

DETERMINANTS OF VERTICAL CROP DIVERSIFICATION IN PERI URBAN AREA

MURSHEDA JAHAN CHOWDHURY



**DEPARTMENT OF AGRICULTURAL EXTENSION AND
INFORMATION SYSTEM**

**SHER-E-BANGLA AGRICULTURAL UNIVERSITY,
DHAKA-1207**

JUNE, 2017

**DETERMINANTS OF VERTICAL CROP
DIVERSIFICATION IN PERI URBAN AREA**

BY

MURSHEDA JAHAN CHOWDHURY

REGISTRATION NO. 16-07571

A Thesis

Submitted to the Faculty of Agriculture,

Sher-e-Bangla Agricultural University, Dhaka

In partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

IN

AGRICULTURAL EXTENSION

SEMESTER: JANUARY-JUNE, 2017

Approved by:



Dr. Ranjan Roy
Supervisor
Associate Professor
Department of Agricultural Extension
and Information System
Sher-e-Bangla Agricultural University
Dhaka-1207

Dr. Md. Rafiqul Islam
Co-Supervisor
Professor
Department of Agriculture Extension
and Information System
Sher-e-Bangla Agricultural University
Dhaka-1207

Md. Mahbubul Alam, PhD
Associate Professor & Chairman
Department of Agricultural Extension and Information System
Sher-e-Bangla Agricultural University
Dhaka-1207



Department of Agricultural Extension and Information System
Sher-e-Bangla Agricultural University
Dhaka- 1207, Bangladesh

CERTIFICATE

This is to certify that the thesis enlighten, “**Determinants of vertical crop diversification in peri urban area**” submitted to the faculty of agriculture, Sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE in AGRICULTURAL EXTENSION**, embodies the result of a piece of bona fide research work conducted by **MURSHEDA JAHAN CHOWDHURY**, **Registration no. 16-7571** under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma.

I further certify that any help or source of information, received during the course of this study has been dully acknowledgement.

Dated: JUNE, 2017

Dhaka, Bangladesh



Dr. Ranjan Roy

Supervisor

Associate Professor

Department of Agricultural Extension and Information System
Sher-e-Bangla Agricultural University
Dhaka-1207

Dedicated to
My
Beloved Parents

ACKNOWLEDGEMENTS

One of the gratified moments of writing this acknowledgement is to look back the entire journey of my study and remember all the people, starting from my supervisor, co-supervisor to course instructors, friends and family, and above all Almighty Allah.

At first, I devote an extraordinary pleasure and respect to express my ardent appreciation, most profound feelings of gratefulness, best respects and significant obligation to my reverend supervisor, **Dr. Ranjan Roy**, Associate Professor, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka, without whom I would not have been able to come this far. He not only supervised this thesis but also guide me immensely to carry out this research work.

Second, I feel proud to express my deepest respect, sincere appreciation and immense indebtedness to my co-supervisor **Professor Dr. Md. Rafiqueel Islam**, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka, for his scholastic and continuous guidance during the entire period of course, research work and preparation of this thesis.

Third, I am happy to extend my heartfelt thanks to all the faculties of the Department of Agricultural Extension and Information System, SAU, for their valuable teaching, suggestions and encouragement during the period of the study.

I would like to extend my appreciations to UAO and SAAO of Dinajpur Sadar Upazila for their cordial help and cooperation.

I would also like to thank my husband and younger brother for their cooperation and dedication to help me out to conduct the surveys when travelling different unions.

Last but not least, I would like to express my sincere appreciation to my parents and all of my well-wishers.

The Researcher

June 2017

LIST OF CONTENTS

CHAPTER	TITLE	PAGE NO.
	TITLE PAGE	
	APPROVAL SHEET	i
	CERTIFICATE	ii
	DEDICATION	iii
	ACKNOWLEDGEMENT	iv
	LIST OF CONTENTS	v-vii
	LIST OF TABLES	viii
	LIST OF FIGURES	ix
	LIST OF APPENDICES	ix
	ACRONYMS AND ABBREVIATIONS	x
	ABSTRACT	xi
CHAPTER I	INTRODUCTION	1-8
1.1	Background of the Study	1-2
1.2	Justification of the Study	3
1.3	Statement of the Problems	4
1.4	Specific Objectives	5
1.5	Limitation and Scope of the study	5
1.6	Assumption of the Study	6
1.7	Definitions of Terms	6-8
CHAPTER II	REVIEW OF LITERATURE	9-20
2.1	Post-Harvest Operations and Technology	9
2.2	Processing of Fruits and Vegetables	10
2.3	General Findings on Vertical Crop Diversification	11-14
2.4	Literatures Related to Relationships between Selected Characteristics of the respondent and extent of VCD	14-18
2.5	Conceptual Framework	19

CHAPTER III	MATERIALS AND METHODS	21-40
--------------------	------------------------------	--------------

3.1	Research Design	21
3.2	Locale of the Study Area	23
3.3	Population and Sample of the Study	26
3.3.1	Population of the Study area	26
3.3.2	Sampling technique and selection of sample	26
3.3.3	Distribution of the population, sample size	27
3.4	Methodological Design	28
3.4.1	Data collection methods and tools	29
3.5	Variables and their measurement techniques	30
3.5.1	Measurement of independent variables	31-36
3.5.2	Measurement of dependent variable	36
3.6	Statement of the Hypotheses	37
3.6.1	Research hypotheses	37
3.6.2	Null hypotheses	37
3.7	Data Processing and analysis Methods	38
3.8	Statistical analysis	38
3.9	Identification the problems of VCD	39

CHAPTER IV	Result and Discussion	40-52
-------------------	------------------------------	--------------

4.1	Characteristics of Selected Indicators of the Respondent	40
4.1.1	Education	40
4.1.2	Access of financial institutions	41
4.1.3	Market access	42
4.1.4	ICTs access	42
4.1.5	Non farming income	43
4.1.6	Organizational participation	44
4.1.7	Training exposure	44

CONTENTS(Contd.)		
4.1.8	Knowledge	45
4.1.9	Risk in VCD	46
4.1.10	Involvement of people in VCD	47
4.1.11	Technology use	48
4.2	Extent of VCD	49
4.3	Determinants of Vertical Crop Diversification in Dinajpur Sadar Upazilla	50
4.4	Problems Faced by Farmers during VCD	52
CHAPTER V	SUMMARY OFFINDINGS,CONCLUSION AND RECOMMENDATION	53-59
5.1	Major Findings	53
5.1.1	Selected Characteristics of the Respondents	54
5.1.2	Extent of VCD	54
5.1.3	Contribution of Selected Indicator to Extent of Vertical crop diversification	55
5.1.4	Comparative Problem Facing of Selected Items of VCD	55
5.2	Conclusion	55-57
5.3	Recommendations	58
5.3.1	Recommendations for Policy Implications	58
5.3.2	Recommendations for Further Study	59
REFERENCES		60-67

LIST OF TABLES

TABLE	TITLE	PAGE NO.
3.3.1	Population of the Study Area	26
3.2	Breakdown of surveyed respondents with their categories and number from the three unions.	27
4.1	Distribution of the respondents according to their Education	40
4.2	Distribution of the respondents according to their access to financial institutions	41
4.3	Distribution of the respondents according to their market access	42
4.4	Distribution of the respondents according to ICTS	43
4.5	Distribution of the respondents according to non-farming income	43
4.6	Distribution of the respondents according to organizational participation	44
4.7	Distribution of the respondents according to Training exposure	45
4.8	Distribution of the respondents according to their knowledge	46
4.9	Distribution of the respondents according to risk in VCD	47
4.10	Distribution of the respondents according to Involvement of people in VCD	47
4.11	Distribution of the respondents according to technology use in VCD	48
4.12	Distribution of the respondents according to extent of VCD	49
4.13	Multiple regression coefficients of contributing factors related to determinants of vertical crop diversification	50
4.14	Rank order of 7 selected problems faced by the farmers in VCD	52

LIST OF FIGURES

FIGURE	TITLE	PAGE
2.1	The Conceptual Framework of the Study	20
3.1	Flow Chart of Methodology	22
3.2	A Map of Dinajpur district showing the study area	24
3.3	A Map of Dinajpur Sadar Upazila showing the study area-Fajilpur union, Chehelgaji union, Shekhpura union	25

LIST OF APPENDICES

APPENDIX NO.	TITLE	PAGE NO.
A	An interview schedule on the study of determinants of vertical crop diversification in peri-urban area	68-73
B	Correlation Matrix	74

ABBREVIATION AND ACRONYMS

AEO	Agricultural Extension Officer
AIS	Agricultural Information Service
BBS	Bangladesh Bureau of Statistics
DAE	Department of Agricultural Extension
FAO	Food and Agriculture Organization of the United Nation
HCD	Horizontal crop diversification
ICT	Information and Communication Technology
NGO	Non-Government Organization
SPSS	Statistical Package for Social Science
SAAO	Sub- Assistant Agriculture Officer
SAU	Sher-e-Bangla Agricultural University
UAO	Upazila Agriculture Officer
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
VCD	Vertical Crop Diversification
WWW	World Wide Web

DETERMINANTS OF VERTICAL CROP DIVERSIFICATION IN PERI URBAN AREA

ABSTRACT

Vertical crop diversification (VCD) is an effective strategy for increasing income, achieving livelihood security and enhancing sustainable crop production. The objective of the study was to determine the extent of vertical crop diversification (VCD) in peri urban area' and explore the contribution of the selected characteristics of the vegetable and fruits growers and producers on the extent of vertical crop diversification (VCD) in peri urban area, i.e. a confluence of rural and urban areas. The selected characteristics were education, access to financial institutions, market access, ICTs access, non-farming income, organizational participation, training exposure, knowledge, risk in VCD, involvement of people in VCD and technology use. Data were gathered from 120 vegetable growers of nine villages under three Unions of Dinajpur Sadar Upazila under Dinajpur district by using a pre-tested interview schedule during November to December 2017. For harmonious representation of the respondents 20 percent vegetables/fruits growers were selected from each village as the sample by using simple random sampling method. Multiple regression analysis was used to estimate the contribution of the selected characteristics of the respondent on VCD. The findings revealed that highest proportion (52.5 percent) of the respondent had medium extent of VCD. Whereas 26.67 percent respondent had low extent and 20.83 percent respondent had high extent in VCD. Regression analysis found that market access (.287), technology use (.256), education (.216), and access to financial institutions (.204) were the main contributory factors to increasing the extent of VCD. Growers and producers faced high to medium problems in 'lower price of vegetables' followed by 'high price of inputs'. The findings recommended that improving market access and use modern technology can play a leading role in enhancing the extent of VCD. Moreover, to increase the benefit of VCD, useful initiatives on educating growers and producers, and improving their access to financial institutions such bank, NGOs and private organizations are required.

CHAPTER I

INTRODUCTION

1.1 Background of the study

Crop diversification is an effective strategy for enhancing sustainable crop production, increasing income and strengthening livelihood security. It leads to diversity in cropping practices and broadens the crop base in smallholder farming. Crop diversification is understood by adding more crops to the existing cropping systems resulting in an increase of cropping intensity, and diversifying cropping practices and broadening the crop base in smallholder farming (Dasgupta and Roy, 2011).

Crop diversification has beneficial effect on increasing production as well as mitigating the nutritional demand, changing food habit and minimizing environmental hazards. Crop diversification is not just about multiple cropping where farmers can grow more of the same crop, for example, intensive rice-rice, rice-wheat cropping systems, rather it promotes farmers' introduction of new crops taking into account their economic returns and other opportunities that may improve their livelihoods.

There are two approaches of crop diversification (i) horizontal crop diversification and (ii) vertical crop diversification. Horizontal crop diversification (HCD) means the broadening of the base of the system, simply by adding more crops to the existing cropping system utilizing techniques such as multiple cropping techniques coupled with other efficient management practices, for example tomatoes + onions + marigold cultivation. The systems of multiple cropping have been able to increase food production potential to over 30 t/ha, with an increase of the cropping intensity by 400-500 percent (Gunasena, 2001).

On the other hand, vertical crop diversification (VCD) is defined as expansion of post-harvest activities including processing and transformation industries to enable food crops to be sorted, graded, processed into both food and industrial products, packed, stored, and moved to domestic or export markets (Hedley, 1987). This could be illustrated by using any crop species, which could be refined to manufactured products, such as fruits, which are canned or manufactured into juices or syrups as the case may be. VCD will reflect the extent and stage of industrialization of the crop.

In other words, vertical diversification refers to the upstream and downstream activities of a particular crop or crops (Yahya, 2006). It is a long process, which starts from primary

production of raw materials, goes through primary and secondary processing and finally the finished products. This vertical form of diversification emphasizes on intra and inter-sector linkages (i.e. within and outside district) there by developing the relevant value chain. Vertical crop diversification increases income on small farm holdings. It creates new business strategy and entrepreneur practice. It also helps to develop leadership and improve livelihood and wellbeing. It increases community food security. (Dasgupta and Roy, 2011)

In vertical diversification, various downstream activities are undertaken. Here, the existing economic produce of different crops is refined and manufactured products and additional values to the produce, such as use of fruits for canned juices, syrups, jams, jellies, pickles etc. (Upmadatta, 2011).

Winters et al (2006) have identified three key factors that derive farmers demand for crop diversity: i) managing risk, ii) value addition and iii) meeting market demands and food security.

The desired level of development of vegetables has not yet been achieved because of a number of constraints like loss and damage due to transports. Due to absence of an appropriate postharvest management system, a bulk quantity of the harvested vegetable is damaged every year. Post-harvest activities include cooling, curing, sorting, grading, handling, storage, processing, wrapping, packaging, transporting and marketing. Post-harvest management is about maintaining quality from production in the paddock to the vegetables being placed on a plate for consumption. Maintaining vegetable quality requires good systems. More importantly, the lack of proper storage and marketing facilities, and seasonal glut force the farmers to sell their hard-earned produce at throw-away prices. The food and nutrition situation in Bangladesh is also fragile due to inadequate and imbalanced diet intake. Consumption of a diversified diet to meet the needs of macro and micro nutrients needs to be promoted (Bhattacharjee et al. 2007).

Maintaining vegetable quality requires better postharvest practices and good communication throughout the supply chain as each step is influenced by the previous; it is a chain of interdependent activities. Farmers produce vegetable crop, which are particularly perishable in nature; it should be brought to the consumer as quickly as possible in order to justify the market requirement. Unfortunately, often poor prepackaging and poor handling methods and marketing systems cause a high post-harvest loss of the commodity. Its quality deteriorates gradually during temporary storage, prepackaging, transport, wholesaling and retailing,

particularly when the conditions remain unfavorable and at a stage it becomes unfit for marketing or human consumption. It is estimated that a loss of nearly 25-40% of the vegetables occurs due to rough prepackaging and improper post-harvest handling, transportation and storage practices and the variation often depends on type of vegetables (Singh and Chadha, 1990).

In response to these postharvest loss and damages, the vertical crop diversification (VCD) has been an important concern of the key agricultural policy documents like National Agricultural Policy and institution such as DAE and Ministry of Agriculture. VCD has been a significant issue of the Crop Diversification Project of the DAE. The study determines key responsible factors of VCD.

1.2 Justification of the Study

Studies on different aspects (e.g., promoting strategy, adoption, and benefits) of crop diversification, particularly on horizontal crop diversification are available, Smallholders have been increasingly investing on vertical diversification as a good source of extra income, and employment and these phenomenon are noticeable in peri-urban area. Peri-urban areas mean a confluence of rural and urban. It is a transition zone which is neither rural nor urban in its characteristics and outlook. It can be described as the landscape interface between town and country or also as the rural-urban transition zone where urban and rural uses mix and often clash. It can thus be viewed as a landscape type in its own right, one forged from an interaction of urban and rural land use.

Vertical diversification mainly deals with agro processing, value addition and export of processed food. Strategic research programs for this diversification approach should focus on developing new cost-effective technologies for post-harvest waste reduction, storage, preservation, processing, and product development; and new tools for quality control and compliance. The pattern witnessed in the West, and now becoming widespread in developing countries, is for consumers to devote less and less time to food preparation. They increasingly require ready-prepared meals and labor saving packaging, such as procure salads. This provides the opportunity for farmer's to diversify into value addition, particularly in countries where supermarkets play a major role in retailing.

The post-harvest practices of fruits and vegetables scenario are quiet unsatisfactory and mostly comprise of traditional techniques practiced by the growers, traders and processors, owing to which considerable deterioration in physical and nutritional qualities of the

harvested in Bangladesh. It is estimated that the post-harvest loss of fruits and vegetables in the country is about 25-35% (Mia et al., 2008). Therefore, improvement of these indigenous practices and development of low cost new technologies through precise research efforts has now become essential to prevent the huge post-harvest losses of vegetables in view of ever increasing, demand for food and nutrition. In the development plans, considered post production phenomenon merely as a support programs and the allocated resources for this sub sector was only negligible amount of the total investment in agriculture sector. Under such situation, reduction of post-harvest losses has become the prime issue to increase the availability of vegetables at household level. However, the existing status of post-harvest handles including sorting, grading, wrapping, packaging, transportation, storage, processing and preservation of our harvested vegetables and to identify the loss reduction interventions. The experience in developed countries shows that the post-harvest losses of vegetables produce could be reduced by using technology together with appropriate selection, sorting, grading, wrapping, packaging, preservation, transportation, processing and marketing. However, the country like Bangladesh suffer much of the post-harvest losses due to a number of factors such as lack of adequate knowledge and information, the unavailability of appropriate practices under funded research and development. However, many countries in this region possess their own indigenous, inherited knowledge in the field of post-harvest practices which perhaps has been neglected in the hurry to modernize. It is high time that researcher and policy makers come together discuss the issue of post-harvest practices and develop knowledge to facilitate the exchange of available practices and information between them.

Vertical crop diversification is an established strategy; however, literature review shows there is a lack of knowledge on how to promote it, what are key factors for improving this diversification. Though this term is much unknown to the farmers and researchers it is difficult to find research on vertical crop diversification in peri urban areas in Bangladesh. Considering the stated understandings this study is designed to fulfil the research gaps.

1.3 Statement of the Problem

There are number of proven recommended technologies but not all of those are accepted by the farmers although they are intelligent and hard working. As a result a wide gap between actual achievement and achievable potential in the vegetable farming system still exists. Attainment of highest possible yields in vegetable and thereby maximum profit may be

achieved only when farmers are well equipped with required technological knowledge and needed inputs and other relevant supports and most authentically if knowledge and skills are applied correctly in the field.

Hence, a systematic research is needed to correctly estimate the levels of postharvest losses, both quantitative and qualitative (nutritional), of the commercially important fruits and vegetables in Bangladesh. Identification of technological and knowledge gaps existing in the entire value chain of vegetables is also a critical research question. On the basis of the above discussion, the researcher undertook an investigation entitled “Determinants of Vertical Crop Diversification in Peri-Urban Area.” The main purpose of the study was to determine the extent of vertical crop diversification. However, the study attempts to find out the answers to the following questions:

1. What are the important variables that describe vertical crop diversification?
2. What are the determinants of vertical crop diversification in peri-urban area?
3. What are the problems faced by the farmers in vertical crop diversification?

1.4 Specific objectives:

The following specific objectives are formulated:

1. To determine and describe some selected characteristics that promotes or hinders vertical crop diversification.
2. To determine the extent of vertical crop diversification
3. To determine the determinants of vertical crop diversification in peri-urban area.
4. To identify the problems of the farmer to adopt vertical crop diversification.

1.5 Limitations and Scope of the Study

Considering the limitations of time, money and other resources available to the researcher, the following limitations were observed throughout the study:

1. The study was confined to 9 villages of 3 unions namely fazilpur, Chehelgazi and Shekhpura of Dinajpur Sadar Upazila under Dinajpur district.
2. Population for the present study was kept confined within the heads of farm families in the study area.
3. There were many characteristics of the farmers in the study area but only 11 of them were selected for investigation.

4. For information about the study, the researcher depended on the data furnished by the selected respondents during their interview with him.
5. Facts and figures collected by the researcher applied to the situation prevailing during the year 2018.
6. Reluctance of the farmers to provide information was overcome by establishing rapport.

1.6 Assumption of the Study

The following assumptions were considered while undertaking this study

1. The respondents included in the sample were capable of furnishing proper responses to the questions included in the interview schedule.
2. The responses furnished by the respondents were reliable. They express the truth while passing their opinions and providing information.
3. The views and opinions furnished by the vegetable growers included in the sample were the representative views and opinions of all the vegetable growers of the study.
4. The researcher who acted as interviewer was well adjusted to the social and cultural environment of the study area. Hence, the respondents furnished their correct opinions without hesitation.
5. Data were normally and independently distributed with their means and standard deviation.
6. The findings of the study will have general applications to other parts of the country with similar personal, socio-economic and cultural conditions.

1.7 Definition of Terms

A researcher needs to know the meaning and contents of every term that he uses. A concept is an abstract of observed thing; events or phenomenon. It should clarify the issue as well as explain the fact to the investigator and readers. However, for clarity of understanding, a number of key concepts/terms frequently used throughout the study are defined and interpreted as follows:

Farmers: The persons who were involved in farming activities are called farmers. They participated in different farm and community level activities like crops, livestock, fisheries, other farming activities etc. In this study, vegetable growers were treated as farmers.

Peri urban area: Peri-urban area is a transition zone which is neither rural nor urban in its characteristics and outlook. The literature about the definition of peri-urban areas provides a geographical construct or defines it from a social relations perspective. Peri-urban areas are thus characterized by uncertain land tenure, inferior infrastructure, low incomes, and lack of recognition by formal governments (Hogrewe et al., 1993).

Level of education: Empirically it was defined to the development of desirable changes in knowledge, skill and attitudes in an individual through reading, writing, walking, observation and other selected activities. It was measured on the basis of classes a farmer has passed from a formal educational institution.

Access to finance: Access to finance is the ability of individuals or enterprises to obtain financial services, including credit, deposit, payment, insurance, and other risk management services. Accumulated evidence has shown that financial access promotes growth for enterprises through the provision of credit to both new and existing businesses. It benefits the economy in general by accelerating economic growth, intensifying competition, as well as boosting demand for labor. The incomes of those in the lower end of the income ladder will typically rise hence reducing income inequality and poverty. The lack of financial access limits the range of services and credits for household and enterprises. Poor individuals and small enterprises need to rely on their personal wealth or internal resources to invest in their education and businesses, which limits their full potential and leading to the cycle of persistent inequality and diminished growth.

Market access: In this study Market access refers to the ability of an individual to sell or buy goods and services into market.

Information and Communication Technologies (ICTs) access: It is referred to the exposure of respondent women to different information media through different Information and Communication Technologies that broadcast, publish and circulate in different times. Information and Communication Technologies included mobile phone, internet connection, television, Radio, computer and telephone.

Non farming income: Non farming income refers to having job other than agriculture. It may be government job, private job, business, seasonal business, labor to mill/factory/another house etc.

Organizational participation: It expresses the nature and duration of participation in different organizations.

Participation: Participation is referred to the taking part by an individual in different activities both physically and mentally. In this study participation referred to the extent of involvement in performing the household and farming activities specially post-harvest activities of vegetables and fruits.

Training exposure: Training exposure of a respondent was referred by the number of days a respondent trained on vegetable cultivation. The measurement included from the day of starting training on vegetable cultivation and till the day of data collection.

Knowledge: Knowledge is operationally defined for the purpose of this investigation as ‘those behaviors and test situations, which emphasized the remembering either by recognition or recall of ideas, material or phenomenon’. It referred to the amount of understood information possessed by the farmers on various aspects of vertical crop diversification.

Vertical crop Diversification: Vertical crop diversification (VCD) is defined as expansion of post-harvest activities including processing and transformation industries to enable food crops to be sorted, graded, processed into both food and industrial products, packed, stored, and moved to domestic or export markets.(Hedley, 1987).

Vertical diversification refers to the upstream and downstream activities of a particular crop or crops (Yahya, 2006).It mainly deals with agro processing, value addition and export of processed food (Winters et al., 2006).

In vertical diversification, various downstream activities are undertaken. Here, the existing economic produce of different crops is refined and manufactured products and additional values to the produce, such as use of fruits for canned juices, syrups, jams, jellies, pickles etc. (Upmadatta, 2011).

This thesis considered the following criteria in vertical crop diversification

1. Using packaging material (e.g. Polly bag or wet gunny bag)
2. Selling product in local market (with in Union)
3. Selling product in export market (Upazilas/Districts/Capital)
4. Using cold storage
5. Preservation(using indigenous and chemical methods)

6. Fruits manufactured into juice or syrup
7. Washing and cleaning for good quality product
8. Using heat treatment
9. Handling of modern equipment
10. Sorting and grading
11. Trimming
12. Direct supplying to chain shops in Upazilas/districts
13. Drying for storing and preservation
14. Direct supplying to industry
15. Processing of sauce, pickle and chutney
16. Curing (with smoke / adding salt) of food products.

CHAPTER II

REVIEW OF LITERATURE

Review of literature gives the clear and concise direction of the researcher for conducting the experiment. In this chapter, review of literatures relevant to the objectives of this study was presented. This was mainly concerned with 'Extent of vertical crop diversification'. There was dearth of literature with respect to this study. So, the directly related literatures were not readily available for this study. Some researchers addressed various capacities strengthening of rural women in carrying out post-harvest activities of vegetables and fruits towards food Security. A few of these studies relevant to this research are briefly discussed in this chapter.

2.1 General Findings on Vertical Crop Diversification

Swagatam et al. (2004) studied on prepackaging, storage losses and physiological changes of fresh bitter gourd as influenced by post-harvest treatments. Bitter gourds (*Momordicacharantia*) were collected immediately after harvest, transferred to the laboratory and subjected to different pre-packaging post-harvest handling treatments, consisting of (1) control; (2) perforated polyethylene bag, (3) imperforated polyethylene bag, (4) wet gunny bag, (5) polyester bag and (6) splashing of water. The physical appearance of bitter gourd (color and degree of shrinkage) at 6 days after storage (DAS) was better in perforated polyethylene and wet gunny bags.

Krumbein and Peters (2003) experimented on changes of aroma volatiles in tomato in postharvest. To ensure good flavor, it is recommended that harvesting take place at the red ripening stage. During a 10-day post-harvest period under retail and home conditions, 12 aroma volatiles and the treatable acid were found to have changed significantly in the cherry tomato Mickey when harvested at the red ripening stage. The changes detected in the flavor substances during the post-harvest period are expected to produce differences in the sensory qualities of the tomato.

Rai et al. (2002) studied on Modified Atmosphere Packaging (MAP) and its effect on quality and shelf life of fruits and vegetables. MAP is intended to create an appropriate to enhance shelf-life and to conserve the quality of the packaged produce. This review is intended to cover the important facets of MAP so that its application to a wide range of fruits and

vegetables may help in ensuring maximum returns to the producer and a long lasting quality product for the consumer.

Kamran and Syed (2002) studied to determine the effect of modified atmosphere packaging technology on post-harvest preservation of carrots. It was observed that peeling treatment, film type and days of storage had significant effect on CO₂ and O₂ percentages within bags of carrots stored at 70 C. The bags with peeled carrots contained significantly lesser CO₂ (9.4%) and more O₂ (16.1%) than non-peeled carrots (17.6% CO₂ and 14.3% O₂) during the 28-day storage period.

Effective post-harvest treatments play a key role in increasing productivity and combating food shortages. A great deal of harvested produce is still lost due to decay. The role of postharvest protection in the food chain is often underestimated. Innovative and safe solutions are vital to protect healthy fruits and vegetables in view of the ever-increasing demand for these important food commodities all year round. Modern crop protection solutions based on innovative active ingredients from Bayer crop science's portfolio make an important contribution to food quality and thus toward ensuring healthy, nutrition and safeguarding the food supply (Bayer, 2009)

Nyalala and Wainwright (1998) studied that the shelf-life of two tomato cultivars (Money Maker and Cal-J) at 4.50 C, room temperature (18-250 C) and 300 C. They found that, weight loss was significantly higher at increased temperatures, and there was an interaction between cultivar and temperature at room temperatures and 300 C. They also found that, loss of fruit firmness was greatest at the 2 higher temperatures, but there was no significant difference between the cultivars.

Sarkar et al. (1997) conducted an experiment to determine the suitable color of polythene film used to extent the shelf-life of banana cv. Giant governor. Bananas were packed (2 kg/pack) using polythene film with or without perforations, and packed in film of different colors (yellow, light yellow, red and pink). It was observed that physiological weight loss was least for fruits packed in non-perforated polythene packs, fruits remaining marketable condition up to 28 days after harvest.

Muntad (2009) reported both quantitative and qualitative losses of extremely variable magnitudes occurring at all stages in the post-harvest system from harvesting, through handling, storage, processing and marketing to final delivery to the consumer, processing and marketing to final delivery to the consumer.

Zheng et al. (1999) observed that the main factors responsible for postharvest losses were lack of proper packaging, no precooling, no proper transportation, and lack of good storage techniques. It was estimated that the postharvest losses of Chinese cabbage and oriental bunching onions after storage were 20% and 50%, respectively.

Anonymous (2005) reported that moreover, it is very regrettable that post-harvest losses of fruits and vegetables are about 30% due to the lack of proper post-harvest management and marketing system. In effect, it means that 30% of land, input and labor used to produce fruits and vegetables go to misuse.

Medagoda (2011) observed in a study that a very low percentage of total produce is consumed as a food amounting 30 percent and greater percentages, amounting to about 70 percent is lost in the form of pre and post-harvest losses. The major constraint reported in marketing were the absence of properly organized marketing structures, lack of processing plants and the poor demand in local market for jack products. An integrated approach would improve productivity, quality and income from jack cultivation contributing to poverty alleviation in the rural sector to a considerable extent.

Rashid (1998) reported that the total value of vegetables produced in Bangladesh is around Tk. 19400 million, calculated at average retail price. About 70% of the vegetables pass through the marketing channels. If the spoilage is 10%, the loss comes to Tk. 1,462 millions. These losses are due to inadequate knowledge on harvesting, carrying, packaging, transport and storage techniques. In the vegetable marketing channels, traders suffer maximum losses, because they handle and transport more quantities from one place to another than any other intermediaries.

An investigation was carried out by Yadav et al. (2007) to assess the level of knowledge of mango orchardists regarding postharvest processing and marketing practices in Saharanpur and Bulandshahr districts of western Uttar Pradesh, India. The percentages of the orchardists had knowledge on postharvest management and grading were 52.13 and 51.06%, respectively. Most of the orchardists were not familiar with storage of fruits after harvesting (60.64%).

Patil (2008) found that 'Higher the value addition better the post-harvest management and lower will be losses'. He also mentioned some reasons for losses such as handling of raw produce through many stages of middlemen, processing is mostly controlled by urban rather than rural entrepreneurs which leads to losses in valuable by products, non-availability of

adequate and efficient equipment and machinery to be used in catchment areas, low level of entrepreneurial urge in rural 35 areas due to constraints of finance, assured market and proper training on technology and on the whole, there exists a fragmented and inefficient value chain.

Paull (1993) reported that estimates of postharvest losses of fruits and vegetables vary widely both in the developed and developing countries.

The contribution of vegetables remains extremely important for ensuring food and nutritional security in Bangladesh. Horticultural crops in Bangladesh cover an area of 873 thousand hectares with a total production of 110 lakh metric tons (BBS, 2009).

The major vegetable growing areas of Bangladesh are Jessore, Bogra, Comilla, Chittagong, Khulna, Kushtia, Dhaka, Tangail, Rangpur, Rajshahi and Dinajpur and a major part of the vegetables produced in this area are transported to the capital or other cities as soon as possible through different marketing channels (Ahmed, 1992; Hossain, 2000).

2.2 Literatures Related to Relationships between Selected Characteristics of the respondent and extent of VCD

2.2.1 Level of education and the extent of VCD

Rahman (2006) observed in his study that education level of the farmers had significant and positive relationship with the extent of VCD.

Islam (2005) in his study explored that education level of the farmers had significant positive relationship with the extent of knowledge on IPM in crop production.

Rahman (2004) in a study found that level of education of the farmers had significant and positive relationship with the extent knowledge on boro rice production.

Hossain (2003) found that with increased level of education of the farmers, there was a corresponding extent the level of modern Boro rice farmers.

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

Farhad (2003) found that the education of the rural women farmer had significant and positive relationship with the extent of knowledge in using IPM in vegetable cultivation.

Sana (2003) showed that education of the respondents had positive relationship with the extent of knowledge in shrimp cultivation.

Sutradhar (2002) revealed that academic qualification of the respondents had a significant positive relationship with the extent of awareness on environmental degradation.

Uddin (2001) reported that education of the BSs had significant relationship with their opinion on environmental hazards and associated problems due to continuous and intensive rice farming.

Hossain (2000) found that education of the respondents had significant positive relationship with the extent knowledge on Binadhan-6.

Hanif (2000) found that in his study there was a positive significant relationship between education of the respondents and the extent of awareness on environmental pollution.

Sarkar (1999) revealed that the level of education of the farmer had significant positive relationship with the perception on environmental degradation.

Hossain (1999) found that education of the farmers had significant positive relationship with the extent of awareness on environmental degradation.

Islam et al. (1988) observed that education of the farmers had significant positive relationship with the extent of awareness on environmental pollution.

Hamid (1997) found that education of the farmers had positive relationship with the awareness on environmental pollution in both cases of the progressive and less progressive village.

Miah and Rahman (1995) found that the level of education of the farmers had positive significant relationship with the extent of awareness on farming environment.

Parveen (1995) found that the level of education of the farm women had a significant positive relationship with the extent of knowledge on the use of fertilizer, pesticides and irrigation water.

2.2.2 Access of Financial Institutions and the extent VCD

Marsh and Coleman (1995) after conducting a study at Washington found that there was a significant relationship between access to finance and adoption behavior of the farmers.

Afrad (2002) found that the access to finance of the respondents had significant relationship with their attitude towards vegetable cultivation.

2.2.3 Market Access and the extent of VCD

Islam (2007) found that market access had a significant positive relationship with extent of BRRi dhan production technologies by the farmers.

Islam (2002) found that majority of respondents marketed more than 75% of their total vegetables while they opted the rest for their own consumption.

Marsh and Coleman (1995) after conducting a study at Washington found that there was a significant relationship between value of products sold and adoption behavior of the farmers.

Afrad (2002) found that market access of the respondents had significant relationship with their attitude towards vegetable cultivation.

Raj and Knight (1977) conducted a research on the influence of farm practices attributes on innovation decision process by the farmers of Dharmapuri district in Tamilnadu, India. They found that profitability was significantly correlated with the adoption of recommended farm practices. They defined profitability as the amount of production cost compared with sold cost. So, profitability as use by them is synonymous with the commercialization of the present study.

Ahaduzzaman (1999) conducted a study on the adoption of modern T. Aman technologies among the rice growers in Sadar Thana of Rangpur District. He found that market access of the farmers had no significant and positive relationship with the extent of modern T. Aman technologies.

2.2.4 ICTs use and the extent of VCD

Roy (2006) found in his study that mass media and ICTs had a great contribution to adopt rice cultivation.

Islam (2005) found that mobile phone, radio, television and from which farmer got any farm information had a positive and highly significant relationship with extent to adopt any type of technology.

2.2.5 Non Farming income and the extent of VCD

Islam (2008) found that non farming income had no positive and substantial significant relationship with extent of any post-harvest activities.

2.2.6 Organizational participation and the extent of VCD

Rahman (2004) found in his study that organizational participation of the farmers had no significant relationship with the extent of any post-harvest activities.

Hossain (2003) found that organizational participation of the farmers was not significantly related to farmer's knowledge on extent modern Boro rice cultivation practices.

Farhad (2003) found that organizational participation of rural women farmer had no significant relationship with the extent of using IPM in vegetable cultivation.

Sutradhar (2002) found that organizational participation of the respondents had a significant positive relationship with the awareness on environmental degradation.

2.2.7 Training exposure and the extent VCD

Islam (2008) found that training on vegetable cultivation had a positive and substantial significant relationship with the extent of vegetables production activities by woman members in homestead area under world vision project.

Sana (2003) found that training received of the farmers had a positive significant relationship with the extent of shrimp culture.

Hossain (2001) found that the length of the training of the respondents had positive relationship with the extent of knowledge on crop cultivation.

Mannan (2001) in his study found that the training received by the farmers had a positive significant relationship with the extent of knowledge on food and nutrition.

2.2.8 Knowledge and extent of VCD

Roy (2006) found in his study that agricultural knowledge of the farmers had a significant relationship with the extent of boro rice cultivation. Similar results were observed by Khan (2005), Islam (2005) and Rahman (2004) in their respective studies.

Akhter (2003) found in his study that the agricultural knowledge of the farmers had a significant relationship with the extent of agricultural activities. Hossain (2003) reported that agriculture knowledge of the farmers was related to extent of modern Boro rice cultivation practices.

Sana (2003) found that agriculture knowledge of the farmers was related to the extent of shrimp culture.

Farhad (2003) concluded that knowledge of the rural women farmers had significant positive relationship with the extent of using IPM in vegetable cultivation.

Sutradhar (2002) revealed that the knowledge of the respondents had a relationship with their awareness on environmental degradation.

2.2.9 Risk and extent of VCD

Rahman (2009) revealed that problems faced by respondents had a negative contribution in extent of vertical crop diversification.

Azad (2013) found that problems faced by the respondent in post-harvest practice had negative relationship with the extent of vertical crop diversification.

2.2.10 Involvement of people in VCD and extent of VCD

Rahman (2009) found in his study that involvement of woman in post-harvest activities had a positive and significant relationship with extent post-harvest practice.

2.2.11 Technology use and Extent of VCD

Swagatam et al. (2004) studied on prepackaging, storage losses and physiological changes of fresh bitter melon as influenced by post-harvest treatments and found a significant relationship with extent post-harvest activities.

Kamran and Syed (2002) found that on his study that adoption of modern technology had a positive and significant relationship with the extent of post-harvest activities.

2.3 Conceptual Framework of the Study

In scientific research, selection and measurement of variables constitute an important task. The hypothesis of a research when constructed properly contains at least two important elements i.e. a dependent variable and an independent variable. A dependent variable is that factor which appears, disappears or varies on the researcher introduces, removes or varies as the independent variables. An independent variable is that factor which is manipulated by the researcher in this attempt to ascertain its relationship to an observed phenomenon. A simple conceptual framework for the study is shown in Figure 2.1

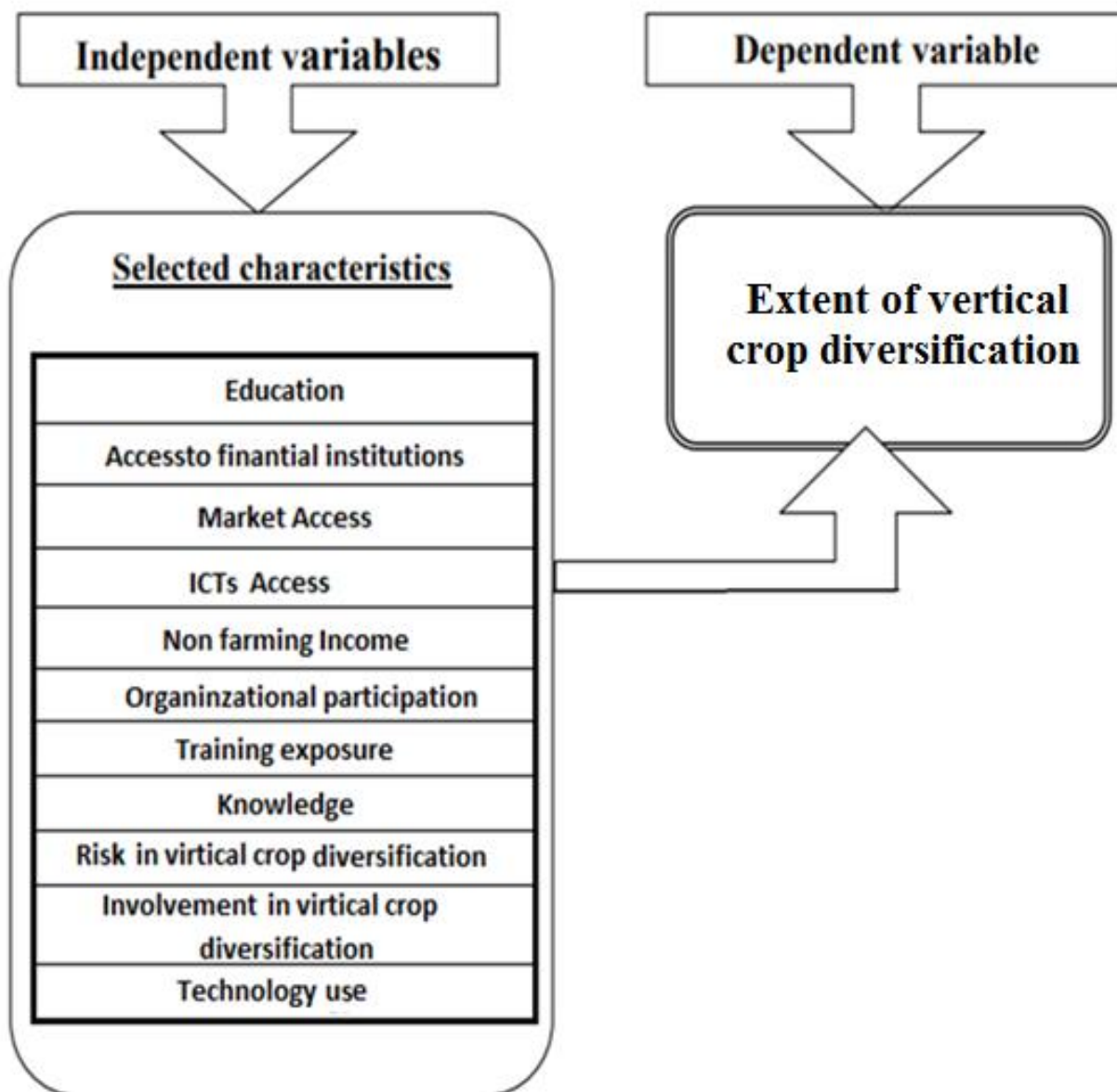


Figure 2.1 The Conceptual Framework of the Study

CHAPTER III

MATERIALS AND METHODS

In any research, methodology deserves a careful consideration. The purpose of this Chapter is to describe the methods and procedures followed in conducting the present study. Methodology should be such that it would enable the researcher to collect valid and reliable information and analyze those data to arrive at reliable decision. The method should be preferred considering the limitation of time and personnel. Keeping this in mind the researcher took utmost care of using proper method in all aspects of this investigation.

3.1 Research Design

A research design is detailed plan of investigation. It is the blueprint of the detailed procedure of testing the hypothesis and analysis of the obtained data. The research design followed in this study was ex-post facto, because of uncontrollable and non-manipulating variables. This is absolute descriptive and diagnostic research design. A descriptive research design is used for fact findings with adequate interpretation. Diagnostic research design, on the other hand, is concerned with testing the hypothesis for specifying and interpreting the relationship of variables.

3.2 Locale of the Study Area

The locale of the study included in 9 villages namely Raniganj, Balapara, Maheshpur, Gopalpur, vattpara, Rajrampur, Gopalganj, Chandganj and Jamtoli under 3 union namely Fajilpur, Shekhpara and Chehelgazi of Dinajpur Sadar Upazila under Dinajpur district. Peri-urban area is a transition zone which is neither rural nor urban in its characteristics and outlook. The literature about the definition of peri-urban areas provides a geographical construct or defines it from a social relations perspective. Peri-urban areas are thus characterized by uncertain land tenure, inferior infrastructure, low incomes, and lack of recognition by formal governments (Hogrewe et al., 1993)

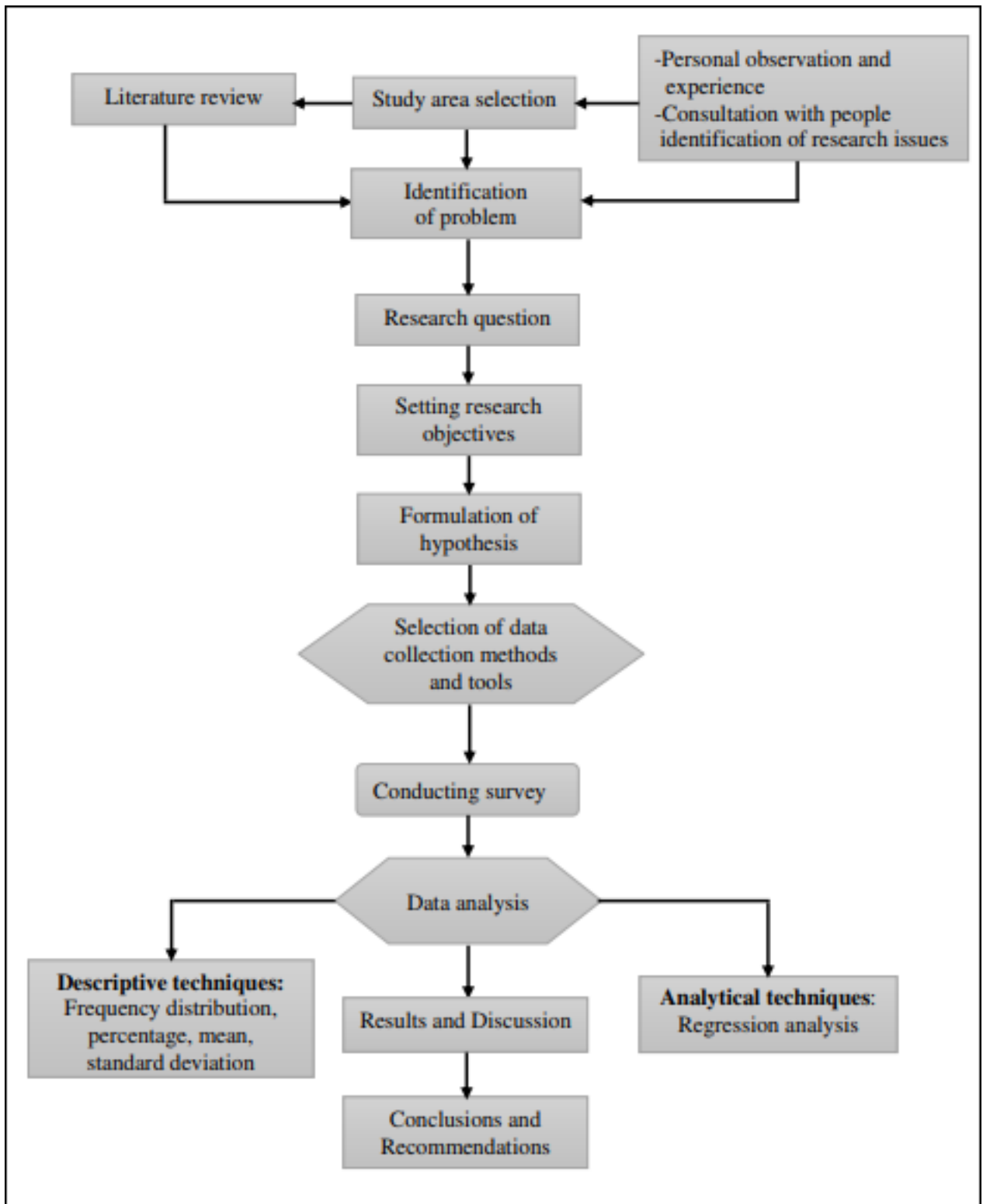


Figure 3.1 Flow Chart of Methodology



Figure 3.2 A Map of Dinajpur district showing the study area.

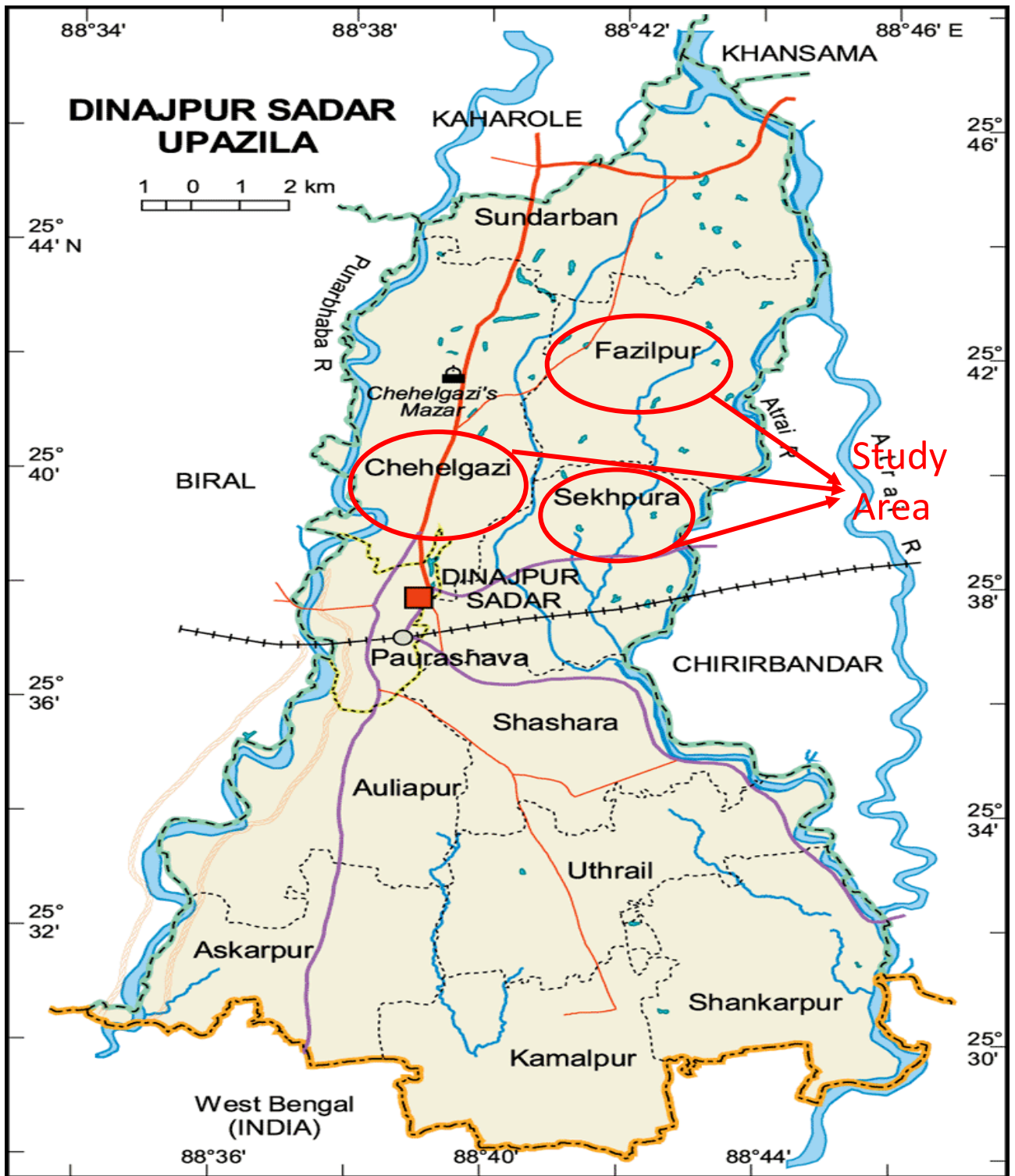


Figure 3.3 A Map of DinajpurSadarupazila showing the study area-Fajilpur Union, Chehelgazi Union, Shekhpura Union.

3.3 Population and Sample of the Study

People involve in vegetable and fruits cultivation as well as postharvest activities for increasing income and food security of three unions of Dinajpur Sadar Upazila under Dinajpur district was the population of the study. However, representative sample from the population were taken for collection of data following random sampling technique. In this technique, each member of the population has an equal chance of being selected as subject. The entire process of sampling is done in a single step with each subject selected independently of the other members of the population. Updated lists of all the farmers of the selected areas were prepared with the help of local leaders, Sub Assistant Agriculture Officer (SAAO) and Agriculture Extension Officer (AEO) in Dinajpur district.

Dinajpur district was selected purposively but the upazila, unions and nine villages from three unions were selected by using simple random sampling technique. 600 farmers from different 9 villages of 3 unions namely Fazilpur, Sekhpura and Cehelgazi under Dinajpur district which constituted the population of the study. The population of the study which is shown in the following table 3.3.1.

3.3.1 Population of the study area

Name of the selected upazila	Name of the selected Unions	Number of the respondents
Dinajpursadar	Fazilpur	220
	Sekhpura	200
	Cehelgazi	180
Total		600

3.3.2 Sampling technique and selection of sample

There are several methods for determining the sample size; here, Researcher used Yamane's (1967) formula for study group

$$n = \frac{z^2 P(1-P)N}{z^2(1-P) + N(e)^2}$$

Where,

n = Sample size;

N, Population size = 600;

e, The level of precision = 5%;

z = the value of the standard normal variable given the chosen confidence level (e.g., z = 1.96 with a confidence level of 95 %)

And P, The proportion or degree of variability = 50%;

The sample size (n) is = 120.

3.3.3 Distribution of the population, sample size and reserve list size:

According to Yamane's formula, the respondents comprised of 120 farmers. The respondent of the villages were measured according to the proportionate of the total sample size (120) which was calculated using Yamane's (1967) formula. The distribution of the population, the number of sample size and number of respondents are given in the following Table 3.2.

Table 3.2 Breakdown of surveyed respondents with their categories and number from the three unions.

Selected Upazila	Selected Union	Selected Villages	Respondent	Sample no.	Reserve list
DinajpurSadar	Fajilpur	Raniganj	75	15	2
		Balapara	67	14	1
		Maheshpara	78	16	2
	Sekhpura	Gopalpur	70	14	2
		Vattpara	65	13	2
		Rajrampur	65	13	1
	Cehelgaji	Gopalganj	62	12	2
		Chandganj	55	11	2
		Jamtoli	63	12	1
Total			600	120	15

3.4 Methodological design

There are different types of quantitative and qualitative approaches available for data collection, and each approach is suitable for a particular situation and purpose. Qualitative methods are appropriate when the phenomena of the study are complex and social in nature and little pre-informative exists (Liebscher, 1998). Participatory research methods are useful when the respondents are mostly illiterate and unable to provide information through a structured set of questions. Both quantitative and qualitative approaches have their strengths and weaknesses and the possibilities of integrating both perspectives are characteristic for complex social studies (Bannan-Ritland, 2003).

Begley (1996) expresses the view that the final choice of method should depend on the research questions to be answered. However, the constraints of time and resources and the researcher's particular skills may also influence the decision. It is therefore important to be able to identify and understand the research approach suitable for any given study because the selection of a research approach influences the methods chosen, the statistical analyses used, the inferences made and the ultimate goal of the research (Creswell, 1994). Furthermore, according to Bryman (2001) an area can be explored in two ways, with an unstructured approach to data collection in which participants' meaning are the focus of attention, and more structured approach of quantitative research to investigate a specific set of issues. A method is used to analyze a given phenomenon, with information coming from different methods, researchers, places and time, and opinions (Denzin, 1978).

There are different scenarios for combining qualitative and quantitative methods (Tashakkori and Teddlie, 2003). Some of these are

- a. Qualitative measures to develop quantitative tools;
- b. Qualitative methods to explain quantitative results;
- c. Quantitative methods to enlarge on a qualitative study; and
- d. Qualitative and quantitative methods equal and parallel.

According to Bryman (2001) qualitative research can be used to improve the design of survey questions for structured interviewing. This study employs both quantitative and qualitative techniques to explore the factors and underlying facts influencing farmer's livelihood. Thus, two kinds of data were obtained: qualitative data on the general perspectives of the people studied; and quantitative data that allow exploring specific issues in which the researcher was interested. In selecting a suitable approach for the present study,

the merits and demerits of various methods were considered and an integrated approach was chosen based on the complexity and sensitivity of the research subject matter. The principal purpose of the current research is to identify the factors influence determinant of vertical crop diversification.

3.4.1 Data collection methods and tools

3.4.1.1 Data collection methods

The survey method was used to collect quantitative data that allow to answer the research questions framed and to gain an understanding of the factors influence sustainable access to rural financial services. Individual interviews were used in the survey and were conducted in a face-to-face (Bryman, 2001) situation by the researcher. This method is useful to get unanticipated answers and to allow respondents to describe the world as they really see it rather than as the researcher does (Bryman, 2001)

3.4 .1.2 Period of survey

For the present study, data collection was started in November 1, 2017 and completed within 60 days. Collection of reasonable and reliable data from the field is not an easy task. After the schedule was finalized, the researcher herself collected necessary primary data through personal interview with individual farmer. Before starting the interview, each respondent was given a brief description about the nature and purpose of the study. Then the questions were asked in the simple manner with explanation however necessary. The information supplied by the farmer was recorded directly on the interview schedules. The interviewees were requested to provide correct information as far as possible.

3.4.1.3 Preparation of the survey schedule and pre-testing

The survey schedule was carefully prepared to record the required data of various aspect of the study. In order to collect desired information, a draft survey schedule initially was carefully prepared in conformity with the objectives of the study. Then it was pre tested in the study area among some respondents of the study area. Some parts of the draft schedules were improved, rearranged and modified in the light of actual and practical experiences gathered in pre-testing and then the final schedule was developed with a logical sequence so that the respondents could give the adequate and accurate information.

3.4.1.4 Data collection tools

Structured interview schedules were used to reach the objectives of the study. A structured interview schedule was prepared containing open (e.g. education, market access, ICTs, training exposure) and closed (e.g. access to financial institution, non-farming income, Organizational participation, knowledge, risk, involvement of people in VCD, technology) questions. The open questions allowed for the respondents to give answers using their own language and categories. The questions in this schedule were formulated in a simple and unambiguous way and arranged in a logical order to make it more attractive and comprehensive. The survey tools were initially constructed based on an extensive literature reviews and pre-tested. The schedule was pretested with 15 randomly selected rural people in the study area. 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 pre-test. The questionnaires were also checked by Supervisor and other Teacher of Dept. of AEIS at Sher-e-Bangla Agricultural University (SAU). Finally, based on background information and the pre-test, the interview schedule was finalized. Data was gathered by the researcher personally. During data collection, necessary cooperation was obtained from local leaders, Sub Assistant Agriculture Officer (SAAO) and Agriculture Extension Officer (AEO).

3.5 Variables and their measurement techniques

The variable is a characteristic, which can assume varying, or different values in successive individual cases. A research work usually contains at least two important variables viz. independent and dependent variables. An independent variable is that factor which is manipulated by the researcher in his/her attempt to ascertain its relationship to an observed phenomenon. A dependent variable is that factor which appears, disappears or varies as the researcher introduces, removes or varies the independent variable (Townsend, 1953). In the scientific research, the selection and measurement of variable constitute a significant task. Based on literature review, 11 variables were selected. The independent variables were: education, access to financial institution, market access, ICTs, non-farming income, organizational participation, training exposure, knowledge, risk, involvement of people in vertical crop diversification and technology. The dependent variable of this study was the 'extent of vertical crop diversification'. The methods and procedures in measuring the variables of this study are presented below:

3.5.1 Measurement of independent variables

The 11 characteristics of the respondents mentioned above constitute the independent variables of this study. The following procedures were followed for measuring the independent variables.

3.5.1.1 Education

Education was measured by assigning score against successful years of schooling by a respondent. One score was given for passing each level in an educational institution (Roy et al, 2014). For example, if a respondent passed the final examination of class five or equivalent examination, his/her education score has given five (5). Each respondent of can't read & write has given a score of zero (0). A person not knowing reading or writing but being able to sign only has given a score of 0.5. If a respondent did not go to school but took non-formal education, his educational status was determined as the equivalent to a formal school student. This variable appears in item number 2 in the interview schedule as presented in Appendix-A. Based on the available information cited by the women, they were classified into five categories.

Category	Education(year of schooling)
Can't read & write	0
Can sign only	0.5
Primary	1-5
Secondary	6-10
Higher secondary	11-12
Above higher secondary	>12

3.5.1.2 Access to financial institute

Financial institution is the private (shareholder-owned) or public (government-owned) organizations that, broadly speaking, act as a channel between savers and borrowers of funds (suppliers and consumers of capital). Two main types of financial institutions (with increasingly blurred dividing line) are: (1) depository banks and credit unions which pay interest on deposits from the interest earned on the loans, and (2) non-depository insurance companies and mutual funds (unit trusts) which collect funds by selling their policies or shares (units) to the public and provide returns in the form periodic benefits and profit

payouts.

Here 10 accesses to financial institute are selected for the study and the score of a respondent could range from 0 to 20 ($10 \times 2 = 20$), where zero indicated no financial access and 20 indicated highest level of financial access. This variable appears in item number 2 (two) in the interview schedule as presented in Appendix-A.

Based on the available information cited by the respondents, they were classified into three categories.

Categories	Score
Sustained access	2
Intermittent access	1
No access	0

3.5.1.3 Market access

Market access refers to the capability of an individual to sell goods and services in the market (FAO, 2015). There are two categories of market access: buying and selling. For each category: 1= yes; 0= no. If yes, the right answer (product name) receives 1 point. A score of one (1) was assigned for each of product buying and selling of a respondent. Thus, 7 items are selected as market access for the study and the score of a respondent could range from 0 to 14 ($7 \times 2 = 14$), where zero indicated no market access and 14 indicated highest level of market access. This variable appears in item number 3 (three) in the interview schedule as presented in Appendix-A.

Based on the available information cited by the respondents, they were classified into three categories (Mean \pm Standard Deviation) namely 'low', 'medium' and 'high' market access.

3.5.1.4 Information and Communication Technologies (ICTs) access

Information and communication technologies access refers to the access to technologies that provide information through telecommunications. It was similar to Information Technology (IT), but focused primarily on communication technologies (Roy, 2015). This included the internet, wireless networks, cell phones, and other communication mediums. Six selected technologies were counted to measure the Information and Communication Technologies (ICTs) access. If he/she uses then receive a score 1 otherwise 0. In the same way if he/she have owns then receive 1 point otherwise 0. And for open question receive max. 1 score for

suitable answer. Thus, Information and Communication Technologies (ICTs) access score of a respondent could range from 0 to 18, where zero indicated no Information and Communication Technologies (ICTs) access and 18 indicated highest level of Information and Communication Technologies (ICTs) access. This variable appears in item number 04 (four) in the interview schedule as presented in Appendix-A.

Based on the information cited by the respondents, they were classified into three categories (Mean \pm Standard Deviation) i.e. 'low use', 'medium use' and 'high use' Information and Communication Technologies (ICTs).

3.5.1.5 Non farming income

Non-farm income refers to the portion of farm household income obtained off the farm, including nonfarm wages and salaries, pensions, and interest income earned by farm families. For examples; do you have any income source other than agriculture? 1= „yes“; 0 = „No“. If yes, then involvement in each activity signifies 1 point. Thus non farming income score of a respondent could range from 0 to 7, where zero indicated no non farming income and 7 indicated highest level of non-farming income. This variable appears in item number 5 (five) in the interview schedule as presented in Appendix-A.

Based on the available information cited by the respondents, they were classified into three categories (Mean \pm Standard Deviation) namely 'low', 'medium' and 'high'.

3.5.1.6 Organizational participation

Organizational participation of a respondent was measured on the basis of the nature of her/his involvement and duration of participation in different organizations. Organization participation was operationalized by using the following formula (Afique, 2006).

Organizational participation score = $\Sigma (A \times D)$ Where,

A= Activities score, D= Duration score

Activities score were assigned in the following manner

Duration of participation	Score assigned
No participation	0
Ordinary member	1
Executive member	2
President/secretary	3

Duration scores were assigned in the following manner

Nature of participation	Score assigned
No participation	0
Participated up to 3 years	1
Participated from 4-5 year	2
Participated above 6 years	3

Organizational participation score of a respondent was obtained by summing scores of the organizations according to the above mentioned formula for her activities in the respective organization. The variable appears in the question no. 6 of the interview schedule of Appendix-A.

3.5.1.7 Training exposure

Training exposure was computed by total number of days a respondent attended in different training programs in her /his life from different organizations (Akter, 2003). A score of 1 (one) was given to a respondent for attend training for one day. A zero (0) score was assigned for no training exposure. This variable appears in the question no. 8 of the interview schedule (Appendix-A).

3.5.1.8 Knowledge

The knowledge of the respondent was measured by asking 10 selected questions and each of the questions was assigned 2(two) scores. Appropriate answer was given full marks and partial answer was partially marked, whereas wrong answer was given zero (0).The agricultural knowledge score could range from 0 to 20.Where zero (0) indicated very poor knowledge and 20 indicate very high knowledge.

Based on the archived score respondents were categorized into low knowledge, medium knowledge and high knowledge.

3.5.1.9 Risk in VCD

Risk in vertical crop diversification measured by knowing from the respondent which problems they are faced during vertical crop diversification. Problem is a situation, matter, or person that presents perplexity or difficulty. It is negative situation that a farmer faces in his farming. (Azad.J 2013).As 7 risk items are selected for the study, the score is ranged from 0 to 21.Where zero (0) means there have no risk and 21 means there have high risk in vertical crop diversification. This variable appears in item number 9 (nine) in the interview schedule as presented in Appendix-A.

Based on the available information cited by the respondents, they were classified into four categories (Mean \pm Standard Deviation) namely 'not at all', low, 'medium' and 'high'.

3.5.1.10 Involvement in VCD

To measure the extent of involvement in VCD , three dimensions of participation namely (i) frequency of performance, (ii) part of work done, and (iii) control over decision (Hasan, 2006) were used as shown in the interview schedule in item no. 10 (Appendix-A). The first dimension included involvement, the second ensured action, and the last dimension covered the psychological aspect of involvement. Each of the dimensions was quantified separately with four-point rating scale against 10 broad categories of VCD of selected vegetable or fruit. (Rahman 2009)

Frequency of performance, the first dimension of involvement, was defined as the regularity of performing certain post-harvest activities. Scores were assigned to the column of frequency of performance for respondent on the basis of responses furnished by subjects in such a way that 0 (zero) was assigned for 'not at all', 1 for 'rarely', 2 for 'sometimes' and 3 for 'regularly/frequently'.(Rahman 2009)

The second dimension of involvement, part of work done, was defined as how much amount of work done by the respondent regarding the selected VCD. (Rahman 2009)

The scores were made in the following way

Part of work done	Score
Not at all	0
less than half of requirement	1
More than half of the requirement	2
Completely	3

In accordance with the third dimension, control over decision, was measured on the basis of decision taken by the respondent in a family. Scores were made in the following way:

	Score
Absolutely no decision by self	0
Shared decision mainly by others	1
Shared decision mainly by self	2
Full decision by self	3

3.5.1.11 Technology Use

Technology refers to methods, systems, and devices which are the result of scientific knowledge being used for practical purpose. As 6 technologies are selected for the study, the score of technology use ranged from 0 to 12(6x2=12). Where zero (0) means there have no use of technology and 12 means there completely use of technology. This variable appears in item number 11 (eleven) in the interview schedule as presented in Appendix-A.

Based on the available information cited by the respondents, they were classified into three categories

Categories	score
Completely	2
Partially	1
No use	0

3.5.2 Measurement of dependent variable

3.5.2.1 Extent of vertical Crop Diversification

Factors influence extent of vertical crop diversification is the dependent variable of this study. To measure this extent the researcher applied 5 -point Likert scale. The method of assigning scores of each statement was as follows

Impact/changes	Score assigned
A great deal of	4
Quite a lot	3
Moderate	2
very few	1
Not at all	0

Eighteen selected items were counted to measure the extent of VCD. Thus, extent of VCD score of a respondent could range from 0 to 72, where zero indicated no extent of VCD and seventy two indicated highest level of extent of VCD. This variable appears in item number 12 (twelve) in the interview schedule as presented in Appendix-A.

Based on the available information cited by the respondents, they were classified into three categories, namely-Low, medium and high.

3.6 Statement of the Hypotheses

As defined by Goode and Hatt (1952) a hypothesis is “a proposition which can be put to test to determine its validity. It may seem contrary to, or in accord with common sense. It may prove to be correct or incorrect. In any event, however, it leads to an empirical test.”

3.6.1 Research hypotheses

In the light of the objectives of the study and variables selected, the following research hypotheses were formulated to test them in. The research hypotheses were stated in positive form, the hypotheses were as follows: “Each of the selected characteristics of the farmers had contribution to their knowledge on postharvest practices of vegetable.”

3.6.2 Null hypotheses

In order to conduct statistical tests, the research hypotheses were converted to null form. Hence, the null hypotheses were as follows: “Each of the selected characteristics of the farmers had no contribution to their knowledge on postharvest practices of vegetables.”

3.7 Data processing and analysis methods

Bogdan and Biklen (2006) insisted that data analysis is an on-going part of data collection. Initially, all collected data were carefully entered in Microsoft Excel. Exported data were checked randomly against original completed interview schedule. Errors were detected and necessary corrections were made accordingly after exporting. Further consultation with research assistants and in some cases with the community people were required. Finally, data were exported from the program Microsoft Excel to SPSS/windows version 15.0, which offered statistical tools applied to social sciences. Qualitative data were converted into quantitative numbers, if required, after processing, scaling and indexing of the necessary and relevant variables to perform subsequent statistical analysis for drawing inferences.

As outlined earlier, there were many different forms and methods that could be used to analyze both quantitative and qualitative data in accordance with the objectives of the study. Both descriptive and analytical methods were employed in order to analyze the data. Descriptive techniques had been used to illustrate current situations, describe different variables separately and construct tables and graphs presented in results. These included: frequency distribution, percentage, range, mean, and standard deviation. In most cases the opinions of respondents were grouped in broader categories. Analytical techniques had been utilized to investigate the contribution of the selected characteristics of the respondents to their sustainable access to rural financial services. Statistical test like regression was used in this study. Each statistical technique is used under specific conditions and depends on the measurement scale of different variables.

3.8 Statistical analysis

Regression analysis was used to identify the linear combination between independent variables used collectively to predict the dependent variables (Miles and Shevlin, 2001). Regression analysis helps us understand how the typical value of the dependent variable changes when any one of the independent variables is varied, while the other independent variables are held fixed. Ordinary Least Squares (OLS) is used most extensively for

estimation of regression functions. The factors that contribute to the extent of VCD by the respondents are analyzed using a regression model. The overall quality of fit of the model has been tested by ANOVA specifically F and R² test. The data were analyzed in accordance with the objectives of the proposed research work.

The factors that contribute to the sustainable access to rural financial services by the respondents are analyzed using a regression model, multiple regression analysis (B) was used. Throughout the study, five (0.05) percent and one (0.01) percent level of significance were used as the basis for rejecting any null hypothesis. If the computed value of (B) was equal to or greater than the designated level of significance (p), the null hypothesis was rejected and it was concluded that there was a significant contribution between the concerned variable. Whenever the computed value of (B) was found to be smaller at the designated level of significance (p), the null hypothesis could not be rejected. It was concluded that there was no contribution of the concerned variables. The model used for this analysis can be explained as follows:

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10} + b_{11}x_{11} + e;$$

Where, Y= is the sustainable access to rural financial services;

Of the independent variables, x₁ is the education of respondent, x₂ is access to financial institute, x₃ is market access, x₄ is ICTs, x₅ is non-farming income, x₆ is organizational participation, x₇ is training exposure, x₈ is knowledge, x₉ is risk, x₁₀ is involvement of people in VCD, x₁₁ is technology. On the other hand, b₁, b₂, b₃, b₄, b₅, b₆, b₇, b₈, b₉, b₁₀ and b₁₁ are regression coefficients of the corresponding independent variables, and e is random error, which is normally and independently distributed with zero mean and constant variance.

3.9 Identification the problems of VCD

Seven problems were selected for the study by review of literature and consultation with supervisor and relevant experts. The respondents were asked to respond to four alternative responses as ‘high problem’, ‘medium problem’, ‘low problem’ and ‘not at all’ for each of seven selected problems. Scores were assigned to those alternative responses as 3, 2, 1, and 0, respectively. Score for particular problem was measured by Problem Faced Index (PFI) as follows:

$$PFI = (P_s \times 3) + (P_m \times 2) + (P_l \times 1) + (P_n \times 0)$$

Where, PFI = Problem Faced Index

P_s = Number of respondents faced severe problem

P_m = Number of respondents faced moderate problem

P_l = Number of respondents faced little problem

P_n = Number of respondents faced no problem

Chapter IV

Result and Discussion

The recorded observations in accordance with the objective of the study were presented and probable discussion was made of the findings with probable justifiable and relevant interpretation under this chapter. The findings of the study and their interpretation have been presented in this chapter.

4.1 Characteristics of selected indicators of the respondent

Behavior of an individual is determined to a large extent by one's personal indicator. There were various indicators of the respondent that might have consequence to extent vertical crop diversification. But in this study, twelve indicators of them were selected as variables, which included education, access to financial institutions, market access, ICTs ,Non farming income, Organizational participation, Training exposure ,Knowledge, Risk, Involvement of people in VCD, Technology, Extent of VCD that may be greatly influenced the determinants of vertical crop diversification in peri- urban area.

4.1.1. Education

Education level of the respondents ranged from 0 to 16 with the mean and standard deviation of 8.01 and 4.31 respectively. According to Education level the respondents were classified into four categories (Mean \pm Standard Deviation) namely- no education, primary, secondary and higher secondary category. Based on educational status the distribution of the respondents is presented I Table 4.1.

Table 4.1 Distribution of the respondents according to their Education

Category	Range(score)		Beneficiaries		Mean	SD
	Score	Observed	Number	Percent		
No education	0	0-16	13	10.83	8.01	4.31
Primary	1-5		36	30		
Secondary	6-10		40	33.33		
Higher secondary	11-16		9	7.5		

Table 4.1 shows that respondents under secondary education category constitute the highest proportion (33.33 percent) followed by primary education (30 percent). On the other hand, 10.83 percent respondent have no formal education. Very few of them can sign only. But 7.5 percent respondents were above secondary category. Some of them possess graduate and master's degree. Education broadens the horizon of outlook of respondents and expands their capability to analyze any situation related to confrontations against vertical crop diversification. To adjust with same, they would be progressive minded to confront against vertical crop diversification.

4.1.2 Access to Financial Institutions

The observed score of access to financial institution ranged from 0 to 12 against the possible scored ranged from 0-20 with a mean and standard deviation of 5.57 and 2.16, respectively. On the basis of access to financial institute the respondents were classified into three categories namely no access, intermittent access and sustained access. The distribution of respondents according to their financial institutions access is presented in Table 4.2.

Table 4.2 Distribution of the respondents according to their access to financial institutions

Category	Range(score)		Beneficiaries		mean	SD
	Score	Observed	Number	Percent		
No Access	<5	0-12	46	38.33	5.57	2.16
Intermittent access	5-8		65	54.17		
Sustained access	>8		9	7.5		

Data revealed that the respondent having intermittent access to financial institutions constitute the highest (54.57 percent), while the lowest access to financial institutions in sustained access category (7.5 percent) followed by no access (38.33 percent). Overwhelming majority (54.17 percent) respondent have no access to intermittent access of financial institutions.

4.1.3 Market Access:

The observed score of market access ranged from 6 to 12 against the possible score ranged from 0-14 with a mean and standard deviation of 8.45 and 1.66, respectively. On the basis of market access the respondents were classified into three categories (Mean \pm Standard Deviation) namely low market access, medium market access and high market access. The distribution of respondents according to their market access is presented in Table 4.3

Table 4.3 Distribution of the respondents according to their market access

Category	Range(score)		Beneficiaries		mean	SD
	Score	Observed	Number	Percent		
Low Access	<8	6-12	20	16.67	8.45	1.66
Medium access	8-9		55	45.83		
High access	>9		35	29.17		

Table 4.3 indicates that the highest proportion (45.83 percent) of the vertical crop diversification had medium market access compared to 29.17 percent in high market access and 16.67 percent in no market access category respectively and the lowest proportion (16.67 percent) had no market access.

4.1.4 Information and Communication Technologies (ICTs) access

Information and Communication Technologies (ICTs) access scores of the respondents ranged from 4 to 12 against possible score of 0 to 18. The average score and standard deviation were 7.39 and 2.36, respectively. Based on the Information and Communication Technologies (ICTs) access scores, the respondents were classified into three categories (Mean \pm Standard Deviation) namely low, medium and high Information and Communication Technologies (ICTs) access

Table 4.4 Distribution of the respondents according to ICTS access

Category	Range(score)		Beneficiaries		mean	SD
	Score	Observed	Number	Percent		
Low	<6	4-12	27	22.5	7.39	2.36
Medium	6-9		61	50.83		
High	>9		32	26.67		

Table 4.11 reveals that 50.83 percent of the respondents had medium Information and Communication Technologies (ICTs) access, 22.5 percent had low Information and Communication Technologies (ICTs) access and 26.67 percent had high Information and Communication Technologies (ICTs) access. It means that majority portion (77.5 percent) of the respondent had the ICTs access which helps to extent vertical crop diversification.

4.1.5 Non Farming Income:

The observed score of non-farming income ranged from 0 to 5 against the possible score of 0-7 with a mean and standard deviation of 2.33 and 1.53, respectively. On the basis of non-farming income the respondents were classified into three categories (Mean \pm Standard Deviation) namely no non-farm income, medium non-farm income and high non-farm income. The distribution of respondents according to non-farming income is presented in Table 4.5

Table 4.5 Distribution of the respondents according to non-farming income

Category	Range(score)		Beneficiaries		mean	SD
	Score	Observed	Number	Percent		
No non-farm income	0	0-5	30	25	2.33	1.53
Medium non-farm income	1-3		65	54.17		
High non-farm income	>3		25	20.83		

Table 4.5 indicates that the highest proportion (54.17 percent) of respondent in vertical crop diversification had medium non-farming income to 20.83 percent in high non farming income and 25 percent have no non farming income. The lowest proportion (20.83 percent) of respondent had high non farming income.

4.1.6 Organizational Participation

According to observed scored of organizational participation the respondent were classified into four category namely-no participation, low participation, medium participation and high participation with an average of 7.05 and standard deviation 1.92. The distribution of respondents according to organizational participation is presented in Table 4.6

Table 4.6 Distribution of the respondents according to organizational participation

Category	Range(score)		Beneficiaries		Mean	SD
	Score	Observed	Number	Percent		
No participation	0	0-12	26	21.66	7.05	1.92
Low participation	1-5		36	30		
Medium participation	6-9		42	35		
High participation	10&above		16	13.33		

Data furnished in the table no 4.6 showed that about 21.66 percent respondent in the study area had no organizational participation, remaining 30 percent had low participation and 35 percent had medium participation in the study area .The lowest proportion of the respondent (13.33 percent) had high organizational participation. More organizational participation develop extrovert mentality and establishes coordinate capability and capacity to extent vertical crop diversification. So it could be said that there were favorable condition for organizational participation in the study area.

4.1.7 Training Exposure:

According to observed scored of training exposure the respondent were classified into four category namely-null, short term, mid-term and long term with an average of 4.35 and standard deviation 2.57. The distribution of respondents according to training exposure is presented in Table 4.7.

Table 4.7 Distribution of the respondents according to Training exposure

Category	Range(score)		Beneficiaries		Mean	SD
	Score	Observed	Number	Percent		
Null	0	0-8	25	20.83	4.35	2.57
Short term	1-3		28	23.34		
Mid term	4-6		49	40.83		
Long term	7 & above		18	15		

Table 4.7 showed that about 20.83 percent of respondent in study area had no training in vertical crop diversification. On the other hand 23.34 percent and 40.83 percent respondent had short term and midterm training respectively. And the lowest proportion of the respondent (15 percent) had long term training in vertical crop diversification. It means that an overwhelming majority (64.17percent) of the farmers had short term and mid-term training exposure. It is logical that there is always a relationship between training exposure and extent of vertical crop diversification. Because training received develops the farmers' knowledge, skill, and attitude in positive manner. The findings suggest that training experience might be the most important factor for the respondents to change their knowledge on VCD.

4.1.8 Knowledge

The knowledge of the respondent was assessed by asking them 10 questions and then score was given to their answer. The observed score ranged from 10-18 against the possible range of 0-20. The average was 12.12 and the standard deviation was 3.28. According to their knowledge score respondents were classified into three categories namely-low knowledge, medium knowledge, and High knowledge. . The distribution of respondents according to their knowledge is presented in Table 4.8

Table 4.8 Distribution of the respondents according to their knowledge

Category	Range(score)		Beneficiaries		mean	SD
	Score	Observed	Number	Percent		
Little Knowledge	<10	5-18	15	12.5	12.12	3.28
Medium Knowledge	10-15		66	55		
High knowledge	>15		39	32.5		

The data from the above table reveals that most of the respondent had medium (55 percent) to high (32.5 percent) knowledge in vertical crop diversification. Whereas only 12.5 percent respondent had low knowledge. Knowledge is to be considered as vision of an explanation in any aspect of the situation regarding vertical crop diversification. It is act or state of understanding; clear perception of fact or truth, that helps an individual to foresee the consequence he may have to face in future. It makes individuals to become rational and conscious about related field. In general the level of knowledge of the respondent was good. So it could be conclude that the level of good knowledge in vertical crop diversification helped the respondent to adopt the vertical crop diversification in peri-urban area. Azad (2013) also observed that similar findings in his study.

4.1.9 Risk in VCD

Risk in vertical crop diversification is observed from 5 to 12 against the possible range of 0-21 with a mean and standard deviation of 8.08 and 1.39 respectively. On the basis risk in VCD the respondents were classified into four categories (Mean \pm Standard Deviation) namely „not at all, low, medium and high. The distribution of respondents according to risk in VCD is presented in Table 4.9

Table 4.9 Distribution of the respondents according to risk in VCD

Category	Range(score)		Beneficiaries		Mean	SD
	Score	Observed	Number	Percent		
Not at all	0	5-12	0	0	8.08	1.39
Low	<8		20	16.66		
Medium	8-10		82	68.33		
High	>10		18	15		

Table 4.9 indicates that the highest proportion (68.83 percent) of the respondent had medium risk in VCD. Whereas 15 percent had high risk and 16.66 percent had low risk in VCD. And no one think that there had no risk in VCD. The lowest proportion (15 percent) of respondent had high risk in VCD in study area. Findings again reveal that all of the farmers faced medium to high risk in vertical crop diversification. It is quite logical that farmers facing lower risk could extent the vertical crop diversification. Azad (2013) also observed that similar findings in his study.

4.1.10 Involvement in VCD

Involvement of people in vertical crop diversification is observed from 10 to 16 with a mean and standard deviation of 12.47 and 2.13 respectively. On the basis of involvement of people in VCD the respondents were classified into four categories (Mean \pm Standard Deviation) namely „not at all, low, medium and high. The distribution of respondents according to involvement of people in VCD is presented in Table 4.10

Table 4.10 Distribution of the respondents according to Involvement in VCD

Category	Range(score)		Beneficiaries		Mean	SD
	Score	Observed	Number	Percent		
Not at all	0	10-16	0	0	12.47	2.13
Low	≤ 11		30	25		
Medium	12-14		62	51.67		
High	≥ 15		22	18.33		

Table 4.10 showed that about 25 percent respondent had low involvement in VCD. Whereas 51.67 percent had medium involvement and 18.33 percent had high involvement in VCD. So the highest proportion (51.67 percent) of respondent had medium involvement in VCD in peri-urban area. Involvement of the people in VCD is an important concern for controlling post-harvest losses and improvement of socio-economic situation of the people. The study reveals that participation of the respondents in VCD was low to medium, which is encouraging. Thus, proper strategy and need-based support should be ensured in order to secure full participation of the people in VCD. Rahman (2009) also observed the similar findings in his study.

4.1.11 Technology use

According to observed scored of technology the respondent were classified into three categories namely-no use, partially use and completely use with an average of 6.45 and standard deviation 1.79. The observed score ranged from 2-10 against the possible score 0-12. The distribution of respondents according to technology use is presented in Table 4.11

Table 4.11 Distribution of the respondents according to technology use in VCD

Category	Range(score)		Beneficiaries		mean	SD
	Score	Observed	Number	Percent		
No use	<5	2-10	18	15	6.45	1.79
Partially use	5-7		73	60.83		
Completely use	>7		42	35		

The table 4.11 showed that the highest proportion (60.83 percent) of respondent partially used technology in VCD. On the other hand the lowest proportion (15 percent) of respondent were no use category and 35 percent respondent were completely used technology in VCD. So it is clear that most of the respondents (95.83 percent) had positive attitude toward technology, which helped them to adopt technologies. It implies that above 90 percent farmer aware of modern technologies and practice.

4.2 Extent of vertical crop diversification

Extent of vertical crop diversification was the main focus of this study. The observed score was ranged from 34 to 48 against the possible range of 0 to 72. The mean and standard deviation 39.04 and 3.21 respectively. On the basis of extent of VCD the respondents were classified into three categories (Mean \pm Standard Deviation) namely low, medium and high. The distribution of respondents according to extent of VCD is presented in Table 4.12

Table 4.12 Distribution of the respondents according to extent of VCD

Category	Range(score)		Beneficiaries		Mean	SD
	Score	Observed	Number	Percent		
Low	<39	34-48	32	26.67	39.04	3.21
Medium	39-42		63	52.5		
High	\geq 43		25	20.83		

Table 4.12 indicate that the highest proportion (52.5 percent) of respondent had medium extent of VCD. Whereas 26.67 percent respondent had low extent and 20.83 percent respondent had high extent in VCD.

4.3 Determinants of Vertical Crop Diversification in Dinajpur Sadar Upazilla

To estimate contribution of indicators to extent of vertical crop diversification, multiple regression analysis was employed. Results were presented in table 4.13.

Table 4.13 shows that there was a significant contribution of respondent's market access, technology, education, access to financial institutions, knowledge, training exposure, ICTs. Based on unstandardized coefficients (b), Education, market access, technology, access to financial institutions and knowledge were the most important contributing factor. (Significant at the 1% level of significance).

Table 4.13 Multiple regression coefficients of contributing factors related to determinants of vertical crop diversification

Developed Indicator	Indicator	b	Beta	P	R ²	Adj.R ²	F	p
Extent Of VCD	Education	1.850	.216	.000**	0.612	0.607	58.678	.000**
	Access to Financial Institute	0.587	.204	.000**				
	Market Access	3.710	.287	.000**				
	ICTS access	0.765	.158	.015*				
	Non farming income	0.573	.138	.112				
	Organization Participation	0.519	.146	.085				
	Training exposure	0.835	.165	.009*				
	Knowledge	1.648	.192	.003**				
	Risk in VCD	0.585	.136	.114				
	Involvement of people in VCD	1.950	.130	.118				
	Technology use	2.775	.256	.000**				

** Significant at $p < 0.01$; * Significant at $p < 0.05$;

The value of R^2 is a measure of how of the variability in extent of vertical crop diversification was accounted for by the selected indicators. So, the value R^2 0.612 means that selected indicators accounts for 61% of the variation in extent of vertical crop diversification.

Education ($\beta = .216$): The standardized coefficient indicates that as the education level of respondent increases by one unit, the amount of extent of VCD increase by .216 units. This interpretation is true only if the effects of other indicators are held constant.

Market access ($\beta = .287$): The standardized coefficient indicates that as market access increases by one, the amount of extent of VCD increase by .287 units. This interpretation is true only if the effects of other indicators are held constant.

Technology ($\beta = .256$): The standardized coefficient indicates that as the technology increases by one standard deviation, the value of extent of VCD increase by .256 standard deviations. This interpretation is true only if the affects others indicator are held constant.

Access to financial institutions ($\beta = .204$): This value indicates that access to financial institutions increases by one standard deviation, extent of vertical crop diversification increases by 0.204 standard deviations. This interpretation is true only if the effects of others indicator are held constant.

So, most contributing factors of extent of vertical crop diversification were education, market access, technology and access to financial institution. It is therefore, can be said that extent of vertical crop diversification can be improved by investing on education, market access, technology and access to financial institutions.

An important part of the table 4.13 is the F-ratio and the associated significance value of that F-ratio. For these data, F is 58.678, which is significant at $p < .001$ (because the value in the column labeled Sig. is less than .001).

This result tells us that there is less than a 0.1% chance that an F-ratio this large would happen. Therefore, we can say the regression model results in significantly better prediction of determinants of vertical crop diversification than if we used the mean value of determinants of vertical crop diversification.

In short, the regression model overall predicted the extent of VCD significantly well. The F ratio is 58.678 which is highly significance ($p < .001$). This ratio indicates that the regression model significantly improved the ability to predict the outcome variable. Besides this regression analysis, the inter relationship among the indicators, their dimensions and extent of VCD are shown in Appendix-B.

4.4 Problem faced index in VCD

Problem defined by Goode (1945) is any significant perplexing and challenging situation, real and artificial, the solution of which requires reflective “thinking”. Problem faced, therefore, refers to the extent to which individual faces difficult situations about which something needs to be done. The observed problem faced by the respondents in VCD ranged from 261 to 299 against the possible range of 0 to 360. The formula for determining PFI has been shown in chapter III. The selected seven problems faced by the respondents which were arranged in rank order are shown in Table 4.14.

Table 4.14 Rank order of 7 selected problems faced by the farmers in VCD

Problems	Extent of problem faced				PFI	Rank
	Not at all (0)	Low problem (1)	Medium Problem (2)	High Problem (3)		
Lower price of vegetables	1	5	42	70	299	1
High price of inputs	2	8	46	65	295	2
Diseases attack	3	7	48	62	289	3
Losses of vegetable production due to natural calamity	5	8	52	55	277	4
Lack of technical knowledge	5	9	58	48	269	5
Lack of Training exposure	4	13	58	45	264	6
Lack of loan facilities	3	15	60	42	261	7

PFI = Problem Faced Index, N = 120

On the basis of PFI, it was observed that ‘Lower price of vegetable’ ranked first followed by high price of inputs, disease attack, losses of vegetable production due to natural calamity, lack of technical knowledge, lack of Training exposure, lack of loan facilities.

CHAPTER V

SUMMARY OF FINDINGS,

CONCLUSION AND RECOMMENDATION

The study was conducted in Fajilpur, Sekhpura and Chehelgaji union of Dinajpur Sadar Upazila under Dinajpur district. Total 600 respondents were selected from the study area as the population and according to Yamane's formula, the respondents comprised of 120 respondents constituted the sample of the study. A well-structured interview schedule was developed based on objectives of the study for collecting information. The independent variables were: education, access to financial institutions, market access, Information and Communication Technologies (ICTs), non-farming income, organizational participation, training exposure, knowledge, risk, involvement of people in VCD and technology. Data collection was started in November 1, 2017 and completed in 30 December, 2017. Various statistical measures such as frequency counts, percentage distribution, average, and standard deviation were used in describing data. In order to estimate the contribution of the selected characteristics of respondents to their extent of vertical crop diversification, multiple regression analysis (B) was used. The major findings of the study are summarized below:

5.1 Major Findings

5.1.1 Selected characteristics of the respondents

Education: Secondary education category constitute the highest proportion (33.33 percent) followed by primary education (30 percent). On the other hand, 10.83 percent respondent have no formal education.

Access to financial institutions: Intermittent access to financial institutions constitute the highest (54.57 percent), while the lowest access to financial institutions in sustained access category (7.5 percent) followed by no access (38.33 percent).

Market access: Highest proportion (45.83 percent) of the vertical crop diversification had medium market access compared to 29.17 percent in high market access and 16.67 percent in no market access category respectively and the lowest proportion (16.67 percent) had no market access.

Information and Communication Technologies (ICTs) access: 50.83 percent of the respondents had medium Information and Communication Technologies (ICTs) access, 22.5

percent had low Information and Communication Technologies (ICTs) access and 26.67 percent had high Information and Communication Technologies (ICTs) access.

Non Farming income: The highest proportion (54.83 percent) of respondent in vertical crop diversification had medium non-farming income to 20.83 percent in high non farming income and 22.5 percent have no non farming income.

Organizational Participation: About 26.66 percent respondent in the study area had no organizational participation, remaining 36 percent had low participation and 35 percent had medium participation in the study area.

Training exposure: About 20.83 percent of respondent in study area had no training in vertical crop diversification. On the other hand 23.34 percent and 40.83 percent respondent had short term and midterm training respectively.

Knowledge: Most of the respondent had medium (55 percent) to high (24.66 percent) knowledge in vertical crop diversification. Whereas only 20.83 percent respondent had low knowledge.

Risk in VCD: The highest proportion (68.83 percent) of the respondent had medium risk in VCD. Whereas 15 percent had high risk and 16.66 percent had low risk in VCD.

Involvement in VCD: About 25 percent respondent had low involvement in VCD. Whereas 51.67 percent had medium involvement and 18.33 had high involvement in VCD. So the highest proportion (51.67 percent) of respondent had medium involvement in VCD in peri-urban area.

Technology Use: Highest proportion (60.83 percent) of respondent partially used technology in VCD. On the other hand the lowest proportion (15 percent) of respondent were no use category and 35 percent respondent were completely used technology in VCD

5.1.2 Extent of VCD: The highest proportion (52.5 percent) of respondent had medium extent of VCD. Whereas 26.67 percent respondent had low extent and 20.83 percent respondent had high extent in VCD.

5.1.3 Contribution of selected indicator to Extent of vertical crop diversification

Out of eleven independent variable only seven variable namely education, market access, training exposure, access to financial institution, knowledge, ICTs and technology have a significant contribution to extent of vertical crop diversification. From these indicators 61.2

percent ($R^2 = 0.612$) of the variation in the respondents changed constraints faced by the respondents in extent of vertical crop diversification.

Education ($\beta = .216$): The standardized coefficient indicates that as the education level of respondent increases by one unit, the amount of extent of VCD increase by .216 units. This interpretation is true only if the effects of other indicators are held constant.

Market access ($\beta = .287$): The standardized coefficient indicates that as market access increases by one, the amount of extent of VCD increase by .287 units. This interpretation is true only if the effects of other indicators are held constant.

Technology ($\beta = .256$): The standardized coefficient indicates that as the technology increases by one standard deviation, the value of extent of VCD increase by .256 standard deviations. This interpretation is true only if the affects others indicator are held constant.

Access to financial institutions ($\beta = .204$): This value indicates that access to financial institutions increases by one standard deviation, extent of vertical crop diversification increases by 0.230 standard deviations. This interpretation is true only if the effects of others indicator are held constant.

5.1.4 Comparative Problem Facing of Selected Items of VCD

In order to compare the problem faced by the farmers in 7 selected items of vegetable production, a Problem Faced Index (PFI) was computed for each item. Farmers faced highest problems in 'lower price of vegetable' followed by 'high price of inputs' and 'diseases attack'. 'Lack of loan facilities' was the least problem faced by the farmers.

5.2 Conclusion

“A conclusion presents the statements based on major findings of the study and these statements mostly confirm to the objectives of the research in the shortest form. It presents the direct answers of the research objectives, or it relates to the hypothesis” (Labon and Schefter, 1990).

Findings of the present study and the logical interpretation of other relevant facts prompted the researcher to draw the following conclusions:

1. The findings of the study revealed that majority (55 percent) of the respondents had medium knowledge on vertical crop diversification, while 20.83 percent had low knowledge and 26.66 percent had high knowledge. It means more than three-fourth

(75.83 percent) of the respondent had low to medium knowledge on vertical crop diversification. Therefore, it may be concluded that there is necessity to increase the knowledge of the farmers on vertical crop diversification.

2. Majority (54.17 percent) of the respondents had medium access to financial institutions in vertical crop diversification. Access to financial institutions of the respondent had a great contribution to extent of VCD. Again it had significant positive relationship with extent of VCD. Therefore, it may be concluded that vertical crop diversification would be extent if access to financial institutions of farmers increase.
3. Majority (60.83 percent) of the respondents had medium use of technology in vertical crop diversification. Multiple regressions revealed that adoption of technology in VCD the respondent had the second highest contribution to extent of VCD. It also revealed that adoption of technology of the respondent had significant positive relationship with extent of VCD. Therefore, it may be concluded that individuals having more adoption of technology can more extent of VCD.
4. Market access of the respondents showed the key contributing factor to extent VCD. This means that high access to market among the respondents might have influenced to extent VCD. Conclusion could be presented that these respondents could be more ameliorated in all aspects of socio-economic life if government takes more care to make it more accessible
5. Study revealed that information and communication technologies (ICTs) access of the respondents was the most contributing factor to the sustainable access to rural financial services. Therefore, it may be concluded that information and communication technologies (ICTs) access of the respondents had influenced to sustainable access to rural financial services by the respondent.
6. The finding of the study revealed that majority proportion (68.83 percent) of respondent have medium risk in practicing vertical crop diversification. Therefore, it may be concluded that emphasis should be taken to minimize the risk.

7. Majority of the respondent (63.33percent) were passed primary to secondary level. Multiple regressions revealed that education of the respondent had the great contribution to extent VCD. And it also revealed that education of the respondent had significant positive relationship with extent of VCD. So it can be concluded that more educated vegetable grower can more capable to extent of VCD.
8. Farmers faced highest problems in 'lower price of vegetable' followed by 'high price of inputs' and 'disease attack'. Therefore, it may be concluded that emphasis should be taken to minimize these problems.

5.3 Recommendations

5.3.1 Recommendations for policy implications

On the basis of observation and conclusions drawn from the findings of the study following recommendations are made:

1. Majority (55 percent) of the vegetable growers had medium knowledge on vertical crop diversification and 20.83 percent had low knowledge. Therefore it may be recommended that attempts should be taken by Department of Agricultural Extension (DAE) and other extension providers to arrange training, motivational campaigning and provide vertical crop diversification guide for increasing knowledge to extent vertical crop diversification.
2. Majority (54.17 percent) of the respondents had medium access to financial institutions. Access to financial institutions of the respondent had a great contribution to extent of VCD. Again it had significant positive relationship with extent of VCD. Therefore, it may be recommended that to extent vertical crop diversification access to financial institutions such bank, NGOs and private organizations are required.
3. Majority (60.83 percent) of the respondents had medium use of technology in vertical crop diversification. Multiple regressions revealed that adoption of technology in VCD the respondent had the second highest contribution to extent of VCD. It also revealed that adoption of technology of the respondent had

significant positive relationship with extent of VCD. Therefore, it may be recommended that motivational campaigning to be arranged for the farmers, so that they can adopt the modern technologies and can minimize the risk in VCD.

4. Market access of the respondents had a significant contribution to the extent of VCD. It indicates the importance of market access for VCD. It may be recommended that arrangements should be made for enhancing the market access of the respondents by the concerned authorities through the establishment of local and regional market.
5. Information and Communication Technologies (ICTs) access was important contributing factors to extent of VCD by the respondents. Therefore, it is recommended that the concern authorities should work with the respondents and prioritize the Information and Communication Technologies (ICTs) access factor which influenced to extent of VCD.
6. Majority proportion (68.83 percent) of respondent have medium risk in practicing vertical crop diversification. Therefore, it may be recommended that necessary technical support to be provided for the vegetable growers to minimize the risk with special emphasis to these problems.
7. About 20.83 percent of respondent in study area had no training in vertical crop diversification. Therefore, it may be recommended that training facilities should be arranged by the local NGOs and GOs.
8. Farmers faced highest problems in 'lower price of vegetable' followed by 'high price of inputs' and 'disease attack'. Therefore, it may be recommended that necessary technical support to be provided for the vegetable growers to minimize their problems with special emphasis to these problems.

5.3.2 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 future study.

1. The present study was conducted in Fajilpur,sekhpara and Chehegazi union of Dinajpur Sadar upazila under Dinajpur district. It is recommended that similar studies should be conducted in other areas of Bangladesh.
2. This study investigated the contribution of eleven indicators of the respondents to extent of VCD. Therefore, it is recommended that further study should be conducted with other characteristics of the respondents to extent of VCD in Peri urban area.
3. All problems affect the performance of the farmers. There is need for undertaking research on the various problems faced by the farmers which affect their performance.
4. Studies need to be undertaken to ascertain the principles and procedures for installation and patronization of nursing organization in the rural areas of Bangladesh.
5. The present study was concern only with the extent of VCD in peri urban area. It is therefore suggested that future studies should be included more reliable measurement of concerned variable is necessary for further study.

REFERENCES

- Afique, A.A. 2006. Rural Women's Perception of Benefit from Agricultural Model Farm Project of SUS. M.S. (Ag. Ext. Ed.) Thesis, Dept. of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh, Bangladesh.
- Afrad, M.S.I. 2002. Farmers' Attitude towards Vegetable Cultivation in DumkiUpazila of Patuakhali District. M.S. (Ag. Ext. Ed.) Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.
- Ahmed, D., 1992. Vegetable marketing system for domestic and export markets. In: Vegetable Production and Marketing: Proceedings of the National Review and Planning Workshop. ACRDC, Shanhua, Tainan, Taiwan, pp: 170-183.
- Akhter, S. 2003. Comparison Between Knowledge and Skill of Women Led FFS of RDRS and Non-FFS Farmers. M.S. (Ag. Ext. Ed). Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.
- Anonymous. 2005. Integrated Quality Horticultural Development Project. Dept. of Agricultural Extension, Khamarbari, Framgate, Dhaka.
- Azad, J.2013. Farmers' knowledge on post-harvest practice of vegetables. M.S. (Ag. Ext. Ed.) Thesis, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University. Dhaka 1207.
- BBS, 2009. Statistical Yearbook of Bangladesh. Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka. p.136.
- Bannan-Rittand, B. (2003). The Role of Design in Research: The Integrative Learning Design Framework. Educational Res. 32(1): 21-24.
- BBS. 2009. Monthly Statistical Bulletin (April). Bangladesh Bureau of Statistics. Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, p. 67.
- Begley, C.M. (1996). Using Triangulation in Nursing Research. J. of Adv. Nursing 24(1): 122-128.

- Bhattacharjee, L. S.K. Saha. B.K. Nandi. 2007. Food-Based Nutrition Strategies in Bangladesh. Food and Agriculture Organization of the United Nations, Regional Office for Asia and the Pacific, Bangkok.
- Bogdan, R.C. and Biklen, S.K. (2006). Qualitative Research for Education: An Introduction to Theory and Methods (5th Ed.). Boston: Allyn & Bacon.
- Bryman, A. (2001). Social Research Methods. Oxford: Oxford University Press.
- Creswell, J.W. (1994). Research Design: Qualitative and Quantitative Approaches. London: Sage Publications.
- Dasgupta, S. and Roy, I. Good Agricultural Governance: A resource guide focused on smallholder crop production, FAO, Regional office for Asia and the Pacific Bangkok, pp. 137.
- Denzin, N.K. (1978). The Research Act: A Theoretical Introduction to Sociological Methods. New York: McGraw-Hill.
- FAO, (2015). Self- evaluation and holistic assessment of climate resilience of farmers and pastoralists. Rome, Italy
- Farhad, A.K.M. 2003. Knowledge attitude and practices of rural women in using IPM vegetable cultivation. An M.S. (Ag. Ext. Ed.). Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.
- Goode, W.J. and P.K. Hatt. 1952. Methods in Social Research. New York: McGraw Hill Book Company Inc.
- Gunasena H.P.M. 2001. Intensification of crop diversification in the Asia-Pacific region, FAO Regional Office for Asia and Pacific, 2001/03, pp. 156-165
- Hamid, M.A. 1997. Farmers' awareness on environmental pollution: A study in Bangladesh. Asia Pacific Journal of Rural Development, VII (2): 107-117.
- Hanif, M.A. 2000. Comparative Analysis between FFS and Non-FFS Farmers Regarding Environmental Awareness. An M.S. (Ag. Ext. Ed.). Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

- Hasan, K. 2006. Participation in Farming Activities by Conventional and Organic Farmers. M.S. (Ag. Ext. Ed.) Thesis. Dept. of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh, Bangladesh.
- Hedley, D.D. 1987. Diversification: Concepts and directions in Indonesian agricultural policy. In Bottema, J.W.T., Dauphin, F., & Gijssbers, G. (eds). 1987. Soybean research and development in Indonesia, CGPRT No. 10. The CGPRT Centre, Bogor.
- Hogrewe, W.; Joyce, S.D. & Perez, E.A. 1993. The Unique Challenges of Improving Peri-Urban Sanitation. WASH Technical Report No. 86 prepared for the Office of Health, Bureau for Research and Development, U.S. Agency for International Development under WASH Task No. 339. Washington D.C
- Hossain, M.D. 1999. A study on marketing of some winter vegetables produced in, selected areas of Bangladesh. MS thesis. Dept. Hort., BAU, Mymensingh Bangladesh, pp; 131
- Hossain, M.I. (2001). Knowledge Gained by the Participating Farmers under Crop Cultivation Programme of CARE in a Selected Area of Mymensingh District. M.S. (Ag. Ext. Ed). Thesis, of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.
- Hossain, M.M. 2003. Farmers' Knowledge and Adoption of Boro Rice Cultivation Practices M.S. (Ag. Ext. Ed). Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.
- Hossain, S.M. 2000. Farmers' knowledge and perception of Binadhan-6. An M.S. (Ag. Ext. Ed.). Thesis, Department of Agricultural Extension Education. Bangladesh Agricultural University, Mymensingh.
- Islam, A. 2002. Proshika Farmers' Knowledge and Adoption of Ecological Agricultural Practices. M.S. (Ag.Ext.Ed.) Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.
- Islam, M. A. 2005. Farmers' Knowledge and Practices in Using IPM Crop Production. M.S. Ag. Ext. Ed). Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural Universtiy, Mymensingh.

- Islam, M.N. 2008. Knowledge on Vegetables Production Activities by Woman Members in Homestead area under world vision project. M.S. (AEIS). Thesis, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka.
- Islam, M.Z. 2007. Adoption of BRRRI dhan 29 production technologies by the farmers. M.S. (AEIS). Thesis, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka.
- Kamran, N and A. M. Syed. 2002. Post-Harvest Preservation of Fruits and Vegetables: Study on Carrots Preserved by Modified Atmosphere Packaging (MAP) Technology. Pakistan. Journal of Scientific and Industrial Research. 45(4):259-261
- Krumbein, A. and P. Peters. 2003. Changes of Aroma Volatiles in Tomato in Post-Harvest. Flavor Research at the Dawn of the Twenty first Century. Proceedings of the 10th Weurman Flavour Research Symposium. Beaune, France.
- Liebscher, P. (1998). Quantity with Quality? Teaching Quantitative and Qualitative Methods in an LIS Master's Program. Library Trends 46(4): 668-680.
- Mannan, I. 2001. Jackfruit in Srilanka. Studium Press LLC, Houseton, USA, pp. 369-392
- Marsh, C.P. and A.L. Coleman. 1955. Relation of Farmers' Characteristics to the Adoption of Recommended Farm Practices. Rural Sociology, 20: 289-296.
- Medagoda, I. 2001. Jackfruit in Srilanka. Studium Press LLC, Houseton, USA, pp. 369-392.
- Miah, M.A.M. and M.M. Rahman, 1995. Farmers' Awareness regarding changes in the farming Environment. A research article accepted for publication in: Bangladesh Journal of Agricultural Science.
- Miles, J. and Shevlin, M. (2001). Applying Regression and Correlation: A Guide for Students and Researchers. London: Saga Publications.
- Mujeri, M.K., 2015. Improving Access of the Poor to Financial Services. The 7th Five Year Plan (2016-2020) of Bangladesh, Planning commission, Dhaka. Pp. 58.
- Muntad, A. (2009). Principal losses, <http://www.fao/docrep/T00731/..on> 01.12.2012

- Nyalala, S.P.O. and H. Wainwright, 1998. The Shelf-Life of Tomato Cultivars at Different Storage Temperatures. *Trop. Science*, 38(3): 151-154. Papadematrion, M.K. and Dent, F.J. RAP Publication 2001/03, FAO, Thailand.
- Parveen, S. 1995. Awareness of farm Women on environmental degradation due to use of some selected Modern Agricultural Technologies. An M.S. (Ag. Ext. Ed.). Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.
- Patil, D. R. T. 2008. Post-Harvest Management and Value Addition of Jackfruit, A Power Point Presentation. Central Institute of Agricultural Engineering, Bhopal.
- Rahman, M. S. 2004. Extent and Level of Knowledge of Farmers' on HYV Boro Rice Cultivation Practices. M. S. (Ag. Ext. Ed). Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.
- Rahman, M. Z. 2006. Knowledge of the Farmers' on Prawn Culture in a Selected Area of Khulna District. M. S. (Ag. Ext. Ed). Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.
- Rai, D.R., H.S. Oberoi and B. Bangali. 2002. Modified Atmosphere Packaging and its Effect on Quality and Shelf life of Fruits and Vegetables. An Overview. *Journal of Food Sciences and Technology*. 39 (3):199-207.
- Raj, A.S. and J.A. Knight (1977). Influence of Farm Practices Attributes on Innovation-decision process. *Indian Journal of Extension Education*. 13(3&4):1-5.
- Rahman, M. Z. 2009. Capacity Strengthening of Rural Women in Carrying out Post Harvest Activities of Vegetables and Fruits towards Food Security. Final Report PR # 8/07. Department of Agricultural Extension Education Bangladesh Agricultural University, Mymensingh.
- Rashid, M. M. 1998. Vegetable Crop Agribusiness- A Consultancy Report. Prepared for the Project: strengthening of Bangladesh AVRDC Vegetable Research Development Programme. 253p.
- Rashid, M.U. 2004. Usefulness of Training Received by the Youths from the Youth Training Center of Mymensingh. M.S. (Ag. Ext. Ed.) Thesis, Dept. of Agricultural

Extension Education, Bangladesh Agricultural University, Mymensingh, Bangladesh.

- Rashid, S., Sharma, M., and Zeller, M. (2004). Micro-lending for small farmers in Bangladesh: does it affect farm households' land allocation decision? *J. of Developing Areas* 37.
- Roy, K.K. 2006. Farmers' Knowledge on Boro Rice Cultivation in Some Selected Areas of Dinajpur District. M. S. (Ag. Ext. Ed). Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.
- Roy, R. 2006. Effectiveness of mass media in adoption of rice production technology. M.S. (Ag. Ext. Ed.) Thesis, Department of Agricultural Extension and Information System, Sher- e-Bangla Agricultural University. Dhaka 1207.
- Roy, R. 2015. Modeling and policy integration of sustainable rice farming system in Bangladesh. PHD Thesis, University Sains Malaysia. pp. 269.
- Roy, R., Chan, N. W., and Rainis, R. (2014). Rice farming sustainability assessment in Bangladesh. *Sustainability Science*. 9: 31–44.
- Roy, R., Chan, N.W. and Xenarios, S. (2015) Sustainability of rice production systems: an empirical evaluation to improve policy. *Environment development and sustainability*. 18: 257-278.
- Sana, M.C. 2003. Farmers' Knowledge of Shrimp Cultivation in AssouniUpazila under Satkhira District. M.Sc. (Ag. Ext. Ed.) Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.
- Sarkar, H. N. M. A. Hasan and P.K. Chattopadhyya. 1997. Influence on Polythene Packing on the Post-Harvest Storage Behavior of Banana Fruit. *Hort. J.*, 10 (1): 31-39
- Sarkar, R.C. 1999. Farmers' perception regarding environmental degradation due to the use of agro-chemicals. Unpublished M.S. Thesis. Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh
- Sarkar, T. 2005. Empowerment of Women Beneficiaries under CONCERN Bangladesh. M.S. (Ag. Ext. Ed.) Thesis, Dept. of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh, Bangladesh. Bangladesh.

- Singh, K. and K.L. Chadha, 1990. Vegetable production and policy in India. In at vegetable Research and Development in South Asia. Proceedings of workshop, held Islamabad, Pakistan, on September 24-29, 1990. S. Shanmugasundaram (Ed.), AVRDC, pp: 89-105.
- Sutradhar, N.C. 2002. Farmers' Awareness on Environmental Degradation caused by the use of modern Agricultural Technologies. M.Sc. (Ag. Ext. Ed.) Thesis. Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.
- Swagatam, T., K.M. Khalequzzaman, M.N.A. Chowdhury, S.M.K.E. Khuda, M. and M. Alam. 2004. Prepackaging, Storage Losses and Physiological Changes of Fresh Bitter Gourd as Influenced by Post Harvest Treatments. Journal of Biological Sciences. 4(5):613-615.
- Tashakkori, A. and Teddlie, C. (2003). The past and Future of Mixed Methods Research: From Data Triangulation to Mixed Model Designs. In: Tashakkori, A.; Teddlie, C. (eds.): Handbook of Mixed Methods in Social and Behavioural research. Thousand Oaks, London, New Delhi: Sage, 671-701.
- Townsend, J.C. (1953). Introduction to experimental methods. International Student Edition. New York: McGraw Hill Book Company, Inc.
- Uddin, M.B. 2001. Opinion of Block Supervisors on Environmental Hazards and Associated Problems Due to Continuous and Intensive Rice Cultivation. M.Sc. (Ag. Ext. Ed.) Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.
- Winters P, Cavatassi R, Lipper L (2006). Sowing the seeds of social relations: The role of social capital in crop diversity. ESA Working Paper No. 6, (16): pp. 1-40.
- Yadav, R.N., T. Dutt and D. Singh. 2007. Assessment of the knowledge level of mango orchardist about the post-harvest processing and marketing practices. Prog. Res., 2(1/2): 96-98.
- Yahya TMBT, 2001 Crop diversification in Malaysia. In: Crop diversification in the Asia pacific region. (Eds).

Zheng, S., L. Wu, L. Gao, and P. Wu. 1999. Assessment of postharvest handling systems of vegetable crops in the Beijing Area. In 'Proceedings of an International Conference on Quality Assurance in Agricultural Produce held at Ho Chi Min City, Vietnam, 9-12 November 1999' (Eds. G.I. Johnson, L.V. To, N.D. Duck, and M.C. Webb), pp. 451-455, (Australian Centre for International Agricultural Research, ACIAR Proceedings No. 100, Canberra)

APPENDIX –A

English version of interview schedule

Department of Agricultural Extension and Information System

Sher-e Bangla Agricultural university

Sher-e Bangla nagar,

Dhaka 1207

An interview schedule on the study of Determinants of vertical crop diversification in peri-urban area

Sample No:

Name of the respondent:

Village Name:

1. Education

Please mention your level of education

- a) Don't know reading and writing.
- b) Can sign only.
- c) I have passedclass.

2. Access to Financial Institutions

Do you have access to the following financial institution	Sustained access(2)	Intermittent access(1)	No access (0)
Friends/Neighbors			
Family			
NGOs			
Public Bank			
Private Bank			
BRDB			
Remittance			
Local lender			
Cooperative			
Loan company			

3. Market Access

Buying				
Do you buy directly from produces?	Yes	No	If yes, for which products?(Max.1 score)	
Do you have any vegetable product, which you can only access from one available seller?	yes	NO	If yes, for which crops?	
Are there seeds, which you can only access from one available seller?	Yes	No	If yes, for which products?	
Do you have sustained access to local markets for buying farming items?	Yes	No	If yes, for which item?	
Selling				
Last year did you sell any of your crops/seeds?	Yes	No	If yes, for which one?	
Do you sell/trade some of those products directly to consumers?	Yes	No	If yes, for which products?	
Do you have any product with only?	Yes	No	If yes, for which product?	

4. ICTs Access

	Do you use?		Do you have own?		How to use ICTs (Max.1 score)
	Yes(1)	No(0)	Yes(1)	No(0)	
Mobile Phone	Yes(1)	No(0)	Yes(1)	No(0)	
Radio	Yes	No	Yes	No	
TV	Yes	No	Yes	No	
Computer	Yes	No	Yes	No	
Tab	Yes	No	Yes	No	
Internet connection	Yes	No	Yes	No	

5. Non farming income

Do you have any income source other than agriculture?

Yes [] No []

If yes then answer the following.....

- a) Government []
- b) Private job []
- c) Business []
- d) Seasonal business []
- e) Labor to moll/factory/other house []
- f) Other(specify) []

6. Organizational Participation

Name of institute	Nature and duration(years)			
	No participation (0)	ordinary member (1)	Executive member (2)	President/ secretary (3)
School committee				
Mosque /temple committee				
BRAC				
ASA				
PROSHIKHA				
NGO group				
Grameen Bank Sangathan				
Union parisad				
World vision				

7. Training exposure

Did you attend any training? Yes/No .If yes, please give the following answer.

Subject of training	Sponsoring agency	Duration(Day)
Proper storage of fruits and vegetable		
Selling crops in the market		
Using of post-harvest instruments		
Processing of fruits and vegetables		
Packaging of fruits and vegetables		

8. Knowledge

Please answer the following questions.

Questions	Weight score	Marks obtained
Mention Two collecting procedure of crops	2	
Mention two maturity symptom of fruits	2	
Mention Two bags name using to package fruits and vegetables	2	
Mention two facilities which is available in the market	2	
Mention two preservation technology	2	
Mention two sells centers name	2	
Mention two marketing risk	2	
Mention two cleaning technique	2	
Mention two processing technology	2	
Mention two treatments which you use in processing fruits and vegetables	2	
Total	20	

9. Risk in VCD

SI No.	Risk	Not at all (0)	Low (1)	Medium (2)	High (3)
1	Crop failure				
2	Drought, flood, hail storm etc.				
3	Decreasing market price				
4	Decreasing the demand of the crop				
5	Transport unavailability				
6	Unavailability of labor				
7	Accident				

10. Involvement of peoples in vertical crop diversification

(a) Frequency of performance

0 = Not at all

1 = Rarely (performs less than half of the requirement)

2 = Sometimes (performs more than half of the requirement)

3 = Regularly / Frequently (performs completely as required)

(b) Part of work done:

0 = Not at all

1 = Less than half of the requirement

2 = More than half of the requirement

3 = Completely

(C) Control over decision

0 = Absolutely no decision by self

1 = Shared decision, mainly by others

2 = Shared decision, mainly by self

Activities	Frequency of performance				Part of work done				Control over decision			
	0	1	2	3	0	1	2	3	0	1	2	3
Washing and drying												
Insect And disease control												
sorting and grading												
Cooling												
i)water cooling												
ii)air cooling												
Packaging												
Transport to processing house												
Transport to market												
Storage of vegetables and Fruits												

11. Technology Use

SI No.	Items	Extent of use technology		
		Completely (2)	Partially (1)	No (0)
1	Packaging (e.g; perforated bag)			
2	Cooling by Air or water			
3	Grading (size, shape, color, volume)			
4	Processing (jam, jelly, syrup)			
5	Storage(drying, canning, curing, salting and freezing)			
6	Cleaning and Washing by water or chlorine di oxide solution			

12. Extent of vertical crop diversification

SI No.	Statements	A great deal (4)	Quit a lot (3)	Moderate (2)	Very few (1)	Not at all (0)
1	Using packaging material (e.g. Polly bag or wet gunny bag)					
2	Selling product in local market (with in Union)					
3	selling product in export market (Upazilas/Districts/Capital)					
4	Using cold storage					
5	Preservation(using indigenous and chemical methods)					
6	Fruits manufactured into juice or syrup					
7	Washing and cleaning for good quality product					
8	Using heat treatment					
9	Handling of modern equipment					
10	Sorting and grading					
13	Trimming					
14	Direct supplying to chain shops in Upazilas/districts					
15	Drying for storing and preservation					
16	Direct supplying to industry					
17	Processing of sauce, pickle and chutney					
18	Curing (with smoke / adding salt) of food products.					

13. Identification the problems of VCD

Problems	Extent of problem faced			
	Not at all (0)	Low problem (1)	Medium Problem (2)	High Problem (3)
Losses of vegetable production due to natural calamity				
High price of inputs				
Diseases attack				
Lower price of vegetables				
Lack of loan facilities				
Lack of Training exposure				
Lack of technical knowledge				

APPENDIX-B

Correlations Matrix

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
X1	1											
X2	.111	1										
X3	.157	.247**	1									
X4	.411*8	.307**	.407**	1								
X5	.405**	.138	.217*	.45	1							
X6	.116	.048	.085	.456**	-.032	1						
X7	.018	.127	.111	.216*	.267*	.234*	1					
X8	.348**	.229*	.223*	.398**	.176	.321**	.543**	1				
X9	.132	.187	.211*	-.089	-.023	.046	.078	.298**	1			
X10	.227*	.389**	.405**	.138	.389**	.345**	.589**	.583**	-.054	1		
X11	.287**	.489**	.387**	.411**	.409**	.567**	.603**	.584**	.213*	.387**	1	
X12	.305**	.127	.639**	.289**	.086	.345**	.405**	.527**	-.354**	.497**	.537**	1

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

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

Legends: X1=Education; X2=Access to financial institutions; X3=Market access; X4=ICTs; X5=Non farming income; X6=Organizational participation; X7=Training exposure; X8=Knowledge; X9=Risk; X10=Involvement of people in VCD; X11=Technology; X12=Extent of VCD.

