FLOATING VEGETABLE GARDENING IN BANGLADESH: A WAY TO IMPROVE INCOME AND LIVELIHOOD OF THE FARMERS

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CERTIFICATE

This is to certify that the research work entitled **"FLOATING VEGETABLE GARDENING IN BANGLADESH: A WAY TO IMPROVE INCOME AND LIVELIHOOD OF THE FARMERS"** conducted by **Md. Shohel Rana, Registration No. 11-04360 (July – December/2018)** under my supervision and guidance in partial fulfillment of the requirements for the degree of **Master of Science (M.S.) in Development and Poverty Studies**, in the faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh. 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.

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TO

MY BELOVED

GRAND PARENTS

FLOATING VEGETABLE GARDENING IN BANGLADESH: A WAY TO IMPROVE INCOME AND LIVELIHOOD OF THE FARMERS

ABSTRACT

The objectives of this study were to assess the socio-economic characteristics and the effect of floating gardening on income and livelihood of the farmers. The study was conducted in Gopalganj and Pirojpur district. Data were collected from the randomly selected 60 respondents during August to September, 2019. Descriptive statistics was used for analysis. Total variable cost of floating bed vegetable production were Tk. 1856, Tk. 1857, Tk. 1876 and Tk. 1922 per bed for tomato, brinjal, chili and red amaranth respectively. Per bed total cost of producing vegetable per year was found to be Tk. 2651, Tk. 2638, Tk. 2640 and Tk. 2734 for tomato, brinjal, chili and red amaranth respectively. Gross margin was found to be Tk. 2734, Tk. 2524, Tk. 2714 and Tk. 2716 per bed for tomato, brinjal, chili and red amaranth respectively. Net return was estimated as Tk. 1939, Tk. 1743, Tk. 1950 and Tk. 1904 per bed for tomato, brinjal, chili and red amaranth respectively. Floating vegetable gardening improves the livelihood status of the growers. Lack of capital was the severe problem followed by lack of awareness of farmers regarding floating gardening system.

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The Author

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ABBREVIATIONS

ANEP	Agriculture and Nutrition Extension Project
APEIS	Asia-Pacific Environmental Innovation Strategies
ASTER	Advanced Space-borne Thermal Emission and Reflection
BARI	Bangladesh Agricultural Research Institute
BBS	Bangladesh Bureau of Statistics
BCR	Benefit Cost Ratio
CBA	Community Based Adaptation
DAE	Department of Agriculture Extension
FAO	Food and Agriculture Organization
GIAHS	Globally Important Agricultural Heritage System
GM	Gross Margin
GR	Gross Return
HSP	Highly Shaded Ponds
HYV	High Yielding Varieties
ICBR	Incremental Cost-Benefit Ratio
IFCAS	Integrated Floating Cage Aqua Geoponics System
IPCC	Intergovernmental Panel on Climate Change
LCI	Livelihood Change Index
MP	Muriate of Potash
MSP	Moderately Shaded Ponds
MWRD	Metropolitan Water Reclamation District
NAPA	National Adaptation Program of Action
NGO	Non-Governmental Organization
NR	Net Return
PFI	Problem Faced Index
PRA	Participatory Rural Appraisal
SPSS	Statistical Package For Social Sciences
TFC	Total Fixed Cost
TRM	Tidal River Management
TSP	Triple Super Phosphate
TVC	Total Variable Costs

CHAPTER I

INTRODUCTION

1.1 Background of the Study

The total area of the wetlands in Bangladesh has been variously estimated at seven to eight million hectares, or about fifty percent of the total land surface (Khan, 1993). This includes 5.4 million hectares of open and closed lakes on flood plains that are inundated every year. At river peak flow during the rainy season, thirty percent of the floodplain area is flooded deeper than one meter for five months (June to October) and a particularly heavy monsoon may see this rise to sixty percent (Brammer et al., 1996), restricting normal agricultural activities. The soilless cultivation method that we have described provides an opportunity for income generation during this normally slack season. Our waterlogged villages in the southern coastal wetlands of Bangladesh have proved its viability and the same or similar methods could be used elsewhere. Women seem to find it particularly advantageous, a progressive aspect of development that is generally agreed to be essential for the future of Bangladeshi society. Bangladesh is well-known to be prone to the sea-level rise that is predicted to be associated with global warming. By 2080 there will be a rise of 38 cm and that up to 22 percent of world's coastal wetlands will be inundated as a result (Warrick et al., 1996; Nicholls et al., 1999). Scholars and institutions such as the Intergovernmental Panel on Climate Change are attempting to evaluate the socio-economic and ecological implications of such a rise in sea-level (Hoozemans and Hulsbergen, 1995) and it is clear that a portfolio of adaptive measures will be needed to cope with the situation. Some authors a reproofing large-scale migration (Nicholls and Mimura, 1998) and structural measures, which might not be feasible for a lower middle income country such as Bangladesh. Perhaps it is more realistic to propose that coastal populations might be best able to deal with sea-level rise if their vulnerability to economic shock is minimized. Floating bed cultivation could be one such measure in those area that avoid salt water intrusion because it offers new opportunities using indigenous knowledge and techniques that are well adapted to local environmental conditions (Chowdhury, 2004).

The floating garden is a clever solution that employs the use of water hyacinth, which is collected to construct a raft. This is then covered with soil and cow dung, in which vegetables can be planted. A new raft needs to be built every year, but the old one can be used as fertilizer during the dry season. The floating gardens provide vital food for people even during the annual monga (period of food shortages) and they can also provide an alternative source of income through sale of any surplus in the market (Islam and Atkins 2007). Indigenous floating gardens for sustainable agricultural practice in wetland of Bangladesh. The rafts can be moved from place to place so are also suitable for those that have temporarily or permanently lost their homes and land.

According to FAO, (2008) research, generally floating garden are practiced by the poor people who have no own land or small farmer in the wetland or submerge area where cultivable land under water more than 6 to 7 month. They rent land and practice floating garden to reduce their poverty or lead a better life. Some educated farmer also doing floating garden. Floating garden is very effect solution to eradicate poverty. It also create employment facility for the poor people when they have merely no work to do. And by those way floating garden increase income to the poor people and reduce poverty in Gopalganj and Pirojpur district.

It’s now proved that climate change is increasing the intensifying of extreme weather events such as floods, droughts, heat waves, etc. and thus reducing agricultural production and food security while increasing health and nutrition risks. Almost every country in the world is experiencing the drastic effects of climate change. Average global temperature has increased by 0.850 C from 1880 to 2012 and global average sea level rose by 19 centimeters while global emissions of carbon dioxide have increased by at least 50 per cent since 1990 (IPCC, 2015). Carbon dioxide most commonly produced by human activities and it is responsible for 64 per cent of man-made global warming. Crop productions as well as trees help to regulate the climate by absorbing carbon dioxide from the atmosphere. But when trees are cut-down that beneficial effect is lost and the carbon stored in the trees is released into the atmosphere.

Bangladesh rated as the third most vulnerable country in the world. Climate change is already negatively impacting agricultural production. Climate risks to agricultural production are expected to increase in coming decades, particularly in low-income countries like Bangladesh where adaptive capacity is weaker. A reasonable portion of Bangladesh is situated in low lying areas, remains submerged for 6-9 months in a calendar year during and after monsoon which is increasing day by day due to climate change. As a result, cultivable lands in coastal areas are often constrained by 7-8 months water stagnation. Even, when farm households manage to cultivate crops in their limited farm lands in low lying areas during monsoon, there is always risk for the crops to be submerged by floodwater. Even after flood, farmlands remain under water for a while due to poor drainage facilities and thus, farmers are unable to cultivate any crops on the submerged crop land.

Hence, the livelihoods of poor farm families in low lying areas are passing days, even months with very little work and therefore income. The household food security of these groups remains fragile while the dream of sustainable food security remains elusive. These families may have to survive an extended period without proper meals and sometimes with no food at all. Malnutrition and poverty remain widespread due to limited resources. The additional challenges of changed climate add to the difficulties posed by repeated flooding, high tides and other natural calamities. Special attention is therefore needed to strengthen and make sustainable household food security as a key approach to improve living standards of flood affected water-logged areas.

To overcome this adverse situation, local communities in southern Bangladesh are using their submerged lands for crop production by adopting ‘Floating Garden’ as alternative technology and growing different type of seedlings, vegetables, spices, etc. in floating bed as floating agricultural practices. This innovated technology is an age-old practice of crops and vegetables cultivation in the southern floodplains of Bangladesh which has vegetable recognized and declared as Globally Important Agricultural Heritage System (GIAHS) of Bangladesh by FAO of United Nation. The Floating Garden has become widely talked about climate change adaptation option. It’s a local innovations where farm households both men and women jointly making ‘floating bed’ on water body as floating agricultural practices by using locally available resources like water hyacinth and bamboo. They are also using some other locally available materials like rice stub, algae, coconut-coir and other aquatic weeds.

Farm households of southern Bangladesh have been practicing the method during monsoon, when most of the land is under water, where the only alternative option is to cultivate crops and vegetables through ‘floating agriculture’. This technology also helps early production of seedlings of winter vegetables which enables farmers to get good price. Under floating bed technology, crops and vegetables requires shorter time to mature which is also an advantage to get higher price in the market. In addition, just after harvesting of crops and vegetables from floating bed, farmers may able to use this old floating bed as organic fertilizer for their next cultivation in winter season. After harvesting crops and vegetables from floating bed, they break this old rotten floating bed and mix it with the soil to enrich the soil quality which is useful for their next crops.

The size of each floating garden is flexible which depends on the area of inundated water body and its shape. It can be around 4 to 7 feet width, 25 to 150 feet long and 2 to 3 feet height. In the initial stage of preparation, the collected water hyacinths major construction material are tied together and overlaid with bamboo to form a good shape. In consecutive days additional water hyacinth is put on to ensure the thickness of the floating bed while beds to be fixed by bamboo poles in a certain area to avoid moving or displaced in windy or stormy weather. Once the basic structure of the bed is prepared, the water hyacinth is allowed to rot. Then they use other smaller size aquatic plants such as Topapana, Dulalilata, Khudipana, etc. on the structure of water hyacinth bed. On the top of the floating bed, a little portion of soil, rice stub, algae, cow dung, coconut coir, etc. will be added, on which vegetables and other crops can be grown. In 2 to 3 weeks of rotten, the top portion of the bed is enriched with primary nutrients (phosphorus, nitrogen, potassium, magnesium, etc.) which acts as organic manure and make suitable for transplanting of different vegetables seedlings. As crops could absorb nutrients such as nitrogen, potassium and phosphorus from the floating beds and water in below, there is no need for application of chemical fertilizers while vegetables grow comparatively faster on floating beds than normally grown on soil.

1.2 Justification of study

Floating gardening is relatively a new practice in southern floodplains in Bangladesh. The main areas of floating cultivation are Gopalganj, Pirojpur and Barisal districts. The land is submerged under flood water for 7-8 months annually, restricting its use for cultivation. Farmers living in the wetlands are mostly very poor because they have to depend only one crop per year. By floating cultivation more than 1200 families have improved their livelihood with reducing the poverty of these districts. Production of vegetables and other crops of these areas has been more than the target recently. But very few studies were conducted on the socio-economic aspects of this technology. Therefore, the study was conducted to find out the solutions of the following research questions.

1.3 Key Research Question

i. What is the socio-economic condition of the farmers?
ii. What is the contribution of floating gardening on income?
iii. What are the changes in livelihood occurred due to floating garden?
iv. What are the problems of floating gardening system?

1.4 Objectives of the Study

i. To assess the socio-economic characteristics of the vegetable growers;
ii. To assess the profitability of floating gardening;
iii. To assess the change in income and livelihood of the farmers due to floating gardening; and
iv. To identify the problems of floating gardening system.

1.5 Outline of the Study

This thesis contains a total of eight chapters which have been organized in the following sequence. Chapter 1 includes introduction. The review of literature is presented in Chapter

2. Methodology of the relevant study is discussed in Chapter 3. Chapter 4 contains the socio- economic profile of the floating garden vegetable farmers. Chapter 5 deals with profitability of floating bed vegetable cultivation. Chapter 6 presents change in income and livelihood of the farmers due to floating gardening. Chapter 7 deals with problems of floating gardening system. Finally, Chapter 8 represents the summary, conclusion and policy recommendations to increase floating bed vegetable production.

CHAPTER II
REVIEW OF LITERATURE

Review of literature in any research is essential because it provides a scope for reviewing the stock of knowledge and information relevant to the proposed research. But there is little information regarding knowledge and information relevant to the present research. Literature and research of the major past works in connection with the present study were searched because this knowledge and information provide guideline in designing the future research problem and validation of the new findings. Some studies relating to floating garden crops are reviewed here.

Bala (2018) conducted a study on floating garden and found that the average cost of floating garden's crops production were different in the different categories (marginal farmer, small farmer and medium farmer) farmer. For the marginal farmer, per acre total cost and variable cost were found Tk. 208,490 and Tk. 93,990 respectively. For the small farmer, per acre total cost and variable cost were found Tk. 219,900 and Tk. 111,400 respectively. For the medium farmer,per acre total cost and variable cost were found Tk.225, 950 and Tk. 125,450 respectively. The major share of total cost is for human labor, support materials and land use. The net return from floating garden crops cultivation Tk. 216,010, Tk. 193,100 and Tk. 198,050 are respectively marginal farmer, small farmer and medium farmer per acre floating garden. The benefit cost ratios were 4.02, 4.00 and 4.01 on variable cost basis and 2.50, 2.40 and 2.45 on full cost basis, respectively.

Islam and Atkins (2007) research work showed that floating-bed cultivation has proved a successful means to produce agricultural crops in various wetland areas of the world. In freshwater lakes and wetlands, vegetables, flowers, and seedlings are grown in Bangladesh using this floating cultivation technique, without any additional irrigation or chemical fertilizer. This study is focused on the nature and characteristics of the Bangladeshi system, where local farmers have demonstrated the potential for the sustainable use of such common-property local water resources.

Irfanullah et al. (2009) showed that floating gardening is a form of hydroponics or soil-less culture. It is an age-old practice of crop cultivation in the floodplains of southern Bangladesh, where aquatic plants such as water hyacinth (Eichhorni acrassipes) are used to construct floating platforms on which seedlings are raised and vegetables and other crops cultivated in the rainy season. The platform residue is used in the preparation of beds for winter vegetable gardening. Floating gardening was introduced in 2006 on a pilot-scale in the north-east wetlands of the country, as a contribution to food security and as a supplementary income for the marginalized community. The overall experience of floating cultivation in three selected villages was encouraging. Local people became aware of this new farming system and their level of knowledge improved. Communities were mobilized into groups to make floating platforms, and platform residues were later used to establish winter gardens. Cultivation was successful on both types of plot, and vegetables were both consumed by the producers and sold in the market. The input–output analysis revealed floating gardening to be a feasible alternative livelihood option for the wetland dwellers. The method provided targeted landless people with parcels of land in the monsoon, enabling them to grow vegetables. Floating gardening and associated winter gardening appear to have the potential for introduction to other parts of the world where aquatic weed management is a major problem.

Yellin (2013) showed floating gardens were an effective habitat solution in urban rivers: Co-founder of Urban Rivers,installed 50 square feet of floating gardens in the Chicago River in June of 2013, which served as the basis for his Master's research study monitoring urban fish populations. Results indicated a nearly 100% increase in the fish abundance in the river immediately surrounding the floating gardens when compared to traditional docks. To expand on Josh's pilot study, Urban Rivers is working with the MWRD (Metropolitan Water Reclamation District) on a four-year study to monitor fish populations at our installation site. This research is already underway, and our measurements include: fish counts, water quality and macro-invertebrate counts. The money raised here will go directly to ward our floating gardens. For every $50 donation, we can add another foot of habitat. Our goal is $10,000, but every dollar exceeding this goal will only extend the gardens, becoming part of our larger vision of eventually rehabilitating an entire one-mile stretch of river, which we hope to turn into an urban wildlife sanctuary. Urban Rivers is a Chicago-based nonprofit and this our pilot project. Our plan is to rehabilitate urban rivers in cities across the globe. By recovering habitat space in city water ways, we can provide a home for fish and other animals, while creating a nature destination for people to enjoy.

APEIS (2014) conduct a research work on floating agriculture is not a new practice in Bangladesh; it has traditional roots in practices dating back to the country's forbearers, although the scientific component is a recent addition. According to their needs, people in different parts of Bangladesh have adopted, modified and named this practice differently (Islam and Atkins, 2007; Irfanullah et al., 2007), such as baira, boor, dhap, gathua, gatoni, geto, kandi and vasomanchash and floating agriculture; all these names are present this same traditional cultivation practice that can be scientifically referred to as hydroponics. Actually, this practice is most successful in the coastal areas that are adjacent to the sea-bank areas, which remain submerged for long periods, especially in the monsoon season, as well as the wet land haor areas (flood at lowland spreading across the middle of the Meghna River basin) (Yoshini and Merabtene, 2007), which halsore main flooded for long periods. The practice helps mitigate land loss through flooding, by allowing cultivation of these areas to continue. In this way, the total cultivatable area can be increased and communities can become more self-sufficient. In addition to this, the area under floating cultivation is upto10 times more productive than traditionally farmed land (Haq et al. 2004) and no additional chemical fertilizers or manure is required. When the crops have been harvested and floating rafts are no longer required, they can be used as organic fertilizers in the fields or incorporated into the following years floating beds as a fertilizer (AEPIS & RIPSO, 2004; Saha, 2010).The approach uses water hyacinth, a highly invasive weed with prolific growth rates, in a highly beneficial way. By harvesting water hyacinth, areas covered by the weed are cleared, with the beneficial side-effect of reducing breeding grounds for mosquitoes and improving conditions for open water fishing.

Haque (2014) showed that people practicing floating-bed cultivation are enjoying a better life economically, than those in other flood-affected areas who have not yet adopted this practice (Saha, 2010).Because the system is fairly labor intensive, it also has the capacity to provide employment opportunities within communities. As both men and women can carry out the floating agriculture practices, it can also lead to improvements in gender equity. In the context of increased vulnerabilities due to changes in climate, more areas of the south-western coastal parts of the country will be susceptible to increased flood and submergence. Unfortunately, there is dearth of information regarding status and determinants of profitability of floating agriculture. Hence potentialities of this locally innovated' floating agriculture' practice need to be assessed for adaptation as a profitable farming practices with the changing climate.

Pavel et al. (2014) conducted an economic evaluation of the floating garden as a means of adapting to climate change in Bangladesh. The study showed that the monthly income of some farmers using such gardens increased from US$12.02 to US$48.08. These folk farmers lacked alternative work especially during the monsoon period. The floating garden uses available natural resources, adjusts to wet conditions and helps the flood-prone people to earn a living, and can be an adaptive response to frequent disaster events in Bangladesh.

BCCTF (2017) conducted a study titled, "Floating Gardens of Bangladesh: A Community Based Adaptation for Combating Climate Change". Impacted by our innovation the national government in Bangladesh has come forward to implement the technique, for example, the National Adaptation Program of Action of Bangladesh identified promotion of floating gardening as one of its 15 adaptation projects. The revised also recognized the potential of this traditional practice. But it was only in early 2013 that the Government of Bangladesh approved a US$ 1.6 million project under its to promote floating gardening for climate change adaptation. This 3-year project will be implemented by the Government's agricultural extension wing in40sub-districts of 8 districts all over the country. Challenges lies in the areas identified for the project were poor and water logged ones, getting the people for the initial arrangements were quite difficult for us in the formative months. Once they realized the potential of the farming technique, the skepticism has evaporated. One of the important lessons learnt in this process is that, small Ideas can have the potential to bring in remarkable change in the lives of poor.

Concluding Remarks

The above mentioned discussion and review indicate that most of the studies dealt with cost, return, profitability and productivity of floating bed vegetable cultivation. Some studies also determine the factors affecting the profitability. Maximum studies examined parameters, which influence production, more than a decade ago. From the above studies the researcher felt the need of conducting and analyzing the productivity of floating bed vegetable cultivation in Bangladesh within the current development context, which will help the policy makers to understand the current situation and take programs to increase floating bed vegetable production and improving the livelihood of people in Bangladesh. On the other hand, researcher believed that the findings of this study would provide useful updated information, which would help the policy makers and researcher for further investigations.

CHAPTER III

METHODOLOGY

Methodology enables the researcher to collect valid information. It is impossible to conduct research work smoothly without proper methodology and it is very difficult to address the objectives with a scientific manner. It requires a very careful consideration on the part of the researcher to collect valid and reliable data and to analyze the same for meaningful conclusion. A sequential description of the methodologies was followed in conducting this research work has been presented in this chapter.

3.1 Location of the study

Gopalganj and Pirojpur district of the Southeast region of Bangladesh was purposefully selected as a location of the study. There are five upazilla under Gopalganj district. Among these upazilla named Gopalganj Sadar and Kotalipara from Gopalganj district and Nazirpur Upazilla from Pirojpur district selected purposively for this study.

3.2 Sample Size and Sampling Procedure

All the floating garden farmers of the selected areas constitute the population of the study. Due to limitation of time and fund only 60 farmers were randomly selected for this study.

Table 3.1 List of the floating garden farmers

Districts	Upazila	Villages	Sample size
Gopalganj	Gopalganj Sadar	Dattadanga	10
		Bajunia	10
	Kotalipara	Purbapara	10
		Wapdagram	10
Pirojpur	Nazirpur	Malikhali	10
		Chapakhali	10
Total			**60**

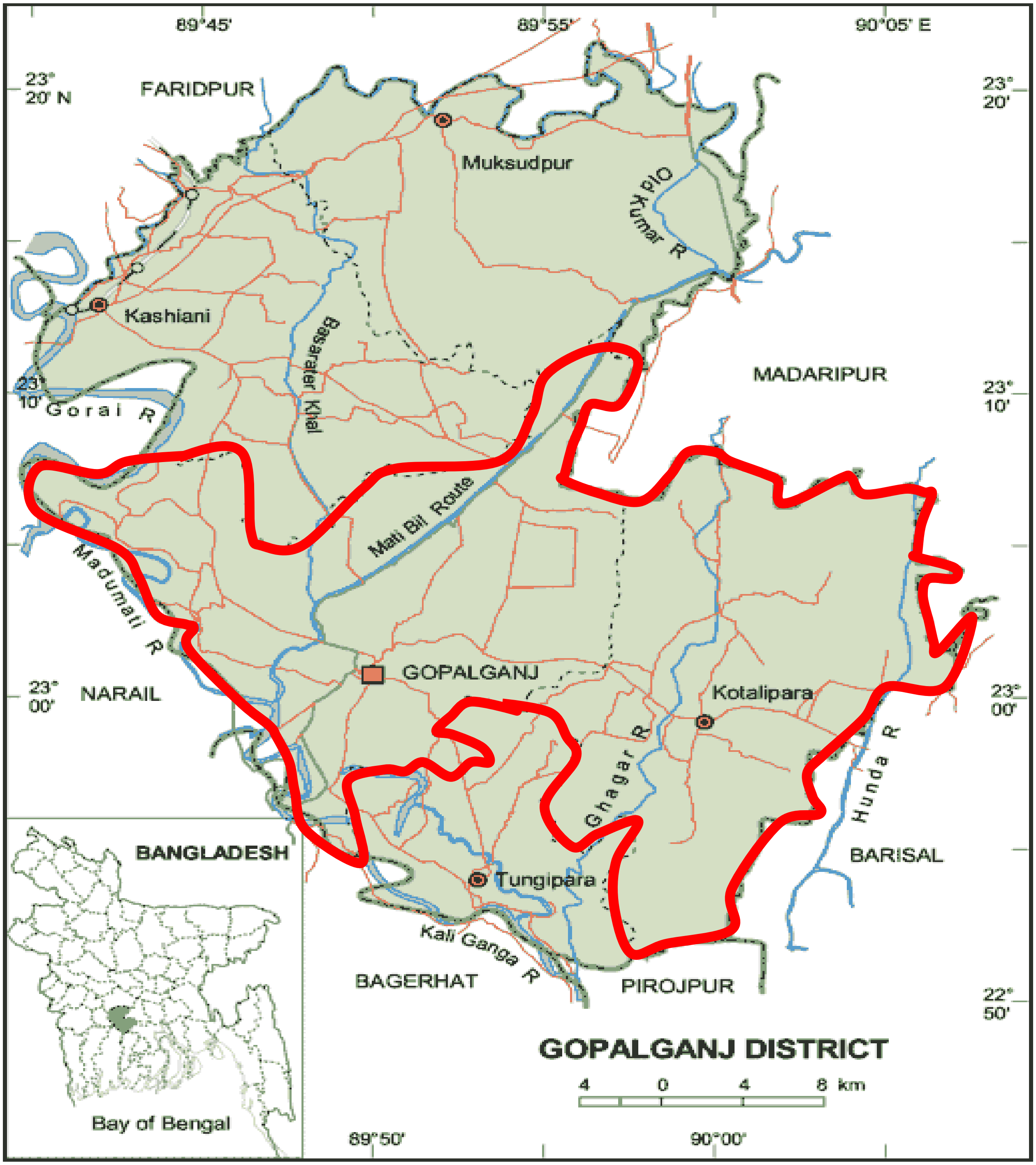

Figure 3.1 Map of Gopalganj district showing the study area

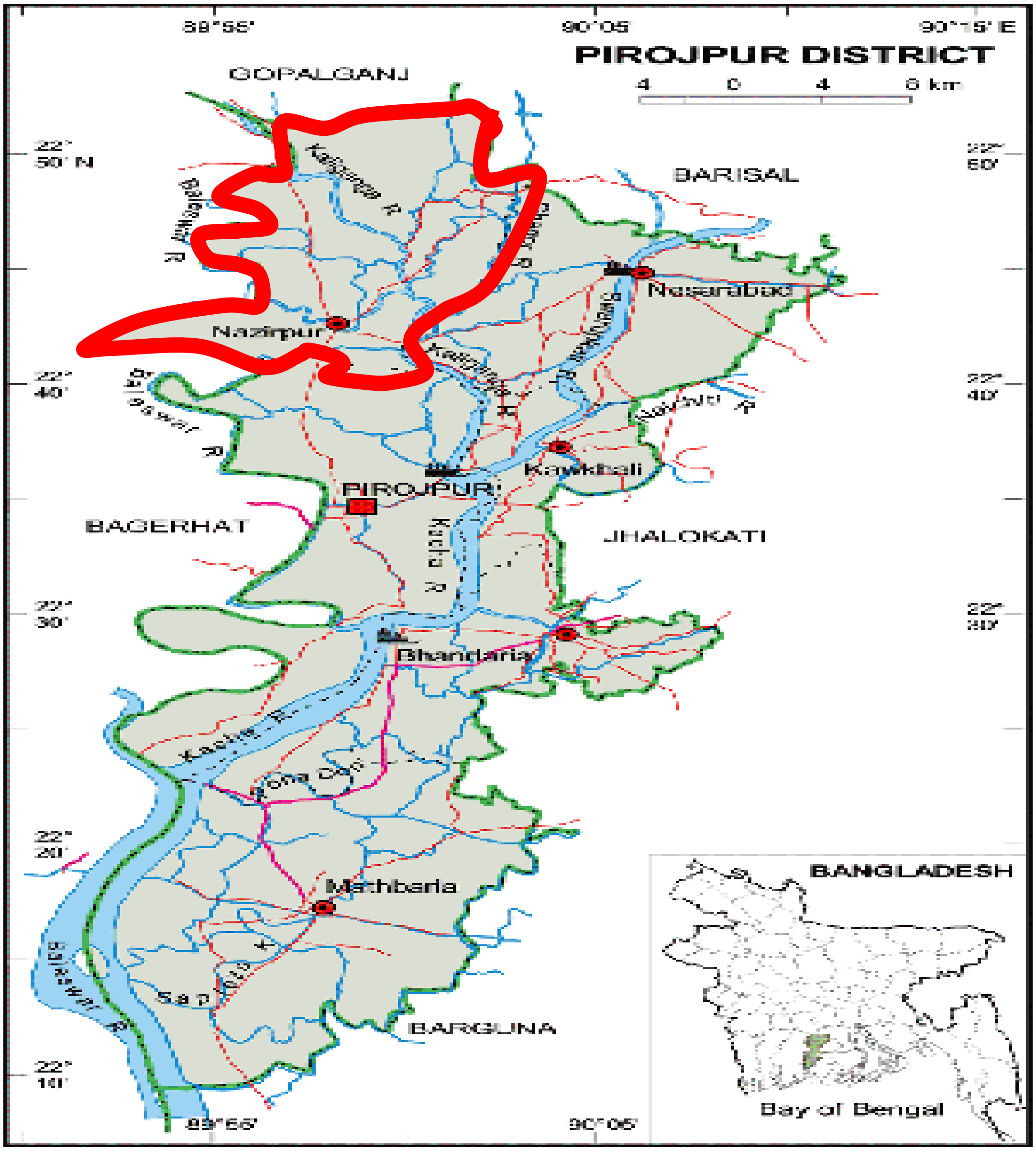

Figure 3.2 Map of Pirojpur district showing the study area

3.3 The research instrument

A well-structured interview schedule was developed based on objectives of the study. The interview schedule was pre-tested with ten local leaders in actual situation before preparing the final draft. Necessary correction, addition, alternation, rearrangement and adjustment were made in the interview schedule based on pretest experience. A copy of the interview schedule is presented into Appendix I.

3.4 Change in livelihood

Change in livelihood of the farmers in floating garden was measured on the basis of nature of change in life style. After consultation with relevant experts and farmer six livelihood change indicator were selected related to farmers life style. A list of six probable livelihood change indicator that farmers could face in different aspects were listed and asked to indicate the extent of their livelihood change indicator. It was measured by using a four point rating scale. For each livelihood change indicator score of 3, 2, 1 and 0 were assigned to indicate extent of change as high, moderate, small and no change respectively. The livelihood change indicator score was computed for each respondent by adding his/her points for all livelihood change indicator. The possible range on livelihood change indicator thus could be 0 and 18. A total point of 18 indicate highest livelihood change in respect of floating garden, while a point 0 indicated no livelihood change.

To ascertain the comparison among the livelihood change a Livelihood Change Index (LCI) was computed using the following formula:

$$LCI=C_h*3 + C_m*2 + C_s*1 + C_n*0$$

Where,

LCI = Livelihood Change Index

C_h=Score having high change

C_m= Score having moderate change

C_s= Score having small change

C_n = Score having no change at all

Thus, LCI is an item which could range from 0 to 180, where 0 indicated no livelihood change at all and 180 indicated high livelihood change.

3.5 Estimation of Cost Items

This section mainly deals with estimation of cost items and returns of vegetable production in floating garden. The cost items considered in this study were as follow: i) cost of human labor, ii) cost of floating bed preparation, iii) cost of seeds , iv) cost of organic fertilizers, v) cost of inorganic fertilizers, vi) cost of pesticide, and x) miscellaneous cost.

In the production process of vegetable in floating garden farmers used both home supplied and purchased inputs. The input items were valued at the prevailing local market rates. For purchased inputs, farmers had to pay cash but home supplied inputs like, family labor, native equipment no cash was actually paid, and pricing was very difficult in such cases. However, in calculating the cost of such inputs, the principle of opportunity costs was followed. In determining the opportunity cost of an individual enterprise the relevant input price is the value forgone by replacing this input from another enterprise. The output was valued at the Gopalganj and Pirojpur district prices.

3.5.1 Cost of human labor

The sources of supply of human labor were classified into (a) family labor for which no payment was made, and (b) hired labor for which fanners had to pay in cash. Family labor includes the operator's own labor and other members of his family, i.e. his brothers, children, etc. The labor of woman and children has been converted into man-equivalent hours by representing a ratio of 2 children hours = 1.5 women hours = 1 man equivalent hours. In pricing the labor as such no distinction was made between the unpaid family and hired labor. The human labor was calculated in man-day units which usually consist of 8 hours a day. The cost of family labor was determined by applying opportunity cost principle and the costs of hired labor were calculated at die actual price paid by the farmers. In the study fixed wage rate was found which was calculated Tk 350 per man-day.

3.5.2 Cost of floating bed preparation

The determining of floating bed preparation cost is really a complex procedure. But for this study a simple method was followed. The floating bed preparation was employed only during the seed bed preparation in the production processes of vegetable. The cost of floating bed preparation was calculated used on the opportunity cost principles when home supplied labor was used by the farmers own farm.

3.5.3 Cost of seeds

The sample farmers were mostly used home supplied seeds but in some cases, purchased seeds were also used by the farmer's vegetable production in floating garden. The seed cost was calculated on the basis of actual prices paid by the farmers in the locality. It may be noted here that there was a variation in the cost of per kilogram (kg) seed in the study area.

3.5.4 Cost of organic fertilizer

In the study areas, farmers used cow dung, ash and oilcake as organic fertilizer in their floating garden production. A large quantity of manure was supplied from the farmer home. While some farmers bought cow dung from the milk producers. The average prices of cow dung ash and oil cake calculated at Tk. 3/kg, Tk. 60/kg and Tk. 30/kg, respectively.

3.5.5 Cost of inorganic fertilizer

There are five kinds of chemical fertilizers namely Urea, Triple Super Phosphate (TSP) and Muriate of Potash (MP) which were used by the farmers. Fertilizer costs were charged at actual prices paid by the farmers. The average prices of these fertilizers were Tk. 21/kg, Tk. 29/kg and Tk. 30/kg, respectively.

3.5.6 Cost of pesticides

Farmers applied pesticides on vegetable production in floating garden but failed to provide its exact quantity and brand names. The cost of insecticides was calculated on the basis of actual amount of money paid by the farmers.

3.5.7 Miscellaneous cost

Tools and equipment's were used in different operations of the production process. However, the cost of human labor and seed bed preparation, as stated previously, has been priced separately taking into account the cost of tools and equipment. In human labor cost, for example, the cost of relevant tools has already been taken into account in determining the total wage rate. In other words, the man who sells his labor for a particular operation generally brings the relevant equipment or tools with him and he does not charge any extra money for using his tools or equipment's. The cost of tools used by the vegetable growing farmers for a particular operation is, therefore, included in the wage rate. Under the circumstances, the cost of tools and equipment would be a negligible amount.

3.6 Calculation of Returns

3.6.1 Gross Return

Gross return was calculated by multiplying the total quantity of the product and average price of the product.

Gross Return= Quantity of the product* Average price of the product

3.6.2 Gross Margin

Gross margin is defined as the difference between gross return and variable costs. Generally, farmers want maximum return over variable cost of production. The argument for using the gross margin analysis is that the farmers are interested to get returns over variable cost. Gross margin was calculated on TVC basis. Per bed gross margin was obtained by subtracting variable costs from gross return.

That is, Gross margin = Gross return – Variable cost

3.6.3 Net Return

Net return or profit was calculated by deducting the total production cost from the total return or gross return.

That is, Net return = Total return – Total production cost

The following profit equation was used to assess the profitability of floating garden vegetable production at the farm level:

$$\prod = P1Q1 - \sum WiXi - TFC$$

Where,

$\prod$= Profit per bed for producing vegetable

P1 = Per unit price of the vegetable;

Q1 = Quantity of vegetable produced (per bed);

Wi = Per unit price of the ith input used for producing the vegetable;

Xi = Quantity of the ith input used for producing the vegetable and

TFC = Total fixed cost

3.6.4 Undiscounted Benefit Cost Ratio (BCR)

Average return to each taka spent on production is an important criterion for measuring profitability. Undiscounted BCR was estimated as the ratio of total return to total cost per bed.

$$\text{BCR} = \frac{\text{Total returns}}{\text{Total cost}}$$

CHAPTER IV
SOCIO-ECONOMIC CHARACTERISTICS OF THE FARMERS

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. Twelve characteristics of the farmers were selected for this research. The characteristics include: age, education, family size, farm size, annual family income, training on floating garden, organizational participation, extension media contact, experience in floating garden, knowledge on floating garden, credit received. However, separate tables are provided while presenting categorizations, discussing and interpreting results concerning each of the characteristics in this chapter.

4.1.1 Age

Age of the farmers ranged from 20 to 45 years, the average being 31.91 years and the standard deviation, 5.92. On the basis of age, the farmers were classified into three categories: 20-30 years, 31-40 years and above 40 years. The distribution of the farmers according to their age is shown in Figure 4.1.

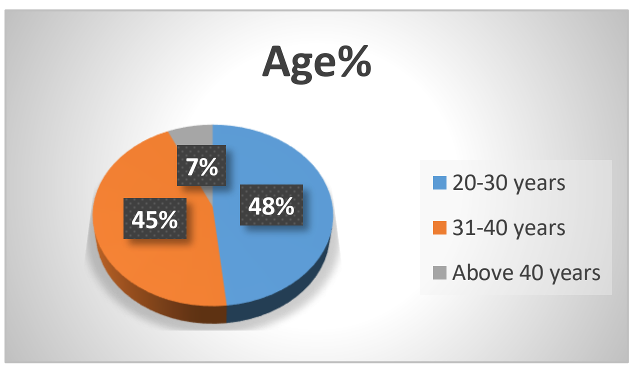

Figure 4.1 Distribution of the farmers according to their age

Figure 4.1 showed that the highest portion 48 percent of the vegetable growers were in the 20-30 years age category, while 45 percent of them were in the 31-40 years age category and 7 percent of the farmers were in the above 40 years age category.

4.1.2 Education

The education class of the farmers ranged from 0 to 16 with an average was 4.86. On the basis of their educational class, the farmers in floating garden 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 Figure 4.2.

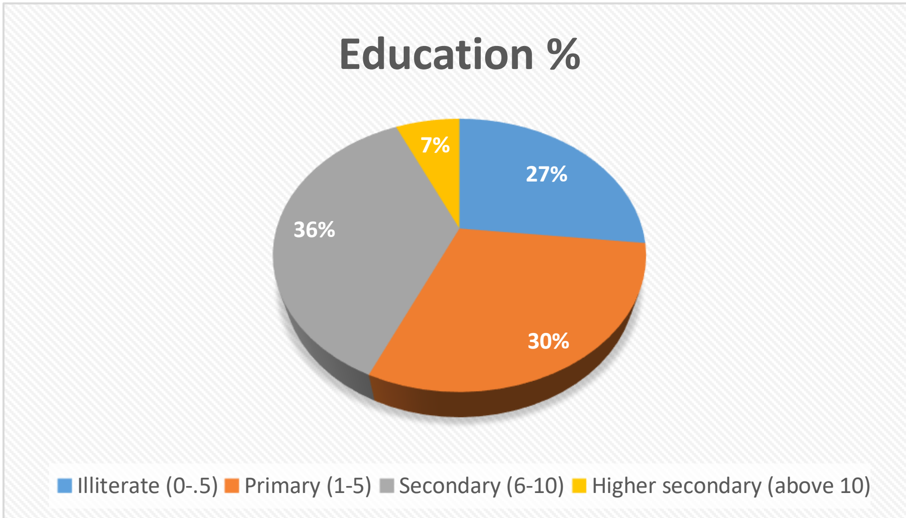

Figure 4.2 Distribution of the farmers according to their education

Figure 4.2 indicated that the majority (36 percent) of the farmers were secondary education compared to 27 percent of them were illiterate. About 30 percent of the farmers were primary level of education, while 7 percent were above secondary level of education.

4.1.3 Family size

The family size of the farmers ranged from 3 to 9 members and the average was 5.61. On the basis of their family size, the farmers were classified into the following three categories: 2-4 members, 5-6 members and above 6 members. Figure 4.3 contains the distribution of the farmers according to their family size.

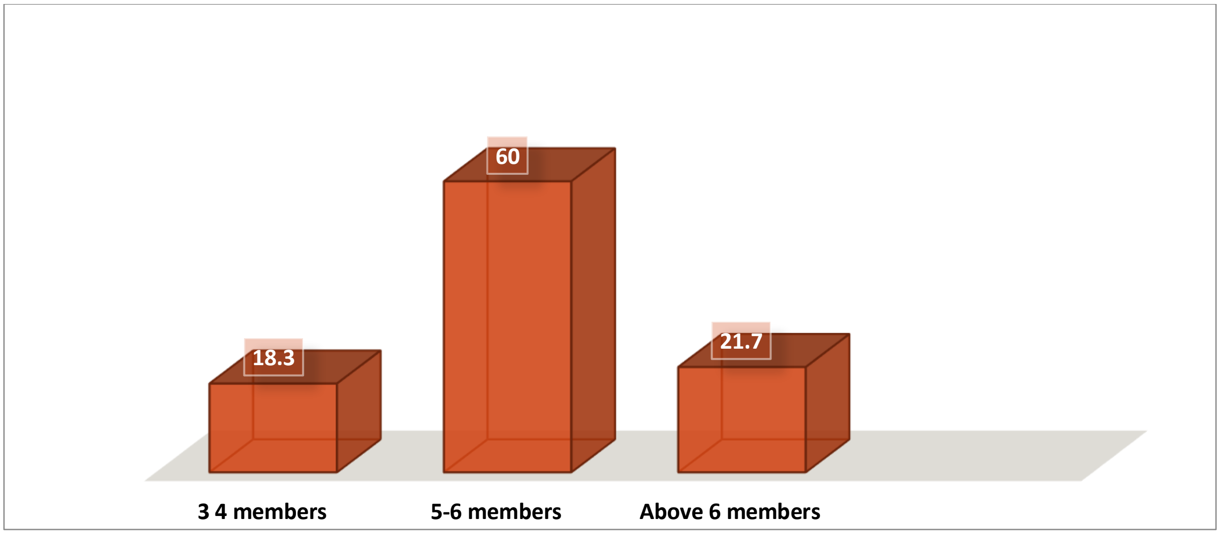

Figure 4.3 Distribution of farmers according to their family size

Figure 4.3 showed that the majority of the 60 percent of the farmers had 5-6 members compared to more different than 21.7 percent of them having of above 6 members. The portion of 2-4 members was 18.3 percent (Figure 4.3).

4.1.4 Farm size

The farm size of the respondents varied from 0.20 to .40 hectares. The average farm size was .29 hectare. The respondents were classified into the following three categories based on their farm size: (0.2-25 ha), (0.26 – 0.30 ha), and (>0.30 ha). The distribution of the farmers according to their farm size is shown in Figure 4.4.

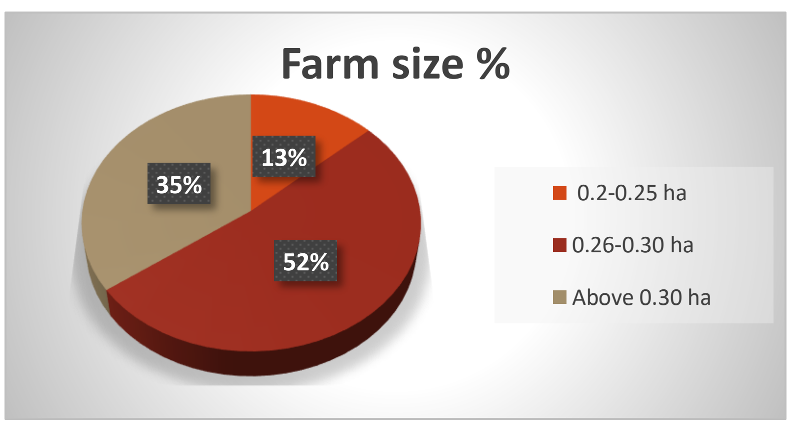

Figure 4.4 Distribution of the farmers according to their farm size

Figure 4.4 indicated that more than half (52 percent) of the farmers possessed (0.26 – 0.30 ha) of land compared to 35 percent of them having above 0.30 ha farms and 13 percent had 0.2-25 ha farms.

4.1.5 Experience in floating garden

The experience of the respondents ranged from 2 to 7 years and the mean score was 4.43. On the basis of experience, the respondents were classified into three categories namely, 2-3 years' experience, 4-5 years' experience and above 5 years' experience, as shown in Table 4.1.

Table 4.1 Distribution of the farmers according to their experience in floating garden

Categories (Scores)	Farmers		Mean
	Number	Percent	
2-3 years' experience	21	35	4.43
4-5 years' experience	29	48.3	
Above 5 years' experience	10	16.7	
Total	**60**	**100**	

Source: Field Survey, 2019

Data contained in the Table 4.1 revealed that the majority (48.3%) of the farmers had 4-5 years' experience as compared to (35%) and (16.7%) having 2-3 years' experience and above 5 years' experience respectively.

4.1.6 Training on floating garden

Training on floating garden of the respondents was found to be varying from 0 to 4 days with an average of 1.06. Based on their days, the farmers were classified into three categories as shown in Table 4.2.

Table 4.2 Distribution of the farmers according to their training on floating garden

Categories (days)	Farmers		Mean
	Number	Percent	
0 days training	16	26.7	1.06
1-2 days training	36	60	
Above 2 days training	8	13.3	
Total	**60**	**100**	

Source: Field Survey, 2019

The Table 4.2 indicate that the majority (60%) of the farmers had (1-2) days training on floating garden while 26.7 percent of the farmers had no training on floating garden vegetable cultivation and 13.3 percent of the farmers had above 2 days training on floating garden vegetable cultivation.

4.1.7 Annual family income

Annual income of the respondents ranged from 68 to 212.7 thousands with an average of 112.45 thousands. On the basis of the annual income, the respondents were classified into three categories as shown in Table 4.3.

Table 4.3 Distribution of the farmer according to their annual family income

Categories (‘000 Tk.)	Farmers		Mean (‘000’ Tk.)
	Number	Percent	
0-100	19	31.7	335.26
101-150	37	63.3	
Above 150	3	5	
Total	**60**	**100**	

Source: Field Survey, 2019

Data presented in Table 4.3 indicate that the highest proportion (63.3 percent) of the respondent had 101-150 thousands income while (31.7 percent) of the farmers having 68-100 thousands income and (5 percent) had above 150 thousand income.

4.1.8 Income from different sub-sector

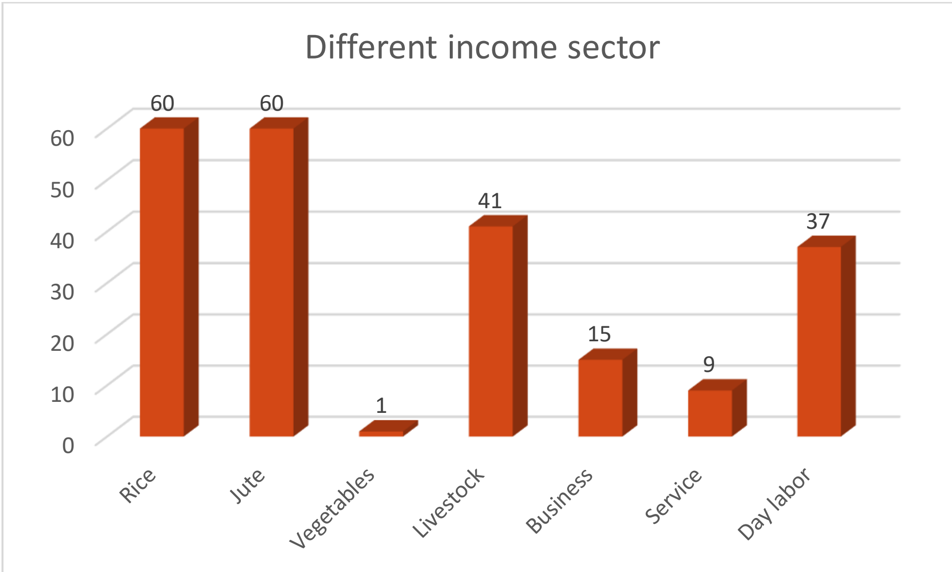

Figure 4.5: Distribution of the farmers according to their income from different sub-sectors

Figure 4.5 indicated that total number of the farmers earn from rice and jute, 41 farmers earn from livestock, 15 farmers earn from business, 37 farmers earn from day labour, 9 farmers engage in services and only 1 farmers earn from traditional vegetable cultivation.

4.1.9 Organizational participation

The observed organizational participation of the respondents ranged from 0 to 1. The mean (was 0.33. On the basis of organizational participation, the respondents were classified into two categories namely, yes organizational participation and no organizational participation, as shown in Table 4.4.

Table 4.4 Distribution of the farmer according to their organizational participation

Organizational Participation	Farmers		Mean
	Number	Percent	
Yes (1)	20	33	0.33
No (0)	40	67	
Total	**60**	**100**	

Source: Field Survey, 2019

Data contained in the Table 4.4 revealed that the majority (67%) of the farmers had no organizational participation and rest 33% respondent had organizational participation in the society.

4.1.10 Extension Media contact

Extension media contact of the farmers ranged from 0 to 1 with an average of 0.95. On the basis of their media contact, the respondents were classified into two categories namely, yes contact and no contact. The scale used for computing the media contact of a respondent is given Figure 4.5.

Table 4.5 Distribution of the farmer according to their extension media contact

Extension Media Contact	Farmers		Mean
	Number	Percent	
Yes (1)	57	95	0.95
No (0)	3	5	
Total	**60**	**100**	

Source: Field Survey, 2019

Data contained in the Table 4.5 indicated that the highest proportion (95.0%) of the respondents had yes extension media contact as compared to (5%) had no extension media contact respectively.

4.1.11 Knowledge on floating garden

The score of knowledge on floating garden of the farmers ranged from 0-8 with a mean of 6.45. On the basis of knowledge on floating garden, the respondents were classified into two categories namely, 'Knowledge 5-6'and 'knowledge above 6' on about floating gardening, season for bed preparation, materials required, how water hyacinth is used, insects affect cultivation, pesticides used during the cultivation parameters asking Yes/No. The scale used for computing the knowledge score is presented in the Figure 4.8.

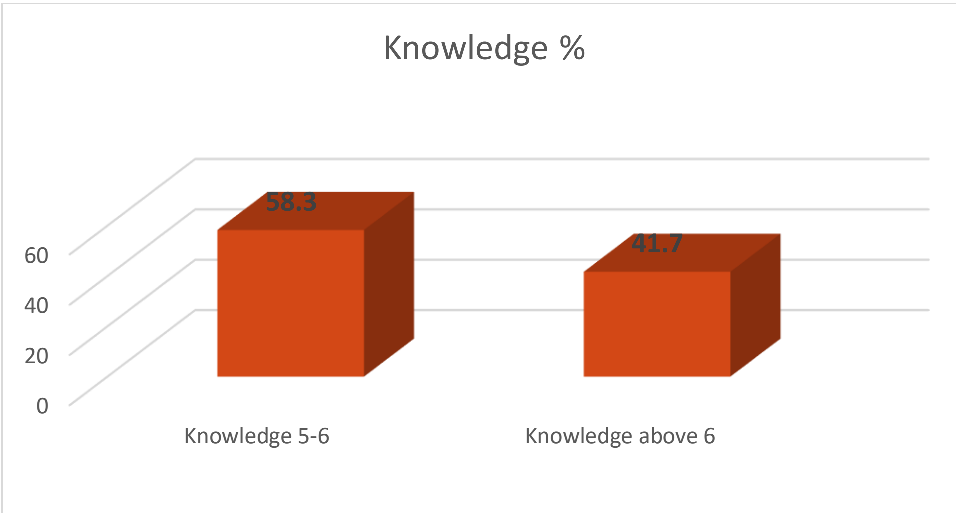

Figure 4.6 Distribution of the farmers according to their knowledge

Data contained in the Figure 4.8 shows that the highest proportion (58.3%) of the respondents had knowledge 5-6 on floating garden and (41.7%) of them had knowledge above 6 on floating garden.

4.1.12 Credit received

The amount of credit received of the farmers ranged from 0-40 thousand with a mean of 6.45. On the basis of credit received, the respondents were classified into four categories namely, '0 credit', '20 thousand credit received', '21-30 thousand credit received' and 'Above 30 credit received'. The scale used for computing the credit received is presented in the Figure 4.9.

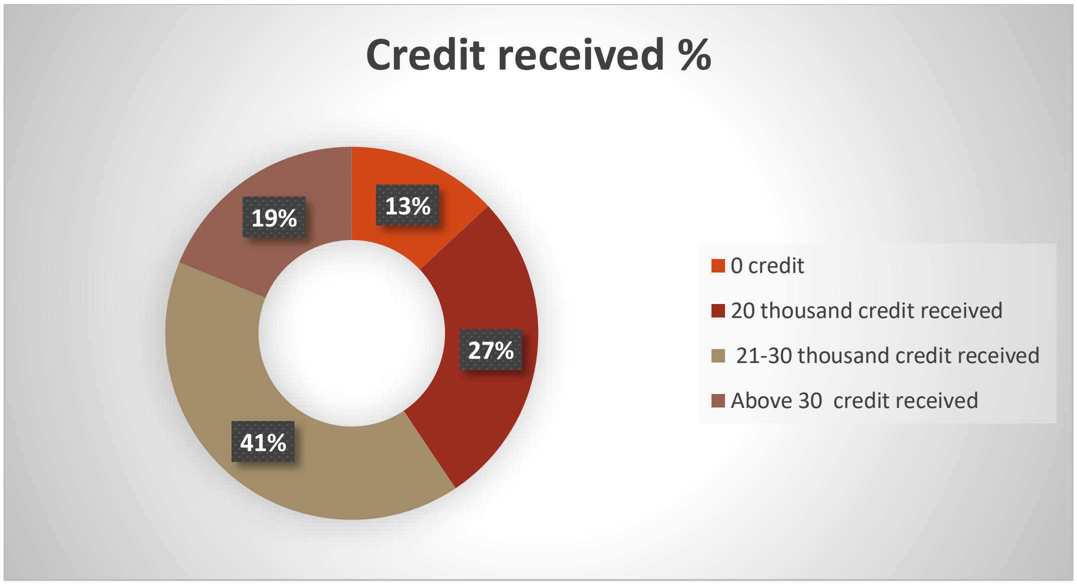

Figure 4.7 Distribution of the farmers according to their credit received

Data contained in the Figure 4.9 shows that the highest proportion (41%) of the respondents had received credit amount of 21-30 thousand, (27%), (19%) and (13%) of them had received credit amount 20 thousand, above 30 thousand and no credit respectively.

4.1.13 Credit received from different sources

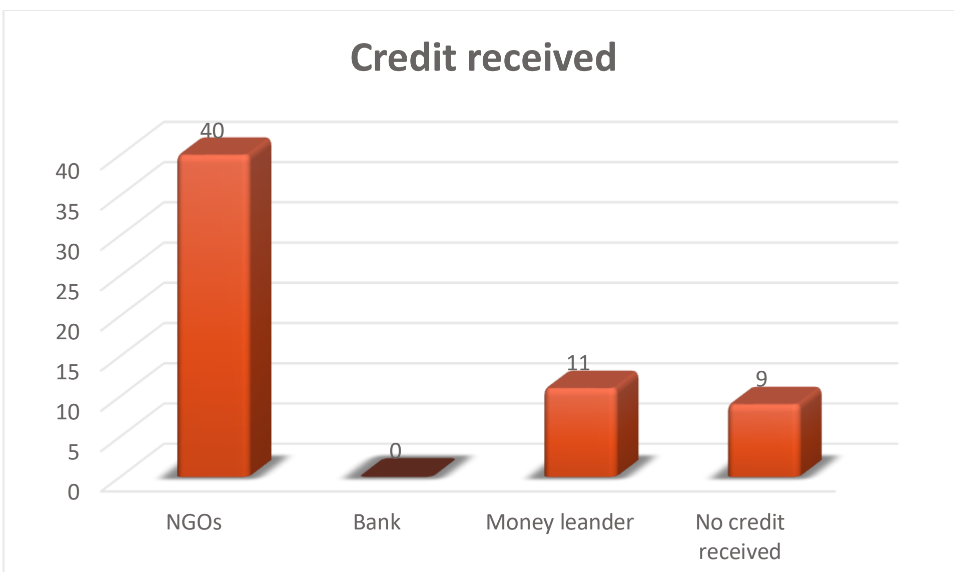

Figure 4.8 Distribution of the farmers according to their credit received

Figure 4.10 indicates that 40 farmers received credit from NGOs, 11 farmers received credit from money lender, 9 farmers did not need any credit and no farmers in this study area received credit from bank.

4.2 Concluding Remarks

This chapter analyzed the socioeconomic characteristics of the sample farmers. The findings of analysis clearly indicate the socioeconomic characteristics from each other in respect of age distribution, education, family size, sources of credit, income, experience on floating bed vegetable cultivation, extension media contact, training on floating bed vegetable cultivation, credit received, knowledge on floating garden and organizational participation etc.

CHAPTER V

PROFITABILITY OF FLOATING GARDEN VEGETAVLE PRODUCTION

5.1 Introduction

Profitability is a major criterion to make decision for producing vegetable at farm level. It can be measured based on net return, gross margin and ratio of return to total cost. The costs of all items were calculated to identify the total cost of production. The returns from the crops have been estimated based on the value of main products and by-products.

5.2 Cost of floating garden vegetable production

5.2.1 Variable costs

5.2.1.1 Labor cost

Labor cost is an important component in floating garden enterprise and this has implication for income and employment generation. Calculating the cost of farm operation, the services of both hired and family labor were taken into consideration. Family labor includes the operator himself and other working members of the family while the hired labor includes permanent hired labor, and labor employed on daily contract basis. The cost of family labor was estimated on the basis of the principle of opportunity cost. It is revealed from Table 5.1 that the cost of hired labor per bed per year were Tk. 448, Tk. 453, Tk. 458 and Tk. 463 for tomato, brinjal, chili and red amaranth for, respectively.

5.2.1.2 Seedling cost

It is another important cost for floating bed vegetable cultivation. Cost of seed varied widely depending on its quality and availability. The average seedling cost per bed per amounted to Tk. 273, 274, 270 and Tk. 284 for tomato, brinjal, chili and red amaranth, respectively.

5.2.1.3 Cost of bed preparation

Bed preparation is needed to make the soil suitable for vegetable cultivation. The average bed preparation cost of floating garden vegetable production was found Tk. 968, Tk. 961. Tk. 965 and Tk. 988 for tomato, brinjal, chili and red amaranth, respectively (Table 5.1).

5.2.1.4 Cost of manure

It is evident from Table 5.1, that per bed costs of manure were Tk. 56, 59, 60 and 61 for tomato, brinjal, chili and red amaranth, respectively.

5.2.1.5 Cost of urea

In the study area, farmers used different types of fertilizers for cultivating floating bed vegetable. On an average, per bed cost of urea were Tk.26, Tk. 24. Tk. 26 and Tk. 27 for tomato, brinjal, chili and red amaranth, respectively (Table 5.1).

5.2.1.6 Cost of TSP

Among the different kinds of fertilizers used, the average cost of TSP was Tk.16, Tk. 14. Tk. 16 and Tk. 16 for tomato, brinjal, chili and red amaranth for floating bed vegetable cultivation, respectively (Table 5.1).

5.2.1.7 Cost of MP

Per bed cost of MP were Tk.12, Tk. 11. Tk. 12 and Tk. 13 for tomato, brinjal, chili and red amaranth for floating bed vegetable cultivation, respectively (Table 5.1).

5.2.1.8 Cost of insecticides

Farmers used different kinds of insecticides to control pests and diseases so that they can get higher yield of floating garden vegetable cultivation. The average cost of insecticides was Tk. 70, Tk. 74. Tk. 73 and Tk. 72 for tomato, brinjal, chili and red amaranth, respectively (Table 5.1).

5.2.1.9 Interest on operating capital

As regards the production of floating bed vegetable cultivation, the interest on operating capital for all different categories of farmers, such as tomato, brinjal, chili and red amaranth were calculated at Tk. 124, Tk. 129, Tk. 119 and Tk. 131 respectively.

Table 5.1: Per bed cost of vegetable cultivation in floating garden

Variable cost items	Tomato	Brinjal	Chili	Red amaranth
Hired labor cost	448	453	458	463
Seedling cost	273	274	270	284
Bed preparation cost	898	893	905	927
Manure cost	56	59	60	61
Urea cost	26	24	26	27
TSP cost	16	14	16	16
MP cost	12	11	12	13
Insecticides cost	70	74	73	72
Interest of operating cost	124	129	119	131
Total variable cost (A)	1923	1931	1939	1994
Own labor	520	508	507	525
Land use cost	151	144	138	156
Tools and equipment cost	57	55	56	59
Total fixed cost (B)	728	707	701	740
Total cost (A+B)	**2651**	**2638**	**2640**	**2734**

Source: Field Survey, 2019

5.2.1.10 Total variable cost

The total variable cost of floating bed vegetable production were Tk. 1923, Tk. 1931, Tk. 1939 and Tk. 1994 per bed for tomato, brinjal, chili and red amaranth, respectively (Table 5.1).

5.3 Fixed cost

5.3.1 Own labor cost

Own labor cost was another crucial cost item for vegetable production in floating garden. It appears from Table 5.1 that the cost of own labor cost per bed was calculated at Tk. 520, Tk. 508, Tk. 507 and Tk. 525 for tomato, brinjal, chili and red amaranth, respectively (Table 5.1).

5.3.2 Land use cost

For floating bed vegetable production, rent value of land claims an important part of the production. Table 5.1 shows that total rent cost per bed per season was Tk. 151, Tk. 144, Tk. 138 and Tk. 156 per bed for tomato, brinjal, chili and red amaranth, respectively (Table 5.1).

5.3.3 Tools and equipment cost

The major tools and equipment used by the floating garden farmers were spade, hoy, Khurpi instruments and heating materials. The tools and equipment cost per bed per year was Tk. 57, Tk. 55. Tk. 56 and Tk. 59 for tomato, brinjal, chili and red amaranth, respectively (Table 5.1).

5.3.4 Total cost (TC) of vegetable production

Total cost was calculated by adding all the cost of variable and fixed inputs. In the present study per bed total cost of producing vegetable per year was found to be Tk. 2651, Tk. 2638, Tk. 2640 and Tk. 2734 per bed for tomato, brinjal, chili and red amaranth, respectively (Table 5.1).

5.4 Return from vegetable production

5.4.1 Gross Return

Return per bed of vegetables production in floating garden is shown in Table 5.2. Per bed gross return was calculated by multiplying the total amount of product with respective per unit price. Therefore, the gross return were found to be Tk. 4590, Tk. 4381, Tk. 4590 and Tk. 4638 per bed for tomato, brinjal, chili and red amaranth, respectively (Table 5.2).

5.4.2 Gross Margin

Gross margin was calculated by deducting the total variable cost from the gross return. On the basis of the data, gross margin was found to be Tk. 2667, Tk. 2450, Tk. 2651 and Tk. 2654 per bed for tomato, brinjal, chili and red amaranth, respectively (Table 5.2).

5.4.3 Net Return

Net return or profit was calculated by deducting the total production cost from the gross return. On the basis of the data the net return was estimated as Tk. 1939, Tk. 1743, Tk. 1950 and Tk. 1904 per bed for tomato, brinjal, chili and red amaranth, respectively (Table 5.2).

Table 5.2 Gross Margin and Benefit Cost Ratio (Undiscounted) of floating bed vegetable production

Sl.	Items	Tomato	Brinjal	Chili	Red amaranth
A.	Gross return (GR)	4590	4381	4590	4638
B.	Total variable costs (TVC)	1923	1931	1939	1994
C.	Total costs (TVC+TFC)	2651	2638	2640	2734
D.	Net return (GR-TC)	1939	1743	1950	1904
E.	Gross margin (GR-TVC)	2667	2450	2651	2654
F.	Benefit-cost ratio (BCR) =	1.73	1.66	1.74	1.70

Source: Field Survey, 2019

5.4.4 Benefit Cost Ratio (undiscounted)

Benefit cost ratio (BCR) was found to be 1.73, 1.66, 1.74 and 1.70 for tomato, brinjal, chili and red amaranth, respectively (Table 5.2) which implies that one taka investment on selective vegetables production generate Tk. 1.73, 1.66, 1.74 and 1.70 in tomato, brinjal, chili and red amaranth respectively (Table 5.2). From the above calculation it was found that chili cultivation is more profitable in Bangladesh.

5.5 Concluding Remarks

It was evident from the results that per bed total variable cost for floating bed vegetable cultivation were more than per bed total fixed costs for floating bed vegetable cultivation. Floating bed vegetable cultivation provides higher returns to the farmers. Floating bed vegetable cultivation is gaining popularity in the country gradually due to its high yield potentiality and high demand in the market. Sample farmers showed their opinion that higher yield and income encouraged them to continue floating bed vegetable cultivation.

CHAPTER VI

CHANGE IN INCOME AND LIVELIHOOD OF THE FARMER DUE TO FLOATING GARDENING

6.1 Impact on income of floating gardening on farmers' income

From, Table 6.1 it is found that average on farm and off farm income is Tk. 12026.85 and 135403.70 respectively. Hence, average total income received is Tk. 147430.55 while floating bed vegetable contributed Tk. 10422 which is 7.07% of total income. Alternatively, out of Tk.100 income floating vegetable gardening contributed Tk. 7.07.

Table 6.1 Contribution of floating gardening income on total income

On farm income (Tk./year)	Off farm income (Tk./year)	Total income (Tk./year)	Income from floating bed vegetable cultivation (Tk./year)	% of total income
12026.85	135403.70	147430.55	10,422	7.07

Source: Field Survey, 2019

6.2 Change in livelihood

The results indicate that floating vegetable gardening plays a vital role in socio-economic development of farmers. Most of the farmers mentioned that highest change was occurred in income followed by sanitation and education. In the case of health and drinking water access moderate change was observed.

Table 6.2 Livelihood indicator with percentage

Livelihood indicator	High	Moderate	low	Total %
Income	98.3	1.7	0	100
Sanitation	85	11.7	3.3	100
Education	71.7	20	8.3	100
Expenditure	58.3	40	1.7	100
Health condition	16.7	83.3	0	100
Drinking water	3.3	90	6.7	100

Source: Field Survey, 2019

Income

From Table 6.2 it can be said that floating bed vegetable cultivation has most significant impact on income for selected respondent. Here, 98.3% respondent chose high influence on income over their livelihood which is maximum among the fixed livelihood indicators.

Sanitation

From Table 6.2 it can be stated that floating bed vegetable cultivation has significant impact on sanitation. 85% respondent support that income generation create capacity to ensure sanitation in their rural life.

Education

From Table 6.2 it is observed that 71.7% respondent given their opinion that income generating activities from floating bed vegetable cultivation ensure their children education. Thus, this operation increase the education rate in the selected area.

Expenditure

It can be said from Table 6.2 that 58.3% respondent has given their opinion as additional income from the floating bed vegetable cultivation enabled them to increase their expenditure for their daily life.

Health Condition

From Table 6.2 it can be said 83.3% of the respondent has given their judgement as their health condition is improving moderately on the other hand rest 16.7% agreed on quicker improvement on their health.

Drinking Water

Besides these the Table 6.2 implies that 90% of the respondent has given their opinion over the moderate improvement in drinking water.

Table 6.3 Change in livelihood with rank order

Livelihood indicator	High	Medium	low	Scores	Rank order
Income	59	1	0	178	1st
Sanitation	51	7	2	169	2nd
Education	43	12	5	158	3rd
Expenditure	35	24	1	154	4th
Health condition	10	50	0	130	5th
Drinking water	2	54	4	118	6th

Source: Field Survey, 2019

Sanitation

The results indicate that income from floating garden vegetable cultivation help the farmers to improve their sanitation facilities. Inadequate sanitation is a major cause of infectious diseases such as cholera, typhoid and dysentery world-wide. It also contributes to stunting and impaired cognitive function and impacts on well-being through school attendance, anxiety and safety with lifelong consequences, especially for women and girls. Improving sanitation in households, health facilities and schools underpins progress on a wide range of health and economic development issues including universal health coverage and combatting antimicrobial resistance.

Education

A farmer with more education level can increase the capabilities to reduce different problems about floating garden vegetable cultivation. So, initiative to improve education can enhances the ability of the farmers to face the problems in floating garden vegetable cultivation and reduce it at short time than others. So, it can be said that floating garden vegetable cultivation increases farmer's family income and it also increases farmers' family education level.

Expenditure

The total amount of money that farmers spends for family maintenance. It's compared changes in social service expenditures with changes in income maintenance expenditures. In floating garden vegetable cultivation increases farmers annual family income. So farmers' family expenditure ultimately increase.

Health condition

The results indicate that floating garden vegetable cultivation change in livelihood. Income from floating garden vegetable cultivation plays a vital role in health condition of the farmers. Therefore, it can be said that more income from floating garden vegetable cultivation possessed by the respondent, higher would be change in livelihood that means health condition improved.

Drinking water

Floating garden vegetable cultivation increases farmers' annual income. Farmers from extra income they can set up tube well and get pure drinking water from it. So income from floating garden vegetable cultivation can easily change in livelihood.

6.4 Concluding Remarks

From the above discussion we can easily said that vegetable cultivation from floating bed helping farmers to attain highest change in income generation activities.

CHAPTER VII

PROBLEMS OF FLOATING GARDEN SYSTEM

The floating garden vegetable producers in the study areas were facing various problems. Some of the problems were lack of capital, insect and pests attack, adverse climatic condition, lack of skilled labors and lack of contact by the extension workers.

7.1 Problem of floating garden system

Lack of capital

Lack of capital is a problem for farmers. Floating garden cultivation sometimes needs credit. In the study area farmers do not get sufficient loan from the banks. Banks are reluctant to give loan to farmers. In this study area 86.7% respondents given their opinion on lack of capital (Table 7.1).

Lack of skilled labors

In the study areas farmers also reported that lack of skilled labor was a minor problem for floating garden vegetable cultivation. In the study area, lack of skilled labor stated as a minor problem by 80% respondent while 20% agreed saying moderate problem (Table 7.1).

Table 7.1. Problems of floating gardens with percentage

Sl. No.	Problems	High problem %	Medium problem %	Low problem %	Total %
1	Lack of capital	86.7	8.3	5	100
2	Lack of skilled labors	0	20	80	100
3	Lack of contact by the extension workers	0	11.7	83.3	100
4	Insect and pest attack	1.7	8.3	90	100
5	Lack of awareness of farmers	0	5	95	100

Source: Field Survey, 2019

Lack of contact by the extension workers

Contact by the extension workers played an important role in floating garden vegetable cultivation. In the study area 83.3% respondent thought lack of contact by the extension workers was low problem while 11.7% stated that as moderate problem (Table 7.1).

Insect and pests attack

In the survey, most of the producers mentioned that the amount of loss in yield of their floating crop was caused by the insect is not a great deal but still significant quantity. During the present investigation 8.3% of the respondent pointed insect and pest attack as moderate problem while 1.7% thought as high problem (Table 7.1).

Lack of awareness of farmers

Lack of awareness of the farmers was the last number of problem in floating garden vegetable cultivation. From Table 7.1 it can be said that 5% of the respondent given their judgement on lack of awareness of farmers as moderate problem while the rest given their opinion as low problem.

7.2 Concluding Remarks

The above mentioned problems and constraints of course are interrelated with one another and hence need to be removed comprehensively through an integrated program for the overall development of floating bed vegetable cultivation. Problems faced by the farmers were calculated on the basis of corresponding percentages. Most of the farmers were reported that lack of capital was the main problem for their floating bed vegetable cultivation.

CHAPTER VIII
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter focuses on the summary in the light of the discussion made in the earlier chapters. Policy recommendations are drawn for improvement of the existing in efficiency of floating garden vegetable cultivation in Gopalganj and Pirojpur district in Bangladesh.

8.1 Summary of the study

The performance of floating garden vegetable cultivation in selected areas of Bangladesh has been evaluated in this study. There results revealed that floating garden vegetable cultivation is highly profitable at farm level.

From socio-economic characteristics of the farmers the highest proportion 48 percent of the vegetable growers in floating garden were in the 20-30 years age category, while 45 percent of them were in the 31-40 years age category and 7 percent in the above 40 years age category. The majority (36 percent) of the farmers had secondary education compared to 27 percent of them having illiterate. About 30 percent of the farmers were primary level education, while 7 percent had above secondary level of education. The majority of the 60 percent of the vegetable growers had 5-6 members compared to more different than 21.7 percent of them having of above 6 members. The proportion of 2-4 members was 18.3 percent. More than half (52 percent) of the farmers possessed 0.26 – 0.30 ha compared to above 35 percent of them having above 0.30 ha farms and 13 percent 0.2-25 ha farms. The majority (48.3%) of the farmers had 4-5 years' experience as compared to (35%) and (16.7%) having 2-3 years' experience and above 5 years' experience respectively. The majority (60%) of the farmers had 1-2 days training on floating garden while 26.7 percent of the farmers had no training on floating garden vegetable cultivation and 13.3 percent farmers had 2 days training on floating garden. The highest proportion (63.3 percent) of the respondent to 101-150 thousand income, while (31.7 percent) had 68-100 thousand income and (5 percent) had above 150 thousand income. Total number of the farmers earns from rice and jute, 41 farmers earns from livestock, 15 farmers earns from business, 37 farmers da labor, 9 farmers engage in services and only 1 farmers earns from vegetables.

The majority (67%) of the farmers had no organizational participation and only 33 percent of the farmers' had yes organizational participation. The highest proportion (95.0%) of the respondents had yes extension media contact as compared to (5%) had no extension media contact respectively. That the highest proportion (58.3%) of the respondents had knowledge 5-6 on floating garden and (41.7%) of them had knowledge above 6 on floating garden. The highest proportion (41%) of the respondents had 21-30 thousand credit received', (27%), (19%) and (13%) of them had l20 thousand credit received', above 30 credit received and 0 credit received, respectively. From total number of farmers among 40 farmers received credit from NGOs, 11 farmers received credit from money Leander, 9 farmers received no credit and no farmers in this study area received credit from bank.

Per bed cost of hired labor per bed per year were Tk. 448, Tk. 453, Tk. 458 and Tk. 463 for tomato, brinjal, chili and red amaranth for floating bed vegetable cultivation, respectively. The average seedling cost per bed per season amounted to Tk. 273, 274, 270 and Tk. 284 for tomato, brinjal, chili and red amaranth for floating bed vegetable cultivation, respectively. The average land preparation cost of floating garden vegetable production was found Tk. 968, Tk. 961. Tk. 965 and Tk. 988 for tomato, brinjal, chili and red amaranth for floating bed vegetable cultivation, respectively. Per bed costs of manure were Tk. 56, 59, 60 and 61 for tomato, brinjal, chili and red amaranth for floating bed vegetable cultivation, respectively. On an average, per bed cost of urea were Tk. 26, Tk. 24. Tk. 26 and Tk. 27 for tomato, brinjal, chili and red amaranth for floating bed vegetable cultivation, respectively. The average cost of TSP was Tk.16, Tk. 14. Tk. 16 and Tk. 16 for tomato, brinjal, chili and red amaranth for floating bed vegetable cultivation, respectively. The average cost of insecticides was Tk. 70, Tk. 74. Tk. 73 and Tk. 72 for tomato, brinjal, chili and red amaranth for floating bed vegetable cultivation, respectively. The tools and equipment cost per bed per year was Tk. 57, Tk. 55. Tk. 56 and Tk. 59 for tomato, brinjal, chili and red amaranth for floating bed vegetable cultivation, respectively.

The total variable cost of floating bed vegetable production were Tk. 1923, Tk. 1931, Tk. 1939 and Tk. 1994 per bed for tomato, brinjal, chili and red amaranth for floating bed vegetable cultivation, respectively. In the present study per bed total cost of producing vegetable per season was found to be Tk. 2651, Tk. 2638, Tk. 2640 and Tk. 2734 per bed for tomato, brinjal, chili and red amaranth for floating bed vegetable cultivation, respectively.

Therefore, the gross return were found to be Tk. 4590, Tk. 4381, Tk. 4590 and Tk. 4638 per bed for tomato, brinjal, chili and red amaranth for floating bed vegetable cultivation, respectively. On the basis of the data, gross margin was found to be Tk. 2667, Tk. 2450, Tk. 2651 and Tk. 2654 per bed for tomato, brinjal, chili and red amaranth for floating bed vegetable cultivation, respectively. On the basis of the data the net return was estimated as Tk. 1939, Tk. 1743, Tk. 1950 and Tk. 1904 per bed for tomato, brinjal, chili and red amaranth for floating bed vegetable cultivation, respectively. Benefit cost ratio (BCR) was found to be 1.73, 1.66, 1.74 and 1.70 for tomato, brinjal, chili and red amaranth for floating bed vegetable cultivation, respectively.

Floating vegetable gardening contributes significantly in total income and thus, improve the income, education, sanitation, and consumption expenditure of the farmers. In this study area lack of capital was the 1st most severe problem and lack of awareness of farmers was the last problem of the farmers.

8.2 Conclusions

The results revealed that floating garden vegetables cultivation is highly profitable at farm level and increases the income of the farmers. It also has influenced on the livelihood status of the farmers. Lack of capital and technical knowledge and infestation of insects and diseases, lack of skilled labor and lack of extension workers contact were major problems found in floating garden vegetable cultivation. Government should take necessary steps to overcome these problems.

8.3 Recommendations

Based on the findings of the study, the following recommendations were put forward for the improvement of floating garden vegetables cultivation at farm level.

Credit and Financial aid

Special incentive should be given to the vegetable cultivars such as credit, vegetable insurance etc. as financial aid. So that they would bear production cost. Attempt should be taken to minimize risk and uncertainty that might appear at any adverse circumstances.

Arrange more training program for farmers

To make the farmer more efficient it is necessary to arrange more training program for floating vegetable farmers. As well as the technology transfer to the grass root area.

8.4 Limitations of the Study

The present study provides some important information for farmers, extension workers and decision-makers regarding the economics of floating garden vegetables production However, a number of limitations of the study are indicated below:

- ✓ Almost all the floating garden vegetables cultivation farmers did not keep any written records related to their farm related transactions As a result, the accuracy of data fully relied upon their memories and sincerity. The task of obtaining data proved to be very challenging and the possibility of data errors, therefore, cannot be fully ruled out.

- ✓ The study was conducted in a limited number Upazilla in Bangladesh with a small number of samples Therefore, the scope of generalization is very limited and findings of the study may not represent the actual situation of other regions of the country.

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APPENDIX-I

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An interview schedule for data collection of the research study entitled

"FLOATING GARDENING IN BANGLADESH: A SOLUTION TO CAPACITY BUILDING OF FARMERS COPING WITH FLOOD"

Serial No…………

Respondent Name:

Village:………………………………. Union:………………………………….

Upazila:………………………………. District:……………………………….

(Please answer the following questions. Put tick wherever necessary)

1. Age:

What is your present age?.................................Years.

2. Level of Education:

a) Cannot read and write……… b) Can sign only……

c) I read up to class ………… d) I passed ………………………class

3. Family Members…………..Persons

4. Farm Size:

Please mention the area of your land possession

Sl. No.	Types of land ownership	**Area of land**		**Total Area** (Hectare)
		Local unit	Hectare	
1	Homestead area (Including pond) (A)			
2	Own land under own cultivation (B)			
3	Land given to others as borga (C)			
4	Land taken from others as borga (D)			
5	Land taken from others as lease (E)			
	Total=A+B+1\2(C+D)+E			

5. Annual family income:

Please state the income from different sources during the last one year:

A. On farm income:

SL. NO.	Sources of income	Total production Kg/unit	Price per kg/unit
1	Rice		
2	Jute		
3	Vegetables		
4	Livestock		
5	Floating garden's vegetables i) Brinjal ii) Tomato iii) Chili iv) Red Amaranths		

B. Off farm income:

SL. NO.	Sources of income	Tk/ month	Tk/ years	Total (Tk)
1	Business			
2	Services			
3	Day labor			
	Total			

6. Training Received:

Have you attended any training programme on floating garden?

Yes……………………… No………………..

If yes, please mention the following information:

Sl. No	Name of the training course	Name of the organization	Duration of training (days)
1			
2			
3			
	Total		

7. Organizational Participation:

Are you a member of societal organization?

Yes……………………….No…………………......

8. Extension Media contact

Do you have any extension contact?

Yes……………………….No……………………….

If yes, how many times you visited extension office last year?

………times

9. For how many years you have vegetable practices floating garden……..Years

10. Knowledge on floating gardening

Please answer the following questions

SL. NO.	Questions	Yes	No
1	Do you know what floating gardening is?		
2	Do you know what the material needs in floating gardening are?		
3	Which month does the suitable for floating gardening?		
4	What is raft?		
5	What is water hyacinth?		
6	Can mention two insects Which found in floating gardening?		
7	Name two insecticides/ pesticides which used in floating gardening?		
8	When does floating garden made?		
	Total		

11. Credit received: Did you receive any credit from any sources? (Yes / No)

If yes, please mention the sources of receiving credit and the amount of credit received.

Sl. No.	Sources of credit	Amount of credit
1.	NGO	
2.	Banks	
3.	Money lender	

12. Cost of floating garden

Cost items	**Brinjal**	**Tomato**	**Chili**	**Red Amaranths**
Seedling				
Bed preparation				
Manure				
Fertilizer				
Urea				
TSP				

MP				
Labor				
Insecticides				
Miscellaneous				
Total cost				

13. Change in livelihood

Livelihood indicator	**Change**			
	High	**Moderate**	**Small**	**No**
Health condition				
Income				
Expenditure				
Sanitation				
Education				
Drinking water				

14. Problems faced in floating gardens
Please mention the extent of problems you faced

Sl. No.	**Problems**	**Extents of problems**			
		High (3)	**Medium (2)**	**Low (1)**	**Not at all (0)**
1	Lack of capital				
2	Insect and pest attack				
3	Adverse climatic condition				
4	Lack of skilled labors				
5	Lack of contact by the extension workers				
6	Lack of awareness of farmers				
Total					

15. Suggestions

1………………………
2……………………...
3……………………..

Thank you for your kind co-operations

Signature of the interviewer