# PLANT SPECIES DIVERSITY OF ROOF TOP GARDEN IN DHAKA CITY

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**PLANT SPECIES DIVERSITY OF ROOF TOP GARDEN IN DHAKA CITY**

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# *CERTIFICATE*

*This is to certify that the thesis entitled "**PLANT SPECIES DIVERSITY OF ROOF TOP GARDEN IN DHAKA CITY**" submitted to the **Faculty of Agriculture,** Sher-e-Bangla Agricultural University (SAU), Dhaka in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (MS) IN AGROFORESTRY & ENVIRONMENTAL SCIENCE,** embodies the results of a piece of bonafide research work carried out by **TANIA HOSSAIN, Registration no. 08-02926** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

*I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.*

**Dated: December 2014**

**Place: Dhaka, Bangladesh**

**_____**

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## ABSTRACT

Dhaka, the capital city of Bangladesh has experienced a higher rate of urban growth in recent decades and emerged as the world's fastest growing mega city. So, the city is facing incredible problems associated with the loss of plant diversity and a threat for our urban agriculture and environment with long term humanity problem but plant species diversity is a resource, property and the characteristic of plant kingdom. We depend on it for our security and health. So to improve the quality of healthy living and to create better opportunities for social and environmental benefits; rooftop gardening will be the solution and natural habitats to conserve some diversity in Dhaka city. With an overview of roof top gardening concept in the global context, the study was conducted within the DAE projected 4 metropolitan area of Dhaka city with the main aim to assess plant species diversity of rooftop garden in Dhaka city with inter species diversity of different plant groups and the prevalence of different plant species and to explore the relation between the plant species diversity and the selected characteristics of garden owners. Both primary and secondary data were collected with reconnaissance survey, direct observation, key informant interview, questionnaire survey and group discussions. The collected data were analyzed by using SPSS and MS Excel. The result revealed that the roof top garden of Dhaka city posses high plant species diversity where Shannon-Weaver diversity index were 3.84. Among species richness, 35 species were fruit and 10 species were medicinal which encompasses 84 families. Mango, beli, brinjal, patabahar and pudina were found most prevalent in their respective category. Inter species diversity was the highest (0.799) in the vegetable species and lowest in medicinal species (0.795). Sixty five percent of the garden owners have higher plant species diversity and 62.5 percent gardeners were interested in rising of roof top garden because they think that gardening products consumption are healthy. Roof top garden showed the direct relationship of plant species diversity with the selected characteristics of the garden owners where age, education, family size, management for gardening had no significant relationship with the plant species diversity. The remaining six selected characteristics such as area of gardening, spending time for gardening, training for gardening, input availability for gardening, problem faced for gardening and income of the garden owners had positive significant relationship with the plant species diversity. Garden owners faced pest attack problems during gardening practices which destroyed the products severely. Manpower seems to be a problem in some houses to look after the garden; in that cases paid services should be provided to continue the gardening activities. Adequate training, motivation and sustainable management are required to encourage the city people in practicing roof top garden to improve plant species diversity elsewhere in Bangladesh based on residential and rental houses.



**Key Words:** Plant species diversity, Roof top garden

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## LIST OF ABBREVIATION

| ABBREVIATION | FULL WORD |
|---|---|
| DAE | Department of Agricultural Extension |
| 0C | Degree Centigrade |
| df | Degree of freedom |
| hr | Hour |
| % | Percent |
| MS Excel | Microsoft Excel |
| RTG | Roof Top Garden |
| SPSS | Statistical Package for Social Science |
| Std. Dev. | Standard Deviation |

# CHAPTER I
# INTRODUCTION

## 1.1 General Background

Dhaka, the capital city of Bangladesh has experienced a higher rate of urban growth in recent decades and emerged as the world's fastest growing mega city. Due to unrestrained urban growth, it will be the fourth largest urban agglomeration of the world with a population of 160.4 million by 2015, up from the 2013 estimate of 156.5 million (World Population Prospects, 2016). This makes Bangladesh the 8$^{th}$ most populous country in the world. The city is considered the largest in all of Bangladesh and the overall metropolitan area is the 9$^{th}$ largest city in the entire world. So, the city is facing incredible problems associated with unplanned development, high level of poverty, social vulnerability, inadequate infrastructure, lack of social services, poor quality of physical and social environment, and inefficient urban management. In urbanization process, it is found that about 20 percent vegetation cover that was present in 1989 has gradually decreased to 15.5 percent and 7.3 percent in the year 2002 and 2010, respectively. Vegetation was found in the Dhaka metropolitan area is only 1.87 percent. The loss of plant diversity has been a common concern of mankind and a threat for our agriculture, environment, and forest also poses long term humanity problem. Diversity of life in all its forms and at all levels of organization has come under serious threat in many places in recent times. Several of the global hotspots of biodiversity are at the same time areas where human population density has increased tremendously, which has contributed to current global species extinction levels paralleling to previous mass extinction events (Myers *et al.*, 2001). To solve this severe problem, rooftop gardening will be the solution and natural habitats to conserve some diversity (Kandit *et al*., 2005) in Dhaka city.

Roof top gardens (RTG) are man-made green spaces on the topmost levels of industrial, commercial, and residential structures. They may be designed to grow produce, provide play space, give shade and shelter, or simply be there as a living, green area. Plants are grown for a variety of utilitarian and non-utilitarian purposes (Sajjaduzzaman *et al.,* 2005). Rooftop garden can supplement the diets of the community it feeds with fresh produce and provide a tangible benefits tie to food production. Plant species diversity is a resource, property and the characteristic of plant kingdom. We depend on it for our security and health; it strongly affects our social relations and gives us freedom and choice. In this case, RTG can be an effective method to rich biodiversity which is important in maintaining the balance of nature (Hoggerbrugge and Fresco, 1993).

## 1.2 Rationale of the study

Roof top garden can be one of the best solutions against deforestation in the cities. City's gardeners and agriculturists, however, cite yet another reason why more house owners getting keens having a patch of greenery on their roofs, which is, they want vegetables and fruits fresh and free from poisonous chemicals. So the objectives of the research are to study plant species diversity of rooftop garden in Dhaka city and to explore the relation between the plant species diversity and the selected characteristic of garden owners for the continuing of roof gardening in Dhaka city. The main aim of this study is to furnish the knowledge of gardening practices for improving the diversity of plant species. This research helps to assess the contribution of RTG to meet the needs of urban garden owners. As the roof top garden technique encompass a wide variety of system and diverse array of herb, shrub, climber and trees species, this research will be attempt to find out the contribution in the conservation of precious natural resources. The finding of the research will be directly beneficial to the garden owners as they get feedback from the research findings. The findings will also useful to all garden owners that

fall in similar ecological zones to get idea for the adoption of new alternatives as roof top gardening or improving the existing practices.

### 1.3 Statement of the problems

In view of the importance of roof top gardening in diversity measurement the investigators of this survey were highly interested to find out the diversity and problems of roof top gardening in Dhaka city entitled "Plant Species Diversity of Roof Top Garden in Dhaka City.''

This study attempted to find out the answer of the following research questions:

1. What are the respondents selected characteristics?

2. What is the level of diversification of the roof top gardening of the respondents?

3. Are there any relationships between the selected characteristics of the respondents with their diversity present in the roof top garden?

### 1.4 Objectives of the study

1. To assess plant species diversity of rooftop gardening in Dhaka city;
2. To assess the inter species diversity of different plant groups and the prevalence of different plant species; and

3. To explore the relation between the plant species diversity and the selected characteristics of garden owners.

## 1.5 Justification of the study

Many studies have so far been conducted on plant species diversity of various aspects of agriculture. But no research has been reported in home and abroad to determine the plant species diversity of roof top garden. However, it is very important to ascertain the plant species diversity due to the loss in urbanization process. Peoples live in Dhaka city which is increasing day by day. On the other hand the numbers of plants of this city are decreasing rapidly. For the modern civilization, our children have to live without green environment that is plants. We have to live just like robot with plants free environment. So avoiding this unfriendly environment, we have to build up garden on every multistoried building and government quarter which will increases the diversity.

In order to achieve this target it is essential to undertake a program or project to motivate for the building owners of Dhaka city for increasing the plant species diversity because plant diversity is a resource, a property and the characteristic of plant Kingdom. However, before making awareness of the respondents for roof top garden it is necessary to gain clear-cut idea about the present status of plant species diversity of roof top garden of the respondents. On the above circumstances the researcher has undertaken the present study entitled "Plant Species Diversity of Roof Top Garden in Dhaka City.''

## 1.6 Assumption of the study

An assumption is the supposition that an apparent fact or principal is true in the light of the available evidence (Good and Hatt, 1983). Following assumption were in the mind of the researcher during conducting the study:

1. The study respondents were competent enough to furnish proper responses to the questions contained in the interview schedule.

2. The researcher who acted as interviewer feels comfortable with study areas social and environmental conditions. Hence, the data collected by her from the respondents were free from bias.

3. Respondents view and opinions were the representative's views and opinions of the whole population of the study area.

4. The responses furnished by the respondents were valid and reliable.

5. The findings might have general application to other parts of the country where similar socio-economic and cultural condition are in view.

### 1.7 Limitation of the study

In order to conduct the research in a meaningful and manageable way, it becomes necessary to impose some limitations in certain aspects of the study. Considering the time, money, labor and other necessary resources to the researcher, the following limitations have been observed throughout the study:

1. The study was conducted only four metropolitan areas under Dhaka city.

2. Characteristics of the garden owners were many and varied but only ten characteristics were sleeted for investigation in this study.

# CHAPTER II
# REVIEW OF LITERATURE

The aim of this chapter is to describe the review of the past research conducted in line of the major focus of this study. Literature having relevance to the present study has been reviewed in three sections. The first section deals with literature on diversity such as species diversity, species richness, relative prevalence, inter species diversity, roof top garden and purpose of gardening. The second section deals with review of studies dealing with the local name of plants, scientific name of plants with family, genus and habit of the plants. Finally, the last section of this chapter deals with the conceptual framework of the study.

## 2.1 Diversity in different agricultural aspects

### 2.1.1 Species Diversity

Species diversity is defined as the number of species and abundance of each species that live in a particular location (Magurran, 1988). There are numerous reasons why species diversity is essential. Each species has a role in the ecosystem. For example, bees are primary pollinators. Imagine what would happen if bees went extinct. Fruits and vegetables could be next, and subsequently the animals that feed off them - this chain links all the way to humans. Various species provide us not only with food but also contribute to clean water, breathable air, fertile soils, climate stability, pollution absorption, building materials for our homes, prevention of disease outbreaks, medicinal resources, and more. Species diversity contributes to ecosystem health. Each species is like a thread holding together an ecosystem. If a species disappears, an entire ecosystem can start to unravel. Species diversity is crucial for ecosystem health.

Human disturbance on natural ecosystems is the major threat to local biodiversity. A pool of species will eventually go locally extinct unless its habitat is repaired or

restored (Dobson *et al.,* 1997). Human efforts to aid the degraded habitat restoration will increasingly become a crucial aspect of the conservation of biodiversity. The application of roof top garden as an integrated approach to biodiversity conservation on garden level in support of nature reserves has received some attention (Dobson *et al*., 1997; Sanchez, 1995).

Studies that take into account the ability of plants to uptake and manage resources have strongly highlighted the importance of functional groups and functional diversity (Lacroix and Abbadie, 1998). A function group is defined as a set of species (taxa) with similar impacts on ecosystem process (Hobbs *et al*., 1993). They are characterized by a set of common biological attributes that relate with their behavior. Related studies that link biodiversity and ecosystem function have been recognized as a way to improve our knowledge on the causal connections between biological variability and ecosystems (Lacroix and Abbadie, 1998). Even though attempts to study the impacts of roof garden on environment have received attention (Sanchez, 1995), our knowledge on the causal mechanisms and approaches to evaluate the influence are poorly documented.

Sharmila (2003) found species diversity in Bharsa 4.03, Baikunthapur 4.25, Terai overall 4.25 and Gulmi 4.418 in Home gardens in western Nepal: Opportunities and challenges for on farm management of agrobiodiversity.

### 2.1.2 Species richness

The number of species that live in a certain location is called species richness.

Mostafa (2013) has published an article named ‘Present Status of Rooftop Gardening in Sylhet City Corporation of Bangladesh: an Assessment Based on Ecological and Economic Perspectives’. He has reported that the survey recorded 53 plant species (35 families) of which Cucurbitaceae family represented highest

eight species. Shrubs (28%) were highest followed by herbs (26%) among agri-crops (36%) and flower species (30%). About 89% of the rooftop gardeners procured planting materials from nursery, market, fair, neighbor, relative and friends and they mostly prefer to use seedlings (48%) for roof gardening followed by direct seed sowing (21%). Gardeners sell products sporadically in different local markets, directly or through intermediaries, with no uniform pricing for system. Rooftop gardening improves the food security and meet nutritional deficiency to the gardeners. Survey revealed that generally very few people consider rooftop gardening commercially to get profit and from the cost-return analysis this gardening system can be economically viable if proper and scientifically managed.

Mannan (2013) has published an article named 'Plant Biodiversity in the Hoar Homesteads of Bangladesh'. He has reported that the eighty four useful plant species were identified during study. Among them 33.33% fruits, 28.57% timber 22.62% summer vegetables and 15.48% were winter vegetable. Number of fruits species were found highest (28 spp) followed by the timber (24 spp), summer vegetables (19 spp) and winter vegetables (13 spp). Coconut, Mahagani, brinjal and bottle gourd were found most prevalent in their respective category.

Suman (2011) has published a thesis paper named 'Contribution of Agroforestry in Biodiversity Conservation and Rural Needs Fulfillment'. He has reported that the Species richness and evenness are very high in study area, which is higher in Bari land than khet and kharbari land. Similarly, Khetland is lower than Bari land and kharbari land. Species richness and evenness are also shown high in kharbari land. Species richness and evenness have shown high in fodder species followed by fruit, medicine, grass, herbs and shrubs, timber and live fences. Agroforestry systems showed the direct relationship of biodiversity conservation and plantation of multipurpose tree species in farmland especially in Bari land with the

fulfillment of diverse needs of the farmers to uplift their socioeconomic condition. There were 172 numbers of species with their respective no. of 64 families found in the study area. Annual consumption of fruit was high. Medicine consumption is very low quantity than other forest product. Contribution of fodder, fruit, and fuel wood, and medicine trees, local and exotic grass seems satisfactory. 72 MAP species were found for agroforestry (Silvomedicinal system) in the study area.

Islam (2001) has published an article named 'Roof gardening as a strategy of urban agriculture for food security: the case of Dhaka city, Bangladesh.' He has reported that about 60 varieties of fruits and vegetables are produced in Bangladesh. Not all types can be produced on the rooftop. The types and mix are chosen in the city depending upon individual household food preferences, availability of seeds types that can be grown on the rooftop, climate and availability of soils. In the food garden the following fruits and vegetables are commonly grown; Guava, Lemon, Papaya, Grapes, Green Chili, Pumpkin, Squash, Onion, Garlic, Coriander leaves, Tomato, Mushroom, Leafy vegetables (e.g., Callaloo, Jute Leaf and Red Amaranthus), and other (e.g., Cucumber, Flat bean, Bitter ground, Ribbed ground, Ladies finger, Amaranthus, Dhudi, Cowpea and Brinjal). Some families also cultivate spices and plants used for medicinal purposes.

### 2.1.3 Relative prevalence

Mannan (2013) has published an article named 'Plant Biodiversity in the Hoar Homesteads of Bangladesh'. He has reported that the mango in 79.33%, guava in 63.67% and papaya in 51.67% haor homestead. Dendrogram analysis shows that betel nut in fruits, mehogony in timber, snake gourd in winter vegetable and red amaranths in summer vegetable were found as the prime contributor of diversity in their respective category.

### 2.1.4 Inter species diversity

Mannan (2013) has published an article named ‘Plant Biodiversity in the Hoar Homesteads of Bangladesh’. He has reported that the inter species diversity was highest (0.799) in the fruit species and lowest in summer vegetable. Among the fruit species coconut was found in 80.67% hoar homestead.

### 2.1.5 Roof top garden

Role of roof top garden systems in biodiversity conservation and urban household consumption in a private land of garden area is biologically and socially more suitable for either through vegetable trees, fruit trees cultivation. A common hypothesis is strongly implied to the roof top garden systems that integration of variety of tree species with herbaceous crops increase the biodiversity and increase the overall productivity consumed by households and provide products to relatives and neighbor. There have been few attempts on this aspect. However, literature reveals ample vacuum as regards to systematic studies on the role of roof top garden in biodiversity conservation and consumption of roof top garden products by urban people in Dhaka. In this chapter, an attempt has been made to review the information available on these aspects of roof top garden systems under following headings.

The word ‘roof’ in this context refers to any continuous surface designed for the protection of inhabitants from the climatic elements, whether open or closed on the sides. They are a powerful tool in combating the adverse impacts of land development and the loss of open space. The vegetated space may be below, at or above grade; located on a podium deck, a ‘sky garden’ on an intermediate floor level, or at the very top level of the building; but in all cases the plants are not planted in the ground (Hossain, 2009). A roof garden is actually very different from a green roof, although the two terms are often and incorrectly used

interchangeably. A roof garden is an area that is generally used for recreation, entertaining, and as an additional outdoor living space for the building's resident(s). It may include planters, plants, dining and lounging furniture, outdoor structures such as pergolas and sheds, and automated irrigation and lighting systems. A green roof is usually constructed to cover a large area in the most economical and efficient means possible with an emphasis on improving the insulation and /or improve the overall energy efficiency within a building. Green roof concept can be most effective in urban areas where the lack of green-open spaces is a common phenomenon.

The standard construction practices of roof greening in many countries have started a hundred years ago. Ornamental roof gardens developed initially by the ancient Mesopotamian civilizations of the Tigris and Euphrates River valleys (the Hanging Garden of Babylon) and by the Romans. Until the mid 20th century, green roofs have been a feature of the vernacular architecture notably of Scandinavia and Kurdistan region. Traditional Scandinavian turf roof (combination of mud and grass on flat roof) helped to reduce heat loss during the long, dark winters. Scandinavian immigrants to the United States and Canada took the idea with them, and grass roofs were used on settler cabins. Traditional Kurdish turf roofs serve to keep heat in winter and keep out the burning sun in summer (Millat-e-Mustafa, 1997).

In the 1960’s, the rapid decline of green space in urban areas raised the interest in green roofs as a ‘green solution’ basically in Northern Europe. In Germany, the green roof market expanded rapidly in the 1980’s. New technical research was carried out on root-repelling agents, membranes, drainage, lightweight growing media, and plant suitability. In two modern advocates of green roof technology were the architects Le Corbusier and Frank Lloyd Wright. The architect Le Corbusier encouraged rooftops as another location for urban green space. Le

Corbusier was perhaps the first to use roof gardens from the 1920s onwards, but only in elite buildings. Frank Lloyd Wright designed a restaurant with a roof garden in Chicago in 1914. They used green roofs as a tool to integrate their buildings with the landscape.

The development of modern roof garden (roof garden or green roof) is a relatively new phenomenon. Roof garden technology was first developed in Germany in the 1980′s which then spread to other European countries such as Switzerland, the Netherlands, Austria England, Italy, France, and Sweden. Even today, an estimated 10 percent of all buildings in Germany have had a roof garden. Besides Germany, Austria (Linz city) has developed a rooftop garden project since 1983, as well as the Swiss began to intensively develop rooftop garden since 1990. In the UK, London and Sheffield city government has even made special policies regarding the development of the roof garden. Development of the roof garden is also popular in the U.S. although not as intensive as in Europe. In America the roof garden concept was first developed in Chicago and then became popular in Atlanta, Portland, Washington, and New York (Wikipedia, 2008). Some countries in Asia such as Japan, Korea, Hong Kong, China and Singapore are activists in the rooftop garden project.

People have been growing things on roofs since the ziggurats of ancient Mesopotamia and the Hanging Gardens of Babylon - it’s not exactly a new idea. Today, rooftop farms can be found in cities around the world, albeit in small numbers.

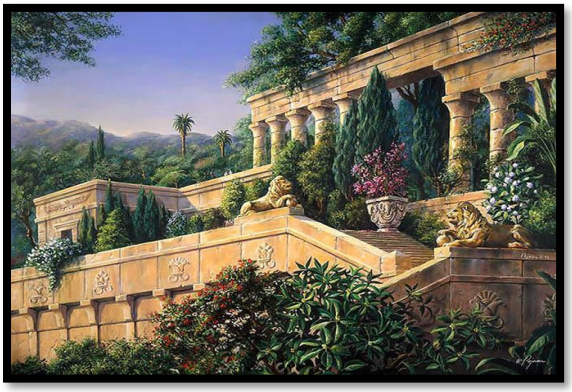

Plate-1: The Hanging Gardens of Babylon

Plate-2: The Ziggurats of Ancient Mesopotamia

On the Botanical Roof Gardens of Augustenborg in Malmö, Sweden, a brown field roof garden was constructed in 2004. A 150 mm layer of chalk forms the base of the 200 square meter garden. The roof design includes dry meadows, shallow water and plant nursery, and spontaneous colonization of plants is encouraged. A clear aim is to obtain the combination of pioneer species, extreme strategists and threatened cultural plants that would flourish in brown field's conditions. This experimental garden aims at gaining practical experience of brown field construction. Research on the dynamics of brown fields is conducted on this roof top garden. Roof conditions are excellent for brown field land construction as the two landscapes share similar conditions, including harsh climatic conditions, wind exposure and rapidly fluctuating temperatures, as well as limited amounts of biomass. This paper shows that roof garden design can benefit from the brown field design concept. With benefits including low maintenance and costs, beauty and species richness, brown field roofs can be valuable contributions to the urban environment.

Wood and Linne (1997) have proposed a research to increase the diversity available to owners and to enhance roof garden capacity to manage this dynamically in any kinds of empty space. Now-a-days many studies on roof

garden in other parts of world have revealed that roof gardens are dynamic systems and are highly acknowledged for retaining higher diversity that represents microenvironments within larger farming system**.** (Agelet *et al.,* 2000;Nair, 2001; Vogl-Lukasser *et al*., 2001; De Clerck and Negreros-Castillo, 2000;Gessler *et al.,* 1998; Hoggerbrugge and Fresco, 1993; Soemarwoto and Conway, 1992; Padoch and De Jong 1991; Okafor and Fernandes 1987).

Krupka (1992) wrote a book named Roof Gardening: "use of plants and vegetation on buildings". This book consists the 20 chapters covering the history and importance of growing plants on buildings from the architectural and town planning aspects, development in technique of roof gardening in last decade, the ecological value of growing plants on buildings, habitat restriction of vegetation on buildings, planning factors, prevention of damage to buildings, preparation and protection of habitat and different forms of greening. Chapter 10 to 15 cover the choice of plants for intensive and extensive greening of roofs , walls and noise reduction screens .Chapter 16 to 17 deal with the qualitative requirement of seeds, plants and vegetation and planting and vegetation stands in relation to decline criteria. Forms of damage, care and maintenance and performance of roof and vegetation are covered in last 3 chapters. The comprehensive coverage of theoretical and practical aspects of growing vegetation on buildings, the clear diagrams and the extensive list of suitable plants make this book a valuable source of information. It is to be hope that an English translation will be made so that the information will be made more accessible to a wider readership.

Islam (2001) has published an article named 'Roof gardening as a strategy of urban agriculture for food security: the case of Dhaka city, Bangladesh.' He has reported that urban agriculture in the cities of developing countries are growing rapidly which also means the number of low –income consumers is increasing. Because of food securities in this cities is increasing. Urban agriculture

contributes to food security by increasing the supply of food and by enhancing the quality of perishable food reaching urban consumers. The exploration of local socio-economic and institutional conditions that might promote and hinder urban agriculture is needed to implement policies that effectively integrate agriculture into the urban environment. This study aims to identify the potential for and barriers to urban agriculture with reference to roof top gardening and to explore strategies to promote food security in Dhaka.

Brenneisen (2001) provide some important information on the topics 'Green roofs-How nature returns to the city' in the International Conference on Urban Agriculture. He has reported that following a promotional campaign in 1996, green roofs become an important factor in the urban planning in the city of Basil, Switzerland. An investigation based on an urban ecological assessment proved the significance of green roofs for modern town planning strategies. It showed that the event of the area with a high environmental load could be reduced from 19 percent to 25 percent of the total. Furthermore bio-ecological surveys underlined the need for the development of green roof concepts at the scale of the town. The wide range of vegetation found on green roofs and the variety of designs available provides example of ecological compensation that can be varied according to the natural and social surroundings.

Kamron (2006) has published an article named 'Adoption of roof gardening at Mirpur-10 area under Dhaka city'. She has reported that the selected characteristics of the respondents, family size, roof gardening experience, use of information sources, attitude towards roof gardening and knowledge of roof gardening had positive significance of relationship with their adoption of roof gardening. Other characteristics namely: age, family education and family income did not show any significant relationship with the respondent's adoption of roof gardening.

### 2.1.6 Purpose of roof gardening

Mostafa (2013) found an article 'Present Status of Rooftop Gardening in Sylhet City Corporation of Bangladesh: an Assessment Based on Ecological and Economic Perspectives' that each gardener was interested in rising of rooftop garden because they think that home gardens could help them to income and save money (29.8 percent), respondents were also interested in environmental amelioration (54.9 percent), the percentage was in favor of mental satisfaction (95.3 percent), aesthetic value (82.5 percent) and leisure time activity (87.8 percent).

Towle (1996) was found in favor of mental satisfaction (10 percent), aesthetic value (12.5 percent) and leisure time activity (5 percent) in the role of ecological restoration in biodiversity conservation: basic issues and guidelines.

Matsuo and Relf (1995); Brown et al. (2004) found that working with plants and in the outdoors benefits are the mental health, mental outlook, and personal wellness of individuals in having roof top gardening.

Hynes (1996); Patel (1996); Hanna (1999); Von Hassell (2002); Saldivar-Tanaka (2002) were found gardeners report that sharing food with friends, families, neighbors, and/or needy members of their community in need are one of the important reasons that they grow produce. This also supported by various researchers in the world.

Zabala (1990) found that trees have a positive effect in ameliorating environmental conditions.

## 2.2 Local name of plants, scientific name of plants with family, genus and habit of the plants

Sultana (2014) has published an article named ‘plant diversity of Sher-E-Bangla Agricultural University Campus’. She has reported that the total number of plants belongs to 152 families under 251 genera and 327 species respectively. Out of all plant species 19 timber species (including 15 genera and 11 families), 42 fruit plant species (29 genera 17 families), 61 medicinal plant species (55 genera and 34 families), 42 ornamental plant species (35 genera and 25 families), 81 flower plant species (53 genera 29 families), 41 vegetable plant species (30 genera 16 families), 13 spices plant species (11 genera 8 families), 6 fodder plant species (6 genera and 5 families), 5 bamboo plant species (2 genera 1 families), 3 ficus plant species (1 genus and 1 family), 2 fibre plant species (2 genus and 2 family), 10 palm plants (10 genera and 3 families), 2 rubber plants (2 genera and 1 families) have been documented.

## 2.3 The Conceptual Framework of the study

In scientific research, selection and measurement of variables constitute an important task .The hypothesis of a research while constructed properly contains at least two important elements i.e. a dependent variable and an independent variable. A dependent variable is that factor which appears, disappears or varies as the research introduces, removes or varies the independent variable (Townsend, 1953). An independent variable is that factor which is manipulated by the researcher in her attempt to ascertain its relationship to an observed phenomenon. In view of prime findings of review of literature, the researcher constructed a self-explanatory conceptual model of the study which is presented in Figure 1.

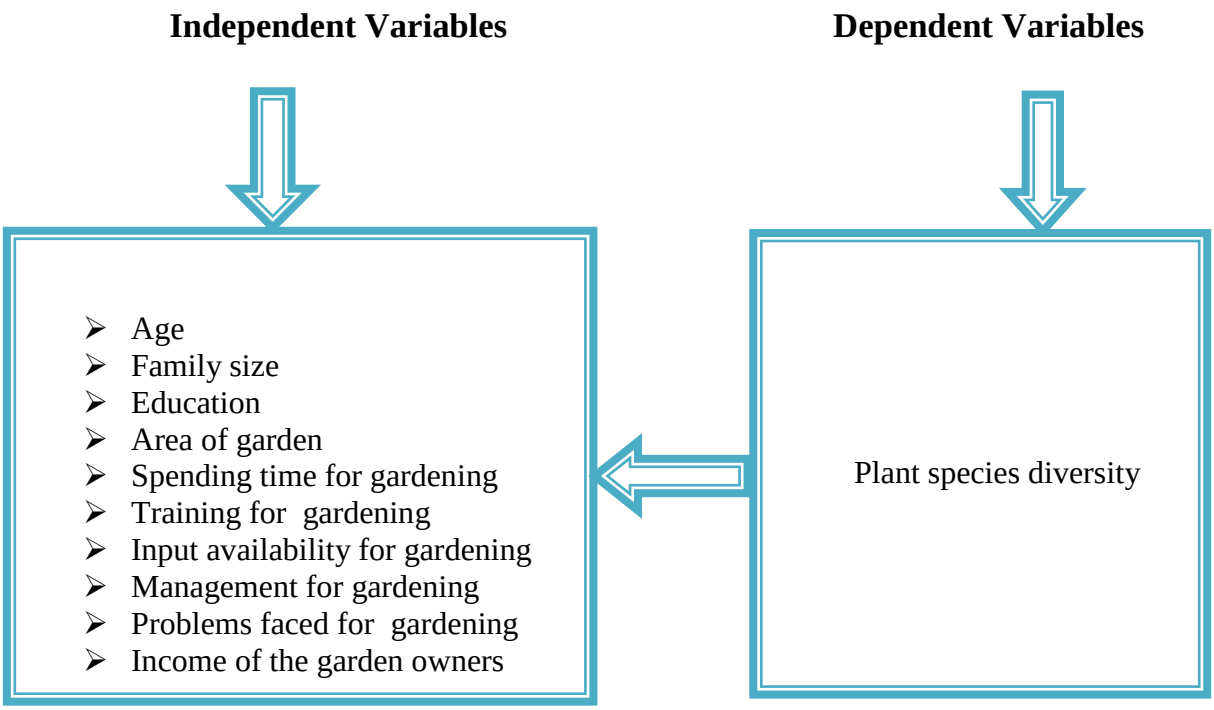


**Fig.1. A Conceptual Framework for the study**

# CHAPTER III
# METHODOLOGY

The method and procedure used in the study are presented in this chapter. The principal method used in this study was field survey using structured interview schedule. In any scientific research methodology plays an important role. To perform a research work systematically, careful consideration of appropriate methodology is a must. It should be such that it would enable the researcher to collect valid and reliable information to arrive at correct decisions. The methods and procedures followed in conducting this study have been described in this Chapter in the following sections.

## 3.1 Description of Study Area

### 3.1.1 Dhaka city

Dhaka is the capital and largest city of Bangladesh. With its colorful history and rich cultural traditions, Dhaka is known the world over as the city of mosques and muslin. Its fame attracted travelers from far and near throughout the ages. Dhaka has been expanding spatially as its population has increased. Over the past decade, the core municipality, Dhaka, increased its population 45 percent. Dhaka may be the worst situated urban area in the world. Dhaka is located in wetlands and virtually surrounded by rivers.

### 3.1.2 Climate of Dhaka city

23°42′0″N 90°22′30″E Dhaka experiences a hot, wet and humid tropical climate. Dhaka has a tropical wet and dry climate. The city has a distinct monsoonal season, with an annual average temperature of 25 °C (77 °F) and monthly means varying between 18 °C (64 °F) in January and 29 °C (84 °F) in August. Nearly 80 percent of the annual average rainfall of 1,854 millimeters (73.0 in) occurs during the monsoon season which lasts from May until the end of September. Increasing

air and water pollution emanating from traffic congestion and industrial waste are serious problems affecting public health and the quality of life in the city. Water bodies and wetlands around Dhaka are facing destruction as these are being filled up to construct multi-storied buildings and other real estate developments. Coupled with pollution, such erosion of natural habitats threatens to destroy much of the regional biodiversity.

### 3.1.3 Demography of roof top gardening in Dhaka city

Roof top gardening becomes growingly popular in the Dhaka city as the land for gardening shrinks every day with construction of more and more new buildings. City's gardeners and agriculturists, however, cite yet another reason why more house owners getting keen on having a patch of greenery on their roofs, which is, they want vegetables and fruits fresh and free from poisonous chemicals.The government Department of Agricultural Extension said around 6,000 roof top gardens are in the Dhaka city. The DAE has divided the Dhaka city in three areas supervised by its three offices called Metropolitan Tejgaon, Metropolitan Gulshan and Metropolitan Mohammadpur. It has found 3082 roof top gardens in the neighbourhoods overseen by its Gulshan office, 2000 have been spotted in areas under its Tejgaon office and 600 in the Mohammadpur neighbourhoods. Vegetables, fruits and flowers on their roofs grown in these gardens include tomato, bottle gourd, ash gourd, beans, pumpkin, mango, sweet tamarind, litchi, banana, lemon, orange, guava, olive, strawberry varieties of seasonal flowers, cacti and orchids.

**Plate-3 Photograph shows the species diversity of roof top gardens in Dhaka city**


**Plate-4 Photograph shows the plant species and planting materials**

**Plate-5 Direct Observation of various roof top gardens by researcher**

### 3.1.4 Population and Sampling Procedure

The survey was conducted within the DAE projected 4 metropolitan area of Dhaka city. There are five metropolitan areas in Dhaka city. The metropolitan areas are Uttora, Kamrangichor, Mirpur, Mohammadpur and Gulshan. Out of 5 metropolitan area of Dhaka four metropolitan area such as Kamrangichor, Mirpur, Mohammadpur and Gulshan were selected purposively as the locale of the study. There are sub areas in four metro in Dhaka city. The sub area of Kamrangichor metro are Khilgoan, South goran, North goran, Rampura, Moghbazar area were selected. The sub area of Mirpur metro are Indira road, Razabazar, Monipuripara, Shewrapara and Mirpur area were selected. The sub area of Mohammadpur metro are Elephant road, Kolabagan, Mohammadpur housing society, Mohammadpur housing limited and Shekhertek area were selected. The sub area of Gulshan metro Gulshan and Baridhara area were selected. Individual households represented the sampling units. Fifty eight (58 %) percent of the population are proportionately randomly selected as the sample of the study by using random number table (Table 3.1). Thus, sample size of the study was 40 rooftop buildings. Responses to open questions were collected on a variety of demographic and socioeconomic indicators: roof garden species, choice of species, consumption access of roof garden products, and so forth. On each topic, the respondents were free to express their views. Survey instruments were collected on two parts, species information on one parts and the demographic information on the other parts. Enumerators were oriented in participatory way. Finalization of the questionnaire was made after pre-testing in adjacent roof gardener of the research site. Direct observation of roof garden was also carried out simultaneously. For quality control, the surveyed questionnaires were passed through edition, revision in different tiers first by enumerator herself, then peer review and editing among enumerators and final editing by the researcher on the same date.

**Table-3.1: Distribution of population and sample size in four selected Metropolitan areas**

| Metropolitan areas | Sub areas under metro | No. of total roof gardeners | No. of roof gardeners finally selected for data collection |
|---|---|---|---|
| **Kamrangichor** | Khilgoan | 4 | 2 |
| | South goran | 5 | 3 |
| | North goran | 4 | 3 |
| | Rampura | 3 | 2 |
| | Moghbazar | 7 | 2 |
| **Mirpur** | Indira road | 3 | 3 |
| | Razabazar | 4 | 2 |
| | Taltola | 2 | 2 |
| | Agargoan | 2 | 2 |
| | mirpur | 7 | 3 |
| **Mohammadpur** | Elephantroad | 5 | 2 |
| | Kolabagan | 3 | 2 |
| | Mohammadpur housing society | 6 | 4 |
| | Mohammadpur housing limited | 5 | 3 |
| | Shekhertek | 2 | 2 |
| **Gulshan** | Gulshan | 4 | 2 |
| | Baridhara | 2 | 1 |
| **Total** | | **68** | **40** |

## 3.2Data Collection

### 3.2.1 Primary data collection

Reconnaissance survey was carried out before conducting the detailed data collection. After getting the general information about the study area, primary data were collected by using following methods:

#### 3.2.1.1 Direct observation of roof top garden with garden owners

Total tree species and their numbers were counted species-wise with the help of garden owners in their garden using checklist. Forty roof top gardens were visited with the help of Sub Assistant Agricultural Officer of metropolitan area and garden owners for obtaining the accurate information about the garden plants. Numbers of species were counted by observing the plants in the roof top garden. The main emphasis was given on the counting and identification of plant species.

#### 3.2.1.2 Questionnaire Survey with Schedule

The pertinent information on the subject was collected from various primary sources. The questionnaires were pre-tested in some roof garden during the preliminary survey and were finalized by incorporating the feedbacks from garden owners. The pertinent information on the subject was collected from various primary sources. The feasibility of RTG was explored through a questionnaire survey of selected public and commercial buildings. The detail of the questionnaire is given in Appendix-1. After modifying questionnaire, out of 68 garden owners, 40 garden owners (58 percent) were selected as a sample, which represent male female respondents. Head of family and elderly individuals were interviewed. Moreover, a focus group discussion was also organized where stakeholders were invited to discuss the prospects and problems of rooftop gardening in the city. Data were collected by face to face interviewing of the respondents' during period from April 19, 2013 to May 5, 2015.

### 3.2.2 Secondary Data Collection

Secondary data were collected from the various sources and records like- reports published by related project, Department of Agricultural Extension, Metropolitan office. Maps, journals, publications, reports of other line agencies, published or unpublished and relevant literature were also consulted in the library and the relevant websites to make better understanding, interpretation and analysis of the research.

### 3.3 Measurement of Diversity

#### 3.3.1 Shannon's Diversity Index

Shannon's diversity index is simply the ecologist's name for the communication entropy introduced by Claude Shannon:

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

Where pi is the fraction of individuals belonging to the i-th species. This is by far the most widely used diversity index. The intuitive significance of this index can be described as follows. Suppose we devise binary code words for each species in our ecosystem, with short codeword used for the most abundant species, and longer codeword for rare species. As we walk around and observe individual organisms, we call out the corresponding codeword. This gives a binary sequence. If we have used an efficient code, we will be able to save some breath by calling out a shorter sequence than would otherwise be the case. If so, the average codeword length we call out as we wander around will be close to the Shannon diversity index.

It is possible to write down estimators which attempt to correct for bias in finite sample sizes, but this would be misleading since communication entropy does not really fit expectations based upon parametric statistics. Differences arising from using two different estimators are likely to be overwhelmed by errors arising from

other sources. Current best practice tends to use bootstrapping procedures to estimate communication entropy.

### 3.3.2 Species richness

Species richness is the number of different species in a given area. Species richness is the fundamental unit in which to assess the homogeneity of an environment.

Typically, species richness is used in conservation studies to determine the sensitivity of ecosystems and their resident species. The actual number of species calculated alone is largely an arbitrary number. These studies, therefore, often develop a rubric, measure for valuing the species richness number, or adopt one from previous studies on similar ecosystems.

The species richness is simply the number of species present in an ecosystem. This index makes no use of relative abundances. In practice, measuring the total species richness in an ecosystem is impossible, except in very depauperate systems. The observed number of species in the system is a biased estimator of the true species richness in the system, and the observed species number increases non-linearly with sampling effort.

Species richness measures the number of species within an area. Roof top garden plants of the five locations were grouped into five categories namely fruit, flower, vegetable, ornamental and medicinal.

### 3.3.3 Inter species diversity

The most commonly used formula of calculating inter species diversity “Simpson index (D)” suggested by Simpson (1949) was used in this study which was as follows -

$D = 1 – Pi^2$

Where, Pi is the proportional abundance of the ith species such that

Pi = Ni/N

Ni = Plant population of ith species and

N = N1+N2+N3+…+Nn where n is the number of species

### 3.3.4 Relative prevalence (RP) of species

Relative abundances must add to unity (save perhaps for some rounding error). Note that relative abundance has no units (it is dimensionless). Alternatively, relative abundances can be expressed as a percentage.

Relative prevalence (RP) of species was calculated by using the following formula:

RP = Population of the species per roof garden × % roof gardens with the species.

These relative prevalence values were used to rank the species in different regions according to Millat-e-Mustafa (1997).

## 3.4 Measurement of Independent Variables

In this study selected personal, economic, social and psychological characteristics of the garden owners were considered as independent variables. These characteristics are as follows:

1. **Age:** Age of a respondent will be measured in terms of years from birth to the time of interview which will found on the basis of response. It was located in the Q no. 1 of interview schedule.

2. **Education:** Education will be measured in terms of one's year of schooling. One score will give for passing each level in an educational institution. For example, if a respondent passed the SSC examination, educational score will be given as 10. If a respondent did not know how to read and write, his

educational score will be given as ‘0’. It was located in the Q no. 2 of interview schedule.

3. **Family size:** The family size will be measured by the total number of members in the family of a respondent. The family members included family head and other dependent members like husband/wife, children, etc. who live and eat together. It was located in the Q no.3 of interview schedule.

4. **Surface area of roof garden:** The surface area of roof (sq. ft.) garden refer to the total area of roof on which his family carried out roof garden operation, the area being in terms of full benefit to the family. It was located in the Q no. 5 of interview schedule.

5. **Spending time for gardening (hour):** Spending time for gardening (Hour) of a respondent will be measured in terms of 1 hr, 2 hr and above 2 hr options of interview which will found on the basis of response. It was located in the Q no. 6 of interview schedule.

6. **Family Annual Income:** Family annual income of the respondents was measured in terms of lack taka. Income from all sources by all the earning family members were added together to obtain family annual income. It was located in the Q no. 4 of interview schedule.

7. **Training for gardening (days):** Training received will be measured by the total number of days a respondent received training in his/her entire life under different roof garden technologies. It was indicated by the total number of days of receiving different technologies of roof gardening. It was located in the Q no. 8 of interview schedule.

8. **Input availability for gardening:** For measuring the input availability for RTG, the respondent were asked to choose one answer among four nature of contact for each media, namely regular, moderate, low and not available. These four options for each media were defined specially to each media considering situation nationality and result of pre-test. Scores were assigned for all extension media in the following manner:

| Extent of contact | Weighting System |
|---|---|
| Regular | 3 |
| Moderate | 2 |
| Low | 1 |
| No available | 0 |

The input availability for RTG of a respondent was determined by adding the total responses against the 4 selected media. Thus the total score could range from 0 to 12, where 0 indicating no input availability of RTG and 12 indicating very high input availability for RTG. It was located in the Q no. 9 of interview schedule.

9. **Management for gardening:** For measuring the management of RTG, the respondent was asked to choose one answer among four nature of contact for each media, namely regular, moderate, low and not available. These four options for each media were defined specially to each media considering situation nationality and result of pre-test. Scores were assigned for all extension media in the following manner:

| Extent of contact | Weighting System |
|---|---|
| Regular | 3 |
| Moderate | 2 |

| | |
|---|---|
| Low | 1 |
| No available | 0 |

The management of RTG of a respondent was determined by adding the total responses against the 4 selected media. Thus the total score could range from 0 to 12, where 0 indicating no management of RTG and 12 indicating very high management of RTG. It was located in the Q no. 10 of interview schedule.

10. **Measurement of Problem Faced Index (PFI) in practicing RTG**

The garden owners of the study area might have faced various types of problems in participating roof top gardening activities. But the investigator gained an experience through personal contact regarding common problems faced by the respondents at the time of data collection. Besides, the researcher gained knowledge through consultation with experts, pre-testing experience and reviewing previous research findings. Finally, the researcher prepared a list of ten possible problems in this regard. A scale was prepared to indicate the extent to which each of the ten problems was applicable in the case of a respondent. The respondents were asked to indicate the degree of severity of the problems in a 5-point scale as ‘very high problem’, ‘high problem’ ‘moderate problem’, ‘little problem’, and ‘no problem at all’. Weights were assigned to those responses as ‘4’ ‘3’, ‘2’, ‘1’ and ‘0’ respectively. It was located in the Q no. 12 of interview schedule.

To measure Problem Faced Index (PFI), the following 10 (ten) items were selected:

1. Lack of capital
2. Adverse climate
3. Lack of high yielding varieties
4. Pest attack
5. Diseases attack

6. Unavailability of pesticide in time
7. High price of seedling
8. High price of tools
9. Lack of training facilities about roof gardening
10. Theft flowers, fruits, vegetables by thief

The Problem Faced Index (PFI) for each problem was computed by using the following formula:

**PFI = (Pvh × 4) + (Ph × 3) + (Pm × 2) + (Pl × 1) + (Pn × 0)**

Where,
Pvh =Percentage of garden owners who faced very high problem
Ph = Percentage of garden owners who faced high problem
Pm =Percentage of garden owners who faced moderate problem
Pl =Percentage of garden owners who faced little problem
Pn =Percentage of garden owners who faced no problem at all.

To determine comparative importance of those ten problems, PFI was computed for each of the ten problems by summing up the scores of all the respondents. Problem Faced Index (PFI) of a specific problem could range from '0' to '160', where '0' indicated 'no problem faced' and '160' indicated 'very high problem faced'.

### 3.5. Measurement of Dependent Variables

Shannon's Diversity Index was used for measuring the plant species diversity of individual garden owner.

For measuring the diversity, it was categorized into three groups such as low diversity, medium diversity and high diversity. Scores were assigned for all extension media in the following manner:

| Extent of diversity | Diversity range |
|---|---|
| Low | 0-1.5 |
| Medium | 1.6-3.1 |
| High | >3.1 |

Diversity of the plants could range from 0 to above 3.1, where 0 indicating no diversity of RTG and above 3.1 indicating high diversity of RTG.

### 3.6 Purpose of gardening

Purpose of rooftop gardening was assessed using a semi-structured open questionnaire which was calculated as percentage in MS Excel in garden owners opinion. It was located in the Q no. 11 of interview schedule.

### 3.7 Statement of Hypothesis

As defined by Goode and Hatt (1952), "A hypothesis, which can be put to a test to determine its validity. It may see contrary to, or in accord with common sense. It may prove to be correct or incorrect. In any event, however, it leads to an empirical test". In studying the relationship between variables, research hypothesis are formulated which state the anticipated relationship between the variables. However, for statistical test it becomes necessary to formulate null hypothesis. A null hypothesis states that there is no relationship between the variables. If a null hypothesis is rejected on the basis of a statistical test, it is assumed that there is a relationship between the concerned variables. The null hypothesis can be assumed for this study as – "there was no relationship between the plant species diversity of roof top garden and the selected characteristics of garden owners". The 10 selected characteristics were: age, education, family size, surface area of roof garden, spending time for gardening (hour), training for gardening (days), input availability for

gardening, management for gardening, income of the garden owners and problem faced by the garden owners.

### 3.8 Compilation of Data

After completion of field survey all the data of the interview schedule were compiled. Local units were converted into standard unit. Appropriate coding and scoring technique was followed to convert the qualitative data into quantitative forms. The responses of the individual garden owner contained in the interview schedules were transferred to a master sheet for entering the data in the computer. As soon as the data entered into the computer, it was then analyzed in accordance with the objectives of the study.

### 3.9 Data Analysis

The data were coded, categorized and fed in computer and analyzed using computer software packages MS Excel and SPSS (Statistical Package for Social Science) 20 versions. Quantitative data were analyzed by simple statistical tools such as frequency, mean, percentage and standard deviation and qualitative data were analyzed by ordering, ranking with descriptive manner. The impacts of various socio-economic factors such as education status, family size, surface area of roof garden, spending time for gardening (hour), training for gardening (days), input availability for gardening, management for gardening, income of garden owners, problem faced by the garden owners and the diversification of plant species with comparison of percent of plants present in roof garden and diversification present in roof top garden were analyzed by using SPSS. The results are presented through text, Tables and Figures with interpretation accordingly. From the primary data, indices of diversification of plant species (species diversity index, species richness index) were calculated following Shannon and Weaver (1949). Species Richness is the simplest of all the measures of species diversity. In its

simplest sense, species richness denotes the number of species present in a community. Diversity indices provide important information about commonness of species in a community. Pearsons Product Moment Co-efficient Correlation (r) has been used to test the null hypotheses concerning the relationship between the variables. At least 0.05 level of probability with an accompanying 95 percent confidence level was used as the basis for rejection of a null hypotheses.

# CHAPTER IV

# RESULTS AND DISCUSSION

The results of the study and related interpretations have been presented in this chapter. The first section deals with the results of Shannon diversity index, species richness, inter-species diversity, relative prevalence of different species with their local name, family name, genus, species and habit and dependent variables i.e. plant species diversity present in roof top garden while the second section deals with the selected individual characteristics of the garden owners. The third section deals with the relationships between the garden owners selected characteristics with plant species diversity present in roof top garden.

## 4.1 Shannon diversity index

Shannon's index accounts for both abundance and evenness of the species present. The proportion of species *i* relative to the total number of species (*pi*) is calculated, and then multiplied by the natural logarithm of this proportion (ln *pi*). The resulting product is summed across species, and multiplied by -1.

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

***H'*** = the Shannon-Weaver Diversity Index

But remember that the S-W index is usually expressed as ***eH'***

Typically the value of the index ranges from 1.5 (low diversity) to 3.5 (high species diversity), though values beyond these limits may be encountered (www.wikipedia.org).

**Table 4.1: Shannon diversity index in the study area**

| Categories of Species | Grand total of each Species | Relative abundance (Pi) | LN (Pi) | Pi*LN(Pi) |
|---|---|---|---|---|
| Fruit | 2873 | 0.21 | -1.57 | -0.33 |
| Vegetable | 4390 | 0.34 | -1.09 | -0.37 |
| Flower | 2285 | 0.19 | -1.66 | -0.32 |
| Ornamental | 2169 | 0.17 | -1.76 | -0.30 |
| Medicinal | 1532 | 0.09 | -2.36 | 0.01 |
| **Grand total** | **13249** | **1** | **ΣPiLn(Pi)** | -1.33 |
| | | | **H'= -ΣPiIn(Pi) 1.33** | |
| | | | **e H' 3.84** | |

The result revealed that Shannon-Weaver diversity index was very high in the study area which was 3.84.

**4.2 Species richness**

Almost all the roof top gardens had mixed vegetation with various annual and perennial trees and seasonal vegetables where 100 useful species were identified (in table 4.4, 4.5, 4.6, 4.7 and 4.8). Among them 35 species were fruits, 22 species were flowers, 20 species were vegetables, 13 species were ornamental and 10 species were medicinal was shown in Table 4.2.

**Table 4.2: Species richness found in the study area**

| Categories of Species | Types of plants |
|---|---|
| Fruit | 35 |
| Vegetable | 20 |
| Flower | 22 |
| Ornamental | 13 |
| Medicinal | 10 |
| **Total** | **100** |

### 4.3 Inter-species diversity

Species diversity index is a measure, which renders considerable ecological insight (Amin, 1997). Simpson index of species diversity (D) varied among the different groups of plant species. Inter-species diversity was found higher for vegetable species (0.799) in the roof garden of the study area followed by fruit species (0.798), flower (0.797), ornamental species (0.796) and medicinal (0.795) in Table 4.3.

**Table 4.3 Inter-species diversity found in the study area**

| Metropolitan areas | Fruit | Vegetable | Flower | Ornamental | Medicinal | Average |
|---|---|---|---|---|---|---|
| Kamrangichor | 0.967 | 0.960 | 0.961 | 0.954 | 0.968 | 0.961 |
| Mirpur | 0.968 | 0.963 | 0.967 | 0.946 | 0.954 | 0.967 |
| Mohammadpur | 0.952 | 0.954 | 0.971 | 0.968 | 0.961 | 0.952 |
| Gulshan | 0.948 | 0.952 | 0.946 | 0.961 | 0.946 | 0.959 |
| **Average** | 0.960 | 0.960 | 0.960 | 0.959 | 0.960 | 0.960 |
| **All** | **0.798** | **0.799** | **0.797** | **0.796** | **0.795** | |

The result showed that diversity index varied with different plant species in different metro area. Higher average inter-species diversity (0.967) was found in Mirpur area followed by Kamrangichor (0.961) and Gulshan (0.959) area. The lowest inter-species diversity was found in Mohammadpur area (0.952) where study area showed the moderate to higher inter- species plant diversity.

### 4.4 Relative prevalence of species with their local name, family name, genus, species and habit

#### 4.4.1 Fruit species

Garden owners had different types of fruit species. Among them 35 fruit species were available in their garden where mango (127.1%) was found in most prevalent and kanthal (10.2%) was found in lowest prevalent. On the basis of

relative prevalence, mango, papaya, straw berry and guava were ranked in top position in Table 4.4.

**Table 4.4 Fruit species with their local name, family name, genus, species, habit and relative prevalence**

| Sl. No. | Local name | Family | Genus | Species | Habit | Relative prevalence |
|---|---|---|---|---|---|---|
| 1 | Mango | Anacardiaceae | *Mangifera* | *indica* | Tree | 127.1 |
| 2 | Guava | Moraceae | *Psidium* | *guajava* | Tree | 114.6 |
| 3 | Papaya | Caricaceae | *Carica* | *papaya* | Herb | 113.5 |
| 4 | Straw berry | Rosaceae | *Fragaria* | *ananassa* | Herb | 103.5 |
| 5 | Kamrangha | Averrhoaceae | *Averrhoa* | *carambola* | Tree | 99.67 |
| 6 | Batabi lebu | Rutaceae | *Citrus* | *grandis* | Shrub | 76.44 |
| 7 | Kagji lebu | Rutaceae | *Citrus* | *aurantifolia* | Tree | 75.33 |
| 8 | Alachi lebu | Rutaceae | *Feronia* | *limon* | Shrub | 70.8 |
| 9 | Amloki | Euphorbiaceae | *Phyllanthus* | *embelica* | Tree | 44.6 |
| 10 | Billimbi | Averrhoaceae | *Averrhoa* | *bilimbi* | Tree | 44.5 |
| 11 | Kazi peyara | Moraceae | *Psidium* | *sp.* | Tree | 38.7 |
| 12 | Malta | Rutaceae | *Citrus* | *sinensis* | Tree | 34.1 |
| 13 | Jalpai | Elaeocarpaceae | *Elaeocarpus* | *floribundus* | Tree | 33.4 |
| 14 | Apple | Rosaceae | *Malus* | *selvestris* | Tree | 32.6 |
| 15 | Lichu | Sapindaceae | *Litchi* | *chinensis* | Tree | 30.1 |
| 16 | Sofeda | Sapotaceae | *Achros* | *sapota* | Tree | 28.88 |
| 17 | Sarifa | Sapotaceae | *Chrysophyllum* | *cainito* | Tree | 23.8 |
| 18 | Kamala | Rutaceae | *Citrus* | *reticulata* | Tree | 23.5 |
| 19 | Ata | Annonaceae | *Annona* | *reticulata* | Tree | 22.8 |
| 20 | Khejur | Palmae | *Phoenix* | *sylvestris* | Tree | 22.3 |
| 21 | Rambutan | Sapindaceae | *Nephelium* | *lappaceum* | Tree | 21.1 |
| 22 | Banana | Musaceae | *Musa* | *sapientum* | Tree | 21.0 |
| 23 | Coromcha | Apocynaceae | *Carissa* | *carandas* | Tree | 19.6 |
| 24 | Amra | Anacardiaceae | *Spondias* | *pinnata* | Tree | 17.9 |
| 25 | Boroi | Rhamnaceae | *Zizyphus* | *mauritiana* | Tree | 17.8 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 26 | Naspati | Rosaceae | *Pyrus* | *communis* | Tree | 17.7 |
| 27 | Jambura | Rutaceae | *Citrus* | *grandis* | Tree | 16.77 |
| 28 | Golapjam | Myrtaceae | *Syzygium* | *jambos* | Tree | 16.4 |
| 29 | Dalim | Punicaceae | *Punica* | *granatum* | Shrub | 15.99 |
| 30 | Beel | Rutaceae | *Aegle* | *marmelos* | Tree | 14.99 |
| 31 | Cherry | Rosaceae | *Prunus* | *avium* | Tree | 13.8 |
| 32 | Tentul | Caesalpiniaceae | *Tamarindus* | *indica* | Tree | 13.3 |
| 33 | Arboroi | Euphorbiaceae | *phyllanthus* | *acidus* | Tree | 13.1 |
| 34 | Kothbel | Rutaceae | *Feronia* | *limonia* | Tree | 12.44 |
| 35 | Kanthal | Moraceae | *Artocarpus* | *heterophyllus* | Tree | 10.2 |

The result revealed that 35 fruit species were recorded under 31 genera and 18 families while 30 species were trees, 3 shrubs and 2 herbs in nature. Among the families, Rutaceae contained 3 genera and 5 species followed by Euphorbiaceae contained 2 genera and 3 species, respectively.

### 4.4.2 Flower species

Various flower species were found in the study area. Among 20 flower species, beli (115.7%) was found in most prevalent and kamini (44.8%) was found in lowest prevalent. On the basis of relative prevalence, beli, petunia, dianthas, jasmine and chondro mollika were ranked in top position in Table 4.5.

**Table 4.5 Flower plant species with their Local name, family name, genus, species, habit and relative prevalence**

| Sl. No. | Local name | Family | Genus | Species | Habit | Relative prevalence |
|---|---|---|---|---|---|---|
| 1 | Beli | Oleaceae | *Jasminum* | *sambac* | Shrub | 115.7 |
| 2 | Petunia | Solanaceae | *Petunia* | *hybrida* | Herb | 113.7 |
| 3 | Dianthas | Caryophyllaceae | *Dianthas* | *chinensis* | Herb | 112.0 |
| 4 | Common | Oleaceae | *Jasminu* | *mauriculatum* | Shrub | 111.7 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Jasmine | | | | | |
| | Jasmine | Oleaceae | *Jasmunum* | *flexile* | Shrub | 111.7 |
| | Night jasmine | Oleaceae | *Nyctanthes* | *arbor-tristis* | Shrub | 111.7 |
| 5 | Chondro mollika | Oleaceae | *Jasminum* | *angustifolium* | Tree | 109.1 |
| 6 | Oleander | Apocynaceae | *Nerium* | *alba* | Shrub | 108.7 |
| | Oleander | Apocynaceae | *Nerium* | *carnea* | Shrub | 108.6 |
| | Oleander | Apocynaceae | *Nerium* | *variegatu* | Shrub | 108.7 |
| 7 | Zinnia -yellow | Compositae | *Zinnia* | *elegans* | Herb | 108.3 |
| | Zinnia -green | Compositae | *Envy* | *sp.* | Herb | 108.3 |
| 8 | Hasnahena- red | Solanaceae | *Cestrum* | *elegans* | Shrub | 105.7 |
| | Hasnahena-white | Solanaceae | *Cestrum* | *nocturnum* | Shrub | 105.7 |
| 9 | Rongon -white | Rubiaceae | *Ixora* | *alba* | Shrub | 104.1 |
| | Rongon -komola | Rubiaceae | *lxora* | *singaporensis* | Shrub | 104.1 |
| | Rongon- golapi | Rubiaceae | *Ixora* | *chinensis* | Shrub | 104.1 |
| | Rongon -yellow | Rubiaceae | *Ixora* | *lutea* | Shrub | 104.1 |
| 10 | Periwinkle | Apocynaceae | *Vinca* | *rosea* | Herb | 102.1 |
| | Periwinkle | Apocynaceae | *Vinca* | *rosea alba* | Herb | 102.1 |
| 11 | Musanda | Apocynaceae | *Musanda* | *sp.* | Tree | 99.6 |
| 12 | Rose | Rosaceae | *Rosa* | *sp.* | Shrub | 98.9 |
| 13 | Bougainvillea | Nyctaginacea | *Bougainvillea* | *grabra* | Climber | 94.6 |
| | Bougainvillea | Nyctaginacea | *Bougainvillea* | *peruviana* | Climber | 94.6 |
| 14 | China rose/Joba | Malvaceae | *Hibiscus* | *rosa sinensis* | Shrub | 94.6 |
| | Joba | Malvaceae | *Hibiscus* | *rosa chinensis* | Shrub | 94.6 |
| | Joba (golapi) | Malvaceae | *Hibiscus* | *rosa chinensis* | Shrub | 94.6 |
| | Joba (sada) | Malvaceae | *Hibiscus* | *rosa chinensis* | Shrub | 94.6 |
| 15 | Justicia | Acanthaceae | *Justicia* | *aurea* | Herb | 88.4 |
| 16 | Allamanda | Apocynaceae | *Allamanda* | *cathartica* | Climber | 79.7 |
| 17 | Duranta | Verbenaceae | *Duranta* | *repens* | Shrub | 55.7 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 18 | Shaora | Moraceae | *Streblus* | *asper* | Shrub | 50.4 |
| 19 | Bakul | Sapotaceae | *Mimosops* | *elengi* | Tree | 46.7 |
| 20 | Kamini | Rutaceae | *Murraya* | *exotica* | Shrub | 44.8 |

The result indicated that 20 flower plant species were recorded under 21 genera and 31 families while 4, 10, 4 and 2 species were found as trees, shrubs, herbs and climbers, respectively. Compositae contained 11 species under 8 genera followed by Solanaceae had 7 species under 3 genera.

### 4.4.3 Vegetable species

All the garden owners liked to plant seasonal vegetable species for their daily consumption. Out of 22 vegetable species, brinjal (130.8%) was found in most prevalent and jute leaf (33.4%) was found in lowest prevalent. On the basis of relative prevalence, brinjal, pipper, tomato and amaranth were ranked in top position in Table 4.6.

**Table 4.6 Vegetable species with their local name, family name, genus, species, habit and relative prevalence**

| Sl. No. | Local name | Family | Genus | Species | Habit | Relative prevalence |
|---|---|---|---|---|---|---|
| 1 | Brinjal | Solanaceae | *Solanum* | *melongena* | Shrub | 130.8 |
| 2 | Pipper | Solanaceae | *Capsicum* | *frutescens* | Herb | 128.4 |
| 3 | Tomato | Solanaceae | *Lucopersicon* | *esculentum* | Herb | 125.7 |
| 4 | Amaranth | Amaranthaceae | *Amaranthus* | *oleraceus* | Herb | 120.3 |
| 5 | Korola | Cucurbitaceae | *Momordica* | *acutangula* | Climber | 116.5 |
| 6 | Okra | Malvaceae | *Abelmoschus* | *esculentus* | Shrub | 115.8 |
| 7 | Green chili | Solanaceae | *Capsicum* | *annum* | Herb | 115.2 |
| 8 | Indian spinach | Basellaceae | *Basella* | *alba* | Herb | 114.9 |
| 9 | Lettuce | Compositae | *Lactuca* | *sativa* | Herb | 102.3 |
| 10 | Shim | Fabaceae | *Lablab* | *purpureus* | Climber | 101.7 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 11 | Ridged gourd | Cucurbitaceae | *Luffa* | *charantia* | Climber | 88.5 |
| 12 | Teasle gourd | Cucurbitaceae | *Momordica* | *dioica* | Climber | 79.4 |
| 13 | Drum stick | Moringaceae | *Moringa* | *oleifera* | Tree | 78.3 |
| 14 | Dhundul | Cucurbitaceae | *Luffa* | *cylindrica* | Climber | 77.9 |
| 15 | Kachu | Araceae | *Alocasi* | *indica* | Herb | 70.3 |
| 16 | Lal shak | Amaranthaceae | *Amaranthus* | *tricolor* | Herb | 66.3 |
| 17 | Capsicum | Solanaceae | *Capsicum* | *sp.* | Herb | 60.1 |
| 18 | Broccoli | Cruciferae | *B.oleracea* | *botrytis* | Herb | 50.5 |
| 19 | Shosha | Cucurbitaceae | *Cucumis* | *sativus* | Herb | 44.8 |
| 20 | Bengal spinach | Chenopodiaceae | *Beta* | *vulgaris* | Herb | 44.3 |
| 21 | Bathua | Chenopodiaceae | *Chenopodium* | *album* | Herb | 34.2 |
| 22 | Jute leaf | Tiliaceae | *Corchorus* | *caapsularis* | Herb | 33.4 |

The result revealed that 22 vegetable plant species were recorded under 21 genera and 13 families with 1, 2, 14 and 5 species were found as trees, shrubs, herbs and climbers, respectively. Cucurbitaceae contained 5 species under 4 genera followed by Solanaceae contained 4 species under 3 genera, respectively.

### 4.4.4 Ornamental species

Out of 13 ornamental species, patabahar (112.3%) was found in most prevalent and thuja (44.7%) was found in lowest prevalent. On the basis of relative prevalence, patabahar, patharcuchi and blood leaf were ranked in top position in Table 4.7.

**Table 4.7 Ornamental species with their local name, family name, genus, species, habit and relative prevalence**

| Sl. No. | Local name | Family | Genus | Species | Habit | Relative prevalence |
|---|---|---|---|---|---|---|
| 1 | Patabahar | Euphorbiaceae | *Codiaeum* | *craigii* | Shrub | 112.3 |
| 2 | Patharcuchi | Crassulaceae | *Kalanchae* | *pinnata* | Herb | 110.9 |
| 3 | Blood leaf | Amaranthaceae | *lindenii* | *Iresine* | Shrub | 109.7 |
| 4 | Cycus | Cycadaceae | *Cycus* | *circunalis* | Shrub | 107.7 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | Lantana | Verbenaceae | *Lantana* | *camara* | Shrub | 100.7 |
| 6 | Henna | Lythraceae | *Lawsonia* | *inermis* | Tree | 99.0 |
| 7 | Patra bilas | Liliacieae | *Dracaena* | *merginata* | Shrub | 97.5 |
| 8 | Fern | Polypodiaceae | *Pteris* | *sp.* | Herb | 97.3 |
| 9 | Orchid | Orchidaceae | *Vanda* | *roxburghii* | Shrub | 88.2 |
| 10 | Cactus | Cactae | *Cactus* | *sp* | Herb | 83.7 |
| 11 | Jhau | Caesalpinae | *Casuarina* | *equisetifolia* | Tree | 68.8 |
| 12 | Christmass tree | Araucariaceae | *Araucaria* | *excelsa* | Tree | 66.2 |
| 13 | Thuja | Pinaceae | *Thuja* | *orientalis* | Shrub | 44.7 |

The result indicated that 13 ornamental plant species were recorded under 13 genera and 13 families with 3 were trees, 7 shrubs and 3 herbs in nature.

### 4.4.5 Medicinal Species

Out of 10 medicinal species, pudina (112.9%) was found in most prevalent and basok (23.6%) was found in lowest prevalent. On the basis of relative prevalence, pudina, tulsi and alovera were ranked in top position in Table 4.8.

**Table 4.8 Medicinal species with their local name, family name, genus, species, habit and relative prevalence**

| Sl. No. | Local name | Family | Genus | Species | Habit | Relative prevalence |
|---|---|---|---|---|---|---|
| 1 | Pudina | Labiatae | *Mentha* | *spicata* | Herb | 112.9 |
| 2 | Tulsi | Labiatae | *Ocimum* | *sactum* | Shrub | 110.2 |
| 3 | Alovera | Liliacieae | *Aloe* | *barbadensis* | Herb | 107.3 |
| 4 | Neem | Meliaceae | *Azadirachta* | *indica* | Tree | 106.6 |
| 5 | Kababchini | Piperaceae | *Piper* | *cubeba* | Tree | 96.8 |
| 6 | Lemon grass | Gramineae | *Andropogon* | *citratus* | Herb | 91.7 |
| 7 | Long pepper | Piperaceae | *Piper* | *longum* | Tree | 59.8 |
| 8 | Thankuni | Umbelliferae | *Centella* | *asiatica* | Herb | 56.7 |
| 9 | Tejpata | Lauraceae | *Cinnamomum* | *tamala* | Tree | 44.3 |
| 10 | Basok | Acanthaceae | *Adhtoda* | *vasica* | Shrub | 23.6 |

The result showed that 10 medicinal plant species were recorded under 10 genera and 9 families with 4 were herbs, 1 was shrub and 5 were trees in nature. Caesalpinieae contained 4 species under 2 genera followed by Liliacieae contained 3 species under 2 genera, respectively.

### *4.5 Number of total individual plants found in the study area*

Different types of plants were present in the roof top garden. Gardeners were chosen many indigenous and foreign species for gardening which were showing in Table 4.9.

**Table 4.9 Number of total individual plants with frequency and percentage found in the study area**

| Categories (Number of plants) | Garden owners | |
|---|---|---|
| | Frequency | Percentage |
| 100-200 | 1 | 2.5 |
| 201-300 | 10 | 25.0 |
| 301-400 | 4 | 10.0 |
| 401-500 | 25 | 62.5 |
| **Total** | **40** | **100.0** |

The result revealed that 62.5 percent garden owners have the highest number of plants (401-500) while 2.5 percent garden owners have the lowest number of plants (101-200).

## 4.6 Dependent Variable

### 4.6.1 Plant species diversity

Plant species diversity of the garden owners in the study area were ranged from 0 to above 3.1 was shown in Table 4.10.

**Table 4.10 Distribution of the garden owners according to their having plant species diversity**

| Category | Garden owners | | | |
|---|---|---|---|---|
| | Frequency | Percentage | Mean | Std. Dev. |
| Low diversity (0 to 1.5) | 0 | 0.0 | 2.5438 | 1.02165 |
| Medium diversity (1.6 to 3.1) | 14 | 35.0 | | |
| High diversity (above 3.1) | 26 | 65.0 | | |
| **Total** | **40** | **100.0** | | |

The result revealed that 65.0 percent garden owners had high plant species diversity while 35.0 percent garden owners had medium plant species diversity in the roof top garden. The mean and standard deviation were 2.5438 and 1.02165, respectively.

### 4.2 Individual characteristics of the garden owners

In this section the findings of the garden owner's individual characteristics have been discussed. Descriptive statistics of eleven characteristics of the garden owners have been presented in Appendix-2.

#### 4.2.1 Age of the garden owners

The age of the garden owners were ranged from 31 to 75 years with a mean of 55.2750 and a standard deviation of 13.51919. On the basis of their age, the garden owners were classified into three categories was shown in Table 4.11.

**Table 4.11 Distribution of the garden owners according to their age**

| Categories | Garden owners | | | |
|---|---|---|---|---|
| | Frequency Number | Percentage | Mean | Standard deviation |
| Young aged (up to 31 years) | 2 | 5.0 | 55.2750 | 13.51919 |
| Middle aged (32 to 50 years) | 13 | 32.5 | | |
| Old aged (above 50 years) | 25 | 62.5 | | |
| **Total** | **40** | **100** | | |

The result revealed that 62.5 percent of the garden owners were old age while 5.0 percent of them were young age.

### 4.2.2 Family size of the garden owners

Family size of the garden owners were ranged from 3 to 7 where 3 to 4 members represented small family size, 5 to 6 members represented medium family size and above 7 members represented large family size. The mean and standard deviation were 4.7250 and 0.98677. Based on their family size scores, the garden owner were classified into three categories was shown in Table 4.12.

**Table 4.12 Distribution of the garden owners according to their family size**

| Categories | Garden owners | | | | |
|---|---|---|---|---|---|
| | **Family Members** | **Frequency Number** | **Percentage** | **Mean** | **Std. dev.** |
| Small | 3-4 | 16 | 40 | 4.00 | 0.9867 |
| Medium | 5-6 | 15 | 37.5 | | |
| Large | >7 | 9 | 22.5 | | |
| **Total** | | **40** | **100.0** | | |

The result revealed that 40 percent of the garden owners had small family size which was a representative of typical family size in Dhaka city while 22.5 percent of the garden owners had large family size.

### 4.2.3 The education level of the garden owners

The levels of education of the garden owners were ranged from 0 to 18. The mean and standard deviation were 11.6750 and 2.50525, respectively. Based on their education scores, the garden owners were classified into four categories was shown in Table 4.13.

**Table 4.13 Distribution of the garden owners according to their family education**

| Categories | Garden owners | | | |
|---|---|---|---|---|
| | **Frequency** | **Percentage** | **Mean** | **Standard deviation** |
| Illiterate | 0 | 0 | 11.6750 | 2.50525 |
| Primary level (1 to 5) | 0 | 0 | | |
| Secondary level (6 to 10) | 19 | 47.5 | | |
| Higher level | 21 | 52.5 | | |
| **Total** | **40** | **100** | | |

The result showed that 52.5% of the garden owners were higher educated while 47.5% had secondary level of education.

### 4.2.4 Area of the roof top garden

The area of the garden was categorized (sq. ft.) into three groups. Among them 1200 to 1600 sq. ft. was small area, 1700 to 2100 sq. ft. was medium area and above 2100 sq. ft. was large area. The mean and standard deviation were 1822.500 and 525.985, respectively was shown in Table 4.14.

**Table 4.14 Distribution of the garden owners according to their garden area**

| Categories | Garden owners | | | |
|---|---|---|---|---|
| | **Frequency Number** | **Percentage** | **Mean** | **Standard deviation** |
| Small area (1200 - 1600 sq. ft.) | 20 | 50.0 | 1822.50 | 525.985 |
| Medium area (1700 -2100 sq. ft.) | 2 | 5.0 | | |
| Large area (Above 2100 sq. ft.) | 18 | 45.0 | | |
| **Total** | **40** | **100** | | |

The result showed that 50 percent was small garden area while 5 percent was medium garden area.

### 4.2. 5 Spending time for gardening (hour)

Spending time (hr) for gardening was categorized into three (0 to >3 hr) groups where 0 hr indicated no spending time for gardening and >3 hr indicated more spending time for gardening in Table 4.15. The mean and standard deviation were 1.7000 and 1.13680, respectively.

**Table 4.15 Distribution of the garden owners according to their spending time for gardening**

| Categories (hour) | Garden owners | | | |
|---|---|---|---|---|
| | Frequency Number | Percentage | Mean | Std. dev. |
| 0-1 | 15 | 37.5 | 1.7000 | 1.13680 |
| 2-3 | 12 | 30 | | |
| >3 | 13 | 32.5 | | |
| **Total** | **40** | **100** | | |

The result showed that 37.5 percent garden owners spend 0 to 1 hr for gardening activities while 30.0 percent garden owners speeded 2 to 3 hr and 32.5 percent garden owner's speeded > 3 hr for gardening activities.

### 4.2.6 Training for roof garden (days)

Garden owners received training (days) from DAE project training program for gardening which was categorized into five (0 to 5 days) groups where 0 day indicated no training received for gardening and 5 days indicated better training received for gardening. The mean and standard deviation were 2.0750 and 1.52564, respectively was shown in Table 4.16.

**Table 4.16 Distribution of the garden owners according to their received training (days) for gardening**

| Categories (days) | Garden owners | | | |
|---|---|---|---|---|
| | Frequency Number | Percentage | Mean | Standard deviation |
| No Training | 7 | 17.5 | 2.0750 | 1.52564 |

| | | | | |
|---|---|---|---|---|
| 1 day | 10 | 25.0 | | |
| 2days | 7 | 17.5 | | |
| 3 days | 7 | 17.5 | | |
| 4 days | 7 | 17.5 | | |
| 5 days | 2 | 5 | | |
| **Total** | **40** | **100** | | |

The result indicated that 25 percent garden owners received training 1 day for gardening while 5 percent garden owners received training 5 days for gardening.

### 4.2.7 Input availability for gardening

Input availability for gardening such as seedling, improved variety, fertilizer and pesticide were ranged from 0 to 12. The mean and standard deviation were 17.8500 and 2.13097, respectively. On the basis of their input availability the garden owners were classified into three categories was shown in Table 4.17.

**Table 4.17 Distribution of the garden owners according to their input availability for gardening**

| Categories | Garden owners | | | |
|---|---|---|---|---|
| | **Frequency Number** | **Percentage** | **Mean** | **Std. dev.** |
| Low input availability | 12 | 30.0 | 17.850 | 2.13097 |
| Medium input availability | 20 | 50.0 | | |
| High input availability | 8 | 20.0 | | |
| **Total** | **40** | **100** | | |

The result revealed that 50.0 percent garden owners received medium input availability while 30.0 percent gardeners received low input availability for gardening.

### 4.2.8 Management practices for gardening

Management practices for gardening such as application of fertilizer, pesticide, fungicide and irrigation which were ranged from 0 to 12. The mean and standard

deviation were 11.3250 and 0.79703, respectively. Management practices were classified into three categories was shown in Table 4.18.

**Table 4.18 Distribution of the garden owners according to their management practices for gardening**

| Categories | Garden owners | | | |
|---|---|---|---|---|
| | **Frequency Number** | **Percentage** | **Mean** | **Std. dev.** |
| Low management practices | 21 | 52.5 | 11.32 | 0.797 |
| Medium management practices | 11 | 27.5 | | |
| High management practices | 8 | 20.0 | | |
| **Total** | **40** | **100** | | |

The result revealed that 52.5 percent garden owners followed low management practices for gardening while 20.0 percent garden owners followed high management practices for gardening.

### 4.2.9 Income of the garden owners with their occupation

In Dhaka city, maximum numbers of garden owner's were service holder but here a large portion them were engaged in business activities. The occupations of the garden owners were categorized into three groups in Table 4.19.

**Table 4.19 Distribution of the garden owners according to their occupation**

| **Categories** | **Garden owners** | |
|---|---|---|
| | **Frequency** | **Percentage** |
| Service holder | 14 | 35.0 |
| Business | 18 | 45.0 |
| Others (housewife, retired person) | 8 | 20.0 |
| **Total** | **40** | **100.0** |

The result showed that 45.0 percent garden owner's occupations were businessmen while 20.0 percent gardener's occupations were housewife and retired person.

Family annual income of the garden owner was determined by his family's total income which was expressed in Taka (lack). The observed range was 100000.00 -700000.00 Taka with mean of 319750.0000 and standard deviation of 141593.26907. On the basis of their family annual income the garden owners were classified into three categories ass shown in Table 4.20.

**Table 4.20 Distribution of the garden owners according to their Annual income**

| Categories | Garden owners | | | |
|---|---|---|---|---|
| | **Frequency Number** | **Percentage** | **Mean** | **Std. dev.** |
| Low income (up to 200000 Taka) | 14 | 35.0 | 319750.0 | 141593.2 |
| Medium income (200001- 400000 Taka) | 18 | 45.0 | | |
| High income (above 400000 Taka) | 8 | 20.0 | | |
| **Total** | **40** | **100** | | |

The result indicated that 45.0 percent garden owners had medium family income annually while 35.0 percent garden owners had low family income.

### 4.2.10 Comparative Problem faced of the garden owners in practicing roof top gardening activities

The problem Faced Index (PFI) was calculated to find out major problems faced by the garden owners in practicing plant species diversity. The severity of problem faced of the garden owners is shown in Table 4.21.

**Table 4.21 Problems Faced Index (PFI) for selected 10 problems with rank order**

| Sl. No. | Problems | Opinion on extent of problems | | | | | PFI | Rank order |
|---|---|---|---|---|---|---|---|---|
| | | Very high | High | Moderate | Little | Not at all | | |
| 1 | Pest attack | 18 | 9 | 8 | 5 | 0 | 128 | 1 |
| 2 | Diseases attack | 14 | 10 | 9 | 2 | 5 | 115 | 2 |
| 3 | Lack of capital | 13 | 10 | 10 | 7 | 0 | 109 | 3 |
| 4 | Adverse climate | 12 | 10 | 8 | 10 | 0 | 104 | 4 |
| 5 | High price of seedling | 12 | 10 | 9 | 5 | 4 | 101 | 5 |
| 6 | Unavailability of pesticides in time | 11 | 10 | 6 | 6 | 7 | 92 | 6 |
| 7 | High price of tools | 12 | 10 | 4 | 5 | 9 | 91 | 7 |
| 8 | Lack of high yielding varieties | 10 | 9 | 5 | 4 | 10 | 81 | 8 |
| 9 | Lack of training facilities | 11 | 7 | 5 | 5 | 12 | 80 | 9 |
| 10 | Theft flowers, fruits, vegetables by thief | 10 | 4 | 6 | 10 | 10 | 74 | 10 |

From Table 4.21 it was observed that –

1. On the basis of Problem Faced Index (PFI), ‘pest attack’ ranked first with a PFI of 128. It was found that most of the garden owners faced pest attack problem for

gardening practices which destroyed the products in severe case. Therefore, to solve this problem it may be suggested that they should follow different pest management practices.

2. 'Diseases attack' ranked 2nd with a PFI of 115. Lack of proper roof top gardening knowledge for practicing gardening, most of the garden owners faced this problem. Therefore, to solve this problem it may be suggested that proper knowledge and training facilities for practicing gardening should be ensured.

3. 'Lack of capital' ranked 3rd with a PFI of 109. Lack of sufficient investment, they could not invest enough money to participate in roof top gardening activities. Therefore, to solve this problem it may be suggested that credit facilities should be increased.

4. 'Adverse climate' ranked 4th with a PFI of 104. Sometimes adverse climate damage the plants in severe case. For this reason, garden owners are not interested for practicing gardening but it is natural calamity. Therefore, to solve this problem it may be suggested that proper gardening structure should be followed to save the plants.

5. 'High price of seedling' ranked 5th with a PFI of 101. As good seedlings were expensive and hard to manage, they could not arrange good seedlings timely. Therefore, it may be suggested that supply of quality seedlings should be ensured to the gardeners.

6. 'Unavailability of pesticides in time' ranked 6th with a PFI of 92. As the supply of pesticides in the market was insufficient and price was high during production season, most of the time the garden owners faced this problem. Therefore, it may be suggested that proper supply of pesticides should be ensured.

7. ‘High price of tools’ ranked 7th with a PFI of 91. Drums and tobs for planting trees, gardening practices tools price was high with unavailability in the local market, most of the time the garden owners faced this problem. Therefore, it may be suggested that proper supply of gardening practices tools with limited price should be ensured.

8. ‘Lack of high yielding varieties’ ranked 8th with a PFI of 81. As high yielding varieties are not available and hard to manage, they could not arrange high yielding varieties timely. Therefore, it may be suggested that supply of high yielding varieties should be ensured to the garden owners.

9. ‘Lack of training facilities’ ranked 9th with a PFI of 80. Some of the garden owners of the study area were unable to take training facilities due to the age because most of them are old aged people, they could not attend the DAE training program for gardening practices and lack of sufficient information about training facilities for gardening. Therefore, it may be suggested that training program for gardening practices should increase in local area basis.

10. ‘Theft flowers, fruits, vegetables by thief’ had the lowest with a PFI of 74. Some of the garden owners of the study area were faced this problem. Therefore, it may be suggested that proper take and care should be created.

### 4.3 Relationship between the selected characteristics of the garden owners with their plant species diversity

This section deals with the relationship between the independen variables and dependent variables of the study. The selected characteristics of the garden owners constituted the independen variables while the dependent variables was the plant species diversity present in the garden owners rooftop. Pearsons Product Moment Co-efficient Correlation (r) has been used to test the null

hypotheses concerning the relationshipa between the variables. At least 0.05 level of significance was used as the basis for rejection of a null hypotheses.

The results of Correlation test has been presented in table. However,a Correlation matrix for all independen and dependent variables has been included in Appendix-3.

**Table 4.22 Co-efficient of Correlation (r) showing relationship between the selected characteristics of the garden owners with their plant species diversity. (N=40)**

| Dependent variable | Selected characteristics (independent variables) | Computed value ("r") | Tabulated value of " r" with 98 df at | |
|---|---|---|---|---|
| | | | 5% level | 1% level |
| Plant species diversity | Age | 0.043 NS | 0.196 | 0.254 |
| | Education | 0.156 NS | | |
| | Family Size | -0.067 NS | | |
| | Area of garden | 0.964** | | |
| | Spending time for gardening | 0.757** | | |
| | Training for gardening | 0.910** | | |
| | Input availability for gardening | 0.922** | | |
| | Management for gardening | 0.191 NS | | |
| | Problems faced for gardening | -0.948** | | |
| | Income of the garden owners | 0.958** | | |

NS=Not Significant

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

### 4.3.1 Age and plant species diversity

The relationship between ages of the garden owners with their plant species diversity was measured by testing the following null hypotheses:" There is no

relationship between age of the garden owners and their plant species diversity". The computed value of r (0.043) was smaller than that of the tabulated value (0.196) with 98 degrees of freedom at 0.05 level of probability. Hence, the concerned null hypothesis was accepted. The result indicated that there was no significant relationship between age of the garden owners and their plant species diversity.

### 4.3.2 Education and plant species diversity

The relationship between educations of the garden owners with their plant species diversity was measured by testing the following null hypotheses: "There is no relationship between education of the garden owners and their plant species diversity". The computed value of r (0.156) was smaller than that of the tabulated value (0.196) with 98 degrees of freedom at 0.05 level of probability. Hence, the concerned null hypothesis was accepted. The result indicated that there was no significant relationship between the education of the garden owners and their plant species diversity.

### 4.3.3 Family size and plant species diversity

The relationship between family sizes of the garden owners with their plant species diversity was measured by testing the following null hypotheses: "There is no relationship between family size of the garden owners and their plant species diversity". The computed value of r (-0.067) was smaller than that of the tabulated value (0.196) with 98 degrees of freedom at 0.05 level of probability. Hence, the concerned null hypothesis was accepted. The result indicated that there was no significant relationship between family size of the garden owners and their plant species diversity. It could be concluded that the family size of the garden owners had a negative significant relationship with their plant species diversity.

### 4.3.4 Area of garden and plant species diversity

The relationship between areas of garden of the garden owners with their plant species diversity was measured by testing the following null hypotheses: "There is no relationship between area of garden of the garden owners and their plant species diversity". The computed value of r ($0.964^{**}$) was greater than that of the tabulated value (0.254) with 98 degrees of freedom at 0.01 level of probability. Hence, the concerned null hypothesis was rejected. The result indicated that the area of garden of the garden owners had a positive significant relationship with their plant species diversity. It could be concluded that the large the roof top garden area, the more was plant species diversity.

### 4.3.5 Spending time for gardening and plant species diversity

The relationship between spending time for gardening of the garden owners with their plant species diversity was measured by testing the following null hypotheses: "There is no relationship between spending time for gardening of the garden owners and their plant species diversity present in the garden". The computed value of r ($0.757^{**}$) was greater than that of the tabulated value (0.254) with 98 degrees of freedom at 0.01 level of probability. Hence, the concerned null hypothesis was rejected. The result indicated that the spending time for gardening of the respondents had a positive significant relationship with their plant species diversity. It could be concluded that the greater the spending time for gardening, the better was plant species diversity.

### 4.3.6 Training for roof garden and plant species diversity

The relationship between training for gardening of the garden owners with their plant species diversity was measured by testing the following null hypotheses: "There is no relationship between training for gardening of the garden owners and their plant species diversity". The computed value of r ($0.910^{**}$) was greater than that of the tabulated value (0.254) with 98 degrees of freedom at 0.01 level of probability. Hence, the concerned null hypothesis was rejected. The result

indicated that the training for gardening of the garden owners had a positive significant relationship with their plant species diversity. It could be concluded that the more the training facilities for gardening, the more was plant species diversity.

### 4.3.7 Input availability for gardening and plant species diversity

The relationship between input availability for gardening of the garden owners with their plant species diversity was measured by testing the following null hypotheses: "There is no relationship between input availability for gardening of the garden owners and their plant species diversity". The computed value of r ($0.922^{**}$) was greater than that of the tabulated value (0.254) with 98 degrees of freedom at 0.01 level of probability. Hence, the concerned null hypothesis was rejected. The result indicated that the input availability for gardening of the garden owners had a positive significant relationship with their plant species diversity. It could be concluded that the more the input availability for gardening, the more was plant species diversity.

### 4.3.8 Management for gardening activities and plant species diversity

The relationship between garden owner's management for gardening with their plant species diversity was measured by testing the following null hypotheses: "There is no relationship between garden owner's management for gardening activities and their plant species diversity". The computed value of r (0.191) was smaller than that of the tabulated value (0.196) with 98 degrees of freedom at 0.05 level of probability. Hence, the concerned null hypothesis was accepted. The result indicated that there was no significant relationship between garden owner's management for gardening activities and their plant species diversity. It could be concluded that the management for gardening of the garden owners had a positive significant relationship with their plant species diversity.

### 4.3.9 Problems faced for gardening and plant species diversity

The relationship between problems faced for gardening of the garden owners with their plant species diversity was measured by testing the following null hypothesis: "There is no relationship between problem faced for gardening and their plant species diversity present in the garden". The computed value of r (-0.948**) was greater than that of the tabulated value (0.254) with 98 degrees of freedom at 0.01 level of probability. Hence, the concerned null hypothesis was rejected. The result indicated that the problem faced for gardening had a negative significant relationship with their plant species diversity. It could be concluded that the less the problem faced for gardening, the more was plant species diversity.

### 4.3.10 Income of the garden owners and plant species diversity

The relationship between incomes of the garden owners with their plant species diversity was measured by testing the following null hypotheses: "There is no relationship between income of the garden owners and their plant species diversity". The computed value of r (0.958**) was greater than that of the tabulated value (0.254) with 98 degrees of freedom at 0.01 level of probability. Hence, the concerned null hypothesis was rejected. The result indicated that the income of the garden owners had a positive significant relationship with their plant species diversity. It could be concluded that the more the income of the garden owners, the more was plant species diversity.

## 4.4 Purpose of roof gardening

Purpose of rooftop gardening was assessed using a semi-structured open questionnaire. Roof top gardening was the most accessible practiced for gardeners in the Dhaka city. Gardener's choice was given in table 4.23.

**Table 4.23 Purpose of roof gardening with gardener's no. and percentage**

| Sl. No. | Purposes | Gardeners no. | Percentage |
|---|---|---|---|
| 1. | Aesthetic value | 5 | 12.5 |
| 2. | Environmental amelioration | 4 | 10 |
| 3. | Leisure time activity | 2 | 5 |
| 4. | Mental satisfaction | 4 | 10 |
| 5. | Healthy product consume | 25 | 62.5 |
| **Total** | | **40** | **100** |

Table 4.23 showed that the garden owners were interested for rooftop gardening because they thought that gardening products were healthy for consumption (62.5%) while 5 percent garden owners were interested for rooftop gardening as leisure time activity.

# CHAPTER V
# SUMMARY, CONCLUSION AND RECOMMENDATION

## 5.1 SUMMARY

### 5.1.1 Plant species diversity

The result revealed that the roof top garden of Dhaka city posses' high plant diversity where Shannon-Weaver diversity index were 3.84. Among species richness, 35 types were fruit, 20 types were vegetable, 22 types were flower, 13 types were ornamental and 10 types were medicinal species. Inter-species diversity was found higher for vegetable species (0.799) followed by fruit species (0.798), flower (0.797), ornamental species (0.796) and medicinal (0.795) species, respectively. Higher average inter-species diversity (0.967) was found in Mirpur area followed by Kamrangichor (0.961) and Gulshan (0.959) area. The lowest inter-species diversity was found in Mohammadpur area (0.952). Among the 35 fruit species, mango (127.1%) was found in most prevalent and kanthal (10.2%) was found in lowest prevalent fewer than 31 genera and 18 families while Rutaceae contained 5 species. Among 20 flower species, beli (115.7%) was found in most prevalent and kamini (44.8%) was found in lowest prevalent fewer than 21 genera and 31 families while Compositae contained 11 species. Out of 22 vegetable species, brinjal (130.8%) was found in most prevalent and jute leaf (33.4%) was found in lowest prevalent fewer than 21 genera and 13 families while Cucurbitaceae contained 5 species. Out of 13 ornamental species, patabahar (112.3%) was found in most prevalent and thuja (44.7%) was found in lowest prevalent under 13 genera and 13 families and out of 10 medicinal species, pudina (112.9%) was found in most prevalent and basok (23.6%) was found in lowest prevalent under 10 genera and 9 families while Caesalpinieae contained 4 species. Sixty five percent garden owners had high plant diversity while 35% had medium plant diversity in theie roof top garden.

### 5.1.2 Selected characteristics of the garden owners

Sixty two (62%) percent of the garden owners were old age and 40% of the garden owners were in small family size which was a representative of typical family size in Dhaka city. Most of the garden owners were higher educated (52.5%). Small size areas of the gardens were found in 50 percent (1200 to 1600 sq. ft.). Most of the garden owners (40.0 %) spend 3 hr for gardening activities. Garden owners received 1day training (25 %) from DAE project training program for gardening practices. Among them 30% of the garden owners did not get enough inputs availability such as seedling, improved variety, fertilizer and pesticide for gardening practices. Only 20% garden owners took high management practices such as regular application of fertilizer, pesticide fungicide and irrigation for gardening. Maximum numbers of garden owners were businessmen (45%). On the basis of descending order of Problem Faced Index (PFI), 'pest attack' ranked first during gardening practices which destroyed the products severely followed by 'diseases attack', 'lack of capital', 'adverse climate', 'high price of seedling', 'unavailability of pesticides in time', 'high price of tools', 'lack of high yielding varieties', and 'lack of training facilities'. Theft flowers, fruits, vegetables by thief ranked last.

### 5.1.3 Relationship between the selected characteristics of the garden owners with their plant species diversity

Pearsons Product Moment Co-efficient Correlation (r) has been used to examine the relationship between the selected characteristics of the garden owners constituted the independen variables while the dependent variables was the plant species diversity present in RTG of the garden owners. These 10 selected characteristics were: age, education, family size, surface area of roof garden, spending time for gardening (hour), training for gardening (days), input availability for gardening, management for gardening, income of garden owners, problem faced for gardening practices by the garden owners. Among the selected

characteristics age, education, family size, management for gardening had no significant relationship with the plant species diversity present in the roof top garden. The remaining six selected characteristics such as area of gardening, spending time for gardening, training for gardening, input availability for gardening, problem faced for practicing gardening and income of the garden owners had positive significant relationship with the plant species diversity present in the roof top garden.

## 5.2 Conclusion

For higher conservation of diversity with better aesthetic, environmental, and economic perspectives, plantation in the roof top is desirable. Roof top garden plays a significant role in urban landscape planning and management. In this study, following conclusions were drawn on the basis of findings:

1. An overwhelming (35.0 percent) of the garden owners had a medium plant species diversity which was not satisfactory. It could be concluded that if there would be the sufficient roof top garden area, the more would be the plant species diversity to meet the high plant species diversity demand for food and nutrition.

2. Mango, beli, brinjal, patabahar and pudina were found most prevalent in their respective category. Inter species diversity was the highest (1.77) in the vegetable species and lowest in medicinal. Sixty five percent of the garden owners have higher diversity and 62.5 percent gardener was interested in rising of rooftop garden because they think that gardening products consumption are healthy.

3. Overwhelming (25.0 percent) garden owners received training 1 day for gardening activities. The results indicated that the training for gardening

which received by the garden owners had a positive significant relationship with their plant species diversity. It could be concluded that the more the training facilities for gardening activities, the more would be the plant species diversity with facing no or little problem.

4. Overwhelming (30.0 percent) garden owners had low input availability for gardening practices which showed positive significant relationship with their plant species diversity. It could be concluded that the proper supply of the input availability for gardening practices, the more would be the plant species diversity.

5. Overwhelming (52.5 percent) garden owners had low management practices for gardening which showed negative significant relationship with their plant species diversity It could be concluded that the better the management practices for gardening, the more would be the plant species diversity.

### 5.3.1 Recommendation

On the basis of results and conclusion of the study, recommendations are made as follows:

1. Different roof top garden practices are important for the fulfillment of the demand of urban garden owners, environmental amelioration and mental satisfaction. But only few garden owners practiced roof top garden activities. It should be extended to all house owners, city dwellers and multistoried building owners under the city area.

2. DAE provided the basic demands of incentives for the gardening activities but adequate training, motivation and sustainable management are required to encourage the city people in practicing roof top garden to improve plant

species diversity elsewhere in Bangladesh based on residential and rental houses.

3. 62.5% garden owners were old aged people where collection of different planting materials are not easy for them and manpower seems to be a problem, since no persons are available in some houses to look after the garden, in that cases paid services should be provided to continue the gardening activities.

### 5.3.2 Recommendations for further research

On the basis of scope and limitations of the present study and observation made by the research work the following recommendations are made for further study:

1. The research had only include the roof top garden but not the garden in "Balcony'', "Kitchen'', "Container'' and "Hydroponics" and "Aeroponics'' or "Air-dynaponics" farming in the roof top were conducted here. At the time of data collection there was found that a large number of respondents had garden in balconies and kitchen. Based on the subject a further research would be done.

2. The present study was conducted in only four metropolitan areas of Dhaka city. Such studies are required to conduct in other areas of the country.

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# Appendix 1

AN ENGLISH VERSION OF THE INTERVIEW SCHEDULE

Department of Agroforestry and Environmental Science
Sher-e-Bangla Agricultural University
Dhaka, Bangladesh

*An interview schedule for a research study entitled*

**PLANT SPECIES DIVERSITY OF ROOF TOP GARDEN IN DHAKA CITY**

**Serial No.** ……. **Date:** ……..

Name of the Survey Collector: **TANIA HOSSAIN**

Name of the garden owners:

Address of the garden owner:

**Q:1. How old are you?** ……Years

**Q:2. Education level of the garden owners:**

……

**Q:3. Family size:**

Male …….. Female ……..…. Total ……..……..

| **Q:4.** | **Give information about your annual income:** | |
|---|---|---|
| | **Sources of income** | **Amount of annual income (Taka)** |
| | 1. Service holder | |
| | 2. Business | |
| | 3.Others | |

**Q:5. What is the approximate surface area of your roof garden?**

Square feet: …….

**Q:6. How much daily time do you like to spend in your roof garden?**

1. 1 hr 2. 2 hr 3. Above 2 hr

| Q:7. | What kind of species would you have in your roof garden which indicates diversification of plant species? | | |
|---|---|---|---|
| | i. Fruit species | | |
| **Sl. No.** | **Plants name** | **Plant Number** | **Habit, family, genus and species** |
| 1. | Mango | | |
| 2. | Payera | | |
| 3. | Papaya | | |
| 4. | Straw berry | | |
| 5. | Kamrangha | | |
| 6. | Batabi lebu | | |
| 7. | Kagji lebu | | |
| 8. | Alachi lebu | | |
| 9. | Amloki | | |
| 10. | Billimbi | | |
| 11. | Kazi peyara | | |
| 12. | Malta | | |
| 13. | Jalpai | | |
| 14. | Apple | | |
| 15. | Lichu | | |
| 16. | Sofeda | | |
| 17. | Sarifa | | |
| 18. | Kamala | | |
| 19. | Ata | | |
| 20. | Khejur | | |
| 21. | Rambutan | | |
| 22. | Banana | | |
| 23. | Coromcha | | |
| 24. | Amra | | |
| 25. | Boroi | | |
| 26. | Naspati | | |
| 27. | Jambura | | |
| 28. | Golapjam | | |
| 29. | Dalim | | |
| 30. | Beel | | |
| 31. | Cherry | | |
| 32. | Deshi Tentul | | |
| 33. | Arboroi | | |
| 34. | Kothbel | | |

| | | | |
|---|---|---|---|
| 35. | Kanthal | | |

## ii. Vegetable species

| Sl. No. | Plants name | Plant Number | Habit, family, genus and species |
|---|---|---|---|
| 1. | Brinjal | | |
| 2. | Pipper | | |
| 3. | Tomato | | |
| 4. | Amaranth | | |
| 5. | Korola | | |
| 6. | Okra | | |
| 7. | Green chili | | |
| 8. | Indian spinach | | |
| 9. | Lettuce | | |
| 10. | Shim | | |
| 11. | Ridged gourd | | |
| 12. | Teasle gourd | | |
| 13. | Drum stick | | |
| 14. | Dhundul | | |
| 15. | Kachu | | |
| 16. | Lal shak | | |
| 17. | Capsicum | | |
| 18. | Broccoli | | |
| 19. | Shosha | | |
| 20. | Bengal Spinach | | |
| 21. | Bathua | | |
| 22. | Jute leaf | | |

## iii. Flower species

| Sl. No. | Plants name | Plant Number | Habit, family, genus and species |
|---|---|---|---|
| 1. | Beli | | |
| 2. | Petunia | | |
| 3. | Dianthas | | |
| 4. | Common Jasmine | | |
| 5. | Chondro mollika | | |
| 6. | Oleander | | |
| 7. | Zinnia | | |
| 8. | Hasnahena | | |

| | | | |
|---|---|---|---|
| 9. | Rongon | | |
| 10. | Periwinkle | | |
| 11. | Musanda | | |
| 12. | Rose | | |
| 13. | Bougainvillea | | |
| 14. | Joba | | |
| 15. | Justicia | | |
| 16. | Allamanda | | |
| 17. | Duranta | | |
| 18. | Shaora | | |
| 19. | Bakul | | |
| 20. | Kamini | | |

| **iv. Ornamental species** | | | |
|---|---|---|---|
| **Sl No.** | **Plants name** | **Plant Number** | **Habit, family, genus and species** |
| 1. | Patabahar | | |
| 2. | Patharcuchi | | |
| 3. | Blood leaf | | |
| 4. | Cycus | | |
| 5. | Lantana | | |
| 6. | Henna | | |
| 7. | Patra bilas | | |
| 8. | Fern | | |
| 9. | Orchid | | |
| 10. | Cactus | | |
| 11. | Jhau | | |
| 12. | Christmass tree | | |
| 13. | Thuja | | |

| **v. Medicinal species** | | | |
|---|---|---|---|
| **Sl. No.** | **Plants name** | **Plant Number** | **Habit, family, genus and species** |
| 1. | Pudina | | |
| 2. | Tulsi | | |
| 3. | Alovera | | |
| 4. | Neem | | |
| 5. | Kababchini | | |
| 6. | Lemon grass | | |
| 7. | Long pepper | | |

| | | | |
|---|---|---|---|
| 8. | Thankuni | | |
| 9. | Tejpata | | |
| 10. | Basok | | |

**Q:8. Did you receive any training on roof top gardening?**

1. YES 0. NO

**If YES, how many days (mention):** ……

**Q:9. Input availability:**

Please give information about following input availability for gardening

| Sl. No. | Inputs | Extent of inputs | | | |
|---|---|---|---|---|---|
| | | Regular (3) | Moderate (2) | Low (1) | No (0) |
| 1. | Seedling | | | | |
| 2. | Improved variety | | | | |
| 3. | Fertilizer | | | | |
| 4. | Pesticide | | | | |

**Q:10. Management for gardening activities:**

Please give information about following management for gardening activities

| Sl. No. | Management activities | Extent of Management | | | |
|---|---|---|---|---|---|
| | | Regular (3) | Moderate (2) | Low (1) | No (0) |
| 1. | Application of fertilizer | | | | |
| 2. | Application of Pesticide | | | | |
| 3. | Application of fungicide | | | | |
| 4. | Application of irrigation | | | | |

**Q:11. Purpose of roof top gardening:**

……

**Q:12. Mention the degree of problems faced by you in roof garden:**

| Sl. No. | Problems | Very high (4) | High (3) | Moderate (2) | Low (1) | No (0) |
|---|---|---|---|---|---|---|
| 1. | Lack of capital | | | | | |
| 2. | Adverse climate | | | | | |
| 3. | Lack of high yielding varieties | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4. | Pest attack | | | | | |
| 5. | Diseases attack | | | | | |
| 6. | Unavailability of pesticides in time | | | | | |
| 7. | High price of seedling | | | | | |
| 8. | High price of tools | | | | | |
| 9. | Lack of training facilities | | | | | |
| 10. | Theft flowers, fruits, vegetables by thief | | | | | |

Thanks for your kind co-operation.

Signature of interviewer

Date ……...

# Appendix- 2

**Descriptive Statistics**

| Characteristics | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Age (Yr) | 40 | 31.00 | 75.00 | 55.2750 | 13.51919 |
| Education (Yr of schooling) | 40 | 7.00 | 18.00 | 11.6750 | 2.50525 |
| Family Size (no.) | 40 | 3.00 | 7.00 | 4.7250 | .98677 |
| Area of garden (sq. ft.) | 40 | 1200.00 | 2500.00 | 1822.5000 | 525.98503 |
| Spending time for gardening (hour) | 40 | .00 | 3.00 | 1.7000 | 1.13680 |
| Training for gardening (days) | 40 | .00 | 5.00 | 2.0750 | 1.52564 |
| Input availability for gardening | 40 | 16.00 | 21.00 | 17.8500 | 2.13097 |
| Management for gardening | 40 | 10.00 | 12.00 | 11.3250 | .79703 |
| Problems faced for gardening (individual) | 40 | 6.00 | 18.00 | 11.2500 | 5.19739 |
| Income of the garden owners | 40 | 100000.00 | 600000.00 | 319750.000 | 141593.26907 |
| Plant species diversity | 40 | 1.23 | 3.97 | 2.5438 | 1.02165 |
| Valid N (list wise) | 40 | | | | |

# Appendix- 3

## Co-efficient Correlation (r)

| | | age | education | family size | area | time | training | input | management | problem | income | plant species diversity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| age | Pearson Correlation | 1 | -.069 | .079 | -.001 | .062 | -.008 | .033 | .263 | -.065 | .014 | .043 |
| | Sig. (2-tailed) | | .671 | .629 | .997 | .703 | .959 | .842 | .101 | .691 | .932 | .790 |
| | N | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| education | Pearson Correlation | -.069 | 1 | .046 | .340* | .460** | .248 | -.062 | .157 | -.417** | .150 | .256 |
| | Sig. (2-tailed) | .671 | | .779 | .032 | .003 | .123 | .703 | .333 | .007 | .355 | .111 |
| | N | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| family size | Pearson Correlation | .079 | .046 | 1 | -.047 | -.030 | -.054 | -.032 | -.014 | .139 | .009 | -.067 |
| | Sig. (2-tailed) | .629 | .779 | | .773 | .856 | .740 | .843 | .932 | .393 | .958 | .680 |
| | N | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| area | Pearson Correlation | -.001 | .340* | -.047 | 1 | .783** | .909** | .861** | .178 | -.918** | .934** | .964** |
| | Sig. (2-tailed) | .997 | .032 | .773 | | .000 | .000 | .000 | .272 | .000 | .000 | .000 |
| | N | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| time | Pearson Correlation | .062 | .460** | -.030 | .783** | 1 | .649** | .553** | .252 | -.725** | .707** | .757** |
| | Sig. (2-tailed) | .703 | .003 | .856 | .000 | | .000 | .000 | .117 | .000 | .000 | .000 |
| | N | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| training | Pearson Correlation | -.008 | .248 | -.054 | .909** | .649** | 1 | .871** | .232 | -.879** | .913** | .910** |
| | Sig. (2-tailed) | .959 | .123 | .740 | .000 | .000 | | .000 | .149 | .000 | .000 | .000 |
| | N | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| input | Pearson Correlation | .033 | -.062 | -.032 | .861** | .553** | .871** | 1 | .165 | -.802** | .940** | .922** |
| | Sig. (2-tailed) | .842 | .703 | .843 | .000 | .000 | .000 | | .308 | .000 | .000 | .000 |
| | N | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| management | Pearson Correlation | .263 | .157 | -.014 | .178 | .252 | .232 | .165 | 1 | -.187 | .203 | .198 |
| | Sig. (2-tailed) | .101 | .333 | .932 | .272 | .117 | .149 | .308 | | .247 | .209 | .220 |
| | N | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| problem | Pearson Correlation | -.065 | -.417** | .139 | -.918** | -.725** | -.879** | -.802** | -.187 | 1 | -.878** | -.948** |
| | Sig. (2-tailed) | .691 | .007 | .393 | .000 | .000 | .000 | .000 | .247 | | .000 | .000 |
| | N | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| income | Pearson Correlation | .014 | .150 | .009 | .934** | .707** | .913** | .940** | .203 | -.878** | 1 | .958** |
| | Sig. (2-tailed) | .932 | .355 | .958 | .000 | .000 | .000 | .000 | .209 | .000 | | .000 |
| | N | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| plant species diversity | Pearson Correlation | **.043** | **.156** | **-.067** | **.964**** | **.757**** | **.910**** | **.922**** | **.191** | **-.948**** | **.958**** | **1** |
| | Sig. (2-tailed) | .790 | .111 | .680 | .000 | .000 | .000 | .000 | .220 | .000 | .000 | |
| | N | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |

| |
|---|
| *. Correlation is significant at the 0.05 level (2-tailed). |
| **. Correlation is significant at the 0.01 level (2-tailed). |