for some large cities)

The thrust areas and strategies were:

- Water should be used as a commodity like any other resource.
- Supply to be based on the principle of effective demand.

- To ensure that such services should be looked after by the municipalities as per their regulations and standards.
- Public-private partnerships should be encouraged.
- Appropriate links should be forged between water supply and environmental sanitation.
- Total concept of sanitation should be encouraged, linking primary health care, water supply, women's welfare, immunisation and provision of sanitation facilities: i.e. all cleanliness related basic human needs.
- Promote decentralised involvement of community.
- Linkage between soil conservation and land/water management thrust to be given to maintenance and operation.

In spite of all the efforts made, provision of water and sanitation has been inadequate. A major problem in this regard has been lack of finances of the local bodies. Hence cost recovery is essential to generate revenue. There is also a need to promote accountability and awareness. The utility infrastructure also needs to be maintained well.

The Eighth Plan decided to follow the New Delhi Declaration of the U.N. General Assembly (1990) guidelines:

- Protection of the environment and safeguarding of health through integrated management of water resources and liquid and solid waste.
- Organisational reforms promoting integrated approach, including changes in behaviour, procedures, attitudes, and participation of women at all levels.
- Community management of services, backed by measures to strengthen local institutions in implementing and sustaining water supply and sanitation programmes.
- Sound financial practices, achieved through better management of existing assets and extensive use of appropriate technology.

Apart from the direct Plan commitments, the various planning Acts, such as Town and Country Planning Act, the Improvement Trust Act, the Development Acts under which Authorities are constituted, all focus on the orderly development of cities. Besides these, cities also benefit from the environment legislation to control and monitor use and misuse of natural/resources within cities. However, despite all the provisions made so far, upgradation of utilities has not been able to keep pace with the increase in population.

Municipal Responsibilities

A city is administered/governed by the municipality. Though Central/State laws and rules/regulations are used to administer a city, the ultimate task rests with the local government. The municipal enactment in India generally contains provisions for exercising control over development of land, its sub-division and tenure (for orderly growth of cities), supply of potable water, maintenance of the water mains, drains, drainage and sewerage works, road construction, public health, public safety and prevention, protection and guidance of dangerous trades and practices that pollute air, land and water, etc. which reduce the quality of life of the citizens if not maintained. Apart from the obligatory functions, discretionary functions such as the laying and maintenance of public parks, gardens and natural recreation grounds, upkeep of plants and trees on roadside, are also taken care of by many Municipal Acts. In some cities the discretionary functions also include the maintaining of dairy farms.

So far the legislative support given to the local governments came from the State. But after the Seventy-Fourth Amendment of the Indian Constitution, the Municipality now forms the third tier of the government to manage cities in a decentralised form, at the local level, so that people's priorities can be given a hearing. In the newly formulated Twelfth Schedule of the Constitution, which has been appended by the Seventy-Fourth Amendment, "urban forestry, protection of environment and promotion of ecological aspects" have been identified as municipal duties. But these responsibilities are to be devolved by the State governments. Hence even though these functions appear to be mandatory, the final decision lies with the State.

Despite all the provisions for orderly growth and maintenance of cities, and preservation of environmental and natural resources, the two were not adequately connected to bring about urban

environmental improvement and protection until the thrust from the Stockholm Conference in 1972 that focussed on human environment. This global agenda alerted all countries to use resources sparingly in order to bring about sustainable development. As a result of this, India formed a committee called the National Committee on Environmental Planning and Coordination (NCEPC) to take care of environment, under the control of the Department of Science and Technology, which ultimately culminated in the formation of the Ministry of Environment and Forests. Side by side, an all pervasive Environmental Protection Act (EPA) was legislated in 1986 to cover major environmental deterrents. But the enactment of the EPA did not ensure the repealing of the earlier legislation on environmental elements such as air, water, etc., which still continues to operate. The EPA, however, focuses mostly on hazardous wastes.

Cultivation of marginal lands, though identified as a development issue in the Sixth Plan, did not get much attention. However, these could be divided into rural and urban. Agriculture in the urban and the peri-urban marginal lands has received attention in the Master Plans of many cities, where peripheral zones are allocated for farmhouses and the growth of exotic agricultural products or poultry or dairying. This will be dealt with in detail in the case study of Delhi. Of late, urban forestry is becoming popular as it helps to assimilate pollution, especially air.

Influence of the Policies and Plans on Urban Agriculture

Review of the plans and policies indicate that practically all aspects of environmental management have been discussed at some stage or the other, in the course of policy planning. But they tend to remain contained in sectoral compartments, like industries, water, urban development, etc. Inter-sectoral integration, or organisational links, especially with a view to developing cities, or an area, has not been attempted. This obviously points to a lack of importance being given to urban development *per se* in the context of environmental management. That cities in India contribute around 50-60 per cent of the GDP and work as major catalysts of growth, has not been taken into consideration while planning. No serious effort has been made to improve living conditions in cities, to raise productivity and the quality of life. This also points to a lack of focus on socio-economic development.

Area, space and location have also not been taken into account while planning. No doubt, sectoral development is very important. But it has to be noted that activities are located space. It is this location-specific element in planning that requires integration along with the different stages of development, so that the problem of malfunctioning does not arise. Within a given area, activities are linked to one another. It is said that every action has a counter reaction. Therefore, any negative impact can produce cumulative effects because of a chain reaction. In fact, when an area is being developed totally, as it is in a city, which is a system by itself, a holistic approach will have to be taken. Merely developing parts of it will not suffice. It is this aspect of development that is missing in environmental planning. To ensure holistic development, proper integration of activities is necessary, which would avoid overlapping of functions and management by different agencies. Hence, there will arise the need for organisational reforms. The legislative support will also have to be very strong. If the need arises, modifications will have to be made to existing laws and regulations.

The policy related to the siting of industry focuses on industries to be located away from large cities, in order to save the city from the hazards of pollution. Normally industries try to take advantage of agglomeration economies and/or the economies of scale. These benefits of development are common close to cities, where people collect to take advantage of a ready market and because of the availability of infrastructure. The congregation of people and their activities give rise to the demand for services. Thus industrialisation is intricately connected to urbanisation. Since industries are located close to cities, the policy for siting industries will influence urban and peri-urban agriculture. In fact, industries can pollute urban agriculture in three ways: through solid, liquid and gaseous waste production. Therefore, while siting industries near cities, precaution should be taken to avoid pollution as far as possible. This would mean careful designing of waste management strategy, including the adoption of the best available technology.

Even though India is without a formal landuse policy today, several attempts have been made by the Ministry of Agriculture to set up national agencies to formulate policies with regard to the protection of land as a resource. The efforts of all the agencies are directed towards the conservation of land and the preservation of good quality soil. The development of wastelands

has also been given a lot of importance. The emphasis has been on soil conservation, cropping pattern, stakeholder participation, afforestation, livestock rearing, commercial agriculture, regeneration of soil, socio-economic crisis related to agriculture and the use of financial instruments to encourage land management. It is interesting to note that all these factors are intimately related to UA and will be of immense help if UA is to be promoted as an economic activity for cities.

The Pollution Abatement Policy details out the different kinds of pollution and then gives guidance on the prevention of pollution, the digestion of waste, the protection from chemical wastes and the impact of human activities on the environment. The policy suggests integration of the environmental considerations at all levels of decision-making. It focuses on pollution prevention at source, development of best available technology, promoting the “polluter pays” principle, improvement of heavily polluted areas and encourages community participation. Emphasis is also laid on strategies and the standards that need to be maintained. It also mentions the economic instruments to be used, based on the need to do so. Moreover, an important aspect of this policy is the endorsing of the integration of different aspects of management into environmental planning.

In the National Conservation Strategy and the Policy Statement on Environment and Development, the focus is on the conservation of natural resources and the control on the use of resources through a reduction of population. This is the only policy statement that links population increase to a threat in food security. It, therefore, suggests the development of UA in the form of growing fruit trees along the roadside and suggests an improvement in crop and animal productivity. The policy statement highlights that to control pollution there is need for conservation and poverty alleviation. Pollution is considered to be a consequence of poverty and the paucity of resources. Both, the Pollution Abatement Policy and the National Conservation Strategy emphasise on community participation to play a major role in management.

Except for the Sixth Five-Year Plan, the other plans do not mention about UA or even link it to city management, or environmental management. However, there is a mention of stabilising

human and livestock population in the Seventh and the Eighth Plans, with regard to environmental management and conservation. The Plans give details of strategies for environmental management and the issues that should be dealt with. All aspects of pollution prevention are also looked into.

In the Sixth Plan UA is suggested in the form of horticulture in and around cities to build up the national food security. But this aspect of development is discussed in the section on promotion of agriculture and improvement in productivity. There is also a mention of the meat processing industries, which is mostly in and around cities. The proposal given is to set up separate organisations for promoting and regulating domestic production. The Sixth Plan, along with the other plans also emphasises on maintaining an ecological balance to nurture good environmental management.

In India, planning for cities has been mostly physical planning. Besides, operation and maintenance (O&M) practices have never been given due importance. Such mistakes in planning have always brought about poor implementation of projects and overuse of infrastructural services. Even though city governance falls in the domain of the local government, macro-level planning for urban development will have to be done at the state level to determine urban policies. It is, therefore, essential to include UA in both the state as well as city planning practices, for micro-level impacts can affect national/state policies. UA is an ideal case of acting locally to impact globally! Hence, policies and plans should consider UA as a management instrument for better development of cities, which in turn will promote economic development.

SECTION III

Chapter VIII

THE CASE STUDY OF DELHI

Distribution of Population, Area and Density

Delhi is the third largest city and the capital of India. The Union Territory of Delhi (DUT) in 1991 had a population of 9,420,644 spread over an area of 1483 sq.kms. The estimated population for 1998 (at an annual growth rate of 3.92%) was 11.45 million. Delhi has been a focal point of politics and administration from historical times. Modern Delhi is the ninth capital after Indraprastha, Mehrauli, Lalkot, Siri, Tughlaquabad, Firozabad, Shahjahanabad and New Delhi. Along with the changing status, Delhi's area has been redefined by each ruler. Today Delhi has grown so large, that it not only encompasses all the capitals of the past, but it has even expanded beyond them.

Delhi's population was less than one million till 1941. But soon after Independence, around 50 lakh refugees moved to Delhi (NCR Plan for 2001) because of the partition of the country. As a result, between 1941-51 Delhi recorded a growth of 90 per cent. But after the initial spurt in population increase, the DUT has continued with a steady growth of about 50 per cent per decade (Table: 2). This is rather high in terms of population increase and requires increased revenue generation for its upkeep. Therefore, to provide employment and livelihood to the new entrants, the government and the local administration encouraged the growth of industries and wholesale trade activities, all of which had a snowballing effect. In the years that followed, growth was monitored and supported by planned activities through the formulation of the Delhi Master Plan and the setting up of the Delhi Development Authority that promoted more physical developments to cater to the needs of the increasing population. However with time, the physical developments were unable to keep pace with population increase, as a result of which infrastructure shortages became common. Neither were all the local governments (3 in Delhi) able to maintain the city well. All this led to environmental deterioration within the city.

Table: 2
Decadal Variation in Population of the DUT

Year	Population	Decadal Variation	Percentage Decadal Growth
1901	405819	-	-
1911	413851	8032	1.98
1921	488452	74601	18.03
1931	636246	147794	30.26
1941	917939	281693	44.27
1951	1744072	826133	90.00
1961	2658612	914540	52.44
1971	4065698	1407086	52.93
1981	6220406	2154708	53.00
1991	9420644	3200238	51.45

Source: NIUA: Urban Environmental Maps, 1994.

Because of the influx of refugees, industrial growth was given an impetus first in the 1960s and then again in the 1980s, with the suggestion to relocate noxious industries away from the city centre to the periphery (to prevent pollution within the city). This helped the population to spread to the neighbouring ring towns of the Delhi Metropolitan Area (DMA), which included Ghaziabad-Loni, Faridabad-Ballabgarh, NOIDA, Bahadurgarh, Kundli and Gurgaon. The newly found industries helped the DMA towns to grow very fast. While the population of Delhi grew by 257 percent between 1951 and 1981, the ring towns grew by 567 percent in just one decade of 1971-81 (NCR Plan for 2001).

Thus Ghaziabad, Faridabad, Gurgaon and NOIDA which were once peripheral to Delhi are today contiguous extensions of Delhi. Moreover, with too much of congestion in Delhi, people are now moving to the DMA towns on the edge of the city, thereby reducing the concentration within Delhi (though just by a few percentage points in 1991). With such population spread, Delhi's periphery is

expanding outwards. Hence, the periphery that was 17-18 kms. away in 1972 (S.Nangia:1976) is today 35-40 kms. (SEEDS: 1998) away from the centre of the city. However, the major volume of the DMA population still remains with Delhi, as can be seen in Table: 3.

Table: 3
Population Distribution of DMA Towns (1991)

Towns	Population (in lakhs)	Percent to DMA
Delhi	94.20	85.98
Faridabad	6.13	5.60
Ghaziabad-Loni	5.56	5.07
NOIDA	1.67	1.52
Gurgaon	1.35	1.23
Bahadurgarh	0.57	0.52
Kundli	0.08	0.07

Source: NCR Planning Board.

The urban population constitutes a major portion of the total population of the DUT. The urban population (in actual numbers) has increased from 3.65 million in 1971 to 5.77 million in 1981 and 8.47 million in 1991. During this period its share in the total population has gone up from 89.70 percent in 1971 to 92.73 percent in 1981, after which it has declined to 89.93 percent in 1991. This decline in the proportion of urban population is indicative of a spread of population into the periphery, which eventually happens when a city is over-crowded. However, in the course of the population expansion of Delhi, there has always been a steady rise in the proportion of urban population till 1981. It is only in 1991 that the proportion has declined, and that too by just a few percentage points as stated above. But in absolute terms there is still an increase in the population (Table: 4).

Areal growth in Delhi has fluctuated with the national politics and the development plans. From Indraprastha to the present city, there has been a sea change in area, population and form.

Table: 4
Urban Population of Delhi

Year	Urban Population	Percentage to Total	Percentage Increase
1901	214115	51	-
1911	237944	56	11
1921	304420	62	28
1931	447442	70	47
1941	695686	76	55
1951	1437134	82	107
1961	2359408	88	64
1971	3647023	90	55
1981	5768200	93	58
1991	8427083	90	46

*Source: Government of National Capital Territory of Delhi, 1997.
(Please note that since the source of the above data is different, there is a slight variation from the census figures.)*

Table: 5
Growth of Urban Area, Delhi

Year	Net Area (sq. km.)	Addition (sq. km.)	Percentage Growth
1901	43.3	-	-
1911	43.3	0	0
1921	168.1	124.8	288.22
1931	169.0	1.5	0.89
1941	170.1	0.5	0.29
1951	195.8	25.7	15.11
1961	326.3	130.5	66.55
1971	451.4	125.1	38.34
1981	591.9	140.5	31.13
1991	685.3	93.4	15.78

Source: Government of National Capital Territory, 1997.

There was an enormous rise of 288 per cent in the urban area between 1911 and 1921, when the Imperial Capital shifted from Calcutta to Delhi. But after the completion of the construction of New Delhi in 1931, Delhi's area remained almost stable for the next three decades. The second spurt in development came after Independence with the formulation of the Master Plan and the industrial developments around 1960s (Table: 5). In fact, since 1962 the Delhi Development Authority has developed more than 20,000ha. of land for various uses (SEEDS:1998). After the setting up of the DDA, considerable developments were taken up within Delhi for the next two decades, which got reduced between 1981-91 as and when the city area got filled in and reached saturation, as a result of which the city started spreading into the countryside.

Table: 6
Distribution of Urban/Rural Area, Population and Density in DUT

Delhi Union Territory	Year	Area in sq.kms. Actual (%)	Population Actual (%)	Population density (Persons /sq.km.)
Urban Delhi	1981	591.9 (39.9)	5768200 (92.7)	9745
	1991	685.3 (46.2)	8471625 (89.9)	12362
Rural Delhi	1981	891.1 (60.1)	452206 (7.3)	507
	1991	797.7 (53.8)	949019 (10.1)	1190
Total DUT	1981	1483.0 (100.0)	6220406 (100.0)	4194
	1991	1483.0 (100.0)	9420644 (100.0)	6352

Source: Census of India, 1991.

The proportion of urban area within the DUT has been steadily increasing. From 30.05 percent (of the total) in 1971 it has increased to 39.91 percent in 1981 and 46.21 percent in 1991 (Table: 6). This

has not only led to an urban expansion, but has also encroached upon the peri-urban areas that have reduced the share of the rural area within the DUT. However, peri-urban areas are not necessarily contained within the administrative jurisdictions, but extend to the adjacent areas, especially along transportation corridors.

Table: 7
Urban Population and Area of Delhi and the Adjacent Districts

Districts	Population			Area		
	1971	1981	1991	1971	1981	1991
Delhi (DUT)	89.70	92.73	89.93	30.05	39.91	46.21
Sonepat	-	17.96	23.58	-	1.68	2.82
Rohtak	15.68	19.83	21.31	0.92	1.27	1.64
Gurgaon	18.51	19.91	20.30	1.26	2.09	2.69
Faridabad	-	40.82	48.57	-	8.79	8.98
Ghaziabad	-	34.13	46.16	-	5.72	10.96

Source: Census of India Note: (-) Not available

The pattern of urban-rural bifurcation of population in the adjacent districts of Delhi is just the reverse of that of the city, with less urban population and more rural population. However, Faridabad and Ghaziabad are gradually getting urbanised. Of late, Gurgaon has also joined the race (Tables: 7,8).

Table: 8
Rural Population and Area of Delhi and the Adjacent Districts

(% to total)

Districts	Population			Area		
	1971	1981	1991	1971	1981	1991
Delhi	10.30	7.27	10.07	69.95	60.09	53.79
Sonepat	-	82.04	76.42	-	98.30	97.18
Rohtak	84.32	80.17	78.69	99.08	98.73	98.36
Gurgaon	81.49	80.09	79.70	98.74	97.91	97.31
Faridabad	-	59.18	51.43	-	91.21	91.02
Ghaziabad	-	65.87	53.84	-	94.28	89.04

Source: Census of India

Note: (-) Not available

The increase in the urban areas of the districts is negligible, except for Ghaziabad where there is a difference of five percentage points between 1981-91. In the case of the other districts, the increase in population without any significant change in area indicates infilling and not expansion of urban areas. It also means that the existing towns are getting more congested.

Along with the number of people, the population density of urban Delhi has also increased over the years from 8172 persons/sq.km. in 1971 to 9745 persons/sq. km. in 1981 and 12362 persons/sq.km. in 1991 (Table: 9). Even though the density is on the increase in the rural areas, it cannot really be compared to the highly congested urban areas. However, it is interesting to note that rural Delhi has also become relatively more congested in the recent years, indicating concentration, especially in the rural-urban fringe (Table: 10).

Table: 9
Urban Population Congestion of Delhi and the Adjacent Districts

Districts	Population Density (population/area)			Congestion (area/1000 population)		
	1971	1981	1991	1971	1981	1991
Delhi	8172	9745	12362	0.12	0.10	0.08
Sonepat	-	4109	4564	-	0.24	0.22
Rohtak	5062	5453	5329	0.20	0.18	0.19
Gurgaon	4082	2984	3136	0.24	0.34	0.32
Faridabad	-	2163	3798	-	0.46	0.26
Ghaziabad	-	4245	4396	-	0.24	0.23

Source: Census of India *Note: (-) Not available*

The area/1000 population is on the decline for both the rural as well as the urban areas. However for urban Delhi, the area containing 1000 population is very small. Urban Delhi has the least area per 1000 population vis-a-vis other districts. In fact, Delhi has less area per 1000 population even in the rural areas. This obviously indicates higher concentration of population in and around the city. Such a pattern is typical of any metropolitan city where land is intensively used for many activities. It also indicates congestion within the metropolis. If inferences can be drawn, it can be safely said that such congestion is bound to bring in pollution, unless technology offsets impacts.

Of the districts around Delhi, urban area/1000 population for Sonapat, Rohtak, Gurgaon and Ghaziabad have remained almost the same between 1981-91, as of the previous decade. The ratio has declined considerably in Faridabad, indicating perhaps a relatively congested condition. However there is an overall move towards congestion because of the increase in population.

Table: 10
Rural Population Congestion of Delhi and the Adjacent Districts

Districts	Population Density (population/area)			Congestion (area/1000 population)		
	1971	1981	1991	1971	1981	1991
Delhi	403	507	1190	2.48	1.97	0.84
Sonepat	-	320	429	-	3.12	2.33
Rohtak	251	284	328	3.98	3.52	3.05
Gurgaon	229	256	340	4.36	3.91	2.94
Faridabad	-	302	397	-	3.31	2.52
Ghaziabad	-	497	631	-	2.01	1.58

Source: Census of India *Note: (-) Not available*

In total the trends of population growth and areal distribution indicate that as a result of rapid population growth, Delhi is expanding very rapidly into the peri-urban areas. With the rural share of DUT reducing because of infilling, Delhi's peri-urban zone is extending even further into the adjacent districts. Also, as can be found, with population concentration over time, the city is getting more congested.

Demand for Infrastructure

As a city grows in size, the demands for civic services and infrastructure rise. Population increase is spatially accommodated in two ways: through densification of existing inhabited parts and through the areal expansion of the city into the adjacent rural surroundings. This areal and population growth demand infrastructure provision of two kinds: upgradation of the existing utility systems for higher capacity and additional developments in the newly urbanised zones/areas. Normally a per-capita standard is used to provide the basic utilities and infrastructure. Unless replenished, a shortfall occurs in the per-capita utilities with population expansion. For example, in Delhi the per-capita norm for water supply is 318 lpcd. Whereas, at present, only 210 lpcd is being supplied (Table: 11). In fact, when the per-capita allocation of resources is over-stretched, areas tend to deteriorate

physically, as it happens in the slums, where infrastructure support and the provision of utilities are in short supply, creating management and socio-economic problems. Delhi has such 30,000 slums that need to be upgraded and/or rehabilitated (The Times of India: Feb.21, 2000). Mismanagement or administrative negligence can also create shortage of utilities. For example, leakage from water pipelines can result into shortage of supply because of wastage. In India, roughly about 20 percent of the potable water produced is lost during distribution (MIDS: 1995).

Demand for infrastructure is generally calculated by multiplying the per-capita norm by the population. For example, the shortage of water in Delhi is 1350 mld, calculated at the rate of 318 lpcd for a projected population of 12.5 million. The supply at present is 2620 mld (Table: 11). However, when such facts are not available, demands can be assessed from the declining per-capita distribution or the rising infrastructure/service provision with population increase (Tables: 12, 13, 14, 15). Surrogate variables can also be used to assess environmental conditions. For example, the increasing number of vehicles and industries or the length of roads can allude to the pollution caused by them (Tables: 16,17,18). Again, the incidence of diseases can indicate the discrepancies in the provision of both the quality and the quantity of sanitation facilities or the public health conditions. This section of the project examines some of the data on basic/civic infrastructure and utility services/supply (that is necessary for a good quality of life) such as potable water, sanitation facilities, electricity, transport, roads, etc. that require augmentation with time/use as the population increases. Very often when the demand created for resources and technology is not tendered, it can lead to environmental deterioration. For example, as the two stroke motor engines cause air pollution, the (increasing) number of two stroke vehicles can be used to estimate their negative impact on the quality of air, so that necessary steps can be taken to avoid pollution. Again, the shortage of water or sanitation facilities like garbage collection, or inadequate sewerage network, etc. that are instrumental in lowering the public health conditions and in causing illness, can give an estimation of the quality of life within a city. The illustrations used for Delhi give an idea of the demand created by city expansion and the need to augment infrastructure, absence of which will impact negatively on the people.

Table: 11
Water Supply in Delhi

I. Total Water Produced (Mld)	1996-97	1997-98
Total	2610	2620
a. Surface	2315	2315
b. Ground	295	305
II. Total Piped Water Supplied (Mld)	1996-97	1997-98
Total	1255	1175
a. Domestic	1076	969
b. Industrial	41	42
c. Commercial	135	165
d. Standpost	-	-
e. Others	3	2
III. Unaccounted Water (Mld)	1064	1112
IV. Per Capita Norm	-	318 (lpcd)
V. Per Capita Supply (for 12.5 million projected population of 1999)	-	210 (lpcd)
VI. Per Capita Shortage	-	108 (lpcd)
VII. Total Shortage	-	1350 (mld)

Source: Data collected for an ongoing NIUA Project on Status of Water Supply, Sanitation and Solid Waste Management in Class I & II Cities/Towns of India, , Delhi Jal Board, New Delhi.

Table: 12
Water Supply And Consumption In Delhi

DESCRIPTION	1980-81	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96
No. Of metered connections	355157	678461	700923	745029	804180	826624	853807
No. of un-metered connections	13143	226960	245451	253977	294174	311262	315687
Water consumption (gallons per day)	1953	4540	4456	4649	4511	4490	4741
A. Domestic	1542	4013	4049	4082	4087	4057	4114
B. Commercial/industrial	411	527	407	567	424	433	627
Per capita consumption of water (gallons per day)	32.07	49.03	47.6	46.66	43.74	42.04	43.76

Source: D.W.S. & S.D. undertaking Thandewalan, New Delhi, as published in Delhi Statistical Handbook 1997.

Table: 13
Augmentation of Domestic Waste Water Treatment Capacity

Location	Present Capacity	Proposed Capacity
Okhla	562	636
Keshopur	327	509
Coronation Pillar	90	182
Rithala	182	364
Kondli	45	205
Vasant Kunj	-	23
Yamuna Vihar	-	68
Ghitorni	-	23
Pappan Kalan	-	91
Narela & Alipur	-	91
Najafgarh	-	23
Badarpur	-	9
Timarpur	55	46
Rohini	-	68
Total	1270	2368

Source: White Paper on Pollution in Delhi with an Action Plan, Ministry of Environment and Forests, GOI, New Delhi.

Table: 14
Solid Waste Collection

Years	Garbage	Silt
1991-92	930054	70582
1992-93	1125684	45628
1993-94	1205366	54803
1994-95	1320530	110254
1995-96	1333736	170785
1996-97	1642738	193195
1997-98	1868894	910140

Source: MCD, as collected by Satpal Singh, NIUA.

Table : 15
Generation and Distribution of Electricity (In/M.U.)

Items	1980-81	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90
Electricity Generated and Purchased							
(a) Locally Generated	1313	1255	1158	1402	1359	1088	1662
(b) Purchased from Nangal and other states	1613	3283	3759	4157	4832	5732	5962
Total (a)&(b)	2926	4538	4917	5559	6191	6820	7624
Electricity Consumed (Locally)@							
Domestic Purpose	701	1162	1286	1385	1483	1635	1915
Commercial Purpose	453	709	779	827	920	960	1030
Industrial Purpose	590	950	1095	1200	1130	1217	1605
Irrigation Purpose	**	**	**	**	**	**	**
Public Water works	134	**	**	**	230	305	200
Street Lighting	41	48	193	73	80	-	130
Licenses (NDMC) and (MES)	453	597	598	599	639	703	720
Total	2372	3466	3951	4084	4482	4820	5600

Note: 1) Data pertains to DESU only.

2) @ Data from 1985-86 to 1987-88 are provisional and 1988-89 are as per Budget estimate

3) ** Included in Industrial

Source: Delhi Statistical Handbook - 1991, Bureau of Eco, & Stat. Delhi Admn.,
as published in Delhi District Census Handbook - 1991, Part XII A&B.

Table : 16
Registered Motor Vehicles in Delhi

Name of the Vehicles	1981	1985	1986	1987	1988	1989	1990	1992	1993	1994	1995	1996
Cars & Jeeps	123655	174890	202905	241851	279708	332761	383610	468809	510242	557543	617585	685850
Motor Cycles & Scooters	364010	637267	746619	867908	978698	1082802	1191186	1381582	1467182	1580817	1707528	1844471
Auto-Rickshaws	20920	31354	40713	45546	51700	57761	62007	69974	71568	74408	77884	80208
Taxis	6583	8654	8772	8919	9094	9422	10026	11212	11679	12225	13384	14593
Buses	8528	13815	14617	15363	16319	17481	18651	22640	23943	25553	27473	29183
Goods Vehicles	38072	58925	61860	71168	80412	89568	99078	110465	114294	122444	131877	139300
Total	561768	924905	107586	1250755	1415931	1589795	1764558	2064682	2198908	2372990	2575731	2793605

As on 31st December:-

Source: 1. Delhi Statistical Handbook - 1991, Bureau of Eco. & Stat. Delhi Admn., as published in Delhi District Census Handbook - 1991, Part XII A&B
2. Transport Department Govt. of N.C.T. of Delhi as published in Delhi Statistical Handbook 1997

Table : 17
Industries in Delhi

Year	No. of Industrial Units (In '000)	Invest- ment (Rs. In Crores)	Produc- tion (Rs. In Crores)	Employ- ment (In '000)
1976-77	37	549	1024	305
1977-78	37	550	1025	300
1978-79	40	600	1200	325
1979-80	41	650	1430	350
1980-81	45	700	1700	375
1981-82	45	867	2196	450
1982-83	50	965	2350	480
1983-84	54	1035	2352	507
1984-85	57	1105	2483	528
1985-86	65	1200	3300	558
1986-87	65	1260	3450	595
1987-88	68	1320	3600	622
1988-89	73	1420	3850	657
1989-90	77	1500	4050	693
1990-91	81	1580	4250	729
1991-92	85	1659	4462	765
1992-93	89	1750	5000	802
1993-94	93	1823	5115	837
1994-95	97	1901	5335	873
1995-96	101	1980	5555	909

Source: Statistical Abstract 1977-1996, Directorate of Economics and Statistics, Govt. of National Capital Territory of Delhi.

Table : 18
Length of Roads in Delhi

(In Kilometers)

Year	MCD	NDMC	Delhi Canton- ment Board	Public work Deptt.		Total
				National Highways	Other Roads	
1976-77	9407	1114	124	282	422	11349
1977-78	9680	1120	124	282	479	11685
1978-79	10880	1127	124	289	570	12990
1979-80	11672	1177	124	302	570	13845
1980-81	12129	1191	124	302	570	14316
1981-82	13136	1198	143	326	684	15487
1982-83	13816	1218	143	372	810	16359
1983-84	14124	1232	143	372	810	16681
1984-85	14676	1239	143	372	826	17256
1985-86	15418	1244	143	372	873	18050
1986-87	15418	1259	143	372	873	18065
1987-88	16750	1267	143	372	873	19405
1988-89	17812	1272	143	330	1011	20568
1989-90	18373	1287	143	330	1042	21175
1990-91	18673	1289	143	324	1135	21680
1991-92	19476	1293	143	324	1251	22487
1992-93	21226	1295	144	337	1400	24402
1993-94	21452	1297	144	337	1400	24628
1994-95	21467	1298	144	337	1400	24645
1995-96	22769	1299	144	337	1400	25948

*Source: Statistical Abstract 1977-1996, Directorate of Economics & Statistics
Govt. of National Capital Territory of Delhi.*

Further, information on the civic amenities of Delhi in 1991 revealed that only 67 per cent of the population was serviced by toilets, 81 per cent was provided with electricity, 96 per cent had safe drinking water and only 63 per cent of the garbage was collected (NIUA: 1997). In the same year only 74 per cent of Delhi's area was serviced by sewer lines.

A recent article in The Times of India (December 1999) says that the Delhi Jal Board can treat only 2,645 mld of raw water. The demand at present is of 4,765 mld. Hence there is a shortage of 45 per cent in the demand for treated water. This gap will rise to 57 percent by the year 2021, even if water from the long pending Tehri dam comes to the capital's rescue.

In power, the peak demand is 2,600 mw. It will be up by 900 mw three years from now. Right now the availability is about 2,355 mw and it is hoped that generation may go up to 2,600 mw by 2002. If nothing is done, the gap will be around 50 per cent in 20 years from now.

In Delhi, three-fifths of the commuters travel by buses and just one per cent use the 120-km rail network. Each month, roughly 10,500 vehicles hit the roads. By the year 2001, around 40 lakh vehicles will be jostling for space in the Delhi roads. The city's pollution load is about 3,000 tonnes a day, as against 100 tonnes per day just a decade ago. More than three-fifths of this pollution is from vehicles.

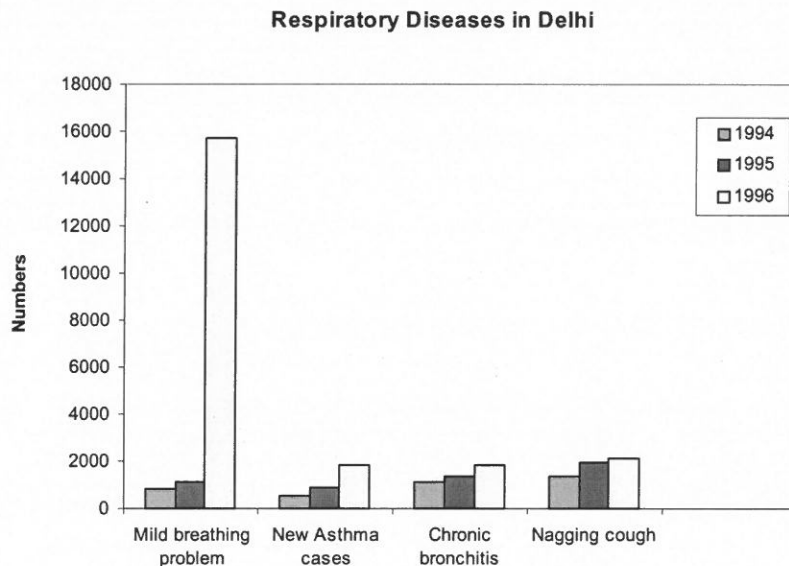
The capital generates around 2,871 mld of sewage, but is able to treat only a little over half the volume. The rest finds its way into the Yamuna, making the water unfit for drinking or other non-agricultural use. Sewerage facility is available to only three-fourths of the population. Besides, the lines laid earlier need to be upgraded.

The message is clear: such shortage of infrastructure can lead to different kinds of pollution, causing human suffering. As has been mentioned earlier, part of this pollution can be offset by nature and part by improved management. UA can help in reducing pollution through the natural assimilation of certain types of waste.

Pollution Levels in Delhi

When appropriate and adequate infrastructure and technology are not provided with the rise in population, pollution tends to increase. This can be injurious to human health, animals and plants. For example, lack of sanitation facilities can cause diseases like cholera, hepatitis or gastroenteritis. Again, inappropriate or crude technology in industries and motor vehicles can lead to air pollution causing human discomfort, as is happening in Delhi with the rise in the respiratory diseases (Chart: 1). Scientific studies have indicated that pollution has a deleterious effect also on crops (Sinha: undated). To illustrate, the main sources of air pollution in India are automobiles, thermal power plants, industries, quarrying etc. At present in Delhi, 64 percent of the air pollution is from vehicular emissions (Table: 19). To mitigate such pollution, efficient pollution prevention technology will have to be used in the manufacturing of motor vehicles. Also, restrictions will have to be put on the use of certain types of fuel like unleaded petrol, diesel, etc. For instance, of late Delhi has put a restrain on the use of cars without Euro I standards of pollution control. As the population increases, there is bound to be more cars on the roads. Therefore preventive measures will have to be adopted to control pollution.

Chart: 1



Source: Basu, Soma(1997); *Pollution Capital, The Hindu Survey of the Environment.*

The three main natural elements within a city that get polluted the most are: air, water and land. Their condition within a city can be best understood by the quality of the ambient air, as compared to the national standards (Table:20,21), the quantity of garbage collected (Table: 14), the incidence of air and water borne diseases (Chart: 1, 2 & Table: 22)) and the pollution load discharged into the rivers (Table: 23). The tables below give some idea of the pollution in Delhi that is harmful for human health and which can be mitigated by UA.

Table: 19

Sources of Pollution in Delhi

Source	1970-71	1980-81	1990-91	2000-01 Projected
Industrial	56%	40%	29%	20%
Vehicular	23%	42%	64%	72%
Domestic	21%	18%	7%	8%

Source: White Paper on Pollution in Delhi with an Action Plan, Ministry of Environment and Forests, GOI, New Delhi.

Table: 20

Ambient Air Quality Data in Delhi

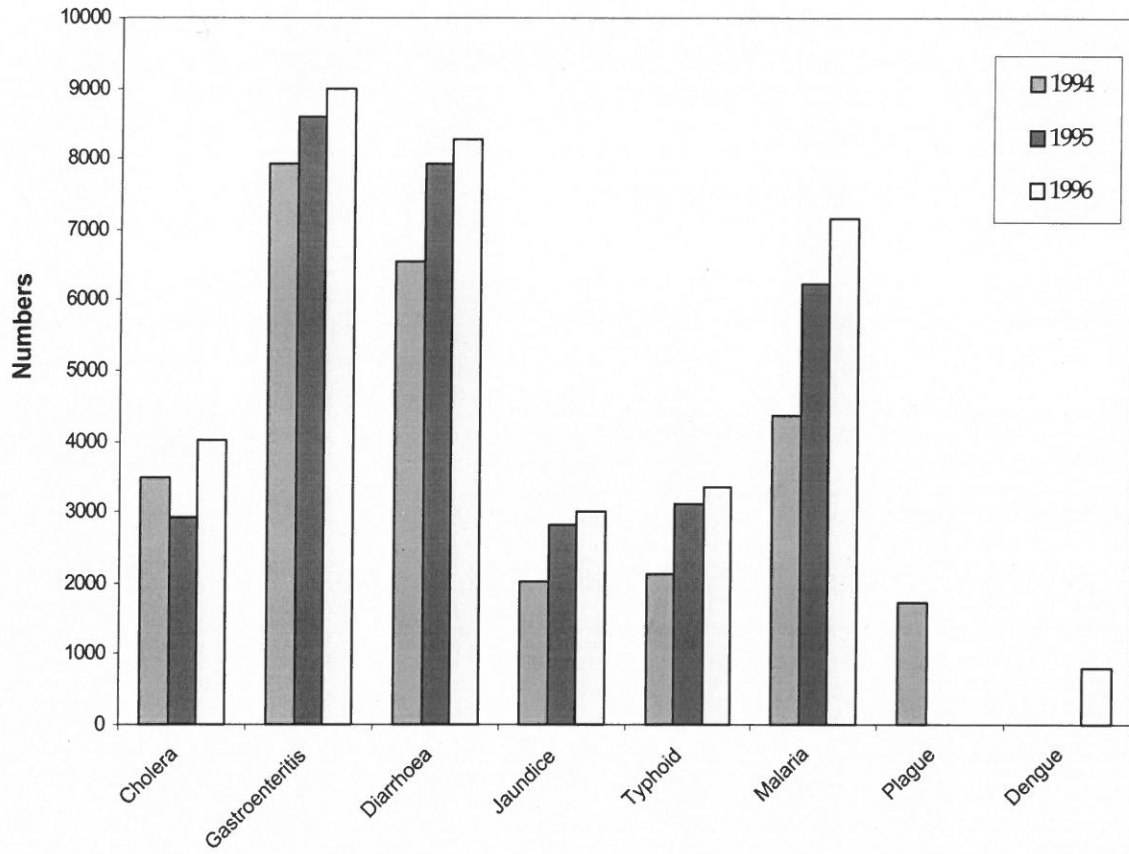
(All Concentrations are in Micrograms Per Cubic Metre)

Year	Sulphur Dioxide		Nitrogen Dioxide		Suspended Particular Matter	
	Annual Mean	% Variation (base 1989)	Annual Mean	% Variation (base 1989)	Annual Mean	% Variation (base 1989)
1989 (Jan-Dec)	8.7		18.5		373	
1990 (Jan-Dec)	10.2	(+)17.0	22.5	(+22)	338	(-)9.4
1991 (Jan-Dec)	13.3	(+)53.0	27.2	(+47)	317	(-)15.0
1992 (Jan-Dec)	18.4	(+)111	30.4	(+64)	377	(+)1.1
1993 (Jan-Dec)	18.5	(+)113	33.2	(+79)	372	(-)0.3
1994 (Jan-Dec)	19.5	(+)124	33.0	(+78)	377	(+)1.1
1995 (Jan-Dec)	19.0	(+)118	34.1	(+84)	407	(+)9.7
1996 (Jan-Dec)	19.0	(+)1118	33.7	(+82)	387	(+)3.8
1997 (Jan-Aug)	16.2	(+)86	33.0	(+73)	370	(-)08

Source: White Paper on Pollution in Delhi with an Action Plan, Ministry of Environment and Forests, GOI, N. D.

Chart : 2

Vector/Water-borne Diseases in Delhi



Source: Basu, Soma(1997); Pollution Capital, The Hindu Survey of the Environment.

Table: 21

National Ambient Air Quality Standards

(microgrames per m³)

Pollutant	Time-Weighted Average	Concentration in Ambient Air		
		Industrial	Residential	Sensitive
Sulphur Dioxide (SO ²)	Annual Average	80	60	15
	24 Hours	120	80	30
Oxides of Nitrogen as NO ²	Annual Average	80	60	15
	24 Hours	120	80	30
Suspended Particulate Matter (SPM)	Annual Average	360	140	70
	24 Hours	500	200	100
Respirable Particulate Matter (Size less than 10µm)	Annual Average	120	60	50
	24 Hours	150	100	75
Lead	Annual Average	1.0	0.75	0.50
	24 Hours	1.5	1.00	0.75
Carbon Monoxide (mg/M ³)	8 Hours	5.0	2.00	1.00
	1 Hours	10	4.00	2.00

Source: *White Paper on Pollution in Delhi with an Action Plan, Ministry of Environment and Forests, GOI, New Delhi.*

Table: 22
Cholera cases in Delhi

Year	Reported cases
1991	114
1992	257
1993	135
1994	165
1995	290
1996	111
1997	97
1998	168
1999*	189

Note: * Till May 19.

Source: MCD, as reported in *Times of India*, May 21, 1999.

Table: 23

Pollution Load being Discharged into River Yamuna

Year	BOD load, tonnes/day
1982	117.3
1983	132.3
1984	119.4
1985	123.2
1986	165.1
1987	148.5
1988	159.6
1989	163.4
1990	167.5
1991	179.8
1995	178.4
1996	193.8

Source: White Paper on Pollution in Delhi with an Action Plan, Ministry of Environment and Forests, GOI, New Delhi.

Facts and figures indicate that pollution is on the rise with increasing urbanisation in Delhi. This is true for air pollution, garbage generation, the pollution load of the river Yamuna in Delhi and the incidence of diseases resulting from the shortage of utilities and basic services. It is also to be taken note of that expansion in population increases the demand for infrastructure and services, which is often very hard to provide with limited resources. Hence, to check pollution, two aspects of development will have to be focused upon: (I) provision of adequate infrastructure and (ii) the introduction of appropriate technology to control the use and misuse of resources and to optimise production.

Often management strategies play an important role in reducing pollution. For example, as mentioned earlier, a study was done in 1985 by the CPCB to assess the impact of autoexhaust lead pollution on the roadside vegetation of Delhi. The concern was that the lead added in the petrol to improve the antiknock property is emitted as particulate matter, of which the roadside soil and vegetation are the immediate receptors. Therefore, the study was done to:

- assess the extent of lead concentration in the ambient air near road crossings;
- assess the relative sensitivity of selected species of plants to Pb;
- screen species of plants suitable for roadside plantation, in search of accumulator-indicator species of plants for lead pollution.

Results identified a few species of plants that are suitable for growing along the road. It was also found out that lead accumulation varied with seasons, thereby asserting the usefulness of UA in pollution control (CPCB: 1985). In fact, plants/vegetation help in digesting waste and reducing waste management expenses.

Rural-Urban Fringe of Delhi and Urban Agriculture

The rural-urban fringe has been described as the zone which lies immediately outside the city area and has strong interactions with the city in terms of daily commuting and exchange of goods and services and bears an urban reflection on the physical, occupational and demographic structure. It is rural compared to the typical urban of the city area and urban compared to the typical rural landscape. In the Delhi Metropolitan Region this is not a concentric zone around the city, but is polygonal in shape, extending along the axial transportation routes (S.Nangia: 1976) between 25-40 miles from the city (SEEDS: 1998).

Apart from the transportation routes, the physiography also determines the extent and form of the rural-urban fringe, such as the low lying and floodable areas in the eastern part of the Yamuna river, the salt-pans/sand dunes and depressions of the west and the south-west, and so on. The areas which are favourable for the development of fringe are in the east towards Ghaziabad, the axial-route strip in the south-west towards Faridabad and in the north-west towards Sonapat (Nangia: 1976). However since Nangia's study, which was done 23 years ago, Delhi has become much larger in area and population. With time the interstitial areas are getting filled in by urban developments (SEEDS: 1998) that is pushing the fringe farther away from the city centre.

The peri-urban areas of larger cities have some common characteristics. The sewage networks and pumping stations are generally located in the rural-urban fringe. In Delhi, this is in Okhla, which is still in the fringe. But rapid expansion of the city will not let it remain so. Another fringe element is the railway marshalling yards. In Delhi this is located in Ghaziabad and Tughlakabad.

The green-belt with its trees, parks and recreational and cremation grounds lies in the fringe of cities. The purpose of having a green belt is to restrict squatter settlements and urban intrusions into good agricultural lands on the edge of the city and to prevent the city pollution from spreading into the rural areas. But urban expansion is devouring the green belts around Delhi. Within the city, too, the open (cultivable) lands are fast diminishing. The Safdarjung airport, which was once upon a time on the fringe, is now part of the city and is not being used as a regular airport. It is now only used for recreational purposes or under emergency.

The urban villages within the city have also started showing signs of infiltration with time. In Delhi, all the agricultural lands belonging to the residents of these villages have been taken away for building the city. However, a few remnants that are left, are still cultivated. Here the grain crops are being replaced by cash crops and vegetables, which are cultivated very intensively. Delhi also grows plenty of fodder crops that indicate livestock rearing within the city. These crops are often irrigated by the wastewater generated by the household and use the biodegradable waste as manure (Farmer Interviews). Many of the urban villages have got totally annihilated in the process of urban development. Those that have remained, have not only changed in their economic structure, population growth, density, literacy, and sex composition, but have also suffered from unplanned growth with no basic infrastructure such as sewerage, drainage, water, electricity, etc. which cause pollution (Field Interviews). In the fringe villages agricultural activities dominate, followed by tertiary activities. There is a distance decay function present both with regard to the size of population and the non-agricultural activities (Nangia: 1976; Dwivedi: 1992).

The major crops in the urban and the peri-urban areas of Delhi are wheat, barley, maize, jowar, mustard, bajra, sugarcane, paddy and cotton. Whereas the south and the west are dry, the northern and southeastern regions are adequately irrigated. The latter grows significant amount of paddy. In these areas gram grows out of cultivation (SEEDS: 1998).

The SEEDS Report also indicates that the size of the landholdings is very small. Since information on Delhi was not available, the estimates were done from the data collected from Gurgaon district. The survey highlighted that with the increase in the size of the family, the plots have been subdivided. There is also a lure of higher paying non-agricultural employment, which is within the daily travelling distances from the villages.

The baseline study by SEEDS identifies a peri-urban belt at 25 kms. from the centre of the city in the north and west, and between 35-40 kms. in the south and the east, where a large proportion of the population is engaged in agriculture (out of 197 villages, 52 have more than 40% of their population engaged in agriculture; and 70 villages with 20-40 percent workers in agriculture). However, most of the villages that are predominantly agricultural today will get urbanised in the future.

The Master Plan of Delhi-2001 suggests a two-pronged strategy to accommodate 12.2 million people by the year 2001: one to increase the population holding capacity of the area within the urbanisable limits of 1981; and the other to extend the urbanisable limits further. While the existing urban limits (DUA-81) are estimated to accommodate about 8.2 million people, the balance population will require 18,000-24,000 ha. that are now under rural use. However, with the recent decision taken to increase the area of the NCR (The Times of India) such predicaments can be taken care of.

Urban agriculture is a paradoxical phenomenon. Since agriculture is the prerogative of the rural areas, its inclusion in the urban development plans is considered to be backward (Yeung: 1985). Therefore, practically all development assistance for agriculture and forest is confined to rural programmes. However, in the Master Plans of Delhi (in both the original and the revised), provision for agriculture does exist. The Master Plan proposes a system of linked open spaces and district parks, including existing orchards and fruit gardens which should be interconnected by green linkages and smaller local parks penetrating through residential and work areas. Again, the Zoning Regulations have permitted the development of non-commercial farms, agricultural gardens, nurseries and green houses in "residential" zones. Besides, an Agricultural Green Belt has been

proposed for Delhi, with permission for uses such as: agriculture, horticulture, dairy, poultry, farming, dairying and milk chilling centres, piggery, nursery, forest, orchards, farm houses and their accessory buildings and uses within one-acre plot area (Use Zone A.1). In Use Zone A.2, which is totally rural, all uses of the Agricultural Green Belt are permitted.

However, land uses in the Urban Extensions have not included agricultural developments. But in the projected workforce for the Union Territory of Delhi-2001, agriculture has been included. The proportion of agricultural workers to total workers within the urban limits has been estimated to be 0.30 per cent. In the rural areas outside the municipal limits, i.e. the peri-urban areas, the proportion rises to 30.00 per cent. The urban/peri-urban bifurcation for agricultural workers results to 18.05 per cent for urban and 81.95 per cent for peri-urban areas. Inclusion of agricultural workers in the estimated workforce indicates that there is an expectation that agricultural activities will be carried out by the marginal workers in the marginal lands. But this aspect of development has not yet been given a "formal" attention within the city.

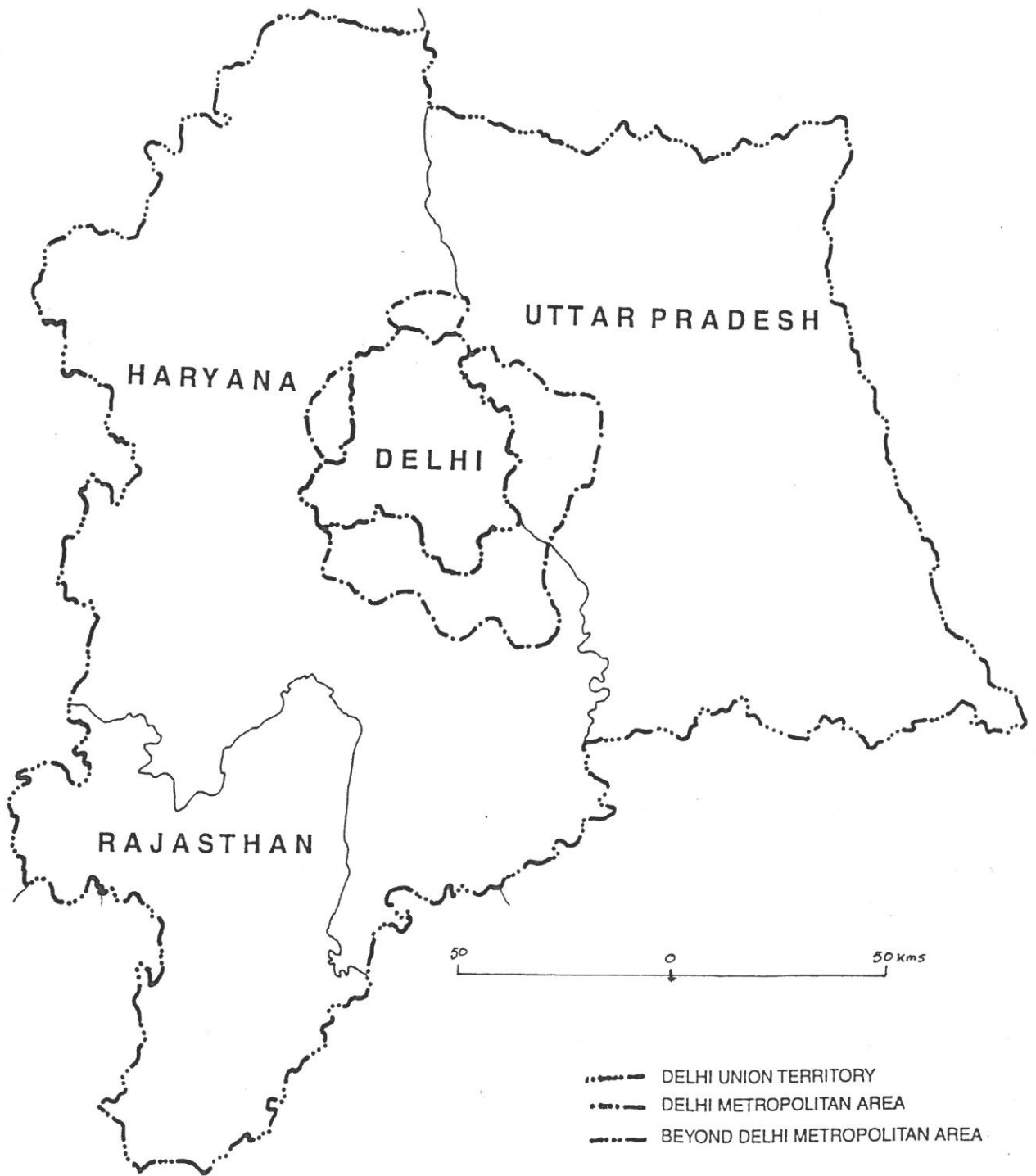
Physical Characteristics of Delhi

Location

Delhi is located in northwest India, spreading latitudinally from 28°24'17" to 28°53'00" in the north and longitudinally from 76°50'24" to 77°24'37" in the east. The greatest length is 51.90 kms. and the maximum width is 48.48 kms. It consists of three statutory towns, 29 census towns and 209 villages, spread over two tehsils of Delhi and Mehrauli (1991 census). Delhi is surrounded by the towns of Ghaziabad and Loni of Uttar Pradesh; Faridabad, Ballabgarh, Gurgaon and Bahadurgarh of Haryana; and Narela of DUT, all within a radius of 20-35 kms. (Map: 1). The area bounded by these towns has been defined as the "Metropolitan Area" in the Master Plan for Delhi, covering almost 2000 sq. kms.(Map: 2).

Within a radius of about 80-130 kms. around Delhi can be found the priority towns of the National Capital Region, such as: Meerut, Ghaziabad, Hapur, Bulandshahr, Khurja and Palwal of Uttar Pradesh; and Panipat, Rohtak, Rewari, Dharuhera and Bhiwandi of Haryana; and Alwar of

Map : 1
Policy Zones

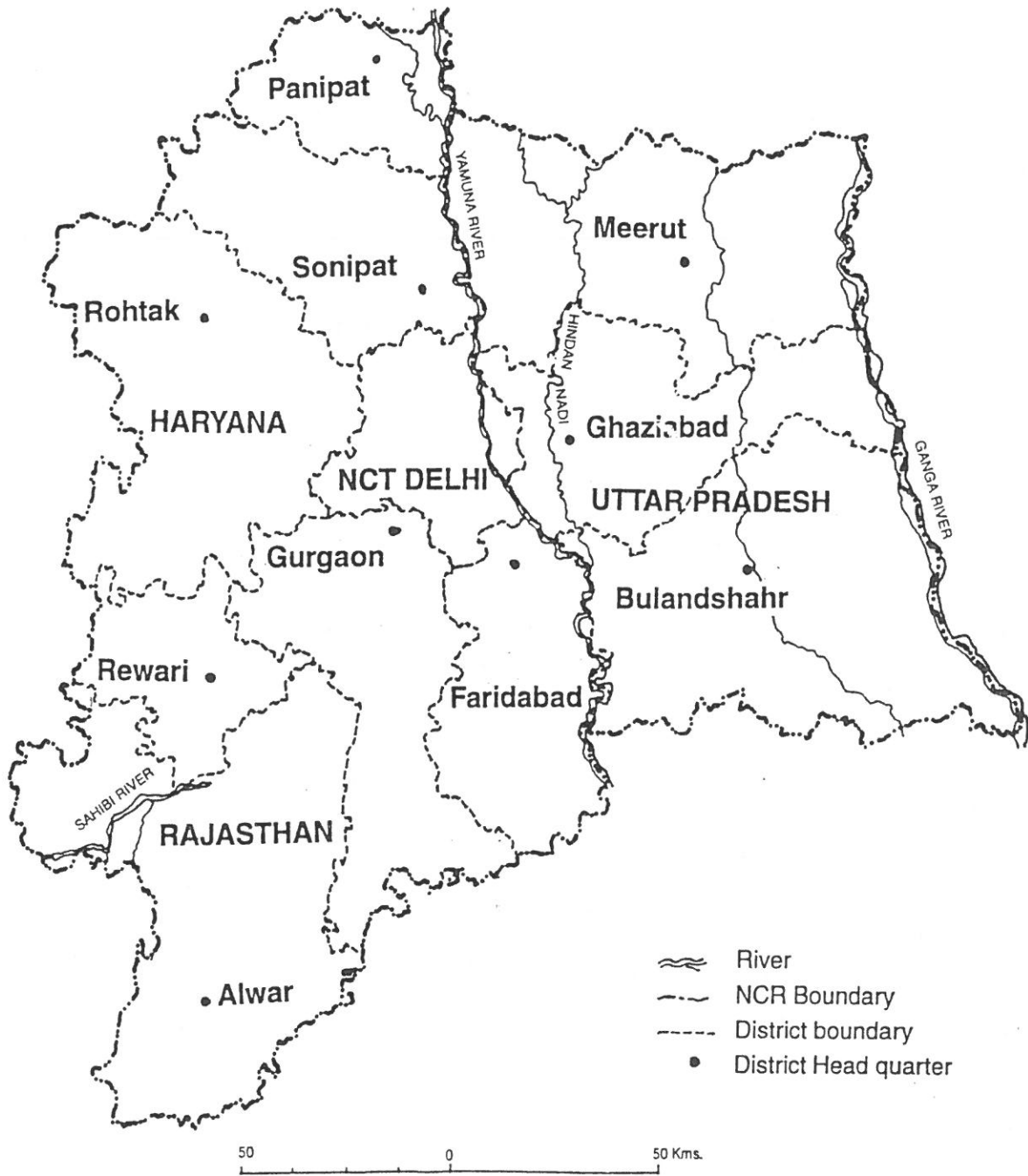


Map : 1
Policy Zones



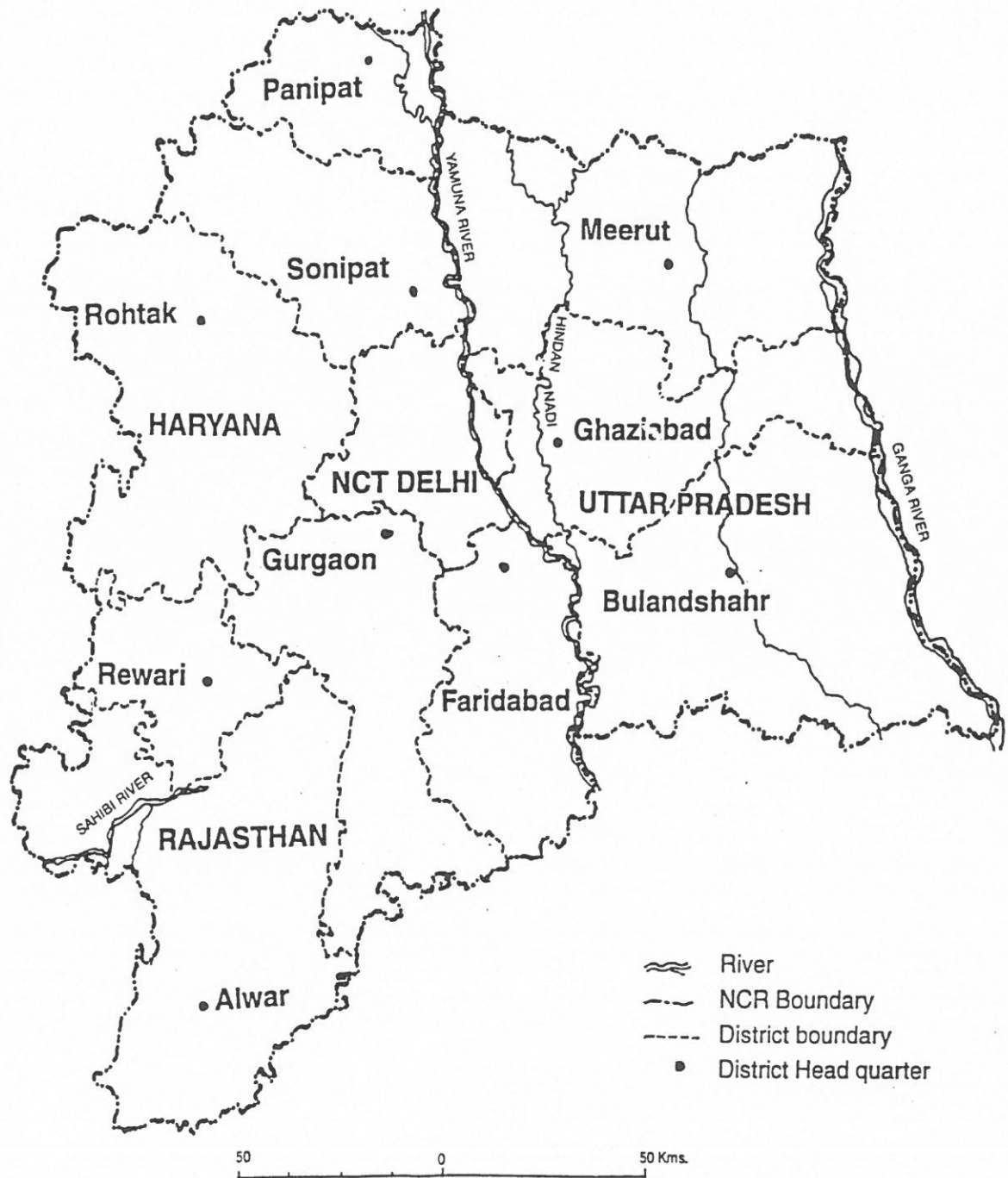
Map : 2

National Capital Region



Map : 2

National Capital Region



Rajasthan. It is surrounded on three sides by the state of Haryana (north, south and west), and bounded in the east by Uttar Pradesh.

Climate

With continental air prevailing for most of the year because of its inland position, Delhi has a semi-arid climate, having an annual average rainfall of around 660 mm., with 75% of the total rain falling during the three monsoon months of July, August and September and one month in winter. The rain advances from the southwest to the northeast. The 600 mm. isohyet surrounds Yamuna khader (flood plain) in the eastern part, while the western part shows the isohyet of 300mm. The relative humidity is above 65 percent, with the barometer rising to 90 percent in the monsoon months. In summer the maximum temperature ranges between 30-40°C, often rising above 45°C; while in winter the maximum temperature is around 25oC. The minimum temperature in winter is less than 10°C.

The winds are strong during summer and generally light during the post-monsoon months. Delhi has a maximum monthly mean of 14.6 kmph. in June, and a minimum of 6.7 kmph.in November. Except during the monsoon months, the winds are predominantly from westerly or northerly directions, which tend to be more northerly in the afternoons. Easterly and southerly winds are more common during the monsoon months. Dust storms are common during the summer months of May and June, when the temperature is quite high. These storms may sometimes occur at a speed of 70-90 kmph., coming especially from the western direction.

Physiography

Delhi ranges between 213-305 m. above the mean sea level (MSL). The DUT is characterised by a piedmont plain, the old flood plains (known as bangar), the Yamuna khader and the Aravalli ridge. The Yamuna River and the Aravalli range mainly influence the physiographic conditions of the area. The Yamuna flood plain is somewhat low lying and sandy and are subject to recurrent floods. During the rainy season the floodwater inundates this region. After the flood subsides, the moisture in the soil lasts for quite sometime, making the land very fertile. UA within Delhi is mostly found in the Yamuna floodplain. The major part of the territory lies on the western side of the Yamuna. The

general slope of the land is from north to south. The ridge constitutes the most dominating physiographic feature of the DUT. It originates from the Aravalli hills of Rajasthan, entering DUT from the south and extends in a northeastern direction. It encircles the city on the northwest and the west. The point near Bhatti has a height of 1045 ft. The Tughlaqabad Fort is located on one of the highest spurs of the ridge.

Five soil classes are found in the DUT, viz.

- 1 sandy loam
- 2 calcareous silty loam (which is very fine)
- 3 mixed calcareous, silty, clay and sandy loam (coarse to fine loam)
- 4 sand, silt and calcareous coarse loam
- 5 rocky Aravalli ridge and dissected land.

The soils found are an intermixture of local quartzite, alluvium of acolian origin and the river alluvium. The soil classes have a very close correlation with the vegetation, surface runoff, drainage efficiency and the structural bearing capacity of the soils. In general, the soils of DUT are of medium fertility. Clay contents generally vary from place to place and salinity is a great problem. The structure is mainly grained or weakly developed granular. The soil is mainly sandy loam in texture, becoming slightly heavier with depth. The southern part of the city is formed of quartzite or sandstone and alluvium brought by small streams.

The water table is quite high. However, the lowest area is adjacent to the Aravalli outcrops. The wells in the east and the northeast of the Mehrauli ranges from 30 ft. to 60 ft. below the ground level (SEEDS: 1998). The Ridge forms the main watershed for the National Capital Territory. The drainage in the east is towards the Yamuna River. In the west the drainage passes into the Najafgarh drain.

Landuse

Landuse within a city is very important. The physical layout, the different uses, the open spaces, the building bye laws etc. are important factors that influence the structure and the health of a city. In the case of urban agriculture, it is essential to know the distribution of the fallow and the marginal lands.

The proximity of the low income housing to such land is also of great significance. Normally, low income housing/slums come up on marginal lands like on the slopes of a drain or canal or nalla, or low lying land, etc. It is even found in the utilities' right of way like along the railway lines, beneath electric towers and so on. Very often flowers and vegetables are seen growing on such land. Vacant lands along railway tracks are also cultivated, as it happens in the city of Bombay.

For the efficient functioning of a city, it is essential to have a good Landuse Plan that will protect residential areas from vehicular pollution (which includes noise and gases), foster easy accessibility without traffic congestion, have enough open/lung spaces for air circulation, have adequate greenery to assimilate local pollution and promote aesthetics. All these contribute to healthy living and a good quality of life. Placed below (Table: 24) is a statement of land utilisation between 1970-71 to 1993-94. The utilisation pattern reveals a trend that indicates cause and effect relationship.

With increase in population, more land is being transferred to non-agricultural use. The area under such use has risen from 34,207ha. in 1970-71 to 57,791ha. in 1993-94, indicating an increase of about 69 percent in a period of almost 25 years. There is also an increase in the barren uncultivable land over the years, which normally happens from construction and seepage of pollutants. It has been observed that pollution from urban use often renders cultivable land unfit for crops.

There is a massive rise (of about 222 percent) in the cultivable wasteland between 1970-71 and 1993-94. It indicates that the newly acquired agricultural land for urban development is left fallow for a long time and is not put to good economic use. It is actually this land that can be used for urban agriculture until development takes place.

The fallow land within Delhi has declined over the years. In urban planning precaution is taken to avoid the use of agricultural land as far as possible. Hence all non-agricultural land is generally used for city expansion. The unbuilt fallow land can also be used for urban agriculture after enriching the soil.

Table: 24

Utilisation of Land in Delhi

Landuse Classification	1970-71	1980-81	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94
										(P)	(P)
Area according to village papers, Professional Survey	147612	147488	147488	147488	147488	147488	147488	147488	147488	147488	147488
Forests	1143	1434	1561	1561	1561	1561	1561	1561	1561	1561	1181
Area not available for cultivation:	47314	52077	71330	68043	68310	69629	72191	74248	74953	78546	77279
(a) Land put to non-agricultural uses	34207	34248	60435	57662	57332	59930	62369	64562	63923	62961	57791
(b) Barren uncultivable land	13107	17829	10895	10381	10977	9699	9822	9687	11030	15585	19488
Other uncultivated land excluding fallow land	3602	2719	5456	11580	11244	11400	12523	12864	10074	11708	11387
(a) Permanent pastures and other grazing lands	402	864	696	746	746	746	746	746	746	64	63
(b) Land under misc. tree crops	41	1064	1225	887	887	887	1267	1267	1470	1143	1143
(c) Cultivable waste land	3159	791	3535	9947	9610	9767	10510	10850	7858	10501	10181
Fallow land	15043	32707	12816	10112	15898	15258	12864	12864	11870	11800	11550
Net area sown	80510	58551	56324	56192	50474	49640	48349	48357	49030	43874	46091
Area sown more than once	36075	29048	25053	30381	18937	27447	22903	27882	16543	8196	14766
Total crop area	116585	87599	81377	86573	69411	77087	71252	76237	65573	52070	60857

Source: District Census Handbook, 1991 and Delhi Statistical Handbook, 1995.

A decrease in the total crop area and the net sown area is also indicative of the gradual devouring of cultivable land for purposes of urban development. The area sown more than once (which indicates intense use of land) has also declined. Such a trend indicates a deterioration of the soil conditions, or a change in the soil structure, as a result of which farmers are unable to cultivate throughout the year. However, efforts can be made to increase the area sown more than once by enriching the soil. Land under forest cover and pasture has also decreased. In fact, there is hardly any pasture left in Delhi.

It is to be remembered that land is a resource that cannot be increased. But its productivity can be improved through efficient use. Proper and intensive use of land is considered beneficial for effective planning. No land should lie fallow or unutilised within a city. The scope for urban agriculture still remains with all such lands that are being unutilised, or are awaiting development. It is, however, heartening to see that the land under miscellaneous trees in Delhi is on the increase (though the projected figures point to a decline). It indicates that efforts are being made to check pollution by growing plants/trees, which also contributes to the ecological balance. The revised Master Plan of Delhi-2001 has recommended the planting of specific trees that can be grown in the different parts of the city (Table: 33). This information corroborates that efforts are being made to make Delhi more green. Such developments are actually considered to be a part of UA, which helps to assimilate waste and pollution.

Agriculture

The NCT (1994) has 60857ha. of cropped area, which is 41.26 per cent of the surveyed area of 147488ha. Within the overall urban landuse there are also the forest lands, pastures, areas with trees, fallow lands and the cultivable waste lands that are very often used for UA. These add up to another 16.35 percent of the NCT. Besides, there are the water bodies and the vacant lands that can be used for UA. In fact apart from the cropped area, agriculture can also be practiced in the fallow, waste and vacant lands, thereby increasing the total area under agriculture. However, an estimate published by The Times of India on December 15, 1997 says that only about 1.2 percent of the city's total income is generated on the farms. The report also says that land under agriculture in Delhi is diminishing rapidly and is now almost half of what it used to be two decades ago. The landuse data of the previous section of this report supports this statement. However, agriculture is by no means a closed

chapter for the city government, which has embarked on a project to promote medicinal and aromatic plants in what is "rural" Delhi (SEEDS: 1998). These high value products have a thriving export market. Indian medicinal herbs are fetching fancy prices in the global market. The city government is probably concerned about the fact that unless farmers are assured of high returns, they would be inclined to sell off their lands for urban use that would fetch them premium prices because of the high value of urban land. As mentioned earlier, the crucial boundary for change rests on productivity. If urban activities generate better revenues, then rural land is transformed into urban. That would mean more pressure on civic amenities, a larger army of jobless population and more shortages of utilities resulting into more pollution and environmental deterioration. To avoid this situation, it is wise to produce high value crops that would strengthen the household income of the agriculturists and improve the city's economy. In fact, in this case, the city government is enterprising enough to use UA as a means to generate more revenues for the city. Such a scheme also sustains farmers.

Agricultural activity in the NCT is mostly to be found along the western and the northern boundaries. These areas are yet to be urbanised, as most of the urbanisation has taken place in the south and the east, where the communication links are better. Even beyond the territorial limits of Delhi, urban extensions are more distinct in the southern and eastern directions in the form of satellite towns and as ribbon developments along the major transportation corridors. As a result, the peri-urban belt towards the north and the west are found at a distance of 25 kms. from the city centre; whereas in the south and the east it is 35-40 kms. away (SEEDS:1998).

Results from a survey done by SEEDS indicate that out of a total of 197 villages in the rural areas (altogether there are 209 villages in the DUT), 52 villages have 40% of the working population in agricultural activities and around 70 villages have 20-40% of the working population in agriculture. But if, as the revised Master Plan of 2001 mentions, about 18,000-24,000 ha. is required to accommodate the growing population of Delhi, increasingly more agricultural land will have to be sacrificed from the peri-urban areas for urban development.

In the southern part of the NCT, since urban development has covered all the peri-urban areas between Delhi and Gurgaon, peri-urban areas beyond Gurgaon are actually that of the latter city, and not that of Delhi. This area, however, is highly underdeveloped with low literacy and employment and access to services (SEEDS: 1998).

Crops

A list of the crops grown in and around Delhi are given below in order of priority:

- | | |
|------------------|------------------|
| 1. wheat | 11. potato |
| 2. spinach | 12. onion |
| 3. moongh | 13. radish |
| 4. mustard | 14. flowers |
| 5. sugarcane | 15. cauliflowers |
| 6. millet(bajra) | 16. brinjal |
| 7. rice | 17. coriander |
| 8. jowar(millet) | 18. mint |
| 9. milk | 19. turnip |
| 10. tomato | 20. gourd |

But the crops for which systematic data were available are: rice, wheat, jowar, bajra, maize, onion and potato. (Note: data could only be collected at the district level, to get an idea of urban and peri-urban agriculture, as peri-urban is relative and not absolute. Hence it is easier to consider the entire district.) There is no specific pattern regarding the area and production of the crops that are cultivated. The yield is also erratic, except for rice and wheat, where there is a general increase in the yield over the years. The yield of wheat per hectare is more than the yield of rice, as the soil conditions in this area are not congenial for rice cultivation. The areas under rice, wheat, jowar and bajra are more than the other crops grown in this area. Very little of area is put to the cultivation of onion and potato. Production of onion is also on the decline (Table: 25).

The decrease in the area under different crops is also erratic. Actually the rural-urban bifurcation in area should correspond to the areal distribution of crops. But data on such areal split is not available in association with the distribution of crops. Normally, as the city expands, additional agricultural

Table : 25
Crop Production & Area Cultivated
Rice

District	Years														
	1970			1980			1985			1990			1995		
	Area	Pro- duction	Yield Prod/area	Area	Pro- duction	Yield Prod/area	Area	Pro- duction	Yield Prod/area	Area	Pro- duction	Yield Prod/area	Area	Pro- duction	Yield Prod/area
Rohtak	15000	19000	1.27	3000	3000	1.00	5000	8000	1.60	10000	21000	2.10	17000	38000	2.24
Sonepat	-	-	-	18000	23000	1.28	24000	63000	2.63	20000	51000	2.55	56000	87000	1.55
Gurgaon	2000	3000	1.50	-	-	-	1000	3000	3.00	2000	6000	3.00	5000	11000	2.20
Faridabad	-	-	-	3000	4000	1.33	10000	27000	2.70	8000	21000	2.63	16000	35000	2.19
Ghaziabad	-	-	-	-	-	-	9153	15350	1.68	9094	18843	2.07	13682	33908	2.48
Varanasi	138063	114277	0.83	142592	200073	1.40	133890	220919	1.65	167970	357447	2.13	141346	282511	2.00
Delhi	2378	2359	0.99	3426	7767	2.27	3659	8069	2.21	3282	1810	0.55	-	-	-

District	Wheat														
	1970			1980			1985			1990			1995		
	Area	Pro- duction	Yield Prod/area	Area	Pro- duction	Yield Prod/area	Area	Pro- duction	Yield Prod/area	Area	Pro- duction	Yield Prod/area	Area	Pro- duction	Yield Prod/area
Rohtak	191000	418000	2.19	133000	311000	2.34	139000	400000	2.88	185000	569000	3.08	141000	496000	3.52
Sonepat	-	-	-	122000	312000	2.56	128000	396000	3.09	81000	270000	3.33	131000	498000	3.80
Gurgaon	150000	242000	1.61	92000	163000	1.77	91000	219000	2.41	98000	258000	2.63	106000	359000	3.39
Faridabad	-	-	-	103000	235000	2.28	104000	305000	2.93	112000	327000	2.92	119000	435000	3.66
Ghaziabad	-	-	-	112152	269525	2.40	107230	322090	3.00	100864	303700	3.01	96894	340608	3.52
Varanasi	54471	66585	1.22	137206	180510	1.32	167215	281633	1.68	188198	380316	2.02	150447	340880	2.27
Delhi	45475	87903	1.93	45078	117744	2.61	38495	110644	2.87	30979	110890	3.58	-	-	-

Note: (-) Not available.

Jowar

District	Years														
	1970			1980			1985			1990			1995		
	Area	Pro- duction	Yield Prod/area	Area	Pro- duction	Yield Prod/area	Area	Pro- duction	Yield Prod/area	Area	Pro- duction	Yield Prod/area	Area	Pro- duction	Yield Prod/area
Rohtak	84000	24000	0.29	46000	14000	0.30	43000	7000	0.16	5700	27000	4.74	57000	10000	0.18
Sonepat	-	-	-	23000	7000	0.30	18000	3000	0.17	9000	4000	0.44	23000	5000	0.22
Gurgaon	37000	8000	0.22	21000	10000	0.48	13000	2000	0.15	23000	11000	0.48	15000	4000	0.27
Faridabad	-	-	-	17000	8000	0.47	13000	2000	0.15	23000	11000	0.48	23000	7000	0.30
Ghaziabad	-	-	-	1902	268	0.14	798	351	0.44	1350	982	0.73	112	76	0.68
Varanasi	8010	6439	0.80	5132	3326	0.65	5589	7514	1.34	5206	5643	1.08	4159	3283	0.79
Delhi	10448	3956	0.38	7976	3227	0.40	8817	3771	0.43	14941	6716	0.45	-	-	-

Bajra

District	Years														
	1970			1980			1985			1990			1995		
	Area	Pro- duction	Yield Prod/area	Area	Pro- duction	Yield Prod/area	Area	Pro- duction	Yield Prod/area	Area	Pro- duction	Yield Prod/area	Area	Pro- duction	Yield Prod/area
Rohtak	115000	110000	0.96	90000	74000	0.82	54000	26000	0.48	48000	47000	0.98	51000	20000	0.39
Sonepat	-	-	-	23000	11000	0.48	10000	7000	0.70	3000	3000	1.00	11000	4000	0.36
Gurgaon	145000	145000	1.00	70000	55000	0.79	37000	19000	0.51	54000	54000	1.00	56000	37000	0.66
Faridabad	-	-	-	42000	41000	0.98	15000	12000	0.80	24000	25000	1.04	19000	18000	0.95
Ghaziabad	-	-	-	16831	9409	0.56	13099	7084	0.54	8977	11909	1.33	5411	4853	0.90
Varanasi	17289	24606	1.42	15536	10238	0.66	19153	20539	1.07	17534	25414	1.45	9293	11513	1.24
Delhi	23625	23153	0.98	10780	11330	1.05	2923	1863	0.64	4754	2655	0.56	-	-	-

Note: (-) Not available.

Maize

District	Years												
	1970	1980			1985			1990			1995		
		Area	Pro- duction	Yield Prod/area	Area	Productio n	Yield Prod/area	Area	Productio n	Yield Prod/area	Area	Productio n	Yield Prod/area
Rohtak	-	-	-	-	-	-	-	-	-	-	-	-	-
Sonepat	-	-	-	4000	2000	0.50	2000	2000	1.00	1000	1000	1.00	-
Gurgaon	-	-	-	-	-	-	-	-	-	-	-	-	-
Faridabad	-	-	-	4000	3000	0.75	4000	3000	0.75	2000	1000	0.50	2000
Ghaziabad	-	-	-	41383	67206	1.62	40097	59173	1.48	32129	52017	1.62	21504
Varanasi	-	-	-	13200	13768	1.04	13004	11222	0.86	8251	4018	0.49	5906
Delhi	-	-	-	839	531	0.63	126	78	0.62	-	-	-	8856

Onion

District	Years												
	1970	1980			1985			1990			1995		
		Area	Pro- duction	Yield Prod/area	Area	Productio n	Yield Prod/area	Area	Productio n	Yield Prod/area	Area	Productio n	Yield Prod/area
Rohtak	-	-	-	200	7400	37.00	100	1600	16.00	450	7200	16.00	-
Sonepat	-	-	-	-	-	-	200	3600	18.00	100	2050	20.50	-
Gurgaon	-	-	-	-	-	-	-	-	-	-	-	-	-
Faridabad	-	-	-	-	-	-	-	-	-	8	80	10.00	-
Ghaziabad	-	-	-	174	2891	16.61	305	4810	15.77	309	4829	15.63	-
Varanasi	-	-	-	527	8695	16.50	423	5855	13.84	548	7720	14.09	-
Delhi	-	-	-	14	101	7.21	200	1300	6.50	-	-	-	-

Note: (-) Not available.

Maize

District	Years														
	1970			1980			1985			1990			1995		
	Area	Pro- duction	Yield Prod/area	Area Productio n	Yield Prod/area	Yield Prod/area	Area Productio n	Yield Prod/area	Yield Prod/area	Area Productio n	Yield Prod/area	Area Productio n	Yield Prod/area	Area Productio n	Yield Prod/area
Rohtak	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sonepat	-	-	-	4000	2000	0.50	2000	2000	1.00	1000	1000	1.00	-	-	-
Gurgaon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Faridabad	-	-	-	4000	3000	0.75	4000	3000	0.75	2000	1000	0.50	1000	2000	2.00
Ghaziabad	-	-	-	41383	67206	1.62	40097	59173	1.48	32129	52017	1.62	21504	30256	1.41
Varanasi	-	-	-	13200	13768	1.04	13004	11222	0.86	8251	4018	0.49	5906	8856	1.50
Delhi	-	-	-	839	531	0.63	126	78	0.62	-	-	-	-	-	-

Onion

District	Years														
	1970			1980			1985			1990			1995		
	Area	Pro- duction	Yield Prod/area	Area Productio n	Yield Prod/area	Yield Prod/area	Area Productio n	Yield Prod/area	Yield Prod/area	Area Productio n	Yield Prod/area	Area Productio n	Yield Prod/area	Area Productio n	Yield Prod/area
Rohtak	-	-	-	200	7400	37.00	100	1600	16.00	450	7200	16.00	-	-	-
Sonepat	-	-	-	-	-	-	200	3600	18.00	100	2050	20.50	-	-	-
Gurgaon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Faridabad	-	-	-	-	-	-	-	-	-	8	80	10.00	-	-	-
Ghaziabad	-	-	-	174	2891	16.61	305	4810	15.77	309	4829	15.63	-	-	-
Varanasi	-	-	-	527	8695	16.50	423	5855	13.84	548	7720	14.09	-	-	-
Delhi	-	-	-	14	101	7.21	200	1300	6.50	-	-	-	-	-	-

Note: (-) Not available.

Potatoes

District	Years														
	1970			1980			1985			1990			1995		
	Area	Pro- duction	Yield Prod/area	Area	Productio n	Yield Prod/area	Area	Productio n	Yield Prod/area	Area	Productio n	Yield Prod/area	Area	Productio n	Yield Prod/area
Rohtak	-	-	-	200	3300	16.50	200	2800	14.00	300	4400	14.67	-	-	-
Sonepat	-	-	-	500	8300	16.60	300	4100	13.67	300	4800	16.00	-	-	-
Gurgaon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Faridabad	-	-	-	500	8000	16.00	300	4000	13.33	400	5400	13.50	-	-	-
Ghaziabad	-	-	-	4975	89679	18.03	5769	112888	19.57	6788	178002	26.22	5176	121978	23.57
Varanasi	-	-	-	6904	136492	19.77	7826	97144	12.41	6757	111680	16.53	5689	102584	18.03
Delhi	-	-	-	223	4643	20.82	201	4491	22.34	59	438	7.42	-	-	-

Note: (-) Not available.

Source: Agriculture situation of India, Ministry of Agriculture, GOI, New Delhi.

land is devoured by the settlements. But the population distribution pattern of the smaller cities indicate densification of population, rather than of areal spread. Hence in the smaller cities and towns less agricultural land is devoured by urban development. The data reveals that there is a sudden reduction in the area under the different crops in practically all the districts in 1980 (data has been collected from the Ministry of Agriculture). In this report such details have not been analysed, as the purpose of this study is to attain a macro view of UA, to highlight its usefulness in city management.

The SEEDS Report, based on field data, indicate slight variations in the local cropping pattern, than those collected from the Ministry of Agriculture, which are at the district level. As per the SEEDS Report, the major crops in the peri-urban areas of Delhi are wheat, mustard and bajra. These crops are mainly grown in the south and the west, where the region is dry. In the northern and the southeastern parts of the periphery that are adequately irrigated, a significant amount of rice is grown. In the area near Gurgaon, where irrigation is possible, gram is also cultivated (SEEDS: 1998). However, seasonal variations should be taken into account while studying the crops and the cropping pattern.

Land Holdings

Most of the land holdings are of 1-2 and 2-3 hectares in size. The number of land holdings decrease with increase in size. Hence, the proportion of area in the larger categories are less than those in the smaller categories. The predominant pattern prevailing is that of smaller land holdings (Table: 26). *(Note: data on land holdings was available only for four districts.)*

Vegetables, Fruits and Flowers

Delhi grows very little of vegetables and fruits. The fruits grown are : citrus, mango, guava, grapes, papaya, ber and bananas in very small quantities. Most of it is used for local consumption. Near Delhi, parts of Haryana grow citrus fruits and grapes that are sold in Delhi's market. These fruits are grown mostly in and around Sonapat, which can be considered to be in peri-urban Delhi. In 1996 Delhi had 248 hectares under fruits, with 3154 mt of production and 12.72 mt/ha of productivity (Table: 27).

Table : 26
Land Holdings: 1990-91

Name of the District	Number of operational holdings by size (in hectares)							Total	
	1-2	2-3	3-4	4-5	5-7.5	7.5-10	10-20		above 20
Faridabad	18610	11965	5739	3011	3144	1296	771	122	44658
%	41.67	26.79	12.85	6.74	7.04	2.90	1.73	0.27	100.00
Gurgaon	21551	21073	7115	4112	5299	2176	560	204	62090
%	34.71	33.94	11.46	6.62	8.53	3.50	0.90	0.33	100.00
Rohtak	31333	18748	11073	7000	8715	4156	3773	831	85629
%	36.59	21.89	12.93	8.17	10.18	4.85	4.41	0.97	100.00
Sonipat	16721	10151	6368	3918	4497	2136	1563	292	45646
%	36.63	22.24	13.95	8.58	9.85	4.68	3.42	0.64	100.00

Name of the District	Area of operational holdings by size (in hectares)							Total	
	1-2	2-3	3-4	4-5	5-7.5	7.5-10	10-20		above 20
Faridabad	25414	26944	19754	13080	18467	10862	10234	4701	129456
%	19.63	20.81	15.26	10.10	14.27	8.39	7.91	3.63	100.00
Gurgaon	27116	60401	22566	20264	28930	17296	7355	4830	188758
%	14.37	32.00	11.95	10.74	15.33	9.16	3.90	2.56	100.00
Rohtak	52313	38642	35331	28625	45034	31803	39355	17935	289038
%	18.10	13.37	12.22	9.90	15.58	11.00	13.62	6.21	100.00
Sonipat	23793	24505	21630	17197	27174	16951	18654	10422	160326
%	14.84	15.28	13.49	10.73	16.95	10.57	11.64	6.50	100.00

Source: Jagaran's Haryana at A Glance, 1998

Table: 27

Fruits in Delhi

AREA IN HECTARE
PRODUCTION IN MT
PRODUCTIVITY IN MT/HA

SL NO	CROP	AREA			PRODUCTION			PRODUCTIVITY			HARVESTING SEASON		
		1993-94	1994-95	1995-96	1993-94	1994-95	1995-96	1993-94	1994-95	1995-96	Beginnin g	Peak	End
1	CITRUS	126	21	31	1224	43	63	9.71	2.05	2.03	NOV	DEC	MAR
2	MANGO	26	13	18	92	108	146	3.54	8.31	8.11	JUN	JUL	AUG
3	GUAVA	298	20	47	1737	294	705	5.82	14.70	15.00	NOV- AUG	DEC- SEP	JAN- OCT
4	GRAPES	46	46	52	409	352	407	8.82	7.65	7.83	MAY	JUN	JUL
5	PAPAYA	35	21	36	318	395	671	9.07	18.81	18.64	FEB	MAR	APR
6	BER	235	NA		4260	NA		18.17			JAN	MAR	APR
7	BANANA		4	4		43	43		10.75	10.75			
8	OTHER	156	32	60	1541	349	1119	9.87	10.91	18.65	THROUGHOUT THE YEAR		
	TOTAL	922	157	248	9581	1584	3154	10.39	10.09	12.72			

Source: National Horticulture Board (1998); Indian Horticulture Database, Ministry of Agriculture, Government of India.

The vegetables grown are potato, onion, cabbage, cauliflower, tomato, okra, peas, aubergine, gourd, etc. all for local consumption. Of all the districts around Delhi, Sonapat grows large quantities of cabbage and cauliflower. The area covered under vegetables is 55664 hectares, with 613113 metric tonnes of production and 11.01 mt/ha productivity (Table: 28).

Of late, flowers have become very popular in Delhi. In fact, this is a characteristic of any metropolitan city. The flowers grown are : rose, gladiolus, marigold, chrysanthemum, carnation, tuberose, etc. However, in the farmhouses of the peri-urban areas of Delhi, some of the exotic flowers are cultivated under controlled conditions for the international markets. (This information is included here as the flowers are grown within the study area, even though the produce is exported. For if we strictly go by the definition of urban agriculture, only those products that are sold in the urban market should be included within its purview. However, in this case, the labour employed is local. So that the growing of such flowers do contribute to the city's economy.) In 1996 about 1866 hectares of flowers were grown in Delhi. The production amounted to 10274 metric tonnes; and the yield was 5.51 mt/ha (Table: 29).

The total area under fruits and vegetables in India has been increasing with time. But in Delhi, the pattern has not been very stable. While area under vegetables has grown, area under fruits has declined drastically. The overall production of vegetables is also increasing; but the productivity has declined since 1993-94. As for fruits, the production has gone down, but not productivity. Area under flowers has increased since 1993-94, as also the production. But the productivity has remained constant.

Marketing of Vegetables

There are three main agencies involved in the trading of fruits and vegetables in Delhi: (1) Vegetable Traders Association, (2) Mother Dairy and (3) NAFED.

Table: 28
Vegetables in Delhi

AREA IN HECTARE
PRODUCTION IN MT
PRODUCTIVITY IN

MT/HA	SL NO	CROP	AREA				PRODUCTION				PRODUCTIVITY			HARVESTING SEASON		
			1993-94	1994-95	1995-96	1993-94	1994-95	1995-96	1993-94	1994-95	1995-96	1994-95	1995-96	1995-96	Beginnin g	Peak
1		POTATO	1485	2830	2879	26987	44395	45776	18.18	15.69	15.90	DEC	FEB	MAR		
2		ONION	1418	1196	1563	33127	31030	40638	23.36	25.94	26.00	APR	MAY	JUN		
3		CABBAGE	510	799	782	15484	23782	23304	30.36	29.76	29.80	OCT	DEC	MAR		
4		CULIFLOWE R	4849	2066	1602	139269	26685	20826	28.72	12.92	13.00	OCT	DEC	MAR		
5		TOMATO	1054	1490	1495	24124	21080	22126	22.89	15.15	14.80	MAR	APR	MAY		
6		OKRA	302	1880	1258	1771	10720	7296	5.86	5.70	5.80	JUN	JUL- AUG	OCT		
7		PEAS	1137	2088	768	8394	12626	4771	7.38	6.05	6.21	OCT	NOV	FEB		
8		BRINJAL	820	1304	1214	19185	14615	13961	23.40	11.21	11.50	SEP-JAN	NOV- FEB	DEC- APR		
9		BOTTLE- GOURD	391			14887			30.05			JUN	JUL	SEP		
10		OTHERS	13368	37606	44103	180669	366299	434415	13.52	9.74	9.85	THROUGHOUT THE YEAR				
		TOTAL	25334	51259	55664	463897	551232	613113	18.31	10.75	11.01					

Source: National Horticulture Board (1998); Indian Horticulture Database, Ministry of Agriculture, Government of India.

Table: 29

Flowers in Delhi

SL NO	CROP	AREA				PRODUCTION			PRODUCTIVITY			HARVESTING SEASON			AREA IN HECTARE PRODUCTION IN MT PRODUCTIVITY IN MT/HA
		1993-94	1994-95	1995-96	1993-94	1994-95	1995-96	1993-94	1994-95	1995-96	Beginnin g	Peak	End		
1	ROSE	192	194	205	498	461	698	2.59	2.38	3.40	DEC-JUL	JAN- AUG	SEP- OCT		
2	GLADIOLU S	57	101	128	93	137	173	1.62	1.36	1.35	OCT	DEC	APR		
3	MARIGOL D	192	488	384	260	7288	5729	1.35	14.93	14.62	NOV	JAN	MAR		
4	JASMINE	-	10	-	-	12	-	-	1.20	-	-	-	-	-	
5	CHRYSAN- THEMUM	73	94	369	1585	100	387	21.59	1.06	1.05	OCT	NOV- DEC	JAN		
6	CARNATIO N	17	513	39	36	2515	190	2.12	4.90	4.87	NOV	DEC	JAN		
7	TUBEROSE	24	20	309	36	30	371	1.50	1.50	1.20	JUL	AUG	OCT		
8	OTHER	246	458	432	1550	585	2726	6.31	1.28	6.31	THROUGHOUT THE YEAR				
	TOTAL	801	1878	1866	4056	11128	10274	5.06	5.93	5.51					

Source: National Horticulture Board (1998); Indian Horticulture Database, Ministry of Agriculture, Government of India.

In the Vegetable Traders Association, the Commission Agents are allotted stalls, where producers/growers bring their products to be auctioned to wholesalers by bags or truckloads. The commission agents are the main price fixing authorities. The prices vary according to the quality of the produce. After the auction, the produce is transferred from the wholesaler to the retailers, and then to the consumers. It is sold per "dhari" (5 kg. each) by the wholesaler to the retailer. Payments are given by the commission agents to the growers/producers on the spot.

In Mother Dairy, which is a semi-government organisation, vegetables and fruits are bought directly from the producers and sold to the consumers through booths, where the prices are more or less identical throughout the city. Sometimes the produce is also bought from the commission agents as well.

NAFED is a central agency dealing with regulations in minimum price level of the vegetables fixed by the government from time to time, depending upon the market behaviour. To monitor the price, NAFED intervenes in the market through market intervention operation (MIO) as and when the need arises. NAFED protects the interests of both the producers as well as the consumers.

However, since Delhi is a regional centre, wholesale transactions are carried out for the entire region. It is, therefore, hard to estimate the actual sale in the city's markets.

Marketing of Fruits

The main fruit market in Delhi is Azadpur Mandi. It markets banana, orange, mausami, apple, mango and chiku. The fruits come from all over India. The main marketing channels are:

1. Producer-Consumer (local sale)
2. Producer-Wholesaler/Commission Agents-Retailer-Consumer
3. Producer-Pre-harvest Contractors (PHC)-Wholesalers/Commission Agents-Retailer-Consumers.

The fruits come from the producers to the commission agents every morning where it is auctioned to area wholesalers (masakhor) and retailers. At this stage, 6 percent commission is charged on the total value. Moreover, one percent is charged, by the Agriculture Produce Marketing Committee (APMC), on the total turnover. No grading is done at this stage; only random checking is done. The area wholesalers who buy from the commission agents fix the price for a particular area. On an average their commission is 5-10 percent. The grading of fruits is done at this stage. The "masakhors", who are overall wholesalers, sell the fruits to the area wholesalers. Their commission is also 5-10 percent. Retailers either buy from the masakhors in the mandis, or from the area wholesalers.

Marketing of Fruits and Vegetables by Small Farmers

The marketing channels used here are somewhat different. The small and marginal farmers either sell their produce to the pre-harvest contractors and to the nearby big producers, or to local retailers. They normally avoid the transport cost that works out to be very high for small quantities. Hence they prefer to sell their produce to local contractors, merchants and retailers to save time, money and energy. The small and marginal farmers do not benefit from the economies of scale and are totally dependent on the big producers for the marketing operations. They are not given a stall in the mandi to sell their produce. They are also deprived from the other mandi facilities as well. Normally 20-25 percent of the farmers pool their produce and hire common transport to send it to the mandi. The pool produce is looked after by individuals in rotation.

The difficulties faced by the small and marginal farmers are: hiring of expensive labour and transport to reach the produce to the mandi and lack of proper grading and packaging because of financial constraints. Neither do they have any storage facility. They are often cheated by the commission agents. They, therefore, prefer to sell their produce at the farm or to pre-harvest contractors or to local mandis (Bhardwaj, et al: 1998).

Within and near a city horticultural products are grown intensely but in small quantities by small and marginal farmers who face problems in marketing their produce. They lack both production and protection technology. Neither are they included in the marketing system of the large producers. In Delhi, such urban agriculturists often sell their produce directly in the local retail markets, of which no records are maintained.

Marketing of Flowers

Marketing of flowers follow a pattern akin to that of vegetables and fruits. But the entire marketing process is informal and thereby less regulated. The place for whole sale markets are self-determined by the traders, for example, in front of the State emporiums in Baba Kharak Singh Marg, Mehrauli, Janpath, etc. Normally the agents bring the flowers from all over India, from where they are sold to retailers/wholesalers through another set of agents and middlemen. Being informal, there are no stalls assigned to the agents.

Local flowers are present in very small quantities. Most of the flowers come from outside Delhi. Hence it is difficult to estimate the contribution of flowers from within Delhi. To quote newspaper information (as published in the Times of India of June 24, 1999), an air-conditioned flower market is being proposed in Delhi on the lines of those in Japan. A committee comprising of senior government officials is monitoring the progress of the flower-market project. The site is going to be near the International Airport. To encourage local farmers, approximately 20 percent of the space will be reserved for them to display their stocks. Moreover, Delhi-based flower-growers will be allotted outlets in the market. The flower market will be built over an area of 35 acres. To quote The Times of India again, there is yet another plan to build a flower market opposite the Dilli Haat, in the INA market precincts.

Supply of Milk

Delhi procures milk from different sources, such as the Mother Dairy, Delhi Milk Scheme (which are the two major suppliers), milk supplied by other states under different brand names like Saras,

Paras, Nanak, Parag, etc. and the local small and marginal farmers doing animal husbandry. Generally the procurement of milk is less than the demand. This gap is often met through the import of powder milk. Delhi's demand is roughly 25 lakh litres per day. The Mother Dairy and the Delhi Milk Scheme meets only 40 percent of the city's requirement. The rest is met from local and other sources. The local milk/dairy industry is generally handled by marginal workers/farmers. The Department of Animal Husbandry of the government has several schemes to promote and monitor the provision of milk and milk products. But most of these schemes are on a national basis. The government has also built good research institutions for dairy development all over the country.

Delhi Milk Scheme (DMS)

The DMS was set up in 1959 with the primary objective of supplying wholesome milk to the citizens of Delhi at reasonable price, as well as for providing remunerative prices to milk producers. The manufacture and sale of milk products like ghee, table butter and curd is also undertaken as an allied activity.

The demand for milk in Delhi was estimated to be 30 lakh litres (by Mother Dairy) seven years ago (latest available data). Since then the demand must have increased (data for which is not available). However, the DMS plant capacity is for producing only 5 lakh litres. The DMS processes and sells only 4 lakh litres on the basis of 250-300gms./person per day (Table: 30). The milk supplied is toned milk (containing 3.0% fat and 8.5% SNF) and double toned milk (containing 1.5% fat and 9.0% SNF). It is distributed through a network of 1237 booths (outlets) spread all over the city. The outlets are operated by students and disadvantaged personnel: like ex-Service men/Retired government servants, etc.

The DMS is selling toned milk at the subsidised rate of Rs.7/kg. and double toned at Rs.6/kg. The DMS is also supplying milk to 159 institutions such as hospitals, government canteens, schools and hostels (Annual Report : 1997-98). The sale price of milk to government institutions has been raised to Rs.10.50/kg. since December 1997. The DMS runs at a loss as the cost of procuring milk

Table : 30**Delhi Milk Scheme**

Year	Procurement of milk ('000 Kgs.)	Distribution of milk ('000 Ltrs.)	Sale (Qtls) Butter	Ghee	Number of milk depots
1974-75	108	287	24	59	1090
1975-76	194	304	45	623	1136
1976-77	241	325	65	484	1131
1977-78	157	347	71	434	1169
1978-79	175	305	28	272	1108
1979-80	153	214	18	572	1007
1980-81	145	267	39	572	1058
1981-82	81	304	26	195	1095
1982-83	134	335	59	185	1074
1983-84	151	371	128	288	1115
1984-85	133	334	79	207	1137
1985-86	209	314	98	441	1171
1986-87	202	358	217	700	1311
1987-88	195	370	783	4266	1340
1988-89	199	376	460	3482	1352
1989-90	276	403	82	789	1390
1990-91	303	488	55	699	1335
1991-92	273	457	53	286	1358
1992-93	310	439	54	678	1353
1993-94	399	395	31	387	1346

Source: *Delhi Milk Scheme, Govt. of India, New Delhi, obtained from the Ministry of Agriculture.*

Note: 1 ltr. = 1.03 kg.

has increased, as also the processing of milk (Table: 31). The sale of milk by DMS is far below the market price. Besides, new technology has been introduced to ensure the high quality of milk. The routes for distribution are continuously rationalised to avoid overlapping. To overcome traffic problems light commercial vehicles have been introduced. Also, productivity linked bonus is given to employees to encourage them.

The DMS is headed by a General Manager with powers of a Head of Department. He is assisted by two Deputy General Managers, a Financial Adviser and a Chief Accounts Officer. The Government of India has constituted a Management Committee with powers of a government department of the Central government to manage the activities, except for creation of posts or writing off losses and reappropriation of expenditure. The present Management Committee comprises of a Joint Secretary (Dairy Development) as the Chairman, Joint Secretary (Finance), General Manager (Mother Dairy), General Manager (DMS) and representatives of consumers. The DMS employs 2200 persons (discussion with DMS).

Table 31
Production of Toned Milk

Year	Cost of Production(per litre in rupees)	Selling Price(per litre in rupees)	Losses(in Rs./Crores)
1994-95	7.82	7.00	8.91
1995-96	11.28	7.00	47.30
1996-97	11.67	7.00	51.35
1997-98(Upto Oct.97)	12.14	7.00	35.05

Source : Annual Report of DMS, 1997-98.

National Dairy Development Board(NDDDB)

This organisation was set up by the Government of India in 1965 as an institution of national importance, to promote plan and organise programmes for dairy development and other agriculture

based and allied industries along cooperative lines on an intensive and nation-wide basis. The NDDDB follows the National Milk Grid (NMG) concept, whereby an agreement is made with the State Dairy Federations, which are the Apex Bodies of the producers and consumers of the different States that liaise with the District Milk Unions who procure milk from the Village Milk Centres (V.M.C.S.). The NMG is divided into four regional grids as per the cardinal directions. Delhi procures milk from the Northern Grid. The Delhi cooperatives supply 70,000 litres; Rajasthan 50,000 litres; Punjab 50,000 litres; Haryana 40,000 litres; and U.P. 1,00,000 litres. In total about 4 lakh litres are procured. The milk collected is processed and sent to 7,000 booths in the morning and 580 booths in the evening (a total of 1280 booths) in sachets (as discussed by DMS officials). The time series data reveals no trend, as decision on supply is erratic because of political interference. However, supply of milk is on the increase, as also procurement. The gap between demand and supply is met by powder milk.

The Mother Dairy

The Mother Dairy is a subsidiary of the NDDDB. The latter oversees the management of Mother

Dairy through a management committee that constitutes of the senior members of the NDDDB. The Mother Dairy was commissioned in December 1974.

The Mother Dairy buys milk only from the cooperatives established under the Operation Flood Programme, set up in 1968. Operation Flood is an integrated dairy development scheme replicating Anand. It aims to capture for the public dairies a commanding share of the milk market of the four metropolitan cities of Bombay, Delhi, Kolkata and Chennai. These dairies are, in turn, to be supplied with liquid milk from modern processing dairies to be located in rural areas with high milk production potentials. The rural dairies also help to balance the seasonal fluctuations in milk production through the separation of milk into fats and other solids in the surplus season and their storage for subsequent use in the lean period. Operation Flood completed its third phase in April 1996. In 1970 the NDDDB succeeded in getting the FAO-WFP (World Food Programme) to fund it.

Once the milk reaches the metropolitan centre, it is handled through large, modern processing facilities capable of handling milk without packaging it. The Delhi Mother Dairy, for example, can store, clarify, homogenize and pasteurize 6.50 lakh litres of milk every day. It is now being expanded to 8 lakh litres per day. It distributes nearly 7.50 lakh litres of milk to the residents of Delhi, through a unique, eco-friendly bulk vending system, distributing milk through 578 automatic bulk vending outlets, with the help of 208 insulated containers and 294 cycle rickshaws. In lean seasons skimmed milk powder and butter oil, both indigenously produced and gifted, are recombined to ensure a continued, dependable supply of high quality of milk in adequate quantities. Table 32 gives in detail the activities of the Mother Dairy over the years.

The Mother Dairy also sells 3.50 lakh litres of milk packed in polythene sachets from the dairy plants of the neighbouring State Cooperative Dairy Federations located at Rohtak, Ballabgarh, Meerut, Alwar and the Model Dairy Plant at N.D.R.I. Karnal. Besides the marketing network, the poly-packed milk is also sold through 945 retail outlets.

Mother Dairy also markets milk products like ghee, butter, paneer, lassi, cream, etc. processed by cooperative organisations. Of late, the Mother Dairy has also diversified into manufacturing and marketing of ice cream. During 1998-99 (till February), on an average, 9100 litres of ice cream is sold per day. The capacity of the ice cream plant is being increased to 20,000 litres per day.

The Delhi Mother Dairy collects milk from Haryana, Rajasthan, Uttar Pradesh and Punjab federations, the traditional supply areas of Delhi, as well as from Madhya Pradesh and Gujarat, wherever surplus milk is available. The milk comes from the State Cooperative Federations. The Delhi Mother Dairy supplies about 10.8 lakh litres of milk every day.

Around 780 employees work in Delhi Mother Dairy. In 1998 the Delhi Mother Dairy has been awarded the ISO-9002 license along with IS-15000 (HACCP) by the Bureau of Indian Standards of the Government of India in 1998.

Table : 32

Activities of Mother Dairy

Year	Bulk vending booths	Insulated Tanks	Sale of butter oil (in Qtl.)	Daily average of milk collected (in '000 ltrs.)			Daily average of milk marketed (in k.ltrs.)		
				Mixed milk	Cow milk	Skimmed milk	STD Milk	Full cream milk	Tonned milk
1974-75	34	-	-	4	0	0	5	0	0
1975-76	87	-	-	15	0	0	28	0	0
1976-77	181	-	6628	77	0	0	132	0	0
1977-78	194	-	8621	55	40	0	181	4	2
1978-79	212	7	2804	96	47	11	262	17	1
1979-80	260	101	5064	167	50	22	322	27	0
1980-81	293	203	12612	177	34	22	349	38	0
1981-82	300	254	940	116	32	5	463	26	470
1982-83	301	300	6366	161	57	39	0	36	498
1983-84	302	285	9683	153	100	13	0	67	510
1984-85	302	284	10077	174	109	31	0	81	539
1985-86	302	319	17391	205	117	82	0	88	489
1986-87	302	327	4477	155	117	54	0	99	466
1987-88	302	316	2800	89	68	31	0	27	523
1988-89	302	324	14249	98	60	47	0	0	560
1989-90	337	291	8311	141	104	100	0	0	536
1990-91	346	254	6604	143	86	74	0	27	541
1991-92	352	239	-	102	36	163	30	0	566
1992-93	372	196	2673	169	18	139	38	62	517
1993-94	395	185	6360	273	-	89	-	100	432
1994-95	400	192	224	300	-	102	-	170	525
1995-96	487	162	5	300	-	88	-	154	621

Source: 1. Mother Dairy, Delhi, obtained from Ministry of Agriculture.

2. Delhi Statistical handbook 1997, Directorate of Economics & Statistics, Govt. of N.C.T. of Delhi

Note: Sale of Std. Milk was discontinued from 06-11-81 Tonned Milk Sales average is from 07-11-81 onwards

Planting of Trees within Delhi

In a broad sense, this is yet another form of agriculture. Trees planted along roads are mostly for purposes of providing shade or improving the assimilative capacity of the air. They also have aesthetic value and are often used for landscaping and beautification of the city. Some of these trees are also economically valuable, like the "jamun" and the "semur" trees of New Delhi, the mangoes of Chandigarh, etc. that are given over on commercial lease.

Trees grown in parks are mostly for beauty and for the assimilation of pollution. The parks are normally the lung spaces within a city. The revised Master Plan of Delhi has included a list of trees which can be planted in the different parts of the city, based on soil and climatic conditions (Table: 33). This addition to the Master Plan indicates environmental consciousness.

Table : 33

Recommended Tree Plantation

(a) East Zone

The following trees are recommended for Group Plantation in low-lying area.

1. Bomboo in clusters
2. Casurina equistifolia
3. Eucalyptus
4. Salyx

The following trees are recommended for the purpose of colour and aesthetics.

1. Callistemon lenceolatus
2. Lagerstroemia-flos-reginil
3. Peltophorum ferru-genium

The following trees are recommended in Wood-land and Road Side Plantation.

1. Dalbergia sissoo
2. Ficus religiosa
3. Ficus retusa
4. Peltophorum ferrugeneum
5. Terminalia arjuna

(b) South Zone

The following trees are recommended in Woodland and Road Side Plantation.

1. *Ailanthus excelsa*
2. *Alstonia scholaris*
3. *Anthocephalus cadamba*
4. *Azadirachta indica*
6. *Bassia fistula*
7. *Cassia siamea*
8. *Dalbergia sissoo*
9. *Ficus infectoria*
10. *Ficus tsiela*
11. *Polyalthia longifolia*
12. *Putranjiva roxburghii*
13. *Schleichera trijuga*
14. *Tamrindus indica*
15. *Terminalia arjuna*.

The following trees are recommended in Parks and Gardens.

1. *Acacia auriculiformis*
2. *Bauhinia* sp.
3. *Bombax malabaricum*
4. *Cassia* sp.
5. *Chorisia speciosa*
6. *Colvillea racemosa*
7. *Crataeva religiosa*
8. *Delonix regia*
9. *Erythrina indica*
10. *Jacrandra mimosaefolia*
11. *Lagerstroemia* sp.
12. *Mimosa pudica*
13. *Peltandra ferruginea*
14. *Plumaria alba* var
15. *Saraca indica*
16. *Tecoma argentea*

(c) West Zone

The following trees are recommended in /woodland and Road Side Plantation.

1. *Alstonia scholaris*
2. *Azadirachta indica*

3. Butea frondosa
4. Cassia fistula
5. Dalbergia sissoo
6. Diospyros montana
7. Ficus in-fectoria glumerata
8. Pongamia glabra
9. Ptospurum aceri folium
10. Tam-rindus indica
11. Terminalia arjuna

The following trees are recommended in Parks and Gardens.

1. Acacia auriculiformis
2. Bauhinia var
3. Cassia fistula
4. Cretavea religiosa
5. Delonix regia
6. Erythrina indica
7. Jacranda mimosifolia
8. Llargstroemia-flos regini
9. Mimusops elengil
10. Peltophorum ferreugenum
11. Plumeria alba var
12. Petrosplnum acerifolium
13. Saraca indica
14. Tecoma argentia
15. Schelichera figuga

(D) North East Zone: As Per East Zone

(E) North West Zone: As Per West Zone

Source: Master Plan for Delhi Perspective 2001, Delhi Development Authority, New Delhi.

Employment

The overall employment in Delhi is higher by 2-3 percentage points than the surrounding districts, indicating the presence of better employment opportunities in the metropolis. However, the rural-urban bifurcation of the total workers indicates a reverse pattern for Delhi vis-a-vis its neighbouring districts (Table: 34). While urban workers are more in the capital, the adjoining districts have more of rural workers. It indicates that peri-urban Delhi is to a large extent agrarian. But a change is

coming with time, as can be seen in the districts of Faridabad and Ghaziabad, where the proportion of urban workers has increased substantially. These two districts have had considerable urban developments as they are basically extensions of Delhi. Gurgaon is also picking up in urban development. However, despite such growth, the rural workforce is still more than the urban workforce in these districts.

Since this study is on urban agriculture, industrywise employment data has been analysed only for agricultural activities such as cultivators, agricultural labour and those employed in livestock rearing, forestry and fishing (Table: 35). Delhi being mostly urban, employment in these sectors is less than in the surrounding districts. Besides, with urbanisation, there is an overall decline in the proportion of cultivators over the years (Table: 36). In Delhi, the proportion of workers in all the three sectors has declined with time. The general trend in the adjoining districts is a decline in cultivators and an increase (though marginal) in agricultural labour, which indicates a structural change. Increase in agricultural labour could be because of more demands from an ever increasing population and the need to produce more. No definite pattern has emerged for livestock rearing (for lack of data), though there is an increase in poultry (Table: 37), which has not been brought out very well by the census data. However, the general pattern points to a larger proportion of cultivators, followed by agricultural labour, with workers in livestock rearing and others being considerably less.

Table : 34
Main Workers with Rural-Urban Bifurcation

Name of Districts	Total (% to total population)		Rural (% to total workers)		Urban (% to total workers)	
	1971	1981	1971	1981	1971	1981
Delhi	30.21	31.93	31.51	6.49	9.19	93.51
Sonepat	-	28.22	29.21	82.34	78.00	17.66
Rohtak	23.66	26.71	29.31	83.83	80.30	19.59
Gurgaon	26.12	27.79	27.75	80.70	79.66	19.30
Faridabad	-	29.43	28.71	54.92	49.53	45.08
Ghaziabad	-	27.46	27.23	64.91	53.29	35.09

Note: (-) Not available. Source: Census of India

Table : 35
Percentage of Agriculture to Total Main Workers

Name of the District		1971	1981	1991
Delhi	Total	4.70	2.57	2.61
	Rural	35.91	30.25	17.03
	Urban	1.59	0.65	1.15
Sonapat	Total	-	59.40	50.14
	Rural	-	70.25	61.07
	Urban	-	8.79	11.41
Rohtak	Total	64.46	58.83	59.34
	Rural	74.61	70.59	70.32
	Urban	11.80	10.54	14.60
Gurgaon	Total	59.04	58.39	54.83
	Rural	71.41	69.73	66.29
	Urban	8.68	10.93	9.92
Faridabad	Total	-	41.93	38.55
	Rural	-	71.19	71.79
	Urban	-	6.29	5.92
Ghaziabad	Total	-	45.29	40.06
	Rural	-	65.62	67.07
	Urban	-	7.67	9.25
Meerut	Total	54.74	55.72	55.23
	Rural	69.78	73.54	74.96
	Urban	8.51	16.34	18.81

Note: (-) Not available.

Source: Census of India

Agriculture = Cultivator+Agriculture Labour+Livestock, Forestry and Fishing

Table : 36

Proportion of Agricultural Workers

Name of Districts	(Percentage to Total Workers)							
	Cultivators		Agricultural Labours		Livestock, Forestry and Fishing			
	1971	1981	1971	1981	1971	1981	1971	1981
Delhi	2.62	1.75	1.24	0.81	0.85	0.84	-	0.64
Sonepat	-	42.49	-	16.91	17.97	-	-	0.54
Rohtak	47.62	45.92	16.11	12.91	15.95	0.72	-	0.85
Gurgaon	47.12	47.53	10.63	10.86	13.72	1.30	-	0.95
Faridabad	-	32.95	-	8.98	11.63	-	-	0.60
Ghaziabad	-	32.75	-	12.54	13.43	-	-	0.74

Note: (-) Not available.

Source: Census of India

Table : 37

Livestock in Delhi

Description	Total Livestock									
	1961	1966	1972	1977	1982	1987	1992			
Cattle	93978	81667	67919	48290	52109	56228	40101			
Buffaloes	100082	103826	128205	108924	177600	218515	248660			
Sheep	9560	5749	4434	9276	2833	5416	198			
Goat	18882	13266	11918	19869	14370	12147	16225			
Pigs	12631	10797	10889	10489	21568	26946	11996			
Poultry	62757	129417	303529	216911	218698	300820	301050			

Source: Statistical Abstract 1977-1996, Directorate of Economics & Statistics, Delhi.

The rural-urban bifurcation reveals a higher share of urban agricultural workers in Delhi than in the other districts. This is because the urban area and the population of Delhi are much larger than those of the other districts. However, the overall proportion of such workers in the capital is less. The rising trend of the proportion of urban agricultural workers indicates the practice of urban and peri-urban agriculture, which is on the increase in the capital. This feature can be interpreted in many ways, such as:

- the need for more agricultural products because of an increasing demand from a larger market caused by urbanisation and concentration of people (especially livestock rearing for purposes of milk and meat)
- the increasing need for the employment of marginal/unemployed workers to augment family income (indicating higher cost of living in cities)
- more rural-urban migration leading to extension of rural activities in the city
- increasing poverty, unemployment and food insecurity leading to cultivation of even the marginal lands
- lack of organised employment in large cities, forcing people to take up informal employment.

Though certain kinds of animal husbandry are prohibited in the city, it is actually the city that has more requirements for animal products than the countryside. This is evident from the fact that in the districts that are urbanising very fast, such as Faridabad and Ghaziabad, urban livestock workers are more. In fact Delhi has the highest figure in this category (Table: 38).

It is understood that rural areas will have more agriculture. Though a receding trend of agricultural labour in the rural areas does indicate increasing migration (Table: 39). But a receding trend of cultivators would mean a structural change in employment because of urbanisation.

Female workers are increasing with time. Particularly in Delhi there is a sizeable increase of female workers as cultivators and in livestock rearing (Table: 40), in both the urban as well as in the rural areas. Livestock rearing has become a common practice because of the growing urban market. This

Table : 38
Urban Agricultural Workers

Name of Districts	(Percentage to Sector Total)					
	Cultivators		Agricultural Labours		Livestock, Forestry and Fishing	
	1971	1981	1971	1981	1971	1981
Delhi	16.08	20.74	23.60	29.58	87.04	77.23
Sonepat	-	1.85	-	4.51	-	17.52
Rohatak	2.56	3.13	3.52	4.84	16.61	39.19
Gurgaon	2.22	2.80	4.88	7.15	11.33	8.80
Faridabad	-	6.34	-	8.29	-	53.93
Ghaziabad	-	4.54	-	9.60	-	42.88

Note: (-) Not available.

Source: Census of India

Table : 38
Urban Agricultural Workers

Name of Districts	(Percentage to Sector Total)											
	Cultivators			Agricultural Labours			Livestock, Forestry and Fishing					
	1971	1981	1991	1971	1981	1991	1971	1981	1991	1971	1981	1991
Delhi	16.08	20.74	25.63	23.60	29.58	31.04	87.04	-	-	87.04	-	77.23
Sonepat	-	1.85	2.65	-	4.51	8.78	-	-	-	-	-	17.52
Rohtak	2.56	3.13	2.78	3.52	4.84	8.53	16.61	-	-	16.61	-	39.19
Gurgaon	2.22	2.80	2.33	4.88	7.15	7.26	11.33	-	-	11.33	-	8.80
Faridabad	-	6.34	5.31	-	8.29	10.87	-	-	-	-	-	53.93
Ghaziabad	-	4.54	8.73	-	9.60	12.96	-	-	-	-	-	42.88

Note: (-) Not available.

Source: Census of India

Table : 39

Rural Agricultural Workers

Name of Districts	Cultivators						Agricultural Labours						Livestock, Forestry and Fishing					
	1971		1981		1991		1971		1981		1991		1971		1981		1991	
Delhi	83.92		79.26		74.37		76.40		70.42		68.96		12.96		-		22.77	
Sonepat	-		98.15		97.35		-		95.44		91.22		-		-		82.48	
Rohtak	97.44		96.87		97.22		96.48		95.16		91.47		83.39		-		60.81	
Gurgaon	97.78		97.20		97.67		95.12		92.85		92.74		88.67		-		91.20	
Faridabad	-		93.66		94.69		-		91.71		89.13		-		-		46.07	
Ghaziabad	-		95.46		91.27		-		90.40		87.04		-		-		57.12	

Note: (-) Not available.

Source: Census of India

Table : 40
Agricultural Workers by Sex

Name of Districts	Cultivators						Agricultural Labours						Livestock, Forestry and Fishing					
	Persons		Male		Female		Persons		Male		Female		Persons		Male		Female	
Delhi	1971	100.00	97.67	2.33	100.00	88.49	11.51	100.00	97.57	2.43								
	1981	100.00	92.48	7.52	100.00	85.98	14.02	-	-	-								
	1991	100.00	92.80	7.20	100.00	87.18	12.82	100.00	93.51	6.49								
Sonepat	1971	-	-	-	-	-	-	-	-	-								
	1981	100.00	83.26	16.74	100.00	81.55	18.45	-	-	-								
	1991	100.00	86.67	13.33	100.00	81.38	18.62	100.00	92.08	7.92								
Rohtak	1971	100.00	97.12	2.88	100.00	90.93	9.07	100.00	97.22	2.78								
	1981	100.00	84.85	15.15	100.00	81.07	18.93	-	-	-								
	1991	100.00	80.99	19.01	100.00	80.50	19.50	100.00	93.11	6.89								
Gurgaon	1971	100.00	97.46	2.54	100.00	89.86	10.14	100.00	97.18	2.82								
	1981	100.00	91.48	8.52	100.00	86.82	13.18	-	-	-								
	1991	100.00	86.80	13.20	100.00	80.77	19.23	100.00	93.50	6.50								
Faridabad	1971	-	-	-	-	-	-	-	-	-								
	1981	100.00	94.71	5.29	100.00	89.48	10.52	-	-	-								
	1991	100.00	87.57	12.43	100.00	83.73	16.27	100.00	95.99	4.01								
Ghaziabad	1971	-	-	-	-	-	-	-	-	-								
	1981	100.00	98.39	1.61	100.00	94.98	5.02	-	-	-								
	1991	100.00	97.18	2.82	100.00	93.93	6.07	100.00	85.60	14.40								

Note: (-) Not available.

Source: Census of India

Table : 40

Agricultural Workers by Sex

Name of Districts	Cultivators			Agricultural Labours			Livestock, Forestry and Fishing			
	Persons	Male	Female	Persons	Male	Female	Persons	Male	Female	
Delhi	1971	100.00	97.67	2.33	100.00	88.49	11.51	100.00	97.57	2.43
	1981	100.00	92.48	7.52	100.00	85.98	14.02	-	-	-
	1991	100.00	92.80	7.20	100.00	87.18	12.82	100.00	93.51	6.49
Sonapat	1971	-	-	-	-	-	-	-	-	-
	1981	100.00	83.26	16.74	100.00	81.55	18.45	-	-	-
	1991	100.00	86.67	13.33	100.00	81.38	18.62	100.00	92.08	7.92
Rohtak	1971	100.00	97.12	2.88	100.00	90.93	9.07	100.00	97.22	2.78
	1981	100.00	84.85	15.15	100.00	81.07	18.93	-	-	-
	1991	100.00	80.99	19.01	100.00	80.50	19.50	100.00	93.11	6.89
Gurgaon	1971	100.00	97.46	2.54	100.00	89.86	10.14	100.00	97.18	2.82
	1981	100.00	91.48	8.52	100.00	86.82	13.18	-	-	-
	1991	100.00	86.80	13.20	100.00	80.77	19.23	100.00	93.50	6.50
Faridabad	1971	-	-	-	-	-	-	-	-	-
	1981	100.00	94.71	5.29	100.00	89.48	10.52	-	-	-
	1991	100.00	87.57	12.43	100.00	83.73	16.27	100.00	95.99	4.01
Ghaziabad	1971	-	-	-	-	-	-	-	-	-
	1981	100.00	98.39	1.61	100.00	94.98	5.02	-	-	-
	1991	100.00	97.18	2.82	100.00	93.93	6.07	100.00	85.60	14.40

Note: (-) Not available.

Source: Census of India

is an indication of the development of entrepreneurship, as in the urban areas certain types of agricultural activities take the form of business.

Increase in agricultural labour is comparatively less. However, this change in the structural pattern does not contribute substantially to a change in the overall distribution pattern of the workforce because of the small size of the agricultural workers. The proportion of agricultural workers in urban Delhi is also on the increase, indicating a trend of migrant workers being employed as agricultural labour until such time they get urban jobs (either formal or informal). However, in rural Delhi and Sonapat there is a decline in the female workers.

Sonapat, Rohtak and Gurgaon also have a higher proportion of female cultivators. It is noticed that female workers are on the increase, with special reference to marginal female workers. Besides, there is also a move towards livestock rearing with urbanisation.

While concluding this section it can be said that an overall structural change in agricultural employment is taking place with urbanisation. Urban agriculture is becoming popular with urbanisation, because of an expanding urban market. With the increase of cultivators in Delhi, with only the marginal lands being cultivated, and with the provision made by the Master Plan for farm houses in the peri-urban areas of the city, along with permission to carry out some urban-oriented agricultural practices (already mentioned), there is a clear indication that the need to practice UA with urbanisation is being gradually accepted in cities. The issue here is not just of growing crops. New forms of agriculture, which manifests as business propositions, are also being considered.

Another feature which is prominent is the increase in female workers with time (Table: 41). This is also an outcome of urbanisation. Which leads to improvements in technology, knowledge and awareness. Besides, urbanisation also brings about higher costs of living to attain a better quality of life, for which more income is required. Hence more female workers are compelled to be inducted into the workforce with time.

Table : 41

Bifurcation of Total Main Workers by Sex

Name of Districts	Total Workers (1971)			Total Workers (1981)			Total Workers (1991)			
	Persons	Male	Female	Persons	Male	Female	Persons	Male	Female	
Delhi	Total	100.00	93.00	7.00	100.00	90.87	9.13	100.00	89.64	10.36
	Rural	100.00	92.93	7.07	100.00	90.42	9.58	100.00	92.47	7.53
	Urban	100.00	93.01	6.99	100.00	90.90	9.10	100.00	89.36	10.64
Sonapat	Total	-	-	-	100.00	87.18	12.82	100.00	88.73	11.27
	Rural	-	-	-	100.00	86.00	14.00	100.00	88.08	11.92
	Urban	-	-	-	100.00	92.69	7.31	100.00	91.00	9.00
Rohtak	Total	100.00	95.59	4.41	100.00	88.07	11.93	100.00	85.66	14.34
	Rural	100.00	95.87	4.13	100.00	87.05	12.95	100.00	84.33	15.67
	Urban	100.00	94.17	5.83	100.00	92.25	7.75	100.00	91.10	8.90
Gurgaon	Total	100.00	95.80	4.20	100.00	92.31	7.69	100.00	89.04	10.96
	Rural	100.00	96.16	3.84	100.00	92.22	7.78	100.00	88.84	11.16
	Urban	100.00	94.34	5.66	100.00	92.70	7.30	100.00	89.79	10.21
Faridabad	Total	-	-	-	100.00	94.45	5.55	100.00	91.16	8.84
	Rural	-	-	-	100.00	94.32	5.68	100.00	89.08	10.92
	Urban	-	-	-	100.00	94.62	5.38	100.00	93.19	6.81
Ghaziabad	Total	-	-	-	100.00	96.21	3.79	100.00	95.33	4.67
	Rural	-	-	-	100.00	96.62	3.38	100.00	96.14	3.86
	Urban	-	-	-	100.00	95.45	4.55	100.00	94.40	5.60

Note: (-) Not available.

Source: Census of India

The third important feature that is being revealed is the development of livestock rearing for meat and milk production for the growing urban market (Table: 37). This is mostly to be found in the peri-urban areas.

The issue then is of diversification of agricultural activities with urbanisation. The need is for varied products because of a growing market. As urbanisation continues, more attention is necessary for food production. While grain crops demand a specific focus, horticultural and other food products seek a different kind of attention that is market related. Within a city this entire phenomenon also influences the socio-economic and the environmental conditions.

The Need for Urban Agriculture

Like all metropolitan cities, Delhi is growing very rapidly. The catalyst came in the form of the country's partition at the time of Independence, when refugees migrated to the city from western Punjab. Since then Delhi has been growing steadily at the rate of about 50 percent per decade.

In the initial years of the "independent" rule, most of the employment generated were tertiary activities related to the country's administration. Subsequently more jobs had to be created for the increasing population, which were generally trading, small scale industries and services. But it was soon realised that to sustain the city, large industries should be brought in to increase productivity and strengthen the economic base.

Though initially the industries were located within the city, like the DCM, as also the small scale industries, with time the large industries were being located away from the city centre to avoid pollution, as planners had by then become conscious of environmental pollution resulting from certain types of developmental activities. However, the small scale industries continued to be within the city. But today, even those are being removed outside the city, as the combination of population growth and industrial growth is leading to severe pollution from congestion. In fact, pollution levels in Delhi are so high now, that several hard decisions, like removing all polluting industries, had to be taken to reduce their impact on the city's environment. Also, technology changes have been

suggested to control pollution. Besides, good management strategies are also being sought after to prevent pollution and to improve the city's environment.

One such management strategy could possibly be to promote UA. Benefits of UA for city management have already been discussed in the first section of this study. Since no management tool is singularly used for solving only one problem, efforts can be made to derive multifarious benefits by making the maximum use of a tool. A study of the concept has shown that UA can not only reduce pollution by digesting waste which will improve the natural assimilation capacity, but that it can also alleviate poverty and improve the city's finances by creating employment. Besides, UA can improve the food security, generate income from more productive use of land, reduce the maintenance costs and make the city more beautiful: all of which will raise the quality of life.

Data on infrastructure in Delhi indicate the nature and amount of shortages in the utilities and the built environment. As often discussed, deterioration of environment is caused either by overuse of resources that cause pollution or from poverty, which is an outcome of shortages. Incidences of diseases indicate the manifestations of insanitary conditions within cities. Hence utilities need to be upgraded with time to meet the demands of the increasing population.

Environmental deterioration can affect air, water and land resources within a city. Newspaper reports inform that Delhi is the fourth most polluted city in the world. Hence, conservation of resources and prevention of pollution are major tasks of urban environmental management in Delhi. If UA can help to reduce the problems created by the destruction of the natural assimilative capacity, many environmental management problems will get solved and public health problems will improve, to ultimately promote a good quality of life. Waste management expenses will also reduce with the development of UA because of its earnings from the reuse of digested waste, like fertilizers.

The existing peri-urban area of Delhi points to a diminishing size of the open areas earmarked for the purpose, which would either act as a buffer for the city, or as lung space for people to breathe freely. But as has been mentioned earlier, peri-urban areas are transient in nature and keep shifting away from the main city centre. As a result, the peri-urban areas of Delhi are merging with those of

the neighbouring towns and cities. That is, the expansion of Delhi and its surrounding towns are virtually filling in the rural gaps between the cities and advancing towards the creation of a large conurbation. Under the circumstances, UA would be very helpful to recreate open lung spaces for the people to breathe some fresh air and act as buffers.

With more land being transferred to non-agricultural use over the years, there is an increase in the built area and a reduction in the total cropped area. But there are also some cultivable wastelands that have been kept vacant. This indicates that the newly acquired agricultural lands, for urban development, are left fallow for a long time. It is this land that can be used for UA. The area sown more than once has also declined, indicating a reduction in soil fertility; for urban development results into severe soil deterioration. Changes in the soil structure prevent farmers from cultivating throughout the year. The changing landuse and the soil structure promote intensive agriculture (often with fertilisers that spoil the soil) in order to meet the demand-supply gap of the growing urban market and to reap higher benefits (which is very urban in its characteristics). Landuse options indicate that a sizeable amount of UA can be carried out in Delhi. However, the nature of agriculture will be of short-term benefits.

The development of UA is guided by the physiography and the pattern of urbanisation. Since urbanisation in the east of Delhi is more intense, developing along the lines of transportation, UA has developed more towards the west. Also, soil conditions promote better agriculture in the west. But there is no definite pattern of UA in and around Delhi. There are immense data constraints regarding UA, as all information is maintained only at the district level. Hence for analysis, districts adjacent to Delhi were considered, especially in diagnosing peri-urban patterns.

Very little of UA is carried out in and around Delhi. As mentioned earlier, only 1.2 percent of Delhi's income is generated on the farms. Besides, a very small percentage of the total workers are employed in agriculture. The land holdings are very small, ranging between 1-3 hectares. Some cereals and vegetables are grown. There are also some fruits grown, the larger share of the produce comes from Haryana. What is more important is the marketing of fruits and vegetables. Delhi being a regional centre, most of the produce from the surrounding areas is brought to Delhi, before being

redistributed. In fact, even flowers and fruits that come from outside the country, consider Delhi to be a centre for redistribution. Hence, marketing strategies are very important in the study of UA. For often, the local farmers meet the deficits created by the gap between the demand and the supply. For example, DMS and Mother Dairy meet only 40 percent of the city's milk requirement. The rest comes from the local farms and the dairies of the neighbouring states. Sometimes the market regulations prevent the local farmers from directly marketing their produce in the local market. They have to route their sale through the wholesale markets or the mandis. Whatever be the quantity and the quality of agricultural produce, it is very pleasant to see green fields of crops and vegetables in the Yamuna river floodplain, often interspersed by flowers that are grown for the urban market.

With the help of the local government and other development agencies, more trees are being grown in Delhi in recent times. Landuse data points to an increase in the area under trees. The revised Master Plan of Delhi has worked out a list of trees suited to the different parts of the city, based on climatic and appropriate soil conditions and a selection of species that will help to improve the urban environmental conditions. All this has happened with the recent consciousness on resource conservation, environmental management and sustainability.

However, the most interesting analysis of this chapter is the changing structure of agricultural employment within Delhi and its neighbouring districts. Though in the neighbouring districts, which are largely rural, urban agriculture does not create a niche, their cropping pattern is an indication of what happens in the peri-urban areas of Indian metropolises. Employment data shows interesting characteristics, such as an increasing female participation in the labour force with urbanisation.

Within Delhi, female cultivators and agricultural labour are on the increase. Delhi also has a large share of people employed in livestock rearing. In a large city the demand for food is so high, that it is necessary to supplement milk and meat by the local farmers. Besides, the highly perishable vegetables like mushrooms, spinach and broccoli, etc. are generally found to be growing in and around cities. Thus the employment structure and the cropping pattern of the urban farms are very different from those of the rural areas. UA, therefore, appears to be very useful in enhancing the food security for the urban areas, both in terms of feeding the poor, as well as supplying the

perishable products to the city that need refrigeration. As mentioned in the first section of the study, UA helps to reduce the use of energy and helps in pollution prevention from it.

It is said that every action has a reaction. Since urbanisation is a multi-dimensional process, the impacts are multifarious and the need for urban management is also manifold, with impacts requiring attention specific to the issues. For example, growth in population can lead to high population density, as a result of which space may have to be used more intensely, leading to the development of high-rise building. However, such congestion can lead to overuse of resources (in this case even space can be considered as a resource) that can bring about pollution from the waste generated by the population, which will reduce the assimilative capacity of the natural elements within a city. Hence the assimilative capacity of air, water, land and the biodiversity should be improved through the prevention of pollution and the conservation of natural resources, which could be done by using better technology, planting more trees or practicing UA.

Again, with the rise in population, the quantity of garbage increases. Therefore, in any kind of urban analysis, the first component to be studied should be the size and the rate of growth of the population that create the activities and their impacts, which need further attention. In addition, attention will have to be given to improve technology in order to prevent pollution. Since the use of resource generates waste that creates pollution, the more the use, the more will be the pollution. This highlights the inherent conflict between environment and development. Such a situation can be offset by the different management practices that include various types of technologies used. However, the level of pollution will also be controlled by urban management practices like monitoring the location of industries, restricting congestion (whether of people, their activities or traffic), regulating the use of resources, practicing UA, etc.

Many factors influence development. For example, a natural physical barrier should never be ignored in planning, as fighting against nature could be an uphill task. Moreover, disturbing nature often distorts the ecological balance. Development of a human settlement should not be incongruous to the natural conditions, if the city is to reap rich benefits. Similarly, the climatic conditions are also important determinants of management strategies and practices. However with the development of

technology, negative elements can be controlled and positive factors can be enhanced. To do so, good management practices will have to be evolved, for which coordination of planning with operation and maintenance practices is essential. Integration is sought at all levels of administration, physical coordination and management practices, including technology. Therefore, an integrated approach will be of immense help to develop UA as a tool for urban environmental management.

Chapter IX

CONCLUSIONS

Urbanisation brings along with it a resurgence of agriculture, but with a difference. As cities expand and the needs increase, the range of economic activities widen. The snowballing effect that fosters population expansion demands more food, stimulating the development of UA. In the metropolitan cities of developing countries, this diversification brings about varied lifestyles, ranging from an extension of the rural life to the most sophisticated standards of modern living and agribusiness. The wide range of lifestyles generates diverse food requirements, which UA tries to satisfy through the city's large and varied urban food market.

UA is not just crop cultivation of the type common in rural areas. It caters to very special and stylised needs of the urban milieu. For example, with the exposure of the metropolitan cities to different culinary pleasures, the demand for special food products like cheese, mushrooms, strawberries, bamboo shoot, pork, or certain kinds of meat and vegetable products that were once rare, have become very popular today. Of course, there is also the sheer necessity to provide for a large population. Therefore, rapid urbanisation has brought back to the cities a type of agriculture that is more conveniently practiced to cater to the city's population. While doing so, UA helps the city to solve some of its socio-economic and management problems, as mentioned in the earlier sections of this study. Some typical examples of urban agriculture include:

- fish and other aquatic products harvested from tanks, ponds, rivers, sewage lagoons and estuaries
- horticulture on excess vacant space at large facilities, principally dedicated to other activities (like airports, factories, etc.)
- chicken, rabbits, guinea pigs raised in bookshelf cages hung on walls
- vegetables grown in hydroponics solution on roofs, patios and stairways
- market gardens on vacant plots, in the green wedges between urbanised corridors or along highways/railroads in peri-urban areas.

Urban farming is perforce intensive, making the best use of space, with a predominance of shorter-cycle, higher-value market crops. It utilises multi-cropping and integrated farming techniques and makes judicious use of both vertical and horizontal space.

An examination of the contribution of UA towards sustainable development indicated a multi-sectoral role of UA in city management. However, UA focuses mainly on environmental improvements, food security and socio-economic development, all of which promote a good quality of life. Its benefits to the poor are crucial factors of city development and thereby city management, as providing for the poor has different economic and management connotations. However it was found that the exact estimation of the quantity and quality of environmental improvement in Delhi was hard to achieve for want of quantitative data, as UA is more informal than formal, as a result of which records are not maintained. Moreover, since agriculture is opposed to "urban", legislation often does not support such activities; though records of land utilisation mentioning the area under crops or multiple cultivation in Delhi did indicate an agreement with the phenomenon. However, on examination of the market mechanism for selling vegetables, fruits, flowers and milk in Delhi revealed an absence of a supportive system for the small and marginal farmers commonly engaged in UA. In fact, a formal market system for flowers is totally missing in Delhi. There is a general apathy in the city towards UA, with very little promotional efforts and very few formal government schemes to improve its position. However, of late the city is trying to bridge this gap by planning to construct wholesale and retail markets like flower markets near the Indira Gandhi International Airport, or that opposite Dilli Haat, adjacent to INA market (The Times of India).

Even though informal economic activities contribute to the city's economy, the revenues generated do not necessarily add to the municipal coffers, as it operates outside the tax structure. While such employment may be beneficial for the poor, generation of these jobs creates management problems in the absence of a planned support system. Yet improving the economic conditions of the poor enhance both the city and the state income. This conflicting position of employment creation vis-a-vis shortage of city revenue for the upgrading and maintenance of infrastructure for the poor (agriculturists) is a continuing dilemma faced by the planners in India, which can only be resolved through policy and legislative changes.

There is again a need to know how much a city can save on the cost of city maintenance through UA: such as the cost of maintaining fallow or marginal land, the roadside trees, garbage collection and disposal, sewage water treatment and disposal, prevention of air pollution, etc. All these along with income from UA add to the actual monetary benefit the city enjoys from UA. To this should be added the benefits of social upliftment: such as improved education, prevention of crime through gainful employment, community participation that assists local administration, improvements in public health conditions resulting from waste digestion, prevention of epidemics and the like, all of which reduce the cost of city management by avoiding difficulties arising from its absence. Each of these sectoral assessments will be an exercise by itself, if detailed analysis is done of the effects of UA on the city. Such an analysis could not be done for Delhi for want of appropriate data and time.

A review of the plans and policies has revealed that UA has so far not been taken up seriously in India as a mode of city management or for promoting employment, or even for poverty alleviation. Neither have the benefits of UA been understood, recognised, or practised in pollution abatement or health care. There is no direct reference made in the plans on the promotion of UA, except in the Sixth Plan which proposes to improve agriculture, including horticulture in and around cities, from the point of view of building a national food security system. However, there was a mention of public policy measures that would stimulate production by small and marginal farmers. The Sixth Plan also suggested the use of marginal lands, without mentioning its rural/urban identification. The Plan also mentioned that the aim of landuse planning should be to optimise opportunities for gainful employment. The proposal was for a systems approach to agricultural production, conservation, consumption, and trade. However, this strategy was meant to be adopted in general for all types of agriculture and was not specifically for cities only.

Conservation policies have emphasised the protection and promotion of greenery and bio-diversity in and around cities. The focus is on prevention of pollution and waste assimilation. It does not mention UA directly. Development of city parks from the viewpoint of creating and maintaining lung spaces in the context of physical planning of urban settlements has also been considered. Social forestry is today a popular phenomenon to increase the assimilative capacity of air. But UA as a

panacea for socio-economic problems has never been formally considered so far. The inclusion of Zones A.1 and A.2 in the Master Plan of Delhi, which constitute a green belt, has been mostly to avoid incompatible industries (that require plenty of space or created some nuisance in congested surroundings, such as dairying) from being located within the city. At the same time these zones are to act as a buffer between the urban and the rural and absorb those rural industries that cater to metropolitan requirements. However, the mandatory requirement of EIA since 1994 has made some improvements in our thinking on the protection of forests, agricultural lands, green belts and other natural elements.

What has never been considered is the beneficial role of UA in poverty alleviation and social development. This needs more thinking. The fact remains that rural is divorced from urban and that rural activities within a city is incompatible to the very concept of urban, which emphasises on non-agricultural activities and a life that is far removed from the soil. Therefore, should such activities be permitted within cities? Or to which extent can UA be practiced? Urban planners are biased against the use of land and water bodies in and around cities, for UA. They attach more value to land supporting housing and industries than agriculture. Besides, water in the urban areas is often a scarce resource/utility.

The study has discussed the beneficial role of UA in city management. As mentioned in the beginning, UA can be used as a business proposition by the rich and as an instrument of poverty alleviation for the poor. This would mean both a social and an economic upliftment. However, the crucial decision of accepting or rejecting UA rests with the city government. How far it will help in city management will have to be examined sectorwise, to weigh the benefits it will accrue to the city. Thus development of UA will need further research. Though present in a limited way, UA has now acquired new dimensions with rapid urbanisation, especially in a country like India where 30-40 percent of the population of the metropolitan cities live in slums and suffer either from unemployment or from low income, both of which lead to shortage of money to buy food.

The case study of Delhi, in this project, brought out the redeeming features of UA vis-a-vis pollution, congestion, shortage of utilities/infrastructure with urbanisation. Though results of the

strategies adopted for UA could not be measured quantitatively, facts and figures indicated towards the acceptance of UA in improving the city's environment and food security. The issue that has emerged is not of a choice for UA in cities, but of the inevitable/spontaneous development of UA with urbanisation. The dilemma is with regard to the institutional support to be given to UA.

The basic question is, whose responsibility should UA be? The nature of responsibility ranges from allocation of land, to provision of water, to building up of a market system, to selling of agricultural produce, to pollution control and the planting of appropriate trees, to improvement of the assimilative capacity of the natural elements and so on. In 1983 Ganapathy had argued that the State alone is not sufficient to promote UA in the Indian cities. To make it successful, commitments at the local level is also required; which would mean decentralisation and complete involvement of the community. He argued that "an important policy goal in urban agriculture will be to develop a contextually relevant optimal balance of power between community, state and the market place." State support would be encouraging by way of research, development impetus to local planning and in provision of inputs. It can act as a negotiator whenever there is conflict in the usage of urban space. Ganapathy, however felt that with the high land prices and the demand on limited land resources, urban agriculture cannot be economical on a large scale. Access to land is an important factor for urban agriculture and its availability to urban poor is crucial. Yet, land use planning and policy-making do not often address this issue from the standpoint of the urban poor (Yeung: 1985).

So far the legislative support given to the local governments in India came from the State. But after the 74th amendment of the Indian Constitution, the municipality now forms the third tier of the government to manage cities in a decentralised form, at the local level, so that people's priorities can be given a hearing. Hence the importance of UA will depend upon the decisions taken at the local level, even though the phenomenon is showing signs of globalisation. That is, even though the issue affects cities all over the world, practice of UA has to be location specific. In India the recent introduction of "urban forestry, protection of environment and promotion of ecological aspects" as a responsibility of the municipality as mentioned in the Twelfth Schedule of the Constitution will help to facilitate the practice of UA by giving it a legal support. This privilege was absent in the past. Thus UA need not necessarily be an informal activity anymore. However, the focus for further

studies will have to be on the main issues of urban management (as mentioned in the section on UA), depending upon their relevance.

As for the peri-urban areas, expansion of the city into the fringe farmlands is reducing traditional agriculture. But since peri-urban areas are belts of perpetual conversion of rural land into urban, transformation of agricultural activities into non-agricultural occupations (that is, from green to brown landuse) is inevitable. At the same time these zones are gaining in horticulture, floriculture, pisciculture and livestock rearing, etc. which produce high value components of food for the urban markets. In fact, Master Plans (as in Delhi and many other cities) are gradually including such usage around cities. Therefore, an appropriate mix of UA and urban development would be more acceptable for city planning, rather than a total change from rural to urban. As Lewis Mumford had visualised almost half a century ago, that “in cities of the future, ribbons of green must run through every quarter, forming a continuous web of garden and mall, widening at the edge of the city into protective greenbelts, so that landscape and garden will become an integral part of urban no less than rural life, for both weekday and holiday uses”. It is hoped that with UA such needs will be met.

Thus, the role of urban and peri-urban agriculture is manifold. In the developed countries UA is carried out to promote recreation and aesthetics, and to improve the assimilative capacity of the natural elements within the city. It also helps in social upliftment. The focus there is on multiple use of urban space and the potency of decentralisation. In India UA is practised for subsistence, for providing employment to the poor and for food security, an externality of which helps to assimilate pollution and waste, apart from its main contribution to the city's economy. It also promotes agribusiness. Therefore, the relationship of UA and city development is of no mean value in India.

Despite all benefits, UA is little understood. Urban farming is often considered as “kitchen gardening”, or marginalised as leftover rural habits. The benefits of UA are lost behind myths that emanate from cultural, planning and policy biases. It is necessary to identify and address the myths surrounding UA to recognise its potential. However, the contribution of UA would be more beneficial in poor/developing countries with threats of unemployment and food insecurity.

This study was done to understand the concept and nature of UA and to find out its possible role in city management. For, the resurgence of agriculture with rapid urbanisation is a spontaneous and a natural way of making cities more sustainable. Hence, it is of global importance today. How far UA has succeeded in attaining sustainability can only be estimated through further in-depth research of the contributions of the different sectors of development resulting from or being influenced by UA. The hurdles in the path to such quest lies in the limited data available, as UA is informal in nature, for which no records are maintained. Hence accurate measures of benefits from UA have still to be found out to assess its contribution to sustainable development. Though the case study of Delhi could not draw definite conclusions of the impact of UA on city management, inferences could be drawn from the illustrative data and the strategies adopted in India and the other countries to indicate the value of UA in city management. It can, therefore, be emphasised that an integrated development of UA, along with city management, will be a very good tool for improving the quality of life within cities.

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