PROFITABILITY OF VEGETABLE CULTIVATION BY THE INTEGRATED PEST MANAGEMENT (IPM) FARMERS

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PROFITABILITY OF VEGETABLE CULTIVATION BY THE INTEGRATED PEST MANAGEMENT (IPM) FARMERS

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CERTIFICATE

This is to certify that the thesis entitled **"PROFITABILITY OF VEGETABLE CULTIVATION BY THE INTEGRATED PEST MANAGEMENT (IPM) FARMERS"** submitted to the department of Agricultural Extension and Information System, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka in partial fulfillment of the requirements for the degree of Master of Science (M.S.) in Agricultural Extension, embodies the result of a piece of bona fide research work carried out by **TAREK MOHAMMAD RAKIB, Registration No. 12-04818** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

Dated: December, 2017
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DEDICATED

TO

MY BELOVED

PARENTS

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The Author

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX

ABBREVIATIONS

FAO	Food and Agriculture Organization
INFS	In Focus Systems, Inc.
HRDP	Human Rights Development and Protection
IPM	Integrated Pest Management
SPPS	Strengthening Plant Protection Services
DAE	Department of Agricultural Extension (DAE
BRRI	Bangladesh Rice Research Institute
SPSS	Statistical Package For Social Sciences

PROFITABILITY OF VEGETABLE CULTIVATION BY THE INTEGRATED PEST MANAGEMENT (IPM) FARMERS

TAREK MOHAMMAD RAKIB

ABSTRACT

The main objectives of this study were to determine the level of profitability of vegetable cultivation by the Integrated Pest Management (IPM) farmers and to identify the factors that significantly influence profitability of vegetable cultivation. The study was conducted with proportionately and randomly selected 115 farmers in Tetuljhora union under savar upazila of Dhaka district. A pre-tested interview schedule was used to collect data from the respondents during 25th August to 25th September, 2018. Profitability of vegetable cultivation by the IPM farmers was the dependent variable and it was measured based on the benefit cost ratio. Eleven selected characteristics of the respondents considered as independent variables of the study. The interview survey revealed that majority (74.8 percent) of the respondents had medium level of profitability while 14.8 percent and 10.4 percent of them had high and low profitability respectively. Out of selected eleven characteristics, five namely number of vegetable grown, training in vegetable cultivation, organizational participation, annual family income and education had significant positive contribution to their profitability of IPM vegetable cultivation. Therefore, to motivate the vegetable farmers for using IPM practices, the policy makers should consider the above mention significant factors.

CHAPTER I
INTRODUCTION

1.1General Background of the Study

Bangladesh is an agro-based country. Most of the farmers cultivate vegetable besides other crops all the year round. Vegetables are cultivated in 4.22 percent of the total cultivatable land. Besides this, the premises of houses, tin sheds and roof tops are used for vegetable cultivation. Vegetable production has increased five times in the past 40 years. Bangladesh has scored 3rd in global vegetable production, next to China and India (FAO, 2017). The farmers are getting large amount of money from vegetable production which is changing their life (Hossain, 2017).

Vegetables are also good source of vitamins and minerals. Nutrition survey of Bangladesh (INFS, 2013) reported that average intake meet only 80 percent of Calorie, 58 percent of Vitamin A, 50 percent of Riboflavin and 51 percent of Vitamin C requirements. The Production of vegetables in Bangladesh is not sufficient that per capita/day available is hardly 32 gm whereas the requirement is estimated to 220 gm. This gap is probably one of the main reasons for widespread malnutrition in the country. (HRDP, 2013).

Being a poor nation, it is difficult to overcome such a big malnutrition problem by eating fish, meat, egg, butter, ghee. But problems related to malnutrition can easily be overcome by eating adequate quantity of vegetables, which require some adjustment in the dietary habit and also by increasing per yield of vegetable (Mahasin, 1996). However, to increase vegetable production, farmers face various problems including pest infestation.

Pest infestation is the major problem in vegetable cultivation. Near about 90% of the pest infestation occurs during vegetable cultivation. The farmers of Bangladesh are mostly dependent on pesticides in the endeavor to control the pests. At present different kinds of pesticides with thousands of trade names have been registered in Bangladesh

and use of pesticides is not only expensive but also leads to negative environmental consequences. In addition, use of pesticide increase health hazards to the growers and consumers of crop products. It helps to develop pest resistance to insecticides, destroys beneficial insects and imbalances the natural position between the pests and their natural enemies which lead to the increase in the population of the target pests and even creates new pest problems. To avoid such consequences and to increase the crop production at the same time, a viable alternative is needed to pest management.

Integrated Pest Management (IPM) is the best alternative strategy for pest management. IPM is not a new practice in Bangladesh and it was started in 1981 on a small scale basis. By inter country programme, FAO gave same thrust on IPM in 1989. Based on the success of FAO's inter country programme, two Integrated Pest Management Project and Strengthening Plant Protection Services(SPPS) project started in 1996 and 1997 respectively. Both the projects were implemented by the Department of Agricultural Extension (DAE) (Roy, 2009). Agricultural development and sustainability are very much linked to maintaining a healthy agricultural environment, ecological balance, sound environment and sustainable agriculture. It should be maintained for the better future and to maintain sustainable agriculture IPM should be implemented with collaboration of other related organizations.

IPM is a broad ecological approach to pest control using various pest control methods in a compatible manner; that is why IPM is a holistic approach to pest control keeping sound environment. To maintain ecological balance, sound human and animal health, increasing farm output and farmers' income on a sustainable basis, IPM is considered as good practices. IPM is better than conventional method in social and environmental aspect but what about economic aspect is not known. Therefore, there is a need to conduct a study on Profitability of vegetable cultivation by the IPM farmers.

1.2 Statement of the Problem

At present, there are three methods or approaches followed in vegetable cultivation. Those are conventional farming system, IPM and organic. Organic vegetable cultivation is sound in environmental aspect but have limitation to gain desire production. In a country like Bangladesh where there is no compromise with production, organic method is not good. Therefore, majority of the farmers cultivate vegetable by following either conventional method or IPM practices. In conventional technique of vegetable cultivation, farmers are only use pesticides to control pest. So, in this regard the cost of production becomes high. Benefit obtained from this very lower than other techniques. In IPM technique pesticides are only used when there are no alternatives. Therefore, cost for pesticides is relatively lower than conventional system. However there may be question arise regarding gaining yield as well as profitability in IPM system. In this regard, following questions should be answered through investigation.

i) What are the characteristics of the IPM vegetable farmers'?

ii) Is vegetable cultivation profitable? If yes, then to what extent vegetable cultivation profitable?

iii) What are the factors that significantly influence IPM vegetable farmer's profitability?

1.3 Specific Objectives of the Study

The following specific objectives were drawn in order to give proper direction to the study:

1. To describe the selected characteristics of the IPM vegetable farmers; the characteristics were as follows:
   i. Age
   ii. Education
   iii. Family size
   iv. Time spent in vegetable farming

v. Experience in vegetable cultivation

vi. Farm size

vii. Training on vegetable cultivation

viii. Annual family income

ix. Organizational participation

x. Extension media contact

xi. Number of vegetable grown

2. To determine the level of profitability of vegetable cultivation by the IPM farmers.
3. To identify the factors that significantly influences profitability of vegetable cultivation.

1.4 Justification of the Study

There are a number of studies have been conducted on vegetable and IPM. Many of them based on the adoption of IPM by the vegetable grower. Some of them focused on farmers' attitude towards effect of IPM. In one hand controlling pest from vegetable can be done through only the use of chemical method. On the other hand, pest can be control by use of IPM. The debate is which one is better especially economic aspect. To get answer, there is a need to conduct study on Profitability of vegetable cultivation by the IPM farmers. So, there is an urgent need to undertake a study on this perspective. The investigator believes that the findings are likely to be helpful to develop at sound policy for the environment friendly agricultural research and extension system of the country.

1.5 Scope of the study

The present study was designed to have an understanding of profitability of vegetable cultivation by the IPM farmers and the characteristics that influence profitability.

The findings of the study will fit to the areas of Bangladesh where physical, socio-economic, cultural and geographic condition do not differ much from those of the study area. Thus, the findings are expected to be useful to students, researchers, extension workers, and particularly for planners in formulating and designing the procedures for maintaining the natural balance. The findings may also be helpful to the field workers of different nation building departments to improve strategies of action to conform environment friendly sustainable production to the rural people. Lastly, the researcher believes that the findings and recommendations of this study will definitely lead to minimize the cost of production for vegetables and simultaneously reduce the risk of environmental damages.

1.6 Assumptions of the Study

An assumption has been defined as "the supposition that an apparent fact or principle is true in light of the available evidence" (Goode, 1945). An assumption is taken as a fact or belief to be true without proof. So the following assumptions were in mind of the researcher while carrying out this study:

i) The respondents included in the sample were capable of furnishing proper responses to the questions of the interview schedule.

ii) Views and opinions furnished by the respondents were the representative views and opinions of the whole population of the study.

iii) The responses furnished by the respondents were reliable and they truly expressed their opinions on the profitability of vegetable cultivation by using Integrated Pest Management (IPM) practices.

iv) The data collected by the researcher were free from bias.

v) The researcher who acted as the interviewer was well adjusted to the social and cultural environment of the study area. Hence, the respondents furnished their correct opinions without any hesitation.

vi) The respondents had almost similar background and seemed to be homogenous to a great extent.

vii) The information sought by the researcher revealed the real situation to satisfy

the objectives of the study.

viii) The findings were useful in choosing the clients as well as for planning execution and evaluation the extension programme.

1.7 Limitations of the Study

The present study was undertaken to have an understanding of the profitability of vegetable cultivation by the Integrated Pest Management (IPM) farmers and to determine the contribution factors with selected characteristics of the farmers. Considering the time, money and other necessary resources available to the researcher and to make the study manageable and meaningful from the point of view of research, it becomes necessary to impose certain limitations. The limitations were as follows:

i. The study was confined in one unions of Savar upazila under Dhaka district.

ii. The study was restricted within the farmers who had some cultivable land under their own cultivation.

iii. The population for the study was kept confined to the heads of the family who regularly cultivated their land.

iv. There were many characteristics of the farmers but in the study only 12 of them were selected for investigation.

v. For information about the study, the researcher depended on the data furnished by the selected respondents during their interview with him.

vi. Major information, facts and figures supplied by the respondents were applicable to the situation prevailing in the locality during the year 2018.

1.8 Definition of Terms

A researcher needs to know the meaning and contents of every term that he uses. 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 defined are interpreted as follows:

Age

Age of a respondent defined as the span of his/her life and is operationally measured by the number of years from his/her birth to the time of interviewing.

Education

Education of a respondents referred on what extent they got formal education from various educational institutes. Are they literate or illiterate? If literate then what extent they literate was also considered as educational background for this study.

Family size

Family size of a respondent referred to the total members in his/her family including him/her, children and other dependents, which live and eat together in a family unit.

Farm size

Farm size referred to the total area on which a farmer's family carries on farming operations, the area being estimated in terms of full benefit to the farmer's family.

Annual family income

Annual income referred to the total annual earnings of all the family members of a respondent from agriculture, livestock and fisheries and other accessible sources (business, service, daily working etc.).

Organizational participation

Organization participation of an individual refers to his participation in various organizations as ordinary member, executive committee member or executive officer within a specified period of time.

Extension media contact

It referred to an individual's (farmer) exposure to or contact with different communication media, source and personalities being used for dissemination of new technologies.

Integrated pest management (IPM)

According to Food and Agricultural Organization (FAO, 2017) IPM can be defined as "A pest management system that, in the context of the associated environment and the population dynamics of the pest species, utilizes all suitable techniques and methods in a compatible manner as possible and maintains the pest populations at levels below those causing economic injury." In this study, IPM practices means 10 selected IPM practices generally advocate by Department of Agricultural Extension (DAE) and Bangladesh Rice Research Institute (BRRI) to practice in rice cultivation.

Profitability

Profitability refers in this study as benefit cost ratio of the IPM vegetable farmers. This means the ratio between gross income or benefit from a vegetable and what is the cost of that vegetable.

CHAPTER II

REVIEW OF LITERATURE

The purpose of this chapter is to review of literature having relevance to the present study. The researcher made an elaborate search of available literature for the above purpose. But it is rare to find a study dealing with the cultivation of vegetable cultivation by the Integrated Pest Management (IPM) farmers and the relationship with their selected characteristics. The researcher attempted to search the literatures and found few studies on the use of vegetable cultivation with IPM technologies and the level of profitability. Therefore, the finding of such studies has been cited in this chapter.

This Chapter is divided into four major sections. The first section deals with vegetable cultivation and IPM practices. The second section deals with the profitability of vegetable cultivation including other crops. The third section deals with the relationship between the selected characteristics of the IPM vegetable farmers with profitability and the fourth sections deals with the conceptual frame work of the study.

2.1 Vegetable Cultivation and IPM Practices

2.1.1 Vegetable Cultivation

Vegetables are considered an indispensable part of the Bangladeshi diet. So, they play an important role in the crop sub-sector through providing nutrition, enhancing food security and ensuring profitability from the economical point of view. In Bangladesh, as many as 95 types of vegetables are grown on 2.18% of the cultivated land, thereby contributing 4.67% of the total production and also contributing 3.7% to the national GDP (BARC, 2004; BBS, 2011). From the picture of last ten years it was observed that there is an increasing trend of vegetable cultivation in Bangladesh.

In Bangladesh, about 95 types of vegetable are grown and among them the major vegetables are eggplant, cucurbits, tomato, bean, okra, cabbage and cauliflower. The

IPM vegetable project also focuses on these selected vegetables. A short description about these vegetables is given below.

Eggplant

Eggplant is the staple vegetable crop in Bangladesh. It covers 16.89% of the total vegetable cultivation area (Siddique and Azad, 2010). The average yield and total production of eggplant is 5862 kg/acre and 341262 metric ton respectively (BBS, 2011). This vegetable can be cultivated both during winter and summer.

Tomato

The national average yield of tomato is 3232 kg/acre and the overall production is 190213 metric ton (BBS, 2011). It covers 6.22 % of the total vegetable cultivation area (Siddique and Azad, 2010). In the past, tomato is grown only during winter. Nowadays, the vegetable is grown both during winter and summer though the summer yield is much lower than the winter yield.

Cucurbits

Cucurbits are not a single vegetable rather the vegetables that are under cucurbitaceae family is called cucurbits. The common cucurbits that are produced in Bangladesh are cucumber, bitter gourd, water gourd, pointed gourd, ribbed gourd, snake gourd, pumpkin, teasle gourd and bottle gourd. The national aggregate production of these cucurbits is about 608,400 metric tons annually (Harris, 2011).

Cabbage

Cabbage is a winter vegetable and sown in the late of October to mid November and harvested from early January to early March. Cabbage is grown on over 41,000 acres of the cultivated area across the country with an overall production of 219,958 metric tons (BBS, 2011).

Cauliflower

Like cabbage, Cauliflower is also a winter vegetable. Interestingly, the sowing and harvesting period of these two winter vegetables are the same. Cauliflower covers 41,211 acres of land, and this is slightly more than the cultivated area of Cabbage (BBS, 2011).

Bean

Bean individually covers about 5% of the total vegetable cultivation area (Siddique and Azad, 2010). The average yield and total production of this vegetable is 2161 acre/kg and 88581 metric tons respectively (BBS, 2011).

Okra

Another name of Okra is Lady's finger. The vegetable can be grown all the year around though the major production is in summer. Summer Okra is sown from mid April to mid June and harvested from June to mid September. Winter Okra is sown from mid September to mid December and harvested from November to March. The area, yield and production of this vegetable are 25204 acres, 1681 kg/acre and 42366 metric ton respectively (BBS, 2011).

2.1.2 IPM practices

IPM is an approach where pests are controlled by using a number of environment friendly practices or technologies. Though these technologies are similar across the countries, to some extent, they may also vary. This variation occurs from country to country as well as from crop to crop. Over the years, several IPM technologies have been developed in Bangladesh. Some of these technologies are presented below.

Biological control: Biological control means managing pests with natural enemies (Shelton, 2010). Natural enemies of insect pest are usually called bio-control agents or beneficial insects, and include predators, parasitoid sand pathogen. According to Alam (2003) nearly every field crop insect pest have natural enemy. In some cases, one insect pest has several natural enemies. For example, eggplant fruit and shoot borer has about 20 natural enemies' including one predator, 16 parasitoids and 3 pathogens. Trichogramma and Bracon are the most common beneficial insects used in controlling harmful insect from vegetables. Trichogramma is a small parasitic wasp that attacks over 200species of moths (Islam, 2010). On the other hand, Bracon eat larvae of many harmful insects.

Cultural control: Cultural control is the manipulation of the agro-ecosystem in order to make the cropping system less friendly to the establishment and proliferation of pest populations. Use of pest tolerant or resistant crop varieties

Mechanical control: Mechanical pest control is the management and control of pests using physical means such as fences, barriers or electronic wires. It includes also weeding and change of temperature to control pests. For example hand picking, flooding to minimize the incidence of insect pest.

Pheromone trap

Pheromone trap is a technology where pheromone, a female sex hormone, is inserted into the soapy water inside a plastic trap. The purpose is to attract the male insect and to kill it. Since insects are killed through the use of sex hormone thus the technology is also called Sex pheromone. The technology has proven to be highly effective for killing fruit fly and other insects (Nasiruddin et al., 2004).

Botanicals

Botanicals are pesticides derived from plants. It is processed into dust and powder made from dried leaves, seeds, roots and flowers. Botanicals generally act in two ways: as contact poison when sprayed on the insect or as stomach poison when eaten. It degrades within a few hours or days but it should be used more frequently.

2.2 Profitability of Vegetable Cultivation Including other Crops

Akhter *et al*., (2011) conducted a study on "An economic analysis of winter vegetables production in some selected areas of Narsingdi district". The studies revealed that production of all the selected vegetables were profitable. The per hectare gross cost of production of tomato, cauliflower and cabbage were Tk. 118000, 116977 and 120522, respectively and the corresponding gross returns were Tk. 217020, 210000 and 220000, respectively. The per hectare net returns of producing tomato, cauliflower and cabbage were Tk. 97000, 93023 and 99478, respectively.

Ameer *et al.,* (2008) revealed that maximum yield (9639.3 kg ha-1) was obtained in T-7010, closely followed by T-7012 and T-7008 with 8002.7 and 7897.9 kgha-1, respectively.

Hossain *et al.,* (2004) reported that tomato variety BARI 7 produced the highest yield (57.02 t/ha) and BARI 5 produced the lowest yield (51.38 t/ha). Evaluated seven promising tomato cultivars and found that DT-39 was the earliest to flower (53.5 days), HYT-1 recorded the highest fruit yield of 41.05 t/ha which was at par with that of

Selection-7 (35.31 t/ha) and RHRT-33-1 recorded the longest shelf life (15 days), followed by RHRT-6-1(14 days).

Adenuga *et al.,* (2013) reported that tomato is one of the major fruit vegetables in Nigeria. In view of its seasonal availability and the need to make it available all-year round, effort must be made to increase efficiency of its production especially during the dry season. A study was therefore carried out to examine the economics of dry season tomato production in Kwara state, Nigeria. Results of the study showed that a gross margin of N 18,956.75/ha (US$ 120.74/ha) was realized from dry season tomato production.

Rashid (1994) conducted a study on the profitability of different cropping patterns with and without potatoes in two villages in Dinajpur district. The average yields per hectare were 15550 and 4720.54 kg for HYVs and LVs of potatoes, respectively and their respective values were TK. 46084.03 and 24574.82. He also observed that the HYVs of potatoes were more profitable than other crops.

Arif (1998) conducted a study on potato production on selected areas of Comilla district. He showed that the per hectare gross returns were TK. 101858.56 , 102358.56 and 101358.56 ; gross costs were TK. 64251.10, 65179.58 and 64741.42; net returns were Tk. 37607.46, 37178.98 and 366617.14 for small, medium and large categories of farmers respectively.

Akhter *et al*., (2001) conducted a survey on potato production in some selected areas of Bangladesh. This study showed that potato production is highly profitable and it could be provide cash money to farmers. In terms of profitability, potato production was more attractive than any other winter vegetables. Per unit yield and gross return of potato were found higher than other competitive crops.

Elias *et al.*, (1980) conducted an economic study on potato production in some selected areas of Bangladesh. They estimated the average per acre production cost of potato at Tk. 7376 and the average gross return at TK. 9931. They obtained average potato yield of 242 mounds per acre.

Elias *et al.*, (1982) studied improved technology of potato in two district of Bangladesh, Bogra and Munshigonj. They found that the yield per acre hectre was much higher Munshigonj (25009 kg) than that of Bogra (13278 kg). They estimated average net

return per hectre was TK. 7211 which was higher in Munshigonj (TK. 8751) than in Bogra (TK. 4953).

Sabur (1988) conducted a study on Marketed surplus of potato in two districts of Bangladesh, he found that production and marketed surplus of potato moved in some positive direction. He observed that the average production cost per hectare was TK. 29635.57 and net return was TK. 30947.82.

Das (1992) conducted a study on the profitability of potato cultivation and found that the average yield of potato was 4720 kg per hectare and the average gross return amounted to TK. 33040 per hectare. He calculated the per hectare net return above full-costs at TK. 11085.89.

Hakim (1993) conducted a comparative economic study on cardinal and multi varieties of potatoes in Bogra district. He found that per hectare total costs were TK. 32097.25 and TK. 30818.50 for cardinal and multi varieties respectively. The costs were estimated at TK. 15896.15 and 12701.60. Net returns per hectare on full costs basis were TK. 45196.65 and 451.65.

Haque *et al*., (2011) conducted a study on profitability of onion cultivation in some selected areas of Bangladesh and found that cultivation of onion is profitable. Moreover, they found that profit obtained from onion cultivation was higher than that of other competitive crops like mustard, groundnut, and cabbage.

Rahman *et al*., (2016) conducted a study on brinjal production in Jamalpur district through profitability analysis and factors affecting the production and found that production on brinjal is profitable.

Hasan *et al*., (2014) conducted a study on profitability of important summer vegetables in Keranigonj upazila of Bangladesh and found that cultivation of summer vegetable is profitable. Moreover, they found that profit obtained from summer vegetable cultivation was higher than that of other competitive crops like bottle gourd and cucumber.

Haque (2001) observed that in most of the vegetable production the MVP of human labour was greater than one and it was also significant implying that it was a very crucial input and there prevails a great chance to generate employment.

2.3 Relationship between characteristics of IPM vegetable farmers and Profitability

2.3.1 Relationship between age and profitability

Mwangi *et al.,* (2015) conducted a study on factors influencing profitability of diversified cash crop farming among smallholder tea farmers in Gatanga district, Kenya and found that age had no significant effect on profitability with IPM.

Venance *et al.,* (2016) conducted a study on factors influencing on-farm common bean profitability; the case of smallholder bean farmers in babati district, Tanzania and found that age had positive significant effect on profitability with IPM.

Gupta *et al.,* (2006) conducted a study on Is environmentally friendly agriculture less profitable for farmers? Evidence on Integrated Pest Management in Bangladesh and found that age had positive significant effect on profitability with IPM.

Adenuga *et al.,* (2013) conducted a study on carried out to examine the economics of dry season tomato production in Kwara state, Nigeria and found that age had positive significant effect on profitability with IPM.

Hoque and Haque (2014) conducted a study on socio-economic factors influencing profitability of rice seed production in selected areas of Bangladesh and found that age had positive significant effect on profitability with IPM.

2.3.2 Relationship between education and profitability

Mwangi *et al.,* (2015) conducted a study on factors influencing profitability of diversified cash crop farming among smallholder tea farmers in Gatanga district, Kenya and found that education had no significant effect on profitability with IPM.

Gupta *et al.,* (2006) conducted a study on Is environmentally friendly agriculture less profitable for farmers? Evidence on Integrated Pest Management in Bangladesh and found that education had positive significant effect on profitability with IPM.

Adenuga *et al.,* (2013) conducted a study on carried out to examine the economics of dry season tomato production in Kwara state, Nigeria and found that education had positive significant effect on profitability with IPM.

Hoque and Haque (2014) conducted a study on socio-economic factors influencing profitability of rice seed production in selected areas of Bangladesh and found that education had no significant effect on profitability with IPM.

Khan (2004) conducted a study on productivity and resource use efficiency of boro rice cultivation in some selected haor areas of Kishoreganj district.reported that level of education significantly affected the return of Boro rice.

2.3.3 Relationship between family size and profitability

Venance *et al*., (2016) conducted a study on factors influencing on-farm common bean profitability; the case of smallholder bean farmers in babati district, Tanzania and found that household size had no significant effect on profitability with IPM.

Hoque and Haque (2014) conducted a study on socio-economic factors influencing profitability of rice seed production in selected areas of Bangladesh and found that family size had no significant effect on profitability with IPM.

Khan (2004) conducted a study on productivity and resource use efficiency of Boro rice cultivation in some selected Haor Areas of Kishoreganj District.reported that family size significantly affected the return of Boro rice.

2.3.4 Relationship between time spend and profitability

There was no available review of literature about on time spend in vegetable cultivation and profitability.

2.3.5 Relationship between experience and profitability

Mwangi *et al*.,(2015) conducted a study on factors influencing profitability of diversified cash crop farming among smallholder tea farmers in Gatanga district, Kenya and found that experience had positive significant effect on profitability with IPM.

Venance *et al.*, (2016) conducted a study on factors influencing on-farm common bean profitability; the case of smallholder bean farmers in babati district, Tanzania and found

that age had no significant effect on profitability with IPM.

Gupta *et al.,* (2006) conducted a study on Is environmentally friendly agriculture less profitable for farmers? Evidence on Integrated Pest Management in Bangladesh and found that experience had no significant effect on profitability with IPM.

Hoque and Haque (2014) conducted a study on socio-economic factors influencing profitability of rice seed production in selected areas of Bangladesh and found that experience had no significant effect on profitability with IPM.

2.3.6 Relationship between farm size and profitability

Mwangi *et al.,* (2015) conducted a study on factors influencing profitability of diversified cash crop farming among smallholder tea farmers in Gatanga district, Kenya and found that farm size had no significant effect on profitability with IPM.

Venance *et al.,* (2016) conducted a study on factors influencing on-farm common bean profitability; the case of smallholder bean farmers in babati district, Tanzania and found that land size had no significant effect on profitability with IPM.

Gupta *et al.,* (2006) conducted a study on Is environmentally friendly agriculture less profitable for farmers? Evidence on Integrated Pest Management in Bangladesh and found that farm size had no significant effect on profitability with IPM.

CIAT (2008) Common bean is a popular crop among small-scale farmers because beans are a short duration crop (2.5-4 months) which permits production even when rainfall is erratic.

Hoque and Haque (2014) conducted a study on socio-economic factors influencing profitability of rice seed production in selected areas of Bangladesh and found that farm size had positive significant effect on profitability with IPM.

2.3.7 Relationship between training and profitability

Gupta *et al*., (2006) conducted a study on Is environmentally friendly agriculture less profitable for farmers? Evidence on Integrated Pest Management in Bangladesh and found that training had positive significant effect on profitability with IPM.

Hoque and Haque (2014) conducted a study on socio-economic factors influencing profitability of rice seed production in selected areas of Bangladesh and found that training had no significant effect on profitability with IPM.

2.3.8 Relationship between income and profitability

Mwangi *et al.,* (2015) conducted a study on factors influencing profitability of diversified cash crop farming among smallholder tea farmers in Gatanga district, Kenya and found that income had no significant effect on profitability with IPM.

Venance *et al.,* (2016) conducted a study on factors influencing on-farm common bean profitability; the case of smallholder bean farmers in babati district, Tanzania and found that income had no significant effect on profitability with IPM.

Gowda *et al*., (2009) found that food legumes have higher prices, compared to cereals, and are increasingly grown to supplement farmers' incomes and Giller (2012) also found the same result.

NBS, *(*2012) found that Common bean (*Phaseolus vulgaris L.)* is the most important food legume for direct consumption and as a source of farm income in Tanzania.

Islam (2010) commented that from the economic point of view, if the farmers get minimum 1:1.50 taka for every taka of investment then it seems to be cost effective and the benefit is economically acceptable.

Hoque and Haque (2014) conducted a study on Socio-economic factors influencing profitability of rice seed production in selected areas of Bangladesh and found that income had no significant effect on profitability with IPM.

2.3.9 Relationship between organizational participation and profitability

There was no available review of literature about organizational participation and profitability.

2.3.10 Relationship between extension contact and profitability

Mwangi *et al.,* (2015) conducted a study on factors influencing profitability of

diversified cash crop farming among smallholder tea farmers in Gatanga district, Kenya and found that extension contact had no significant effect on profitability with IPM.

Venance *et al*., (2016) conducted a study on factors influencing on-farm common bean profitability; the case of smallholder bean farmers in Babati district, Tanzania and found that access to extension had no significant effect on profitability with IPM.

2.3.11 Relationship between number of vegetable grown and profitability

No literature was available regarding the relationship between the number of vegetable grown and profitability.

2.4 The Conceptual Framework of the Study

This study is concerned with the profitability of vegetables cultivation by the Integrated Pest Management (IPM) farmers. Thus the profitability was the main focus of the study and 11 selected characteristics of the farmers were considered as those might have relationship with profitability. It is not possible to deal with all the factors in a single study. Therefore, it was necessary to limit the factors, which included age, education, family size, time spent in vegetable cultivation, experience in vegetable cultivation, farm size, training on vegetable cultivation, annual family income, organizational participation, extension media contact and number of vegetables grown. The conceptual framework of the study has been presented in Fig. 2.1.

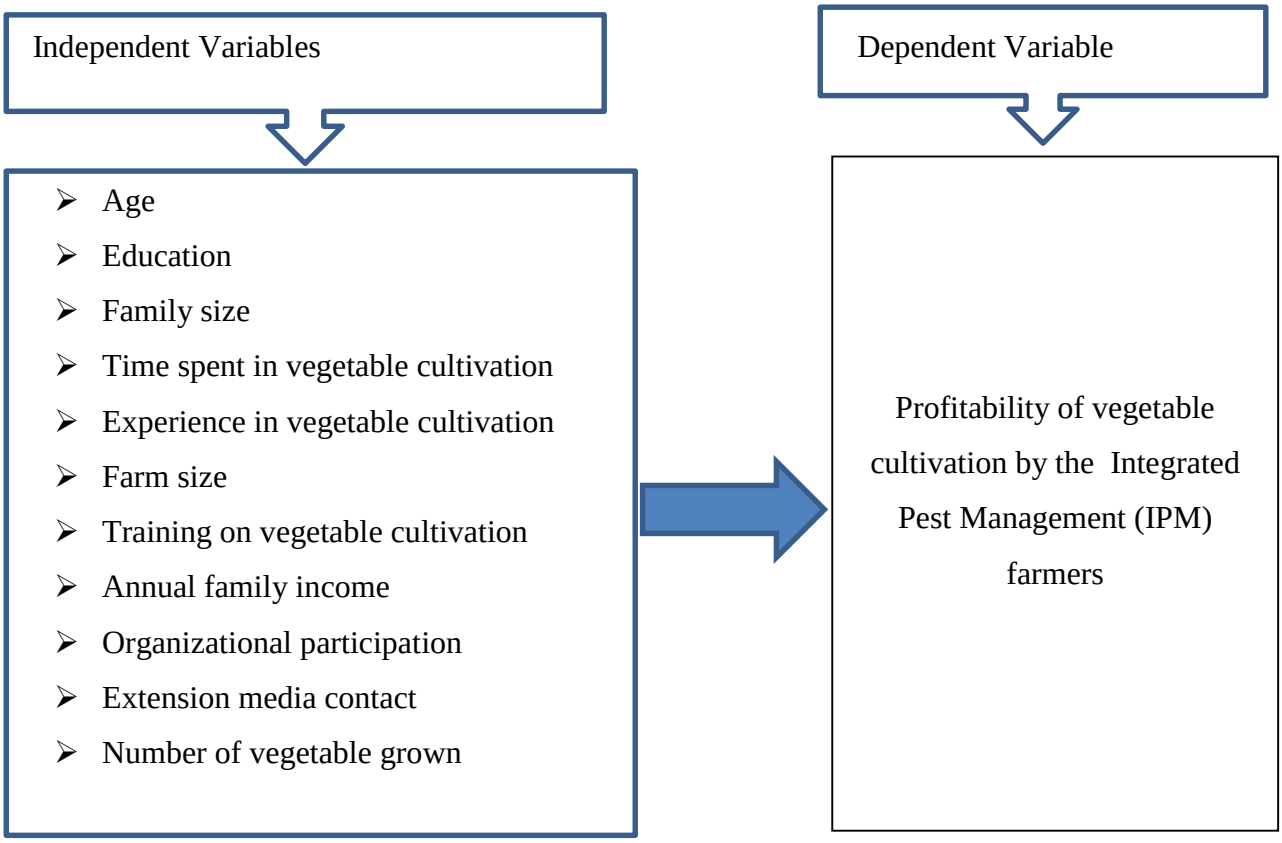

Figure 2.1: Conceptual framework of the study

CHAPTER III

METHODOLOGY

Methods and procedures used in conducting research need very careful consideration. Methodology should be such that enables the researcher to collect valid information and to analyze them properly to arrive at correct decisions. The methods and procedures followed in this research are described in this chapter.

3.1 Locale of the Study

The study was conducted at Savar upazila under Dhaka district. Savar is located at 23.8583°N 90.2667°E . It has 66956 units of household and a total area of 280.13 km². It is bounded by Kaliakair and Gazipur Sadar upazilas on the north, Keraniganj upazila on the south, Mirpur, Mohammadpur, Pallabi and Uttara thanas of Dhaka City on the east and Dhamrai and Singair upazilas on the west. The land of the upazila is composed of alluvium soil of the Pleistocene period. The height of the land gradually increases from the east to the west. The southern part of the upazila is composed of the alluvium soil of the Bangshi and Dhalashwari rivers. Main rivers are Bangshi, Turag, Buriganga and Karnatali.

Dhaka District was purposively selected as the locale of the study. There are 6 upazilas in the district. Among those Savar upazila was selected randomly for this study. Savar upazila is one of leading upazila in vegetable cultivation .The researcher is very familiar with the local of the study area from his childhood. The map of Savar Upazila under Dhaka district showing the study area is presented in fig 3.1 and 3.2.

3.2 Population and Sample

Considering research issue, time and budget the study was conducted in selected villages of Tetuljhora union of ‘Savar Upazila’ under ‘Dhaka’ District. The IPM vegetables farmers of selected two villages under Tetuljhora were constituted as the population of the study. There were 459 vegetable farmers’ in the selected villages which was constituted the population of the study.

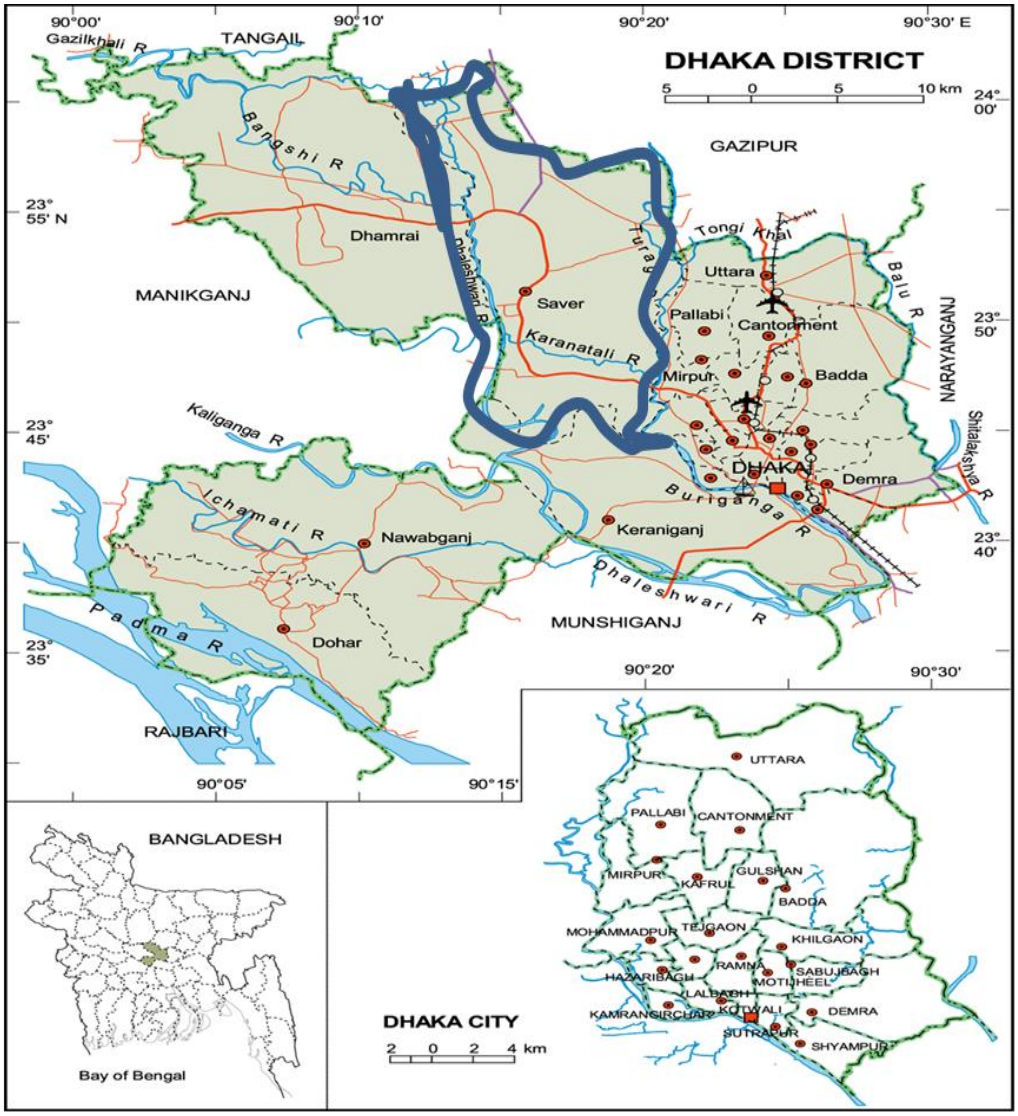

Figure 3.1: Map of Dhaka District showing Savar Upazila

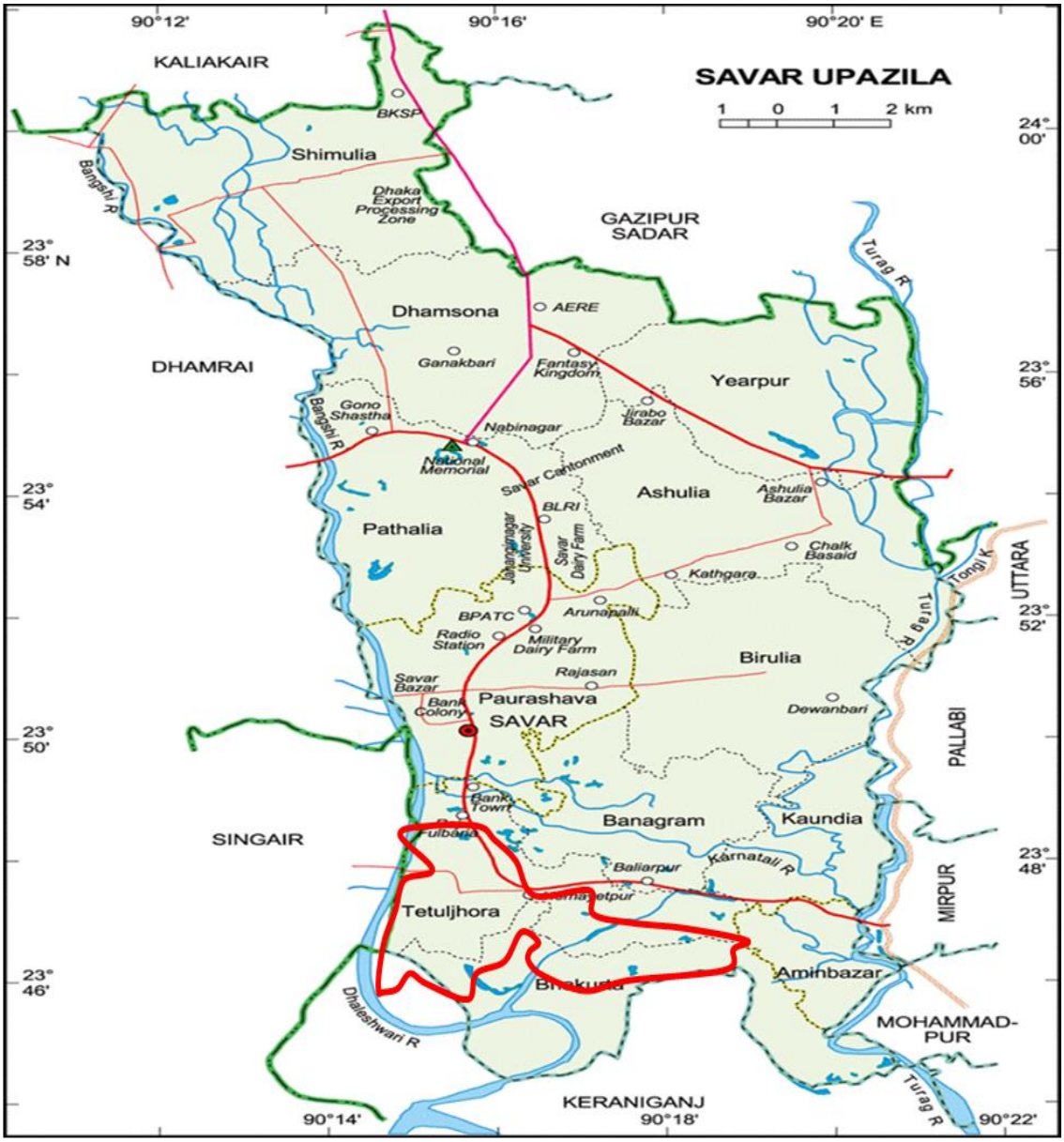

Figure 3.2: Map of Savar Upazila showing Tetuljhora Union

Out of the 459 IPM vegetable farmers a sample of 115 (25% of 459) were selected proportionately and randomly as the sample for this study. Besides this, a reserved list of 12 (10% of total sample) vegetable farmers was prepared by taking randomly for each village for use when the IPM vegetable farmers under samples were not available during data collection. The Distribution of the vegetable farmers constituting the population, Sample and reserve list are showing in table 3.1.

Table 3.1 Distribution of the IPM vegetable farmers constituting the population, Sample and reserve list

Name of Villages	No. of farmers		Reserve List
	Population	Sample	
Jhauchar	276	69	7
Harindhara	183	46	5
Total	**459**	**115**	**12**

3.3 Instrument of Data Collection

In order to collect valid and reliable data from the farmers interview schedule (questionnaire) was designed keeping the objectives in mind. Simple and direct questions and different scales were used to obtain information. Both open and closed form questions were designed to obtain information relating to qualitative variable which was finally be measured by adding score. The interview schedule was pre-tested with 10 sample respondents from the study area. Questions were asked systematically and explanations were made whenever it is necessary. The respondents were interviewed at their leisure time so that they can give accurate information in a cool mind.

3.4 Data Collection Procedure

Data were collected through personal interviewing by the researcher himself. The researcher made all possible efforts to establish rapport with the respondent so that they could feel ease and comfort to response the questions in the schedule. Necessary steps were taken to explain the purpose of the study to the respondents and their answers

were recorded sincerely. If any respondent felt difficulty in understanding any question, care was taken to help him getting understood. The researcher did not face any serious problem in data collection. The data collection took 31 days from 25th August to 25th September, 2018. The collected data were complied, tabulated and analyzed. Qualitative data were converted into quantitative form by means of suitable scoring whenever needed.

3.5 Variables of the study

A variable is any characteristics, which can assume varying or different values in successive individual cases. An organized piece of research usually contains at least two important variables viz., dependent and independent variables. But, it is very difficult to deal with all the factors in a single study. Taking the relevant available literature, discussion with teachers, experts and research fellows in the relevant field and considering the time and resources available to the researcher, variables were selected. Profitability of vegetable cultivation by the integrated pest management (IPM) farmers was considered as the dependent variable of the study. The researcher selected eleven characteristics of the respondent as the independent variables. The characteristics includes age, education, family size, time spent in vegetable cultivation, experience in vegetable cultivation, farm size, training on vegetable cultivation, annual family income, organizational participation, extension media contact and number of vegetables grown.

3.6 Measurement of Variable

In order to conduct study in accordance with the objectives, it was necessary to measure the selected variables. This selection contains procedure for measurement of both dependent and independent variables of the study. The procedures followed in measuring the variables are presented below.

3.6.1 Measurement of Independent Variables

The selected characteristics of the respondent farmers constituted the independent variables of the study. To keep the research within the manageable sphere, 11 independent variables were selected for the study. The procedures of measurement of the selected variables were as follows:

3.6.1.1 Age

The age of an individual is one of the important factors pertaining to his personality make up which can play an important role in her adoption behavior. Age of the respondents was measured in terms of actual years from their birth to the time of interview. This variable appears in item number 1 in the interview schedule as presented in Appendix-A.

3.6.1.2 Level of education

Education was measured as the ability of an individual vegetable farmer to read and write or formal education (school/college) completed up to a certain standard. It was expressed in terms of year of schooling. A score of one (1) was assigned for each year of schooling completed. For example, if the respondent passed the SSC examination his education score was given as 10, if passed the final examination of class seven, his education score was given as 7, if the respondent did not know how to read and write, his education score was given as '0' (zero). A score of 0.5 (half) was given to that respondent who could sign his name only. This variable appears in item number 2 in the interview schedule as presented in Appendix-A.

3.6.1.3 Family size

Family size of a respondent was measured in terms of actual number (dependents) of members in his family (including himself) during interview. The actual number given by the respondents made the scoring. This variable appears in item number 3 in the interview schedule as presented in Appendix-A.

3.6.1.4 Time spend in vegetables farming

Time spend in vegetable cultivation by the vegetables growers was measured by total hours per week. This variable appears in item number 4 in the interview schedule as presented in Appendix-A.

3.6.1.5 Experience in vegetable cultivation

In a measuring score of one (1) was assigned for each year of working experience of a respondent either in his own farm or to that of his parents. This variable appears in item number 5 in the interview schedule as presented in Appendix-A.

3.6.1.6 Farm size

Farm land is the most important capital of a farmer and the farm size has influence on many personal characteristics of a farmer. Farm size of the farmer was measured by the land area possessed by him. Data obtained in response to questions under item No. 3 of the interview schedule formed the basis for determining the farm size of the respondent. Here, farm size was computed by using the following formula:

Farm size = $A_1 + A_2 + ½ (A_3+A_4) + A_5+A_6$

A_1 = Homestead Area (A_1)

A_2 = Own land under own cultivation (A_2)

A_3 = Land given to others on borga system (A_3)

A_4 = Land taken from others on borga system (A_4)

A_5 = Land taken from others on lease (A_5)

A_6= Others (Pond, Orchard etc.) (A_6)

The unit of measurement was hectares. This variable appears in item number 6 in the interview schedule as presented in Appendix-A.

3.6.1.7 Training on vegetable cultivation

Training on vegetable cultivation was determined by the total number of days a respondent received training in his/her entire life on vegetable cultivation from different organizations. In a measuring score of 1 was assigned for each days of training. This variable appears in item number 7 in the interview schedule as presented in Appendix-A.

3.6.1.8 Annual income

Annual income of a respondent was measured on the basis of total yearly earning from agriculture and other sources (service, business, daily labour etc.) by the respondent himself and other family members. The value of all the agricultural products encompassing crops, livestock, fisheries, fruits, vegetables etc. were taken into consideration. For calculation a score, of one (1) was assigned for each one thousand taka of income. This variable appears in item number 8 in the interview schedule as

presented in Appendix-A.

3.6.1.9 Organizational participation

Organizational participation of a respondent was measured by computing an organizational participation score according to his/her nature of participation in five (4) selected different organizations up to the time of interview. The organizational participation score was evaluated for each respondent on the basis of participation was the respondent no participation, participation as ordinary member of his/her membership with four different types of organization. The nature of participation was no participation, ordinary member, executive member and participation as secretary/president. The score for the nature of participation was 0, 1, 2 and 3 respectively. Organizational participation score of a respondent was determined by adding together the scores obtained from each of the four types of participation. Organizational participation score of the respondents could range from 0 to 12, where, 0 indicating no participation and 12 indicating highest participation. This variable appears in item number 9 in the interview schedule as presented in Appendix-A.

3.6.1.10 Agricultural extension media contact

The agricultural extension media contact of a respondent was measured on the basis of the extent of his contact with selected 5 media in a scale ranging from- regularly, frequently, occasionally, rarely, not at all. The responses were scored as 4, 3, 2, 1 and 0 respectively. The use of agricultural extension media contact score of the respondents ranged from 0 to 60 where, 0 indicates no contact and 60 indicates very high contact. Based on their extension media contact, the respondents were classified into three categories as low contact, medium contact, and high contact. This variable appears in item number 10 in the interview schedule as presented in Appendix-A.

3.6.1.11 Number of vegetable grown

The number of vegetable grown of the IPM farmers was measured on the basis of types of vegetable grown on their vegetable field in a season. This variable appears in item number 11 in the interview schedule as presented in Appendix-A.

3.7 Measurement of Dependent Variable

Profitability of vegetable cultivation by the IPM farmers was considered as the dependent variable of the study. In this study, profitability was measured in terms of Benefit Cost Ratio. For this, as the farmers cultivated more than one vegetable, at first cost and benefit was calculated individually. Later, a ratio was determined. For more than one vegetable, the average was calculated.

Profitability from vegetables was measured as follows:

$$\text{Profitability} = \frac{\text{Benefit}}{\text{Cost}}$$

For example; a farmer cultivated three vegetables such as carrot, bottle gourd and cauliflower. His costs were 17000, 19000 and 15000 taka and benefit was 40000, 30000 and 25000 taka respectively. Therefore,

In case of carrot the benefit cost ratio is $\frac{40000}{17000} = 2.35$

In case of bottle gourd the benefit cost ratio is $\frac{30000}{19000} = 1.58$

In case of cauliflower the benefit cost ratio is $\frac{25000}{15000} = 1.67$

Then, the profitability = $\frac{\text{Benefit}}{\text{Cost}} = \frac{2.35+1.58+1.67}{3}$

$= 1.86$

3.8 Statement of Hypothesis

A set of hypotheses was formulated for empirical testing. The following null hypothesis was formulated to test the contribution of 11 independent variables with profitability of vegetable cultivation by the integrated pest management (IPM) farmers:

"There is no contribution with profitability of vegetable cultivation by the integrated pest management (IPM) farmers and each of the independent variables of the study."

3.9 Data Processing and Analysis

3.9.1 Compilation of data

After completion of field survey, data from all the interview schedules were coded, compiled, tabulated and analysed in accordance with the objectives of the study. In this process, all responses in the interview schedule were given numerical coded values. Local units were converted into standard units and qualitative data were converted into quantitative data by assigning suitable scores whenever necessary. The responses of the questions in the interview schedule were transferred to a master sheet to facilitate tabulation.

3.9.2 Categorization of data

For describing the different characteristics and their use of technologies, the respondents were classified into several categories. These categories were developed by considering the nature of distribution of data, general understanding prevailing in the social system and possible observed scoring system. The procedure for categorization of data in respect of different variable is elaborately being discussed while describing those variables in chapter 4.

3.9.3 Statistical technique

The analysis was performed using SPSS (Statistical Package for Social Sciences) computer package. Descriptive analyses such as range, number, percentage, mean, standard deviation were used whenever possible. Linear model of regression (β) was used in the order to identifying contributory variables. Throughout the study, at least five percent (0.05) level of probability was used as basis of rejecting a null hypothesis. Co-efficient values significant at 0.05 level is indicated by one asterisk (*), and that at 0.01 level by two asterisks (**).

CHAPTER IV
RESULTS AND DISCUSSION

In this chapter the findings of this study have been discussed in relation to the present findings and also to those found in other studies. The study investigated the profitability of vegetable cultivation by the Integrated Pest Management (IPM) farmers. In accordance with the objectives of the study, presentation of the findings has been made in three sections. The first sections deals about selected characteristics of the IPM farmers. The second section deals about profitability of vegetable cultivation by the Integrated Pest Management (IPM) farmers. And the third section deals about Contribution with the selected characteristics of the IPM farmers and their profitability of vegetable cultivation.

4.1 Selected Characteristics of the IPM Farmers

Eleven characteristics of the farmers were selected for this research. The characteristics include: age, education, family size, time spent in vegetable cultivation, experience in vegetable cultivation, farm size, training on vegetable cultivation, annual family income, organizational participation and extension media contact. Some descriptive statistics of these features are given in Table 4.1 Data contained in the Table 4.1 reveal the salient features of the characteristics of the farmers in order to have an overall picture of these characteristics at a glance. However, for ready reference, separate tables are provided while presenting categorizations, discussing and /or interpreting results concerning each of the characteristics in this chapter.

Table 4.1 The salient features of the selected characteristics of the IPM farmers

Categories	Measuring unit	Rang		Mean	S D
		possible	observed		
Age	Years	-	30-72	50.80	8.81
Education	Year of schooling	-	0.00-16	5.70	4.52
Family size	Member	-	3-9	5.29	1.30
Time spent in vegetable cultivation	Hours	-	21-56	42.50	7.80
Experience in vegetable cultivation	Years	-	10-50	26.13	8.78
Farm size	Hectare	-	0.29-1.06	0.70	0.24
Training on vegetable cultivation	Days	-	0-15	4.01	3.82
Annual family income	'000'taka	-	70-540	320.94	117.04
Organizational participation	Score	0-12	0-8	2.21	2.12
Extension media contact	Score	0-60	4-30	15.04	5.67
Number of vegetables grown	Number of vegetable	-	2-6	4.12	1.36

4.1.1 Age

Age of the farmers ranged from 30 to 72 years, the average being 50.80 years and the standard deviation, 8.81. On the basis of age, the farmers were classified into three categories: "young" (up to 35), "middle aged" (36-50) and "old" (above 50). The distribution of the vegetable growers according to their age is shown in Table 4.2.

Table 4.2 Distribution of the farmers according to their age

Categories	Farmers		Mean	SD
	Number	Percent		
Young aged (up to 35)	3	2.6	50.80	8.81
Middle-aged(36-50)	68	59.1		
Old(>50)	44	38.3		
Total	**115**	**100**		

Table 4.2 showed that the highest proportion 59.1 percent of the vegetable growers fell in the "middle aged" category, while 2.6 percent of them fell in the "young aged" category and 38.3 percent in the "old aged" category. The findings indicate that a large proportion (97.4) of the farmers were middle to old aged.

4.1.2 Education:

The education scores of the farmers ranged from 0 to 16. The average was 5.70 and the standard deviation was 4.52. On the basis of their educational scores, the vegetable growers were classified into four categories, namely "illiterate (0-0.5), primary (1-5), secondary (6-10) and above secondary (above 10). The distribution of the farmers according to their education is shown in Table 4.3.

Table 4.3 Distribution of the farmers according to their education

Categories	Farmers		Mean	SD
	Number	Percent		
Illiterate/can sign only(0-0.5)	36	31.3	5.70	4.52
Primary level(1-5)	10	8.7		
Secondary level(6-10)	48	41.7		
Above secondary level(>10)	21	18.3		
Total	**115**	**100**		

Table 4.3 indicated that the majority (41.7 percent) of the vegetable growers had secondary education compared to 31.3 percent of them having illiterate and can sing. About 21.6 percent of the farmers were primary level education, while 18.3 percent had above secondary level of education. About 70% of the respondents were literate which

is consistent with national average.

Possession of some education by the vegetable growers is a positive aspect in the context of vegetable cultivation. Education helps the vegetable growers to gain knowledge on the improved methods of cultivation by reading books, leaflets, bulletins and other printing materials. Thus, farming community in the study area may be well considered as a suitable ground for the cultivation of vegetable cultivation.

4.1.3 Family size:

The family size of the vegetable growers ranged from 3 to 9 members. The average was 5.29 with a standard deviation of 1.30. On the basis of their family size the farmers were classified into the following three categories: "small family" (up to 4), "medium family" (5-6) and "large family" (above 6). Table 4.4 contains the distribution of the vegetable growers according to their family size.

Table 4.4 Distribution of farmers according to their family size

Categories	**Farmers**		Mean	SD
	Number	Percent		
Small family(up to 4)	31	27.0	5.29	1.30
Medium family(5-6)	66	57.3		
Large family(>6)	18	15.7		
Total	115	100		

Table 4.4 showed that the majority of the 57.3 percent of the vegetable growers had "medium family" of 5 to 6 members compared to more different than 15.7 percent of them having "large family" of above 6 members. The proportion of "small family" was 27.0 percent (Table 4.4). Thus 84.3 percent of the vegetable growers had medium to small families. The average family size was 5.29 which is consistent with national average (BBS, 2017).

4.1.4 Time spends in vegetable cultivation

Time spends in vegetable farm by the farmers varied from 21 to 56 hrs per week with an average of 42.50 and standard deviation of 7.80. Based on their time spends in vegetable farm, the farmers were classified into three categories namely less time spend (up to 27), moderate time spend (28 to 35) and high time spend (above 35). The distribution of the vegetable farmers according to their time spend in vegetable cultivation is presented in Table 4.5.

Table 4.5 Classification of the respondents according to their time spends

Categories	Farmers		Mean	SD
	Number	Percent		
Less time spend (up to 35)	30	26.1	42.50	7.80
Moderate time (36-49)	61	52.0		
High time spend (>49)	24	21.9		
Total	115	100		

Data presented in Table 4.5 indicates that majority (52.0 percent) of the respondents had moderate time spend against 26.1 percent of the respondents had less time spend and 21.9 percent had high time spend in vegetable cultivation. Time spends in vegetable cultivation is helpful to increase knowledge, improve skill and change attitude of the farmers. It also builds confidence of the farmers for making appropriate decisions at the time of need. Generally, time spends in vegetable farming helps to cope up any problematic situation as well as increase skill.

4.1.5 Experience in vegetable cultivation

The experience score of the respondents ranged from 10 to 50. The mean score was 26.13 with the standard deviation 8.78. On the basis of experience, the respondents were classified into three categories namely, low experience, medium experience and high experience, as shown in Table 4.6.

Table 4.6 Distribution of the farmers according to their experience

Categories (Scores)	Farmers		Mean	SD
	Number	Percent		
Low (up to 18)	17	14.8	26.13	8.78
Medium (19-34)	72	62.6		
High (above 34)	26	22.6		
Total	**115**	**100**		

Data contained in the Table 4.7 revealed that the majority (62.6%) of the farmers had medium experience as compared to (14.8%) and (22.6%) having low and high experience respectively. The majority (85.2%) of the respondents had medium to high experience in vegetable cultivation. From the findings it can be said that farmers were engaged with vegetable cultivation since long

4.1.6 Farm size

The farm size of the respondents varied from 0.12 to 1.06 hectares. The average farm size was .70 hectare with a standard deviation of 0.24. The respondents were classified into the following three categories based on their farm size: "marginal farm" (upto 0.2 ha), "small farm" (0.21 – 1.0 ha), and "medium farm" (1.0 -3.0). The distribution of the farmers according to their farm size is shown in Table 4.7.

Table 4.7 Distribution of the farmers according to their farm size

Categories	Farmers		Mean	SD
	Number	Percent		
Marginal farm(up to 0.2 ha)	18	15.7	0.70	0.24
Small farm(0.21-1.0 ha)	72	62.6		
Medium farm(>1.0 ha)	25	21.7		
Total	**115**	**100**		

Table 4.6 indicated that more than half (62.6 percent) of the farmers possessed small farms compared to above 21.7 percent of them having medium farms and 15.7 percent marginal farms. Thus, the overwhelming majority 84.3 percent of the farmers were the

owners of small to medium farms. Majority of the farmers were under small farmer's category which is consistent with national scenario.

4.1.7 Training on vegetable cultivation

Training on vegetable cultivation score of the respondents was found to be varying from 0 to 15 days with an average of 4.01 and standard deviation of 3.82. Based on their score, the farmers were classified into three categories as shown in Table 4.8.

Table 4.8 Distribution of the farmers according to their training

Categories	Farmers		Mean	SD
	Number	Percent		
Low training (up to 1)	24	20.9	4.01	3.82
Medium training (2-7)	71	61.7		
High training (above 7)	20	17.4		
Total	**115**	**100**		

The Table 4.8 indicate that the majority (61.7%) of the farmers had medium training on vegetable cultivation that comprised by 20.9 percent and 17.4 percent farmers have low training and high training on vegetable cultivation. The majority (82.6%) of the respondents had low to medium training on vegetable cultivation.

4.1.8 Annual family income

Annual income score of the respondents ranged from 70 to 540 (in thousands) with an average of 320.94 and standard deviation 117.04. On the basis of the annual income, the respondents were classified into three categories as shown in Table 4.9.

Table 4.9 Distribution of the farmers according to their annual income

Categories	Farmers		Mean	SD
	Number	Percent		
Low income (up to 203)	19	16.5	320.94	117.04
Medium income (204-337)	78	67.8		
High income (above 337)	18	15.7		
Total	**115**	**100**		

Data presented in Table 4.9 indicate that the highest proportion (67.8 percent) of the respondent to medium annual income, while (16.5 percent) had low income and (15.7 percent) had high income. As a result, the most (84.3 percent) of the respondents in the study area were low to medium income earners.

The average income of the respondents in the study area was much higher than the average per capita income of the country i.e. 1751 U.S. dollar (BBS, 2018). This might be due to the fact that the respondents in the study area were not only engaged in agriculture but also earn from other sources, such as service, business etc. Higher annual income of the respondents allows them to invest more in vegetable operations.

4.1.9 Organizational participation

The possible organizational participation score of the respondent ranged from 0 to 12.The observed organizational participation score of the respondents ranged from 0 to 8. The mean score was 2.21 with the standard deviation 2.12. From the observed range, on the basis of organizational participation, the respondents were classified into four categories namely, no organizational participation, low organizational participation, medium organizational participation and high organizational participation, as shown in Table 4.10.

Table 4.10 Distribution of the farmers according to their organizational participation

Categories (Scores)	Farmers		Mean	SD
	Number	Percent		
No (0)	18	15.7	2.21	2.12
Low (up to 3)	72	62.6		
Medium (4-6)	17	14.7		
High (above 6)	8	7.0		
Total	115	100		

Data contained in the Table 4.10 revealed that the majority (62.6%) of the farmers had low organizational participation as compared to (15.7%) and (14.7%) having no and

medium organizational participation respectively. And only 7.0 percent of the farmers' had high organizational participation.

4.1.10 Extension Media contact

The possible extension media contact score of the respondent ranged from 0 to 60. Extension media contact scores of the farmers ranged from 4 to 30 with an average of 15.04 and standard deviation of 5.67. On the basis of their media contact, the respondents were classified into three categories namely, low contact, medium contact and high contact. The scale used for computing the media contact score of a respondent is given Table 4.11.

Table 4.11 Distribution of the farmers according to their media contact

Categories (Scores)	Farmers		Mean	SD
	Number	Percent		
Low (up to 10)	25	21.7	15.04	5.67
Medium (11-20)	79	60.0		
High (above 20)	21	18.3		
Total	115	100		

Data contained in the Table 4.11 indicated that the highest proportion (60.0%) of the respondents had medium extension media contact as compared to (21.7%) and (18.3%) having low and high extension media contact respectively. The majority (81.7%) of the respondents had low to medium extension contact in vegetable cultivation.

4.1.11 Number of vegetables grown

Number of Vegetable grown scores of the farmers ranged from 2 to 6 with an average of 4.12 and standard deviation of 1.58. On the basis of their vegetable grown, the respondents were classified into three categories namely, small, medium and large grown. The scale used for computing the vegetable grown score of a respondent is given Table 4.12.

Table 4.12 Distribution of the farmers according to their number of vegetable grown

Categories (number)	Farmers		Mean	SD
	Number	Percent		
Low (up to 2)	5	4.4	2.49	1.36
Medium (3-4)	49	42.6		
High (above 4)	61	53.0		
Total	115	100		

Data contained in the Table 4.12 indicated that the highest proportion (53.0%) of the respondents had large vegetable grown type as compared to (42.6%) and (4.4%) having medium and small vegetable grown respectively. The types vegetable that are commonly grown by the farmers likes cauliflower, cabbage, bottle gourd and carrot.

4.2 Profitability of vegetable cultivation by the Integrated Pest Management (IPM) farmers

Profitability of vegetable cultivation by the Integrated Pest Management (IPM) farmers was the dependent variable of the study. The observed profitability scores of the respondents ranged from 0 to 3.40. The mean scores were 1.46 with the standard deviation of 0.55. Based on their profitability scores, the respondents were classified into three categories namely low profit, medium profit and high profit as shown in Table 4.13.

Table 4.13 Distribution of the farmers according to their profitability

Categories (Scores)	Farmers		Mean	SD
	Number	Percent		
Low (up to 1.1)	12	10.4	1.46	0.55
Medium (1.11-2)	86	74.8		
High (above 2)	17	14.8		
Total	115	100		

Data contained in the Table 4.13 revealed that the majority (74.8%) of the IPM vegetable farmers had medium profit from vegetable cultivation as compared to

(14.8%) and (10.4%) having high and low profit from vegetable cultivation respectively. The majority (89.6%) of the IPM farmers had medium to high profitability in vegetable cultivation.

4.3 The Contribution of the selected characteristics of the respondents on their Profitability of vegetable cultivation

In order to estimate the farmers profitability of vegetable cultivation by the integrated pest management (IPM) farmers, the multiple regression analysis was used which is shown in the Table 4.14**.**

Table 4.14 Multiple regression coefficients of the contributing variables related to profitability of vegetable cultivation by the Integrated Pest Management (IPM) farmers

Dependent variable	Independent Variable	β	P	R^2	Adj. R^2	F
Profitability of vegetable cultivation	Age	-0.010	0.947	0.536	0.487	10.83
	Level of education	0.232	0.047*			
	Family size	-0.014	0.868			
	Time spent in vegetable cultivation	-0.049	0.600			
	Experience in vegetable cultivation	-0.004	0.978			
	Farm size	-0.070	0.395			
	Training on vegetable cultivation	0.254	0.005**			
	Annual family income	0.170	0.036*			
	Organizational participation	0.324	0.005**			
	Extension media contact	-0.173	0.101			
	No of vegetable grown	0.247	0.001**			

** Significant at p<0.01;

*Significant at $p<0.05$

Table 4.14 shows that number of vegetable grown, organizational participation, training on vegetable cultivation, annual family income and level of education of the respondents had significant positive contribution with their profitability of vegetable cultivation by the integrated pest management (IPM) farmers. Of these, vegetable grown, organizational participation, training on vegetable cultivation were the most important contributing factors (significant at the 1% level of significance) and annual family income and education were less important contributing factors (significant at 5% level of significance). Coefficients of other selected variables don't have any contribution on their profitability of vegetable cultivation.

The value of R^2 is a measure of how of the variability in the dependent variable is accounted by the independent variables. So, the value of R^2 = 0.536 means that independent variables accounts for 53% of the variation with their profitability of vegetable cultivation by the integrated pest management (IPM) farmers. The F ratio is 10.83 which is highly significant ($p<0$).

However, each predictor may explain some of the variance in respondents their profitability of vegetable cultivation simply by chanced. The adjusted R^2 value penalizes the addition of extraneous predictors in the model, but value 0.487 is still show that variance is farmers their profitability of vegetable cultivation by the integrated pest management (IPM) farmers can be attributed to the predictor variables rather than by chanced (Table 4.13). In summary, the models suggest that the respective authority should be considers the farmers' number of vegetable grown, organizational participation, training on vegetable cultivation, annual family income, and level of education on their profitability of vegetable cultivation and in this connection some predictive importance has been discussed below:

4.3.1 Contribution of number of vegetable grown on the farmers profitability of IPM vegetable cultivation

From the multiple regression, it was concluded that the contribution of number of vegetable grown to the farmers' profitability of vegetable cultivation was measured by the testing the following null hypothesis;

"There is no contribution of number of vegetable grown by the IPM farmers to their profitability of vegetable cultivation".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The analysis showed that number of vegetable grown was significant at 1% level of probability.
b. The null hypothesis could be rejected.
c. The direction between number of vegetable grown and profitability was positive.

The b-value of number of vegetable grown was (0.247). So, it can be stated that as number of vegetable grown increased by one unit, farmers' profitability of vegetable cultivation increased by 0.324 units.

Based on the above finding, it can be said that IPM farmers had more number of vegetable grown increased IPM farmers' profitability of vegetable cultivation. This may be due to the fact that much number of vegetable grown is safety regarding economic region. In some case, if farmers get loss for some specific vegetable but a number of vegetable cultivation makes them positive on an average.

4.3.2 Contribution of organizational participation on the farmers profitability of IPM vegetable cultivation

From the multiple regression, it was concluded that the contribution of organizational participation to the farmers' profitability of vegetable cultivation was measured by the testing the following null hypothesis;

"There is no contribution of organizational participation of the IPM farmers to their profitability of vegetable cultivation".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the organizational participation of the IPM farmer to their profitability of vegetable cultivation was significant at 1% level (.005)
b. So, the null hypothesis could be rejected.

c. The direction between organizational participation and profitability was positive.

The b-value of organizational participation was (0.324). So, it can be stated that as organizational participation increased by one unit, farmers' profitability of vegetable cultivation increased by 0.324 units.

Based on the above finding, it can be said that IPM farmers had more organizational participation increased IPM farmers profitability of vegetable cultivation. So, Organizational participation has high significantly contributed to the IPM farmers' profitability of vegetable cultivation. Organizational participation increase farmer's knowledge about various aspect which helps farmers make enough profit by vegetable cultivation.

4.3.3 Significant contribution of training on vegetable cultivation on the farmers profitability of IPM vegetable cultivation

Training on vegetable cultivation was one of the independent variable. To test whether this variable was significant or not following null hypothesis was tested.

"There is no contribution of training on vegetable cultivation to the IPM farmers profitability of vegetable cultivation".

The analysis showed that training on vegetable cultivation was significant at 1% level of probability. The direction between training on and profitability was positive.

Based on the above finding, it can be said that IPM farmers had more training on vegetable cultivation it will increase the profitability of vegetable cultivation. So, training on vegetable cultivation has high significantly contributed to the IPM farmers' profitability of vegetable cultivation. Training helps farmers to gather more knowledge on vegetable cultivation which ultimately helps farmers grain more profitability by vegetable cultivation.

4.3.4 Contribution of annual family income on the farmers' profitability of IPM vegetable cultivation

From the multiple regression, it was concluded that the contribution of annual family income on the farmers' profitability of vegetable cultivation was measured by the testing the following null hypothesis;

"There is no contribution of annual family income to the IPM farmers' profitability of vegetable cultivation".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the annual family income was significant at 5% level (.036)

b. So, the null hypothesis could be rejected.

c. The direction between annual family income and profitability was positive.

The b-value of annual family income was (0.170). So, it can be stated that as annual family income increased by one unit, farmers' profitability of vegetable cultivation increased by 0.170 units.

Based on the above finding, it can be said that the IPM farmers who had more annual family income increased farmers' profitability of vegetable cultivation increase. So, annual family income has high significantly contributed to the IPM farmers profitability of vegetable cultivation. Annual family income makes farmers self-dependent which helps farmers to satisfy on vegetable cultivation.

4.3.5 Significant contribution of education on the farmers' profitability of IPM vegetable cultivation

Education on vegetable cultivation was one of the independent variable. To test whether this variable was significant or not following null hypothesis was tested.

"There is no contribution of education to the IPM farmers' profitability of vegetable cultivation".

The analysis showed that education on vegetable cultivation was significant at 5% level of probability. The direction between education and profitability was also positive.

Based on the above finding, it can be said that IPM farmers education if increased then the IPM farmers' profitability of vegetable cultivation will increase. So, education has significantly contributed to the IPM farmers profitability of vegetable cultivation. Education plays an important role to gain more profitability in vegetable cultivation in many case.

CHAPTER V

SUMMERY OF FINDINGS, CONCLUSIONS AND RECOMMENDATION

This chapter presents the summery of findings, conclusions and recommendations of the study.

5.1 Summary of Findings

The major findings of the study are summarized below:

5.1.1 Selected characteristics of the IPM farmers

Findings in respect of the 14 selected characteristics of the farmers summarized below:

Age

The highest proportion (59.1 percent) of the farmers was middle aged while 38.3 percent was old and 2.6 percent was young aged.

Education

The highest proportion (41.7 percent) of the respondent had secondary level of education, while 8.7 percent had primary level of education, 31.3 percent had illiterate and 18.3 percent had above secondary level of education.

Family size

The highest proportion (57.3 percent) of the farmers had medium family size, while 27.0 percent had small family size and 15.7 percent had large family size.

Time spends in vegetable cultivation

The highest proportion (52.0 percent) of the farmers had medium time spends in vegetable cultivation, while 26.1 percent had less time spends in vegetable cultivation and 21.9 percent had high time spends in vegetable cultivation.

Farm size

The highest proportion (62.6 percent) of the farmers had small farm size, while 15.7 percent had marginal farm size and 21.7 percent had medium farm size.

Experience in vegetable cultivation

The observed experience scores of the farmers ranged from 10 to 50 with the mean of 26.13. The highest proportion (62.6 percent) of the farmers had medium experience; while 14.8 percent had low and 22.6 percent farmers had high experience in vegetable cultivation.

Training on vegetable cultivation

The observed training on vegetable cultivation scores of the farmers ranged from 0 to 15 with the mean of 4.01. The highest proportion (61.7 percent) of the farmers had training on vegetable cultivation; while 17.4 percent had high and 20.9 percent farmers had high training on vegetable cultivation.

Annual family income

Annual family income of the farmers ranged from 70 to 540 thousand Tk. with the mean of 320.94 thousand Tk. The highest proportion (67.8 percent) of the farmers had medium annual family income compared with 16.5 percent and 15.7 percent having low and high annual family income respectively.

Organizational participation

The observed organizational participation scores of the farmers ranged from 0 to 8 with the mean of 2.21. The highest proportion (62.6 percent) of the farmers had medium organizational participation; while 15.7 percent had no and 14.7 percent farmers had medium organizational participation. Only 7.0% 0f the respondents had high organizational participation.

Extension media contact

Extension media contact ranged from 4 to 30 with an average 15.04 and standard deviation 5.67. The highest proportion (60.0 percent) of the respondents of the study area had the medium extension media contact, while 21.7 percent had low contact and 18.3 percent had high extension media contact.

Number of vegetables grown

The scores of the farmers regarding number of vegetable grown ranged from 1 to 3 with the mean of 2.49. The highest proportion (53.0 percent) of the farmers had high vegetables grown, while 42.6 percent had medium and 4.4 percent of farmers had low vegetables grown.

5.1.2 Profitability of vegetable cultivation by the Integrated Pest Management (IPM) farmers

The profitability scores of the farmers ranged from 0 to 3.40 with an average of 1.46 and the standard deviation 0.55. The highest proportion 74.8 percent of the farmers fell under medium profitability category while 14.8 percent had high profitability and 10.4 percent had low profitability.

5.1.3 Contribution of the selected characteristics on the profitability of IPM vegetable cultivation

Number of vegetable grown, training on vegetable cultivation, organizational participation, annual family income and education had significant positive contribution to their profitability of vegetable cultivation.

Characteristics of the farmers like age, family size, time spent in vegetable cultivation, experience in vegetable cultivation, farm size and extension media contact had no significant contribution with their profitability of vegetable cultivation.

5.2 Conclusions

Results of the study and the logical interpretations of their meanings in the light of other relevant facts prompted the researcher to draw the following conclusions:

i. The number of vegetable grown of farmers had a positive significant contribution on profitability of vegetable cultivation. Therefore, it may be concluded that number of vegetable grown helps the farmer to secure more profit.
ii. Training on vegetable cultivation of farmers had a positive significant contribution with their profitability. Therefore, it may be concluded that if the farmers get more training facilities on vegetable cultivation then their profitability will be increased
iii. Organizational participation of farmers had a positive significant contribution

with their profitability on vegetable cultivation. Therefore, it can be concluded that the farmers organizational participation helps the farmers to secure more profit.

iv. Annual income of farmers had a positive significant contribution with their profitability of vegetable cultivation. Therefore, it can be concluded that more the annual income possessed by the farmer higher would be the profitability of vegetable cultivation.

v. Education of farmers had a positive significant contribution with profitability of vegetable cultivation. So, therefore it may be concluded that education enables the farmer to face the problem of vegetable cultivation in a shortest period of time.

5.3 Recommendations

5.3.1 Recommendations for policy implications

i. Majority of the farmers of the study area were found to have low to medium number of vegetable grown. So, DAE and NGO should take initiative to influence farmers to cultivate much number of vegetable in a season.

ii. The DAE and NGO who work with environmental friendly practice should take initiative to provide more training to the farmers.

iii. In order to increase organizational participation of farmers, cultural activities, food programme, monetary facility etc. should be organized.

iv. The IPM farmers who had more income had more opportunity to cultivate vegetables. So, the SAAO should motivate the IPM farmers who had less income to cultivate more number of vegetables.

v. Bangladesh government through Bureau of Non-formal Education (BNFE) and NGOs can take necessary steps to increase farmers' primary level of education through non-formal education (adult education) and regular farmers' training, workshop; rally needs to be organized to broaden their knowledge.

5.3.2 Recommendations for the future study

The following recommendations are made for the future study:

1. The present study conducted on the population of the farmers of 2 villages of one union under Savar upazila of Dhaka district. The findings of the study need to be varied by undertaking similar research in other zones of the country.

2. The study investigated the contributions of the 11 selected characteristics of the farmers with their profitability of vegetable cultivation by the Integrated Pest Management (IPM) farmers. But their profitability of vegetable cultivation by IPM practices might be affected by other various personal, social, psychological, cultural and situational factors of the farmers. It is, therefore, recommended that further study should be conducted involving other characteristics in this regard.

3. In addition to their profitability of vegetable cultivation by using IPM practices farmers also faced other problems such as social, economic, housing, sanitation, nutrition and domestic etc. Therefore, it may be recommended that research should be conducted contribution to other profitability of the farmer.

4. The research was conducted to find out their profitability of vegetable cultivation by the IPM farmers. Further research should be taken related to other issues like inter cropping, other crop cultivation etc.

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APPENDIX-A

An Interview Schedule on

"PROFITABILITY OF VEGETABLE CULTIVATION BY THE INEGRATED PEST MANAGEMENT (IPM) FARMERS"

(This interview schedule is entitled for a research study)

Serial No:

Respondent Name:

Village:

Union:

Upazilla:

District:

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

1. Age:

How old are you? Ans:.....years.

2. Education:

Please mention your level of education.

a) I cannot read or write.

b) I can sign only

c) I have studied up to class (…..)

3. Family Size:

Please mention the members of your family who are involve in agriculture

a) Male member …….. person
b) Female member …….. person
c) Total member …….. person

4. Time spent in vegetable farming: ..... hrs/week.

5. Experience in Vegetable Cultivation:

Please state the duration of your direct involvement in vegetable farming.

Ans:……years

6. Farm Size:

Please indicate the area of land under your possession:

Sl No.	**Types of land use**	**Land area**	
		Local unit	**Hectare**
1.	Homestead area		
2.	Own land under own cultivation		
3.	Given to others as borga		
4.	Taken borga from others		
5.	Taken lease from others		
6.	Others (Pond, Orchard etc.)		
	Total		

7. Training on Vegetable Cultivation:

Have you received any training on vegetable cultivation?

Ans: (Yes) (No)

If yes, please give the following information:

Sl. No.	**Name of the Training**	**Sponsoring Organization**	**Duration (Days)**
1.			
2.			
3.			
Total			

8. Annual Family Income:

Please indicate the income of your family from different sources in the last year.

Sl. No.	**Sources of income**	**Amount of Production**	**Value (TK)**
1.	Agriculture (Vegetable)		
2.	Agriculture (Other crops except vegetables)		
3.	Livestock & Poultry		
4.	Fisheries		
5.	Service		
6.	Business		
7.	Others (please specify)		
Total			

9. Organizational Participation:

Please state the nature of your participation in the following organizations:

Sl. No.	**Name of the organization**	**Nature of participation**			
		Not involved	**Ordinary member**	**Executive member**	**President/ Secretary**
1.	Farmers' co-operative association				
2.	IPM club				
3.	NGO association				
4.	Common Interest Group (CIG)				

10. **Extension media contact:**

Please indicate your extent of contact with following media:

SI. No	Communication media	Extent of communication				
		Regularly (4)	Frequently (3)	Occasionally (2)	Rarely (1)	Not at all (0)
Individual contact						
I	Friend/Neighbor					
2	Sub Assistant Agricultural officer(SAAO)					
3	Upazila Agriculture Officer/Additional Agriculture Officer/Agriculture Extension Officer					
4	NGO Workers(s)					
5	Local leader					
6	Agricultural input dealer(s)					
7	Other govt. extension worker (e.g. health workers, BRDB's field officer etc.					
Group contact						
I	Participation in group discussion					
2	Participation in demonstration meeting (Result &					

	method demonstration)					
3	Participation in Field Day/Farmers Rally					
4	Others					
Mass contact						
1	Listening agricultural program in radio					
2	Watching agricultural related program in television					
3	Reading agricultural magazine (Krishi Katha/Leaflet/ Booklets etc.)					
4	Observing agricultural folksongs, fair etc.					

11. Number of vegetables grown:

How many types of vegetables you grown in the last season?

Ans:

1.

2.

3.

4.

5.

12. Profitability of vegetable cultivation by the IPM farmers:

Please mention following information:

Sl No	Item of cost	Value of cost (tk)	Output/Benefit
1.	Land Preparation		
2.	Seed		
3.	Irrigation		
4.	Fertilizer		
5.	Pesticide		
6.	Miscellaneous		
	Total		

$$P = \frac{B}{C}$$

Where, P = Profit

B = Benefit

C = Cost

Thank you for your co-operation.

Date:……

……

Signature of interviewer