Study of Urban Forestry through Road Side Tree Plantation in Dhaka City

SABEQUN NAHAR MUKTI

MASTER OF URBAN AND REGIONAL PLANNING

Department of Urban and Regional Planning
BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLY

2006

The thesis titled **Study of Urban Forestry through Road Side Tree Plantation in Dhaka City** submitted by Sabequn Nahar Mukti Roll No.:100115021 F Session: October 2001 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Master of Urban and Regional Planning on 30th September ,2006

BOARD OF EXAMINERS

Mrs, Ishrat Islam
Assistant Professor
Dept. of Urban and Regional Planning
BUET, Dhaka — Chairman (Supervisor)

Head
Dr. Roxana Hafiz
Professor
Dept. of Urban and Regional Planning
BUET, Dhaka — Member

Dr. K. M. Maniruzzaman
Professor
Dept. of Urban and Regional Planning
BUET, Dhaka — Member

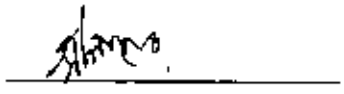
Dr. Gulshan Ara Parvin
Assistant Professor
Dept. of Urban and Regional Planning
BUET, Dhaka — Member

Dr. Nurul Islam Nazem
Professor
Dept. of Geography and Environment
Dhaka University — Member (External)

CANDIDATE'S DECLARATION

It is hereby declared that this thesis or any part of it has not been submitted elsewhere for the award of any degree or diploma.

Signature of the candidate



Sabequn Nahar Mukti
Roll No: 100115021 F

ACKNOWLEDGEMENTS

At first all praises belong to Almighty Allah, the Most Merciful, the Most Beneficent to man and his actions.

The author wishes to express her sincere gratitude and indebtedness to Mrs Ishrat Islam, Assistant Professor, Department of Urban and Regional Planning, Bangladesh University of Engineering and Technology, Dhaka, under whose careful supervision, constant guidance and inspiration this study has been completed

The author expresses her profound gratitude to Professor, Mir Shahidul Islam for his strong support towards the successful completion of the study

The author also expresses gratitude to all the honorable teachers of Department of Urban and Regional Planning, for their help and cooperation during the study period.

The author is grateful to Mr. Tariq Bin Yousuf, Executive Engineer, Zone -3, of DCC and Mr. Assaduzzaman, Geographer in the Town Planning Section of Dhaka City Corporation, for their valuable suggestion and co-operation during the research. The author believes that the acknowledgment will be incomplete if proper recognition is not shown towards her friend, Sanjida Shamsher Elora, Senior Research Associate, Centre for Policy Dialogue (CPD), for her continuous support in technical and editorial help.

The author is ever grateful to her husband for his enthusiastic encouragement during the whole study period

Finally, the author is grateful to the BUET for providing financial assistance in the form of fellowship and for providing the necessary expenditure involved for this work. The author is also indebted to Mamun, Sadat, Mohsin, Shakhoat, and Shuvra Roy for their helping in data collection.

ABSTRACT

Urban forestry is an economic asset, when they are increasingly regarded as a vital component of the urban infrastructure, essential in maintaining a livable and sustainable environment. This research focuses on the overall planning and management of the roadside tree plantation in Dhaka city through its different tree plantation programs and projects including the existing "Dhaka City Beautification Project". This study encompasses Dhaka City Corporation (DCC) area where plantation programs have been undertaken by DCC and the Forest Department (FD) during the years. Primary and secondary materials have been used to analyze the available information and to examine the existing plantation situation in practice.

Trees are very important part for improving people's livelihood as well as balancing ecological, social and economical environment in an urban area The scope and importance of urban forestry through roadside tree plantation of Dhaka city have been highlighted in this paper. The aspects of management to maintain the health and strength of roadside tree plantation have been narrated. The main finding is that the practice of roadside plantation is increasing. In 2004 and 2006, two field surveys have been conducted by the author to find out the growing trend of plantation in urban forestry through road side plantation. The study found that the use of ornamental trees for road side tree plantation has been increased over the years and foreign varieties of plants have predominated over the local varieties for city beautification. Government has contracted out most of the city beautification projects and/or road side tree plantation projects to the private companies to get better results from these projects Appropriate tree species have been recommended for roadside plantation in Dhaka city The role of urban trees in reducing the air, gas and sound pollution in the urban area has been discussed. The contribution of vegetation to provide comfort to urban dwellers by improving the urban environment has also been mentioned

TABLE OF CONTENTS

		Page no
Acknowledgement		i
Abstract		ii
Table of contents		iii
List of tables		v
List of figures		v
List of maps		vi
List of photograph		vi
Glossary and abbreviations		vii

CHAPTER ONE: INTRODUCTION

1.1	Introduction	1
1.2	Statement of the problem	2
1.3	Importance of the study and expected result	3
1.4	Objectives of the study	4
1.5	Scope and limitation of the research	4
1.6	Methodology of the research	4

CHAPTER TWO: URBAN FORESTRY MANAGEMENT

2.1	Introduction	11
2.2	Definition of urban forestry	11
2 3	Scope of urban forestry	12
	2.3.1 Avenue	12
	2.3.2 Urban Park	13
	2.3.3 Industrial shelterbelts	13
	2.3.4 Urban campsites	13
	2.3.5 Wilderness trails	13
2.4	Roadside Tree plantation	13
2.5	Benefit of roadside tree plantation	14
	2.5.1 Social benefits of urban areas	14
	2.5 2 Environmental benefit	15
	2.5.3 Economic benefit of roadside tree plantation	17
2.6	Management of road side plantation	18
	2.6 1. Tree Planting,	18
	2.6.2. Maintenance	21
	2 6.3. Growth control	22
2.7	Urban environment management through roadside tree plantation	23
	2.7.1. Reduction of air pollution	23
	2 7.2. Reduction of sound pollution	24
	2.7.3. Amelioration of climate	25
	2.7.4 Air Movement and Wind Protection	26

CHAPTER THREE: PLANNING AND MANAGEMENT OF URBAN FORESTRY IN BANGLADESH: EXPERIENCE IN DHAKA CITY

3.1	Introduction	27
3.2	Historical background of forestry management in Bangladesh	28
	3.2.1 Forest management in ancient India	28
3.3.	Forest Management Program and Practice of road side tree plantation in Bangladesh	29
	3.3.1 Forest Extension Scheme (Phase – 1)	29
	3 3 2 Forest Extension Scheme (Phase – 2)	30
	3 3.3 Development of Community Forestry Project	30
	3.3.4 Extended Social Forestry Project	31
3.4	Urban forest management in Dhaka city: Historic background	32
3.5	Urban plantation program in Dhaka city in 1993 to 2003	33
	3.5.1 Nagar Banayan Prokolpo	34
	3 5.2 Zone Wise Tree Plantation Program in Dhaka City	36
	3 5.3 Dhaka Mahanagarir Obokathamo Ebong Poribesh Unnoyan Prokolpo: (2002 to 2004)	38
	3.5.4 Dhaka City Beautification Project: (2003 to 2008)	39
3 6	Over view of the tree plantation project in Dhaka City (1994 to 2008)	43
3.7	Status of roadside tree plantation in study area	45
	3.7.1 Species selection	45
	3.7.2 Plantation in urban design in study area	52
3.8	People perception of design perspective of roadside plantation in study area	60
	3.8.1 Designed aspect of road side plantation	60
	3.8.2 Issues of shade and comfort to traveler	62

CHAPTER-FOUR: NESSECITY OF ROAD SIDE PLANTATION TO IMPROVE THE CITY ENVIRONMENT

4.1 Introduction	63
4.2 Reduction of sound pollution	63
4.3 Reduction of temperature	65
4.4 Reduction of air pollution	65
4.5 Air movement and wind protection	66

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.1. Conclusion	68
5.2: Summery of the findings	68
5.3: Recommendation	71
REFERENCES	75
APPENDICES	80

LIST OF TABLES

Table 1.1. Study roads at a glance 6
Table 2.1: Road side and avenue planting for beautification 20
Table 3.1: Forest area of Bangladesh by different Years 27
Table 3 2: The completed plantation and training activities under the different Projects 31
Table 3.3: Urban Plantation program in Dhaka City 34
Table 3.4: Indicates the major items of investment 35
Table 3.5: Yearly plan of tree plantation program of Dhaka city (zone 3) 36
Table 3.6: Yearly plan of tree plantation program of Dhaka city (zone 10) 37
Table 3.7: Plantation program under "Dhaka Mahanagarir Obokathamo Ebong Poribesh Unnoyan Prokolpo (2002 to 2004)". 39
Table 3.8: Tree Plantation Projects of Dhaka city (1994 to 2008) 44
Table 3.9: Administrative authorities responsible in tree plantation program in different year in Dhaka City 44
Table 3.10: Types of plantation in the study area 45
Table 3.11: Variety of species planted in different roads under the "Dhaka Beautification Project". 51
Table 3.12: Median width in study area 53
Table 3.13: Past and present trend of space using for tree plantation program in study area 55
Table 3.14: Side walk width in study road in Dhaka City 56
Table 3.15. Row types of plantation in different roads 58
Table 3.16: Species composition of different Road 60
Table 3.17: The study road in relation to design of plantation in Dhaka City from people's perception. 61
Table3.18: Comfortable Roads as per people perception in Dhaka City 61
Table 4.1: Status of sound level in the selected areas of Dhaka City 64
Table 4.2: Width of the tree covers both sides of the roads 64
Table 4.3. Ambient air quality status of some areas in Dhaka City (in Microgram\ M^3) 66

LIST OF FIGURES

Figure 1.1: Methodology of the study 5
Figure 3.1: Trend of forest area in Bangladesh 28
Figure 3.2: Amount of plantation in Dhaka city (Zone-3) 36
Figure 3.3: Amount of plantation in Dhaka city (Zone-10) 37
Figure 3.4: Organizational diagram of "City Beautification Project" in Dhaka City 42
Figure 3.5: Choice of species in Dhaka City (2004-2006) 47
Figure.3.6: Spaces using in different roads for plantation 55
Figure 5.1: Proposed organizational diagram of tree plantation and beautification project in Dhaka City 74

LIST OF MAP

Map 1.1: Dhaka City Corporation area (Zone Wise) 7
Map 1.2. Study road in Dhaka city 8

LIST OF PHOTOGRAPH

Photograph 3.1: Study site selection 50
Photograph 3.2a: Unfavorable condition of roadside for plantation 50
Photograph 3.2b: Shallow, compacted, soil in a narrow median is not suitable for ornamental plantation 50
Photograph 3.3: Past plantation trend in the study roads 50
Photograph 3.4: Options of plantation in the study roads 50
Photograph 3.5: Ornamental plantation in different study roads 54
Photograph 3.6: Present plantation design in different study roads 59
Photograph 3.7: Unplanned plantation in median 59

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
BARI	Bangladesh Agriculture Research Institute
BBS	Bangladesh Bureau of Statistics
BAT	Bangladesh America Tobacco Company
BWDB	Bangladesh Water Development Board
CEO	Chief Executive Officer
CIDA	Canadian International Development Agency
CEO	Chief Executive Officer
CGP	Coastal Greenbelt Project
DCC	Dhaka City Corporation
DUTP	Dhaka Urban Transport Project
DESCO	Dhaka Electric Supply Company
DUTP	Dhaka Urban Transport Project
DCBC	Dhaka City Beautification Cell
FSP	Forestry Sector Project
FSMP	Forestry Sector Master Plan
FSMPF	Forestry Sector Master Plan
FAO	Food and Agriculture Organization
FD	Forest Department
MCCI	Metropolitan Chambers Of Commerce and Industry
MoEF	Ministry of Environment and Forests
PMO	Prime Minister's Office
RHD	Roads and Highways Department
SAARC	South Asian Association for Regional Co-Operation
SDNP	The Sustainable Development Networking Program
USAID	United State Agency for International Development
WB	World Bank

INTRODUCTION

1.1 Introduction

In this world, there was a time when most places of the area were covered by forest. People used to believe that the great forest will never vanish. But the rapid urbanization and cutting of tree is affecting the forest and is deteriorating the environment and ecological balance. In 1980 a FAO report said that every year 10 lakh hectare of tropical forest is decreasing. Forest is the main component for ecological balance. Urban dwellers are increasingly recognizing and articulating the importance of urban forest as a vital component of the urban landscape infrastructure and quality of life (Kuchcilmeister, 2000). The urbanization of society has led to the increasing importance of urban green spaces as contributors to the quality of the urban environment and urban life. Forest and tree resources have a wide range of socio-cultural, economic and environmental values. In order to optimize these values in a sustainable way, within the framework of a range of urban pressures and problems, integrated approaches and research for the planning and design, selection and establishment, and management of urban forests and trees are asked for. Urban forestry offers considerable potential to meet this demand. It can be defined as the art, science and technology of managing trees and forest resources in and around urban community ecosystems for the physiological, sociological, economic and aesthetic benefits provide to society. Urban forestry includes trees and vegetation found in parks, river valleys, streets and roadways, as well as trees growing on private lands. In this context, urban greening is increasingly acknowledged as a development tool. Many urban development projects include an urban forestry component. Many cities implementing Agenda 21 locally (e.g. la Paz, Bolivia; Sao Paulo, Brazil; Tehran, Islamic Republic of Iran; Durban, South Africa; Kampala, Uganda; Zurich, Switzerland; Bombay, India; and Yokohama, Japan) have incorporated urban greening components (Kuchelmeister, 1998).

Urban forestry has already started formally in Bangladesh. Different projects have been adopted for plantation. Dhaka City is given priority for plantation to create urban forestry. A large scale plantations programs have been under taken in the country which also include plantation along the roadside, avenues, highways, railways and other places in the cities. This research took an attempt to evaluate the plantation process through different projects in Dhaka City.

1. 2 Statement of the problem

Dhaka was once a beautiful city for its green coverage. The Mughals were fond of tranquil flowering gardens; they adorned the city with many interesting and rare plants (Islam, 2002). The Ramna Park and Baldah Garden are still present as the reminiscence of the past efforts of raising plantation. The natural forest covers subsisted in the peripheral belt of the old Dhaka city, mainly at Ramna in the south to Tongi canal in the north. The east and western low-lying areas was occupied with the water enduring plants species. As time passes, unfortunately, most of those trees were cut down in the name of development activities. The green Dhaka has became faded through conversion of greeneries and open spaces to various urban land uses in response to rapid urbanization.

In Bangladesh, the level of urbanization has increased very rapidly to 8.78% in 1974, 15.54% in 1981, 20.15% in 1991 and 23.39% in 2001 (BBS, 2001). As the world's 6th largest developing nation, Bangladesh has 129.2 million people (BBS, 2001). Urban population density in Bangladesh was 2179 persons/sq.km in 1991 and the estimated density in 2004 is approximately 3008 persons/sq.km. Population density of Dhaka mega city was found to be 4795 persons/sq in 1991 and in 2004; the estimated density is 8573 persons/ sq.km. In the DCC area density is much higher of 18055 persons/sq.km (SDNP, 2005).
It is necessary to meet the growing need of space for housing, business and industries for increasing population and thus land use is transforming rapidly in this city. Conversion of agricultural land to urban use is a common trend. In addition to that low density urban areas are transforming to high density areas. As a result loss of greenery is the unavoidable outcome. These kinds of urbanization trend results in tremendous scarcity of trees, which is affecting the physical, economical social and natural environment of urban areas. The environmental degradation in Bangladesh particularly in Dhaka city is increasing and one of its major causes is deforestation (Islam, 2002).

Trees are very important in balancing the ecological and social environment of a country. The experts say that one country should have 25% forestry of their total land for a healthy environment and for the ecological balance where as in Bangladesh, the forest cover is only 18% of the total land (BBS, 2005). Contrarily, most of the specialists in Bangladesh believe that the government statistic's is far away from the existing forest area in the country. According to several other sources and USAID (2001), only 6 % area of Bangladesh is covered by forest, which is catastrophic to us (Islam, Hoq and Hossain, 2002) and in Dhaka

city, the scenario is much more disappointing. To maximize the green coverage in an urban area, the concept of urban forestry is an acknowledged tool (Islam, Hoq and Hossain, 2002). Urban forestry is the management of tree plantation in and around the city or town areas. Many different environments such as park, street, residential areas, industrial and commercial zones, parking lot, community centers like school, college, mosque, temple, church, rest house memorial place, etc. are included in urban forestry (Sattar, 2000). In Dhaka city, rapid urbanization is reducing open space, park and fertile land for forestation. In this case, roadside tree plantation can play a significant role in terms of environment, aesthetic and socio-economic perspective.

1. 3 Importance of the study and expected result

The aim of roadside tree plantation is to provide comfort to travelers and beautify the city. In the same way, roadside tree plantation projects aim at creating or manipulating nature in order to achieve a livable environment for human habitation. Environmental improvement in one part of a country or/and region can have the spill over benefit to the whole region and/or country (Chaturvedi and Tiwari, 1938). Increasing forest areas in both rural and urban areas can be an effective tool for improving environment. But in Dhaka city, the rapid urbanization makes it very difficult to protect some land for planned forest area. In this case a possible alternative is to use the roadsides and medians for increasing plantation to ensure the ecological balance in this mega city.

The study evaluates the present plantation management status in Dhaka city. It thoroughly focuses on the planning and management aspects of tree plantation program in the study area by analyzing different plantation programs undertaken by FD (Forest Department) of Bangladesh and DCC (Dhaka City Corporation) from 1993 to 2006. Furthermore, the study rendered the present status of plantation program in Dhaka city. It would be valuable for the researchers as well as the general readers to apprehend the changes over the time. It will also give some ideas on how the plantation programs have been managed by different government and private organizations.

1. 4 Objectives of the study

In brief, the objectives of the study are summarized as follows:

a) To investigate in to the existing program of tree plantation

b) To investigate planning and management aspects of tree plantation in city corporation

c) To investigate how to improve the city environment through roadside tree plantation.

d) To formulate guidelines for tree plantation in Dhaka City

1. 5 Scope and limitations of the study

The main focus of the study was on road side tree plantation program under supervision of DCC and FD in DCC area. Very limited information was available regarding the planning and management process of urban forestry in Dhaka city. This research concentrates on "Dhaka City Beautification" project started in the year 2004. At the beginning of research work in 2003 a number of study sites were surveyed but later these were brought under Dhaka City Beautification Project and significant change took place in term of planning and management. This research tried to compare trend of plantation both from 2003 and Dhaka City Beautification Project. Due to time and resource constraint it is not possible to cover all the roads of Dhaka city. About 47.29 km roads were taken as sample. Data of past plantation program in Dhaka city which was done by the DCC (Dhaka City Corporation) and FD (Forest Department) is not available. It was very much difficult to collect detail information about present plantation management activities done by different organizations under "Dhaka City Beautification Project".

1. 6 Methodology of the research

The present study investigates existing plantation program and management system of road side tree plantation in Dhaka city. This study also reveals the way to improve city environment through roadside tree plantation in Dhaka city. The study is based mainly on primary data. The secondary sources have also been analyzed to show the comparison among different plantation projects and various species of trees planted in the roadside in 2004 and 2006. Figure1.1 shows the flow diagram of research methodology.

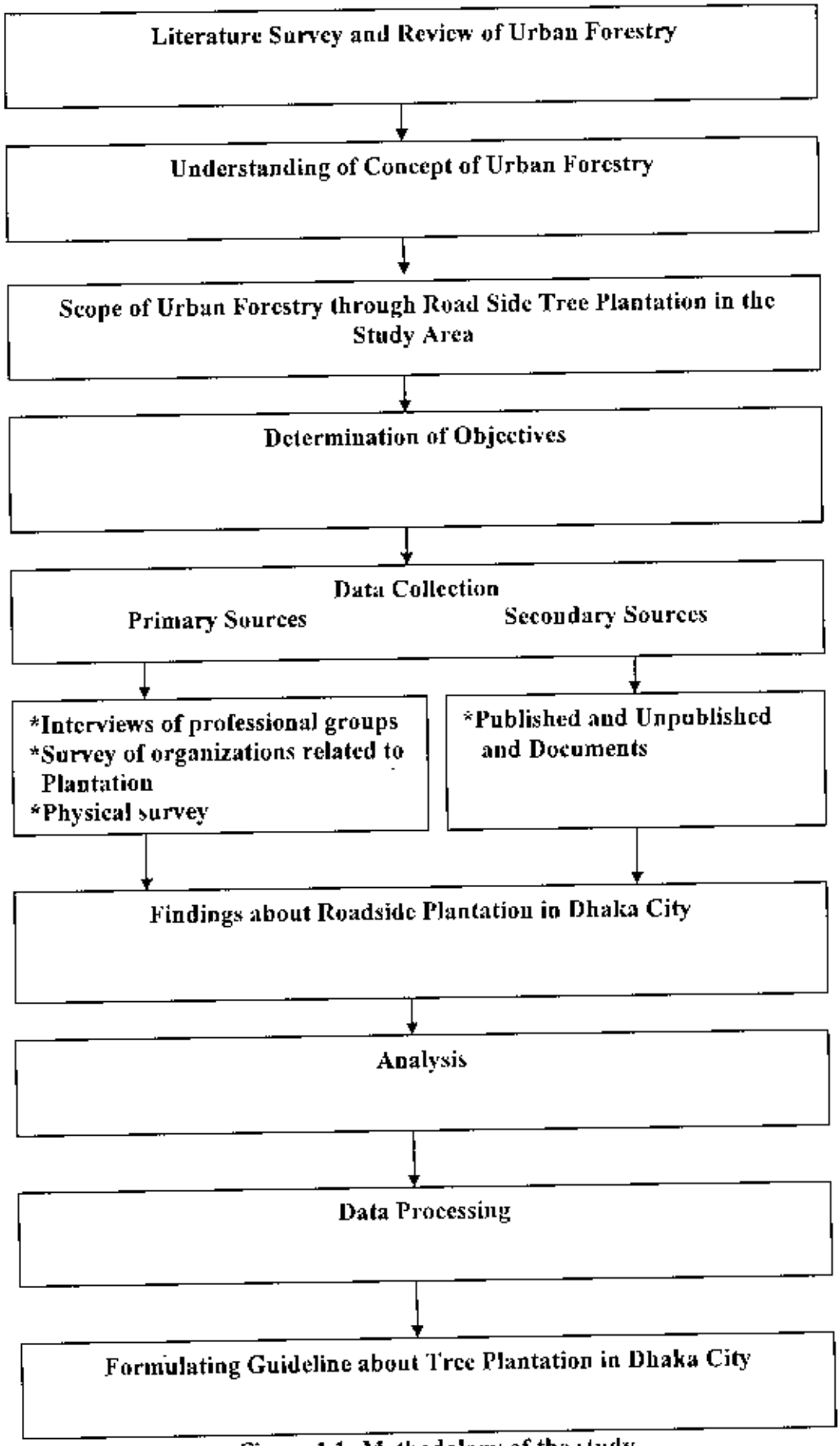


Figure 1.1: Methodology of the study

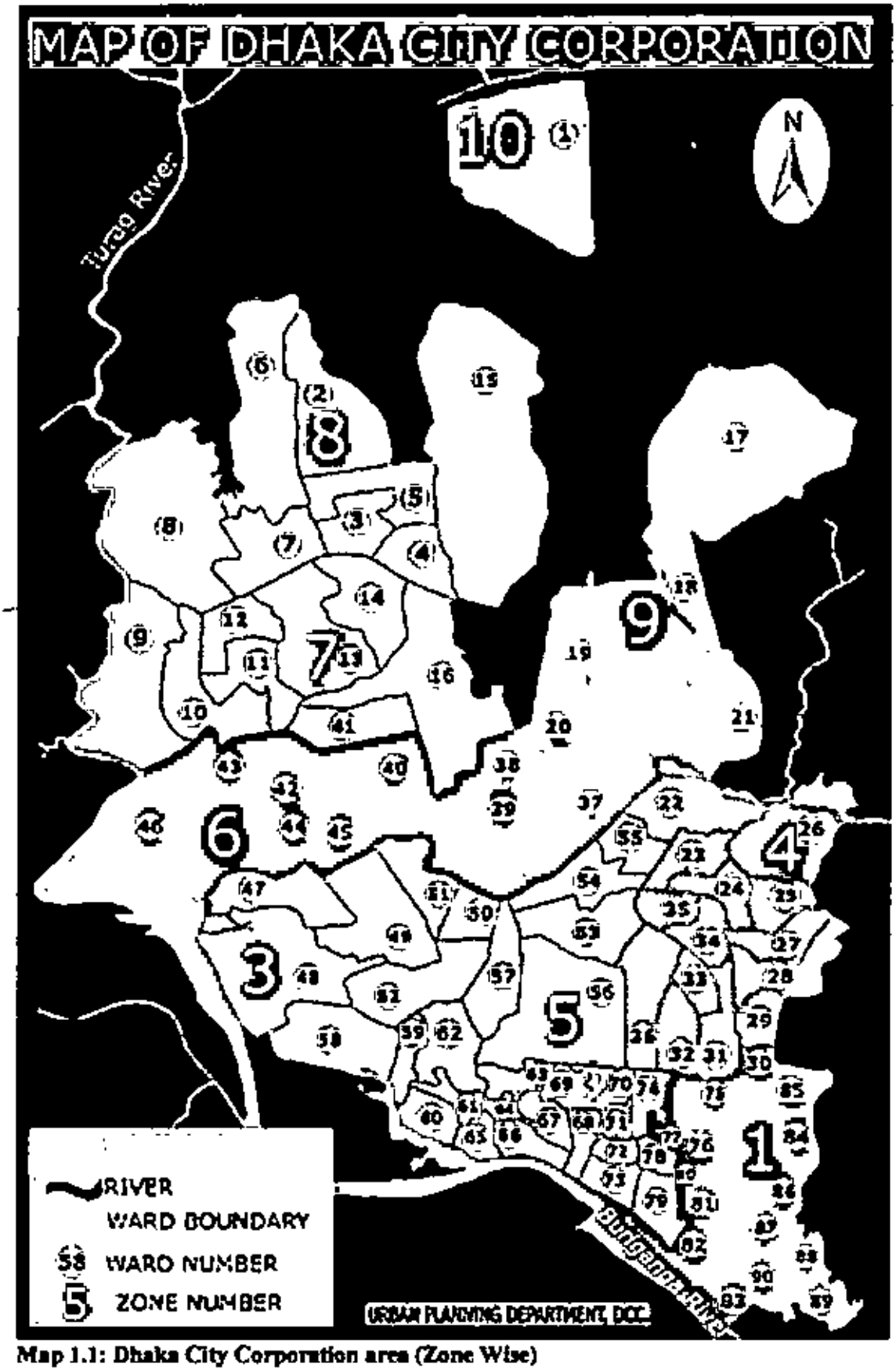
1.6.1 Selection of the study area

The present study was carried out in Dhaka City. A cluster sampling system is used to specify the zones of Dhaka city. Six zones are selected randomly out of 10 Zones of Dhaka City Corporation (Map 1.1). From the selected six zones, 12 major roads were studied where plantation program has been undertaken. Map 1.2 is showing the study area of major roads where plantation is done on both side of the roads as well as the medians. Table 1.1 is showing the length and names of the studies roads and the selected study zones. Total 39.49 km median from 47.9 km length of the road is studied where plantation has been done in the study area. Under the beautification program unpaved parts of the road, footpaths and medians are being covered with decorative plants, grasses and trees.

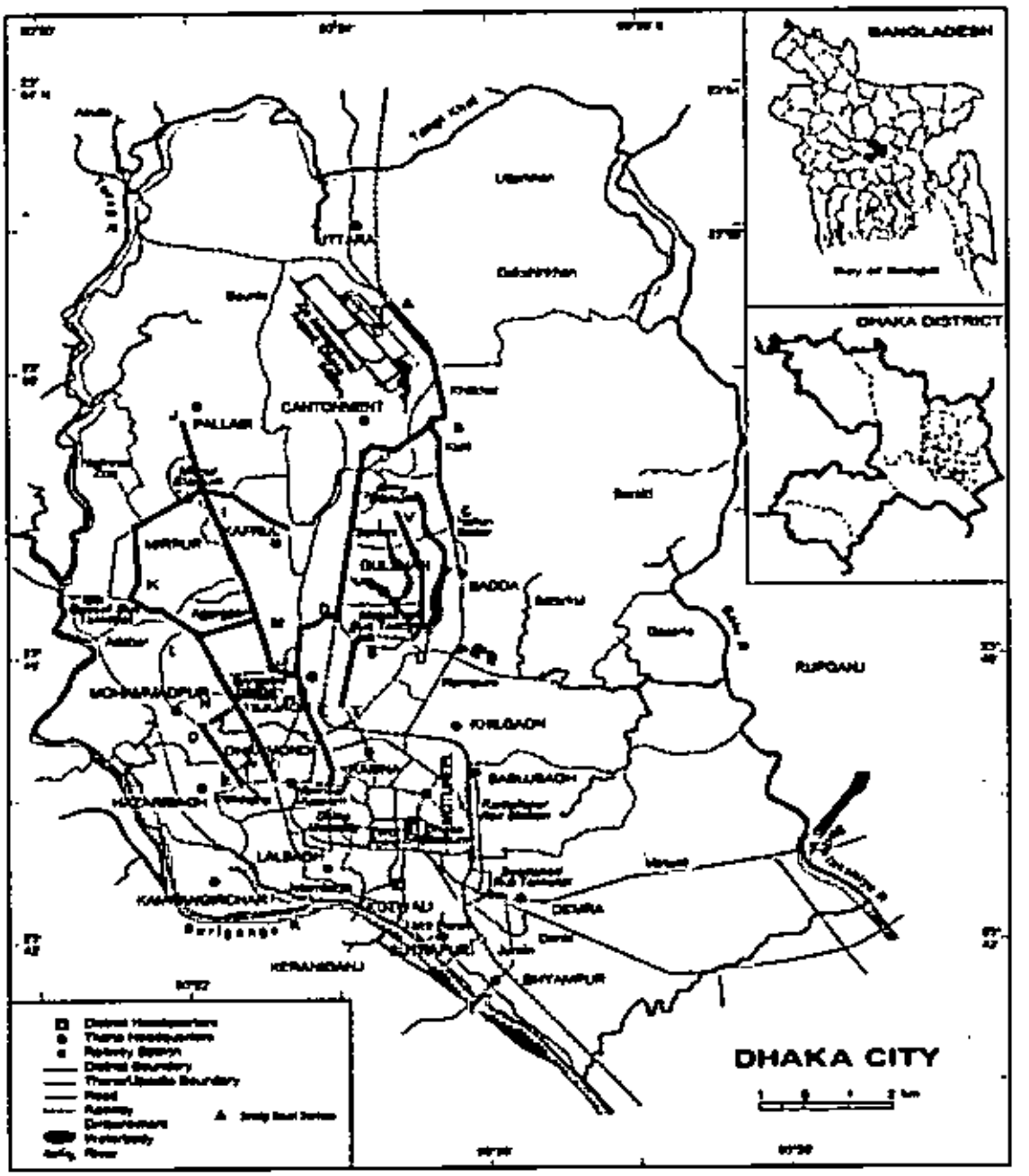
Table 1.1: Study roads at a glance

Zone Name	Name of the Major Roads	Name of Part of the Studied Road	Length (km)	Total length (Km)
Zone 5	Mirpur Road	1)Nilkhet to Manik Mia Avenue	3.90	6.16
	Satmosjid Road	1) BDR 8 No Gate to Dhanmondhi 27 No.	1.74	
	Kaji Najrul Islam Avenue	1) SAARC Foara to Shabag.	1.31	
Zone 6	Panthapath	1)Rasel Square to Sonargaon Hotel	1.66	7.25
	Manik Mia Avenue	1)Manik Mia Avenue	0.91	
	Mirpur Road	1) Manik Mia Avenue to Gana Vhaban	.73	
	Bijoy Sarani	Porjoton Office to China Maitri	1.15	
	New Airport road	Jahangir Gate to SAARC Foara	2.86	
Zone 7	Rokeya Sarani and Mirpur Road	1)China Maitri Conference to Mirpur 10 No 2) Gana Vhaban to Technical Training Centre to Mirpur 1 No.	4 27 4.87	9.12
Zone 8	Mirpur Road	1) Mirpur 1 to 10 No. Bus Stand to Mirpur 14 No. 2) Mirpur 10 No. to Mirpur 12 No.	4.00 2.53	6.53
Zone 9	Mymensing Road	1) Banani Rail Crossing to Mohakhali Rail crossing	2.16	10.9
	New Airport Road	1) Mohakhali Rail Crossing to Zahangir Gate	1	
	Tajuddin Ahmed Sarani	1) Tejgaon Sat Rasta to Nabisco	1.59	
	Progoti Sarani	1) American Embassy to Mymensing Road	2.70	
	Gulshan Avenue	1) Shooting Club to Pakistan Embassy.	3.45	
Zone 10	Mymensing Road	1) Zia International Airport to Banani Rail Crossing	7.33	7.33

Source: Field Survey, 2006



Map 1.1: Dhaka City Corporation area (Zone Wise)
Source: www.sdnpd.org



Map 1.2: Study road in Dhaka city

Source: Dhaka City Map 2000, Capital of Bangladesh

1.6.2 Data collection

To conduct the study information were collected from the followings two sources:

Secondary source

Information regarding road side tree plantation program under taken by DCC and FD in Dhaka city were collected from various secondary source. Published or unpublished reports, studies, news papers, web address were reviewed with a view to understand the existing tree plantation program, condition and management system by government and different non government organization.

Information regarding the roadside tree plantation project undertaken by DCC and FD, their planning and management status and historical background are collected from different cell and administrative zonal offices of DCC and FD.

Primary data

Primary data collection was done by physical observation survey in the study areas and interview was conducted with professional and experts involved with the issue. In this study; three steps were followed to collect detail information about present plantation program and management aspects in Dhaka city. Steps are described bellow:

1. Survey / interviews of professional groups /experts.
2. Survey of organizations related to plantation.
3. Physical observation survey

A questionnaire survey was conducted (Appendix B) with 40 professionals, i.e., urban planners, architects and horticulture experts. In addition, 20 people from different professions are interviewed to get idea about the present status of plantation and their importance in urban area. (Appendix C).

Survey of organizations related to present plantation program (Dhaka City Beautification Project) was done through visiting different private organizations like ARKEY Group of Company, Advance Add, Kohinoor Co. (BD) Ltd., IBN SINA Trust, Grameen Phone Ltd., Lab Aid, Bangladesh Navy, Eastern Housing Ltd., Daffodil International University, Roads and Highways Department. From the survey, the existing plan and program and role of those organizations have been identified.

Naturalistic physical observation survey has been carried out to collect information about types of plantation, number of plantation, plantation design in 11 major roads from 6 zones in Dhaka City.

Microsoft Office Excel 2003, Photo Impression- 3 were used for the processing and analysis of the survey data. Google Earth is used to obtain the actual road length of the study area. The data were presented in tabular and graphical forms, keeping in view the objectives of the research study by using Microsoft Office Excel 2003.

URBAN FORESTRY MANAGEMENT

2.1. Introduction

World wide urbanization trend is a threat to forestry and as a consequence urban environment is degrading day by day. The total environmental condition of the urban area now greatly depends on the existence urban trees, plants herbs and shrubs. In this context, today urban tree plantation has become an obligatory responsibility for reducing deforestation and improving environment. Urban forestry is one of the parts of social forestry practice. Social forestry is a great instrument for reducing the deforestation level of natural forest. There is no clear definition of social forestry. According to Rao (1987), social forestry practice include ; planting shelterbelts , planting along roadside and railways lines , planting woodlots on the farm , planting of tress in urban areas etc.

2.2. Definition of urban forestry

Urban forestry is the specialized branch of social forestry. According to Sattar 2000, it is the management of the plantation in and around the city or town areas, many different environments, such as park , street , residential place , industrial and commercial zones , parking lot , community centre like school, collage , mosque, temple, church rest house, memorial place, etc. are included in urban forestry. The society of American Foresters defined urban forestry as the cultivation and management of trees for their contribution to the physiological, sociological and economic well being of the urban society. Therefore we can say that the urban forest consists of the tree in and around the cities we live.

Urban forestry is the large expanse of trees growing along the streets and streams, in parks and natural areas, neighborhoods and residential areas. Many urban foresters in industrialized countries use the terms "urban greening" and "urban forestry" inter changeably (Kuchelmeister, 2000). The broadest definitions regard urban forestry as the entire forest area influenced by the urban population. In a more restricted sense, urban forestry relates to trees and woodland in towns and cities: garden and farm trees, street and park trees, remaining woodlands and emerging woodlands on vacant and neglected land (Kuchelmeister, 2000). In industrialized countries, urban forestry has focused on amenities and environmental benefits. In the developing countries the role of urban forestry must be to assist in fulfilling basic necessities. Multiple resource management can be achieved by this

program (Kuchelmeister and Braatz, 1993). In developing countries urban forestry is still in its infancy and is strongly oriented towards the style of industrialized countries (Tiwari, 1985). Urban forestry is a combination of arboriculture, ornamental horticulture and forest management. It is closely related to landscape architecture and park management and must be done in consultation with professionals in these fields as well as with city planners (FAO, 1993).Urban forestry includes activities carried out in the city center, suburban areas and urban fringe. Forestry activities can differ significantly according to the zone, in central areas, the potential for significant new urban forestry efforts are relatively limited in most cities (Kuchelmeister and Braatz, 1993). Rao defined urban forestry as.....raising of tree crops in urban areas a forest or for amenity planting to prevent and minimize pollution (Rao, 1987).

According to Nowak (2000), urban forestry is the care and management of tree populations in urban settings for the purpose of improving the urban environment. Urban forestry advocates the role of trees as a critical part of the urban infrastructure. Urban foresters plant and maintain trees, support appropriate tree and forest preservation, conduct research and promote the many benefits trees provide. Urban forestry is practiced by municipal and commercial arborists, municipal and utility foresters, environmental policymakers, city planners, consultants, educators, researchers and community activists.

2.3. Scope of urban forestry

Urban forestry has a very wide scope. It requires contribution from various fields of studies like environmental planning, urban design and planning, horticulture, arboriculture and so on. Urban forestry includes the creation of avenues, shelterbelts, parks, camping sites, wildlife parks etc.

2.3.1 Avenue

Plantation is usually raised along roads in urban areas. This helps in establishment of a green belt and adds to aesthetic value. Tree area also raised along tragic round about and tragic islands. Most of the trees species raised in such avenues have an ornamental and aesthetic value.

2.3.2 Urban park

Urban recreational parks provide a source of recreation to the city dwellers. It can help the city to keep the clean air by offering a green zone. These parks with wide verities of trees and greenery work as lung for entire city. These breathing spaces have both environmental and social benefits.

2.3.3 Industrial shelterbelts

Plantations are raised around industries, so of the act as buffers belt between the industrial complex and other urban areas. It provides a sense of demarcation between conflicting land use.

2.3.4 Urban campsites

Special areas have been set aside for serving as urban campsites in almost all modern well planed cities. Such areas are planted with the tress species of ornamental and aesthetic value (Negi, 1986). Campsites serve the camping ground for tourist which act as a recreational site. It also acts as a green belt in a city.

2.3.5 Wilderness trails

The idea of wilderness trails was developed for the first time in the U.S.A, wilderness trails are the forest areas which are set aside exclusively for conservation and recreation purposes. Such areas are usually selected in the vicinity of urban centers. so that the city people may visit them and derive maximum benefit (Negi, 1986). Wilderness trail provide a recreational spot for city dwellers and also help in conserving natures and natural resources

2.4 Roadside tree plantation

The roadside tree plantation or avenue planting is as old as the Vedic period (Tiwari and Sing, 1984). The Mughals concentrated on the creation of oasis around mosques at intervals of about 5 kilometers. The Marathas also took up the construction of roads and planting or trees along them (Sagreiya, 1949). It was however, with the establishment of British rule that the systematic opening of the country side with the roads was taken up. In the beginning, emphasis was laid on the construction of road to improve the communication in the country side and it was during the latter half of the nineteenth century that road side avenue planting was taken up in earnest with the primary objective of providing much

needed shade to the travelers, particularly during the summer month (Tewari and Sing, 1984).

Trees were planted along the roads mainly to provide shade and shelter to the traveller. Avenue planting is aimed at public comfort rather than economic returns. Particularly in states where the area under forests and consequently the forest revenue are very small, the acute shortage of forest products provide support to the view point that the strip plantations along roads should be managed primarily to meet the requirement of the local people and industries for various forest products and the consideration of comfort to the travelers and aesthetics should receive only a secondary consideration.

The road side plantations are required to meet two main objectives , such as, the provision of comfort to travelers using the road , and in addition , maximization of the production of tree products needed by society (Tiwari and Sing, 1984).

2.5 Benefit of roadside tree plantation

Trees are important part of the natural life system, and they have a vital role in sustainability of town and cities. Urban forest improves the quality of urban life in many ways. Multipurpose urban forestry is especially important for the urban life. The benefit of trees in an urban area can be grouped into social, community, environmental and economic categories.

2.5.1 Social benefits of urban areas

Aesthetic benefit

- It is the aesthetic and recreational value of trees, forest and parks that is most directly identified by most urban dwellers, in developed and developing countries. Trees fulfill certain psychological, social and cultural needs of the urban dwellers.
- The main aim of roadside plantation is the provision of comfort to the travelers.
- In the present age of automobiles, planting of tree groves to provide shade and good environment at some selected places where the travelers may stop and rest is also necessary. Roadside plantation provides shade and maintains the aesthetics of the roads.

- If the species selected produce colored flowers and are of good foliage, they add to the beauty of the road. This sort of planning is called bio-aesthetic planning (Rao, 1987).
- It provides architectural and engineering functions which screen out unwanted views, creates privacy, and gives a space and sense of place.
- Trees are beautiful. They soften the hard edges of buildings and streets, making the city a more pleasant place to be for residents and tourists alike.

Individual and community value

- The individual and community health benefits include the development of stronger neighborhood ties and sense of community, reduced rates of crime and violence, and increased recreational opportunities. In addition, contact with nature has been shown to have positive physiological and psychological effects on people, including decreasing stress, restoring mental energy and reducing the recovery time from illness (Davey, 2004).
- It provides shade to the pedestrians, school going children, working labors.
- Encourage pedestrian movement in the community which enhances scope of interaction among the residents.

Urban trees are also good for people's psyches

- Hospital patients recover faster when they have a view of trees. Big, strong, old trees have a reassuring sense of endurance. Studies have shown that brief encounters with nature can improve people's capacity to concentrate. Another study found that people who saw nature regularly during their work day reported higher job and life satisfaction and less illness than those who didn't (Davey, 2004).

2.5.2 Environmental benefit

Trees alters the environment by moderating climate, improving air quality, conserving water and harboring wild life; all of which increase the quality of life for residents for the community.

Oxygen production

One acre of tree can produce enough oxygen to keep 18 people alive. For every ton new wood produced, about 1.3 tons of oxygen is released a large tree can produce enough air for two people for one year (Davey, 2004).

Carbon dioxide reduction

A healthy tree can use about 500 pounds of carbon dioxide per year. For every ton of wood produced, about 1.8 tones of carbon dioxide are removed from the air. A large tree will store the same amount of carbon dioxide as is released by three cars driven 15000 mile (Davey, 2004).

Cleaning the Air

One of the major problems in urban areas is poor air quality. Plants help remove pollutants from the air in three ways: absorption by the leaves or the soil surface, deposits of particulates on leaf surface, and fallout of particulates on the leeward (downwind) side of the vegetation because of the slowing of movement. Trees also bring pollutants such as ozone, carbon, monoxide and sulfur dioxide.

Cooling in summer

Three deciduous trees can cut air conditioning costs 10 percent. A large tree has the cooling capacity of 15 room air conditioners (Davey, 2004).

Modifying Temperature Extremes

Trees, bushes and other vegetation help to control temperature extremes in urban environments by modifying solar radiation.

Noise Reduction

Noise is often referred to as an invisible pollution. Excessive noise levels contribute to both physical and psychological damage. Tree can help both by absorbing and dissolving noise such as that produced by the heavy vehicular traffic, which characterizes urban areas. Each 100-foot width of tree can absorb six to eight decibels of sound intensity (Davey, 2004).

Air Movement Wind Protection

Tree reduces air movement and be use as shelter belts in most critical areas where it causes discomfort and occasional loss of life and property. Choice of right type of tree species is important in windbreak efficiency in urban areas.

From the above discussion, some of the major contributions of trees for the environment can be summarized as follows:

- Lowering the atmospheric temperature
- Clearing the bad odors and undesirable gases by absorbing them through their leaves,
- Minimizing the intensity of sound
- Minimizing the velocity of wind and absorbing of neutralizing many green house gases,
- Providing shelter to the population of birds and many small animals.

2.5.3 Economic benefit of roadside tree plantation

The economic benefits of trees can be both direct and indirect. Direct economic benefits are usually associated with energy costs. And indirect economic benefits are available to the community or region.

Meeting resources – combat poverty

Food from trees in roadside tree and private agro forestry gardens or allocated plots in public gardens can contribute significantly to food security in developing countries. Road side tree plantation can fulfill the necessity of fuel wood, timber and other economic products nearer home.

Trees increase real estate values

Trees increase real estate value of both commercial and residential property. Property value of landscaped area is higher than those of non landscaped area.

Employment opportunities include

Roadside tree plantation provides employment opportunity in a city. Employment opportunity includes:

- Cities and municipalities
- Governmental agencies (county, state and federal)
- Arboricultural service companies
- Real estate developers
- Utility companies
- Private land estates
- Colleges and universities
- Research institutes
- Private organization

Possible jobs include City Corporation and municipalities and different private and governmental office directing private and government-fund.

2.6 Management of road side plantation

Urban forestry needs multiple management approach. It thus necessitates appropriate planning before embarking upon an urban forestry program. The goals based on the local needs have to be determined in the planning phase. A management plan should be developed by involving all the concerned agencies and owners of the lands. It has to be designed in such a way that it should serve to sustain psychological health for human perception as well as to maintain wholesome environment (Zabala, 1991).

The primary objective of urban forest management is to maintain the health dynamism of the vegetation without excessive interference from the city dwellers. Urban forest management has three fundamental among other needs, as follows;

2.6.1 Tree Planting ,

2.6.2 Maintenance and

2.6.3 Removal.

2.6.1 Tree planting

Planting of trees is the primary need in the management of urban forest. The following are the factors, which should be considered for urban planting of trees.

Species – site selection

The urban site is complex environment where soil, temperature, moisture availability, pollutants, etc. vary from one place to another. The environmental condition in the city streets is quite different from that of residential area. The species, therefore, selected for planting at a given site must be adapted to it. Urban forestry site includes open space, park, roadside, water reservoir, homestead backyard etc. consider those sites. and species selection is very important factor in an urban area.

Species composition

Single species may cause problem of mortality due to insect attack and disease infection. Monoculture also gives monotonous scenery. Thus diversification of species is needed. As a general rule, the species composition promotes species diversification by restricting a

species to no more than 15 % of the population. Diversification is thus needed where several species of different shapes, color, ages, and sizes are used. It is easier to control insect and pest rather using only one species.

Spacing of trees

Spacing of trees should be determined by local conditions, species, and plant height, spread from use. Screen and windbreak planting require close spacing. Street trees are more precise and require different type of planting as regards to availability of space, potential interference with curbs, side works, driveways, overhead wires, underground facilities, traffic signals, etc. the form of tree and spacing should be given primary concern.

In the case of Shrubs flower distance of 1 to 2 feet should be needed. And trees flower species need 20 to 40 feet gap (Hossain, 2005).

Design of planting

In the urban areas, the street corridors deserve special attention for design. The ideal street corridor is scientifically engineered and artistically form of expanding and contrasting spaces in which adequate variety exists. Motorists and pedestrians should move safely and freely through corridor, enjoying a streetscape designed to keep them relaxed, happy and alert. The designs of roadside planting systems can be categorized in to the following types:

1. Balanced line
2. Unbalanced continuous line
3. Unbalanced discontinuous line
4. Sporadic system
5. Parkway system.

Of those first two are most widely practiced. The balance line system producing a continuous green wall of uniform size trees as in the case of long stretches of eucalyptus avenue is not aesthetically desirable. Unbalanced continuous line produced as a result of alternation a venues of different species interspersed by ornamental trees should be more desirable. The avenues should be so planned as also to keep out of sight ugly spots, slaughter houses, severely eroded areas and the like. At some selected spots the parking system of planting may be adopted to develop picnic spots or resting places for the travelers.

Selection of species

Availability of space is the most critical factors in selecting tree species in the cities since it is limited by buildings, overhead wires, curbs , etc. so , trees species have to be selected considering the available space when these will mature. For roadside and avenue plantation, flowering trees of different colors may be selected. Experts suggested some of the following tree the species, which may be used in the urban forestry program in Bangladesh. (Sattar, 2000, Haque 2003; and Sharma 1980 ;)

Table 2.1: Roadside and avenue planting for beautification

Local name	Scientific name	Local name	Scientific name
Ashok	*Saraca Asoca*	Kesia Nodsoa	*Kesia Nodsoa Buch-Ham*
Akashmony	*Acacia Auricoliformis*	Krishnachura	*Delonix Regia Raf.*
Acacia	*Acacia Monoliformis*	Mahagini	*Switetenia Mahagoni Linn*
Albizzia	*Albizia Richardiana King and Pram*	Mohua	*Madhuka Latifolia Roxb*
Ban Pui	*Bauhimia Alba*	Minjiri	*Cassia Siamea*
Bakphul	*Sesbenia Grandiflora*	Nageshsar	*Mesua Ferrea*
Belati Jhau	*Casuarina Equisetifolia Forst*	Neem	*Azadirachta Indica*
Bakul	*Mimsops Elengi Linn.*	Peltuforam	*Peltophorum Inerme (Roxb) Lanos*
Barun	*Cratavea Religiosa*	Pink Showeer	*Cassia Nodosa*
Cashew nut	*Anacardium Occidentale*	Porsa	*Thespesia Populea*
Champa	*Michelia Champaka Linn*	Polash	*Butea Monosperma*
Debdaru	*Polyalthia Longifolia*	Raj Korai	*Albizia Richarddiana*
Dakshini Babul	*Pithecolobium Dulce Benth*	Rain Tree	*Enterolobium Saman Prain*
Eucalyptus	*Eucalyptus Camaldulensis*	Royal Palm	*Roystonea Regia O. F*
Goldmohur	*Peltophorum Pterocarpum*	Segun	*Tectona Grandis Linn*
Gamari	*Gmelina Arborea Linn*	Shetkanchan	*Bauhinia Veriegata*
Jacaranda	*Jacaranda Ovalifolia*	Shishu	*Dalbergia Sissoo Roxb*
Jarul	*Lagerstroemia*	Sonalu	*Cassia Fistula*
Kanjail	*Bischofia Javanica*	Telshur	*Hopea Odorota Rox*
Korai	*Albizia Procera*		

2.6.2 Maintenance of trees

One of the primary concerns of urban forest management is to maintain the health, vigor and compatibility of vegetation with the environment. It involves all practice of tree watering, pruning, control of growth, damage, insect and disease from the time of planting to removal. Those practices can minimize the urban tree loss. For trees, proper care can enhance life span, health and strength.

Tree watering

The watering needs of trees vary according to the type of the species, soil type, site drainage and rainfall. A general rule is to apply one gallon of water for every square foot of surface area under the tree drip line. Every day tree watering is the essential work for urban forest management. Here are some tips for tree watering in urban areas.

- Soak the total area around the trees / shrubs to help it develop a healthy root system. Water around the tree's drip-line (an imaginary line extending from the outermost branch tips straight down to the ground), rather than just around the trunk.
- During drought conditions, the soil may first sepal the water. Water lightly several times on the first day until the soil will accept the water. Then saturate the total area, applying sufficient water so that the soil is quite moist to a depth of at least 30 cm (12 to 16 in) of soil.
- Avoid constantly soggy condition because tree roots require oxygen to live. Instead of watering often, water generously in one application. Once saturated, let the area dry for at least a week before watering again.
- Newly planted trees should be watered once a day during a drought and half as often during normal conditions. Organic wood mulch helps to keep the roots cool and moist.
- The best time to water a tree is early morning or evening.
- Unless adequate rainfall occurs, new trees should be watered from early spring until the leaves drop off in the fall. During normal dry times, once a week is adequate. If the afternoon temperatures are extreme, try twice a week. Be careful not to over water, tree roots need some breathing time.
- Unless adequate rainfall occurs, new trees should be watered from early spring until the leaves drop off in the fall. During normal dry times, once a week is adequate. If

the afternoon temperatures are extreme, try twice a week. Be careful not to over water, tree roots need some breathing time.

Pruning of Trees

Trees are pruned to remove dead and unproductive branches, to control to make trees structurally safe and balanced. The following tips will help accomplish this objective without causing undue harm of tree.

- Chose the right time to prune trees.
- Keep the pruning tools sharp and clean.
- Prune diseased trees with special care, disinfecting the tools with bleach hydrate between cuts to reduce the risk of spreading disease organisms.
- Remove all dead and dying limbs.

2.6.3 Growth control

The objectives of growth control are to retard or redirect and accelerate growth of trees. The first objectives may be achieved by pruning and application of growth retardant chemicals. The second one can be met by fertilization, irrigation and control of competing vegetation.

Pest and Disease

The insects and disease that attack that attack the forest tress are also those which attack urban tress as well. The urban trees are generally high valued, and as such pest control is aimed at single tree, rather than simultaneous treatment of all trees as practiced in the forest plantations. There are three types of control method are used for insect attack, such as biological, mechanical and chemical control. For selecting the insecticides, attention must be given to city animals and human beings.

Tree disease may be grouped as infectious and non-infectious. Infectious diseases are caused by living organisms, i.e. fungi, bacteria and virus, and can be transmitted from one tree to another. Non – infectious disease is caused by non-living factors and is not transmittable. These include unfavorable weather condition, soil nutrient deficiency, chemical injury and mechanical damage. The cause of many tree diseases cannot be diagnosed apparently. It needs thorough observation of physical conditions around the tree and background

information about the tree and its problem. Disease control is thus complicated requiring professional expertise for its effective treatment.

Removal

The purpose of removal of trees from urban forests is to reduce the risk of injury to people and damage to property as well as to clean the surroundings of unsightly debris. Dead trees, hazardous trees, over crowded trees, pruning debris, storm debris, stumps and leaves must be removed. Debris and leaves need to be collected when these fall in the roads, sidewalks , residential lawns, etc. in the plantations. These are not necessarily taken out as they add to the fertility of the soil once decomposed.

2.7 Urban environment management through roadside tree plantation

The urban environment is complex. It is characterized by predominance of concrete structures, such as building, road, post, and stone, asphalt and metal. These materials absorb and reradiate heat easily. The materials have also high reflective power for light and sound (Sattar, 2000).

Trees alter the environment in which we live by moderating climate, improving air quality, conserving water and harboring wildlife. Trees have significant impact on micro climate. By obstructing sun rays it can reduce temperature in a particular site. Radiant energy from the sun is absorbed or deflected by leaves on deciduous trees in the summer and is only filtered by branches of deciduous trees in winter. Environmental benefit through roadside plantation is discussed below:

2.7.1 Reduction of air pollution

One of the major problems in the urban areas is air pollution. Metabolic and industrial activities in the cities produce a great amount of heat and dust. The air thus becomes filled with carbon dioxide, carbon monoxide, sulpher dioxide and many other pollutants and dust. As a result, the climate of a large city is affected adversely resulting in higher temperature and lower humidity. The sunlight is often partially covered by haze, smoke or even fog induced by emission.

Air quality can be improved through the use of trees, shrubs and turf. Leaves filter the air we breathe by removing dust and other particulates. Rain washes the pollutants to the ground.

Leaves absorb carbon dioxide from the air to form carbohydrates that are used in the plants structure and function. In this process, leaves also absorb other air pollutants such as ozone, carbon monoxide, and sulfur dioxide, and give off oxygen.

Trees have proven beneficial effects of reducing air pollution by fixing some toxic substances and cleansing atmosphere. The leaves of trees have large surface area and act as filters for dust through sedimentation. Particles are usually deposited on the upper surface of the leaves. The rougher and smaller the size of the dust particles the more chances it has being retained in the rougher and broader surface of leaves and other parts of a plant (Grey and Deneke 1978). Trees can reduce gaseous air pollutants by 5 percent in the urban environment. Trees are considered an important part of cleaner air in urban areas.Large healthy trees greater than 75 cm in trunk diameter remove approximately 70 times more air pollution annually (1.4 kg/yr) than small healthy trees less than 10 cm in diameter (0.02 kg/yr), (Nowak, 2000).

2.7.2 Reduction of sound pollution

Loud and unpleasant sound is noise. It is often referred to as invisible pollution. It involves both physical effects with transmission of sound waves though the air, while the psychological effect is the human response to sound. Noise can be reduced in intensity through absorption by the leaves, branches and twigs of trees, and thus reduce the vibration, reflect ability and resonance of sound produced in immediate environment. Absorption occurs when trees receive sound wave and entrap them, converting the sound energy into eventually heat energy. Porous materials like leaves can absorb up to 95 % of the sound energy (Cook and Haverbeke, 1971). A well managed urban forest can thus calm sound and reduce sound pollution significantly.

Beeping horn of the vehicles generates sound, which may be harmful to the health of those living near the road; sound levels above 50 decibels may be irritable and those in excess of 130 decibels may become harmful to human beings. Trees and shrubs can be effectively used as a noise –reducing medium; each 30 m width of trees can absorb about 6 to 8 decibels of sound intensity. The effectiveness of a belt of trees and shrubs as noise – reducing medium depends upon the height of the tree, width and overall density of planting and foliage distribution. The width of the belt of trees being limited by the space available for the purpose, the trees and shrub producing denser belts will prove more effective in noise

abatement. To reduce the noise generated by high speed traffic on national highways to tolerable limits, about 20 to 30 m wide belts of trees and shrubs may be necessary. To reduce the noise generated by moderate speed car traffic in the cities, 7 to 15 m wide belts of trees and shrubs may be required.

2.7.3 Amelioration of climate

The major elements of climate are air temperature, humidity and air movement. Human comfort is directly related to these elements. The vegetation can contribute to provide some comfort is directly related to these elements. The vegetation can contribute to provide some comfort by amelioration the climate.

Oxygen Production

One acre of trees can produce enough oxygen to keep 18 people alive. For every ton of new wood produced. about 1.3 tons of oxygen is released. A large tree can produce enough air for two people for one year.

Carbon Dioxide Reduction

A healthy tree can use about 500 pounds of carbon dioxide per year. For every ton of wood produced, about 1.8 tons of carbon dioxide is removed from the air. A large tree will store the same amount of carbon dioxide as is released by three cars driven 15,000 miles.

Air Temperature

The urban climate is usually drier and warmer than the surrounding rural areas because of more solar radiation absorbed by concrete, metal, asphalt and others. Besides, the fumes from the engines and heat generated by vehicles contribute to the warmer condition in the cities. Temperature in the vicinity of trees is cooler than that away from trees. Larger the tree, greater the cooling. By using trees, heat can be moderated in the city

Tree ameliorates air temperature in urban environment by controlling solar radiation. The leaves of trees intercept, reflect, absorb and transmit solar radiation. The effectiveness of this process depends upon the tree density of species, foliage, leave shape and branching Pattern. During the sunny days, trees intercept solar radiation, and through evapotranspiration, they lower the temperature. It is found that a medium size isolated tree can be transpired about 400 liters of water per day (Kramer and Kozlowki, 1970). This may be compared to five

average room air conditioners each with a capacity of 2500 kcal / hr running 20 hours a day (Federer, 1971). A large tree has the cooling capacity of 15 rooms. And also a Large shade trees can reduce local ambient temperatures by 3°C to 5°C (Nowak, 2000).Thus is why trees are called nature's air conditioners.

2.7.4 Air Movement and Wind Protection

Like temperature and relative humidity, air movement or wind affects human comforts as well. It can increase evaporative cooling during the day. As mentioned earlier, trees screen sunlight and transpire moisture which lowers down the temperature (Islam, Hoq and Hossain, 2000).

Trees reduce air movement and may be used as shelter belts in most critical areas where it causes discomfort and occasional loss of life and property. Windbreaks perpendicular to prevailing winds may reduce wind two to five times the height of the tallest trees in front of the barrier and for distance of 30 to 40 times on the leeward sides (Grey and Deneke, 1974). The choice of the right types of tree species is important in windbreak efficiency in urban areas. Trees with dense foliage should be selected in the north and west sides where protection from winter wind is desired. Deciduous species are preferred on the south and east. As they protect against hot and dry wind during the summer and allow incoming solar radiation during the winter.

PLANNING AND MANAGEMENT OF URBAN FORESTRY IN BANGLADESH: EXPERIENCE IN DHAKA CITY

3.1 Introduction

Bangladesh has relatively high rainfall patterns and warm temperatures, which offers favorable climatic conditions for the growth of trees, both natural and planted. But unfortunately, destruction of forest in Bangladesh is a normal practice. The main cause of destruction is rapid urbanization. In the 1980s, in Bangladesh, the rate of destruction was 8000 hectares per year. But survey conducted by FAO in 1990, showed that this rate has grown up to 37,700 hectors per year (Pandy, 1995). A document of a multilateral development bank reckoned the annual deforestation rate at 3.3 (however the Bangladesh Forest Department does not agree with these figures), (Huda and Roy 2000).

The actual forest in Bangladesh is based on approximate estimation and the figure is different. A report of USAID states the forest cover in Bangladesh is 1 million ha or only 6 percent of the total land area, (WRI and CDIE, 1990). This estimation doesn't match with the government estimation. According to the BBS (2005), data the forest area of Bangladesh is increasing over the years. Table 3.1 shows the forest areas of Bangladesh in different years.

Table 3.1: Forest area of Bangladesh by different years

Year	Forest Area (% of total area)
1975-76	15.48
1981-82	17.32
1986-87	13.40
1989-90	12.60
1993-94	13.16
1995-96	13.60
2001-02	13 36
2002-03	17.08
2.003-04	18.0

Source: BBS (2005) and Rahman & et. al (2001).

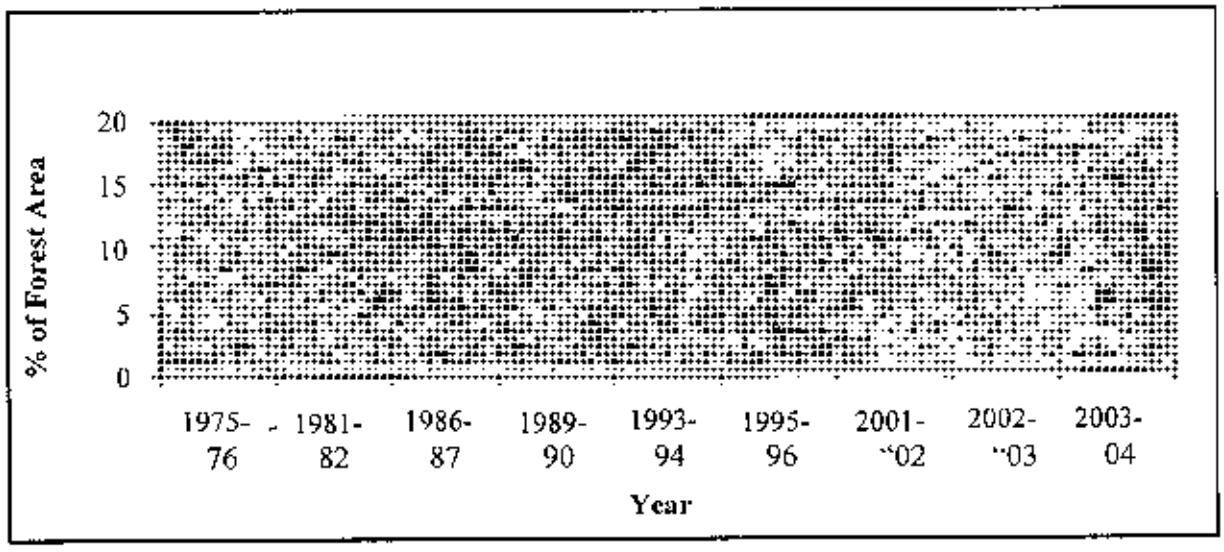


Figure 3.1: Forest areas coverage in Bangladesh (1975-2004)

Source: ibid

3.2 Historical background of forest management in Bangladesh

3.2.1 Forest management in ancient India

The history of forest management in Bangladesh is an integral part of the facts that prevailed in India, since 1947. It comprises the history in East Pakistan, and after 1971, that of the independent nation of Bangladesh. (Farooque, 1997)

The history of forestry in ancient India is perhaps, more of deforestation of destruction caused by human agencies and the natural phenomena. For long, no state control over the forests existed in Indian subcontinent and any person could utilize the same according to needs. The changes came with the advent of rulers from outside India.

During the Mauryan period, the forests came under the supervision of the state more effectively and a number of rules were framed. Later, the forests of India were perceived in terms of eight forest divisions covering huge areas including north and south of Bengal. The first regular constituted forest department was introduced by the Mauryan at that time.

From 14th century to middle of 19th century, different parts of Indian forests were exploited by the British ruler. At that time forest were shrunk by the extension of agriculture. The Sunderbans forest alone shrank by about 1000 sq.miles.

Attempts to raise plantations in Bangladesh started in 1872-73 with Teak (*Teetona Grandis)* but remained confined to the Chittagong hill tracts until 1920. In 1921, plantations were extended to Cox's bazaar and Sylhet divisions (Farooque, 1997). In 1872-73, there were five forest divisions under the conservator of forest in Bengal, namely Coachbiahar division, Assam division, Dacca division, Chittagong division and Bhagalpur division.

With effect from 16th November 1927, the Bengal forest circle was divided into two circles, namely, northern and southern circles. The southern circle included; Sunderbans, Chittagong, Chittagong hill tracts; Coxe's bazaar, Dhaka-Mymensing. In the year 1937, a permanent working plan was established. Since the partition of India in 1947, the Forest Department (FD) as part of government of Pakistan and after that in 1971, as part of the Bangladesh government has been preparing and executing management and working plans

With the partition of India in 1947, the forest resources of Pakistan were very poor About 5 % of the total land surface of Pakistan was under forest in the 1950s which was one of the lowest. In the then East Pakistan the coverage was 16 % of her land surface (Farooque, 1997). To overcome the demand and supply, the 'Grow More Tree" campaign was started in 1949. Since then, a "National Tree Plantation Week" has been observed each year in the month of July that continues even today (Farooque, 1997).

3.3 Forest management program and Practice of roadside tree plantation in Bangladesh

3.3.1 Forest extension scheme (phase – *1)*

In 1960, Bangladesh had started forest extension in different zillas In that time different types forest extension schemes (phase-1) had been taken by FD to develop forestry. From 1960 to 1980, forest extension scheme (phase- 1) aimed to provide 2 core 42 lakh trees with less cost/ free cost for the village people

Since 1980, British American Tobacco Bangladesh has been driving its country-wide afforestation program based on the belief that planting trees is the best way of preserving environment balance. More than four and a half crore saplings have been planted as a part of this program over the last 25 years, 90% of these saplings have survived in different parts of the country. BAT Bangladesh has planted (or distributed) saplings of three kinds of plant

species — timber, fruit-bearing and medicinal, in remote areas, road sides, river banks and homesteads of Kushtia, Manikganj, Rangpur. Chittagong and Chittagong Hill Tracts. These have contributed not only in adding beauty but also in preserving environmental balance.

British American Tobacco Bangladesh has been distributing free saplings to different organizations and city dwellers since 1994 with an objective to make a "Greener Dhaka". Every year in rainy season, this company distributes more than one lakh saplings. This initiative covers Chittagong city as well. Besides, saplings are distributed also in major cities like Sylhet, Khulna and Bogra to meet the expectation of the local dwellers.

3.3.2 Forest extension scheme (Phase – 2)

After the independence of Bangladesh, Forest Department (FD) had under taken different types of forest extension schemes. To maintain ecological balance and they had implemented a number of social forestry project. The first community forestry project started in 1979 in Betagi village in Rangunia Thana in southern Chittagong district.

Forest Extension Scheme Phase -2 was started with 4 years duration project (1981-82 to 1984- 85). This project was implemented in 14 districts in Bangladesh. This project covered 1,215 km roads and highways, 145 km railways, 368 council road. 76 km embankment plantation, and 3,180 villages for forestation. This was the first steps to raise and manage roadside tree plantation in Bangladesh through social forestry practices.

3.3.3 Development of community forestry project:

Later, participatory forestry started in Bangladesh in 1981 with the commencement of "Development of Community Forestry Project". The project was implemented in north and north western parts of Bangladesh covering 23 districts (FD, 2004) The main aim of this project is to develop tree resources, involving people through organized benefit- sharing schemes. The forest department tried to plant trees along roadside marginal lands through people's participation, particularly with the help of selected landless farmers from nearby communities. The government also involved some NGOs to raise, maintain, and protect strip plantations along the roads, highways, railways and embankment. Subsequently tow more participatory projects were implemented such as:

1. The Thana Afforestation and Nursery Development Project [ADB Loan No .- 0956 -BAN (SF)]
2. Coastal Greenbelt Project [ADB Loan No – 1353- BAN (SF)]

3.3.4 Extended social forestry project

A participatory forestry project (Bridge Project) captioned Extended Social Forestry Project was implemented by the Govt. of Bangladesh (from 1989-90 to 1994-95) *and Coastal Greenbelt Project* (CGP, 1995-96 to 2001-02). A Government of Bangladesh funded participatory forestry project *(Extended Social Forestry Project)* was implemented during 1995-96 to 1996-97 as a bridge project before taking up another ADB supported project. A considerable area of vacant marginal lands and encroached and degraded forest lands has been brought under tree plantations during implementations of the above mentioned projects. Strip plantations in 35060.0 km have been established in marginal land throughout the country involving poor and landless people as beneficiaries. Woodlot plantations in 25060 hector and Agro forestry Plantations in 6,268 Ha have been established in degraded and encroached forest lands involving 32,000 landless and poor people as beneficiaries. Social forestry training has been imparted to 166,619 beneficiaries and village leaders. The completed plantation and training activities under the different projects is shown in the Table 3.2:

Table 3.2: The completed plantation and training activities under the different projects

Name of the Project and Duration	Types of Plantation (Strip)			
	Roads and Highways (K.M)	Embankment (K.M)	Railways (K.M)	Feeder Road (K.M)
Development of Community Forestry Project (1981-82 To 1986-87)	810.0	406.0	408.0	2664.0
Thana Afforestation and Nursery Development Project (1989-90 to 1994-95)	18180.0			
Extended Social Forestry Project (1995-96 to 2001- 02)	1391.0			2267.0
Coastal Green Belt Project (1995-96 to 2001-02)	804.0	1394.0	34.0	6702.0
Forestry Sector Project (1997 – 98)	6072 0			
Total Strip Plantaion-41132.0 Km				

Source: Forest Department, 2004.

ADB supported Forestry Sector Project (FSP) is being implemented since 1997-98. The ongoing FSP is the major intervention to attain the goals of the National Forest Policy and the twenty year Forestry Sector Master Plan (FSMP).Till 2002-03, the plantation programs achieved under FSP are as follows: Woodlot 7604 ha; Agro forestry 2510 ha; Strip Plantation 9787 Km; Charland 150 ha; Barendra Gully 102 Km; Banks of Ponds/tanks 19 nos.; Buffer Zone plantations 1277 ha and Hill Forest Woodlot 370 ha. .

Recent inventories and estimates generally note that 20 to 30 percent of all plantations established during the last 30 years no longer exist. Officially, the reported total plantation area in the country in 1990 was 332000 ha, of which 113000 ha were in costal regions, 21100 ha in the Sal forest zone and the rest 19800 ha, in the hill forests. Most of the Sal (*Shora Robustaa)* plantations are not – existent and only 122000 ha of other long – rotation plantations are traceable (MoEF, 1993).

3.4 Urban forest management in Dhaka city: historical background

Though the concept of urban forestry is new. but practice of tree plantation along the road side and garden forestry was initiated by the Mughal emperor. During the Mughal periods (1610-1713), many parks and garden were developed. From James Rennell survey in 1764, it was showed that most of the present built up areas of Dhaka were covered by the forest at that time (Islam, 2002). British rulers took some important initiatives for the development of Dhaka city with sufficient greenery in 1830. Patric Gaddes came in Dhaka in 1915 to survey and develop a plan for Dhaka town planning. Gaddes stressed to maintain a substantial portion of area for gardening and park development to create a wholesome city. He suggested to allot 150 acres of land for 7500 people , of which 100 acres should be used for residential purposes and rest 50 acres for educational, recreational (by developing gardens and parks), and infrastructural purposes. At that time he noticed that only 19 acres of parks and gardens were available in Dhaka for its 300 thousand inhabitants. Gaddes proposed additional 1184 acres of lands to be developed for raising gardens and parks in Dhaka (Islam, 2002):

The British rulers took several attempts to develop Dhaka as a beautiful capital city with adequate greenery. In response to their plan, the city beautification work was started in 1908s in true sense (Sharma, 1980 and Islam, 2002). At that time British Horticulturist Robert Luise Proudlock was given assignment to beautify Dhaka. He collected various types

of tropical veritics from different places for Dhaka parks. After that the incomplete work of tree plantation, was completed by his co-worker in 1928 (Sharma, 1980). The park Ramna is a successful outcome of his endeavor. Except Ramna Park, no successful plantation work took place in Dhaka (Islam, 2002).

During Pakistan period, Dhaka City Corporation was established with the birth of Pakistan in 1947. The Dhaka municipality created under the act III of 1864 was entrusted to provide civic services to this little town and small population which included maintenance of roads, conservancy health services, and education etc. After 1947, the Dhaka municipal government suffered from the conflicting demands of political expediency and administrative efficiency. In vie of the critical political situation; City Corporation could not make proper planning for plantation in urban area. During Bangladesh period the "The 1983 ordinance" was made. Its functions includes public health , water supply and drainage, matters related to food and drink, animals, construction and maintenance at roads, street lighting, street watering, public safety, maintenance of parks and gardens and forests, education ,culture etc. In this continuation, Dhaka City Corporation is still working for increasing greenery, through, plantation in the roadside, park and open space. But the concern is, Dhaka city is growing too fast without taking any account of the environmental issues and the facilities of urban amenities to its residents. As its consequence. the huge areas of parks, open spaces are disappearing. Moreover most of the century old tree in Dhaka city are reminiscences of the past efforts, were cut down in the name of development activities. As we know desire level of forestry in Bangladesh is about 25 % where actual figure is 6 % of the total land (USAID, 1990). From this scenario it can be easily understood the catastrophic situation of Dhaka city. According to Islam (2005), it is difficult to measure the quantity of green coverage which should be needed in a city. The minimum 25 % of green coverage should be ensured for any healthy city. For an example, Honkong city has 40% green coverage of their total city area (from interview and Karmaker, 2005).

3.5 Urban plantation program in Dhaka city in 1993 to 2003

Due to rapid urbanization, urban trees are reducing day by day especially in Dhaka city. As a result, urban various environmental problems increased at all levels statistics from the house hold to the regional level global. These problems range from impairment of human health to economic, environmental and other welfare losses. To improve the urban environment, urban forestry is increasingly acknowledged as a development tool in

worldwide. In this context urban forestry has already been started formally in Bangladesh. There are different program for roadside tree plantation in Dhaka city which most of has been completed and one of is going under supervision of Dhaka city corporation. The management and planning of the projects are described bellow:

a) *Nagar Banayan Prokolpo* (City Forestry Project)(1993- 1998 To 1999-2000)
b) Zone Wise Tree Plantation Program (1994 To 2000)
c) *Dhaka Mahanagarir Obokathamo Ebong Poribesh Unnoyan Prokolpo* (Dhaka Metro Infrastructure and Environmental Improvement Project)(2002 To 2003)
d) Dhaka City Beautification Project (2003 to 2008)

Table 3.3: Urban plantation programs in Dhaka City

Name of the Project	Year	Responsible Department	Cost of the Project (Local Currency)
Nagar Banayan Prokolpo	1993- 1998 to 1999-2000	FD	538.58 Lakh
Zonal Wise Tree Plantation Program	1994 to 2000	DCC	----------
Dhaka Mahanagarir Obokathamo Ebong Poribesh Unnoyan Prokolpo	2002 to 2004	DCC	1 Crore 7 Lakh
Dhaka City Beautification Project	2003 to 2008	DCC	150-crore

Source: PP of Nagar Banayan Prokolpo, 1993; DCC, 2006 and FD, 2006.

3.5.1 *Nagar Banayan Prokolpo* (City Forestry Project) (1993- 1998 to 1999-2000)

Location of the Project

Location of the project is metropolitan cities of Dhaka, Chittagong, Rajshahi, Khulna, Barishal and Sylhet including suburb.

Objectives of the project

By forest department, a five years plan project named "*Nagar Banayan Prokolpo*" has been taken. The original project was approved 20 October 1993 and PP (Project Proposal) of the project was approved on 10 March, 1994 by the component authority. Project was proposed to be completed by 1999-2000 .The main objectives of this project were;

a) To plant tree on unutilized and vacant land of metropolitan cities of Bangladesh.

b) To improve environment and beauty of metropolitan city.

c) To beautify the towns, institutions, and flood protection embankment and roadside tree plantation.

d) To distribute low-cost plant among the people.

e) To motivate people to plant trees and to aware people to plan through different publicity works.

The project area included the metropolitan cities of Dhaka, Chittagong, Khulna, Rajshahi, Barishal and Sylhet. The total allocation of that project was about 538.58 lakh taka. Ministry of Environment and Forests is the sponsoring agency of this project. Forest Department was operating and maintaining this project. This project included 237.40 km roadside tree plantation, 24 km embankment plantation, 756 block plantation.

Table 3.4: Indicates the major items of investment

Item	Unit	Physical	Financial (In lakh taka)
Plantation establishment			
Roadside plantation (including maintenance)	km	237.40	99.319
Embankment plantation	Km	24	17.323
Block plantation	Ha	756	228.014
Seedling for distribution	Lakh no.	26.35	82.50
Publicity	LS	-	9.095
Motor cycle	NO	10	7.50
Pay and allowances	Ls	-	45.079
Contingency	Ls	-	49.75
Total	-	-	538.58

Source: PP of Nagar Banyan Prokolpo (1993)

Organizational structure of the project

The MoEF was the sponsoring agency of the project. FD was the executing agency. A conservative officer (CF) was designed as project director who was responsible for overall implementation and supervision of the project.

For Dhaka Division, Organizational Structure is given below

1. Mayor , Dhaka City Corporation , Dhaka.....chairman
2. Chairman, RAJUK.....member
3. Chief Engineer, City Corporation..... ....."
4. Additional Chief Engineer R and H Dept.....
5. Divisional Railway Manager / Additional Chief Engineer Bangladesh Railway

6. Cf, Central Circle
7. DY. Director, Education Directorate
8. Executive Engineer, BWDB
9. Divisional Forest Officer, Dhaka Ext. DI.....Member Secretary

3.5.2: Zone wise tree plantation program in Dhaka city

To increase plantation in Dhaka city, DCC worked zone wise during 1994 to 2000 period. Government had sanction money for different development work including tree plantation in different areas and roads in different zone. Mainly woody trees were planted in this project. Types and numbers of plantation in different zone are shown in table 3.5:

Table 3.5: Yearly plan of tree plantation program of Dhaka city (zone 3)

Serial no.	Year	Plantation no.	Cost (Lakh)	Name of the tree (local name)
1	1994 – 1993	650	1.32	*Mahagini, Bokul, Arjun, Weeping Debdaru ,Segun* etc.
2	1995 – 1996	600	1.41	
3	1998- 1999	750	1.55	
4	1999-2000	6800	19.07	
total		8700	23.35	

Source: DCC zone office -3 (2006)

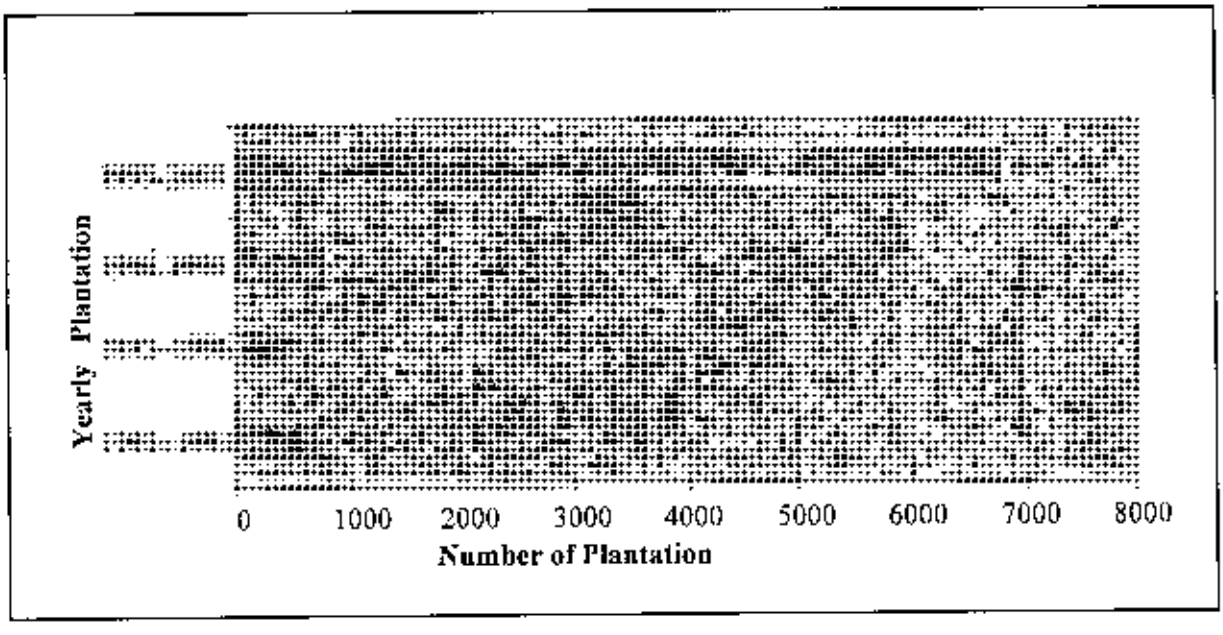


Figure 3.2: Amount of Plantation in Dhaka City –Zone -3

Source: ibid

Table 3.6: Yearly plan of tree plantation program of Dhaka city (zone 10)

Serial no.	Year	No. of Plantation	Cost taka	Name of the tree (Local name)
1	1994 – 1995	578	74927	*Mahagini, Arjun, Aam, Krishnachura, Segun* etc.
2	1995 – 1996	2379	249480	
3	1999-2000	6060	2854082	
4	2000-2001	-----	20000	
Total	-	9017	3198489	

Source: DCC zone office 3 (2005)

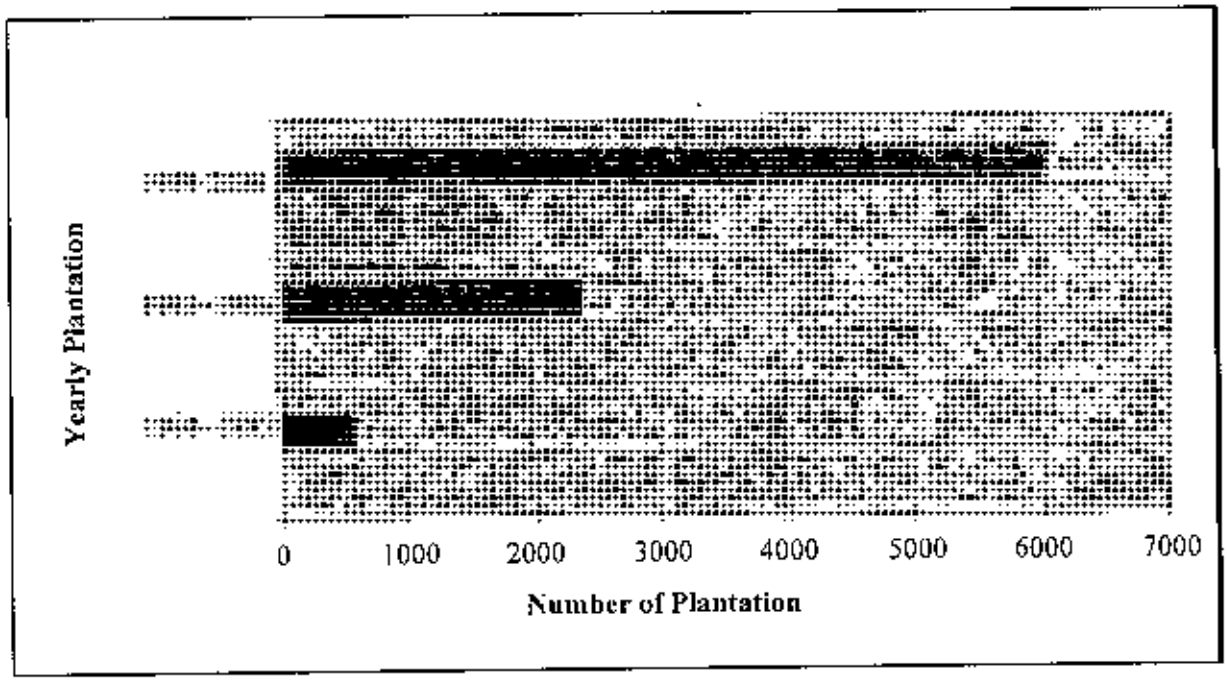


Figure 3.3: Amount of Plantation in Dhaka City (Zone-10)

Source: ibid

From table 3.5 and 3.6, it is found that amount of plantation is higher than previous year. Timber trees like *Arjun, Mahagini, Weeping Debdaru, Segun, Bokul and Babul* were planted in that project. There was no ornamental tree found in this program. This is one of the important finding of the study.

Figure 3.2 and 3.3 shows that the scenario of plantation in Dhaka city in zone 3 and 10 respectively. This program was done by DCC from 1994 to 2000. From this figure it is revealed that plantation trend in Dhaka city is increasing. However there is missing data about how many trees had been cut in the name of development project in Dhaka city during

the same period. But practice of tree plantation in Dhaka city through DCC and FD was continued.

3.5.3. Infrastructure and Environment Improvement Program of Metro Dhaka 2002 to 2004 *(Dhaka Mahanagarir Obokathamo Ebong Poribesh Unnoyan Prokolpo)*

Location of the project

Under the supervision of DCC, three years plan project named "*Dhaka Mohanagarir Obokathamo Ebong Poribesh Unnoyan Prokolpo*" has been done. The main objective of this project was to improve the city environment and to increase the tree plantation in Dhaka city. In this project was undertaken for the period 2002-2004.

In this project 19 areas are selected for plantation. Areas includes , Uttara (Sector 1,3, 4, 6, 7,), Banasri Prokolpo, Goran, Mathertek, Pollobi, Mirpur (12 to 14), Elephant Road, Shajadpur, Mirpur (10 to 2), MP Office, Baridhara, Gulshan, Niketon, Eastern Housing, Dhanmondi Lake, Mirpur, Kalshi Road, Mohammadpur.

Objective of the project

To raise plantation for developing environment along roadside, median and circle about in different roads under Dhaka city corporation.

Types of species

Woody trees were predominant in this project. Woody trees such as Mahagini, Nageshwar, Krishnachur, Bokul, and Kamini; Fruit Trees such as Mango, Jackfruit, and Olive, Coconut; herbal tree such as Neem, Horitoki, Arjun etc were planted. Table 3.4 Shows the Plantation types and total amount of the plantation in this project.

Administrative authority

DCC was responsible for operating, maintaining monitoring the project.

Total allocation for plantation

Total allocation for plantation was about one corer seven lakh, funded by Bangladesh Government. Total plantation is about 63546 were planted under this program.

Table 3.7: Plantation program under "*Dhaka Mahanagarir Obokathamo Ebong Poribesh Unnoyan Prokolpo* (Infrastructure and Environment Improvement Program of Metro Dhaka) (2002 to 2004)"

Serial No.	Name of the Location	Name of the Trees (Local Name)	Total Plantation
1	Uttara Sector 1	*Aam ,Kathal, Mahagini, Neem,*	1803
2	Uttara Sector 3	*Mahagini Neem, Jolpai, Arjun, Narikel, Krisnachura*	4772
3	Uttara Sector 4	*Kathal, Mahagini, Nageshar, Horitoki,*	3906
4	Uttara Sector 6	*Aam, Kathal, Mahagini*	3024
5	Uttara Sector 7	*Mahagini,Neem,Krisnachura,Arjun,Kamini*	4586
6	Banasri Prokolpo	*Aam, kalojam, Kathal , Mahagini, Neem, Krisnachura,*	9198
7	Goran Mathertek	*Aam, kalojam, Kathal ,Mahagini, Neem, Krisnachura*	5028
8	Mirpur Extension Pollobi	*Mahagini, Neem,Shishu*	1471
9	Mirpur Eastern Housing	*Mahagini , Aam , Mahagini*	4989
10	Mirpur (12 to 14)	*Mahagini ,Bokul,*	2659
11	Elephant Road	*Mahagini , Aam*	469
12	Shajadpur	*Mahagini , Bokul,*	735
13	Mirpur 10 No to 2 No	*Mahagini ,*	7110
14	Prime Minister Office	*Mahagini ,*	184
15	Baridhara	*Mahagini ,*	492
16	Gulshan Niketan	*Mahagini , Krisnachura, Bokul,*	1990
17	Dhanmondi Lake	*Mahagini , Aam, Neem, Bokul,*	2550
18	Mirpur Kalshi Road	*Mahagini, Aam, kalojam, Kathal, Bokul,*	5480
19	Mohammadpur	*Mahagini, Aam, kaloJam , Kathal, Neem,*	400

Source: DCC, 2005

3.5.4 Present urban plantation program and management aspects in Dhaka city ("Dhaka City Beautification Project"2003 to 2008)

The ongoing tree plantation program in Dhaka city called "The Dhaka City Beautification". The plan was launched in 2003 during "*Dhaka Shohorer Shusashon and*

Uannayan" meeting by the component authority at the PMO *and* by DCC formed by Dhaka City Beautification Cell (DCBC). It was on June 26, 2004 that 109 private organizations were given the nudge The initial phase of the beautification work was completed before the SAARC summit January 7, 2004. The long -term arrangements with the companies are to continue till March 31, 2008.

Location of the project

Major and minor roads of DCC area are selected under this project, which has divided the city into 98 segments.

Main objective of the project

The DCC has taken 'The Dhaka City Beautification Project' to keep Dhaka clean and beautiful through tree plantation, adding color with flowering plants and revamping of medians and the sides of the roads in collaboration with some private organizations.

Financial statement of the existing project

The process started with the Dhaka Urban Transport Project (DUTP), a Tk 1200 crore WB-(World Bank) funded project, the Dhaka City Corporation (DCC) and the Roads and Highways Department (RHD). These organizations jointly undertook the program to repair and construct 2447.69 kilometers of wide and narrow lanes, along with 163 kilometers of footpath. In addition to this, a Tk 150-crore DCC project was undertaken for the greening of Dhaka through planting trees, and adding color with flowering plants has been on the stream for the last three years. With taka 50 lakh spent, and little progress made. In October, 2003 a ten- member committee "Dhaka City Beautification Cell", was forced under the direct supervision of the Prime Minister's Office (PMO), and with the Chief executive Officer (CEO) of the DCC. Then the cell came out with an innovative idea. The government will not have to spend any money for implementing the city beautification project as it is being done by public-private partnership. As for the benefits of the participating organizations, they are allowed to put their billboards, plaques or signs specified by the DCC. Prime Minister will distribute awards among the best organizations for their efforts in planting and maintaining the median of the city roads (The Bangladesh Observer, 2004).

Planning and organizational management of roadside plantation in the present project

Under the "*Shushashon*" project, DCC formed the beautification cell with 11 members headed by the chief executive director of DCBC (Dhaka City Beautification Cell).

Under the directives of the PMO (Prime Minister Office). the involved private and government organizations were assigned the job of planting trees and revamping medians and the sides of the roads. They have started the work after getting the final approval from City Corporation. These organizations will maintain their respective zones until March of 2008. DCC monitor the development of the work on monthly basis and submit regular report through its 10 zonal office staffs throughout the city. If the development progress is not satisfied, responsible organization is hacked by DCC. Then new interested organization is appointed by the DCC to continue the work. It is the landscape gardening expert from BARI, and representative of the nursery who played the key role in approving the project designed by architects and the consultants. The organizational diagram has shown figure 3.4.The project is being implemented by 90 different public and private organizations where the streets of Dhaka were divided into 109 segments. The major project implementing organizations are Dutch-Bangla Bank, Bata Shoe Company (Bangladesh) Ltd., Exim Bank, LGED, Bangladesh Railway, Grameen Phone, City Cell, Basundhara, Hotel Sonargaon, Prime Textile, DESCO, British America Tobacco Company, City Bank, Metropolitan Chambers of Commerce and Industry (MCCI), Advance Add, ARKEY group, Roads and Highways Department (RHD), Bangladesh Navy, MCCI, etc. With all that total 90 private and government organizations are working together to beautify the city (See appendix I). At present, different private and Govt. organizations under Dhaka City Corporation are planning and managing trees on roadside. Managing Director of different organization gives the charges to senior vice president or executive officer. It is evident from discussion with the officials that almost all the organization follows a typical procedure. Under executive officer, 2 to 20 labors and gardeners are appointed for plant maintenance. Labour number varies to one organization to other organizations. For an example, Kohinor Chemical Co. Ltd. has 15 field labours for planting, pruning and watering the plants. On the other hand IBN SINA has 4 to 5 gardener to maintain the Satmasjid Road. They are watering thrice or four in a week. All the responsible organizations have their own gardener who is primarily responsible for selecting trees. The labor cost in each organization varies from 500 to 10000 taka per month. Most of the organizations don't consult with any landscape architects, environmental expertise. Only Mymensing road is designed by the designer and architect.

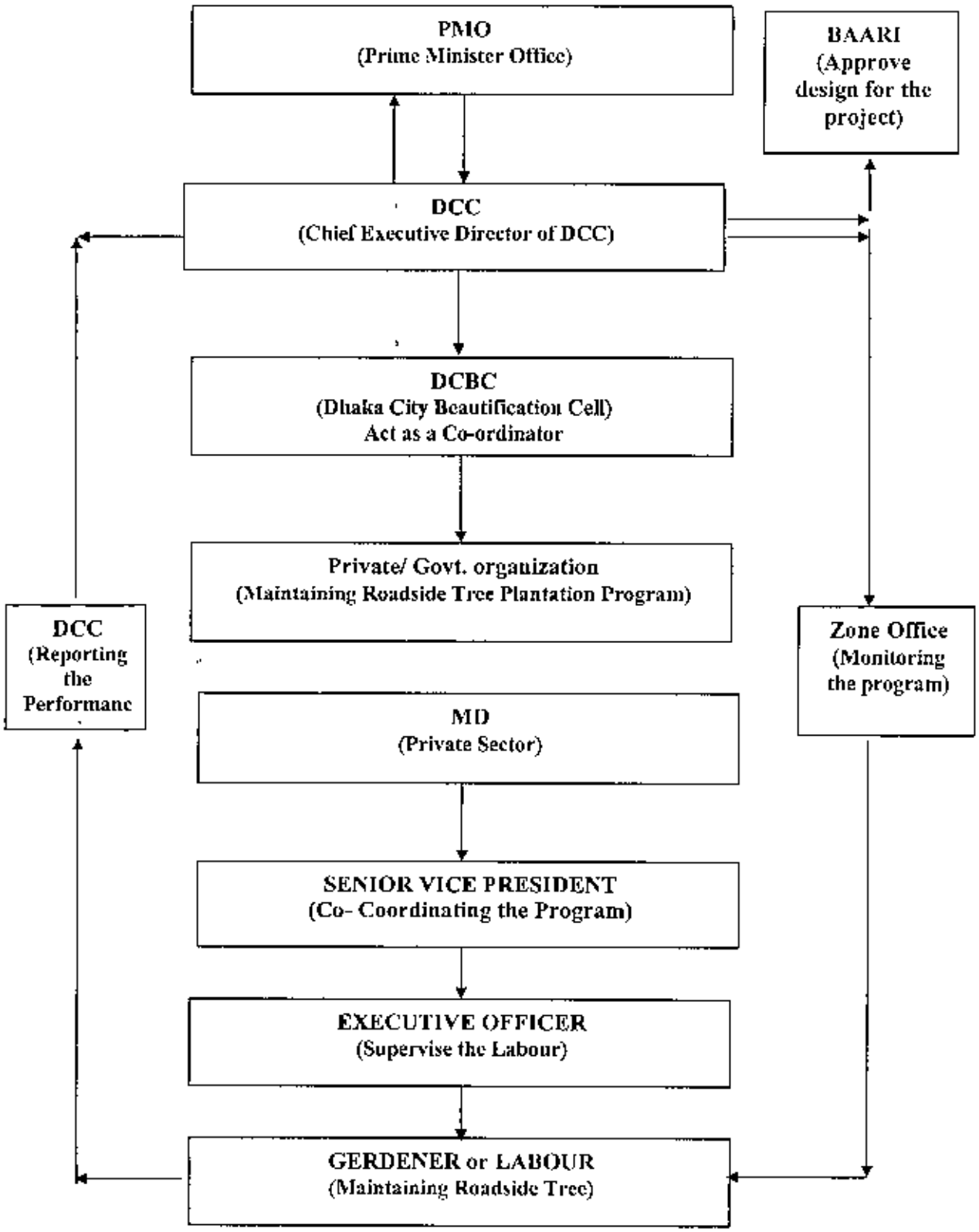


Figure 3.4: Organizational Diagram of City Beautification Project in Dhaka City

3.6 Over view of tree plantation projects in Dhaka City (1994 to 2008)

In Dhaka city, there is a strong historical background of city beautification through tree plantation which was not well maintained in later years for different reasons. The Mughals were the pioneer of the concept of city beautification through increasing parks and gardens during 1610 to 1713. As a continuation of this effort the British also took some initiatives for developing green Dhaka in 1830. They strictly enforced some rules for city beautification again in 1928. The evidence shows that the past effort for Dhaka city beautification was better planned and well managed. The survey list 1965 of Dwizen Sharma proves that there were rare species of trees and plants in Dhaka city which are now been diminished (please see Appendix E for detail). During 1971 to 1993 there were no projects initiated to increase the plantation in the Dhaka city. During this period there were lots of projects for developing Dhaka as a metropolitan to mega-politon city which did not emphasized on a well managed plantation program.

The practice of urban forestry starts at Dhaka in 1993 through "Nagar Banayan Prokolpo" under the forest department. This project ensures roadside, embankment and block plantation. Additionally, the khash lands are also used for tree plantation under this project to fulfill its aim of improving microclimate of Dhaka city and of enhancing city beautification. Following this project, now DCC has initiated a tree plantation program to improve the environment of Dhaka city along with beautification which will continue till 2008. A list of projects taken during 1993 to 2008 has been shown in Table3.8 including their objectives, cost and types of species chosen for plantation.

Though the main objectives of all the projects are to increase tree plantations and to improve environmental condition of Dhaka city but there is no monitoring aspects of these projects. There is no consistency about the project information among DCC and FD as well as in the project completion result, so the projects are not comparable. For example project 1 is giving the information about the length plantation area in km whereas, project 2 is providing the total area of plantation in sq km and project 3 is only showing zone-wise information which is not comparable with other two and project 4 is giving very detailed information on the specific roads and segment of roads, species used in each segment etc. Moreover, these organizations, DCC and FD, also cannot give any evidence whether the projects are fulfilling their aims or not in the long run. Project 1, 2 and 3 are given much emphasis on planting woody trees like *Mahagini, Arjun, Jarul, Bokul, Mango, Jackfruit* etc. On the other hand,

Project 4 is giving much emphasis on planting ornamental trees. Table 3.8 shows the list of trees planted in project 2, 3, 4. Regarding the management of the projects, Project 1 was managed under both DCC and FD where project 2 and 3 were managed only by DCC. Project 4 is under DCC but the works have been contracted out to some private organisations for getting better result and for enhancing people's participation in the process. This approach is very much accepted and a monitoring system can be developed, than this contracting out to the private organisations will be a better tool for managing such projects.

Table 3.8: Tree plantation projects of Dhaka city (1994 to 2008)

Name of the Project	Year	Number of species types	Main objectives of the project	Cost of the Project (Local Currency)
Nagar Banayan Prokolpo (project 1)	1993 to 2000	information not available	To utilize vacant land along different roads. parks, premises of office and other institutes and *khas* land for plantation and improve the micro climate and increase beatification.	538.58 lakh
Zonal Wise Tree Plantation Program (zone -3 an 10) (project 2)	1994 to 2000	6	To use vacant land, roadside for plantation to beautify the Dhaka city	55.34 lakh
Dhaka Mahanagarir Obokathamo Ebong Poribesh Unnoyan Prokolpo (project 3)	2002 to 2004	14	To raise plantation for developing environment	1 Crore 7 Lakh
Dhaka City Beautification Project (project 4)	2003 to 2008	49	To beautify the Dhaka city	150 crore

Source: PP of Nagar Banyan Prokolpo, 1993; DCC. 2006 and FD, 2006.

Table 3.9: Administrative authorities responsible for different tree plantation program in Dhaka city

Responsible administrative authority	Project -1	Project -2	Project -3	Project -4
Sponsoring	Ministry of Environment	DCC	DCC	PMO
Executive	Forest Department	DCC	DCC	DCC
Operational maintenance	Forest Department	DCC	DCC	Private and Govt. Organization

Source: PP of Nagar Banyan Prokolpo, 1993; DCC, 2006 and FD, 2006.

3.7 Status of roadside tree plantation in the study areas

3.7.1 Selection of tree

Selecting the most appropriate species and variety of tree for a particular location and function profoundly influences the quality of a design. Species selection in an urban area depend on aesthetic criteria (such as, structure dimension, density, growth rate) cultural criteria (regional determinants, local determinants such as: air quality, soil types, water, light), operational criteria (site use, management),(Arnold, 1980).The climate, site conditions, objects of planting, intensity of damaging agents also influence the choice of species in urban area. Dhaka is situated at a tropical climate zone. Annual temperature is ranging from 24.4° C to 26.7° C and annual rainfall is about approximately 2540 mm (Alam and Islam, 2006). In this climatic zone all locally available plants can be grown easily.

Under the "Dhaka City Beautification" project, many of the bare streets in Dhaka city have been planted with young trees. From table-3.10, it is revealed that total existing plantation in Dhaka City is about 21495 (woody tree) and 82, 974 (ornamental tree). Total plantation has increased in this city with the addition of ornamental trees. From field survey of 2004, it was found that ornamental trees were totally absent in the plantation program. This is the positive approach of the project to increase a tree in Dhaka city. All the study roads are decorated with ornamental tree and shrubs. Proper maintenance of ornamental tree can give beautiful look in a city. But regular maintenance is not reflecting in the some part of the study road. Photograph 3.1 is an evidence of such a road. It is showing that the ornamental trees are planted in the medians of the study area are very poorly managed.

Table 3.10: Types of plantation in study area

		Type of Plantation			Type of Plantation		
Name of the major roads	Name of the studied intersection	2004			2006		
		Timber No. (%)	Ornamental No (%)	Total No (%)	Timber No (%)	Ornamental No (%)	Total No (%)
Mymensing Road	Zia International Air Port to Mohakhali	(4013) (100%)	(0) (0%)	(4013) (100%)	(5780) (8.26%)	(64220) (91.74%)	(7000) (100%)

Name of the major roads	Name of the studied intersection	Type of Plantation 2004			Type of Plantation 2006		
		Timber No. (%)	Ornamental No (%)	Total No (%)	Timber No (%)	Ornamental No (%)	Total No (%)
Air Port Road	Mohakhali Fly Over to Farm Gate	(757) (100%)	(0) (0%)	(757) (100%)	(522) (41.43%)	(738) (58.57%)	(1260) (100%)
Kaji Najrul Islam Avenue	Farm Gate to Ps Shabag	(0) (0%)	(0) (0%)	(0) (0%)	(102) (13.69%)	(643) (86 31%)	(745) (100%)
Bijoy Sarani	Porjoton Office to China Conference	(757) (100%)	(0) (0%)	(757) (100%)	(2085) (94.85%)	(132) (5.95%)	(2217) (100%)
Mirpur Road	Nilkhet to Mirpur 14, Mirpur 10 to 12	(3245) (100%)	(0) (0%)	(3245) (100%)	(6837) (66.0 %)	(3528) (34.0%)	(10365) (100%)
Satmosjid Road	BDR -4 No Gate to Dhanmondi 27	(300) (100%)	(0) (0%)	(300) (100%)	(300) (16.89%)	(1476) (83.11%)	(1776) (100%)
Tajuuddin Ahmed Sarani	Satrasta to Taltola shooting club	(66) (100%)	(0) (0%)	(66) (100%)	(790) (53.38%)	(690) (46.62%)	(1480) (100%)
Pragati Sarani	Bisharoad and Mymensing Road Interlink to Badda Ps	(714) (100%)	(0) (0%)	(714) (100%)	(714) (39.59%)	(1090) (60.42%)	(1804) (100%)
Agargaon Road	-	(0) (0%)	(0) (0%)	(0) (0%)	(684) (39.68%)	(1040) (60.32%)	(1724) (100%)
Gulshan Avenue	Gulshan shooting club to Pakistan embassy	(1979) (100%)	(0) (0%)	(1979) (100%)	(2246) (19.53%)	(9254) (80.47%)	(1150) (100%)
Rokeya Sarani	China conference to Mirpur 10	(1213) (100%)	(0) (0%)	(1213) (100%)	(1213) (88.15%)	(163) (11.845%)	(1376) (100%)

Source: Field Survey, 2004 and 2006

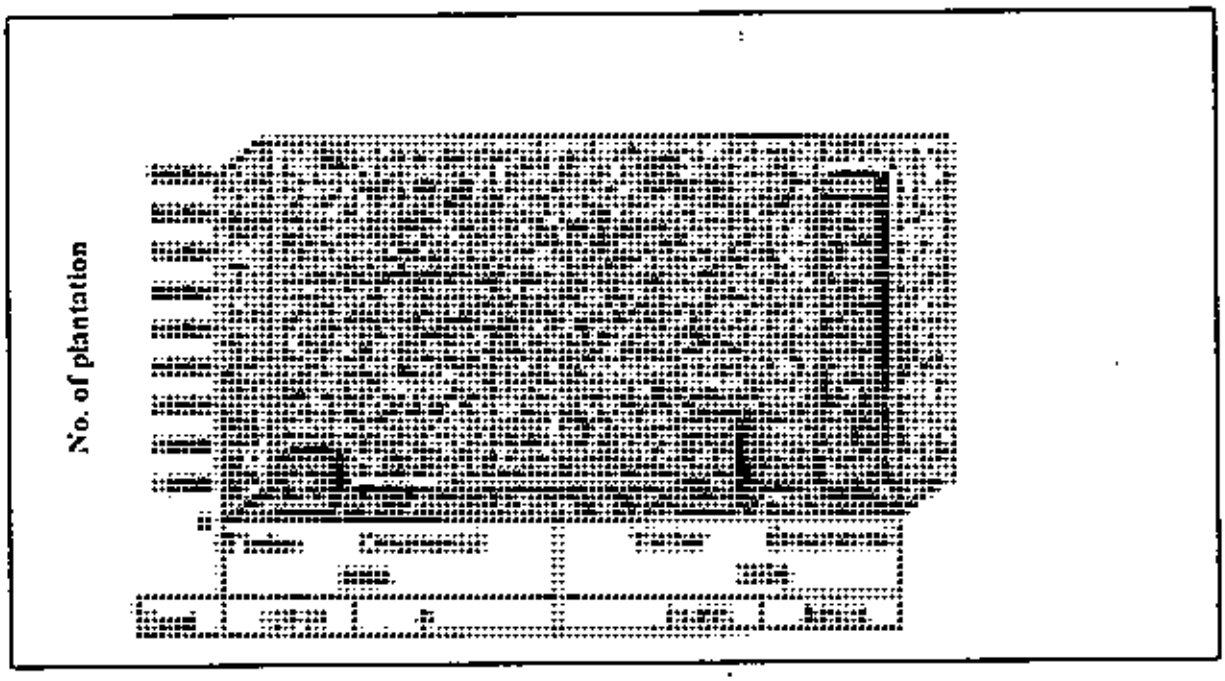
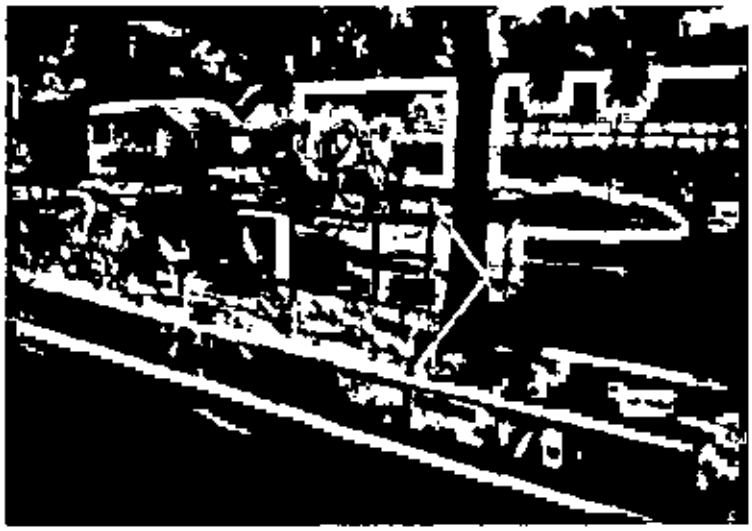


Figure: 3.5 Choice of species of trees in Dhaka City (2004-2006)

Roadside environment is complex. It is drastically, disturbed during construction, resulting in shallow, compacted soils with little or no topsoil. These soils are not favorable for supporting ornamental plants growth easily. From the photograph 3.2a and 3.2b, it is assumed that most part of Mirpur road, median is not suitable for ornamental plantation. The plants selected along roadsides must be able to withstand harsh conditions. Timber or any woody trees are more able to withstand adverse environment than ornamental plants. It is understood from experts' interview, (see appendix G) that some of the criteria for increasing urban forestry are planting tall trees which have timber values and can generate oxygen while planted in clusters. Only these characteristics of plantation can contribute both in city beautification and in increasing urban forestry though it takes long time to have the timber value from tall trees. For example, they cited that in Ramna Park the woody trees are dominated and clearly contributing in urban forestry. Photographs 3.3a and 3.3b shows the past plantation effort in Dhaka city has more contribution to urban ecology and environment rather than focusing on only esthetic issue. They also said that it is very difficult to select tree species in urban areas. In Dhaka city there is scarcity of suitable space for encouraging cluster plantation but, if there is some space along with the wide roads, these sides can be used for cluster plantation, for example, Bijoy Sarani and Mymensing Road have wide strips of land on both sides which can be used for cluster plantation. Notably, these roads now are considered only for beautification under the Dhaka City Beautification Project, but there were woody and tall shade trees planted in clusters before this project. This road has space to plants more trees in future (photograph 3.4a, 3.4b).

Most of the median of the study roads are used for plantation (See table 3.13). But those medians are too narrow to plant woody tree. It is found from study area that most of the median is decorated with *Weeping Debdaru ,Kanta Mehedi,Red Border*, Zhau , (Mymensing Road, and Gulshan Avenue, Mirpur Road), *Bougainvillea* (Satmosjid Road and Bijoy Sarani to Farmgate), *Babul, Mahagony* (Rokeya Sarani, Mirpur Road) (photograph 3.5a, 3.5b, 3.5c,3.5d and 3.5e). *Bougainvillea* is not ideal tree for narrow median (photograph 3.5b). The maintenance cost of *Bougainvillea* is low if they are planed in any open area or parks, but if they are planted in the narrow spaces like median or narrow strips, they always need trimming which increase their maintenance cost at the end. Interview with some specialist from different organizations, it is understood that bushy plants with dense green coverage are suitable for narrow median. According to some experts (see appendix G) it is better not to plant anything in narrow median. but others suggested Weeping *Debdaru* in narrow medians with a periodical proper care.

The recent trend in choosing plant types for the road side tree plantation or for the city beautification has been changed. Two separate surveys have been done in the same roads to compare the plant types in 2004 and 2006. Table 3.10 shows that in 2004, ornamental trees were not used in the road side at all and 100 percent plantation was timber based. In 2006, the scenario changed and use of ornamental trees has been increased to 20.41 percent in roadside tree plantation, and the timber use has decreased to 79.59 percent. Among the timber types, table 3.11 shows the recent (2006) trend of using more *Weeping Debdaru, Mahagini and Bokul* for beautification. Weeping Debdaru is not our local variety but recently this variety is predominating over any other local varieties of timber/woody trees in Dhaka city. According to Sharma, in 1965 the local varieties were mostly used for road side tree plantation, namely, *Nagaligam, Telsur, Nageswer, Arjun, Ashttha, Rain Tree, Segun, Tamal, Kadom, Ipil Ipil, Parul* (for the full list, please see Appendix E)



Photograph 3.1: *Most of the median is used as a site for plantation in a study road*

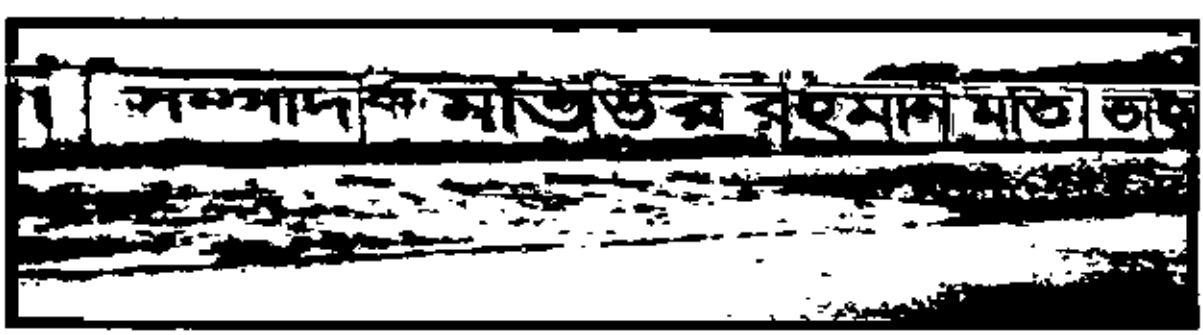
Photograph 3.2.a *The complex roadside environment is disturbed by construction which is creating unfavorable soil for plantation.*

Photograph 3.2b *Shallow, compacted, soil in a narrow median is not favourable for ornamental plants.*

Photograph:3.3a *Past plantation project preferred roadside as a site for plantation. Mahagini was predominant in past plantation project in Rokeya Sarani.*

Photograph 3.3b: *Woody tree can contribute in an urban forestry. Timber tree was preferred in Mymensing*

Photograph 3.4a: *median of Bijoy Sarani is one of option to raise cluster of trees.*



Photograph 3.4b *There is an option to raise more plantations in road side of Rokeya Sarani*

At present the management cost for tree plantation is very high because they need more care and maintenance. But it is clear from the above pictures and from the plantation pattern that day by day the choice of species in tree plantation is changing. Most of the old species of trees are diminishing from Dhaka city which once made the city glorious, some of those species can still be seen in the Dhaka University area. According to experts, (see appendix G) it is very difficult to choose right type of trees in an urban area as the city environment is very complex, so the type of species should be chosen based on their longevity. They suggested planting *Sonalu Krishnochura, Jarul* etc. at the road side to add beauty to the city and this plant require less maintenance cost as a whole in the long run. They also suggested to plant woody and tall trees by the road side where there are some wider spaces but they also encouraged ornamental trees in the places where there is narrow strips by the road side and median.

According to Sattar (2000), for Dhaka city, *Sonalu , Goldmohur, Minjiri, Krishnochura , Polash, Jacaranda, Ashok, Jarul, Setkachan, Poras , Pink Shower,Kanjail, Barun, Korai, Neem, Banpui, Bakphul, Debdaru, Raj Korai, Jhau* For beautifying the road. Screening for hiding undesirable objects, *Nageshwar, Shetkanchan, Akashmoni, Karamja, Babulet* are right choice of tree for roadside trees as a roadside tree plantation.

Table 3.11: Variety of species planted in different roads under the "Dhaka City Beautification Project".

		Name of Different Types of Species		
Serial no.	**Name of the Road**	**Ornamental Plantation**	**Bushy**	**Timber Tree**
1	Mymensing Road	*Allamanda, Ixora Olender, Jacaranda, Goldmohur, Indian Laburnum Bougainvillea, Chinabox,*	*Kanta Mehedi, Sheora, Odelia And Lantana.*	*Mahogany, Palm, Weeping Debdaru, Cocoanut Palm, Flam Tree, Date Palm, Australian Oak, Margosa Tree, Travelers Tree, White Muradha*
2	Bijoy Sarani	*Gendha , Inka, Jhau, Silvia, Pantho Padop,*	*Border Tree,*	*Weeping Debdaru, Palm Tree, Tal, Travelers Tree*
3	Satmasjid Road	*Bougainvillea*	*Yellow Mehendi, Red Mehendi*	*Flam Tree*
4	Tajuddin Ahmed Sarani	*Ixora Kanchan, , Bougainvillea Kenna, Benajamina*	*Kanta Mehedi , Red Border, Lantana,*	*Arjun, Margosa Tree Ficus,, Weeping Debdaru*
5	New Airport Road	*Zhau*	*Kanta Mehendi*	*Indian Medlar, Weeping*

		Name of Different Types of Species		
Serial no.	Name of the Road	Ornamental Plantation	Bushy	Timber Tree
			Border Tree	*Debdaru*
6	Progoti Sarani	*Zhau*	*Kanta Mehendi. Red Border*	-
7	Panthopath	*Zhau.*	-	*Weeping Debdaru*
8	Mirpur Road	*Rangan, Allamanda, Bougainvillea, Kolaboti*	-	*Weeping Debdaru, Babul, Mahogany, Indian Medlar, Margosa Tree*
9	Gulshan Avenue	*Kolabati, Bokul Zhau, Palm*		*Bottle Brush, Weeping Debdaru,*
10	Rokeya Sarani	*Zhau*	-	*Mahogany, Weeping Debdaru Madras Thorn,*
11	Kaji Najrul Islam Avenue	*Ixora, Bougainvillea zhau, ChinaBox, Palm*	*Red Border, Lantana*	
12	Manik Mia Avenue	*Indian Laburnum,*		*Segun, Indian Medla, Royal Palm. Mahogany, Indian Almond*

Source: Field Survey, 2006

3.7.2 Plantation in urban design

Site selection of the study area

Selection the site for plantation in urban area is difficult. When a street is selected for plantation, it is more complex than the other plantation site in urban area like park and any other open space. When a road is selected as a site for plantation, road way width, side walk width, strip width and median width should be taken into consideration. Availability of strip land is very much important for roadside plantation. According to Sharma (1980), an ideal road for plants tree should have 250 feet right of way. A single row of trees can be planted after having 85 feet roadway and 31 feet side walk. After the plantation row, there should be 38 feet grassland and another single row of tall deciduous plants. In Dhaka city, street width, within the old part of Dhaka, varies between 10 ft (3.0m) and 24 ft (10m) and in new part of Dhaka city between 80 ft to and 160 ft which is far way from an ideal situation. Only Mymensing Road and Bijoy Sarani and Manik Mia Avenue have 4 to 6 lane roadway (25 ft to 30 ft) with 13 to 23 feet strip of land. Other than those none of the roads have that much of strip land on the both side for plantation. So it is clear from the study," Dhaka Beautification Project" has given emphasis on increasing plantation on medians of the major roads. In study area, total 39.49 km long median and 29.12 km road side are used for plantation (table. 3.13). In the study area the median width is also insufficient for plantation. According to Wright (1996), highway median strip varies from 1.2 (4 ft) to 18 m (60 ft) or more. A Median less than that is discouraged. A sufficiently wide median can provide good

vegetation and shrubs to reduce the headlight glare of opposing traffic and serves many other purposes. Median of Dhaka city road varies from 0 .50 to 2 m except Bijoy Sarani and Manik Mia Avenue (the median width varies approximately 3.50 to 7 m).

Table 3.12: Median width in study road in Dhaka City

Serial No.	Major Road Name	Median width in meter (Approx)
1	Mymensing Road (Zia International Airport to Banani Rail Crossing)	0.45 to 1
2	Airport Road	1 to 1.5
3	Mirpur Road	1 to 2
4	Bijoy Sarani	4.50 to 6.17
5	Rokeya Sarani	2 to 3
6	Kaji Najrul Islam Avenue	1 to 1.5
7	Tajuddin Ahmed Sarani	1 to 1.5
8	Gulshan Avenue	1 to 2
9	Progoti Sarani	0.50 to 1
10	Satmosjid Road	1 to 1.5
11	Manik Mia Avenue	3. to 5
12	Panthopath	0.50 to 1

Source: Field Survey, 2006

In respect to the design perspective, it is shown from Table 3.12 that most of the roads in the study area are not designed properly for efficient plantation. The widths of the medians are not sufficient for plantation. Mostly, the wide medians are found in Manik Mia Avenue and Bijoy Sarani which have sufficient spaces for plantation.

3.5a: Mymensing road

Photograph 3.5 ornamental plantations in study roads.

3.5b: Airport Road

3.5c: Kaji Najrul Islam Avenue

3.5d: Rokeya Sarani

3.5e: Farm Gate

Table 3.13: Past and present trend of using spaces for roads side tree plantation under Dhaka City

	Road Name	Trend of Using Spaces for road side tree plantation (in Km)			
		2006		2004	
		Median	Road side	Median	Road side
1	Mymensing Road	3.66	14.66	0	14.66
2	Tajuddin Ahmed Sarani	1.66	0	0	1
3	Gulshan Avenue	3.5	0	3 5	0
4	Bijoy Sarani	1.6	3.2	1.6	3.2
5	Airport Road	3.86	0	1.2	1.2
6	Satmasjid Road	1.8	0	1.8	0
7	Manik Mia Avenue	1.66	3.26	1.66	3.26
8	Rokeya Sarani	1.46	0	1.46	0
9	Pantha Path	1.66	0	0	0
10	Kaji Najrul Islam Av:	1.33	0	0	0
11	Progoti Sarani	2.66	0	0	0
12	Mirpur Road	12.33	7.54	10.16	12.38
	Total	37.18	28.66	21.38	35.7

Source: Field Survey, 2004 and 2006

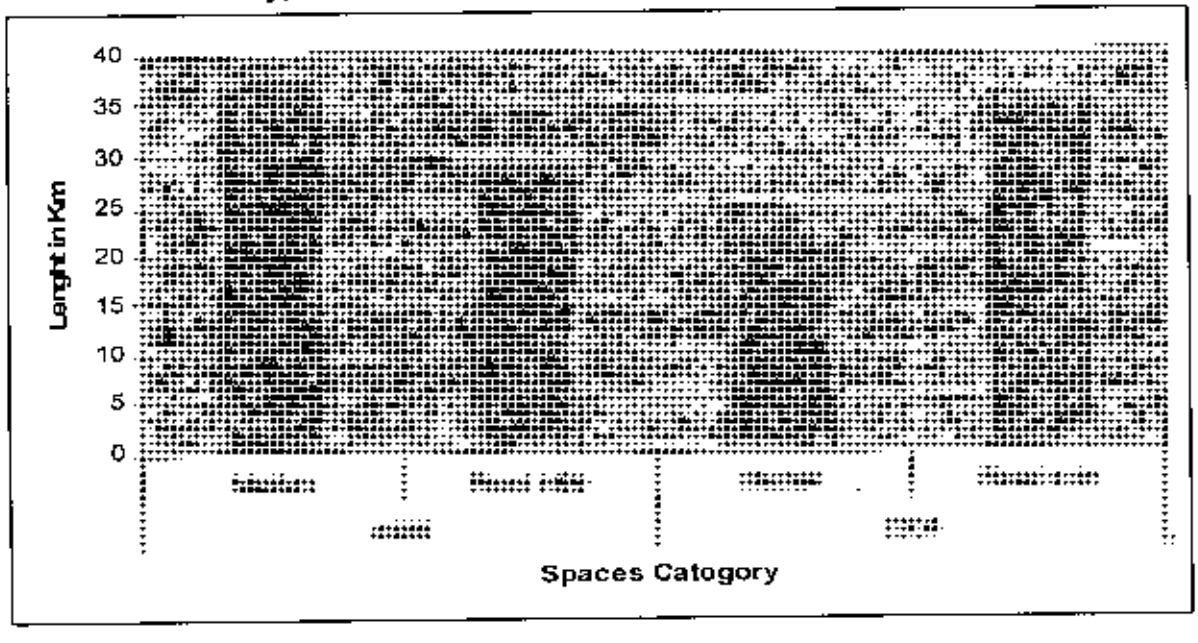


Figure.3.6: Spaces using in different roads for plantation in study area

It is evident from the survey that all study roads have plantation but road side plantation decreased by 19.72 percent and plantation in median increased by 42.5 percent. In both the study years, roadside plantation is not found though in many of study roads there are foot

paths which could be used for plantation. As a result the pedestrian do not enjoy shade and comfort of trees while walking.

Plantation in relation to sidewalk

An urban sidewalk without trees is like a building without roof. In addition to the functional values provided by trees, they are indispensable in a city as they give a sense of scale. The street side near the curb is the best location for trees along sidewalks this is one of the few purely aesthetic judgments that should become a rule in most urban situation (Arnold, 1980). In that case sidewalk should have minimum 7 feet wide if it contains trees or 4 feet wide for grass. It may be reduced to 2 feet if paved and used for utilities only (Lynch, 1972).

The recent plantation program has given emphasis on median plantation. Table 3.14 shows that the land availability beside the road sides is not sufficient for plantation. In that case it is observed that the strips of Mymensing road and some part of Mirpur road (Mirpur 2 to Mirpur 10 and Mirpur 14) have been used only for unplanned plantation though there were sufficient lands for a well designed landscaping through plantation. On the other hand the Bijoy Sarani and the Manik Mia Avenue have left strips for side walks after using the road sides for tree plantation (Photograph 3.6a, 3.6b and 3.6c). Other than this, there is no scope for planned plantation in existing road sides of Dhaka city.

Table 3.14: Side walk width in study road of Dhaka City

Serial No.	Major Road Name	Side Walk Width In Meter (Approx)
1	Mymensing Road (Zia International Airport to Banani)	6.06 to 7.20
2	Airport Road (Mohakhali Flyover to Bijoy Sarani)	0.6 to 0.9
3	Mirpur Road (Mirpur 2 to Mirpur 10 to Mirpur 14)	1.2 to 3
4	Bijoy Sarani	4.50 to 7.20
5	Rokeya Sarani (IDB Vhaban to Mirpur 10)	1 to 1.2
6	Kaji Najrul Islam Avenue (SAARC Foara to Shabag)	0.3 to 0.6
7	Tajuddin Ahmed Sarani	0.3 to 0.6
8	Gulshan Avenue (Pakistan Embassy to Shooting Club)	0.3 to 0.6
9	Progoti Sarani	0.3 to 0.9
10	Satmosjid Road (BDR 4 No Gate to Dhanmondi 27)	0.6 to 0.9
11	Manik Mia Avenue	3 to 4.50
12	Pantha Path	0.3 to 0.6

Source: Field Survey, 2006

Spacing of trees in study area

Tree spacing in urban designing is largely an aesthetic question except where functional requirements dictate the ground plan. As such, spacing will vary in relation to specific design requirements in each individual circumstance (Arnold, 1980). In urban design, trees should be grown close enough to form continuous and arched canopy to provide enough shade and achieve visual unity (Arnold; 1980). If the trees are spaced too far apart, each tree develops a more dense lower branched crown.

The spacing between the trees in the first row of shade or ornamental trees will have to be wider than that between the trees in the remaining rows. Shading trees normally have broad crowns; a spacing of 12 to 14 m is suggested. With the introduction of social forestry project the spacing between trees has been reduced from 10 m to 2 m to make optimum use of the available land. The spacing between the trees in row depends upon the species to be planted. Spacing is 10 m for shad trees, 5 m for timber species, and 2 m for fuel wood and fodder specie (Tiwary and Sing, 1984). In this case, Mamynsing Road Mirpur and Manik Mia Avenue Road only has shade trees like *Babul, Mahagini* , *Mango, Arjun, Seghun* , *Bokul* , *Krishnachura* etc. where suggested spacing is followed.

This city is a highly congested city where street doesn't have sufficient of land (see table 3.14). In that case, double row plantation can be possible in some of the roads like Bijoy Sarani, Mymensing Road; Manik Mia Avenue. Bijoy Sarani has double row plantation (Table 3.15) where multiple row plantation can be done. There is no provision in any other road for double or multiple row plantations. Mirpur road (Mirpur 2 to Mmirpur 14) has provision to plant tree in single line. Single row babul, *Mahagini* trees with a spacing of 8 to 10 feet apart in that road is observed from observation survey.

Trees should not be planted under electric or telephone lines. Bushes and short ornamental trees can be planted in such places. Trees in the first row are normally planted at least 6 m away from the electric or telephone line. In that case, it is found that most of the plantation in Dhaka city has been done in median. And electric poles are found in some of the medians. For example, Satmoshjid road has electric poles in median where electric wires create obstacle for Flame (Krishnochura) tree (see photograph 3.7). This unplanned tree plantation in some part of Mirpur road leads to a hazardous situation for city people and may cause accident.

The group of flowering trees may be planted at specific distance to break the monotony of a continuous green canopy of avenue trees. In that case Mymensing Road, Airport road (Jahangir gate to Bijoy Sarani), Manik Mia Avenue are better than other roads in Dhaka city.

Table 3.15: Row types of plantation in different roads

Serial no.	Name of the major roads	Plantation site	Types of row
1	Mymensing Road	Roadside	Multiple Row Planting
2	Tajuddin Ahmed Sarani	Median	Single Row Planting
3	Gulshan Avenue	Median	Single Row Planting
4	Bijoy Sarani	Roadside	Double Row Planting
5	Airport Road	Median	Single Row Planting
6	Satmasjid Road	Median	Single Row Planting
7	Mirpur Road	Median	Single Row Planting
8	Manikmia Avenue	Roadside	single row planting
9	Rokeya Sarani	Median	Single Row Planting
10	Kaji Najrul Islam Avenue	median	Single Row Planting
11	Progoti Sarani	median	Single Row Planting
12	Patha Path	median	Single Row Planting

Source: Field Survey, 2006

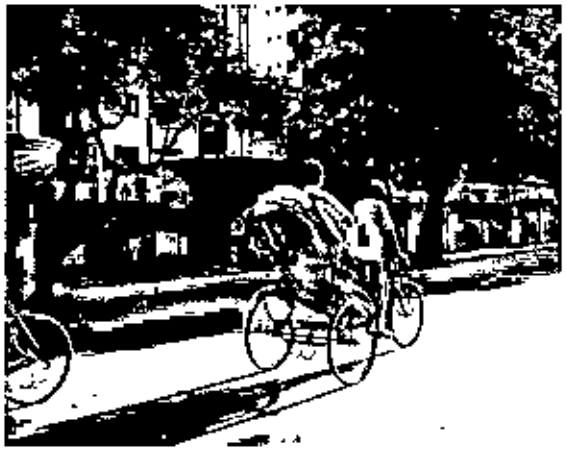
From above table it is observed that most of the median is used for plantation single row plantation because the widths of those medians are not sufficient for double row plantation. Only Bijoy Sarani has maximum median width where double row plantation can be done, but from the observation survey it is found that this median is not properly used for plantation

Species composition

In urban situations, there are few choices. As a result often the design is based on a single type of plant that will grow best in that locality. Moreover trees of the same species do not kill each other off in a fight for survival (Arnold, 1980). But our plantation trend is found to be mixed species composition in narrow median. The species composition in our city is aesthetically too poor. Rokeya Sarani has dressed with *Madras Thron (Babul Tree)* in single line with 8 to 15 feet interval. Between two trees, one *Zhau* has been planted. This composition is absolutely unwise. Under this shade tree, *Zhau* can not survive in long run. (See photograph 3.8). Mymensing Road gives pleasing and stunning scenery which is aesthetically desirable in terms of diversification of species composition. Banani Rail Crossing to Zia International Airport is one of good examples of this composition. The species composition of study roads are showed in table 3.16.

Photograph 3.6a plantation designs in relation to the side walk

Theses are some of the examples of well managed plantation from a design perspective, which also leaves spaces for side walks.



Photograph 3.6b Manik Mia Avenue

Photograph 3.6c Mirpur 14

Photograph 3 7: in Satmasjid Road median, electric pole disrupting the growth of tall tree

Table 3.16: Species composition of different Roads

Name of the Major Roads	Species Composition	
	2004	2006
Mymensing Road	Multiple species	Multiple species
Airport Road	Single species	Double species
Mirpur Road	Single species	Single species
Satmosjid Road	Single species	Multiple species
Tajuuddin Ahmed Sarani	Single species	Multiple species
Ghulshan Avenue	Single	Multiple species
Kaji Najrul Islam Road	No species	Multiple species
Progoti Sarani	No species	Double species
Manik Mia Avenue	Multiple species	Multiple species
Pantha Path	No species	Single species
Bijoy Sarani	Single species	Multiple species
Rokeya Sarani	Single	Multiple

Source: Field Survey, 2004 and 2006

From observation survey in 2004 and 2006 (See table 3.16), it is found that in 2004 most of the species were single but in 2006 multiple species have been preferred. In 2004 mainly timber species were found but in 2006 ornamental species and shrubs are added. In this case, perfect species composition is seen in Mymensing road and wide road side land is used properly. Tall trees are found in the last rows and ornamentals are in first rows. In most of the medians, ornamental trees are planted between two trees, where it would be difficult to maintain the plants in long run. For example in Satmosjid road bushy shrub are planted between Flame trees (*krishnachura*). From this study it is found that multiple species composition in narrow spaces like median is not suitable. Because different types of fertilizers are needed for different types of trees which are very difficult to maintain, moreover tall trees prevent the growth of multiple ornamental trees. Considering the above points, single species can be planted in narrow spaces where uniform soil composition exists and single fertilizers are used.

3.8 People perception of design perspective of roadside plantation in study area

3.8.1 Design aspect of roadside plantation

Design of plantation of an ideal street should be scientific and engineered for safe moving of pedestrian and motorist. An ideal plantation design can give enjoying mood to the motorist to keep them relaxed, happy and alert. So it is very important factor for road side plantation. A design plantation of a road depends on roadway width, median width and

width of roadside land. A median of multilane highway strips varies from 1.2 m (4ft) to 18 m (60 ft). A median strip less than 1.2 m (4 ft) to 1.8 m (6 ft) in width is considered to be little more than a centerline stripe and its use, except for special conditions, should be discouraged. The median should have sufficient width to maintain vegetation and to support low – growing shrubs that reduce the headlight glare of opposite traffic (Wright, 1996).

From questionnaire survey, from 20 landscape specialist, and 20 planners, it is reveled that, in our city road, Manik Mia Avenue is the most engineered and artistic form of designed plantation. About 42.5 % respondents agree with this comment (Table 3.17). After that plantation of Mymensing Road is marked as a moderate designed (67.50%)

Table 3.17: The study road in relation to design of plantation in Dhaka City from people's perception

Serial No.	Name of the road	Well design plantation(%)	Moderate design plantation(%)	Poor design plantation(%)	Total(%)
1	Mymensing Road	32.5	67.50	0	100
2	Bijoy Sarani	25	50	25	100
3	Rokeya Sarani	17.5	57.5	25	100
4	Mirpur Road	0	32.5	67.5	100
5	Kaji Nazrul Islam Avenue	17.50	57.5	25	100
6	New Airport Road	25	17.5	57.5	100
7	Progoti Sarani	7.5	17.5	75	100
8	Manik Mia Avenue	42 5	57.5	0	100
9	Pantho Path	7.5	42.5	50	100
10	Satmasjid Road	0	32.5	67.5	100
11	Gulshan Avenue	0	42.5	57.5	100

Source: Field Survey, 2006

Table 3.18: Comfortable Roads as per people perception in Dhaka City

Serial no.	Name of the road	Most comfortable (%)	Moderate comfortable (%)	Uncomfortable (%)	Total (%)
1	Mymensing Road	57.5	25	17.5	100
2	Bijoy Sarani	17.5	75	7.5	100
3	Rokeya Sarani	15	67.5	17.5	100
4	Mirpur Road	7.5	50	42.5	100
5	Kaji Nazrul Islam	17.5	32.5	50.0	100
6	New Airport Road	0	57.5	42.5	100
7	Progotisarani	15	42.5	42.5	100
8	Manik Mia Evenue	75	25	0	100
9	Panthopath	3.7	57.5	5	100
10	Satmasjid Road	7.5	50	42.5	100
11	Gulshan Avenue	0	67.5	32.5	100

Source: Field Survey, 2006

3.8.2 Issues of shade and comfort to traveler

The main aim of avenue planting is to provide shade and comfort to the travelers or pedestrians on hot sunny days. Trees with thick foliage are most desirable as the provide shades and comfort (Arnold1980). It is been observed that most of the road have been decorated and revamped with ornamental trees and shrubs in our city. According to availability of roadside land in Dhaka city, emphasis has been given to medians for plantation which are not suitable place for thick foliage tree plantation. From the people perception it is revealed that the existing road side plantation of air port road, Tajuddin Ahmed Sarani, Progoti Sarani , Kaji Najrul Islam Avenue do not provide much comfort to them while traveling. It is found that (Table 3.18) 75 percent of people feel comfortable in using Manik Mia Avenue, and 57.5 percent people are happy to use most part of Mymensing Road. Notably, this road have thick foliage plantation at both side which provide shade and comfort to the traveler.

NESSECITY OF ROAD SIDE PLANTATION TO IMPROVE THE CITY ENVIRONMENT

4.1 Introduction

Many urban areas have relatively poor quality environmental condition due to less urban trees. Urban trees and herbaceous open space play a vital role in the environmental and aesthetic "health" of cities, yet they are rarely identified in land-use inventories of urban areas. Complex urban environment is the creation of deforestation process and development of concrete structures in urban area. The main complexities of urban environment are;

4 High temperature,
5 Lower humidity,
6 Polluted air,
7 High sound

4.2 Reduction of sound pollution

Excessive noise is one form of environmental pollution. Noise can be reduced from the source by using mufflers in the vehicles and baffles in the loud speakers, and at the receiver by the use of ear protector or between the source and receiver with an acoustic barrier. Trees can provide such barrier. The intensity of sound can be reduced as well as the frequency spectrum barrier can be changed by the vegetation (Sattar, 2000). A well managed urban forest can soothe and reduce sound pollution significantly. Sound pollution in Dhaka city crossed the maximum level. The status of sound level in some areas of Dhaka city is presented in Table 4.1. In that study, it is discovered that the noise pollution of Dhaka city is much higher compare to allowable sound level, remarkably in residential areas. It has been seen that recent tree plantation program covers the major roads of the Dhaka city. So minor road in the residential areas remains out of the tree plantation program. Therefore it is recommended that the minor and small roads of the residential areas should be brought under tree plantation program in order to reduce noise pollution.

Vehicular traffic on a sound intensity of about 72 to 78 decibels, a beeping horn up to 110 decibel, and a screaming jet more than 140 decibels. Sound levels of above 50 decibels are irritable and above 130 decibel are harmful. Trees and shrubs along the roads will reduce the effect of sound. According to Rao, (1987) 30 m wide trees cover can absorb 6 to 8 decibels of sound intensity. To reduce truck noise a belt of 20 to 30 meters wide and for car noise 7 to

8 meters wide belts can be raised. Here also density of tree is the factor for reducing the sound intensity. In this case, it is found that in Dhaka city only one road like Mymensing Road has 6.06-7.20 m of tree covering which can reduce the sound level. Except this road none have that much of tree covering to reduce the sound pollution Table 4.2. In Bijoy Sarani there is also provision to make deep covering of tree. Before the beautification project thick foliage trees were seen like *Mahagini*. After cutting those trees more Weeping Debdaru is planted in continuous line. But total land strip is not used for thick foliage tree which can be easily used. 300 tall trees have been cut after the beautification project. So dense tree covering is absent in these road where provision is there. Manik Mia Avenue can be an example where sufficient covering of tall tree is found.

Table 4.1: Status of Sound Level in the Selected Areas of Dhaka City

Bangladesh standards for different areas	Locations	Daytime sound level decibel
Commercial (Allowable 70)	Motijhil Rajuk Avenue	73.3 77.3
Residential Area (Allowable 45)	Gulshn Banani Mirpur	69.0 66.3 61.0
Industrial (Allowable 75)	Tejgaon Nabisco Factory	63.0 72.3
Others	Zia International Airport Mohakhali	92.0

Source: Ministry of Environment and Forestry (1997)

Table 4.2: Width of the tree covers both sides of the roads

		Tree covering (m)	
	Major Road Name	**Left / Right Side(Approx)**	**Median (Approx)**
1	Mymensing Road (Zia International Airport to Banani Rail Crossing)	6.06-7.20	0.45 to 1
2	Airport Road	0	1 to 1.5
3	Mirpur Road	0- 3.00	1 to 2
4	Bijoy Sarani	4 50 -7.20	4 50 to 6.17
5	Rokeya Sarani	0	2 to 3
6	Kaji Najrul Islam Avenue	0	1 to 1.5
7	Tajuddin Ahmed Sarani	0	1 to 1.5
8	Gulshan Avenue	0	1 to 2
9	Progoti Sarani	0	0.50 to 1
10	Satmosjid Road	0	1 to 1.5
11	Manik Mia Avenue	4.50	3. to 5

Source: Field Survey, 2006

4.3 Reduction of temperature:

The urban climate is warmer than rural areas because of more solar radiation absorbed by concrete, metal, asphalt and others. Besides, the fumes from the engines and heat generated by vehicles contribute to the warmer condition in the cities (Sattar, 2000). During the sunny days, trees intercept solar radiation, and through evaporation, they lower the temperature. It is found that a medium sized isolated tree can transpire about 400 liters of water per day (Kramer and Kozlowki 1970). This may be compared to five average room air conditioners each with a capacity of 2500 kcl \ hr running 2o hours a day (Federer, 1971). The sunny summer days, the area beneath the forest canopy can be as much as 14° C cooler than open area. It is evident from the studies that number of trees have been increased in the city the trend is maintained well it can reduce temperature in sunny days (Davey, 2004).

4.4 Reduction of air pollution

Urban trees affect the local and regional air quality. With proper species selection, design, and management, urban trees can help to improve the air quality.

Tree species selection within urban area can influence the overall forest effect on air quality. increasing urban tree and shrub cover (both horizontal and vertically) can improve air quality by increasing leaf surface area through which the polluted air will pass , and by deflecting pollutions away from receptors beneath or down wind canopy.

According to (Nowak, 2000), the prime strategies for urban forest design and management to improve the air quality are:

1. Increase the number of healthy trees.
2. Use long live and low maintenance tree
3. Avoid pollutant sensibility species (increase tree health)
4. Utilize evergreen trees for particulate matters reduction
5. Sustain large, healthy trees (large trees have greatest per tree effect.

In Dhaka city air pollution is one of the major problems. The following table 4.3 shows the ambient air quality status of some selected areas in Dhaka city. It is evident from the table that suspended particulate matter is quite high in the commercial, industrial and even residential areas of Dhaka city. It has far exceeded the maximum limit of standards followed in Bangladesh.

Table 4.3: Ambient air quality status of some areas in Dhaka City (In Microgram\ M^3)

Parameter	Farmgate Police station	Mohakhali Police station	Tejgaon	Gulshan police station	Bangladesh standards of ambient air in areas		
					commercial	Industrial	Residential
Suspended particulate matter	424.1-2235.9	450.4-9504	424.1-686.6	4029.502.6	400	500	200
Nitrogen dioxide	15.3-45.5	26.6-48.1	3.3-46.0	2.5-47.6	100	100	80
Sulpher dioxide	56.3-162.5	93.7-150.5	38.9-129.0	64.4-199.4	120	100	80

Source: Anon (1997)

From the strategies of Nowak 2000, it is understood that large leaf surface, long lived ,low maintenance , and ever green healthy tree can only improve the air quality in any kind urban area. From this study zone, it is found that recent plantation program is more prone to give aesthetical look with ornamental tree. Without high cost maintenance this ornamental plantation can not sustain long. It is reveled that evergreen healthy tree are replaced by ornamental small plants. These ornamental plants can not contribute to improve the air quality in Dhaka city. Picture shows the poor condition of ornamental tree in Progoti Sarani.

4.5 Air movement and wind protection

Tree reduces high speed air movement and can be used as shelter belts in most critical areas where it causes discomfort and occasional loss of life and property. Choice of right type of tree species is important in windbreak efficiency in urban areas. Trees with dense foliage should be selected in the north and west sides where protection from winter wind is desired. Deciduous species are preferred on the south and east, as they protect against hot and dry wind during they summer and allow incoming solar radiation during the winter (Sattar, 2000).

To improve the city environment, tree can play an important role; it can be used as an important tool for preventing air pollution. Some time over pollution can also be harmful for some tree species. A healthy and sufficient huge amount of tree can contribute to improve the air quality, reduce the city temperature, minimize the sound level and prevent storm air movement in a city. It is assumed from the study that there is a great short of good healthy tall tree in our city. Tall and thick foliage green tree can improve the air quality, provide the

shade and comfort in sunny day, minimize the sound level and protect the storm wind. But from the study area it is revealed that there is little scope for planting tall tree in our congested city. Beside this, main aim of existing plantation project is to beautify the city. To observe the overall situation it can be understood that this program is not considering the environmental improvement of the city. Table 3.10, shows the plantation trend in Dhaka city. In 2003 timber trees were the primary choice where in 2006 little timber trees were added and ornamental plants were given priority.

Conclusion and Recommendation

5.1 Conclusions

Urban forestry has a major role to play in modern cities As a matter of fact this has become an integral part of all city planning processes. Well designed road, parks, and shelter belt, open space should be taken as a primary consideration for city planning.

This study is focused on urban forestry practice through roadside tree plantation in Dhaka city. As a mega city, Dhaka is expanding with encroachment of open space, water reservoir site, park etc. In this case only road side is the main provision for tree plantation in our city. Practice of Road side tree plantation is a great opportunity to contribute in an urban forestry.

During Bangladesh period, from the beginning of DCC, its function included maintenance of park gardens, forest and road side planting. FD also contributed in urban forestry from the beginning. With the co-ordination of FD and DCC has been planning and maintaining the city tree plantation. Now DCC has given the responsibility to different organizations for maintaining roadside tree plantation. This approach can be considered as a social participation in urban forestry which is most appreciable.

5.2 Summery of the findings

To fulfill the objectives , this study tries to revel the existing planning and management aspects of roadside tree plantation, and how the city environment improve by the roadside tree plantation in Dhaka city. A summary of the findings is given below.

1 The concept of urban forestry practice was started in 1993 named "Nagar Banayan Prokolpo" under FD supervision in Dhaka city. Total 237.40 km road (including 4 City Corporations in Bangladesh) was taken for plantation After that DCC had taken steps to plant more trees in Dhaka city. Under The DCC supervision "Zone Wise Tree Plantation Program" (2002 to 2004), "*Dhaka Mahanagarir Obokathamo Ebong Poribesh Unayan Prokolpo*" (2003 to 2004) program has been finished Only zone - 3 was planted with the cost of 23.35 lakh taka in the year 2002 to 2004 (Table 3.5) And the cost is about 3198489 taka for zone 10 in 1994 to 2001 (Table 3.6). "*Dhaka Mahanagarir Obokathamo Ebong Poribesh Unayan Prokolpo* (2003 to 2004)" took one corer seven lakh taka Funded by

Bangladesh government for total 63 thousand 5 hundred 46 plantation. The last and ongoing project "Dhaka City Beautification Project" is cost about 150-crore for the greening of Dhaka through planting trees, and adding colour with flowering plants. With taka 50 lakh spent, then the cell came out with an innovative idea. The government will not have to spend any money for implementing the city beautification project as it is being done by public-private partnership. As for the benefits of the participating organizations, they are allowed to put their billboards, plaques or signs specified by the DCC (The Bangladesh Observer, 2004)

2 Recent program of "Dhaka City Beautification Project" is maintained by 90 private and government organization under the DCC supervision. Roads are divided in 99 intersections in the Dhaka city for tree plantation (appendix-E). Total 47.29 km road has been taken for study (table 1.1). From that study area, 37.18 km for median and 29.12 for roadside is used for plantation (table 3.13). From the survey 2004, it is observed that roadside was preferred for plantation. Most of the roads in Dhaka city are 4 to 6 lane with narrow median. Median width is approximately 0.15 m to 4.50 m (table 3.12).It is clear from that study, median is used more for plantation due to unavailability of strip land. But those median are too narrow for plantation.

3 Trend shows that the types of tree species are changing in Dhaka city. From the table 3.7, it is found that past plantation program of DCC was concerned about timber or fruit tree. In 2002 to 2003 they planted 55 thousand 8 hundred 46 tree in different place in Dhaka city which include *Mango, Black Berry, Jack Fruit, Olive Coconut, Mahagony, Arjun, Iron Wood Tree, Neem Tree, Bakul, China Box, Flam Tree* etc. (table 3.7). Recently the practice of using ornamental trees has been increased and the use of woody tree has been decreased to 79.59 percent in 2006 where it was 100 percent in 2004. Ornamental Plantations are *Allmanda Oleander, Goldmohur, Indian Laburnum Bougainvillea Jacaranda, Chinabox, Musunda, Ixora Gendha, Inka, Zhau, Silvia, Pantho Padop Kolabati* etc. (table 3.11). Among the woody type, *Weeping Debdaru*, a foreign verity, is predominating over local varieties of timber trees in Dhaka city (see 3.7.1 for more information).

Design of planting trees in roadsides is very much important factor in overall urban design. Reinforcement of the grid-iron pattern with straight rows of trees on both side of the street usually achieves grater aesthetic integrity and improves the scale and continuity of pedestrian zones (Arnold1980). But scarcity of land in Dhaka city both side of the road

cannot be counted for plantation except Mymensing Road, Bijoy Sarani and some part of Mirpur Road. All medians are planted with ornamental trees (like *Allmanda, Olender, Goldmohur, Indian Laburnum, Bougainvillea, Jacaranda, Chinabox, Musunda, Ixora Gendha, Inka, Jhau, Silvia, Pantho Padop Kolabati*) and timber plantation (like *Weeping Debdaru, Bakul, Mahagony Neem Tree, Madras Thron,)*. The entire median is planted with single row plantation with multiple species (table 3.15 and 3.16). It is found from table 3.16 that the trend was to plant same species throughout Dhaka city which now has changed to multiple species.

5 Urban trees and herbaceous open space can improve the overall urban environment (economic, social, aesthetical environmental) in many ways. The main aim of street plantation is to provide shade and comfort to the travelers. Tall tree with big foliage can provide shade to the traveler, but our street strips are not much wide to accommodate long tree with big crown. In that case median with ornamental tree can not provide shade and comfort to the traveler. Table 3.18 shows the comfortable roads from people perception. This is the evidence that most of the roads in this city which is not very comfortable from the perspective of having shades. From the questionnaire survey it is found that only Manik Mia Avenue is comfortable. The ornamental and flowering trees will never grow for ensuing comfort and providing shade. In our city major roads should be planted with tall trees which can give shades for years.

6 According to Rao (1987), 30 m wide trees cover can absorb 6 to 8 decibels of sound intensity. To reduce the noise made by truck/bus, a 20 to 30 meters wide tree belt can be built. Similarly a 7 to 8 meters wide tree belts can be planted to reduce noise made by cars. From Table 4.2, it can be assumed that within the study area, the highest tree covering exist in Mamynsing Road which ranges from 6.06-7.20 m. Though the intensity of tree coverage is not very satisfactory but it is easily possible to provide dense tree coverage in the both side of this road. One side of Bijoy Sarani ,Manik Mia Avenue and some part of Mirpur road have the provision for increasing tree coverage because lands are available at the strips of these roads.

7 Increasing number of healthy, long lived and low maintained tree can improve the air quality. Mainly urban air quality can be improved by increasing tree and shrub coverage. From table 3.10, it is shown that the trend of selecting evergreen healthy long lived trees has

been diminished and ornamental trees have been taken their place predominantly in the Dhaka city which basically cannot contribute to improve the air quality of the city. On the other hand, maintenance cost of ornamental trees is higher than other species which may not be suitable for long term plantation plan.

8 Spacing between the trees is very important factor for plantation design. Trees can grow properly in their fullest capacity of spreading crown and brunches with the availability of wide space around them. In Dhaka city, Mirpur road has tall trees like *Weeping Debdaru* in the median. This tall shade tree planted with 1 to 3 feet interval which is not sufficient for their proper growth. However, the tall trees are not suitable for narrow median, but a large number of *Weeping Debdaru* has been planted in the medians of Mymensing Road, Mirpur Road, Bijoy Sarani, some part of Rokeya Sarani. Planning tree spacing in relation to the light post spacing is likely to produce the best solution. This method may also bring to mind an alternate tree form or light fixture distribution pattern and may produce a better design (Arnold, 19980).

7.4 Recommendations

Urban forestry through increased road side tree plantation is an effective tool for maintaining ecological balance as well as for ensuring nice and healthy city. In many instances where land improvements projects were undertaken, an effective tree-scape could have been ensured and integrated within the same cost of landscaping. For making a healthy city through roadside plantation some recommendations came from the findings which have already mentioned above. Some more recommendations are given below:

Need sufficient room for plantation

For a green city, every open space should be used for different types of plantation as per their suitability with the available land. A standard should be followed for city road construction where the plantation plan can also be integrated effectively. The expertise opinion is that there should be a strong co-ordination in designing street and landscape together as an effective roadside tree plantation. The concerned authorities, Roads and High Way, LGED and RAJUK should take integrated planning and management scheme for provision of plantation while constructing further roads. The curbs plantation should be encouraged and ensured in all types of streets. When the trees reach maturity, the effect is more spectacular.

Right species selection

Species selection for roadside tree plantation may differ in the availability of space. Following steps should be taken for selection species in roadside tree plantation.

Species selection for strip land

To create urban forestry in Dhaka city timber and herbal tree should be planted in large scale on both sides of the road depending on the availability of land. Planting ornamental trees should be limited to very special roads as they need frequent maintenance and they become expensive. For strip plantation *Mahagony, Jarul, Weeping Debdaru, Bakul* etc. can be selected which were actually there in Dhaka city in the past.

Species selection for the median

In Dhaka city, the medians are glorifies with hodge podge little ornamental plants and other non plant constructions which contribute an unattractive street view. Evidently there is obviously scope for a unifying canopy of trees but in practice these available places are not been used for well designed plantation in our city street (see photograph 3.4a). In these narrow medians only bushy trees can be planted with other green coverage, for example, *kanta Mehedi, Red Border, Sheora* (busy), the local species are best selection for planning in the median strips. Jahangir Gate to Bijoy Sarani might be followed for other narrow median in Dhaka city while designing new plantation scheme. Some experts opined that *Weeping Debdaru* should not plant in narrow Median. If it is planted in a narrow median, it should be trimmed time to time to protect its proper growth.

Need tree plantation inventory

An effective plantation inventory should design by FD and Arboriculture department. This inventory should include name of the suitable species for urban forestry. There is a need for research in this area to understand the perfect species which can make a city green with low maintenance cost and can contribute in ensuring a healthy environment in a congested city like Dhaka

Chose pollution tolerant tree to improve the air quality

In urban area, tree plays a role to in improving air quality. On the other hand trees are damaged by atmospheric pollutants which common in a city. It is found that in Dhaka city,

ornamental tree plantation practice has been started in over polluted atmospheric condition. Our city roads are full of polluted air by automobile emission. Under environmental condition this ornamental tree may not survive in long run. In that case we will have to choose most pollution tolerant trees for center city planting. Local researchers should be consulted in addition to the national ones along with publications for having a list of tolerant tree species.

Need organizational co-relation

- Currently the trees growing in the cities can survive virtually without maintenance. They would be healthier and more attractive with proper maintenance. Different private and government organizations are responsible to manage and maintain the Dhaka city plantation schemes. This new approach of managing urban trees privately in Dhaka city is participatory and achieving the project targets. Existing plantation programs are not being reflected in the overall planning approach. There is an urgent need for this integrated planning consists of plantation planning with overall city planning.
- To make an effective planning, there is a need for co-ordination between Roads and High way, DCC, FD, and other public and private organizations which are responsible for managing city plantation. This coordinated planning process can make an efficient and healthy plantation program in a city which will contribute to increase the share of urban forestry.
- Overhead lighting, in streets must be coordinated with the tree planting.
- To make an effective and successful planning design for roadside plantation, a separate cell needs to be built including professional landscaping planners and designers.
- Provision of plantation of the roadside should be given emphasis in the construction of new road.

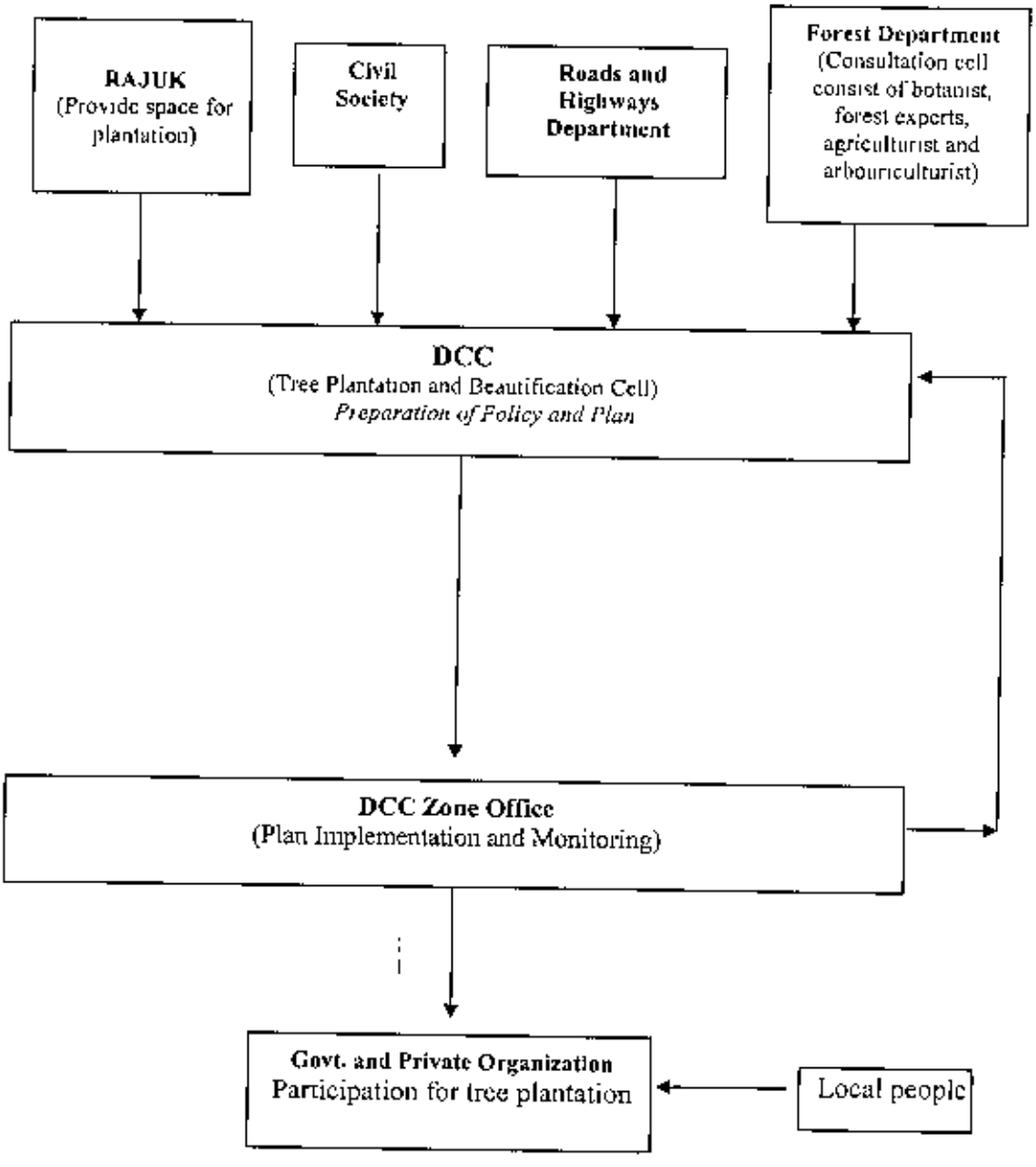


Figure 5.1: Proposed organizational diagram of tree plantation and beautification project in Dhaka City

Currently, DCC has a special cell for city beautification project which is working well. Additionally, DCC should give a plantation layout for all the roads of Dhaka city in consultation with Roads and Highways Department, Forest Department and RAJUK and civil society representatives. DCC should give a clear cut policy on the tree plantation for the whole city where design and implantation of the plans related to the beautification project should also be finalized only after getting inputs from the above mentioned stakeholders.

This beautification cell of DCC usually selects the private organizations who will implement the city beautification project through planting different kinds of trees Before selecting the firms DCC should consult with their zonal offices to get more information about potential private firms which can contribute more effectively to implement the project.

Forest department could be included directly in the whole process other than providing the consultancy. FD should prepare an inventory of the tree species according to the location, environmental need, space and weather of Dhaka city and publish a list of their inventories. FD should have an assigned cell to give technical assistance related to the plantation project. This cell should appoint expertise from different background, such as, agriculturists, architects, planners, arbouriculturists, forest experts etc.. This team will be responsible for providing information related to the efficiency of the plantation project to the DCC zonal officials as well as the private and government firms who will plant the trees at the end.

Rajuk should provide spaces while planning their new plots. They should make it mandatory to leave some spaces in the newly designed plots for plantation. RAJUK should plan the plots such a way that the plantation spaces get enough natural lights.

DCC zonal offices should maintain direct liaison with DCC Beautification cell for consultation before contracting out the plantation spaces to the private firms. These zonal offices will monitor the private firm's work according to the contract and provide written weekly reports about their performance to the DCC city beautification cell.

DCC zonal offices should encourage local people to plant more trees around their houses and provide the guidelines from the FD's inventory list. This office will be responsible for the implementation of the plantation project.

Both private and government firms should continue to play their role more innovatively in enhancing city beautification through plantation. They could also consult with forest department about how they can contribute more on increasing the forest coverage in Dhaka City. Private firms should submit weekly reports to the zonal office about their plantation situation, difficulties and contribution as per the contract. Local people can give their opinion to the firms and they can be integrated in the whole process of city beautification.

References

Arnold, H.F. (1980), *Trees in Urban Design,* Van Nostrand Reinhold Company, New York.

Agarwal, S.K.(1991), *Automobile Pollution and Control Aspects, Automobile Pollution,* Ashish Publishing House, New Delhi.

Ali (et al.2001), Peoples Report on Bangladesh Environment 2001,vol:I and II, in Sattar (2002) Bangladesh Environment , vol:I, Bangladesh Poribesh Andolon (BAPA), Ddhaka.

Alam, S. M. And Islam, N. (2006), *At A Glance Dhaka City (Ek Najare Dhaka Mohanagari),* Biam Foundation and Center for Urban Studies and City Corporation, Dhaka.

Acquaah, G. (1999), *Horticulture: Principles and Practices,* Simons and Schuster AViacom Company, New Jerssy.

Ahmed, N. (1999) "The Contribution of Tree/Greeneries to Urban Life." *CUS Bulletin,* no-37, 1999, July December, pp27, Dhaka.

Bangladepia.com.bd URLhttp://banglapedia.search.com.bd/Maps/MD_0145E.GIF access on 23 december,2006

BBS (1998) Statistical Yearbook of Bangladesh 1997.Bureau of Statistics, Ministry of Planning, Gov. Bangladesh. 419 pp.

BBS (Bangladesh Bureau of Statistics) (2001). statistical year book of Bangladesh 2001 Ministry of Planning, Government of The People's Republic of Bangladesh, Dhaka.

BBS (Bangladesh Bureau of Statistics) (2005). Handbook on Environment Statistics, 2005, October. Planning Division, Ministry of Planning, and Government of the People's Republic of Bangladesh.

Bentley, I (1985) *Responsive Environments- A Manual for Designers*, the Architecture Press,

Ck D.I. and Haverbeke, D.F. 1971. Trees and Shrubs for Noise Abatement, Univ.Nebracka Agri Exp.Sta. Res. Bull No. 246 77 Pp.

DCC (2005), Obokathamo *Unnayan Cell,* Dhaka City Corporation, Dhaka.

Davey (2004), "Trees are the Answer: Facts about Trees" The Davey Tree Expert Company, URL: http: www davey.com access on September 15, 2006.

Dhaka City Map 2000, Capital of Bangladesh, collected from http://dhakadailyphoto.blogspot.com/2007/06/maps-dhaka-and-bangladesh.html, last visited on September 3, 2007

Esrar, I.(1993) "Home Based Trip Generation Modeling for Dhaka City" unpublished master's thesis, Department of Urban and Regional Planning, BUET,Dhaka.

Environment Management Urban the Linkage Program Between Bangladesh University of Engendering (Technology (BUET) North Carolina A and T State University (NCATSU), organized By Directorate of Continuing Education, BUET, 7-9, 2004.

FAO 1993 *Forest Resources Assessment 1990-Tropical Countries*, FAO Forestry Paper No.112.Rome

Farooque, M. (1997) *Law and Custom on Forests in Bangladesh: Issues and Remedies* Bangladesh Environmental Lawyers Association (BELA), Dhaka, Bangladesh.

Federer, C.A. (1971), Effects of Trees in Modifying Urban Microclimate in Trees and Forest in an Urbanizing Environment. Univ. Mass. Coop. Ext Service Monograph .No.17.23-28

Forest Department (2004), National Plantation Movement and Tree Fair 2004, FD, Gob

Grey, G.W. and Deneka, F. S. (1978) *Urban Forestry*. John Willy and Sons, New York.

Huda, N. and Roy, K. N. (2000) "state of the forest" Bangladesh state of environment report 2000, p.178, Dhaka.

Huda, N. and Roy, K. N. (2000) "state of the forest" Bangladesh state of environment report 2000, p.178, Dhaka.

Hossain, Z.A.B.M (2002), *Medical Plant Fruit Flower Tree Cultivation Use and General Health Care*, Charulipi Prokashan, Banglabazar, Dhaka.

Hossain, S (2004), "City Greening Move Fast" News from Bangladesh, URL:http://www.bangladesh_web.com

Islam, K. (2005), Beautification Project Struggling, *The Daily Star*, 2nd October.

Islam, T. S. (2002) "Grinning and Fading the Dhaka City: Past, Present and Future Perspectives" A Non Published Report August 2002, Submitted to the Asiatic Society of Bangladesh Dhaka.

Islam, M., Hoq, S.A.K.M and Hossain, M. M. (2002) "Social Forestry: A New Dimension of Afforestation". A Compilation of Technical Papers Presented at the 2nd International Conference (ICBEN) 2002, held in Dhaka on December 19-21, 2002, Published by Bangladesh Poribesh Andolon (BAPA), Dhaka.

Karmakar, Arun (2005), "City Greening is Faded (Shobaz Nagari Ekhon Dhushor)", *The Daily Prothom Alo*, 2[6th] June.

Kramer, P.J. And Kozlowski, T.T. (1970) *Physiology of Trees*. Mc.Graw-Hill, New YORK.

Kuhns, I., Gover, A. and Johnson, J. (2005) "Successful Roadside Tree and Shrub Planting" URL: http://www.govemgr.com, Access on 15 July 2006.

Kucheilmeister, G. (2000), Tree for the Urban Millennium: Urban Forestry Update. Unasylva, No51: Vol 49-55.

Kucheilmeister, G. (1998) "Urban Forestry in the Asia-Pacific Region-Status and Prospects" Asia pacific forestry sector outlook study working paper series no 44.rome, FAO.

Kucheilmeister, G. and Braatz, S. (1993) Urban Forestry Revisited. Unasylva, NO.51: Vol 49-55. URL http://www.fao.org/forestry/site/unasylva/en/ Access on 18 December 2006

Lynch, K. (1972), *Site Planning*, The M.I.T. Press, Press, Cambridge. Massachusetts, and London, England. Colonial Pres Inc. United State of America.

MoEF 1993, *Forestry Master Plan, Main Plan – 1993-2013*, Ministry of Environment and Forests, Dhaka.

Nowak, D. (2000). Tree Species Selection, Designed Management to Improve Air Quality Construction Technology. *Annual Meeting Proceedings of the American Society of Landscape Architects.*

Negi, S.S. (1986) *A Handbook of Social Forestry,* International Book Distributors, Book Sellers and Publishers, Dehra Dun, India.

Olembo, R J. And Rhman, D. (1987) "Urban Forestry in Tow Different Worlds", Unasylva, Vol. 155, No.39:Pp. 26-35.

Pandy, D. (1995) "Forest Resources Assessment 1990-Tropical forest plantation resources" Report No 128, FAO, Rome.

Participatory Forestry Newsletter, 2004. Bulletin No. 2 June, Bangladesh Forest Department.

Rao, S. M. (1987) *Introduction to Social Forestry*, Mohan Primalani for Oxford and IBH, New Dehli, India.

Rezauddin, M. (19999). *Personal Communication*, Department Of Environment, Gov. Bangladesh, Dhaka.

SDNP (2005), "World Environment Day 2005: From Grim City to Green City", URL: http://www.sdnpbd.org/sdi/international_days/bangladesh Access on 9 August 2006.

Sharma, D. (1980*), Description of Trees (Shyamolee Nirsharga),* Bangla Academy, Dhaka

Sharma, D. (2000), *Nishargo, Nirman O Nandonic Bhabna,* University Press Limited, Dhaka.

Sultana, M. (2004), "Beatifying Capital city" The Financial Express, URL: http://www.financialexpress-bd.com/index3.asp

Sattar,M.A.(2000),"Urban Forestry In Bangladesh for Maintaining Environment" A Compilation of Technical Papers Presented at The 2nd International Conference (ICBEN) 2000, Held in Dhaka on January 14-15, 2000, Published By Bangladesh Poribesh Andolon (BAPA), DHAKA.

Sargreiya, (1941), "Ornamental Trees, Their Planting and Care", C.P. Forest Voll No.4.P.66, Gvt Printing .C.P and Berar, Nagpur.

The Bangladesh Observer, (2004) Road Beautification between ZIA Banani Completed, City News,andJuly16,2004collectedfrom<http://www.bangladeshobserveronline.com/new/2004/07/16/city.htm> (accessed on January 3, 2007)

The Bangladesh Observer (2004), "So how are the Street Actually Looking" June 6, 2004 collected from URL: http://www.bangladeshobserveronline com/news/ (accessed on June 13, 2007)

Tiwary, K.M., Sing, R.V. (1984), *Social Forestry Plantations Along Roadside, Railway Lines and Canals,* Mohan Primalani for Oxford and IBH, New Dehli, India.

Wright H. (1996). *Highway Engineering,* Jhon Wiley and Sons, Inc. New York.

WRI and CDIE (1990), "Environment and Natural Resource Assessment", Final Report, P19, USAID, Washington D.C.

World Environment Day (2005), "Bangladesh Desertification" banglapedia, national encyclopedia of Bangladesh <URL:httwww.sdnpbd.org/sdi/internationaldays/wed/2006/bangladesh/landuse.htm,> (accessed on June 10, 2005)

Zabala, N. Q. (1991) "Urban Forestry and World" Repot No. BGD-85 / 001, Field Document No. 29.133 pp, FAO / UNDP.

Zaman, M. (2005), The Costly Cosmetic Job, *star weekend magazine,* 4rth February.

Appendix-A

Table: Total plantation in study area

Name of The Major Road	Name of The Studied Intersection	2004			2006		
		Timber	Ornamental	Total	Timber	Ornamental	Total
Mymensing Road	Zia International Air Port to Mohakhali Flyover	4013	0	4013	5780	64220	70000
Air Port Road	Mohakhali Fly Over to Farm Gate	631	0	631	744	738	1482
Kaji Najrul Islam Avenue	Farm Gate to PS Shabag	0	0	0	102	643	750
Bijoy Sarani	Porjoton Office to China Conference	757	0	757	2085	132	2217
Mirpur Road	Nilkhet to Mirpur 14 Army Gate	2568	0	2568	6103	2960	9063
Satmosjid Road	Bdr 4 No Gate To Dhanmondi 27	300	0	300	300	1476	1776
Tajuuddin Ahmed Sarani	Satrasta Mor to Taltola Shooting Club	66	0	66	790	690	1480
Pragati Sarani	Bisharoad and Mymensing Road Interlink to Badda Ps	714	0	714	714	1090	1804
Agargaon Road	Mirpur Agargaon Intersection to Agargaon Rokey Sarani Intersection	0	0	0	684	1040	1724
Hazi Mollah Sorok	Mirpur 10 To 12	678	0	678	734	568	1302
Gulshan Avenue	Gulshan Shooting Club to Pakistan Embassy	1979	0	1979	2246	9254	11500
Rokeya Sarani	China Conference to Mirpur 10	1213	0	1213	1213	163	1376

Appendix B: Questionnaire

Name of the interviewer:

Profession: Date:

1. Which road have well designed plantation, what do you think?

Name Of Road	Well Design Plantation	Moderate Design Plantation	Poor Design Plantation
Mymensing Road (Zia International Airport to Mohakhali Fly Over)			
Bijoy Saroni			
Rokeya Saroni (China Maitri to Mirpur 10)			
Mirpur Road (Science Laboratory to Mirpur 2)			
Kazi Najrul Islam Avenue (SAARC Foara to Shabag)			
Air Port Road (Mohakhaly Fly Over to SAARC Foara)			
Progoti Sarani (American Embassy to Mymensing Road Intersection)			
Manik Mia Avenue			
Panthapath			
Satmosjid Road (BDR 8 No Gate to Dhnmondi 27)			

2. Which road is most comfortable in relation to provide shade, what do you think?

Name Of Road	**Most Comfortable**	**Moderate**	**Uncomfortable**
Mymensing Road (Zia International Airport To Mohakhali Fly Over)			
Bijoy Saroni			
Rokeya Saroni (China Maitri To Mirpur 10)			
Mirpur Road (Science Laboratory To Mirpur 2)			
Kazi Najrul Islam Avenue (SAARC Foara To Shabag)			
Air Port Road (Mohakhaly Fly Over To SAARC Foara)			
Progoti Sarani (American Embassy to Mymensing Road Intersection)			
Manik Mia Avenue			
Panthapath			
Satmosjid Road (BDR 8 No Gate to Dhnmondi 27)			

3. Give Your Overall Suggestion about present plantation project in Dhaka city

Appendix-C

Interview Questionnaire

1. what is the positive and negative things of Dhaka city beautification project
2. do you thing this plantation program contributing to the urban forestry
3. Do u encourage to plant ornamental tree in our city road?
4. Recent plantation program has given to different organization for management and maintenance; do you think this approach can contribute to city greening more than before plantation program?
5. What types of species should plant in an urban roadside and median. what is your opinion?

Appendix-D

Table: Local and scientific name of trees in study road

Serial no.	Local name	English name	Scientific name
1	Arjun	White Muradah	*Tarminalia Arjuna*
2	Ashvattha	Peepul Tree	*Ficus Religiosa Linn*
3	Alokananda	Allamanda	*A.Cathartica*
4	Belati Jhau	Australian Oak, Beef Wood	*Casuarina Equisetifolia Forst*
5	Bakul	Indian Medlar	*Mimsops Elengi Linn*
6	Bottle Brush	Bottle Brush	*Callistemon Lanceolatus*
7	Bagan Bilsh	Bougainvillea	-
8	Dakshini Babul	Madras Thorn,	*Pithecolobium Dulce Benth*
9	Debdaru	Mast Tree	*Polyalthia Longifolia*
10	Genda	Merigold	*Togetes Erecta*
11	Jarul	Queen Flower	*Lagerstroemia*
12	Zhau	Zhau	*Casuarinasequistifilia*
13	Jacaranda	Jacaranda	*Jacaranda Mimosa*
14	Joba	Chaina Rose	*H. Rosa-Sineriss Lm.*
15	Krishnachura	Flame Tree	*Delonix Regia Raf.*
16	Kat Badam	Indian Almond	*Terminalia Catappa Linn*
17	Kamini	Chinese Box	*Murraya Paniculate (Linn)*
18	Khajur, Khejur	Date Palm	*Phoenix Sylvestris Roxb*
19	Mahagini	Mahagany	*Switetenia Mahagoni Linn*
20	Madhuchanda	Musunda	-
21	Nim	Margosa Tree	*Azadirachta Indica A .Juss.*
22	Narikel	Cocoanut Palm	*Cocos Nucifera Linn*
23	Panthapadap	Travellers Tree	*Ravenala Madagascariensis*
24	Royal Palm	Royal Palm,Mountain Glory	*Roystonea Regia O.F. Cook*
25	Rongan	Ixora	*Rubiaceae*
26	Sonail	Indian Laburnum,Golden Shower	*Cassia Fistulallinn*
27	Tal	Palmyra Palm	*Borassus Flabellifer Linn*

Appendix-E

Table: Survey list of plant species of Dhaka in 1965

No	Bangla name	Scientific name
1	Champa	*Michelia Champaca*
2	Debdaru	*Polyalthia Longifolia*
3	Sajna	*Moringa Oleifera*
4	Kamranga	*Averrhoa Carambola*
5	Jarul	*Logerstroemia Speciosa*
6	Silver Oak	*Grevillea Robusta*
7	Chalta	*Dillenia Indica*
8	Kanak Chapa	*Ochna Squarrosa*
9	Telsur	*Hopea Odorata*
10	Kalojam	*Syzgium Cumini*
11	Eucalyptus	*Eucalyptus Citriodora*
12	Hizol	*Barringtonia Acutangula*
13	Naglingam	*Couroupita Guianensis*
14	Kath Badam	*Terminalia Catappa*
15	Arjun	*Tarminala Catappa*
16	Arjun	*Tarminalia Arjuna*
17	Nageswar	*Mesus Nagassarium*
18	-	*Leuchea Endopogon*
19	-	*Berria Cordifolia*
20	Budhanarikel	*Pterygota Alata*
21	Jangli Badam	*Sterculia Foetida*
22	Muchkunda	*Pterospermum Acerifolium*
23	Shimul	*Bombox Ceilba*
24	Paras Pipal	*Thespesia Populnea*
25	Putranjiva	*Drypetes Roxburghi*
26	Amlaki	*Emblica Officinals*
27	Krishnachura	*Delonix Regia*
28	-	*Cassia Nodosa*
29	Sonail of Bandar Lathhi	*Cassia Fistula*
30	Asoka	*Saraca Indica*
31	Debkanchan	*Bauhinia Variegate*
32	Tentul	*Tamarindus Indica*
33	Rain Tree	*Enterolobium Saman*
34	Shirish	*Albizzia Lebbek*
35	-	*Albizia Richardiana*
36	-	*Acacia Monoliformis*
37	Dakshini Babul	*Pithecolobium Dulce*
38	Palash	*Butea Monosperma*
39	-	*Gliricida Maculate*
40	-	*Millettia Ovalifolia*
41	Sisu	*Dalbergia Sissoo*
42	Karanja	*Pungamia Pinnata*
43	Mandar	*Erythrina Variegate*
44	Padauk	*Pterocarpus Indicus*
45	Bakphul	*Sesbania Grandiflora*

No	Bangla name	Scientific name
46	Bilati Jhau	*Casuarina Equisetifoia*
47	Kathal	*Artocarpus*
49	Bot	*Ficus Benghlensis*
50	Ashttha	*Religiosa*
51	Bel	*Aegle Marmelos*
52	Kamini	*Murraya Paniculata*
53	Nim	*Azadirachta Indica*
54	Mchagini	*Swietenia Mahagoni*
55	Kusum	*Schleichera Oleosa*
56	Lichu	*Litchi Chinesis*
58	Aam	*Mangifera Indica*
59	Ankura	*Alangium Salvifolium*
60	Tamal	*Diospyros Cordifolia*
61	Gab	*Diospyros Perigrina*
62	Mahua	*Madhuka Indica*
63	Bakul	*Minsops Elengi*
64	Sapheda	*Manilkara Zaota*
65	Shephali	*Nyctanthes Arbor-Tristis*
66	Chameli	*Plumeria Rubra*
67	Chhatim	*Alstonia Scholaris*
68	Kurchi	*Holarrhena Antidysenterica*
69	Kalki	*Thevetia Peruvian*
70	Gamhar	*Gmelina Arborea*
71	-	*Spethodea Camppanulata*
72	-	*Tababuia Triphylla*
73	Kadom	*Anthocephalus Chinesnsis*
74	Segun	*Tectona Grandis*
75	Panthopadap	*Revenala Madagascariensis*
76	Narikel	*Cocos Nucifera*
77	Supari	*Areca Catechu*
78	Khejur	*Phoeix Sylvestris*
79	Palm	*Roystonea Regia*
80	Bansupari	*Caryota Urens*
81	Tal	*Borassus Flabellifer*
82	-	*Livistona Chinensis*
83	Ipil Ipil	*Leucaena Lencocephala*
84	Parul	*Sterospermum Suaveolesns*
85	-	*Jacaranda Mimosifolia*
86	Akash Nim	*Millingtonia Hortensis*

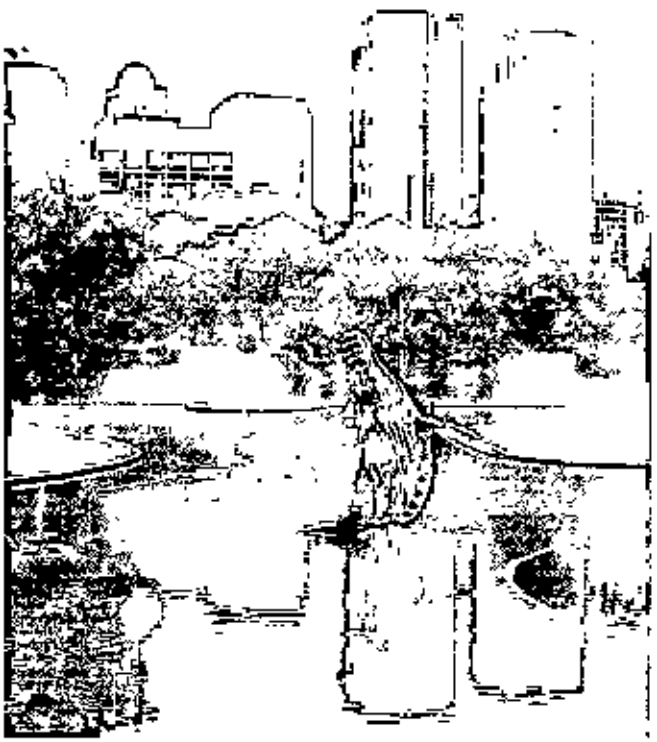
Source: Sharma, D., 1980.

Appendix-F

Some examples of roadside tree plantation in different country

Road side tree plantation in china

Roads are choice site for tree planting, providing motorists with pleasant scenery and screening out traffic dust and noise: rain trees (samenea saman) line a protocol road leading to the Parliament house of Malaysia



City parks are major attractions for recreation and tourism-pictured, a landscape with indigenous species at Kuala Lampur city centre (KLCC) park

Name	Position/ Organization	Signature	Date /Time
Md. Shakil Bin Kashem	Lecturer, Dept. of URP BUET		6/09/06
SHAMIM ARA HASSAN	ASSOC PROF. DEPT OF. ARCH BUET		11/09/06
Dr. Md. Nazrul Islam	Associate professor Dept. of Horticulture		13/09/06
Dr. Nurul Islam Nagem	Dept. of Geography & Environment Dhaka University		2/12/06
Prof. Nazrul Islam	Chairman, CUS		5.12.06
Radhagobinda Roy	DCA (Concord Group of Comp.		22.05.07
ASHRAF ZIAUR RAHMAN	SR. Res. Architect		23/05/07
Javed Hossain Khadem	Architect	J. H. Khadem	23/05/07
A. B. M. S. Zaman	Architect		23/05/07
Nandini Sanyal	Researcher Dept. of Geography & environ Univ. of Durham	Nandini	3.11.06
Sheikh Towhidul Islam	Assistant Prof., Professor Geography Jahangirnagar University	ST Islam	17.11.06

Name	Position/ Organization	Signature	Date / Time
Md. Shakil Bin Kashem	Lecturer, Dept of URP BUET		6/09/06
SHAMIMARA HASSAN	Assoc Prof. Dept. Of. Archi BUET		11/09/06
Dr. Md. Nazrul Islam	Associate professor Dept of Horticulture		13/09/06
Dr. Nurul Islam Nazem	Dept of Geography & Environment Dhaka University		2/12/06
Prof. Nazrul Islam	Chairman, CUS		9.12.06
Radhagobinda Roy	DCA (Concord groups of Comp.		22.05.07
ASHRAF ZIAUR RAHMAN	SR. Res. Architect		23/05/07
Javed Hossain Khadem	Architect		23/05/07
A.B.M.S. Zaman	Architect		23/05/07
Nandini Sanyal	Researcher dept of Geography & environ Univ of Durham U.K		3.11.06
Sheikh Towhidul Islam	Assistant Prof Dept of Geography Jahangir Nagar University		17.11.06