

**STUDY ON ROOFTOP GARDENING AS AN AGRIBUSINESS PRACTICE IN
DHAKA CITY**

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**STUDY ON ROOFTOP GARDENING AS AN AGRIBUSINESS PRACTICE IN
DHAKA CITY**

BY

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CERTIFICATE

This is to certify that the thesis entitled ‘**STUDY ON ROOFTOP GARDENING AS AN AGRIBUSINESS PRACTICE IN DHAKA CITY**’ submitted to the Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **Master of Science in Agribusiness and Marketing**, embodies the result of a piece of bona fide research work carried out by **MAISA TASLIM WASHI**, Registration Number:14-06275, under my supervision and guidance. No part of the thesis has been submitted for any other degree, diploma, title, recognition before.

I further certify that any help or source of information received during the course of this investigation has duly been acknowledged.

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DEDICATED
TO MY BELOVED
FAMILY
&
WELL WISHERS

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ABBREVIATION AND ACRONYMS

AEO: Agricultural Extension Officer

AO: Agriculture Officer

BADC: Bangladesh Agricultural Development Corporation

BBS: Bangladesh Bureau of Statistics

BCR: Benefit Cost Ratio

DAE: Department of Agricultural Extension

DAM: Department of Agricultural Marketing

RTG: Rooftop Garden

SPSS; Statistical Package for Social Sciences

Sq ft; Square feet

TK: Taka

UN: United Nation

VIF: Variance inflation factor

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STUDY ON ROOFTOP GARDENING AS AN AGRIBUSINESS PRACTICE IN DHAKA CITY

ABSTRACT

The main thrust of the study was to determine the factors that affecting rooftop production and the scope and possibility of agribusiness through rooftop gardening production in Dhaka city. The study was conducted at five selected areas namely Dhanmondi, Mirpur, Mohammadpur, Uttara and Badda. Data were collected by using an interview schedule(Questionnaire) and Multiple linear regression was used to analyze the data. The result showed that 65% old aged (above 50 years) respondents involved in RTG from Dhanmondi, Mirpur and Uttara area and majority of the respondent was female. All the factors cooperatively contribute 52.7% of the variance of rooftop production ($R^2 = 0.527$). Total roof space, family income, support from government organization, support from online platform, government employees and others profession such as homemaker were found significant contribution to rooftop gardening while rest of the variables found having no significant contribution. To estimate the agribusiness scope and possibility five fruits and five vegetables were selected those were common in maximum rooftop. The production level per rooftop was medium (71-100) kg/year in Dhaka city but it had maximum small family (upto3 members) to consume. There will be an opportunity to sell the surplus. After family consumption the BCR was calculated with the surplus production. Final result showed that every selected region from this research has an opportunity and scope of agribusiness as BCR was greater than 1. Mirpur region BCR value was 1.345 which was highest among other areas. So Mirpur region had highest production of fruits and vegetables among five selected areas.

CHAPTER I

INTRODUCTION

Rooftop farming can help meet rising food demand while also promoting a more sustainable and livable city. Roof gardens in Dhaka city can offer local, fresh, and safe food. Because of the production of rooftops is increasing every day, it is now possible to have a sustainable agribusiness with rooftop gardening on a small scale. Rooftop agriculture has the potential to reduce food poverty. Green roofs will provide a rare opportunity to grow food efficiently in often underutilized locations, assisting in the support and sustainability of food for urban people. Alternative agricultural production systems, such as green roof technologies, will become increasingly important as human populations get more urbanized and urban customers become more interested in local food for their families. Green roofs provide area for vegetable crop cultivation, allowing agriculture to become more integrated into urban neighborhoods. The majority of homemakers will engage in agribusiness with their rooftop cultivation, which will boost a family's income while also ensuring organic food sourcing and nutritional security. Our agricultural land is dwindling. In today's world, rooftop farming can give a solution in which we can grow our own food on our roofs and sell the surplus to agribusiness. Our building's roof will be used to raise vegetables and fruits for family consumption and also for selling purpose. So, rooftop production can give health security to produce organic fruits and vegetables, ensure food security, scope of agribusiness and employment opportunity by agribusiness (Wardard, 2014).

Rapid urbanization and expansion are putting a pressure on city food supply systems. Today in this urban planet, 54 percentage of the world's population are living in urban areas and the share is expected to increase to 66 percentages by 2050 (United Nations, 2014). Rapid urbanization and urban growth is placing massive demand on urban food supply systems. Moreover, many cities in the world are facing problems like rapid decrease in green space and increase in heat island effects. Urban agriculture or farming is promoted as a potential solution to these problems. For city dwellers, urban agriculture can provide a source of fresh produce, a healthier diet, and significant financial savings. Vegetated surfaces offer important sound-insulating capabilities and are frequently employed in urban contexts for noise reduction. Green roofs can help

buildings reduce noise pollution significantly. Through its backward and forward relations, it can also provide jobs and economic opportunities (Islam and Ahmed, 2011).

In Dhaka, one of the world's fastest growing mega cities, open and cultivable land has been converting to built-up area indiscriminately and thus agricultural land has been decreased at an alarming rate (Islam and Ahmed, 2011). Implementing rooftop farming can be a possible solution to reduce the food supply problems, make urban living more self-sufficient and make fresh vegetables more accessible to urban individuals. It is estimated that 10,000 ha space of Dhaka city can be brought under rooftop farming and the residents of the city can taste fresh vegetables as well as over 10 percent of the demand can be fulfilled through rooftop farming (Wardard, 2014). A survey shows that most of the roofs of Dhaka city are suitable for gardening and do not require major improvement work, sometimes only need some modifications (Islam, 2002). A rooftop garden can supplement diets of a community as it supplies with fresh produce and provide a tangible benefits tie to food production. With rapid and unplanned urbanization, incidence of urban poverty and food insecurity has been also increasing alarmingly in Dhaka (Choguill, 1995).

A rooftop garden can be the primary way of our urban agriculture to keep the environment calm and cool. It can be a great source of our local food system, employment and daily engagement with nature (Jahan, 2016).

A survey found that the majority of Dhaka city's rooftops are suitable for gardening and do not require costly renovations; in some cases, modest alterations are all that is required (Islam, 2002).

In Dhaka, one of the world's fastest growing megacities, open and cultivable land has been unlawfully changed to builtup area, resulting in an alarming loss of agricultural l and (Islam and Ahmed,2011). Using rooftop farming to alleviate food shortages, enhance urban selfsufficiency, and make fresh vegetables more available to city people could be a viable option. RTGs might provide Bologna (Italy) with more than 12,000 t of vegetables per year¹, satisfying 77 percent of the city's demands (Orsini *et al.*, 2013).

Dhaka is one of the world's most populated cities with current population of 20.628 million within a small area of 300 square kilometers (BBS, 2018). Population is increasing day by day. However, to maintain a pleasant living environment, the balance between green and concrete built-up areas cannot be overlooked. With the fundamental layout of cities unlikely to change for some years to come, city planners and decision makers face the challenge of finding other solution of increasing and enhancing the amount of greenery in city areas. The fiber glass containers and raised beds set up are used for the roof farming in cities of Hong Kong (Hui, 2011). In Montreal, Lufa farmers utilize sustainable hydroponics methods, which poses less environmental impact, to produce foods (Carrot City, 2014). In recent years, some people in Taiwan are trying to develop effective growing methods for promoting rooftop farming (Hui, 2011).

Rooftop gardening can be an effective way to provide food security and meet people's nutritional needs. Understanding the problems and opportunities associated with policy of insurance adoption will go a long way towards improving the city's food supply.

A study of Dhaka's densely populated rooftop gardens is urgently needed in light of the aforementioned situations. The current study looks at the production of rooftop gardening in Dhaka and tries to figure out the scope and possibility of agribusiness. The goal of this research is to find out the scope and possibility of agribusiness by rooftop production and figure out the significant factors that affecting most in rooftop gardening production.

OBJECTIVES

The present study has been taken under consideration to achieve the following objectives:

- To analyze socio economic status of rooftop gardeners in Dhaka city.
- To determine the factors that affecting rooftop production in Dhaka city.
- To find out the scope and possibility of agribusiness through rooftop gardening production in selected region of Dhaka city.

CHAPTER II

REVIEW OF LITERATURE

A literature review is a descriptive, analytic summary of the existing material relating to a particular topic or area of study. This study is mainly concerned with influencing factors of roof top gardening. There were very few literatures works with respect to research studies on this agenda. Therefore, the findings of such studies related to roof top gardening by the house owners and other partial studies have been reviewed in this Chapter.

Section 1: Socio economic status of rooftop owner and affecting factors of rooftop production

Section 2: Review of the previous research findings on rooftop gardening

Section 3: Find out the rooftop gardening scope and possibility of agribusiness through production

Section 4: Research gap of the study

Section 5: Conceptual framework on the objectives

2.1. Section 1: Socio economic status of rooftop owner and affecting factors of rooftop production

2.1.1. On the basis of Age

Mithon (2016) observed that the old-aged rooftop gardeners comprised of the highest proportion (76.8 percent) and the middle-aged category constituted by 23.2 percent respondents in Dhaka city.

Rahaman's (2014) findings was that there is no relationship between age of the respondents and roof top gardening in Dhaka city.

Nira (2006) found that there is no relationship between age of the respondents and their adoption of roof gardening.

Akhter (2003) established that the age of the farmers had no significant relationship with their knowledge on agricultural activities.

2.1.2. On the basis of Education

Mithon (2016) examined that there was negative significant relationship between Education of the respondents and their problems of roof top gardening.

Rahaman (2014) also found that there was negative significant relationship between education of the respondents and their problems of roof top gardening.

Adhikary (2012) explained that there was positive significant relationship between education and their awareness on the environmental pollution caused by the use of pesticides.

Nira (2006) found that there is no relationship between family education of the respondents and their adoption of roof gardening.

Akhter (2003) experienced in his study that level of education of the farmers had a significant and positive relationship with their knowledge on agricultural activities.

2.1.3. On the basis of Family size

Mithon (2016) examined that the medium size family constitute the highest proportion (67.1 percent) followed by the small size family (24.4 percent).

Rahaman (2014) examined that the finding indicated that the family size of the respondents had no significant relationships with their problems of roof top gardening.

Nira (2006) explained that family size of the respondents had a positive significant relationship with their adoption of rooftop gardening.

2.1.4. On the basis of Income

Mithon (2016) found that from house rent : Medium annual income constituted the highest proportion (67.1%), while the lowest proportion in low annual income from house rent (13.4 percent)category.

Rahaman (2014) concluded from the finding that there was no significant relationship between family annual income of the respondents and their problems of roof top gardening.

Nira (2006) examined that there is no relationship between family annual income of the respondents and their adoption of roof gardening.

2.1.5. On the basis of Roof top area

Mithon (2016) examined that most of the respondents (40.2 percent) had medium rooftop area while 23.2 and 36.6 percent of them had low and high rooftop area respectively.

Rahaman (2014) examined that the finding implied that roof top space of the respondents had no significant relationship with their problems of roof top gardening.

Nira (2006) explained that there is no relationship between roof top area of the respondents and their adoption of roof gardening.

2.1.6. On the basis of Training exposure

Mithon (2016) explained that the highest proportion (48.8 percent) of the roof top gardeners had medium training exposure compared to 28.0 percent in low training exposure.

Rahaman (2014) examined that 65 percent of the respondents' had no training exposure; while 20 percent of the respondents' very low training exposure and 15 percent had low training exposure.

2.1.7. On the basis of Knowledge

Mithon (2016) concluded that 63.4 percent of the respondents had medium rooftop gardening knowledge, 19.5 percent had low knowledge and 17.1 percent had high knowledge on rooftop gardening.

Rahaman (2014) observed that half of the respondents possessed medium knowledge on roof top gardening.

Nira (2006) explained that there is no relationship between roof gardening experience of the respondents and their adoption of roof gardening.

Akhter (2003) found in his study that level of education of the farmers had a significant and positive relationship with their knowledge on agricultural activities.

2.2. Section 2: Review of the Previous Research Findings on Rooftop Gardening

Mithon (2016) found that the highest proportion (42.7 percent) of the respondents had medium use of information sources as compared to 30.5 percent of them having low use of information sources.

Mithon (2016) found that rooftop gardeners attitudes at Dhaka city, the findings was that maximum (62.1 %) of the roof top gardeners had moderately positive attitude towards roof top gardening.”

Kamrujjaman (2015), Bangladesh Agricultural Research Institute, wrote a Book name “Green Banking” regarding the Rooftop Gardening. The book contains 7 chapters describing the thermal benefits of roof gardens and the overall techniques and farming procedures of vegetables, fruits, flowers/ornamental plants and multipurpose use of Roof garden.

Rahaman (2014) stated that there is no relationship between use of information sources of the respondents and their problems of roof top gardening.

Nira (2006) stated that there is no relationship between use of information sources of the respondents and their adoption of roof gardening.

Nira (2006) found that 62% of the roof owners possessed no adoption compared to 15% and 23% had low and medium adoption of roof gardening respectively. Lack of time was the main problem for roof gardening. Maximum people wanted to grow flowers.

Kashem (2001) found in his study that farm size of the farmers had no relationship with the awareness on the environmental pollutions.

Hanif (2000) noticed that there was a negative insignificant relationship between farm size of the respondents and their awareness on environmental pollution.

2.3. Section 3: Find out the rooftop gardening scope and possibility of agribusiness through production

In a survey done by Stamford University -- on 2,700 buildings in Dhanmondi, Lalmatia, Mohakhali DOHS and Uttara, researchers found 36.4 percent rooftops were used for gardening.

There is no previous work on rooftop gardening production in Dhaka city.

2.4. Section 4: Research Gap of the Study

Rooftop gardening had been studied in the lab, but there is a social science component missing. Some study had been done on the social science aspects of home owners' problems and adoption of rooftop gardening, with a focus on assessing house owners' attitudes about rooftop gardening.

Some researchers also conducted on problem faced and adoption of rooftop gardening were held in Mohammadpur , Mirpur-10 and Mirpur-1, Dhaka.

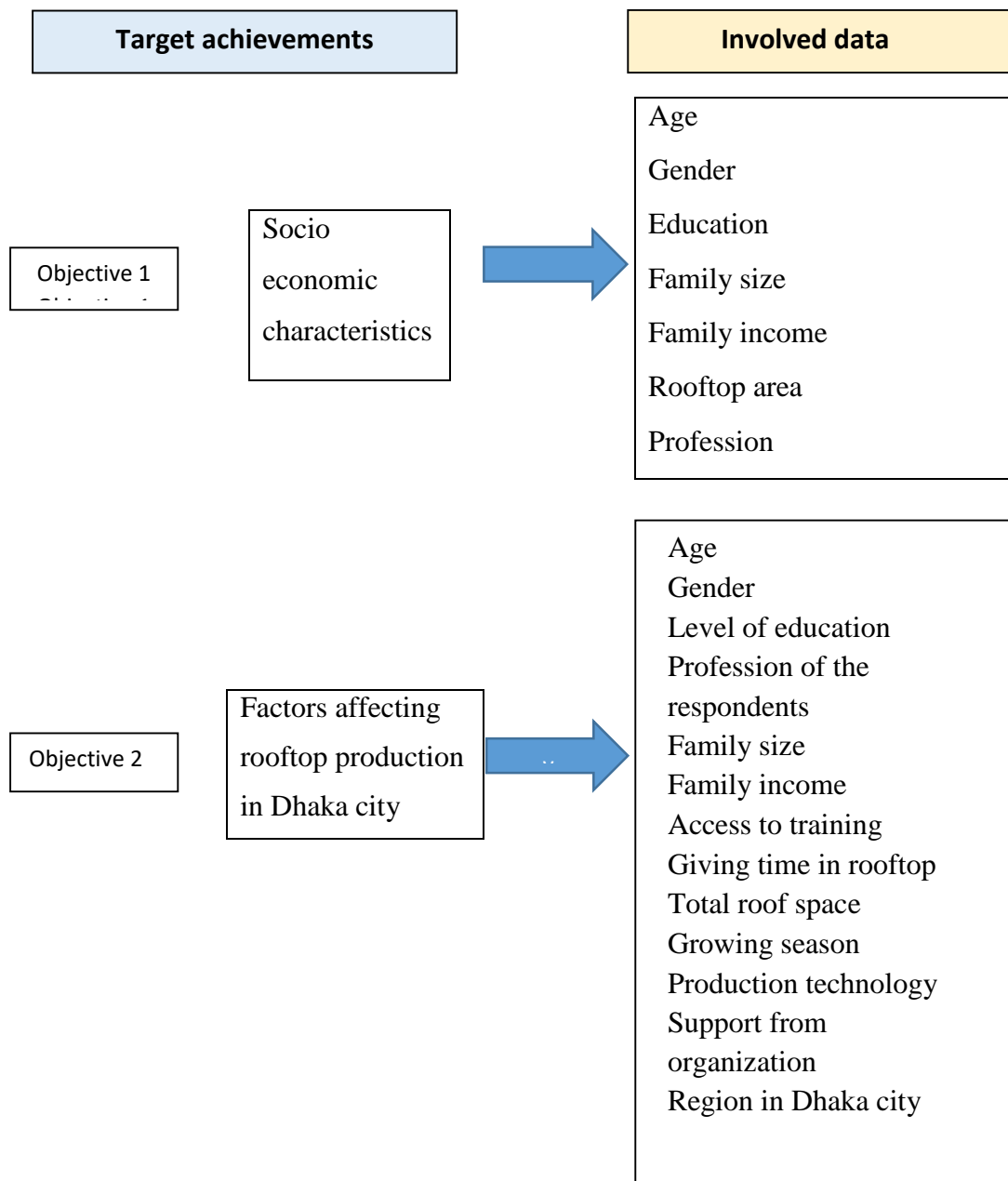
There was previous work on rooftop gardeners socio economic characteristics but this study based on agribusiness scope and possibility in Dhaka city. On the other hands the researcher covered total 5 selected areas as in previous study we could find only one region.

The present study had done on the basis of Multiple linear regression analysis and calculation of BCR whereas the past study on rooftop gardening were analyzed through correlation analysis

2.5. Section 5: Conceptual framework of the objectives

According to Rogers and Havens (1960), the conceptual framework is kept in mind while framing the structural arrangement for the dependent and independent variables. A dependent variable is that which appears, disappears or varies as the researcher introduces, remove or varies the independent variables (Townsend,1953).

This study is concerned with the “Rooftop gardening as an agribusiness practice in Dhaka city”. Here for objective 1 socio economic characteristics are independent variables. For objective 2 rooftop production is dependent variable. The researcher can select a lots of independent variables if he/she wants. But it is quite impossible to deal with the independent variable in single thesis. So, the researcher chose some selective independent variables. The independent variables are age, gender, level of education, profession, family size, family income, access to training, giving time in rooftop, total roof space, growing season, production technology, support from organization and region in Dhaka city. For objective 3 Profitability is analyzed with BCR and tabular analysis is used. Depend on the above discussion a conceptual frame work has been developed.



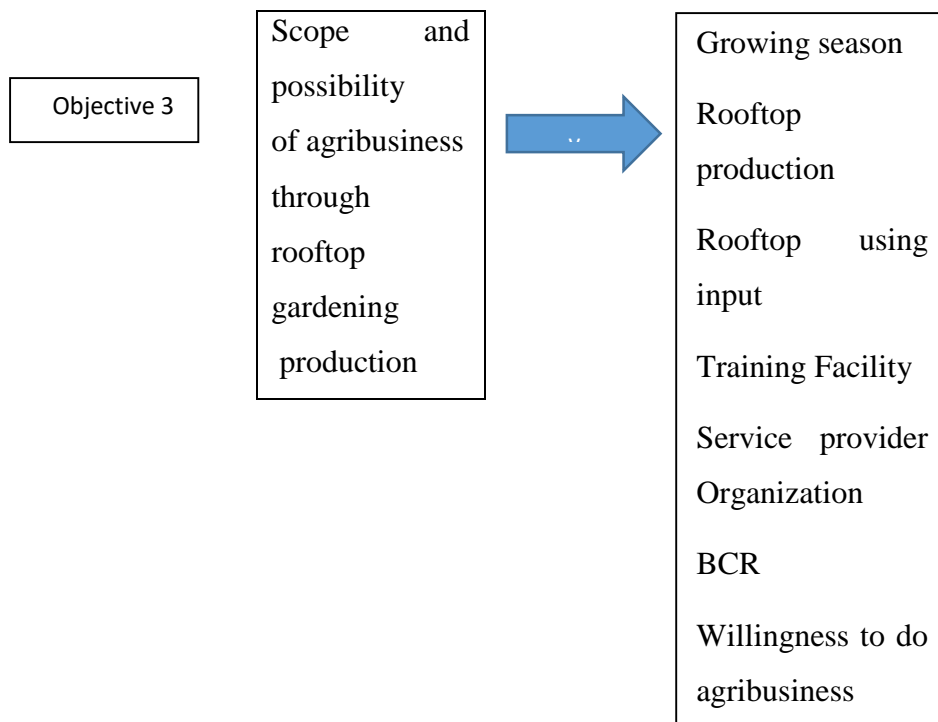


Figure 2.5. Conceptual Framework of the objectives

CHAPTER 3

MATERIALS AND METHODS

The approach used in each scientific study is crucial. Appropriate technique aids the researcher in gathering valid and reliable data and appropriately analyzing the data in order to reach correct findings.

This chapter explains the methodologies and procedure that were used to perform the research. In the later section of this Chapter, statistical methods and their applications are also discussed.

The research approach used is divided into the following sections:

3.1 Study Area

Dhaka city has a huge population and total rooftop in Dhaka city is around 7000 (Islam and Ahmed, 2011)..So it was quite impossible to collect data from all of them. The data was collected from the existing rooftop that had a minimum level of productions.

So, Study area is divided into 5 groups from Dhaka city. These are Mohammadpur, Uttara, Mirpur, Dhanmondi and Badda. The researcher compiled a list of city Dwellers with rooftop gardens with the help of Green Bangladesh Society , Fablab Sher-e-Bangla Agricultural university and Asters innovation ltd, Dhaka.

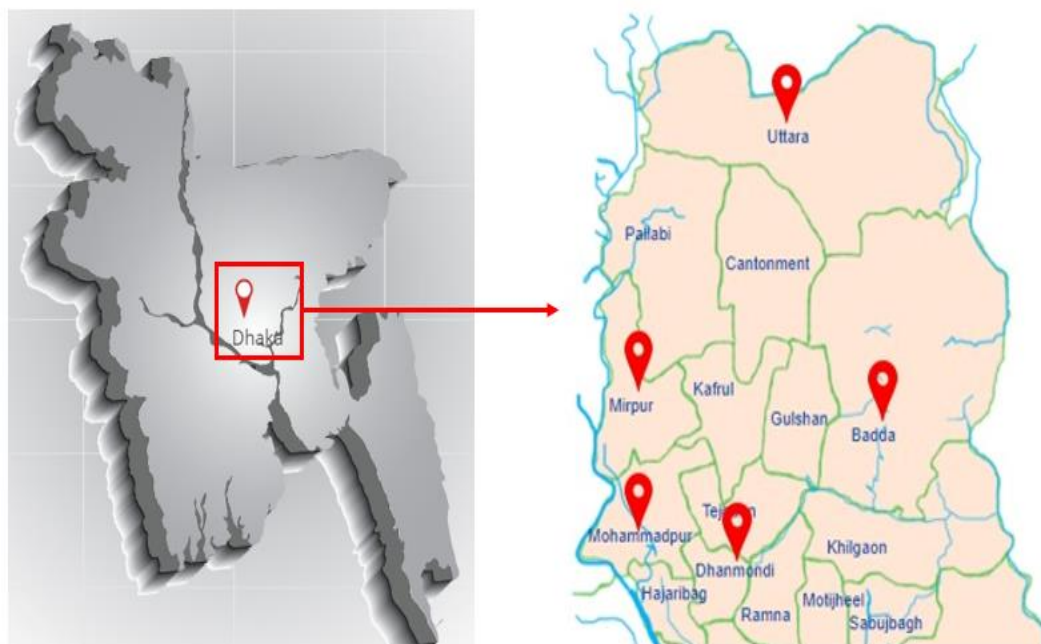


Figure 3.1: Map of the selected areas in Dhaka city

3.2 Population and Sample of the Study

The active population of this stored consisted of people who lived in the designated area permanently and the owner and tenant of a multi-story building. However, data were collected using the percentage approach on a representative sample of the population. The respondent was one rooftop gardener (who mostly operated the rooftop garden) from each of the family. With the support of Green Bangladesh Society online platform and Aster innovation ltd, Agargawn, Dhaka updated lists of all respondents who owned and rented in the designated area were compiled. The respondents for the research region were chosen using a random sampling process. The overall number of rooftop gardeners in the study area was estimated to be around 2500, with 200 selected for an interview session.

Table 3.2. Sample size of the study

Name of the city	Name of the area	Sample size
Dhaka	Mohammadpur	40
	Dhanmondi	40
	Mirpur	40
	Uttara	40
	Badda	40
Total		200

3.3 Data collection methods

The survey approach was used to obtain quantitative and qualitative data that allowed researchers to answer study questions and gain a better knowledge of respondents' factors. While interviews, over the phone conversations (if extra information was needed), and face-to-face interviews with 200 respondents were employed in the survey. Face to face interviews were excellent for eliciting unexpected responses and allowing respondents to explain the world as they see it rather than as the researcher sees it (Bryman, 2001).

3.4 Data collection tool

Structured interview schedule was prepared to reach the objectives of the study. A structured interview schedule was prepared containing open and closed questions. The instruments were first developed in English and then translated into Bengali. The survey tools were initially constructed based on an extensive literature reviews and pre-tested. The schedule was pre-tested with 12 randomly selected respondents in the study areas. The pre-test was helpful in identifying faulty questions and statements in the draft schedule. Thus, necessary additions, deletions, modifications and adjustments were made in the schedule on the basis of experiences gained from pretest.

The questionnaires were also checked for validity by supervisor, co-supervisor and educational experts at Sher-e-Bangla Agricultural University (SAU). Finally, based on background information, an expert appraisal and the pre-test, the interview schedule was finalized. Data were gathered by the researcher personally. During data collection, necessary cooperation was obtained from Urban roof gardeners society of Dhaka city, specially Green Bangladesh. The primary data were collected from 1 October to 15 October, 2019 for the draft to finalize the questionnaire. The final data was collected from 20 October 2019 to 25 February 2020. Books, journals, thesis, reports and internet documents were used as secondary sources of data supporting or supplementing the accurate findings of the study.

3.5 Measurement of Variables

The researcher used Microsoft Excel as data analysis tools for BCR calculation and SPSS statistical software for analyzing multiple linear regression.

3.6 Variables of the Study

In the present study, selected characteristics of the respondents, viz. age, education, family size, rooftop garden size, family income, profession, cost of rooftop, sales portion of rooftop and BCR are selected characteristics and their perception of rooftop garden constituted focus issue.

3.7. Measurement of dependent and independent variables

The selected characteristics of this study were some selected characteristics of the respondents. Rooftop production is dependent variable and independent variables are age, gender, education, family size, rooftop garden size, family income, profession,

access to training, growing seasons, support from organization and technical production knowledge. The procedures followed in measuring the independent variables are briefly discussed below:

3.7.1 Age

Actual age of a respondent was measured by counting the actual years from his/her birth to the time of collecting data with an interview schedule. It was expressed in terms of complete years. Age variable was counted on both categorical and continuous basis. This variable appears in the interview schedule as presented in Appendix-A section 1. SPSS Coding is shown below:

Table 3.7.1: Age coding by SPSS

Variable Information	
Name	Age
Label	Age of the respondents
Type	F8
Missing Values	None
Measurement	Ordinal
Value	Label
1	Young Aged (Up to 30) Years
2	Middle Aged(31-50) Years
3	Old Aged (Above 50) Years

3.7.2 Gender

Gender is an indicator that shows the percentage of male and female, whose were maintaining the rooftop garden. For male the researcher considered 0 and for female considered 1. This variable also appears in item in the interview schedule as presented in Appendix-A. section 1. SPSS Coding is shown below:

Table 3.7.2: Gender coding by SPSS

Variable Information	
Name	Gender
Label	Gender of Rooftop Gardeners
Type	F8
Missing Values	None
Measurement	Nominal
Value	Label
0	Male
1	Female

3.7.3 Education

Education of a respondent was measured by the number of years of schooling completed in an educational institution. A score was given for each year of schooling completed. If a respondent completes primary level of education his/her score was considered as 1 as well as 2 for secondary level of education ,3 means graduation, 4 means Masters and 5 for PhD. This variable appears in the interview schedule as presented in Appendix-A. section 1. SPSS Coding is shown below:

Table 3.7.3: Level of education coding by SPSS

Variable information	
Name	Education
Label	Level of Education
Type	F8
Missing values	None
Measurement	Ordinal
Value	Label
1	Primary
2	Secondary
3	Graduate
4	Masters
5	PhD

3.7.4. Profession: This variable appears in the interview schedule as presented in Appendix-A. section 1. Other sector counted housewife, student, freelancers .SPSS Coding is shown below:

Table 3.7.4: Respondent's profession coding by SPSS

Variable information	
Name	Profession
Label	Profession of the respondent
Type	F8
Missing values	None
Measurement	Nominal
Value	Label
1	Govt. Employee
2	Private Employee
3	Business
4	Other(homemaker, freelancer)

3.7.5. Family size

The family size was 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, brother and sister, parents, children etc. who lived and ate together. The total number of family members was considered as his family size score. Family size variable was counted on both categorical and continuous basis This variable appears in the interview schedule as presented in Appendix-A section 1. SPSS Coding is shown below:

Table 3.7.5: Respondents family size coding by SPSS

Variable Information	
Name	Family Size
Label	Total Family Members
Type	F8
Missing Values	None
Measurement	Ordinal
Value	Label
1	Small Family (Up to 3 members)
2	Medium Family (4-6 members)
3	Large Family (Above 6 members)

3.7.6. Rooftop garden size

Rooftop garden size of a respondent is referred to the total roof area which his/her family carried out farming operations, own roof under own gardening, roof given to others on share roof taken from others on share and roof taken from others on lease. Rooftop garden size variable was counted on both categorical and continuous basis This variable appears in the interview schedule as presented in Appendix-A section 1. SPSS Coding is shown below:

Table 3.7.6: Respondents roof area coding by SPSS

Variable Information	
Name	Area
Label	Total roof space sq feet
Type	F8
Missing Values	None
Measurement	Nominal
Value	Label
1	Small – (Up to 2200) Sq-ft
2	Medium – (2200-3200) Sq-ft
3	Large - (Above 3200) Sq-ft

3.7.7. Monthly family income

The income of a respondent is an important indicator that shows how much he can invest in his rooftop gardens. Income of a respondent was measured in taka on the basis of monthly earnings in which the respondent as well as his family members were involved. This variable also appears in item in the interview schedule as presented in Appendix-A section 1. SPSS Coding is shown below:

Table 3.7.7: Respondents monthly income coding by SPSS

Variable Information	
Name	Income
Label	Family Income
Type	F8
Missing Values	None
Measurement	Ordinal
Value	Label
1	Low – (Up to 30000) Tk
2	Medium - (40001-50000) Tk
3	High – (Above 50000) Tk

3.7.8. Access to training: Respondents those were took part in rooftop gardening training and those are wanted to attend the training session were counted to see the willingness of the respondents. section 2. SPSS Coding is shown below:

Table 3.7.8: Access to training coding by SPSS

Variable Information	
Name	Training
Label	Access to Training
Type	F8
Missing Values	None
Measurement	Nominal
Value	Label
0	Taking Training
1	Does not attend training

3.7.9. Growing season of rooftop production

Rooftop farming is a policy that vegetable and fruit production are an important goals of rooftop farming for ensuring organic food. So sustainability of rooftop covers that every agricultural session has sessional fruits and vegetable production. This variable also appears in item in the interview schedule as presented in Appendix-A section 2. SPSS Coding is shown below:

Table 3.7.9: Growing season coding by SPSS

Variable Information	
Name	Growing Season
Label	Growing Season
Type	F8
Missing Values	None
Measurement	Nominal
Value	Label
1	Kharif 1
2	Kharif 2
3	Rabi
4	All season

3.7.10. Given time in rooftop

The respondents may spend how many hours in rooftop garden. Minimum 1 hour to maximum above 3 hours is counted. This variable also appears in item in the interview schedule as presented in Appendix-A section 2. SPSS Coding is shown below:

Table 3.7.10: Given time in rooftop coding by SPSS

Variable Information	
Name	Time
Label	Giving time in rooftop
Type	F8
Missing Values	None
Measurement	Nominal
Value	Label
1	1-2 hours
2	2-3 hours
3	Above 3 hours

3.7.11. Production technique to implement for developing rooftop garden

This variable also appears in item in the interview schedule as presented in Appendix-A section 2. SPSS Coding is shown below:

Table 3.7.11: Production technology coding by SPSS

Variable Information	
Name	Technique
Label	Production Technology
Type	F8
Missing Values	None
Measurement	Nominal
Value	Label
1	Aquaponics
2	Hydroponics
3	Vertical Garden
4	Other

3.7.12. Selected region in Dhaka city: This variable also appears in item in the interview schedule as presented in Appendix-A section 1. SPSS Coding is shown below:

Table 3.7.12. Respondents region coding by SPSS

Variable Information	
Name	Location
Label	Location in Dhaka City
Type	F8
Missing Values	None
Measurement	Nominal
Value	Label
1	Mohammadpur
2	Dhanmondi
3	Mirpur
4	Uttara
5	Badda

3.7.13. Service provider Organization

Respondents who got help from any government organization like Agricultural university, DAE, BADC, Horticultural center those were counted. Private organization like Aster innovation ltd, Nagar krishi, etc. On the other hands online platform is kike social media group, youtube, etc. This variable also appears in item in the interview schedule as presented in Appendix-A section 2. SPSS Coding is shown below:

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Table 3.7.13: Service provider organization coding by SPSS

Variable Information	
Name	Support
Label	Support from organization
Type	F8
Missing Values	None
Measurement	Nominal
Value	Label
1	Govt. Organization
2	Private Organization
3	Online platform

3.8. Statement on rooftop production gives more nutrition than buying from market

The respondents that are positive with this statement, count as 0 and those are negative upon the statement count as 1. This variable also appears in item in the interview schedule as presented in Appendix-A section 3.

3.9. Vegetables and fruits produced in current RTG in Dhaka

10 common fruits and 10 common vegetables were counted on the basis of respondent cultivation in the rooftop

3.10. Collection amount from rooftop production

The respondents may collect the fruits and vegetables per day, per week or monthly basis. This amount is counted as kg basis as continuous variable. For factors affecting rooftop production it is calculated in SPSS and for BCR it is calculated by Excel. This variable also appears in item in the interview schedule as presented in Appendix-A section 3.

3.11. Used of pesticides for controlling pest and diseases of fruits and vegetables in the existing roof top garden

The respondents whose are using pesticides count as 1, those are using herbal method count as 2 and those are not using any method count as 3. This variable also appears in item in the interview schedule as presented in Appendix-A section 3.

3.12. Intension to do rooftop Business

The respondents whose are willing to do rooftop business count as 0 and those are not willing to do rooftop business count as 1. This variable also appears in item in the interview schedule as presented in Appendix-A section 3.

3.13. Existing plant with respective yield and income in the last year on 1 year

Most Common five fruits and vegetables among all the data was selected for calculating the yield.

BCR : A benefit-cost ratio (BCR) is a ratio used in a cost-benefit analysis to summarize the overall relationship between the relative costs and benefits of a proposed project.

$$\text{BCR Calculation} = \frac{\text{Proposed total cash benefit of a project}}{\text{Proposed total cash cost of the project.}}$$

BCR can be expressed in monetary or qualitative terms.

If $\text{BCR} > 1$, the return from rooftop garden is expected and economically satisfactory for the investors.

$\text{BCR} < 1$, the return from rooftop garden is rejected and economically not satisfactory for the investors

$\text{BCR} = 1$, There exist economic breakeven point that the rooftop owners did not have any profit or loss, it totally depends on their thought that they would invest or not.

3.14. Model fitting Assumptions: There was a question why the researcher used regression analysis. So there was similarity with this data that Regression could run for this thesis research.

i) Linear relationship: It was examined that the data had liner relationship.From graph 3.14a it would be clear which was attached in Appendix.

ii)No auto correlation: There was no auto correlation because all the correlation value was below 0.7. From table 3.14c it would be clear which was attached in Appendix.

iii) No multi collinearity: Tolerance was greater than 0.10 and VIF was below 10 as shown on table 3.14b in Appendix.

3.15. Creating Dummy Variable: For multiple linear regression model dependent variable was continuous. Some independent variables were categorical for that dummy variables were created by SPSS.

3.16. Data processing and Analyzing

The collected raw data were carefully analyzed for inaccuracies and omissions. The investigator created a detailed coding plan after consulting with the study supervisor. The information was then entered into a coding sheet. In the case of qualitative data, appropriate scoring techniques were used to assign correct weight to each of the traits in order to convert the data into quantitative forms. The study's collected data was collated, tabulated, and analyzed in accordance with the study's objectives with the help of Excel and SPSS. The variables of the study were described using statistical measures such as number and percentage distribution, range, cost calculation and BCR. For ease of comprehension, tables and figures used to show data.

CHAPTER IV

RESULTS AND DISCUSSION

Under this chapter, the recorded observations were presented in accordance with the study's purpose, and a probable discussion of the findings was held, with a likely justifiable and applicable interpretation. This chapter summarizes the study's findings and discusses how they were interpreted. According to the study's goal, these are organized into three divisions. The first half focuses on the respondents' chosen socioeconomic factors, while the second section focuses on factors affecting rooftop production. The final portion looks into the breadth and potential of agribusiness through rooftop gardening.

4.1 Socio Economic Characteristics of the respondents

Personal qualities play a big role in determining an individual's behavior. The respondents had a variety of traits that could have an impact on rooftop gardening. However, seven characteristics of them were chosen as independent variables in this study for socio economic characteristics, including their age, gender, level of education, family size, profession, family income and rooftop area, all of which could have a significant impact on the house owner's attitude toward rooftop gardening production.

4.1.1. Age

The age of the respondents has been varied from 25 to 66 years. Considering the recorded age, the respondents were classified into three categories namely 'young', 'middle' and 'old' aged. young aged people considered as up to 35 years, Middle aged considered as 36 to 50 years and old aged considered as above 50 . From this figure, it explained that majority of old aged people did rooftop gardening in Dhaka city. The distribution of the respondents from selected area in accordance of their age is presented in the following tables.

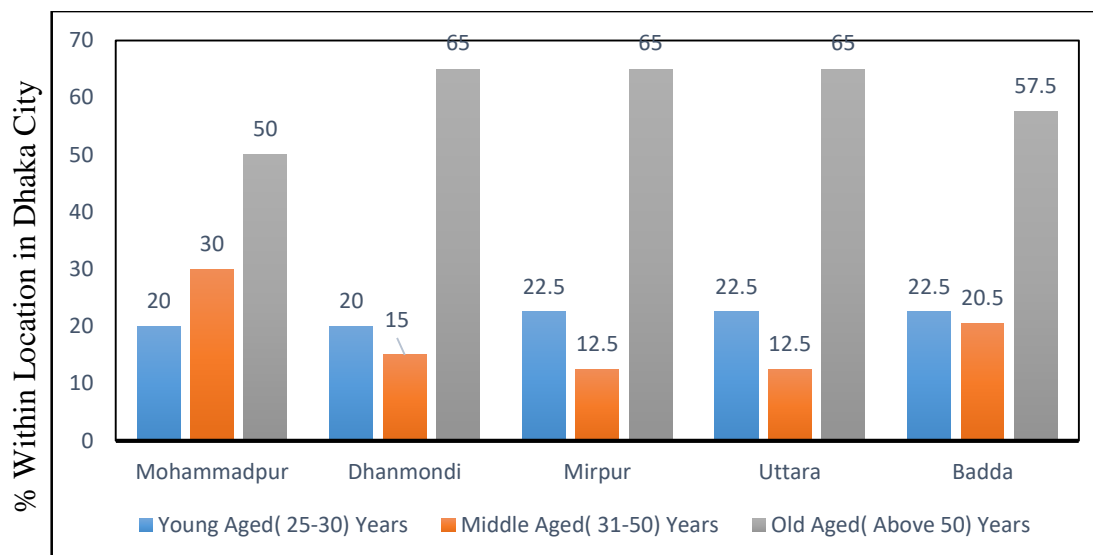


Figure 4.1.1. Distribution of the respondents according to their age

Table 4.1.1. Distribution of the respondents according to their age is presented in Mohammadpur

Category	Range(years)		Respondent	
	Year	observed	Number	Percent
Young aged	Up to 30	25-66	8	20
Middle aged	31-50		12	30
Old aged	Above 50		20	50
Total			40	100.0

From Table 4.1.1 total 40 respondents are selected from Mohammadpur area, it was revealed that the old-aged respondents comprised the highest proportion (50 percent) followed by middle aged category (30 percent) and (20 percent) respondents were in the young aged category. Data indicates that young aged, middle and old aged respondents were involved in rooftop gardening in Mohammadpur.

Table 4.1.2. Distribution of the respondents according to their age is presented in Dhanmondi

Category	Range(years)		Respondent	
	Year	observed	Number	Percent
Young aged	Up to 30	25-66	8	20
Middle aged	31-50		6	15
Old Aged	Above 50		26	65
Total			40	100.0

From Table 4.1.2 total 40 respondents are selected from Dhanmondi area, it was revealed that the old-aged respondents comprised the highest proportion (65 percent) followed by young aged category (20 percent) and (15 percent) respondents were in the middle-aged category. Data indicates that young and old aged respondents were involved most in rooftop gardening in Dhanmondi.

Table 4.1.3. Distribution of the respondents according to their age is presented in Mirpur

Category	Range(years)		Respondent	
	Year	observed	Number	Percent
Young aged	Up to 30	25-66	9	22.5
Middle aged	31-50		5	12.5
Old Aged	Above 50		26	65
Total			40	100.0

From Table 4.1.3 total 40 respondents are selected from Mirpur, it was revealed that the old-aged respondents comprised the highest proportion (65 percent) followed by young aged category (22.5 percent) and (12.5 percent) respondents were in the middle-aged category. Data indicates the old aged respondents mostly found in leisure time to do rooftop gardening at the study area for their recreational activity. Rahman (2014) also found the similar findings in his studies related to rooftop gardening in Dhaka city.

Table 4.1.4. Distribution of the respondents according to their age is presented in Uttara

Category	Range(years)		Respondent	
	Year	observed	Number	Percent
Young aged	Up to 30	25-66	9	22.5
Middle aged	31-50		5	12.5
Old Aged	Above 50		26	65
Total			40	100.0

From Table 4.1.4. total 40 respondents are selected from Uttara; it was revealed that the old-aged respondents comprised the highest proportion (65 percent) followed by young aged category (22.5 percent) and (12.5 percent) respondents were in the middle aged category. Data indicates the old aged respondents mostly found in leisure time to do rooftop gardening at the study area for their recreational activity. Rahman (2014) also found the similar findings in his studies related to rooftop gardening in Dhaka city.

Table 4.1.5. Distribution of the respondents according to their age is presented in Badda

Category	Range(years)		Respondent	
	Year	observed	Number	Percent
Young aged	Up to 30	25-66	9	22.5
Middle aged	31-50		8	20
Old Aged	Above 50		23	57.5
Total			40	100.0

From Table 4.1.5 total 40 respondents are selected from Badda, it was revealed that the old-aged respondents comprised the highest proportion (57.5 percent) followed by young aged category (22.5 percent) and (20 percent) respondents were in the young aged category. Data indicates the old aged respondents mostly found in leisure time to do rooftop gardening at the study area for their recreational activity. Rahman (2014), also found the similar findings in his studies related to rooftop gardening in Dhaka city.

4.1.2. Respondents according to their Gender

Gender refers to biological identification of the respondents in the form of either male or female. In the study area, the level of gender of the respondents were divided into two categories such as male and female.

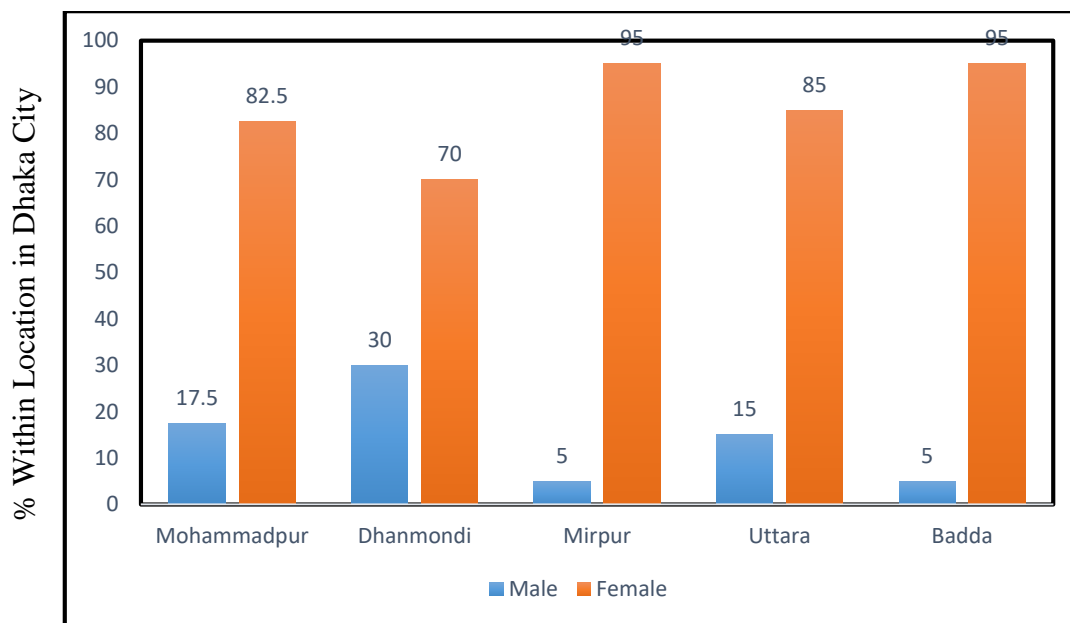


Figure 4.1.2: Respondents according to their Gender

Figure 4.1.2. shows that the majority of the rooftop gardeners in Mohammadpur has female which was account to 82.5 percent and rest 17.5 percent of the respondents were male. In Dhanmondi region, 70 percent of the respondents were female and 30 percent were male while 95 percent female and 5 percent male respondents were found in Mirpur area. In Uttara and Badda region, the majority of the respondents were female which was account to 85 percent and 95 percent respectively. The number of male respondents was 15 percent for Uttara and 5 percent for Badda.

4.1.3. Level of education

The respondent's education can be extremely beneficial to effective administration and operations, as well as successful output. A well-educated person will have easier access to essential technical and scientific information and will be able to make more informed economic decisions. The respondents' educational levels in the study area were divided

into five categories: primary, secondary & higher secondary, graduate, master's, and PhD.

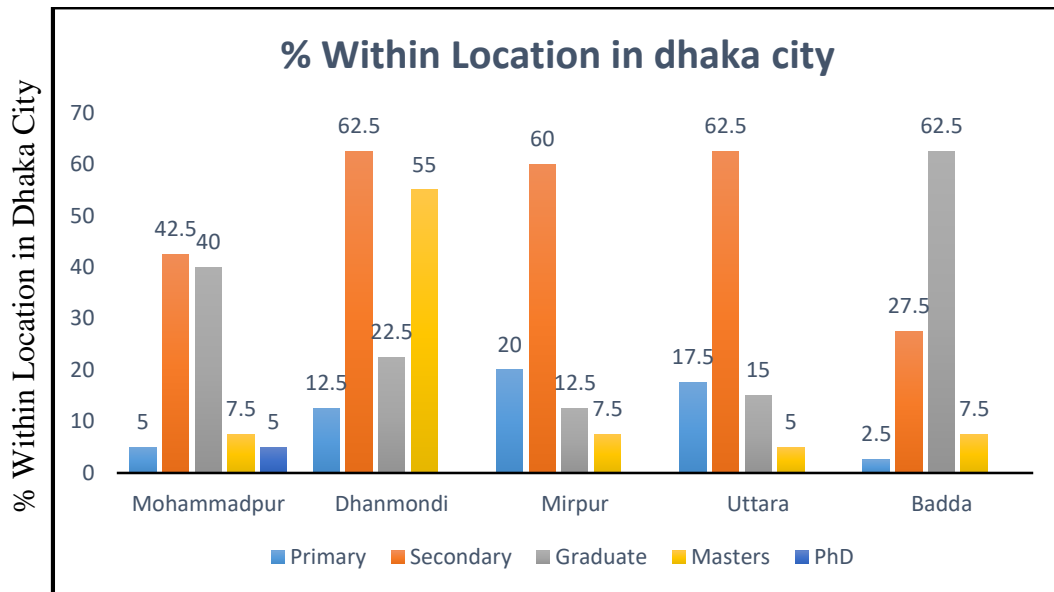


Figure 4.1.3 : Distribution of the respondents according to their Level of education

Figure 4.1.3 shows that in the Mohammadpur area, 42.5 percent of the respondents had secondary & higher secondary level of education, while 40 percent had a graduate degree, compared to 7.5 percent who had a master's degree, 5 percent had primary degree and the remaining 5 percent had a PhD degree. However, the results of this research show that all of the respondents in the Mohammadpur area had some level of schooling.

In the Dhanmondi area, the highest 62.5 percent of respondents were graduates, while the lowest respondents were from primary education level (0 percent). Across all Mirpur areas of Dhaka city, the highest 60 percent of the respondents were graduates, while the lowest 7.5 percent had a PhD. In Uttara, the highest 62.5 percent of the respondents were graduates, while the lowest 5 percent had a PhD level of education. In the Badda area, the biggest percentage of respondents (62.5 %) had a graduate level of education, while there were no one who had a PhD level of education. This result indicates that in those area all the respondents have some level of schooling.

4.1.4. Respondents according to their family size

The respondents' size of family in the study area were divided into three categories such as small size, medium size and large size family. Small size family consists of up to 3 members, medium size family consists of 4-6 members and large size family has more than 6 members. This was categorized by Kabir (2018). From this figure we can understand that small family in Dhaka city has highest portion.

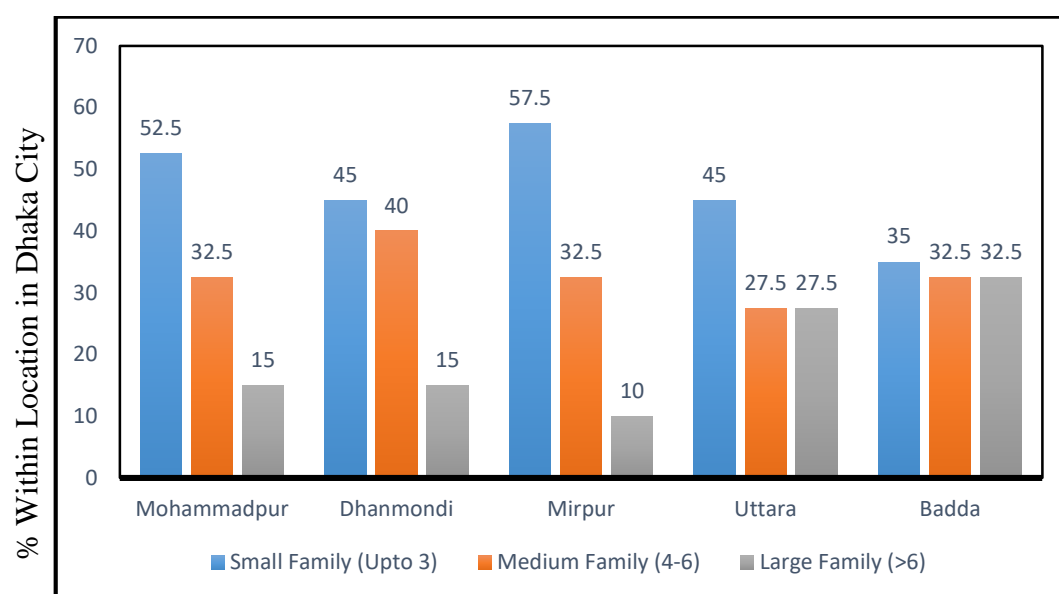


Figure 4.1.4: Respondents according to their family size

Table 4.1.4a. Distribution of the respondents according to their family size (Mohammadpur)

Category	Range(member)		Respondent	
	Member	observed	Number	Percent
Small Family	Up to 3	2-7	21	52.5
Medium Family	4-6		13	32.5
Large Family	>6		6	15
Total			40	100.0

Table 4.1.4a shows that in Mohammadpur area 52.5 percent respondents were belong to small size family and about 32.5 percent had medium size family.

Table 4.1.4b. Distribution of the respondents according to their family size (Dhanmondi)

Category	Range(years)		Respondent	
	Year	Observed	Number	Percent
Small Family	Up to 3	2-7	18	45
Medium Family	4-6		16	40
Large Family	>6		6	15
Total			40	100.0

Table 4.1.4b. shows that in Dhanmondi area 45 percent of the respondents were from small size family compared to 40 percent were from medium size family. In these area 15 percent rooftop gardeners had a family which is large in size

Table 4.1.4c. Distribution of the respondents according to their family size (Mirpur)

Category	Range(years)		Respondent	
	Year	Observed	Number	Percent
Small Family	Up to 3	2-7	23	57.5
Medium Family	4-6		13	32.5
Large Family	>6		4	10
Total			40	100.0

In Mirpur area, the highest 57.5 percent of the respondents had a small size family while 32.5 percent had a family which is medium in size and 10 percent belonged to a large size family.

Table 4.1.4d. Distribution of the respondents according to their family size (Uttara)

Category	Range(years)		Respondent	
	Year	Observed	Number	Percent
Small Family	Up to 3	2-7	18	45
Medium Family	4-6		11	27.5
Large Family	>6		11	27.5
Total			40	100.0

In Uttara region, about 45 percent of the respondents belonged to small size family and 27.5 percent were from medium size family and large size family each.

Table 4.1.4e. Distribution of the respondents according to their family size (Badda)

Category	Range(years)		Respondent	
	Year	Observed	Number	Percent
Small Family	Up to 3	2-7	14	35
Medium Family	4-6		13	32.5
Large Family	>6		13	32.5
Total			40	100.0

Table 4.1.4e. shows that the highest respondents in Badda region (35 percent) had a family which is small in size. About 32.5 percent of the respondents were from medium size family and large size family each in this area.

4.1.5. Respondents according to Rooftop Area

Potential space on rooftops is an utmost important for improving or establishing the garden in the cities. In the study area, respondents' level of area was categorized into small area, medium area and large area. Small area has a space which is ranges up to

2200 sq.ft, medium area ranges from 2200 to 3200 sq.ft and large area ranges above 3200 sq.ft.

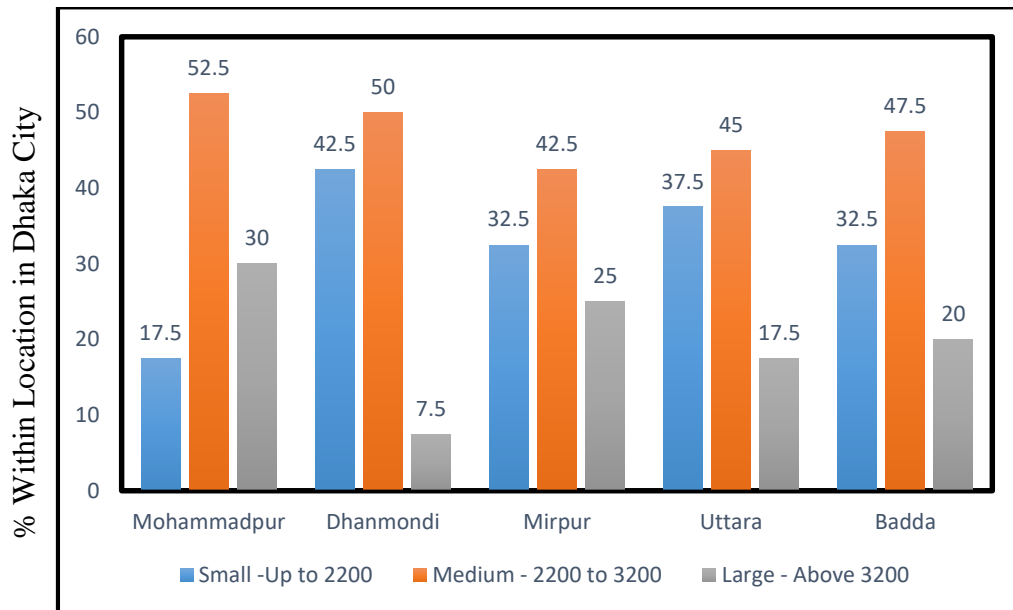


Figure 4.1.5: Respondents according to their Rooftop Area

In the study area, it was found that in Mohammadpur region, majority of the respondents has medium sized area for rooftop gardening where total rooftops space was recorded up to 2200 sq.feet-3200 sq. feet While only 17.5 percent had small area and 30 percent had large area as rooftop gardens in Mohammadpur area. About 50 percent of the respondents in Dhanmondi had medium sized area (2200sq.feet-3200 sq.feet)used as rooftop gardens followed by 42.5 percent and 7.5 percent had a area which was small and medium in size respectively for gardening. Most (42.5 percent) of the respondents in Mirpur area had medium size area (2200 sq.feet-3200 sq.feet) compared to 32.5 percent having small area(up to 2200 sq. feet) for rooftop gardening and large area were used by only 25 percent of the respondents in these area.In Uttara, medium area(2200 sq.feet-3200 sq.feet) were used as rooftop by 45 percent of the respondents while only 17.5 percent of respondents used large area(above 3200 sq.feet) as potential space for rooftop garden. In Badda area, the researcher found that majority (47.5 percent) of the rooftop gardeners used 2200 sq. feet-3200 sq. feet which is considered as medium area for potential gardening while small area and medium area were used by only 32.5 percent and 20 percent of the respondents respectively. Kabir (2018), found that rooftop space was (1500-4200) sq.feet.

4.1.6. Respondents according to family income

In the study area, respondents were divided into three categories according to their family income which included as low income, medium income and large income households. Low-income family is defined as a family where total family income not more than thirty thousand per month while medium income and large income family has a total income thirty thousand to fifty thousand and more than fifty thousand per month respectively.

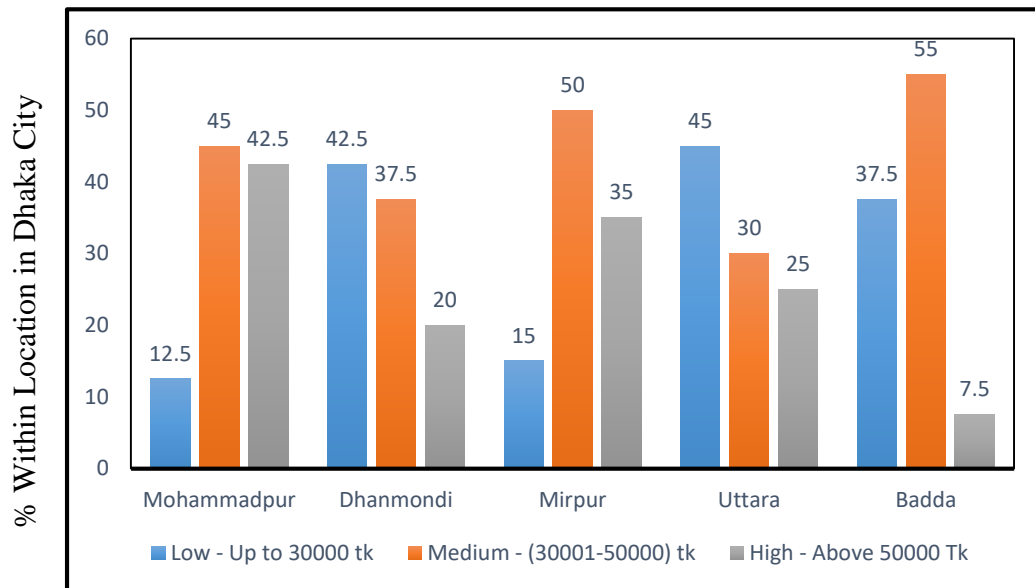


Figure 4.1.6: Respondents according to family income

Figure 4.1.6. shows that in Mohammadpur area, 45 percent of the respondents had medium family income while 12.5 percent and 42.5 percent of the respondents had low and high annual family income respectively. Most (42.5 percent) of the respondents from Dhanmondi area were belong to low-income family as compared to 37.5 percent had medium income family and only 20 percent had a high annual income family. Majority of the respondents (50 percent) of Mirpur area were belong to medium income family compared to 35 percent had highest annual family income and rest 15 percent of the respondents were belong to low-income family. About 45 percent respondents of Uttara region had low family income per year while 30 percent of respondents had medium annual family income and only 3 percent had high annual family income. In Badda area, most (55 percent) of the respondents had a medium income family and 37.5 percent had low and remaining 7.5 percent had high annual family income.

4.1.7. Respondents according to their Profession

In the study area, profession of the respondents is classified into four categories which is namely as government employee, private employee, business and others occupation (home maker, freelancer, etc)

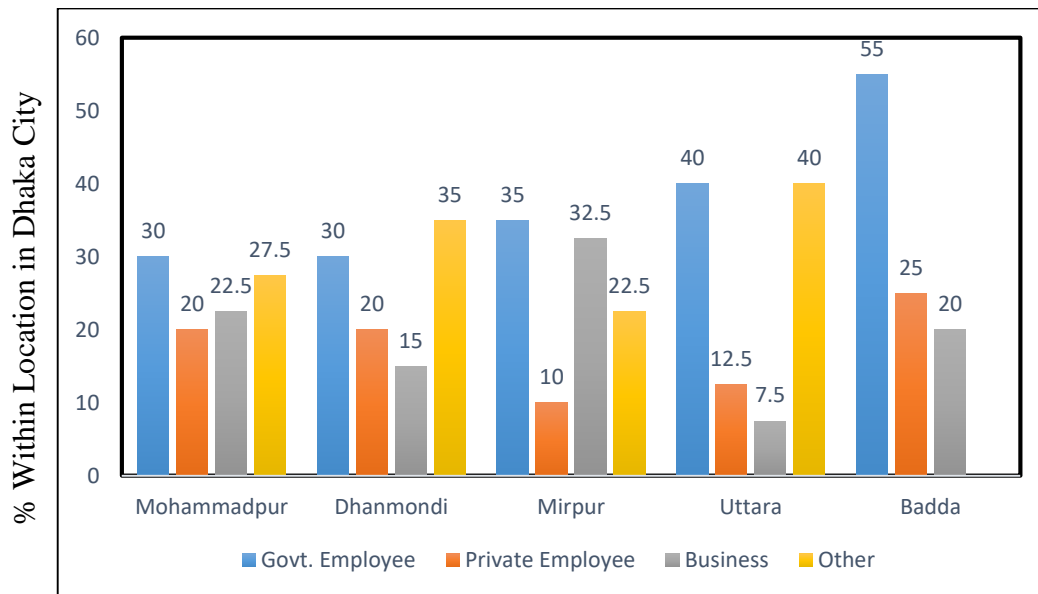


Figure4.1.7: Respondents according to their Profession

Figure 4.1.7 shows that in Mohammadpur area, 30 percent of the respondents worked as government employee followed by 20 percent worked as private employee and 22.5 percent involved in business. In Mohammadpur area, remaining 27.5 percent involved in others occupation. In Dhanmondi area, about 30 percent, 20 percent and 15 percent worked as government employee, private employee and business respectively while large portion of the respondents (35 percent) were involved in others profession. Majority of the respondents (35 percent) in Mirpur area associated with government employment and lowest (10 percent) of the respondents worked as private employee. In Uttara, majority (40 percent) of the respondents involved in government employee and others profession each while only 7.5 percent respondents took business as profession. Most of the respondents (55 percent) in Badda area earned a living as government employee followed by 25 percent worked as private employee and 20 percent involved in business respectively.

Table 4.2 To determine the factors that affecting rooftop production in Dhaka city

Rooftop production was dependent variable and independent variables were age, gender, level of education, profession of the respondents, family size, family income, access to training, giving time in rooftop, total roof space, growing season, Production technology, Support from Organization and Region in Dhaka city.

Multiple Linear regression coefficients of the selected factors indicating contribution to Rooftop production in RTG.

Dependent Variable	Independent Variable	β	P	S.E
Rooftop Production	Age of the respondents	0.062	0.286	.087
	Gender of rooftop gardeners	-0.096	0.127	3.261
	Access to training	0.025	0.684	2.255
	Total roof space sq feet	0.114	0.068*	.002
	Total family members	-0.010	0.864	.615
	Family income	0.159	0.011**	.000
	Aquaponic technique	-0.054	0.565	4.150
	Hydroponic technique	0.039	0.679	4.562
	Vertical garden technique	0.008	0.939	4.121
	Other technique	0.084	0.347	5.753
	Government organization support	0.423	.001***	4.328
	Private organization support	-0.051	0.699	4.898
	Online support	0.285	0.013**	4.294
	Level of education primary	0.004	0.950	10.598
	Secondary education	0.043	0.754	5.923
	Level of education Graduate	0.075	0.639	5.862
	Level of education Masters	0.087	0.460	6.220
	Level of education PhD	0.090	0.283	7.848
	Government employee	-0.201	0.100*	4.609
	Private employee	-0.128	0.213	5.019
	Business	-0.006	0.953	5.175
	Profession(home-maker)	0.227	0.046**	4.733
	Given time(1-2) hours	-0.172	0.181	5.074
	Given time(2-3) hours	-0.077	0.542	4.620
	Given more than 3 hours	-0.051	0.636	4.699
	Growing season kharif 1	0.022	0.761	4.324
	Growing season kharif 2	0.044	0.539	4.587
	Growing season Rabi	0.097	0.355	4.416
Growing season- All	0.121	0.292	4.269	

R²=0.527, Adj. R²=0.430, F=5.410

Note :*** Significant at $p < 0.01$, ** Significant at $p < 0.05$ and * Significant at $p < 0.10$

From the hypothesized relationship, six (6) variables namely, Total roof space, Family income, Support from Government Organization, Support from online platform, Government employees and others profession such as homemaker were found significant contribution to rooftop production while rest of the variables found having no significant contribution. Among them Family income, Support from Government Organization, Support from online platform, others profession such as homemaker and All growing season had positive significant contribution to the Rooftop production. All the factors cooperatively contribute 52.7% of the variance of Rooftop production ($R^2 = 0.527$). Each of the independent variable may explain some of the variance of Rooftop production of Rooftop gardeners.

4.2.1. Significance contribution of Total roof space of the rooftop gardeners to rooftop production in Dhaka city: The coefficient for total roof space was 0.114 and P value was 0.068. It explained from above table that the coefficient(beta) of total roof space for rooftop production is statistically significant with 10 percent level of significance. This result means that if other things remain constant ,1 percent increase of total roof space would increase the rooftop production by 11.4 percent.

The following observation was made based on the value of concerned variable of the study under consideration.

1. The contribution of the total roof space was at 10% significance level.
2. So, the null hypothesis could be rejected

Total roof space had a positive influence on rooftop production in Dhaka city. It had significant contribution on the total rooftop production. Thus, it could be concluded that the more rooftop space in Dhaka city leads to increase rooftop production. Kabir (2018),also found similar findings with towards factors influencing rooftop gardening in Bangladesh.

4.2.2. Significance contribution of family income of the rooftop gardeners to Rooftop production in Dhaka city: The coefficient for family income was 0.159 and P value was 0.011. It explained from above table that the coefficient(beta) of family

income for rooftop production was statistically significant with 5 percent level of significance. This result means that if other things remain constant, 1 percent increase of family income would increase the rooftop production by 15.9 percent.

The following observation was made based on the value of concerned variable of the study under consideration.

1. The contribution of the total roof space was at 5% significance level.
2. So, the null hypothesis could be rejected

Family income had a positive influence on rooftop production in Dhaka city. It had significant contribution on the total rooftop production. Thus, it could be concluded that the more family income in leads to increase rooftop production. Kabir(2018), found that income had insignificant influence on rooftop gardening.

4.2.3. Significance contribution of Support from government organization to Rooftop production in Dhaka city:

The coefficient for support from government organization was 0.423 and P value <0.001. It explained from above table that the coefficient(beta) of support from government organization for rooftop production was statistically highly significant with 1 percent level of significance. This result means that if other things remain constant, 1 percent increase of support from government organization would increase the rooftop production by 42.3 percent.

The following observation was made based on the value of concerned variable of the study under consideration.

1. The contribution of the total roof space was at 1% significance level.
2. So, the null hypothesis could be rejected

Support from government organization had a positive influence on rooftop production in Dhaka city. It had significant contribution on the total rooftop production. Thus, it could be concluded that the more support from government organization in Dhaka city leads to increase rooftop production. Kabir (2018), explained that organizational support had insignificant influence on rooftop gardening. So, present situation indicates that organizational support was helpful to produce higher production.

4.2.4. Significance contribution of Support from online platform to Rooftop production in Dhaka city: The coefficient for support from online platform (facebook,website,youtube) was 0.285 and P value 0.013. It explained from above table that the coefficient(beta) of support from online platform for rooftop production was statistically significant with 5 percent level of significance. This result means that if other things remain constant ,1 percent increase of support from online platform would increase the rooftop production by 28.5 percent.

The following observation was made based on the value of concerned variable of the study under consideration.

1. The contribution of the total roof space was at 5% significance level.
2. So, the null hypothesis could be rejected

Support from online platform (facebook,website,youtube) had a positive influence on rooftop production in Dhaka city. It had significant contribution on the total rooftop production. Thus, it could be concluded that the more support from online platform in Dhaka city leads to increase rooftop production. There was no previous findings on online support for rooftop gardening production.

4.2.5. Significance contribution of government employee to rooftop production in Dhaka city: The coefficient for government employee was -0.201 and P value 0.100. It explained from above table that the coefficient(beta) of government employee for rooftop production was statistically significant with 10 percent level of significance. This result means that if other things remain constant ,1 percent decrease of government employee profession would increase the rooftop production by 20.1 percent.

The following observation was made based on the value of concerned variable of the study under consideration.

1. The contribution of the total roof space was at 10% significance level.
2. So, the null hypothesis could be rejected

Government employees had a negative influence on rooftop production in Dhaka city. It had significant contribution on the total rooftop production. Thus, it could be concluded that the less government employee profession in Dhaka city leads to increase rooftop production.

4.2.6. Significance contribution of other profession such as homemaker, freelancers to rooftop production in Dhaka city: The coefficient for other profession was 0.227 and P value 0.046. It explained from above table that the coefficient(beta) of other profession for rooftop production was statistically significant with 5 percent level of significance. This result means that if other things remain constant ,1 percent increase of other profession would increase the rooftop production by 22.7 percent.

The following observation was made based on the value of concerned variable of the study under consideration.

1. The contribution of the total roof space was at 5% significance level.
2. So, the null hypothesis could be rejected

Other profession such as housewife, freelancer (whose worked from home) had a positive influence on rooftop production in Dhaka city. It had significant contribution on the total rooftop production. Thus, it could be concluded that the more homemakers or freelancer profession in Dhaka city leads to increase rooftop production. On the other hands Kabir (2018), explained that media contact had significance influence on rooftop gardening.

The researcher accepted 90 percent confidence interval and 1 percent, 5 percent and 10 level of significance. On the other hands age, gender, education, family size, access to training, giving time in rooftop, growing season and production technology were statistically insignificant. From the survey, the researcher found many rooftop owners with proper technological knowledge and asset with higher production. The researcher also collected data from those had training facility, there rooftop production was also high because of proper guidance and implementation in rooftop. But this research sample size was 200 as it was covered five regions in Dhaka city. So these types of variable result were insignificant by this regression model. The researcher suggests to re-examine the result for specific region.

4.3. Scopes and possibility of agribusiness through rooftop gardening production

Table 4.3.1. Statement on sustainability of rooftop production

There was a closed question on the basis of the respondents opinion. Sustainability means rooftop production grows fruits and vegetable in all season to ensure food security.

Category	Mohammadpur	Dhanmondi	Mirpur	Uttara	Badda
	%	%	%	%	%
Sustainable	80	75	72.5	65	70
Unsustainable	20	25	27.5	35	30
Total	100	100	100	100	100

From this table, 80 percent respondents agreed that rooftop production is sustainable in Mohammadpur, that was the highest portion among five selected areas. Respondents thought that rooftop production is sustainable because rooftop owners grow fruits and vegetable in the whole year.

4.3.2. Growing Seasons in rooftop

Growing season is that when the fruits and vegetables are cultivated. The planting date for each vegetable depends upon the weather that the vegetable can best tolerate.

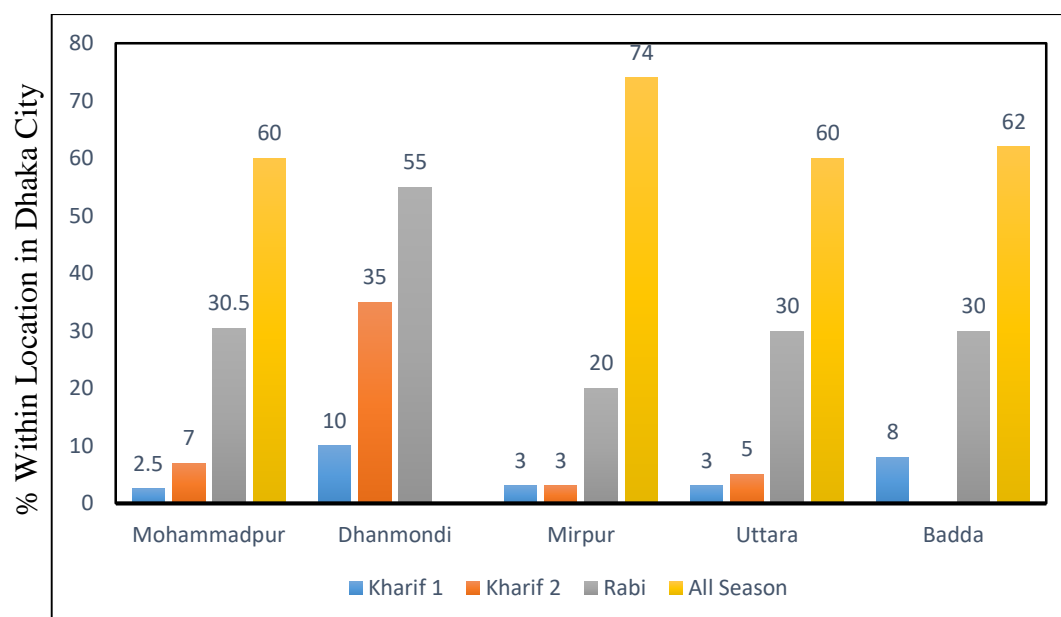


Figure 4.3.2 Growing season in Dhaka city

The figure represents that in Mirpur, highest number of respondents cultivated fruits and vegetables in all seasons of the year. In Rabi season maximum cultivation happened by the respondents of Dhanmondi. From the table it is clear that Maximum area respondents cultivates either in all seasons or in Rabi season.

4.3.3. Relationship between production and growing season:

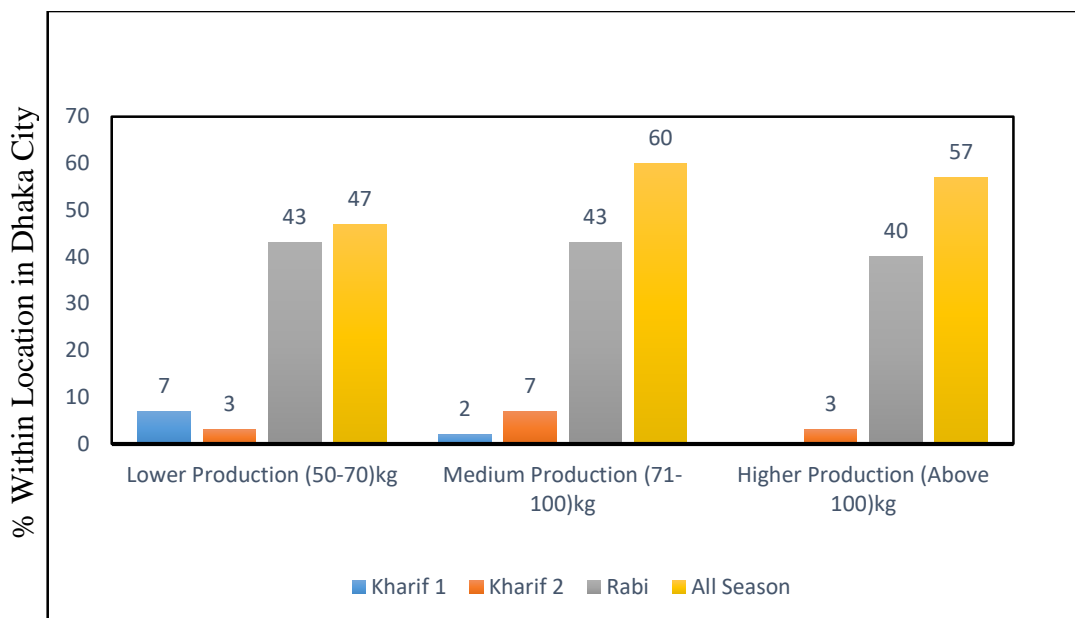


Figure 4.3.3: Relationship between production and growing season

From the figure 4.3.3 it is clear that respondents who cultivate in all seasons, having the highest level of production. Rabi season cultivators also had an average portion production.

Table 4.3.4 Statement on rooftop production gives more nutrition than buying from market

When respondents produced their own fruits and vegetables, they did not have any query about the quality of food.

Frequency	Mohammadpur	Dhanmondi	Mirpur	Uttara	Badda
	%	%	%	%	%
Yes	77.5	95	77.5	85	75
No	22.5	5	22.5	15	25
Total	100	100	100	100	100

Above table represents that majority of the respondents agreed that rooftop production gives more nutrition than buying from market. 95 percent respondents at Dhanmondi region agreed that rooftop production has more nutrition than buying from market.

Table 4.3.5. Vegetables and Fruits produced in current RTG’s in Dhaka

The responses were discovered to grow a variety of fruits and vegetables. The house's green plants and vegetation contribute to a sense of peace, simplicity, and genuineness. However, not all kinds of fruits can be grown on a rooftop. As a result, selecting plants for roof gardening is a critical undertaking for all gardeners. Individual household Food preferences, availability of seeds/sapling varieties that may be grown on the rooftop, climate, and soil availability are all factors that influence the types and mix chosen in the city.

The following are some of the findings of the study:

Sl No	Fruits produced in rooftop garden		Vegetables produced in rooftop garden
1	Guava	1	Tomato
2	Lemon	2	Brinjal
3	Papaya	3	Chilli
4	Mango	4	Ladies finger
5	Banana	5	Bean
6	Orange	6	Bitter gourd
7	Strawberry	7	Red amaranth
8	Litchi	8	Capsicum
9	Sapota	9	Coriander
10	Grape	10	Cauliflower

4.3.6. Given time in rooftop

Generally the urban dwellers work in garden either in morning or evening depending on their leisure time. Moreover, they enjoy while gardening.

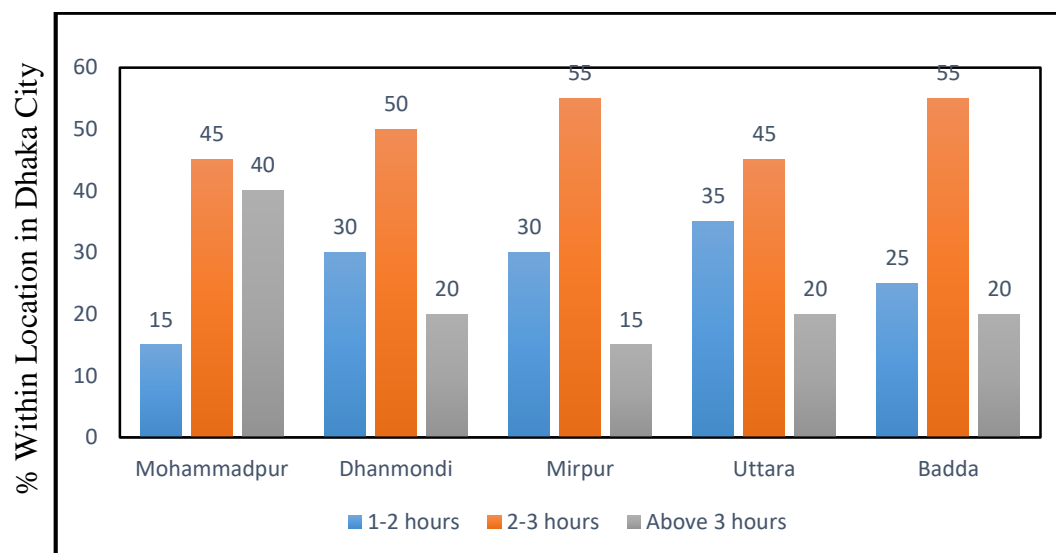


Figure 4.3.6 : Given time in rooftop on the basis of region

From the figure, respondents from Mirpur gave highest time (2-3) hours in rooftop per day, maximum respondents gave (1-3) hours per day in rooftop. It also varies from person to person to the purposes, some respondents also gave time for walking in the roof. But Maximum respondents were taking care of their roof plants.

Table 4.3.7. Collection amount from rooftop (crop harvested)

Collection from rooftop varies day to day and also varies season to season. Maximum rooftop growers collected daily basis monitoring. When it will be needed for harvesting, the respondents harvested in that time.

Category	Mohammadpur		Dhanmondi		Mirpur		Uttara		Badda	
	Kg range	Mean	Kg range	Mean	Kg range	Mean	Kg range	Mean	Kg range	Mean
Per day	3-5	4	2-5	4.2	2-7	4.5	1.5-7	4.25	2-7	4
Per week	21-35	28	14-35	29.4	14-15	32	10.50-45	29.75	14-49	28
Per month	80-150	115	60-150	126	80-180	130	61-150	124.5	60-420	120

From the above table per day collection is highest in Mirpur with the amount of 4.5 kg fruits and vegetables. Then Uttara rooftop owners collect 4.25 kg fruits and vegetables per day. So, Mirpur respondents collect highest portion of production per day and per month.

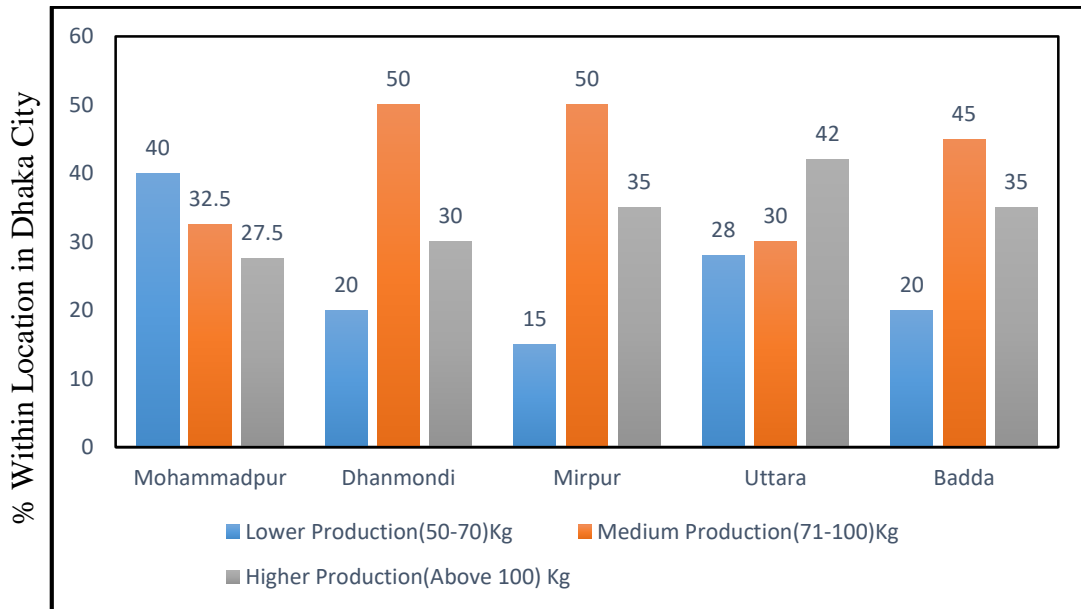


Figure 4.3.7 : Production per rooftop in a year on the basis of region

With the help of this figure, it was explained that both Mirpur and Uttara area had higher amount of production. But total production is highest in Mirpur.

Table 4.3. Use of pesticides for controlling pest and diseases of fruits and vegetables in the existing roof top garden

Bio-pesticides are currently being used to manage invertebrate pests, plant pathogens, and weeds. Controlling pest and disease of the species is important for increasing the productivity and higher income. Integrated pest and diseases management is an important issue for RTG. Most of the respondents did not follow the appropriate measures for controlling the pest and diseases in the RTG. This might be happened due to lack of training in this regard.

Inputs	Mohammadpur %	Dhanmondi %	Mirpur %	Uttara %	Badda %
Used pesticide	33.67	37.57	30.65	40.45	39.40
Used herbal method	49.33	49.33	54.92	55.62	41.77
None	17	13.10	14.43	3.93	18.83
Total	100	100	100	100	100

40.45 percent respondents in Uttara used pesticide with the highest portion among all the selected area. On the other hands 55.62 percent respondents used herbal pesticides in Uttara. After Uttara, for using herbal method, Mirpur area had highest portion with 54.92 percent.

4.3.9. Training about strategy of rooftop that people want to attend

Training needs assessment on RTG is essential for developing skill of the urban dwellers which can lead to food and nutritional security at household level. In the study, based on respondent's opinions on training duration and training location on rooftop gardening were identified during the study. But it was varied with the training topic that also respondent said.

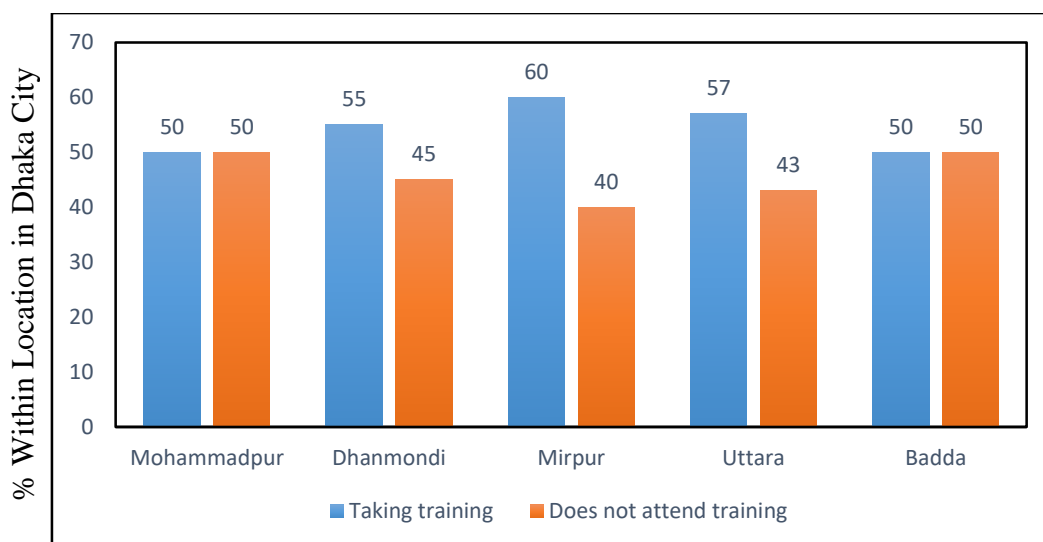


Figure 4.3.9 : Access to training on the basis of area

From this figure it is clear that Mirpur area respondents had training experiences on rooftop gardening and they wanted to access training also.

4.3.10. Technique implementation for developing rooftop garden

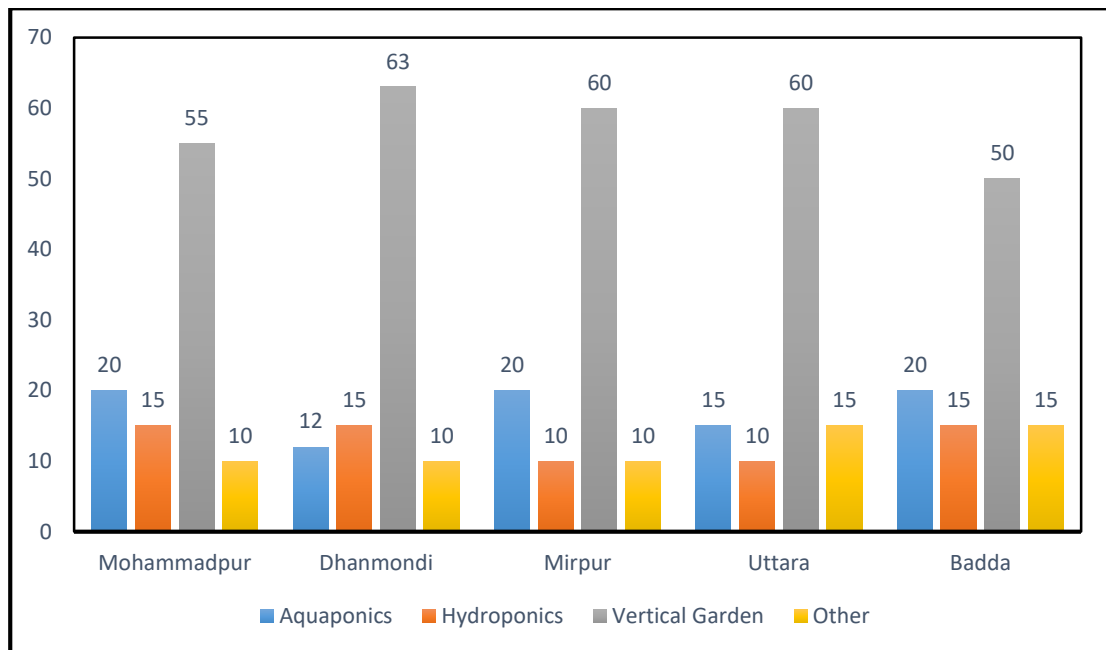


Figure 4.3.10: Production Technology on the basis of region

From the 4.3.10 figure it was seen that majority of rooftop owner wanted to do vertical garden. Maximum respondents already implemented vertical garden in their rooftop. But Aquaponics was also popular that respondents wanted to try. In this other section the respondents said, light weight media, IPM, etc.

4.3.11. Service provider Organization

A particular question was throwing to the respondents for getting their responses on the support needed from organization. such as government organization like Department of Extension (DAE), Research Institute for RTG or other online groups. The types of supports are technical support, input/logistic support, cash/credit support, training support, suggestions and monitoring through regular visit.

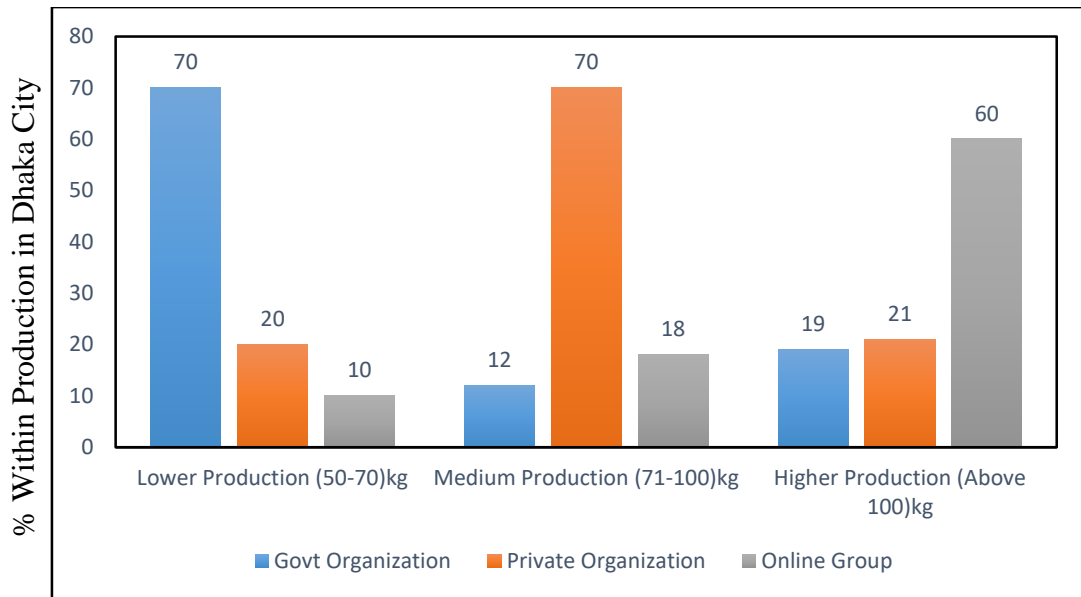


Figure 4.3.11: organizational support and production

From the 4.3.11 figure it was clear for higher production online groups support was reason for higher production. Respondents were very much known to Green Bangladesh society online platform.

4.3.12. Organizational support on the basis of area:

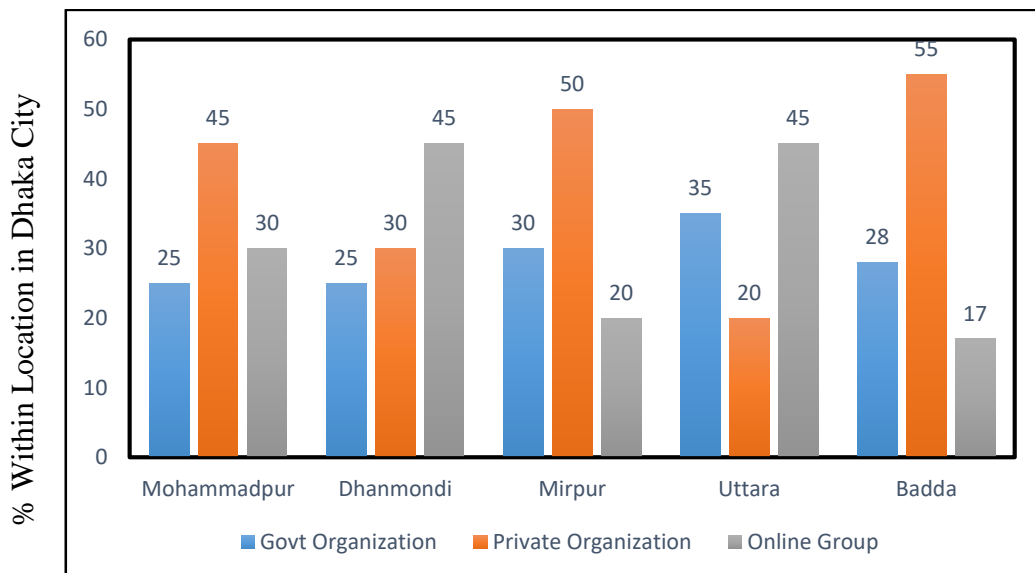


Figure 4.3.12 : Organizational support on the basis of area

From the 4.3.12 figure, It was found that government organizational support is highest in Uttara, private organizational support is highest in Badda and Online support was highest in Dhanmondi.

4.3.13. Existing plants with respective average yield and income in last one year

The average yield of vegetables and fruits was obtained for 10 common vegetables and fruits in the study. The yield data was converted into kilogram per household per year basis.

Vegetables	Fruits
Tomato	Guava
Brinjal	Lemon
Chili	Papaya
Ladies finger	Mango
Bean	Banana

In total cost, there is fixed cost and variable cost. Average cost was measured with fertilizer cost, seedling cost, other input cost (jar, container etc) and labor cost. But the respondent did not explain it clearly because they bought this input from yearly basis. It was not easy to explain it for single fruits or vegetables. From an average cost amount it was calculated.

On the other hand, Consumed yield was that the owner family consumed the amount of production from his rooftop garden total production of fruits or vegetables in a year. Remaining yield was the extra production after consumption of the family.

Sales portion is the respective yield multiplied by its market price. The market price for each fruits and vegetables is average market price of a year.

So, Market price for 1 kg tomato 30 Tk followed by Brinjal 42 TK/kg, chilli 45 TK/kg ladies finger 55 TK/kg, Bean 45 TK/kg, Guava 40 TK/kg, lemon 60 TK/kg, papaya 50 TK/kg, Mango 60 TK/kg and Banana 60 TK/kg. Lemon and Banana were measured by kg because the researcher has calculated with same This price was collected from Average price list by Department of Agricultural marketing website.

Table 4.3.13a. Existing plants with respective average yield and income in last one year in Mirpur

Sl. No.	Vegetables and fruits name	Yield (Kg/year)	Cost TK	Consumed Kg	Remaining Yield Kg	Sales TK
1	Tomato	58.32	1100	15.1	43.22	1296.6
2	Brinjal	32.5	825.75	8.75	23.75	997.5
3	Chili	40.25	990.5	12.5	27.75	1248.75
4	Ladies finger	38.56	970.25	16.5	22.06	1213.3
5	Bean	23.12	720.3	7.25	15.87	714.15
6	Guava	36.25	900.5	14.5	21.75	870
7	Lemon	45.3	925.75	10.27	35.03	2101.8
8	Papaya	42.75	1210.45	12	30.75	1537.5
9	Mango	47.25	1150.25	18.75	28.5	1710
10	Banana	35.7	1030.25	10.25	25.45	1527
	Total		9824			13216.6
	BCR					1.345

Results revealed in Mirpur that the average yield was found to be higher from Tomato (58.32 kg/year/RTG) followed by Brinjal (32.5 kg), chili (40.25kg), lady's finger (38.56 kg), bean (23.12 kg).From fruits higher found in Lemon (45.3 kg/year/RTG) followed by Guava (36.25)kg, Papaya (42.75 kg),Mango (47.25 kg), Banana (35.7 kg).

From the above table Total cost of production is 9824 and total sales portion is 13216.6 TK.

$$\text{BCR} = \frac{13216.6}{9824} = 1.345$$

Total value is not calculated because From total production the consumed production is subtracted. Because the main focus is the producer surplus. So, Benefit cost ratio is 1.345 that means the result is economically satisfactory. So, the rooftop owners from Mirpur can do agribusiness with the extra production in a small scale.

Table 4.3.13b. Existing plants with respective yield and income in the last one year in Mohammadpur

Sl. No.	Vegetables and fruits name	Yield (Kg/year)	Cost TK	Consumed Kg	Remaining Yield Kg	Sales TK
1	Tomato	55.25	1050.32	15.50	39.75	1192.5
2	Brinjal	35.11	890.43	13.55	21.56	905.52
3	Chili	32.21	950.11	10.50	21.71	976.95
4	Ladies finger	28.13	970.42	10.25	17.88	983.40
5	Bean	25.38	697.21	9.50	15.88	714.6
6	Guava	41.55	952.37	15.23	26.32	1052.80
7	Lemon	47.21	970.32	27.75	19.46	1167.6
8	Papaya	40.32	1055.21	15.44	24.88	1244
9	Mango	38.43	1230.21	14.55	23.88	1432.80
10	Banana	31.42	1040.13	12.56	18.86	1131.60
	Total		9806.73			10801.77
	BCR					1.101

From the above table Total cost of production is 9806.73 and total revenue portion is 10801.77.

$$\begin{aligned} \text{BCR} &= \frac{10801.77}{9806.73} \\ &= 1.101 \end{aligned}$$

So, Benefit cost ratio is 1.101 that mean the result is economically satisfactory. So, the rooftop owners from Mohammadpur can do agribusiness with the extra production in a small scale.

Table 4.3.13c: Existing plants with respective yield and income in the last one year in Uttara

Sl. No.	Vegetables and fruits name	Yield (Kg/year)	Cost TK	Consumed Kg	Remaining Yield Kg	Sales TK
1	Tomato	57.44	1183	10.22	47.22	1416.6
2	Brinjal	37.47	910.33	9.75	27.72	1164.24
3	Chili	26.55	957.37	9.22	17.33	779.85
4	Ladies finger	32.77	1023.55	9.98	22.79	1253.45
5	Bean	24.36	700.04	7.67	16.69	751.05
6	Guava	40.22	940.44	14.55	25.67	1026.8
7	Lemon	46.88	860.33	29.05	17.83	1069.8
8	Papaya	38.88	1114.55	16.55	22.33	1116.5
9	Mango	40	1100.03	12.99	27.01	1620.6
10	Banana	29.33	980.04	9.07	20.26	1215.6
	Total		9769.68			11414.49
	BCR					1.17

From the above table Total cost of production is 9769.68 and total sales portion is 11414.49.

$$\text{BCR} = \frac{11414.49}{9769.68} = 1.17$$

So, Benefit cost ratio is 1.101 that mean the result is economically satisfactory. So, the rooftop owners from Uttara can do agribusiness with the extra production in a small scale.

Table 4.3.13d. Existing plants with respective yield and income in the last one year in Dhanmondi

Sl. No.	Vegetables and fruits name	Yield (Kg/year)	Cost TK	Consumed Kg	Remaining Yield Kg	Sales TK
1	Tomato	57.02	1145	15.5	41.52	1245.6
2	Brinjal	32.08	910.33	12.57	19.51	819.42
3	Chili	30.11	920.13	12.01	18.1	814.5
4	Ladies finger	35.66	1000.03	9.05	26.61	1463.55
5	Bean	21.9	727.55	8.9	13	585
6	Guava	41.55	952.37	12.89	28.66	1146.4
7	Lemon	45.02	860.33	28.99	16.03	961.8
8	Papaya	39.05	1055.22	17.04	22.01	1100.5
9	Mango	39.02	1040.44	13.77	25.25	1515
10	Banana	31.42	1040.13	7.02	24.4	1464
	Total		9651.53			11115.77
	BCR					1.15

From the above table Total cost of production is 9651.53 and total sales portion is 11115.77.

$$\text{BCR} = \frac{11115.77}{9651.53} = 1.15$$

So, Benefit cost ratio is 1.15 that mean the result is economically satisfactory. So, the rooftop owners from Dhanmondi can do agribusiness with the extra production in a small scale.

Table 4.3.13e.Existing plants with respective yield and income in the last one year Badda

Sl. No.	Vegetables and fruits name	Yield (Kg/year)	Cost TK	Consumed Kg	Remaining Yield Kg	Sales TK
1	Tomato	50.5	1000.2	15	35.5	1065
2	Brinjal	36.2	900.15	13.5	22.5	945
3	Chili	35.5	975.11	10.5	25	1361.2
4	Ladies finger	35.25	975.42	10.5	24.75	1086.25
5	Bean	20.25	715.3	8.25	11.75	528.75
6	Guava	38.1	910.58	13.52	24.48	979.2
7	Lemon	44.2	930.1	25.25	18.95	1137
8	Papaya	45.15	1225.75	18.44	26.88	1344
9	Mango	40.45	1180.2	15.6	24.85	1491
10	Banana	30.7	990.1	1086	19.84	1190.4
	Total		9802.91			11127.8
	BCR					1.135

From the above table Total cost of production is 9802.91 and total sales portion is 11127.8.

$$\text{BCR} = \frac{11127.8}{9802.91} = 1.14$$

So, Benefit cost ratio is 1.15 that mean the result is economically satisfactory. So, the rooftop owners from Badda can do agribusiness with the extra production in a small scale.

But in this study the researcher picked only five fruits and vegetables those are common. So total sample size was not selected in calculating BCR as total production was not covered because many respondents had other fruits or vegetables those were not similar from one to another rooftop production. Only those respondents had similar fruits and vegetables they were selected. The price is also fluctuated from one season to another as the researcher selected the average price. The researcher suggested that to re-examine the BCR with a specific fruits or vegetables in rooftop.

4.3.14. Willingness to do rooftop Business

Rooftop production business is that the owners had extra production after consumption of the family. So, in a small scale if the owners could find any platform to sale the extra production it would be an agribusiness. One respondents to other respondent concept could varied because of the perception. Majority of the respondents had time consuming issue

Table 4.3.14. Willingness to do rooftop Business

Frequency	Mohamma dpur		Dhanmondi		Mirpur		Uttara		Badda	
	No.	%	No.	%	No.	%	No.	%	No.	%
Yes	22	55	23	57.5	33	82.5	25	75	31	77.5
No	18	45	17	42.5	7	17.5	10	25	9	22.5
Total	40	100	40	100	40	100	40	100	40	100

From the 4.3.14 table, Mirpur had highest respondent with 82.5 percent that they wanted to do rooftop business if they could find a platform. Majority of the respondents agreed to sale extra rooftop production after their consumption. But some respondents did not allow it because of time consuming issue.

Table 4.3.15. BCR on the basis of Region in Dhaka city:

Region	BCR
Mirpur	1.35
Uttara	1.17
Dhanmondi	1.15
Badda	1.14
Mohammadpur	1.10

BCR was highest in Mirpur region, So possibility of agribusiness is high in Mirpur region. On the other hands every region had scope of agribusiness as BCR was greater than 1.

From total yield the researcher subtracted the consumed portion. After that the BCR was greater than 1. So, family income was also saved from rooftop production and

ensure fresh fruits and vegetables. It was explained that rooftop production has a scope and possibility for agribusiness through rooftop production.

CAPTER V

Summary of Findings, Conclusions and Recommendations

The study was conducted in the Dhaka region to find out the factors affecting rooftop production with the possibility and scope of agribusiness towards rooftop gardening at Dhaka city. Total 200 rooftop gardeners were selected from the study. A well-structured interview schedule was developed based on objectives of the study for collecting information. From the hypothesized relationship, six (6) variables namely, total roof space, family income, support from government organization, support from online platform, government employees and others profession such as homemaker were found significant contribution to rooftop production while rest of the variables found having no significant contribution. Among them Family income, Support from Government Organization, Support from online platform, others profession such as homemaker and All growing season had positive significant contribution to the Rooftop production. The dependent variable of this study was Production of per rooftop gardening. Data collection was started in 20 October, 2019 and completed in 25 February, 2020. Various statistical measures such as frequency counts, percentage distribution, average, range and mean were used in describing data. In order to estimate the contribution of the selected characteristics of rooftop gardeners towards rooftop gardening production, multiple regression analysis was used. For estimating the scope and possibility of agribusiness BCR was calculated. The major findings of the study are summarized below:

5.1 Major Findings

From the above discussion, here author summarized all the findings together. The major findings of the study are given below:

- In Dhaka city, it reveals that the old-aged respondents comprised the highest proportion in every region which is greater than 50 percent as well as Dhanmondi, Mirpur and Uttara region have the is 65 percent old aged (above
- 50) rooftop gardeners. It's also found that middle-aged respondents comprised the least proportion in every area except Mohammadpur.

- In all the five region in Dhaka city female respondents are more involved in rooftop gardening. In Mirpur and Badda 95 percent of the rooftop gardeners are female while Mohammadpur, Dhanmondi and Uttara has 82.5%, 70% and 85% of female gardeners respectively.
- According to the research it's found that most of the rooftop gardeners are graduates in every region except Mohammadpur. In this (Mohammadpur) region, respondents who has secondary or higher secondary education are more involved in rooftop gardening. Primary students are least involved in all the region.
- In all the region most of the respondents involved in rooftop gardening are belongs to small size families (3 members or less). In Uttara and Badda, contribution of both medium (4-6 members) and large (more than 6 members) families are same while in Mohammadpur, Dhanmondi and Mirpur has the least respondents from large size families.
- In this study it is found that most of the respondents have medium sized (2200-3200 square feet) garden in every region. Gardeners from Mohammadpur uses least amount of small sized (up to 2200 square feet) garden while gardeners from all the other region uses least amount of large sized (more than 3200 square feet) gardens for rooftop gardening.
- In this study we can see that in Mohammadpur, Mirpur and Badda region families with medium family income are more involved in rooftop gardening. In other two region Dhanmondi and Uttara respondents from low income family are more involved in rooftop gardening.
- Among the respondents who are Govt-employees comprised the highest proportion in rooftop gardening in every region. Private sector employees and businessmen are less likely to involve in this. There are also respondents from other profession involved in rooftop gardening.
- It is found that, in every region most of the respondents cultivate fruits and vegetables in all seasons of the year. There are also a lot of respondents who cultivates only in the rabi season. Very few respondents cultivate fruits and vegetables in kharif 1 or kharif 2 season.

- Respondents who cultivated in all season produces the most amount of crops. People who cultivates only in rabi season also cultivates fair amount of crops.
- In this study we found that most of the respondents spend 2 to 3 hour every day in their garden. In Mohammadpur least people spend less than 2 hours while in all other region least amount of respondents spend more than 3 hours in their garden.
- The coefficient of total roof space is significant at 10 percent level of significance. If other things remain constant ,1 percent increase of total roof space would increase the rooftop production by 11.4 percent.
- The coefficient of total roof space is significant at 5 percent level of significance. If other things remain constant ,1 percent increase of family income would increase the rooftop production by 15.9 percent.
- The coefficient for support from government organization is 0.423 and P value <0.001. This result means that if other things remain constant ,1 percent increase of support from government organization would increase the rooftop production by 42.3 percent with 1 percent level of significance.
- The coefficient for support from online platform is 0.285 and P value 0.013. This result means that if other things remain constant ,1 percent increase of support from online platform would increase the rooftop production by 28.5 percent with 5 percent level of significance.
- If other things remain constant ,1 percent decrease of government employee profession would increase the rooftop production by 20.1 percent with 10 percent level of significance.
- If other things remain constant ,1 percent increase of other profession (homemaker, freelancer) would increase the rooftop production by 22.7 percent with 5 percent level of significance.
- Education, Age, family size, gender, access to training, giving time in rooftop, growing season and production technology were statistically insignificant. So there was no relationship with rooftop production.

- 80 percent respondents agreed that rooftop production is sustainable in Mohammadpur, that was the highest portion among five selected areas.
- Majority of the respondents agreed that rooftop production gives more nutrition than buying from market. But in highest result, 95 percent respondents at Dhanmondi region agreed that rooftop production has more nutrition.
- Respondents from Mirpur gave highest time (2-3) hours in rooftop per day, Maximum respondents gave (1-3) hours per day in rooftop.
- In this research it is found that among all the region Mirpur respondents collect highest portion of production per day and per month.
- 40.45 percent respondents in Uttara used pesticide with the highest portion among all the selected area. On the other hands 55.62 percent respondents used herbal pesticides in Uttara. After Uttara, for using herbal method, Mirpur area had highest portion with 54.92 percent.
- Among all the region Mirpur area respondents had training experiences on rooftop gardening and they wanted to access training also.
- From the study it was seen that majority of rooftop owner wanted to do vertical garden. Maximum respondents already implemented vertical garden in their rooftop.
- It is found that in higher production online groups are more helpful for the respondents. On the other hands public organizations are helpful for lower production and private organizations are more helpful for medium production.
- It is found that respondents from Mohammadpur, Mirpur and Badda region gets most of their support from the private organizations while respondents from Dhanmondi and Uttara region gets most of the support from the online groups.
- 5 common fruits and vegetables were selected from respondent rooftop by the basis of highest production and sales was calculated by the average market price.
- In Mirpur, Benefit cost ratio was 1.345 which was highest among all regions that means the result was economically satisfactory. So, the rooftop owners from Mirpur can do agribusiness with the extra production in a small scale.

- Every region has scope of agribusiness as BCR is greater than 1.
- From five selected region, Mirpur region has highest production of fruits and vegetables in Dhaka city.

5.2. CONCLUSION

The ultimate decision or judgment made at the end or termination of a research project is referred to as a conclusion. It includes assumptions and logical interpretations of the research findings. The conclusion should be so constructive that it draws the attention of the relevant individuals/organizations with its words and arguments. The researcher drew the following conclusions based on the findings and relevant facts of the research work. Rooftop gardening, in particular, helps to the construction of a healthy environment and food security. It improves the quality of perishable goods reaching urban customers by increasing the supply of fresh food. There is no explicit policy provision or regulation in Bangladesh that promotes urban agriculture in general or rooftop gardens in particular. In Dhaka there is no special city strategy that promotes urban agriculture. This is critical, as several countries such as Switzerland and Germany have demonstrated, and roof gardening has enormous potential.

Maximum old aged people cultivate in rooftop because they have leisure time after retirement or they enjoy this work as well. Those rooftop owners have training experience their production level was high from this research. Rooftop owners wanted to improve their technical knowledge for increasing the production. It also found that it has regional impact because Bengali people want to do the same to see other, so it has a positive effect. On the other hand, rooftop production secure organic food there is minor chemical using for ripening fruits also. Rooftop owners those were cultivating the whole season (kharif 1, kharif 2, rabi) had a huge production. After consumption the respondents had extra portion that was spoiled or giving to the neighbors. But in Dhaka city, maximum respondents did not know their neighbor for that the production would be damaged or destroyed.

Rooftop production has an agribusiness possibility and scope in a small scale. The calculated BCR was greater than 1. Majority people agreed to do agribusiness if they will find any platform. If the government or any private organization will take this initiative to sell the rooftop vegetables, fruits and collect the production by a supply chain, then it will be a profitable platform. On the other hands Dhaka will be a livable city with green roof and fresh air.

5.3. RECOMMENDATION

- Vegetable and fruit yields in current RTGs could be enhanced with careful management. So proper training facilities both online and offline platform will be required.
- Agribusiness platform is required for selling extra production as benefit cost ratio is higher in every region in Dhaka city. So rooftop production has agribusiness scope and opportunity.
- Rooftop fruits and vegetables price is greater than the market price as proper techniques and care are maintained and input cost is high from village market.
- Management and ensuring that the respective service provider, DAE, or NGO personnel visit on a regular basis in every RTG.
- To improve RTG in the individual areas, proper crop, technical knowledge and training facility is required.
- Rooftop gardening production will make employment opportunity if the agribusiness platform will be made.

5.4. RECOMMENDATIONS FOR FURTHER STUDY

On the basis of scope and limitations of the present study and observation made by the researcher, the following recommendations are made for further study.

- The present study was conducted in five regions in Dhaka city. It is recommended that similar studies should be conducted in other areas of Dhaka city.
- This study examined the contribution of independent variables of the respondents with their rooftop production as dependent variable. Therefore, it will be recommended that further study should be conducted with other characteristics of the respondents.
- This study calculated that BCR is higher in every region. Further researcher can find the platform of selling the surplus production in Dhaka city.

CHAPTER VI REFERENCE

- Adhikary, S. (2012). Study on Farmers' Awareness on the Impact of Using Pesticides on Environmental Pollution (Doctoral dissertation).
- Akhter, M.S. (2003). Comparison Between Knowledge and Skill of Women Led FFS of RDRS and Non-FF Farmers. M.S. thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University.
- BBS. (2018). Statistical Yearbook of Bangladesh, Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of People Republic of Bangladesh, Dhaka.
- Bryman, A. (2001). Social Research Methods. Oxford: Oxford University Press.
- Carrot City (2014). Lufa Farms / Fermes Lufa. Retrieved February 7, (2016), from ryerson.ca:(http://www.ryerson.ca/carrotcity/board_pages/rooftops/lufa_farms.html).
- Choguill, C.L.(1995). Urban Agriculture and Cities in the Developing World. *Habitat International*. **19**(2): 149-235.
- Hamid, M.A., Halim, A. and Hossain, S.M.A. (1997). Farmers' Awareness on Environmental Pollution: A Study in Two Selected Villages in Bangladesh. *Asia-Pacific Journal of Rural Development*, **7**(2): 107-117.
- Hanif, M.S. (2000). Comparative Analysis Between FFS and Non-FFS Farmers Regarding Environmental Awareness. M.S.. Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University.
- Hui, D.C. (2011). Green roof urban farming for buildings in high-density urban cities. the Hainan China World Green Roof Conference, pp. 1–9. China.
- Islam, K. M. (2002, September). Rooftop gardening as a strategy of urban agriculture for food security: The case of Dhaka City, Bangladesh. In *International Conference on Urban Horticulture* **643**, pp. 241-247.
- Islam, M. S., & Ahmed, R. (2011). Land use change prediction in Dhaka city using GIS aided Markov chain modeling. *Journal of Life and Earth Science*, **6**, 81-89.
- Jahan, N. (2016). Pleasures of Roof top Gardening. *Nature, the daily star*, Bangladesh.
- Kabir, MS (2018). Factors influencing use of rooftop gardening in Dhaka city. M.S Thesis, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka.
- Kamrujjaman, R. (2015). Vertical Farming: Social Work and Sustainable Urban Agriculture in an Age of Global Food Crises. *Australian Social Work* **66**(2): 187–203.

- Kashem, M.S. (2001). Farmers Awareness on the Effect of Insecticides on Environment: A Study in Kalihati Upazila under Tangail District. M.S. Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University.
- Mithon, M.S. (2016). Attitude of the house owners towards rooftop gardening at Dhaka city. MS Thesis. Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka.
- Nira, K.N. (2006). Adoption of Roof Gardening at Mirpur-10 Area under Dhaka City. M.S. Thesis. Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka.
- Orsini, F., Kahane, R., Nono-Womdim, R. and Gianquinto, G. (2013). Urban agriculture in the developing world. A review. *Agronomy for Sust. Dev.* **33**:695–720.
- Rahman, M.S. (2014). Problems of Roof Top Gardening at Mohammadpur Thana under Dhaka City. M.S. Thesis, Department of Agricultural Extension and Information System, Sher-E-Bangla Agricultural University, Dhaka.
- Seraj, D. M. (2012). Private sector housing. Pearl Publication.
- Smit, J., Nasr, J., & Ratta, A. (1996). Urban agriculture: food, jobs and sustainable cities. New York, USA, **2**:35-37.
- Sprouting Good Urban Farming Sydney (2014). January 23. PORTABLE ROOFTOP FARM EDUCATION CENTRE. Retrieved February 8, 2016, from sproutinggood.com: (<http://sproutinggood.com/2014/01/23/urban-rooftop-farming-is-changing-the-world/>).
- Townsend, J.C. 1953. Introduction to Experimental Methods. International Student Edition, New York. McGraw Hill Book Company Inc.
- United Nations (2014). World Urbanization Prospects: The 2014 Revision. Retrieved from [esa.un.org: \(<http://esa.un.org/unpd/wup/Highlights/WUP2014-Highlights.pdf>\)](http://esa.un.org/unpd/wup/Highlights/WUP2014-Highlights.pdf).
- Wardard, Y. (2014). November 19. Rooftop gardening can meet Dhaka's 10pc of vegetable demand. Retrieved from [thefinancialexpress-bd.com: \(<http://www.thefinancialexpress-bd.com/2014/11/19/66659/print>\)](http://www.thefinancialexpress-bd.com/2014/11/19/66659/print).

CHAPTER VII

APPENDIX A

INTERVIEW QUESTIONS

Department of Agribusiness and Marketing

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An Interview Schedule for the Study Entitled

ROOFTOP GARDENING AS AN AGRIBUSINESS PRACTICE TO ENSURE FOOD PRODUCTION

Name of the respondent: Serial No.:

House No.: Road No.:

Section:

(Please provide the following information. Your information will be kept confidential and will be used for research purpose only.)

Section 1: Socio Economic Characteristics:

Region in Dhaka city	Age	Gender	Profession	Family members	Area of rooftop (sq.foot)	Education	Income

Section 2: Factors affecting rooftop production in Dhaka city

2.1. Did you attend any training program?(√)

Taking any training on RTG	Not taking any training on RTG
----------------------------	--------------------------------

2.2 Mention the Growing season when you cultivate(√)

Kharif 1	Kharif 2	Rabi	All season
----------	----------	------	------------

2.3. Do you want to give time in your rooftop?

Yes or No

If yes, please tell the time (tick)

(1-2) hours	(2-3) hours	Above 3 hours
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2.4. Which type of Production technology that you want to implement ?. (✓)

Aquaponics	Hydroponics	Vertical garden	Other technic
------------	-------------	-----------------	---------------

2.5. Do you got support from any service provider for your RTG ? If yes then please mention –(✓)

Government organization	Private organization	Online platform
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Section 3: Scope and possibility of agribusiness through rooftop gardening production

1. Do you think rooftop production is sustainable?

Yes	No
-----	----

2. Do you think rooftop production give you more nutrition than buying from market?

Yes	No
-----	----

3. Mention the Vegetables Name and production with input cost in a year?

Common vegetables Name from your rooftop	Total production of the vegetable(kg)	Consumed by the family(kg)	Total cost of production for that vegetable(tk)

4. Mention the Fruits Name and production with input cost in a year?

Common Fruits Name from your rooftop	Total production of the Fruits(Kg)	Consumed by the family in a year (Kg)	Total cost of production for that fruit (Tk)

5. How much amount you may collect from your rooftop?(kg)

Per day	Per week	Per month

6. Used of bio-pesticides for controlling pest and diseases of fruits and vegetables in the existing rooftop garden(√)

Used pesticide	Used herbal method	None

7. Do you want to do rooftop business if you have extra production after consumption of your family? (√)

Yes	No

Thanks for your kind cooperation.

Dated:

Signature of interviewer

APPENDIX B

Multiple linear regression model fitting assumptions

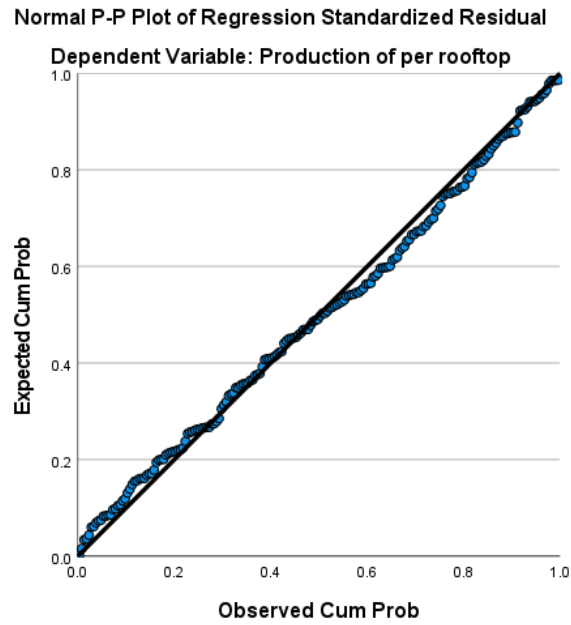


Figure 3.12a: Linear relationship

Table 3.12b: Independent variables collinearity statistics

Coefficients		
	Collinearity Statistics	
Model	Tolerance	VIF
Age of the respondents	0.844	1.185
Gender of rooftop gardeners	0.734	1.363
Access to training	0.766	1.305
Total roof space sq feet	0.745	1.343
Total family members	0.782	1.279
Family income	0.744	1.344
Aquaponic technique	0.327	3.054
Model	Tolerance	VIF

hydroponic technique	0.330	3.034
vertical garden technique	0.240	4.175
other technique	0.357	2.801
Government organization support	0.251	3.986
Private organization support	0.168	5.950
online support	0.222	4.511
Level of education primary	0.583	1.715
secondary education	0.153	6.517
level of education Graduate	0.114	8.790
level of education Masters	0.208	4.814
level of education PhD	0.409	2.444
Government employee	0.193	5.172
Private employee	0.272	3.674
Business	0.320	3.130
Other profession	0.225	4.454
Given time(1-2) hours	0.176	5.691
medium_time	0.181	5.513
Given more than 3 hours	0.247	4.041
Gs kharif 1	0.529	1.891
kharif 2	0.562	1.781
Rabi season	0.261	3.828
All season	0.218	4.587
Mohammadpur area	0.202	4.951
Dhanmondi area	0.196	5.115
Mirpur area	0.218	4.587
Uttara Area	0.198	5.057
Badda area	0.252	3.961

Table 3.12c: Independent variables correlation statistics

Independent variable	Correlation
Age of the respondents	.083
Gender of rooftop gardeners	-.119
Access to training	.032
Total roof space sq feet	.142
Total family members	-.013
Family income	.195
Aquaponic technique	-.045
hydroponic technique	.032
vertical garden technique	.006
other technique	.073
Government organization support	-.295
Private organization support	-.030
online support	.192
Level of education primary	.005
secondary education	.024
level of education Graduate	.037
level of education Masters	.058
level of education PhD	.084
Government employee	-.128
Private employee	-.097
Business	-.005
Other profession	-.155
Given time(1-2) hours	-.104
medium_time	-.047
Given more than 3 hours	-.037
Independent variable	Correlation
Gs kharif 1	.024
kharif 2	.048

Rabi season	.072
All season	.082
Mohammadpur area	-.146
Dhanmondi area	-.065
Mirpur area	.019
Uttara Area	-.062
Badda area	-.015

APPENDIX C

Field Visit and Interviewing during Survey work

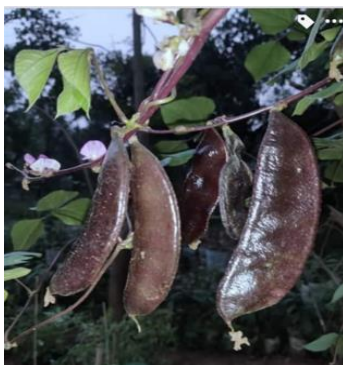


Plate: Interview and Field visit