AN ECONOMIC ANALYSIS OF BOTTLE GOURD PRODUCTION IN A SELECTED AREA OF NARAYANGANJ DISTRICT

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CERTIFICATE

This is to certify that the thesis entitled "AN ECONOMIC ANALYSIS OF BOTTLE GOURD PRODUCTION IN A SELECTED AREA OF NARAYANGANJ DISTRICT" submitted to the DEPARTMENT OF AGRICULTURAL ECONOMICS, Sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE (M.S.) in AGRICULTURAL ECONOMICS, embodies the results of a piece of *bona fide* research work carried out by HAMIDA AKTER, Registration. No. 07-02410, under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma in any other institution.

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

3 December, 2015
Dhaka, Bangladesh

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DEDICATED TO
MY
HEAVENLY MOTHER

ABSTRACT

In Bangladesh, among different kinds of winter vegetables bottle gourd is important because of its high nutritive value and higher economic return. The present study was designed to determine the profitability and resource use efficiency of bottle gourd *(Lagenaria siceraria)* production and its impact on the socio economic status of the farmer in Rupganj Upazilla of Narayanganj district. A purposive random sampling technique was used in this study. A total of 60 bottle gourd farmers from three villages Pitalganj (15), Jangir (20), and Shimolia (25)) of Rupganj upazilla were selected. Tabular technique and statistical technique such as Cobb douglas production function and perceived impact score (PIS) technique was used to achieve the major objectives of the study. The major findings of the study revealed that bottle gourd production was highly profitable. Per hectare gross cost of bottle gourd production was Tk. 153261.27 and per hectare gross return was Tk. 340197.00. From the profitability analysis per Benefit Cost Ratio was found 2.22. The results of Cobb-Douglas production function showed that per hectare gross return of bottle gourd was significantly influenced by the use of human labor, power tiller, seed, fertilizers and manure, irrigation, and insecticides. Resource use efficiency analysis revealed that farmers were not efficient in using resources in bottle gourd production and most of the resources were underutilized except fence & mancha which was over utilized. From the analysis of perceived impact score, the highest SPIS was found for income 61.67 followed by sanitation and drinking water source (43.33), health (42.78), education (41.67), household furniture (39.44), mobile & technology (38.89). It was found that high price of fence & mancha items, high price of fertilizer, high wage rate of labor and non availability of HYV seed were major constraint in producing bottle gourd. Government should take initiative to ensure availability of good quality HYV seeds, launch institutional credit programme, search for new export markets of bottle gourd to overcome the constraints and increase production of bottle gourd.

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ABBREVIATION AND ACRONYMS

ASA	Association for Social Advancement
AD	Anno Domino
BARI	Bangladesh Agriculture Research Institute
BBS	Bangladesh Bureau of Statistics
BC	Before Christ
BCR	Benefit Cost Ratio
BDT	Bangladesh Taka
BER	Bangladesh Economic Review
BP	Before Present
BRAC	Bangladesh Rural Advancement Committe
CARE	Cooperative For Assistance and Relief Everywhere
CDP	Crop Diversification Programme
DAE	Department of Agriculture Extension
DRC	Depreciated Replacement Cost
EPB	Export Promotion Bureau
et al	et alia (and others)
etc	et cetra (others and so forth)
F_1	First generation
FY	Fiscal Year
GDP	Gross Domestic Product
g	Gram
Govt	Government
ha	Hectare
HSC	Higher Secondary Certtifiacte
HYV	High Yielding Variety
i.e.	That is
IOC	Interest on Operating Capital
IRRI	International Rice Research Institute
Kcl	Kilocalorie
Kg	Kilogram
Kj	Kilojule

km^2	Square kilometer
ln	Natural log
MFC	Marginal Factor Cost
mg	Miligram
mm	Milimeter
MOP/MP	Murate of Potash
MS	Microsoft
M.S	Master of Science
MVP	Marginal Value Product
NGO	Non –Government Organization
No	Number
OLS	Ordinary Least Square
Oz	Ounce
PIS	Perceived impact Score
RDA	Recommended Dietary Allowance
SFYP	Sixth Five Year Plan
SPSS	Statistical Package for Social Science
Tk	Taka, Bangladeshi Currency
TSP	Triple Super Phosphate
TVC	Total Variable Cost
UAE	United Arab Amirates
UK	United Kingdom
US	United States
USDA	United States Department of Agriculture
USAID	United States Agency for International Development
$	United States Dollar
^0C	Degree Celsius
%	percentage

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CHAPTER 1
INTRODUCTION

1.1 Background of the Study

Bangladesh is predominantly an agricultural country where agriculture sector plays a pivotal role in accelerating its economic growth. It has an area of 1, 47,570 km^2 and a population reaching nearly 152.90 million with the density of about 964 person per square kilometer (BBS, 2011). Per capita income is about US $1190 and people have a life expectancy of 69 years (BER, 2014). The growth and stability of the economy depend largely on the growth of agriculture. The agricultural sector comprises crops, forests, fisheries and livestock. Hence, agriculture is one of the drivers of growth of Bangladesh economy. Agriculture contributed 16.50 percent to the Gross Domestic Product (GDP) in 2013-14; approximately 9.28 percent of the GDP was derived from crops, where livestock, fisheries and forestry contributed to 1.78 percent, 3.69 percent and 1.74 percent respectively to the GDP at constant prices (BBS, 2014).

Agriculture is the foundation of Bangladesh economy and rice is the main food item for the people of the country. But rice alone cannot solve the demand for balanced diet. Nutritional deficiency is a very serious problem for the people of Bangladesh today. Government of Bangladesh has called for a departure from “rice-led” growth to a more diversified production base that includes several non-rice crops like maize, legumes, livestock, and vegetables (Hoque, 2000).

Vegetables are considered as one of the most important groups of food crops due to their high nutritive value, relatively higher yield and higher return. Vegetables provide dietary fiber necessary for digestion and health and combating malnutrition, as well as curing some diseases like anemia, blindness, scurvy, goiter, etc. Vegetables are also necessary for physical and mental growth that helps to increase efficiency of labor and span of working life. Moreover, vegetables are the most inexpensive and rich sources of vitamins. In Bangladesh, a good number of vegetables are grown throughout the year both in winter and summer seasons. It is an important sector in the total agricultural exports of Bangladesh (Karim, 2008).

The vegetable sector occupying a more or less significant position in our export sector helps to meet our need of foreign currency as well as ensure our economic development

(Qayum and Samadder, 2013). However, financial returns from vegetables shows that winter vegetable is more profitable than the production of most field crop (Sharfuddin and Siddique, 1998). Now-a-days, food security is the burning question in Bangladesh. Commercially produced highly nutritious vegetables can play an important role to meet the extra demand for vegetables to ensure food security (Amin, 2013). In view of increase in income, population and nutritional consideration, there is a great need for vegetables cultivation.

The vegetables which are grown mainly from November to March in Bangladesh may be called rabi or winter vegetables. In some cases, early phase of rabi vegetables starts from September and continue up to last April. Among winter vegetables bottle gourd is important because of their dietary values and sources of income. Bottle gourd name comes because of its shape. In Bangladesh, it is called *laau* or *kaddu.* Bottle gourd is believed to help the liver function. The juice from the leaves help to cure jaundice and juice from the gourd helps to reduce greying of hair. Besides these, gourd juice is also used for the treatment of urinary infection while it is consumed with the lime juice. Ayurveda highly recommend this food for diabetic patients and young children.

Bottle gourd can be grown by direct seed sowing or transplanting of 15 to 20 days old seedlings. Its fruits develop is very fast and it requires much attention at harvest time. It usually takes 15 days to reach marketable size from the day of fruit set or 60 to 80 days from sowing. Mostly used common varieties of bottle gourd in our country are BARI lau-1, Khetlau and Hazari (BARI, 2013). In the FY 2012-13, production of bottle gourd 157 thousand metric tons with an area of 41 thousand acre (BBS, 2013).

1.2 Vegetables Cultivation in Bangladesh

Rice monoculture dominates the cropping system in Bangladesh. But monoculture of rice for prolonged periods has led to a number of serious physical and biological problems. Consequently, a large percentage of people of Bangladesh are suffering from severe malnutrition (Awal, 2013). If enough vegetables are not provided to the people, the nutritional deficiency will be to a greater extent. The relation between productivity and malnutrition cycle continuously gets worse overtime. In such a worse situation vegetables are a major and efficient source of micro nutrient both per unit area of land and per unit cost of production.

Bangladesh have gradually been changing such as continuous increase in population and urbanization, increase in income, changes in agricultural input and output prices,

developments of physical infrastructure etc. On the food demand side, emphasis is now shifting from basic nutrients to balanced diets (i.e. calories, protein and micronutrients). Due to the soil and favorable climatic condition, a good number of vegetables are grown round the year. However, commercial production of vegetables is getting momentum. At the same time small and medium farmers with proper technical knowledge and skill are also coming forward increasingly to undertake this venture.

Nearly 100 different types of vegetable comprising both local and exotic type are grown in Bangladesh. However, the availability of vegetable is only about 1/5th of the recommended requirement of 200 g per capita per day (Rahim *et al.* 2014).

In Bangladesh based on the growing season, vegetables are categorized as:

- summer/rainy season vegetables,
- winter season vegetables, and
- all season vegetables/year round vegetables

Summer vegetables are grown from May to October. Out of the summer vegetables, various cucurbits, vegetables cowpea, hyacinth bean, stem amaranth, several aroids and Indian spinach are predominant. Winter vegetables include tomato, cabbage, chinese cabbage, cauliflower, eggplant, carrot, spinach, bottle gourd, bush bean and radish. Like okra, heat-tolerant tomato, eggplant, carrot, potato, spinach, many leafy vegetables and small onion are grown all year round. The production of vegetables is higher during winter season (60-70 %) and most district produce marketable surplus during that season. But these crops were neglected and relegated in the past, as research and extension work mostly concentrated on cereals. In this aspect, the present study therefore, was undertaken to measure the profitability and resource use efficiency of selected winter vegetable.

Among different kinds of important winter vegetables the present study was conducted on bottle gourd. The reason behind this, recently, commercial bottle gourd farming is getting importance as a way of investing lesser amount of capital but earning maximum income with increased participation of women in production activities. Rahman (2000) reports that the overall share of women in vegetable production in terms of labor hours performed is high (11 to 18 percent in food grains), only a minor share of them performed by hired labor (1.2 %).

Farmers are now diverting to bottle gourd production because it has a relatively short production cycles and proved as a more profitable that of some other staple crops and

pulses. Besides these, bottle gourd can also be cultivate in fallow land beside the home or relatively high land areas in which many field crops can't be cultivated. Besides economical value it has also nutritional value. The problems of malnutrition and ill health can be reduced to a great extent by taking leafy and green fleshy vegetables like bottle gourd which supply sufficient amounts of carbohydrate, vitamins, minerals and protein in the human diet.

The main emphasis of this study was given to analyze the profitability and input use efficiency of bottle gourd in a selected area of Bangladesh. Besides these, impact of bottle gourd production on socio economic status of the farmer also analyzed. Production analysis will help in providing information regarding farmers' income generation. Further, input use efficiency will help in providing information regarding farmers' can use of inputs efficiently or inefficiently.

1.3 Role of Vegetables in the Economy of Bangladesh

In everyday usage, a vegetable is any part of a plant that is consumed by humans as food as part of a savoury meal. Vegetables can be eaten either raw or cooked and play an important role in human nutrition, being mostly low in fat and carbohydrates, but high in vitamins, minerals and fiber. Many governments encourage their citizens to consume plenty of fruit and vegetables, five or more portions a day often being recommended**.**

There is a great need of vegetables cultivation in view of increase in income, employment and reduce widespread malnutrition in Bangladesh. People of Bangladesh take 463.9 gm of cereals per capita per day whereas actual cereals need is 372g per capita per day (BBS, 2011). So, people take more cereals daily than what they need. On the other hand, people take 166.1g vegetable per day where requirement is 200 g per capita per day (BBS, 2011). Realizing the importance of minor crops for the improvement of nutritional status of the people, the government of Bangladesh has taken a Crop Diversification Programme (CDP) in the Sixth Five-Year Plan (2011-2015). Under the CDP strategy, emphasis was placed to increase production and consumption of nutrient rich foods. The cultivation of vegetables can help to increase income and livelihood status of the farmers. Some most important role of vegetables are as follows:

1.3.1 Contribution of Vegetables to Value Added in Agriculture

As production of vegetable is more labor intensive so, Bangladesh is in advantageous

position due to its abundant labor supply. It should thus, take advantage of profitable production potentials in vegetables. Contribution of vegetable sector to value added in agriculture is shown in table 1.1.

Table 1.1 Contributions of Vegetables to Value Added in Agriculture at Current Market price

Year	Estimated value of the product Tk	% of total agriculture value
2004-05	32888	9.13
2005-06	38083	9.79
2006-07	46828	11.29
2007-08	49093	10.65
2008-09	59264	11.33
2009-10	75668	12.48
2010-11	71516	11.84
2011-12	64534	9.63

Source: BBS, 2013

From the above table, it can be seen that in 2008/09 vegetables contributed 11.33 percent value added to agriculture while in 2011/12 it stood at 9.63 percent.

1.3.2 Nutritional Value of Vegetables

In Bangladesh common deficit nutrient are calories, Vitamin A, Vitamin C, riboflavin and folic acid. Vegetables are the main sources of many essential nutrients. Vitamins such as Vitamin A, Vitamin C, niacin, riboflavin and thiamin and minerals like calcium and iron make human diet complete and balanced. Dieticians, in general, recommended a daily allowance of 285g requirements 85g should come from root vegetables and 115g from green leafy vegetables and 85g from others vegetables respectively (Hazra, 2008). To reduce the nutritional deficiency in Bangladesh commercial vegetable production can play a significant role.

Table 1.2 Nutrient Contents of Various Food and Vegetables Products (Per 100 g)

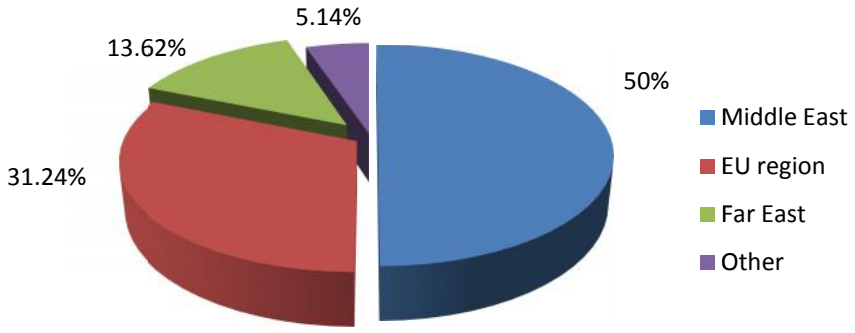
Items	Water	Carbo	Protein	Fat	Calorie	Vitamins	Iron

	(g)	hydrate (g)	(g)	(g)	(cal)	carotine	B1	B2	C	
Rice	12.60	77.40	8.50	0.60	349	0.01	0.27	.12	-	2.80
Vegetable	88.50	4.30	2.90	0.40	36	6.80	0.66	.15	54	9.00
Tubers	87.50	9.10	1.60	0.10	44	0.58	0.03	.08	19	0.70
Fruits	88.00	8.40	2.20	0.40	46	1.00	0.04	.02	25	0.80
Milk	87.50	4.40	3.20	4.10	67	0.01	0.05	.19	2	0.20

Source: USDA, 2014

1.3.3 Contribution of Vegetables to Total Export Earnings

More than 100 fruits and vegetables are exported from Bangladesh (EPB, 2014). Export of all horticultural crops to total country's exports share is below 0.5 percent and all policy makers may not take equal interest in expanding horticultural crop exports. It may be noted that the demands for vegetables is steadily rising at home and abroad. Export of fresh fruits and vegetables from Bangladesh are significantly increased from $ 9.44 million in FY1993-94 to $ 182.23 million in FY2012-13.

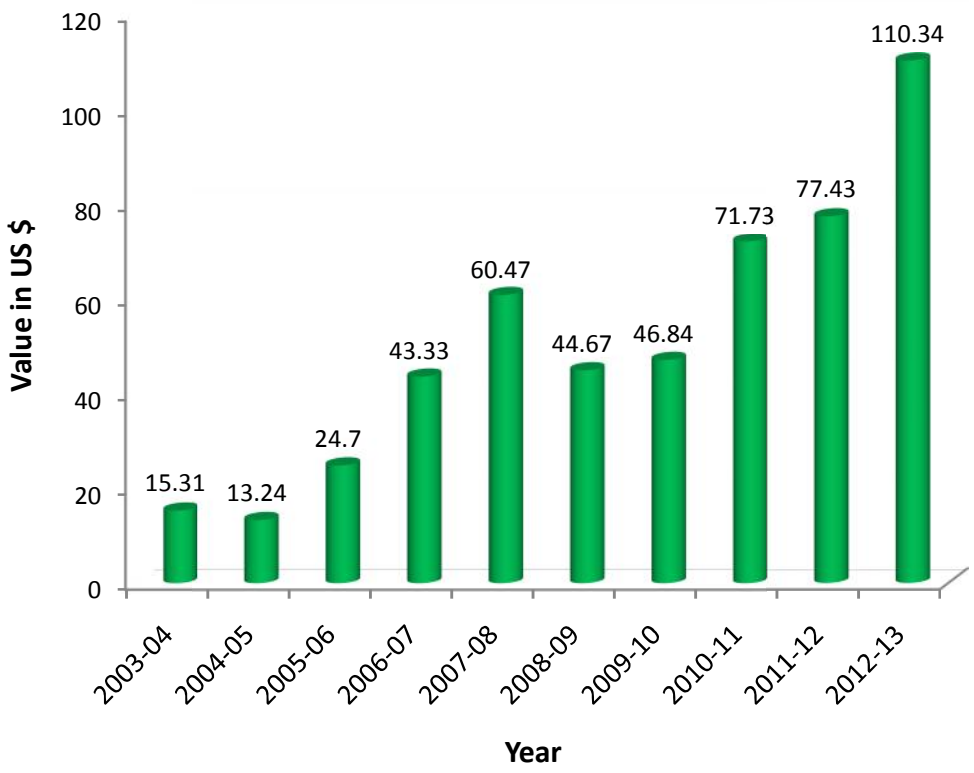


Source: Export promotion Bureau, 2014

Figure 1.1 Country Wise Vegetable Export of Bangladesh in 2012-13

It showed that, In FY 2012-13, fresh vegetables export market comprises Middle East countries about 50% (Saudi Arabia 25.72%, UAE 7.61%, Kuwait 6.97%, Qatar 6.97%, Bahrain 1.39%, Oman 0.92%), EU region 31.24% (UK 24.63%, Italy 4.75%, France 0.88%, Germany 0.48%, Sweden 0.25%, Greece and others country 0.25%), Far East

countries 13.62% (Malaysia 10.57%, Singapore 3.05%) and other countries 5.14% . Exports are targeted mainly for ethnic market.



Source: EPB, 2014

Figure 1.2 Year Wise Export Earnings from Vegetables (value in million US$)

The above figure showed that, the export earning of vegetables sector are increasing day by day. It experienced a steady increase during the period 2003-04 to 2007-08, but in 2008-09 to 2009-10 it showed a slight decrease. After that period the amount of export earning began to rise again and showed a sharp rise in the fiscal year 2012-13.

1.4 Status of Bottle Gourd

Originally, vegetables were collected from the wild by hunter-gatherers and entered cultivation in several parts of the world, probably during the period 10,000 BC to 7,000 BC, when a new agricultural way of life developed. At first, plants which grew locally would have been cultivated, but as time went on, trade brought exotic crops from elsewhere to add to domestic types. Now days, most vegetables are grown all over the world as climate permits, and crops may be cultivated in protected environments in less suitable locations. China is the largest producer of vegetables, and global trade in agricultural products allows consumers to purchase vegetables grown in faraway

countries.

Bottle gourd is an annual, vigorous, climbing vine with large leaves and white flowers. The calabash or bottle gourd, also known as opo squash or long melon, long Opo, long upo, Pul Qua or white flowered gourd plant (Chimonyo and Modi, 2013). It is a member of the Cucurbitaceae family, and Cucurbitoideae sub family, is a vine grown for its fruit, which can either be harvested young and used as a vegetable, or harvested mature, dried, and used as a bottle, utensil, or pipe. In Southern Italy, a similar plant is cucuzza, which grows to 3 feet long. The fresh fruit has a light-green smooth skin and a white flesh. They grow in a variety of shapes: they can be huge and rounded, small and bottle shaped, cylindrical, or slim and serpentine, more than a meter long. Rounder varieties are called calabash gourds. The gourd was one of the first cultivated plants in the world, grown not primarily for food, but for use as water containers.

1.5 History of Bottle Gourd

Bottle gourd (*Lagenaria siceraria)* is one of the most important crops in the cucurbitaceae family, although it is considered as a poor man's crop due to the socioeconomic restrictions governing its production and use.

Bottle gourd has a bi-hemisphere distribution with regional and sub-regional importance. Archeological findings have shown that the independent use and possible cultivation of the crop started from around 9000 to 10000 BP (before present) in the Americas (New world), 6000 – 10000 BP in East Asia and 4000 – 5000 BP in Africa. Based on this archeological evidence, bottle gourd is said to be one of the first species domesticated by humans. Bottle gourd has long attracted an interesting debate about its centre of origin. In that debate, there is strong evidence, that bottle gourd originated from Asia or, despite the lack of early remains but commonly thought, Africa south of the equator to be more precise. The centre of origin of a crop can be described as the area containing the highest number of the wild relatives of that crop and its subsequent domestication. Both continents contain wild species of bottle gourd; however, the discovery of an additional wild indigenous species (*L.breviflora*) in Zimbabwe in 2004 by Decker-Walter reinforced the latter hypothesis of Africa as the centre of origin. The origins and subsequent dispersal of bottle gourd still perplexes many scientists. The crop is said to have reached Asia and the Americas about 10 000 to 8 000 years ago, possibly as a wild species whose fruits and seed had floated across the seas and oceans with the aid of currents (Chimonyo and Modi, 2013).

1.6 Nutritional Value of Bottle Gourd

Bottle gourd reported as an easily digestible vegetable which keeps the body cool and prevents constipation. Bottle gourd is one of the least calorie vegetable, providing just 14 calories per 100g. It is one of the vegetable recommended by the dieticians in weight-control programs.

Folate of bottle gourd helps to reduce the incidence of neural tube defects in the newborns when taken by anticipant mothers during their early months of pregnancy. Fresh calabash-gourd is a moderate source of vitamin-C (100 g of raw frit provides 10 mg or about 17% of RDA). Vitamin-C, one of the powerful natural antioxidants that helps human body scavenge deleterious free radicals one of the reasons for cancer development. Calabash facilitates easy digestion and movement of food through the bowel until it is excreted from the body. In addition, the vegetable is also a moderate source of thiamin, niacin (vitamin B-3), pantothenic acid (vitamin B-5), pyridoxine (vitamin B-6) and minerals such as calcium, iron, zinc, potassium, manganese and magnesium.

Table 1.3 Nutritional Values per 100 g (3.5 oz)

Nutrient component		Amount
Energy (Kj)		63
Carbohydrate(g)		3.69
Fiber (g)		1.2
Fat(g)		0.02
Protein(g)		0.6
Vitamin (mg)	B1	.029
	B2	0.02
	B3	.39
	B5	.144
	B6	.038
	C	8.5
Mineral (mg)		24
Calcium(mg)		24
Iron(mg)		0.25
Zinc(mg)		0.45
Phosphorus(mg)		11
Sodium(mg)		2

Source: USDA, 2014

1.7 Use of Bottle Gourd

Laau or gourd is one of the well known vegetable in all of the market which has wonderful taste. Bottle gourd can be used as a vegetable, container, musical instrument while its seeds are used for oil and protein. Bottle gourd found in every kitchen of a

Bangladeshi household and people of Bangladesh consume this vegetable by making a variety of dish. Apparently it is green in its outer surface with a waxy finish. Once one cut it from the middle, a soft spongy appearance that is white in color will be found. Some people take out the outer surface of gourd and makes pieces of the inner portion to make a curry out of it. Some people make pulp out of the gourd and combine it with prawn to get favorable taste. Leaf (with branch) of bottle gourd commonly known as laau shak also used as vegetables. Some delicious dishes of bottle gourd are: bottle gourd seed bhorta, shrimp-in-leaf, laau shak bhaji, Laau khichuri, laau er jorda etc. Other people also consume gourd as soup. As it contains mostly 92% of water (USDA, 2014); it is perfect for juice extraction. Laau juice and its leaves juice has impressive health benefit as well as beauty benefits.

1.8 Production of Bottle Gourd in Bangladesh

A tropical location, lush greenery, moisture-rich loamy soil and production-friendly climate make Bangladesh one of the notable growers of a vast range of fruits and vegetables of impeccable quality. It is believed that vegetable production can be increased in Bangladesh, particularly in winter season. As the winter vegetables are relatively short duration crops, farmers can take advantage of a quick harvest and thereby can increase their farm income and improve nutritional status. Besides local demand, there is a good scope of export of vegetables to Middle East and some European countries.

Climatic condition of Bangladesh is congenial for bottle gourd production and possibilities of cultivating a wide variety of this vegetable are found in Bangladesh. Traditionally bottle gourd has been regarded as a subsistence crop for low-income families. Recently the view of bottle gourd as simply a subsistence crop has begun to change and there is growing interest in developing its commercial potentiality through increased acres, improved varieties, increased productivity, harvesting and marketing facilities. Now a day's commercial bottle gourd production is gaining continuous popularity and recognition by the village farm households and impacting gradually in the socioeconomic upliftment of the producers. In order to explore the potentials and possibilities of expansion in the acreage and production of bottle gourd and to examine the performance of this vegetable it is essential to analyze the profitability of this vegetable.

Table 1.4 Production of Bottle Gourd in Bangladesh

Year	Area'000 acres	Production'000

		M.Tons
2004-05	31	101
2005-06	32	110
2006-07	32	117
2007-08	33	126
2008-09	34	132
2009-10	34	134
2010-11	35	137
2011-12	35	139
2012-13	41	157

Source: BBS, 2014

From the analysis of the last few years' data we found that area and production of bottle gourd follows an increasing trend. Table 1.6 represents areas and production of bottle gourd. It showed that in the fiscal year 2004-05 the area under cultivation of bottle gourd was 31 thousand acre and production was 101 thousand M. Tons. After that period it showed a steady increase both in terms of area and production. In the FY 2012-13, it reached at 41 thousand acre as area of bottle gourd production where production was 157 thousand M.Tons.

1.9 Export Earning of Bottle Gourd

Bangladesh seemed to have prospects of vegetables export for its high demand to the foreign ethnic market (EPB, 2013). Quantity and earning of bottle gourd export is increasing day by day due to its high demand in foreign market. As bottle gourd has least calorie, foreigner used it as weight-control program and intake juice of leaves and gourd to cure jaundice and greying of hair.

Table 1.5 Foreign Exchange Earnings from Exporting Bottle Gourd in 2012-13

Items	Value
Total export (Million Tk)	22
Total consumption at home (Million Tk)	1100
Total production (Million Tk)	1122
Export earning as % of total value of vegetable production	2.0

Source: EPB, 2014

In the FY 2012-13 total export earning of bottle gourd was 22 Million Tk. with a export earning of total value of vegetable production 2.0 percent. In this fiscal year total production of bottle gourd was 1122 Million Tk. where total home consumption was 11000 Million Tk. The export of fresh bottle gourd is more profitable due to high value addition (EPB, 2013). But export of this vegetable still not reached at satisfactory level. There is a great scope to increase the foreign earning by increasing its production and exports.

1.10 Production of Bottle Gourd in Naraynganj District

A large number of farmers in Naraynagnj district are now engaged in bottle gourd cultivation as it becomes a profitable farming in recent time. The bottle gourd farming area and production are increasing rapidly in this district.

Table 1.6 Area, Production and Yield of Bottle Gourd in Narayanganj District

Year	Area (in acre)	Production (M.tons)	Yield (in Kg)
2008-09	689	2166	3144
2009-10	673	2110	3135
2010-11	678	2130	3128
2011-12	683	2152	3152
2012-13	691	2177	3187

Source: BBS, 2014

Table reveals that area, production and yield of bottle gourd in Narayangnaj district is increasing day by day. In FY 2008-09 production of bottle gourd was 2166 metric tons and area was 689 acre. But in FY 2009-10 it reduced to 2110 M. tons and 673 acre respectively. However after that period it started to increase in terms of area, production and yield. In FY 2012-13 it reached at 2177 M. tons and 691 acre.

1.11 Justification of the study

Agriculture sector continues to play a very important role in the economy of Bangladesh. It attained its modest growth and experienced in slow transition since independence. Thus, it

is essential to ensure easy availability of agriculture inputs, execution of agriculture extension principle and modernization of research techniques to improve the quality of agricultural products. Since the mid sixties, all the government programs have been aimed at achieving self sufficiency in food grain production. This illusive chasing toward self sufficiency in food grain production led to adverse effect on the acreage and production of winter vegetables. As a result, the people of Bangladesh are suffering from severe malnutrition.

Now, the government of Bangladesh has placed much emphasis on vegetable production to meet the nutritional need for growing population and for increasing employment opportunities and income of farmers. In this context, bottle gourd may be considered as an important winter crop, which may provide such opportunities.

For giving emphasis on the production of these vegetables, relevant and adequate information on different aspects of production of these vegetables at farm level are required. Such knowledge of production is also necessary to make appropriate decision by the growers especially when several alternatives are open to them. However, little systematic economic investigations on these vegetables have been undertaken either by the government or private organization in order to satisfy the demand of extension workers, policy makers, research personnel, NGO officials and the farmers. Therefore, the present study is an attempt to analyze the relative profitability and resource use efficiency of bottle gourd production. Besides these, this study has attempt to measure the impact of bottle gourd production on socio economic status of farmers.

Although several field level studies have been conducted on economic analysis of major winter vegetables such as cabbage, cauliflower, brinjal etc there were hardly on bottle gourd and specially on resource use efficiency measurement and its impact on socio economic status of the farmers. Moreover, this type of study has not been conducted before in this study area.

Therefore, study of such nature will definitely help the policy makers, researchers and government officials (dealing with food policy) in formulating future strategies for vegetable production in Bangladesh. The result of this study will be helpful to the planner for making effective and judicious plan to extension personnel that are directly involved in the different agricultural development programs and help them to learn about various problems of the selected winter vegetable. Therefore, they will be able to give suggestions to the farmers relative to various aspects of bottle gourd production.

1.12 Objectives of the Study

The overall objective of the study is to determine profitability and resource use efficiency of bottle gourd production in a selected area of Bangladesh.

The specific objectives of the study are:

i. To identify the socio- demographic profile of sample farm households
ii. To measure the profitability of bottle gourd producing farms
iii. To estimate resource use efficiency of selected inputs of bottle gourd farms
iv. To examine the impact of bottle gourd production on farmers socio economic status and
v. To identify the major constraints associated with production of bottle gourd.

1.13 Organization of the Study

This study consists of nine distinct chapters which have been organized in the following sequences. After this introduction, Chapter 2 furnishes a brief review of literature related to this study. Chapter 3 provides information about the research design used in this study. A brief description of the study area is presented in Chapter 4. Socioeconomic and demographic profile of the sample farmers have been presented in Chapter 5. Chapter 6 presents costs, returns and therefore profitability of bottle gourd farming. Chapter 7 provides Effects and resources use efficiency of inputs used. Chapter 8 represents farmer's perception regarding the impact of bottle gourd on socio economic status. Chapter 9 information regarding constraints of producing bottle gourd faced by the farmer. Chapter 10 furnishes an executive summary of the overall study with policy recommendations.

CHAPTER 2
REVIEW OF LITERATURE

Review of literature in any research is essential because it provides opportunities for reviewing the stocks of knowledge and information for the researcher which give a guideline in designing the future research problems. The purpose of this chapter is to

review the results of some previously completed researches related to the present study. This study is concerned with the profitability and resource use efficiency of bottle gourd production. The economic studies on bottle gourd are limited in Bangladesh. However, some of the important works regarding present study are viewed here.

Chowdhuri *et al.* (2014) depicted the production cost, return and profitability of three winter vegetables (brinjal, country bean and cabbage) production in Narshingdi district. It showed that cost of production per hectare was higher for brinjal than that of cabbage and country bean. The study also showed that per hectare yield, gross returns, gross margin, net return and benefit cost ratio of cabbage were higher than those of country bean and brinjal. Therefore, it was clear that cabbage production was most profitable among these three crops.

Hasan *et al.* (2014) examined the profitability of important summer vegetables namely bottle gourd, brinjal, and cucumber in Keranigonj upazilla. The study found that the benefit cost ratios (BCR) considering variable cost were 2.83, 4.88 and 4.57 for bottle gourd, brinjal and cucumber respectively. The highest BCR was for brinjal (3.72) and the lowest for bottle gourd (2.40) on the basis of total cost. Major problems identified by the study were lack of capital, low price of output, high price of input, price fluctuation, and lack of storage facilities etc.

Amin (2013) analyzed the profitability of commercial bean farming and its impact on livelihood improvement of the farmer of Pabna district. He found that commercial bean farming was highly profitable from the viewpoint of small, medium, and large sampled farmers. Per hectare net return from commercial bean farming for small, medium, large and all sampled farmers were Tk. 356077, Tk. 347403, Tk. 343156 and Tk. 351007, respectively. The net return was the highest for small farmers and lowest for large farmers. It was also found that all kinds of livelihood assets of sampled farmers were increased due to commercial bean farming.

Awal (2013) summarized the economic proficiency of potato and carrot production in Mymensingh district where per hectare gross cost of potato was higher compared to carrot but per hectare net return of carrot production was Tk. 105720.66 which was higher than that of potato Tk. 195350.86. It was observed that gross returns were significantly influenced by the use of inputs such as human labor, tillage operation, seed, fertilizers, irrigation, insecticides and manure where lack of capital, high price of fertilizers and insecticides etc. were major constraints faced by farmers.

Khandoker (2013) conducted a study to assess the profitability, resource use efficiency, and factors affecting the production of brinjal, bean, and radish. The benefit cost ratio on

full cost basis for brinjal, country bean and radish were 1.86, 1.42 and 1.50 respectively. Human labor, land preparation, seed, TSP, experience in farming, and training had positive and significant effect on country bean, brinjal, and radish production.

Nasrin (2013) evaluated the financial profitability of aromatic rice production and its impacts on livelihood of Tangail district farmers. Per hectare net return was estimated at Tk. 31366.9 and undiscounted BCR of aromatic rice production was 1.61. Cobb-Douglas production function analysis revealed that human labor, seed, fertilizer, power tiller and irrigation had significant impact and insecticides had insignificant impact on the per hectare output of aromatic rice production**.** It was found that through aromatic rice production 60 percent farmers in the study area experienced good health condition, better schooling and education, and increasing saving.

Saha (2012) examined the economic analysis of homestead vegetables production in selected areas of Netrokona district. The major findings of the study revealed that production of selected homestead vegetables were profitable. Per acre gross cost of production of cucumber was highest followed by tomato, and cabbage where farmers earned the highest profit from tomato followed by cucumber and cabbage. Per acre benefit cost ratio of tomato, cucumber, and cabbage were 1.97, 1.63 and 1.95, respectively.

Chowdhury (2011) concluded that commercial vegetable growers of Gazipur district earned the highest profit than small scale vegetable growers. He showed that per hectare BCR of brinjal, bitter gourd, and teasle gourd production in small scale were 1.91, 1.46, and 1.63 respectively where BCR in commercial scale production were 2.35, 1.73, and 1.95 respectively. Cobb Douglas production function model revealed that small scale growers allocated their resource in the zone of decreasing returns and commercial growers in the zone of increasing returns.

Islam *et al.* (2011) attempted to determine the productivity, profitability and resource use efficiency of four promising spices crops such as garlic, chili, ginger and turmeric in Bangladesh. Productions of all the crops were profitable. Functional analyses showed that variables such as farm size, seed, fertilizers, power tiller, irrigation, education, farming experience and training, had positive impact on the production of spices. Increasing returns to scale prevailed in the production process for garlic, chili, and ginger where constant returns to scale prevailed for the production of turmeric. The average estimated technical efficiency for garlic, chili, ginger and turmeric were respectively 88, 80, 69 and 79%.

Khayer *et al.* (2011) designed a study to analyze the comparative economic aspect of bean and bottle gourd production in Mymensingh district. The findings of the study revealed that the production of selected vegetables were profitable. He showed that bottle gourd farmers received the highest gross return and net return compared to bean producers. Functional analysis revealed that the variation of yield was greatly influenced by inputs such as human labor, animal labor, cow dung, fertilizers, and date of sowing.

Akter (2009) concluded that production of all the selected vegetables namely tomato, cauliflower, and cabbage were profitable in Narsingdhi district. However, in the study area farmers earned the highest profit from cabbage. The revenue type Cobb-Douglas production function analysis indicated that per hectare gross returns were significantly influenced by the use of human labor, tillage, seeds, fertilizers, irrigation, and insecticides. These factors were directly or jointly responsible for influencing the per hectare gross returns.

Karim *et al.* (2009) viewed the profitability of hybrid tomato, contribution of factors to production and changes in socio-economic status of the farmers in Jessore district. On an average benefit cost ratio was found to be 4.19 on full cost basis and 5.09 on cash cost basis. The functional analysis showed that MP and TSP had positive significant contribution to yield while human labor, hormone, irrigation and seed had negative significant impact on yield of hybrid tomato. The overall socio-economic status of the sampled farmers was found to increase at 20.33 percent.

Nahar (2009) concluded that year round vegetables production in Jessore distict was profitable from the view point of marginal, small, medium and large farmers. This study revealed that bean, cabbage, cucumber and snake gourd were mainly produced in the study area and undiscounted BCR of these vegetables came out 1.81, 1.87, 1.82, and 1.76 respectively. The farmers earned the highest profit from cucumber. Considering food security of farmer households average daily per capita calorie intake was the highest for large farm household (2312 kcal) followed by medium (2102 kcal), small (2099 kcal), and marginal (1912kcal) farmer household.

Quamruzzaman *et al.* (2009) studied heterosis in bottle gourd in a set of 13 F_1 with 26 perents. Results indicated that there were highly significant differences among all of the characters. The study showed that heterosis was higher for yield per plant, number of fruits per plant and individual fruit weight, medium in fruit length and fruit diameter, and lower in days to 1st harvest. In case of yield per plant hybrids (F_1) 10 x 17 and 19x 26 manifested

the highest heterosis over midparent (73.1%) and better parent (61.8%) respectively.

Suraiya (2008) conducted an economic analysis of some selected summer vegetables (cucumber, okra, white gourd, and snake gourd) production in Purbadhala upazila of Netrokona district. The major findings of the study revealed that all the selected vegetables were profitable. Per hectare net return of producing cucumber, okra, white gourd, and snake gourd were Tk. 93452, 70380, 96896 and 58843, respectively. However, the farmers earned the highest profit from white gourd.

Reza (2003) designed a study to assess the input output relationship and technical efficiency of snake gourd production in Gazipur district. The findings of the study revealed that most of the sampled farmers belonged to owner-cum-tenant category. Human labor cost, and animal power cost was highest for large farmer than small and medium farmer and gross return and net return was also highest for large farmers. It was found that human labor cost, draft cost, land cost, seed cost, and mancha preparation cost significantly increased snake gourd production where large farmers scored highest technical efficiency.

Kabir *et al.* (2002) found that per hectare gross cost of ash gourd production in Gazipur and Hathazari were Tk. 52140 and Tk. 50317, while net return above cash cost and full cost were Tk. 44789, Tk. 51553 and Tk. 27460, Tk. 33283 respectively. It also revealed that farmers were inefficiently allocated the ash gourd production inputs. Some inputs were excessively used where some others were underused by the farmers in the study area.

Ahmed (2001) carried out a comparative economics study of potato and cauliflower production in a selected area of Comilla district. The study was undertaken to analyze the comparative profitability of potato and cauliflower production. 60 households were selected of which 30 were potato and 30 were cauliflower farmers. It was found that per hectare gross return of potato and cauliflower were Tk.102761.38 and Tk. 186643.60 respectively. It showed that production of cauliflower was more profitable than potato on the basis of full costs and cash costs.

Haque (2001) attempted to assess the economic performance of crops and vegetables production and resource use efficiency of the farmers in Mymensingh district. It revealed that all the crops were profitable in terms of cash cost, full cost and variable costs. In order to measure the efficiency to dominant cropping patterns land use efficiency and production efficiency were calculated. In most cases, these were the highest in the case of the vegetable based cropping patterns. She concluded that the sampled farmers found vegetables more profitable than other crops.

Sultana (2001) showed the comparative profitability of selected winter vegetables like

potato, cauliflower, and tomato in Comilla district. It revealed that all the vegetables were profitable. However net return was the highest for cauliflower followed by potato and tomato. In case of producing potato and cauliflower, per hectare yield was the highest for small farmers followed by medium and large farmers. But in the case of tomato, per hectare yield was the highest (48164.00kg) for large farmers followed by medium (47444.10kg) and small farmers (46143.00kg).

Islam (2000) carried out a study on economic analysis of winter vegetables like brinjal, cabbage, radish and tomato in three villages of Sadar thana under Mymensingh district. However he showed that for producing these winter vegetables, per hectare cost was the highest for cabbage followed by brinal, radish and tomato. On the other hand per hectare yield was the highest for brinjal followed by cabbage, tomato and radish which were Tk. 80240.00, Tk. 60540.00, Tk. 45353.00. and Tk. 44751.90 respectively.

Islam *et al.* (2000) analyzed the productivity and resource use efficiency of potato production using TPS technology in the farmer's field in district of Bogra and Jessore of Bangladesh. The TPS technology found to have a higher benefit-cost ratio (BCR) than the traditional technology. It was revealed from the efficiency analysis that the potato growers using TPS technology allocated their resources in rational stage of production. However, there existed inefficiency in the uses of human labor, seed, manure and fertilizers in TPS technology and had a potentiality to increase potato output by 20 percent with efficient organization of these resources.

From the above discussion it is clear that several studies were conducted in Bangladesh concerning the issue related to comparative profitability of vegetable production mainly on cabbage, cauliflower, cucumber, brinjal, tomato, potato, carrot, bean, snake gourd, bitter gourd, radish etc. While some of the research focus on the effects of input to the production process, others gave priority on the resources use efficiency of different inputs used. It reveals that a very few research was conducted on bottle gourd production and all of them were analyzed the profitability combined with other vegetables. Moreover there is no research which conducted only on bottle gourd production and covered all aspects. Therefore, this study has attempts to analyze the profitability, input output relationship, and resource use efficiency of bottle gourd production in a wider aspect.

CHAPTER 3
METHODOLOGY

3.1 Introduction

The word method originates from the Greek words *meta* and *hodos* which mean “a way” and methodology is thus defined as “the underlying principles and rules of organization of a philosophical system and inquiry procedure” (Amin, 2013). The methodology of the study is adopted by various steps to select the best method fit to attain the set objectives of research. Methodology is not a formula but set of practices. This chapter deals with the methodology used for the study which included the selection of study area, selection of samples, collection of data and analytical techniques. The farm management study usually involves with the collection of information on individual farmers. The reliability of a scientific research depends to a great extent on the appropriate methodology used in the research. The design of any survey is pre-dominantly determined by the nature, aims and objectives of the study. This study was based on field level data where primary data were

collected from different bottle gourd producers. There are several methods of collecting this basic information. For the present study farm survey method was adopted for collecting the primary data. The word "survey" refers to a method of study in which an overall picture of a given universe is obtained by systematic collection of all available data on the subject. There are three methods by which farm survey data can be gathered (Dillon and Hardaker 1993). These are:

i. Direct observation

ii. Interviewing respondents, and

iii. Records kept by the respondents

Since the farmers of Bangladesh do not usually maintain records and accounts of their farm operations, the second method was followed to achieve the objectives of this study. The survey method has advantages over other methods. This method is less expensive and its coverage is much wider. However, survey method is not free from drawbacks. The drawback of this method is to rely on the memory of the respondents. To overcome this problem, repeated visits were made to collect data in the study area and in the case of any omission or contradiction, the farmers were revisited to obtain the missing and/or correct information. The selection of the study area, period of the study, sampling technique and sample size, preparation of the survey schedule, data entry and processing, and analytical techniques are given in the following section:

3.2 Selection of the Study Area

The selection of the study area is an important step for farm management or production economics study and such a study usually requires selection of an area for collecting data in accordance with the objectives set for the study. The area in which a farm business study is to be made depends on the particular purposes of the survey and possible cooperation from the farmers.

The present study was conducted in Rupganj upazilla of Narayanganj district. As Rupganj is my birthplace so I had selected this area for easy accessibility, time and resources constraints. Apart from these, although a lot of production economics studies were conducted on different region of Bangladesh specially on Mymensingh, Jessore, Rajshahi, Narsingdhi, Tangail, Gazipur, Pabna, Netrokona, Bogra, Keraniganj etc. there were hardly any research conducted on Narayanganj district. So I made an attempt to analyze the profitability of bottle gourd production and socio economic condition of vegetable growers. Three villages of Rupganj upazilla under Narayanganj district namely Pitalganj, Jangir and Shimolia were selected. The main reasons for selecting the villages were as follows:

i. These villages had some identical characteristics e.g. homogeneous soil type, topographical and climatic conditions those are favorable for producing this winter vegetable
ii. The study areas were well communicated with researcher's house that helped her in data collection. It was also easier and less expensive to collect data from that area
iii. The large number of respondents and reliable sources of data were expected to obtain under these study areas
iv. Accessibility to the area is good due to developed communication system.

Before selection of the study areas, the researcher made a few visits in these villages to get her acquainted with the characteristics of the farmers and more especially to know the cultural practices of bottle gourd production.

3.3 Selection of Sampling Technique

The main purpose of sampling is to select a small group which will represent a reasonably true picture of the population. In selecting samples for a study two factors need to be taken into consideration. The sample size should be as large as to allow for adequate degrees of freedom in the statistical analysis. On the other hand, administration of field research, processing and analysis of data should be within the limitation imposed by physical, human and financial resources (Mannan, 2001). Because of diversity in the technical and human environment, it is necessary to several numbers of the population before any conclusion can be drawn. Therefore, the purpose of sampling is to select a sub-set of the population that is representative of the population (Rahman, 1993). The term 'population' refers to the households, the farms etc. where a sample is representative under a study.

In this study a purposive random sampling technique was applied. At first, Narayanganj district which is in central of Bangladesh was selected purposively. After that, among 5 upazillas in Narayanganj district, Rupganj upazilla was selected through purposive random sampling. Rupganj upazilla is divided into 9 unions. Union wise information for the specified vegetable of each union have been taken from the upazilla office of the DAE for selecting the union. The unions have also been selected based on the highest concentration of selected vegetable, among highly concentrated vegetable produced unions two unions namely Kayetpara and Rupganj were randomly selected. Finally, among most concentrated selected vegetable produced villages three villages were randomly selected from those unions. The villages were Pitalganj, Jangir and shimolia.

3.4 Sample Size

It was not possible to include all the farmers in the study area due to limitation of time, money and personnel. Here a reasonable size of sample was taken into account to satisfy the objectives of the study. In total 60 farmers were selected to achieve the ultimate objective of the study. To get the desired sample at first the list of bottle gourd producers were collected from the agricultural extension officer of the selected upazilla agricultural office. It was found that 200 farmers of the selected study area had grown bottle gourd. The next task was to identify small farmers (having land 0.05 to 2.49 acres) who cultivated bottle gourd minimum for three years. Out of 200 farmers 100 farmers were identified as small farmer who cultivated bottle gourd minimum for 3 years. Then a total of 60 farmers were randomly selected from the selected villages.

Table 3.1 Sample Distribution

Name of Villages	**Bottle gourd**
Pitalganj	15
Jangir	20
Shimolia	25
Total	60

Source: Field Survey, 2014

3.5 Preparation of Survey Schedule and Pre-testing

Preparation of the survey schedule is very important in any farm management or production Economics study (Amin, 2013). The main consideration in this respect is to obtain reliable data from the respondents for the preparation of a suitable survey schedule. In conformity with the objective of the study a draft survey schedule was prepared in such a way that reliable data could be collected from the farmers. Then the draft schedule was tested and attention was paid for inclusion of new information which was not included in the draft schedule. The draft survey schedule was pre-tested by researcher herself. The draft survey was conducted among 5 bottle gourd producers of small farmers in selected area. Thus the draft schedule was improved, rearranged and modified in the light of the actual and practical experience gained during the pre-test. After making necessary adjustment a final survey schedule was developed in logical sequence.

The final schedule included the following information parts:

i. General information of respondents
ii. Respondent's socio-demographic information
iii. Farm holding status of the respondents
iv. Information about bottle gourd production
v. Respondent's opinion

The first part of the questionnaire contained respondent's identification, village and union name. Second part contained information about respondent's socio-economic conditions, their age, sex, education, occupation, income etc. Different code was used for this purpose. This part also contained questions about respondent's family member's source of income, education, occupation etc. The third part provided the farm holding status of the farmers such as the information on homestead land, owned land, land given to others, land taken from others etc. The fourth part contained the bottle gourd production related information such as the unit cost of inputs and the price and quantity of output. The last part of the questionnaire contained respondent's perception regarding impact of bottle gourd production in socio economic status of the farmers and constraints faced by them to bottle gourd production.

3.6 Period of the Study

The researcher herself collected necessary data through personal interviews with the selected farmers. Data were collected during the period from 1 March to 15 April 2014.

Data relating to inputs and outputs involved in the production of bottle gourd were collected by visiting the study area during this period.

3.7 Collection of Data and Accuracy of Data

Collection of accurate and reliable data and other necessary information from the field is not an easy task. It must be done properly since the success of the survey depends on the reliability of data. The researcher herself collected the relevant data from the farmers through face to face interview. Data was collected according to the structured questionnaire and face to face interviews had been carried out by paper and pencil. After fixing the survey schedule, the researcher herself stayed in the respective area and collected the primary data from individual households. Before conducting actual interviews, the whole academic purpose of the present study was clearly explained to the respondents. Initially, the farmers hesitated to answer the questions but when they were assured that the study was purely an academic one and it would not affect them adversely then they were cooperative with the researcher. Farmers were requested to provide correct information as far as possible. Usually, the respondents do not keep records of daily/ annual transactions of their activities. Hence, it was very difficult to collect actual data and the researcher has to rely on the memory of the respondents. Questions were asked systematically in a simple manner and explanation was made whenever felt necessary. After each interview was over, the schedule was checked so as to ensure that information to each item had properly recorded. If there were such items which was over looked or contradictory were corrected by another interview. In order to minimize the errors, data were collected in local unit and later those were converted into standard international units. In the case of any inconsistency and lapses, the neighboring farmers were asked for necessary verification and data were checked and corrected through repeated visits.

3.8 Entry and Processing of Data

For the sake of consistency and completeness each survey schedule was verified after data collection. For proper editing the filled interview schedules were sorted, scrutinized and checked to avoid inconsistency. The data were then transferred from the interview schedule to MS Excel sheet and analysis was done by using STATA and SPSS 11.5.

3.9 Analytical Technique

Data were collected in accordance with the specified design to accomplish the objectives set for the study. After that the collected data were classified, tabulated and analyzed in

terms of the objectives of the study. Both tabular and statistical techniques were used to find important relationships among the relevant variables.

For this study, the following techniques were used:

i) Tabular technique

ii) Statistical technique

3.9.1 Tabular Technique

Tabular technique of analysis is commonly followed to find out the crude association or differences between variables and output. Tabular technique was applied to classify data in order to derive meaningful findings by using simple statistical measures like sum, means, percentages and ratios etc. In this study data were presented mostly in tabular form because of its well known characteristics of simple, convenient and easy to understand.

3.9.1 Profitability Analysis

Seven variables such as cost of human labor, cost of seed, cost of power tiller, cost of fertilizer and manure, cost of irrigation, cost of insecticides and cost of fence & mancha in producing bottle gourd was considered for profitability analysis as well as Cobb-Douglas production function. Profit function of the following algebraic form was used in this study,

$$\text{Profi } (\pi) = \sum_{i=1}^{n} (P_{yi}.\mathrm{Y}_i) - \sum_{i=1}^{n} (P_{xi}.\mathrm{X}_i) - \mathrm{TFC}$$

Where,

Π= Net Return,

P_{yi}= Price per unit of the ith produce

Y_i= Quantity of the ith produce

P_{xi}= Price per unit of the ith inputs

X_i = Quantity of the ith inputs

TFC= Total Fixed Cost.

3.9.2 Statistical Technique

3.9.2.1 Multiple Regression Analysis

The general purpose of multiple regression analysis is to learn more about the relationship between several independent or predictor variables and a dependent or criterion variable. For example, the yield of bottle gourd per hectare depends upon quantity of seed, human labor, fertilizer and manure, irrigation water used etc. It enables us to study the individual influence of these variables on yield. The most common form of multiple regression analysis, i.e. Cobb-Douglas revenue type production function has been used in the present research.

Cobb-Douglas Production Function

Cobb-Douglas production function was chosen to estimate the effects of key variables on production processes of bottle gourd. The double log form of the Cobb-Douglas production function proved to be a superior alternative on theoretical and econometric grounds. Thus Cobb-Douglas function was selected for this study. In this study seven independent variables were hypothesized to explain the production of bottle gourd. In this model, yield per hectare was considered as the dependent variable

The specification of the Cobb-Douglas production function model was as follows:

$$Y = aX_1^{b_1}X_2^{b_2}X_3^{b_3}X_4^{b_4}X_5^{b_5}X_6^{b_6}X_7^{b_7}e^{u_i}$$

By taking log in both sides the Cobb-Douglas production function was transformed into the following logarithmic form, because it could be solved by the ordinary least squares (OLS) method.

$$ln\,Y = lna + b_1 lnX_1 + b_2\,lnX_2 + b_3 lnX_3 + b_4 lnX_4 + b_5 lnX_5 + b_6 lnX_6 + b_7 lnX_7 + U_i$$

Where,

Y = Return per hectare (Tk/ha);

ln a = Intercept of the function;

X_1 = Cost of human labor (Tk/ha)

X_2 = Cost of powert tiller (Tk/ha);

X_3 = Cost of seed (Tk/ha);

X_4 = Cost of fertilizer and manure (Tk/ha);

X_5 = Cost of irrigation (Tk/ha);

X_6 = cost of insecticides (Tk/ha);

X_7 = Cost of fence and mancha (Tk/ha);

b_1, $b_{2.\ldots}$ b_7 = Coefficients of the respective input to be estimated; and

Ui = Error term.

Cobb-Douglas Form of Production Function has the Following Advantages:

- $\frac{dy}{dxj} = \frac{bj}{xj} y$ [if y=f(xj)]
- Elasticity of Y upon xj can be easily read out from bj
- In Cobb-Douglas production function, returns to scale can be easily calculated by simply summing up the elasticity of Y with respect to Xj
- This form of production function explains that agricultural production operates under either constant increasing or decreasing returns to scale.

Production function analysis was done to determine the resource use efficiency and productivity of bottle gourd producing small farmers. Cobb-Douglas function was fitted to determine the effects of selected inputs on the productivity of bottle gourd. Marginal productivity of selected inputs was calculated to ascertain the level of efficiency of individual input use.

3.9.2.2 Measurement of Resource Use Efficiency

To accomplish the objective of profit maximization for efficient allocation of resources, one should use more of the variable resource so long as the value of the added production is greater than the cost of the added amount of the resource used in producing it. The standard way to examine such efficiency is to compare marginal value product (MVPs) with marginal factor costs (MFC_S) of each variable input (Rahman et al. 1993)

In order to test the efficiency the ratio of Marginal value product (MVP) to the Marginal Factor Cost (MFC) for each input is computed and tested for its equality to 1.i.e;

$$\frac{\text{MVPxi}}{\text{MFCxi}} = 1$$

The marginal productivity of a particular resource represents the additional to gross returns in value term caused by an additional one unit of that resource, while other inputs are held constant. When the marginal physical product (MPP) is multiplied by the product

price per unit, the marginal value product (MVP) is obtained. The most reliable, perhaps the most useful estimate of MVP is obtained by taking resources (Xi) as well as gross return(Y) at their geometric means (Dhawan and Bansal, 1977). Since all the variables of the regression model were measured in monetary value, the slope co-efficient of given resources with the ratio of geometric mean (GM) of gross return to the geometric mean (GM) of the given resource i.e.

$$\ln Y = \ln a + b_i \ln X_i$$

$$\frac{dy}{dx} = bi\frac{Y}{Xi}$$

Therefore, MVP (Xi) = $bi\frac{\bar{Y}(GM)}{\bar{X}i(GM)}$

Where,

Y= Mean value (GM) of gross return in Taka
Xi=Mean Value (GM) of the ith variable input in Taka
i=1, 2, 3, 4, 5, 6, and 7.

$\frac{dy}{dx}$ = slope of the production function as well as MVP of the ith input

Marginal factor cost (MFC) is the price of per unit of input. If the marginal factor costs of all the inputs expressed in terms of an additional, Taka in calculating the ratio of MVP to MFC , the denominator will always be one and therefore, the ratio will be equal to their respective MVP.

In order to identify the status of resources use efficiency it was computed that a ratio equal to unity indicates the optimum use of that factor, a ratio more than unity indicates that the gross return could be increased by using more of that resources and a value of less than unity indicates the unprofitable level of resource use which should be decreased to minimize the losses.

Resources use efficiency will give direction of adjustments required in the long run to improve the level of economic efficiency by resources allocation. To the individual bottle gourd farmer, the result of this analysis would be helped in evaluating the effectiveness of his present production technique.

3.9.2.3 Impact on Socio Economic Status

Perceived Impact Score (PIS) technique (Rahman, 2006) was used to elicit the impact of bottle gourd production on the socio economic status of the farmers. Each farmer indicated the extent of change that has been occurred for bottle gourd production by checking any of the four responses, i.e. excellent, moderate, average and constant. For excellent, moderate, average and no change the assigned weights were 3,2,1,0

respectively. The PIS for a particular change item was standardized by using the following formula

$$\text{Standardized PIS (SPIS)} = \frac{\text{Observed perceived impact score}}{\text{Possible perceived impact score}} \times 100$$

3.10 Estimation of Cost and Return

3.10.1 Procedure of Evaluating the Major Cost Items

The relative efficiency of selected vegetable production was to be ascertained on the basis of different measures of enterprise incomes of the farmers. This required specification and measurement of variables in the form of input used and output received in the production of the vegetable. Inputs used included human labor, power tiller, different materials used and output was yield per hectare of crop and by-product. Farmers had to pay cash for the purchased inputs like hired labor, seeds, fertilizers, insecticides, irrigation water charge, etc. On the other hand, for home supplied inputs i.e. family labor, manure, etc. cost was estimated by applying the opportunity cost principle. The input items were valued at the existing market price in the area during survey period or the prices, at which the farmers really bought the inputs. Different input and output figures were multiplied by the average prices of the respected vegetables to get cost and return figures for producing vegetables.

The costs of inputs are important factor that influences the production. Farmers are bearing the cost of inputs through the capital. A list of cost items and their estimation procedure has been discussed under the following heads:

i Cost of human labor;

ii Cost of power tiller;

iii Cost of seeds;

iv Cost of fertilizers and manure;

v Cost of irrigation water;

vi Cost of insecticides;

vii Cost of fencing items and mancha;

viii Cost of interest on operating capital; and

ix Cost of land tax

i. Cost of Human Labor

Human labor was found to be the major input in producing bottle gourd. There were two types of human labor, family and hired labor. Family labor consists of the farm operator himself and other family members. In determining family labor cost, actual man days devoted by the workers were taken into account. Eight hours of work were equivalent to one man-day (Mondal, 2005).

The average wage of the family supplied labor was taken as the opportunity cost of the hired labor. In pricing the labor no discrimination was made between the family and hired labor. Family labor was priced at the prevailing wage paid in cash to the hired labor. There were also two types of family labor: male labor and female labor. Human labor was computed by converting all female hours and children hours into male hours by assigning appropriate ratios. This was performed as follows (Yang, 1965):

1 adult man = 1.5 adult woman = 2 children

In the study villages, the average wage rate was found Tk 300.00 per man-day.

ii. Cost of Power Tiller

In the study area land preparation is mainly done by power tiller in producing the selected winter vegetable. Power tiller was used by almost all farmers. There was a competitive rate for using power tiller in the study areas. The farmers paid the charge for power tiller used at a fixed rate prevailing in the study area. In the study area per bigah (30 decimal) power tiller cost was Tk.1500.

iii. Cost of Seed

In the study area, most of the farmers used purchased seeds for bottle gourd production. A few number of farmers used home supplied seeds. The cost of purchased seeds was calculated on the basis of actual price paid by the farmers. The cost of home supplied seed was also estimated at the prevailing marketing price.

iv. Cost of Fertilizers and Manure

In three sampled villages of Rupganj upazila, farmers produced bottle gourd both for commercial selling purpose and their own consumption. They used different kinds of fertilizers for higher yield. They normally used Urea, Triple Super Phosphate (TSP), Muriate of Potash (MoP) and Gypsum. Costs of these fertilizers were estimated according to the price paid by the farmers. They also used growth hormone for fast growth of vegetable locally known as vitamin.

For producing bottle gourd farmers used cow dung as manure application. In this study area farmers mainly used home supplied cow dung. The cost of cow dung was calculated at the prevailing local market prices.

v. Cost of Irrigation

Irrigation is an essential input for cultivating bottle gourd. In the study area farmers used open water sources to irrigate their plot. River water, pond water, and ditch water were widely applied in the study area. In the study area farmers mainly irrigated their vegetable plot by using low lift pump.

vi. Cost of Insecticides

In the production of bottle gourd, insecticide is a very important input. All the farmers intensively used insecticides Diazinon 50 EC, Furadon 5G, Dursban 20 EC, Malathion 57 EC, Theovit, Bordeaux mixture etc. The cost of insecticides was estimated according to the actual price paid by the farmers.

vii. Cost of Fencing items and Mancha

Wire or rope, bamboo, wood, dhanchia and jute sticks were used for making matcha and fencing the vegetables plots. The cost of making fence and mancha was determined by the actual amount of money paid by the farmers.

viii. Cost of Interest on Operating Capital

Interest on operating capital (IOC) was determined by taking all the variable costs incurred on various operations in the process of cultivation of bottle gourd. Interest on operating capital was determined on the basis of opportunity cost principle. The operating capital actually represented the average operating cost over the period because all costs were not incurred at the beginning or at any single point of time. It was assumed that if the farmers borrowed the money from a bank, they had to pay interest at the same rate.

Since all expenses were not incurred at the beginning of the crop season; rather they spreaded over the whole production period; hence at the rate of 10 percent per annum interest on operating capital for four months was computed for bottle gourd. The interest on operating capital was computed using the following formula (Miah and Hardekar, 1988):

$$\text{Interest on operating capital (IOC)} = AI \times i \times t$$

Where,

AI = Total investment/3;

i = Interest rate (which was 10.00 percent per annum)

t = Total time Period of a cycle (in month)

ix. Land use cost

In the study area the cost of land was different to plots depending on location, topography and fertility of the plots. It also varies from one season to another, i.e., from kharif to rabi season and from crop to crop. Land use cost was calculated on the basis of opportunity cost of the use of land per hectare for the cropping period of six months. Land use cost may be calculated by using one of the following concepts:

i. Interest on the value of land
ii. Rental value of land
iii. Forgoing income from the alternative use

In this study, the cost of land use was considered by taking into account the rental value of land. According to the assessment of the farmers, in the study area per hectare average rental value of the bottle gourd cultivable land for one year was estimated to Tk 41167.

3.10.2 Calculation of Return

i. Gross return

There were two return items such as- (i) selling of product, (ii) selling off by-product. Gross return was calculated by multiplying the total volume of output of an enterprise by the average price in the harvesting period (Dillon and Hardaker, 1993). It consisted of sum of the volume of main product and by-product.

ii. Gross margin

Gross margin was derived by subtracting variable cost from the gross return. Sum of the gross margin of the individual enterprises represented gross margin from the whole farm business. 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.

iii. Net return

To determine the net return of bottle gourd production, the total cost was deducted from the gross return. The formula is-

Net Return= Gross Return- Total Cost

iv. BCR (Benefit Cost Ratio)

The BCR is a relative measure, which is used to compare benefit per unit of cost. The BCR estimated as a ratio of gross returns and total costs. It indicates the benefit of per unit cost at present worth. BCR (undiscounted) was calculated by using the following

formula-

$$BCR = \frac{\text{Gross Return}}{\text{Total Cost}}$$

CHAPTER 4

DESCRIPTION OF THE STUDY AREA

4.1 Introduction

This chapter presents a brief description of the salient feature of the study areas. Knowledge of the study area is quite essential to understand the location, physical features, agro-ecological condition i.e., topography, soil, temperature, rainfall, agricultural activities, road and communication and marketing facilities available in the study area. To understand the activities of the farmers, their attitude, possible development opportunities and potentials as well as the limitations, it was necessary to know about the selected study areas. A brief description on important characteristics of the study area and the sampled households such as location, population and households, physical features and topography, communication, literacy rate, educational facilities, cropping pattern, land control etc. are presented below:

4.2 Geographic Area and Location of the Study Area

Narayanganj District is a district in central Bangladesh, part of the Dhaka Division. The river port of Narayanganj is one of the oldest river port in Bangladesh. It is also a center of business and industry, especially the jute trade and processing plants, and the textile sector of the country. It is nicknamed the Dundee of Bangladesh due to the presence of lots of jute mills. Due to many common reasons, it is well known in the whole Asia.

Narayanganj District is bounded by Gazipur and Narsingdi Districts on the north, Brahmanbaria and Comilla Districts on the east, Munshiganj District on the south, and Dhaka District on the west. Geologically, the area lies on the edge of the Madhupur Tract

and Holocene floodplain deposits form the aquifer. The total area of the district is 759.57 km², of which 48.56 km² is riverine and 0.60 km² is under forest. The district lies between 23°33´and 23°57´ north latitude and between 90°26´ and 90°45´ east longitude. Rupganj is located at 23.7931°N 90.5167°E . It has 64902 units of house hold .The total area of Rupganj upazilla is 43,835 acre of which 498 acre is under river, 232 acre under forest, 833 acre area is fallow and total cultivated area is 26,711 acre.

4.3 Administrative Area

Narayanganj Zila consists of five upazilas (Narayanganj Sadar, Bandor, Rupganj, Sonargaon and Araihazar), 6 paurashava, 47 unions, 1204 villages and 827 mauzas. There are also 7 police stations here, which are: Narayanganj Sadar, Bandor, Fatulla, Sidhirganj, Rupganj, Sonargaon and Araihazar. Out of the five upazilas Rupganj is the largest with an area of 247.97 km² which is 32.65% of the total area of the zila. Table 4.1 revealed the no. of union, ward, mahalla and mauzas of the study area.

Table 4.1 Area, Union/ward. Mahalla & Mauza of Rupganj Upazilla

Area(Sq.km)	No. of union	No of ward	No fo mahalla	No. of mouza
247.97	9	18	50	146

Source: BBS, 2011

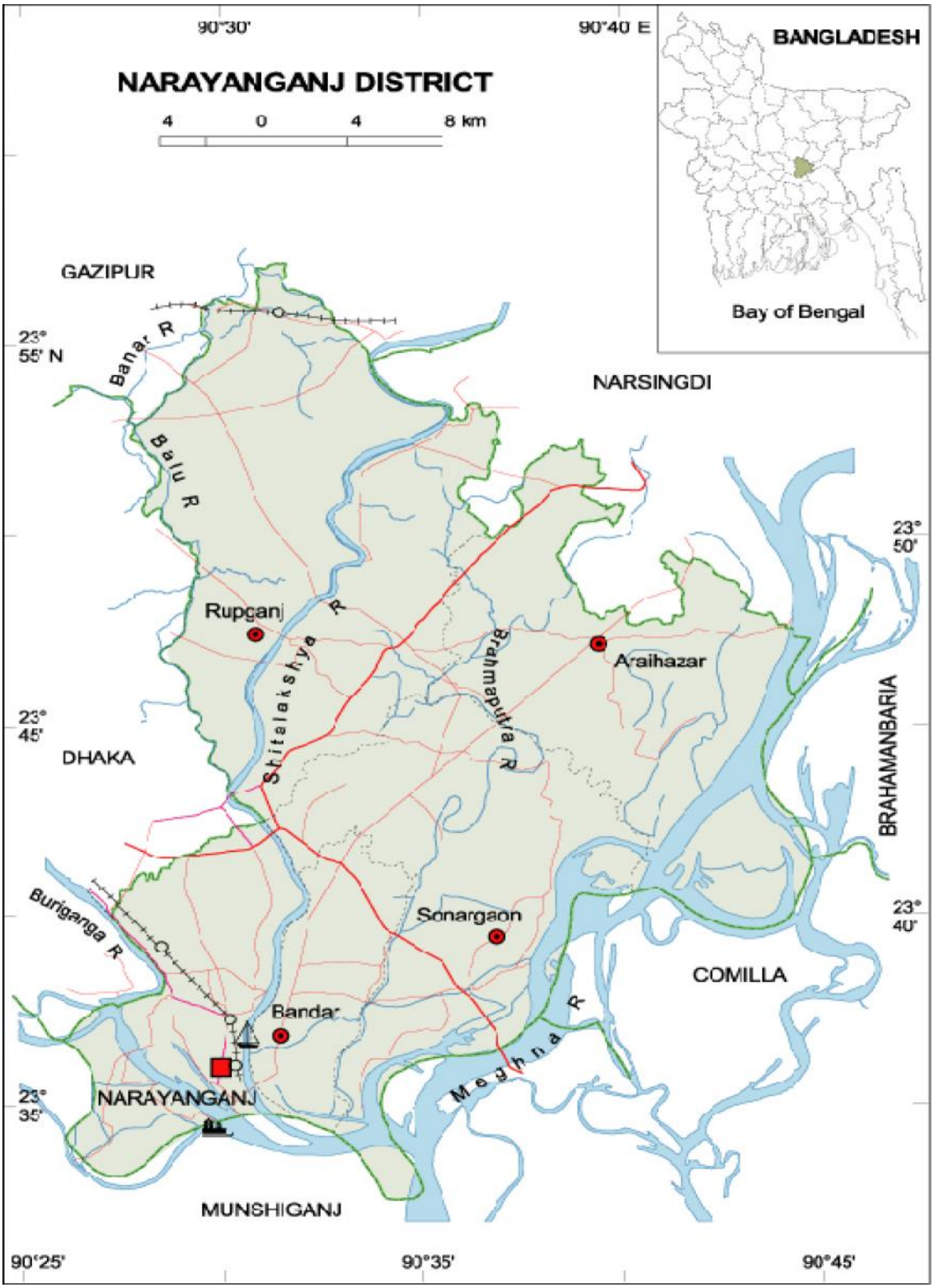
4.4 Population

The Narayanganj district has a total population of 2,173,948 (BBS 2011) with density of population 3,900/km^2 (10,000/sq mi). The total population of Rupganj upazila are 534868; where Muslim 94.68 percent, Hindu 5.27 percent and others .05 percent. Average household size of this upazilla is 4.36, male 52.88 percent, female 47.12 percent, male female ratio 1.09. The number of household in this upazilla is 122140 and density of population is 3031 per sq Km.

Table 4.2 Population, No of household, Male –Female Ratio of Rupganj Upazilla

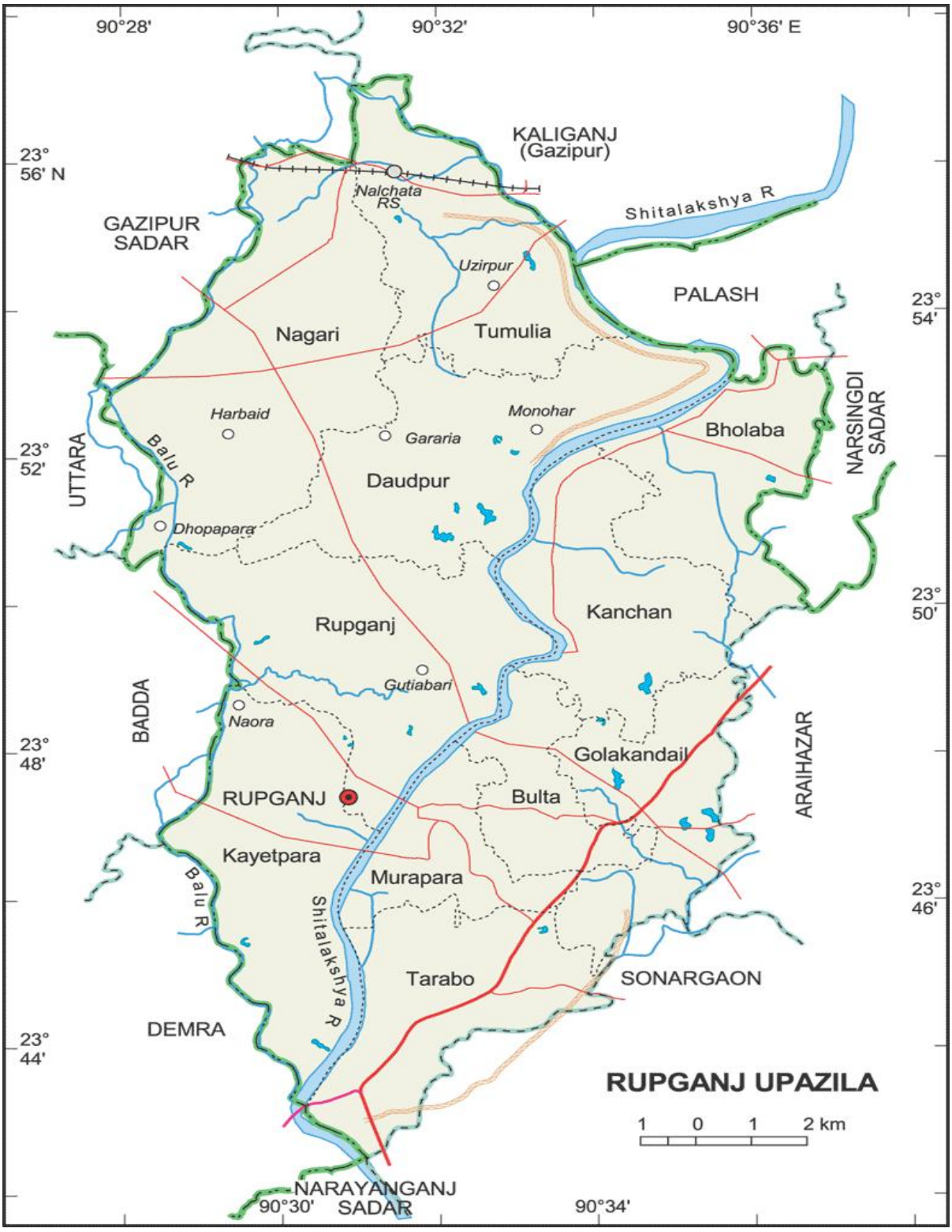
Population	No of household	Population density/sq.km	Household size	Male (%)	Female (%)	Male-female ratio
534868	122140	3031	4.36	52.88	47.12	1.09

Source: BBS, 2011



Source: Adapted from Banglapedia.com

Figure 4.1 Geo Code of Narayanganj District



Source: Adapted from Banglapedia.com

Figure 4.2 Geo Code of Rupganj Upazill

4.5 Topography and Soil

Almost the whole of Narayanganj district lies on the meander flood plain. Most of this

area is now flooded only by rain-water. Only minor areas near the Lakka. Old Brahmaputra, Meghna, shitalakha and Dhaleswari River are affected by river water and receive fresh silt deposits. A wide variety of soils occurs in this district (BBS, 2011).

4.6 River System

There are a few rivers and rivulets flowing through the district. Among those the Shitalakhya, the Dhaleshwari, the Buriganga, the Balu and the Meghna are important. Those are non-tidal and navigable throughout the year. They have been playing a vital role in the economy of the district as they facilitate irrigation, drainage, and water supply of the area. The riverine area is about 111.46 sq (BBS, 2011).

4.7 Climate, Temperature and Rainfall

In the study area summer begins from the middle of March and continues till the middle of August. Average annual rainfall is 2550 mm, 80 to 90% of which occurs between May and October.

Table 4.3 Monthly Temperatures and Rainfall of Narayanganj District for 2014

Months	Maximum temperature (^{o}C)	Minimum temperature (^{o}C)	Average rainfall(mm)
January	23.2	12	00
February	27.7	16.9	08
March	31.0	21.5	26
April	32.4	22.2	32
May	32.6	23.6	378
June	31.3	26.7	325
July	30	26.3	302
August	31	26.4	212
September	31	26.2	172
October	28	23.9	131
November	24	19.2	00
December	23	15.0	04

Source: BBS, 2014

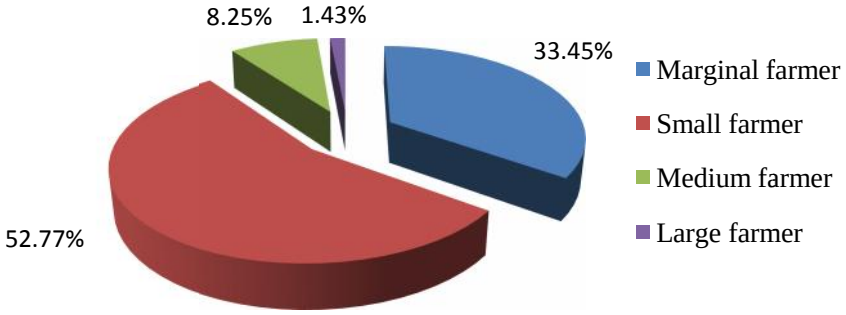
4.8 Economy

The rural economy of Rupganj is agriculture. But many small and medium industries of cotton are increasing day by day. In this region the main occupations of the people are agriculture 29%, agricultural laborer 16%, wage laborer 3%, commerce 17%, service 11%, industry 6%, transport 5% and others 13%. Some people are working as foreign

workers in the Middle East countries. But now a day many people work in the buying house, garments sector and Shipyards sector (BBS, 2011).

4.9 Agricultural Land Ownership, Land Use, Crops and Cropping Pattern

Figure 4.3 showed that among the farmers of Rupganj upazila, 33.45 percent are marginal, 52.77 percent small, 8.25 percent medium and 1.43 percent large farmers.



Source: BBS, 2011

Figure 4.3 Land Ownership Patterns of Farmer in the Study Area

Total cultivable land is 20255 hectare and cultivable land per head is 0.10 hectare. In the study area, rice is the principal crop which is grown in three traditional seasons namely, Aus, Aman, and Boro. Besides, the other winter crops namely, jute, wheat, mustard, pulses and vegetables like brinjal, cucumber, bottle gourd, bean, tomato, lalshak, spinach, cabbage, cauliflower, etc. are also grown in the village. However, major fruits such as mango, jackfruit, litchi, banana, guava, coconut, and papaya are also grown in home-yards of the study area. Boro paddy was the most important crops of the village. It covers more than 70 percent of total land area during the Boro season and Transplanted Aman covered 50 percent of land area in Aman season. Distribution of land under different cropping pattern in the study area are presented in table 4.4

Table 4.4 Land Distribution under Different Cropping Pattern

Cropping pattern	Single crop	Double crop	Treble crop	Net crop
Percentage of land	69.45	7.80	5.25	79.03

Source: BBS, 2011

4.10 Literacy Rate and Educational Institutions

Average literacy rate in Rupganj upazila is 54.80 percent; male 57.5 percent and female

51.9 percent. Among educational institutions in Rupganj upazilla there are 82 govt primary school, 115 kindergarten school, non government secondary school 30, Non government college 5, madrasha 19, ebtedayee madrasha 28, technical and vocational institution 2 (BBS, 2011).

4.11 Transportation and Communication

The transportation system in Narayanganj is very good, like the capital city Dhaka. There are 21 bridge, 1036 culvert, 58 pool, 12 shako in this district. Among them 2 Bridge, 2 baily Bridge and 477 culvert are located in Rupganj upazilla. There are 20 embankment road and 17 canal in this upazilla (BBS, 2011).

4.12 Marketing Facilities

Marketing facilities are the key of modern economic life and play an important role in the rural development. There are some local Bazars and Hats in the study area. The people buy their essential goods and also sell their surplus products to the Hats. Moreover, the villagers very often go to district town. Thus, the transportation and marketing facilities of the study areas are reasonably satisfactory for performing business activities.

Total number of Hats and Bazaars in this upazila are 25, most noted of which are Rupganj Hat, Chonpara Hat Boktobari Bazar, kanchan Bazar, shimoliya hat , Hatabo bazar, Jangir Bazar, Harinda, Musuri , Ranipura etc are the main local Bazars and Hats, where villagers of the sampled villages sell their products (BBS, 2011).

4.13 Industries and Institutions

The district is pioneer in merchandising yarn and dying items. Cottage industry like weaving is abounds in this district. Small and medium industries of cotton are increasing day by day which fills the employment aids of peoples. Table 4.5 showed that there are 4 jute mills, 7 rice mill, 27 garments factory and 159 textile mill are located in Rupgang upazilla.

Table 4.5 No. of Industries in the Study Area

Jute mills	Rice ills	Garments factory	Textile mill
4	7	27	159

Source: BBS, 2011

4.14 Archaeological Heritage and Relics

Tomb of Sultan Giasuddin Azam Shah (1389-1411 AD), Baba Saleh Mosque (1481 AD), Goaldi Mosque (1519 AD), three domed mosque of Sultan Jalaluddin Fateh Shah (1484

AD), Hajiganj Fort, Sunakanda Fort, Pagla Bridge, Kadam Rasul Dargah, Bandar Shahi Mosque etc are notable archaeological heritage and relics of this district (BBS, 2011).

4.15 Health and Social Welfare

The Number of private hospital/clinic in this district is 68 of which 12 are situated in Rupganj. In this upazilla no. of physician are 38, and 9 health centre providing health and family planning (BBS, 2011).

4.16 NGO Activities

In Rupganj upazila a number of NGOs work there to help the people to improve their economic and social conditions. There are total 62 NGOs operate in this district of which 13 are operate in Rupganj upazilla.Operationally important NGOs are Grameen Bank, BRAC and ASA (BBS, 2011).

CHAPTER 5
DESCRIPTION OF SOCIO-DEMOGRAPHIC PROFILE OF BOTTLE GOURD PRODUCERS

5.1 Introduction

The term "socio demographic" refers to a group defined by its sociological and demographic characteristics. Socio demographic groups are used for analyses in the social science as well as for marketing and medical studies. *Demo-* from Ancient Greek *demos*, means "the people" and *graphy* from *grapho* implies writing, description or measurement (Ehmer *et al*. 2011). Demographic analysis can cover whole societies, or groups defined by criteria such as age, sex, place of residence, religion, nationality, educational level, marital status, and ethnicity. Sociological characteristics are more objective traits, such as membership in organizations, household status, interests, values and social groups. The attitudes of the farmers are mostly influenced by their social and economic condition. However, the aim of this chapter is to illustrate the socio demographic profile of the selected bottle gourd producer.

In this study to know about the socio demographic information of the selected bottle gourd farmers a number of related aspects of the sample households were examined. These were age distribution, composition of family size, dependency ratio, level of education, occupation, household income, farm size and land ownership pattern etc.

5.2 Age Distribution of Respondents

Age distribution plays an important role for better farming practices. The age of the bottle gourd farmers were examined by classifying the farmers into five age groups. It was found that the maximum age of the respondent was 71 and minimum age was found 32 in the study area. So the classification was started from 31 and end to 71+.

Age distribution of the selected vegetable growers is given in Table 5.1. The highest numbers of farmers (38.33 percent) were belonged to the age group 41-50 years.

Table 5.1 Distribution of Sample Farmers According to Age

Age Group	Bottle gourd farmer	
	No.	Percent (%)
31-40	8	13.33
41-50	23	38.33
51-60	21	35

61-70	7	11.67
Age category	**No**	**Percent (%)**
71+	1	1.67
Total	60	100

Source: Field survey, 2014.

Table 5.1 reveals the age distribution of the respondents living in the three sampled villages of Rupganj upazila. It shows that lowest 1.67 percent small farmers belong to the age groups 71-80 and highest 38.33 percent belong to the age group 41-50 years. It was found that only 1.67 percent sample farmers were above 70 years.

5.3 Age Distribution of Respondent's Family Members

Family size (or number of family members) in this study has been defined as total number of persons living together and taking meal from the same kitchen under the administration of the same head of the family. The family member includes husband, wife, son, daughter, brother, father and mother. A person, who has been employed for household work of a family, say for example, servant was not considered as the family member in this study. The age of the bottle gourd producer's family members was examined by classifying them into four age groups:

1. 0-5 years
2. 6-15 years
3.16-50 years
4. above 50 years

Table 5.2 revealed that, total number of family members of 60 sampled farmers was found 278. After categorized them it was found that, maximum family members almost 55.75% belonged to the age group 16 to 50 years and only 2.51 percent family members were fell into age group 0-5 years old. Out of total 278 family members, 24.10 % of them belonged to the age category 6-15 years and almost 49 members belonged to the age group above 50.

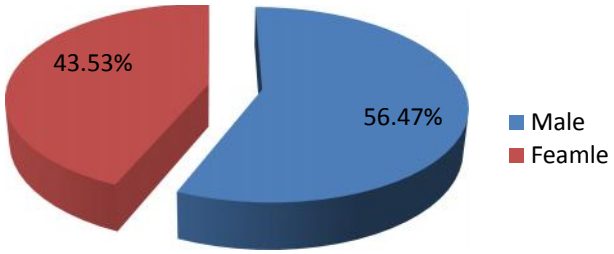
Table 5.2 Family Size & Age of Family Members including Respondents

0-5 years	Male	3	
	Female	4	
	All	**7**	2.51
6-15 years	Male	32	
	Female	35	
	All	**67**	24.10
16-50 years	Male	83	
	Female	72	
	All	**155**	55.75
Above 50 years	Male	32	
	Female	17	
	All	**49**	17.62
Total no. of family members		**278**	**100**
Average family size		**4.63**	
Male- female ratio		**1.17 (117 male per 100 women)**	

Source: Field survey, 2014

5.4 Male Female Ratio

The study showed that the total number of family members of bottle gourd respondents were 278 of whom 150 (53.95%) were male and 128 (46.05%) were female. In the study area, the male-female ratio was found 1.17. The average family size of the farmers was 4.63. The average family at national level was about 4.60 (BBS, 2013 b). The average family size in the study area was found slightly higher than at national level. Figure 5.1 represents ratio of male- female in the study area.



Source: Field survey, 2014

Figure -5.1 Male-Female Ratios of the Respondents Family Members

5.5 Educational Status of the Respondents

Education helps individuals to become conscious of their environment and developed the rational insight into many matters of life. Education has its own merits and it contributes to economic and social development. Education enhances farmer's knowledge and provides easy access to information about improved production system. Education is likely to influence the farmers to adopt the modern technology and it enables them to manage scarce resources efficiently so that they can earn higher profit. In the present study, literacy level of an individual was determined on the basis of year of schooling. Those who can neither read nor write were considered as illiterate. Those who have no knowledge of reading and writing but can give sign only the name was considered as able to signature only. Distribution of the respondents according to literacy level showed in Table 5.3.

Table 5.3: Educational Status of the Respondents

Literacy level	**Bottle gourd farmer (60)**	
	No	**(%)**
Illiterate	22	36.67
Can signature only	15	25
Up to primary	12	20
Secondary	07	11.67
HSC and above	04	6.67
Total	60	100

Source: Field survey, 2014

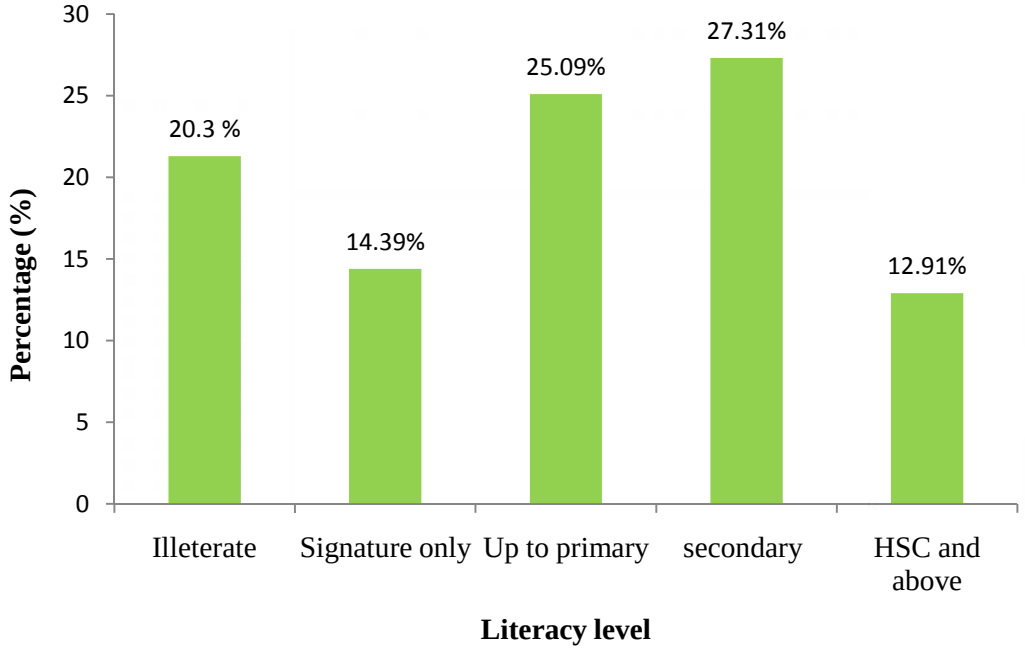
The above table shows that total illiterate members among all sampled farmers were 36.67 percent where total 25 percent farmers were able to signature only and 20 percent in total farmers had received primary education. In case of secondary level of education the overall value was 11.67 percent and total 6.67percent respondents received HSC and above level education.

5.6 Educational Status of the Respondents Family Members

Socio economic status of a family largely depends on the education level of the family members. It's not only depends on household head education level but also their family members educational status. Education improved their standard of living as well as their household income.

The figure 5.2 represents the educational status of bottle gourd family members under different sub group. It showed that the highest number of family members of all sampled

farmers received secondary level education which stood at 27.31 % where only 12.91 % of them received HSC degree. At the same time, about 20.30 percent of family members including respondent were illiterate in the study area and 25.18 percent of the respondent's family members were completed up to primary level education. For details also see in appendices (Table A.5.1).



Source: Field survey, 2014.

Figure 5.2 Educational Levels of Respondent's Family including Respondents

5.7 Occupational Status of the Respondents

The work in which a person engaged throughput the year is known as the main occupation of that person. Agriculture was the main source of livelihood almost 80 percent of the selected farmers in the study area. The selected farmers of the study area were engaged in various types of occupations, although agriculture was the main source of employment for most of the respondents of the study area. Besides agriculture, some farmers were engaged in small business; some were engaged in government, semi-government or non- government services, some were engaged as day laborer and other wage earning activities.

Table 5.4 shows the occupational status of the selected bottle gourd respondents. It provides a clear picture on occupational disbursement of the sampled household head.

Table 5.4 Occupational Status of the Respondents

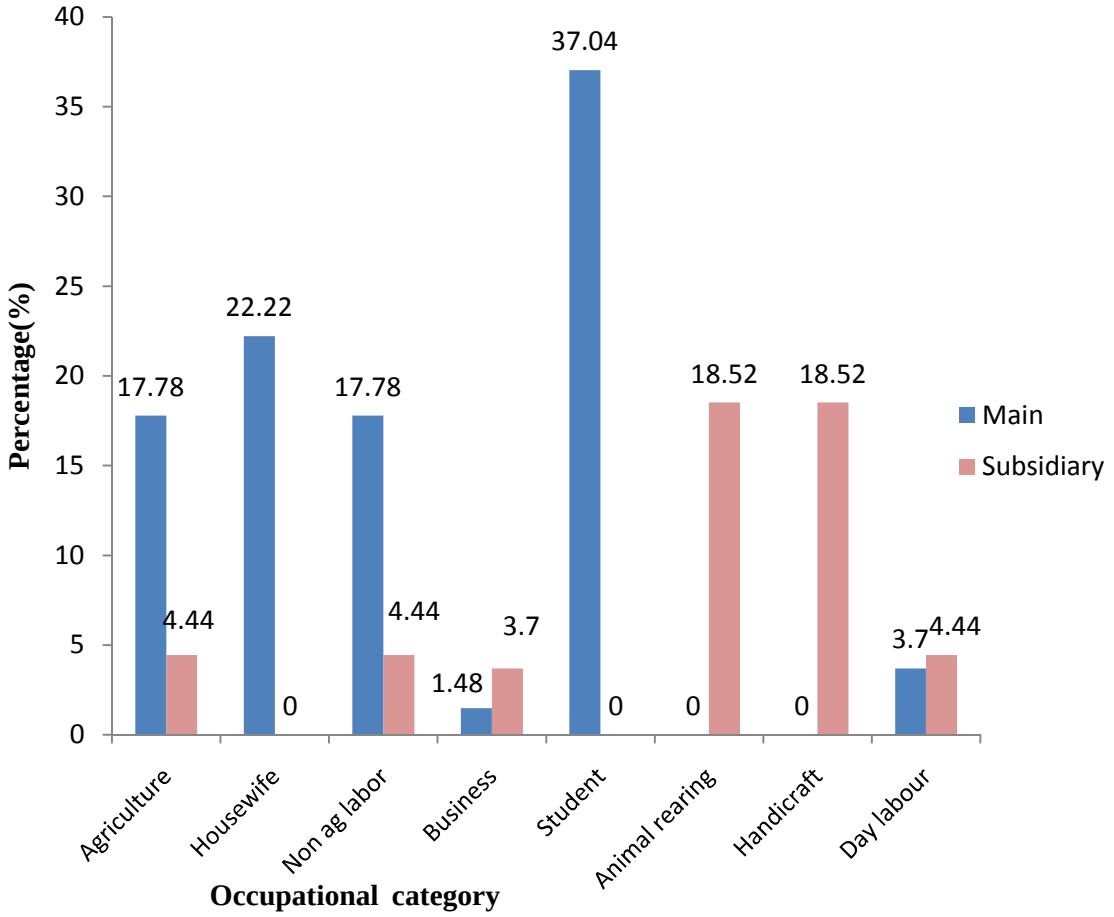
Occupational category	Main (%)	Subsidiary (%)
Agriculture	81.67	16.67
Non agricultural labor	13.33	20
Business	3.34	15
Ag labor	2.33	15
No	00	33.33
Total	100	100

Source: Field survey, 2014

In case of all sampled farmers 81.67 percent farmers engaged in agriculture as main occupation and 16.67 percent farmers engaged as secondary occupation. Almost 13.33 percent of farmers were engaged in non agricultural labor as main occupation where 20 percent of farmers were engaged this as secondary occupation. Besides these 3.34 percent of farmers were operate business as their main occupation where 15 percent run business as their secondary source of livelihood. It was found that about 33.33 percent of the sampled farmers had no subsidiary occupation.

5.8 Occupational Status of the Respondents Family

From the study it was observed that as farmers were engaged in agriculture as their main occupational source besides various secondary occupations, their family members were also involved different types of income earning activities. The occupational distribution of selected bottle gourd respondent's family shown in Figure 5.3.



Source: Field survey, 2014

Figure 5.3: Occupational Status of the Respondents Family Members

The occupations of the farmers and their family members were classified into two broad groups: main and subsidiary. Table 5.3 shows that incase of bottle gourd growers 17.78 percent family members were engaged in agriculture and Non agricultural labor, 22.22 percent housewife and 37.04 percent student as their main occupation. On the other hand 18.52 percent of members were involved in handicraft and animal rearing and 4.44 percent as day laborer as their secondary occupational source. For details also see in appendices (Table A .5.2)

5.9 Dependency Ratio

In economics, geography and demography the dependency ratio is an age-population ratio of those typically not in the labor force (the *dependent* part) and those typically in the labor force (the *productive* part). The real (or effective) dependency ratio looks at the ratio of economically active workers compared to inactive. The effective dependency ratio doesn't just look at the age profile but, whether people are economically active or

not.

It is used to measure the pressure on productive population. As the ratio increases there may be an increased burden on the productive part of the population to maintain the upbringing and pensions of the economically dependent. This results in direct impacts on financial expenditures on things like social security, as well as many indirect consequences.

Each and every family is rationally composed of both income earners and dependents. Table 5.5 present the depending members per income earner. In this present study the average dependency ratio was found 1.73.

Table 5.5 Dependency Ratio of Sample Farmer's Family

Items	No
Total family members	278
Total dependent members	176
Total earning members	102
Dependency ratio	**1.73**

Source: Field survey, 2014

Note: Depending ratio = Total dependent members ÷ Total earning members

5.10 Average Land Holding of the Sampled Farmers

Size of farm was the area which was actually cultivated by the farmer during the period under study whether it was owned by him as well as obtained from the others by renting in or mortgaged in. In other words, according to Yang (1965) farm size refers to the entire land operated by the operator. Farm size includes land holdings, which the farmers has got ownership upon and has the prospect of engaging in farm activities as and when they wishes. The land holding of the respondents were categorized into several categories such as homestead land, pond, orchard, own land in cultivation, rented in, mortgage in, rented out and mortgage out. Table 5.6 reveals the average farm size and land ownership pattern of bottle gourd producer. From the table, it was clear that there was no tenant out and mortgage out land.

The average farm size of a farmer was measured by using following formula.

Farm size = Owned land (Orchard, pond, own cultivated land, fallow land) + Rented in land + Mortgaged in- (Rented out + Mortgaged out).

We know that the farmers who have the farm land between 0.5-2.49 acres are called small farmer (BBS, 2011). From the present study it was found that, the sampled farmers were

mainly small farmers in terms of the land hold holding pattern. In the study area per farm average cultivated land under bottle gourd cultivation was found 26 decimal.

Table 5.6: Average Land holding of Farm Families (in Decimal)

Category	Area
Homestead	12.76
Pond	3.5
Orchard	5.2
Fallow land	2.35
Own land in cultivation	86.36
Rent in	8.65
Rent out	00
Mortgage in	5.47
Mortgage out	00
Total land	**124.29**

Source: Field Survey, 2014

5.11 Average Yearly Household Income of the Farmers

Income is the most important indicator of socio-economic status of the people living in rural Bangladesh. Average yearly income of the respondent households has been estimated from the earnings of all active members of the family from various income generating activities during the study period. Household income is calculated from different types of income activities: agriculture (crop, vegetables, poultry, livestock, fish, and fruit), business, day labor, handicraft and remittance etc. Most of the household in the study area earned income from both farm and non-farm sources.

Table 7.1 shows the total yearly income shares from different sources of income. In the context of agricultural activities, the income share of household is 50.71 percent which is a bit high compared to nonfarm activities income share which is 49.29 percent. In case of farm income 19.91 percent income comes from crop production and 24.79 percent income comes from bottle gourd cultivation.

Table 5.7: Yearly Household Income of the Respondents

Income source	Amount	Percent (%)
Farm income		
Crop production	30000	19.91
Bottle gourd	37384	24.79
Other (vegetable, livestock poultry	10000	6.63
Total	**77384**	**51.33**

Non –farm income		
Small business	11000	8.24
Service	35800	24.58
Day labour	8460.67	5.81
Handicraft	2000	1.32
Remittance	14000	9.67
Others	3000	1.99
Total	**74260**	**48.97**
Gross Income	**151644**	**100**

Source: Field survey, 2014

In the study area, in nonfarm activity service and remittance were found to important source of income. From the present study it was observed that 24.58 percent of family income comes from service and 9.67 percent incomes from remittances. The reason behind this picture it can be mentioned here that, the study area is recently an industrially developed area. Beside the previous jute industry, a large number of garments factory were established recently. As a result the people who were engaged in different agricultural labor activity and were in temporary odd job now work in these garment factories which brings a significant improvement of their income which is now more steady and reliable and improved their standard of living.

CHAPTER 6
PROFITABILITY OF BOTTLE GOURD PRODUCTION

6.1 Introduction

This chapter presents the input use pattern and yield of bottle gourd production. The main purpose of this chapter is to assess the costs, returns and profitability of growing bottle gourd. The average gross return and average net return was also estimated in this chapter. Besides these undiscounted Benefit Cost Ratio (BCR) was also estimated for determining the profitability of bottle gourd farming. In the decision making process of farmers, cost of any input used for producing an enterprise plays a vital role. In calculating profit or loss the cost benefit items need clarification. Farmers used both purchased and home supplied inputs in producing bottle gourd vegetable. For purchased inputs they had to pay in cash, but for home-supplied inputs no cash payment was made. Therefore, the costs of home-supplied inputs were estimated by using the opportunity cost principle. To determine the relative profitability of different crops and vegetables it was, however, necessary to compute all the cost items which were deducted from the value of output. The input costs were calculated using actual price paid by the farmers. The output was valued at the prevailing farm gate price.

6.2 Estimation of Costs of Bottle Gourd Production

Cost estimation is necessary for determining the viability of the enterprise from the view point of producers. Costs refer to the total amount of funds used in production. In the present study, the total cost per hectare was worked out. For calculating the costs, return and profitability of bottle gourd, the costs items were classified into two groups:

(1) Variable cost and;

(2) Fixed cost.

Hence variable costs and fixed costs were calculated separately. On the other hand, fixed cost was calculated for land use cost only.

6.2.1 Variable Cost

Variable costs included the cost of all variable factors like human labor, power tiller, seed, fertilizer & manure, irrigation water, insecticides, fence and mancha. These costs vary with the level of production. Higher the production more will be the variable costs; lower the production lower will be the production. Variable costs which were taken into account in the present study are discussed below:

6.2.1.1 Cost of Human Labor

Human labor was considered the most important and largely used input in producing bottle gourd. It shared a large portion of total cost of production. Human labor is required for various activities and management such as land preparation and hilling up, planting, weeding and mulching, fertilizing, using insecticides and herbicides, harvesting etc. There were two sources of human labor in the study area, one was family supplied labor and another one was hired labor. For hired labor the owners had to pay wages in cash and for family labor principle of opportunity cost was followed. It can be seen from Table 6.1 that the amount of human labor used for bottle gourd cultivation was 162 man -days per hectare. Total cost of human labor was Tk. 48600 per hectare which represents 31.71 percent of total production cost. It can be observed from Table 6.1 that bottle gourd grower's used 162 man-days/ha as total human labor where as on an average130 man-days/ha was family supplied labor. In the study area, on an average wage rate was Tk.300.00 per man- day. So, total cost of family supplied labor for bottle gourd amounted to Tk. 39000 per hectare which shared 25.84 percent of total cost of production.

Table 6.1 Per Hectare Human Labor Cost of Bottle Gourd Production

Category	Man days/ha	Wage rate (Tk. / Man day)	Cost (Tk. /ha)	% of total cost
Family labor	130	300	39000	25.44
Hired labor	32	300	9600	6.26
Total labor	162	300	48600	31.71

Source: Field survey, 2014

6.2.1.2 Cost of Power Tiller

Power tiller was used in lieu of animal power. It is time and labor saving modern technology. In the study area, power tiller has widely been used for land preparation. For bottle gourd production, the average per hectare power tiller cost was estimated at Tk. 12350. In percentage terms it shared 8.06 percent of total cost (Table 6.3).

6.2.1.3 Cost of Seed

The production quantity and quality of crops or vegetables mainly depends on good quality of seed. In the study area, most of the farmers used purchased seeds. They used to buy packet seed of bottle gourd. The total amount of seed requirement per hectare for producing bottle gourd was 61 packets. The average price of seed was Tk. 70 per packet

for bottle gourd production. The total cost of seed for bottle gourd production was Tk. 4270. This variable cost item shared 2.79 percent of total production cost (Table 6.3).

6.2.1.4 Cost of Fertilizers and Manure

In the study area commonly used fertilizers were Urea, TSP and MOP, and Gypsum etc. They also used Vitamin that means growth hormone. In the study area, farm gate prices of Urea, TSP, MoP and gypsum were Tk. 20.22,19, and 12 per Kg respectively. Per hectare total costs of Urea, TSP, MoP and Gypsum per were Tk. 6220, 8910, 2565, 480 respectively for bottle gourd production (Table 6.2).

In the study area it was found that farmers also used cow dung as manure. For bottle gourd production the total cost of manure was Tk. 2180 per hectare. In case of bottle gourd production per hectare total cost of fertilizers and manure was Tk. 21255 (Table 6.2) which shared 13.87 percent of its total cost.

Table 6.2 Per Hectare Fertilizer and Manure Cost of Bottle Gourd Production

Items	Quantity	Price (Tk. /unit)	Total cost (Tk./ ha)	% of total cost
Urea (kg/ha)	311	20.00	6220	4.06
TSP (Kg/ha)	405	22.00	8910	5.81
MoP (Kg/ha)	153	19.00	2565	1.67
Gypsum (Kg/ha)	40	12	480	0.31
Growth hormone (Packet /ha)	3	300	900	0.58
Total Fertilizer cost	-	-	19075	12.44
Manure	-	-	2180	1.42
Fertilizer & Manure cost	-	-	21255	13.87

Source Field survey, 2014

6.2.1.5 Cost of Irrigation

Irrigation water is an important input in bottle gourd cultivation. Per hectare cost of irrigation water was Tk. 23100 for bottle gourd production, which represented 15.07 percent of total cost (Table 6.3).

6.2.1.6 Cost of Insecticides

In the survey area, farmers applied insecticides to protect their vegetables from the attack of pests and diseases. In the study area cost of insecticides amounted to Tk 6200 per

hectare for bottle gourd cultivation, which shared 4.05 percent of total cost (Table 6.3).

6.2.1.7 Cost of Fence and Mancha

Fence and mancha is an important input in bottle gourd production. In the study area per hectare cost of fence and mancha was found Tk.19263 which represented 12.57 percent of total production cost (Table 6.3).

6.2.1.8 Interest on Operating Capital

Interest on operating capital was calculated by taking into account all the variable cost incurred during the production period of bottle gourd. Interest on operating capital was computed at the rate of 10 % for four month. Per hectare interest on operating capital was estimated at Tk. 4501.27 for bottle gourd production which covered 2.94 percent of the total cost (Table 6.3).

6.2.1.9 Total Variable Cost

Summation of all the costs of variable inputs gave the total variable costs of bottle gourd production in the study area. The total variable cost of bottle gourd cultivation was Tk. 139539.27 per hectare. In percentage terms total variable cost covered 91.05 percent.

Table 6.3 Per Hectare Costs of Bottle Gourd Production

Items	Unit	Quantity	Price (Tk./unit)	Cost (Tk./ha)	% of total cost
Operating Cost					
Human labor cost	Man days	162	300	48600.00	31.71
Power tiller cost	-	-	-	12350.00	8.06
Seed Cost	Packet	61	70	4270.00	2.79
Fertilizer & manure cost	-	-	-	21255.00	13.87
Irrigation cost	-	-	-	23100.00	15.07
Insecticides cost	-	-	-	6200.00	4.05
Fence and mancha	-	-	-	19263.00	12.57
A. Total Operating Cost				**135038.00**	**88.11**

Interest on operating capital @ 10% for 4 month				4501.27	2.94
B. Total Variable Cost				**139539.27**	**91.05**
Rental value of land				13722.00	8.95
C. Total Fixed Cost				**13722.00**	**8.95**
D. Gross Cost				**153261.27**	**100**

Source: Field survey, 2014

6.2.2 Fixed Cost

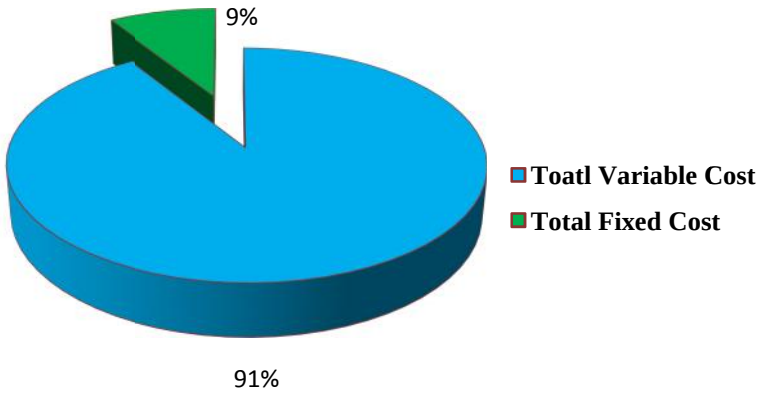
Fixed costs do not change in magnitude as the amount of output changes and are incurred even when production is not undertaken. In the present study, land use cost was considered as fixed cost for bottle gourd cultivation.

6.2.2.1Land Use Cost

Land use cost was calculated on the basis of current rental value of land in the study area. In the study area per hectare rental value of vegetable produced area was Tk. 41167 for a year. So the rental value for four month period estimated at Tk. 13722 which share 8.95 percent of total cost (Table 6.3).

6.2.3 Gross Cost/Total Cost

In order to estimate gross cost per hectare, all the resources used in production have been recaptured together. All of the variable costs and fixed costs were taken into account. In this study, per hectare gross cost was found Tk. 153261.60 (Table 6.3).



Source: Field Survey, 2014

Figure 6.1 Share of Variable Cost and Fixed Cost to Total cost of Bottle Gourd

6.3 Estimation of Returns of Bottle Gourd Production

6.3.1 Gross Return

Gross return is the money value of total output. In this study, gross return was calculated by summing up all the returns earned from selling bottle gourd and laau shak including home consumption of vegetable and shank. Per hectare average yield of bottle gourd was estimated to 11650 pieces. In the study area the farm gate price of per piece bottle gourd was found to Tk. 28. Per hectare gross return was calculated by multiplying the total amount of products and by products with the farm- gate price. Per hectare gross return of bottle gourd production was Tk. 340197 (Table 6.4).

Table 6.4 Per Hectare Gross Return of Bottle Gourd

Items	Unit	Quantity	Price / unit (Tk.)	Total value	% of total
Main product (Laau)	Piece	11650	28	326200	96.35
By product (Laau shak)	-	-	-	13997	3.65
Gross Return	-	-	-	**340197**	**100**

Source: Field Survey, 2014

6.3.2 Gross Margin

Gross margin calculation was done to have an estimate of the difference between total return and variable costs. Per hectare gross margin of bottle gourd cultivation in the selected area was found to Tk. 200657.73 (Table 6.5).

6.3.3 Net Return

Net return is a very useful tool to analyse the performance of enterprise. Per hectare net return was obtained by subtracting gross costs from gross return, or deducting fixed cost from gross margin. Per hectare net return of bottle gourd production was Tk. 186935.73 (Table 6.5).

Table 6.5 Per Hectare Net Return and BCR of Bottle Gourd Production

Particulars	Total value (Tk)
A. Gross Return	340197.00
B. Variable Cost	139539.27
C. Gross Cost	153261.27
D. Gross Margin(A-B)	200657.73
E. Net return(A-C)	186935.73

F. BCR(Undiscounted) (A/C)	2.22

Source: Filed Survey, 2014

6.3.4 Benefit Cost Ratio (undiscounted)

The undiscounted Benefit Cost Ratio (BCR) of bottle gourd was calculated as a ratio of gross returns and gross costs. Benefit cost ratios of bottle gourd production per hectare was 2.22 which implies that Tk. 2.22 will be achieved by expending or investing of every Tk. 1.00 (Table 6.5).

6.4 Concluding Remarks

Profitability of a crop depends on yield, price of the product, and cost of inputs as well. Any variation in any of the above factors obviously will change the profitability. It is changed over time, place and management level. On the basis of above discussion it could cautiously be concluded that the cultivation of bottle gourd is profitable. As, bottle gourd production is a labor intensive enterprise, small farmers have a great potential to use their idle family labor and increase their earnings. However, it can be conclude that the cultivation of bottle gourd would help farmers to earn more household income.

CHAPTER 7

EFFECTS AND RESOURCE USE EFFICIENCY OF INPUTS USED

7.1 Introduction

The main focus of this section is to estimate and compare the relative economic potential of bottle gourd production in tabular form. In this chapter an attempt has been made to identify and measure the effects of some important variables of production on gross return of bottle gourd in the framework of production function analysis. For the purpose Cobb- Douglas production function model has been chosen to determine the effects of selected variables on production.

7.2 Factors Contributing to Yield and Economic Return of Bottle Gourd

Bottle gourd production depends on different kinds of inputs, such as human labor, power tiller, seed, fertilizer and manure, irrigation, insecticides etc. Considering the effects of explanatory variables on yield of bottle gourd seven explanatory variables namely human labor cost (X_1), power tiller cost (X_2), seed cost (X_3), fertilizer and manure cost (X_4), irrigation cost (X_5), insecticides cost (X_6), and fence & mancha cost (X_7) were chosen as key independent factors to estimate the quantitative effect of inputs on yield of bottle gourd. All these variables have been estimated as per hectare monetary values. However, other important variables such as management, farm size, land quality, soil type, sowing time and weather etc. also might affect production of bottle gourd. But uses of these inputs were excluded in the analysis due to paucity of reliable data.

7.3 Functional Analysis

Functional analysis was designed to study the contribution of resources employed in the production of the enterprises. Production function is a relation (or mathematical relationship) specifying the maximum output that can be produced with given inputs for a given level of technology. It applies to a firm or as an aggregate production function to the economy as a whole (Samuelson and Nordhans 1995).

To explore the input output relationships Cobb-Douglas production function was chosen on the basis of best fit and significance result on output. Moreover, use of Cobb-Douglas production function enables one to obtain the returns to scale directly. When the Cobb-Douglas production function takes the form of multiple linear regression of ordinary least squares (OLS) in logarithm, the regression coefficients represent production elasticities and if all the inputs related to the production take into account as the independent

variables, the sum of the production elasticities indicates whether the production process as a whole yields increasing, constant or decreasing returns to scale. This model is also popular in applied work. The functional form of the multiple regression equation is as follows:

$$Y = aX_1^{b_1}X_2^{b_2}X_3^{b_3}X_4^{b_4}X_5^{b_5}X_6^{b_6}X_7^{b_7}e^{u_i}$$

By taking log in both sides the Cobb-Douglas production function was transformed into the following logarithmic form, because it could be solved by the ordinary least squares (OLS) method.

$$ln\,Y = lna + b_1 lnX_1 + b_2\,lnX_2 + b_3 lnX_3 + b_4 lnX_4 + b_5 lnX_5 + b_6 lnX_6 + b_7 lnX_7 + U_i$$

7.4 Estimated Values of the Cobb-Douglas Production Function

Estimated values of the coefficients and related statistics of the Cobb -Douglas production function of bottle gourd are presented in Table 7.1.

Estimated Cobb-Douglas production function for bottle gourd was:

Ln Y= 4.837***+ 0.248*** X_1 + 0.136* X_2 + 0.110 *X_3 + 0.181*** X_4 + 0.137*** X_5 + 0.099* X_6 - 0.045 X_7

The following features were noted:

1. Cobb-Douglas production function fitted well for bottle gourd growing farms as indicated by F-values and R.
2. The values of coefficients of multiple determinations $R^2$was 0.91, which indicates that 91 percent of the total variations in return were explained by the independent variables included in the model.
3. The F-values was highly significant implying that all the included explanatory variables are important for explaining the variation of income of farmers in Bottle gourd production.
4. For testing the significance level of individual coefficient which has sufficient degrees of freedom, 1 percent, 5 percent and 10 percent probabilities were used.
5. The result from the summation of all production co-efficient was 0.86. These figures imply that production function for bottle gourd farmers presents decreasing returns to scale.
6. The relative contribution of individual key variables affecting productivity of bottle

gourd farms can be seen from the estimates of regression equation. The results showed that most of the co-efficient had expected sign. However, the explanatory variables like human labor (X_1), power tiller (X_2), seed (X_3), fertilizer and manure (X_4), irrigation (X_5) and insecticides (X_6) were found to have significant effect on production but fence and mancha (X_7) was found to have insignificant effect on production of bottle gourd.

Table 7.1 Estimated Values of Coefficient and Related Statistics of Cobb-Douglas Production Function

Explanatory Variables	Values of Coefficients	Standard Error	t-Value
Intercept/Constant	4.837***	1.054	4.59
Human labor cost(X_1)	0.248***	.075	3.30
Power tiller cost(X_2)	0.136*	.072	1.87
Seed cost(X_3)	0.110*	.060	1.83
Fertilizer and ManureCost(X_4)	0.181***	.057	3.15
Irrigation cost(X_5)	0.137***	.050	2.71
Insecticides cost(X_6)	0.099*	.053	1.86
Fence and matcha cost(X_7)	-0.045	.037	-1.22
F- Value	75.68***		
R^2	0.91		
Returns to scale scale ($\sum$ bi)	0.866		

Source: field survey, 2014

(Note: denotes significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent)*

Interpretation of the Results

Human Labor Cost (X_1): The magnitude of the regression coefficient of human labor cost was 0.248 with a positive sign. It was significant at one percent probability level. It implies that one percent increase of human labor cost, keeping other factors constant, would lead to an increase in the gross return by 0.248 percent for bottle gourd production (Table 7.1).

Power Tiller Cost (X_2): It is evident from the Table 7.1 that the coefficient of power tiller cost was 0.136 which was significant at 10 percent level. That means, 1 percent in

cost of this input keeping other factors constant would result in an increase of gross return by 0.136 percent (Table 7.1).

Seed Cost (X_3): The magnitude regression coefficient of seed cost was 0.110 for bottle gourd. It was positive and significant at 10 percent probability level. This indicates that gross return of bottle gourd would be increased by 0.110 percent by an increase in one percent seed cost while other factors remain constant (Table 7.1).

Fertilizer and Manure Cost (X_4): The estimated value of the co-efficient of fertilizer was 0.181 and was significant at one per cent level. It can be said that 1 percent increase in fertilizer cost keeping other factors constant, would increase the gross returns by 0.181 percent (Table 7.1).

Irrigation Cost (X_5): The co-efficient of the variable was 0.137 and significant at one percent level. This suggests that an additional spending of one percent on irrigation water would enable the owner farmers to earn 0.137 percent of gross return from bottle gourd (Table 7.1).

Insecticides Cost (X_6): The co-efficient of the variable was 0.099 and significant at 10 percent level. This reveals that an additional spending of 1 percent on insecticides would enable the farmers to earn 0.099 percent of gross return from bottle gourd (Table 7.1).

Fence and Mancha Cost (X_7): It can be seen from the Table 7.1 that the estimated coefficient of fence and mancha was negative for farmers (0-.045) which indicated an inverse relationship between gross return and fence & mancha cost. That means, in 1 percent increase of this cost decreased gross return by 0.045 percent while other factors were kept constant. However, this coefficient was not statistically significant. The possible cause of this insignificancy might be the irrational use of fence items. In the study area it was found that the price of fence and mancha items was very high. So, farmers can have better per hectare return of bottle gourd by reducing the use of this variable input (Table 7.1).

Value of R^2: The co-efficient of multiple determinations, R^2 was 0.91 for farmer which indicates that about 91 percent of the total variation in return of bottle gourd production is explained by the variables included in the model. In other words the excluded variables accounted for 9 percent of the total variation in return of bottle gourd (Table 7.1).

Goodness of Fit (F - value): The F-value was 75.68 for bottle gourd, and the estimated production was significant at one percent probability level (Table 7.1), which implies good fit of the model. That is, all the explanatory variables included in the model were important for explaining variation of bottle gourd production.

Returns to Scale $[\sum bi]$**:** The elasticity of production refers to the percentage increase in output compared to the percentage increase in input**.** The summation of all the production coefficients indicates returns to scale. In the present study for bottle gourd production the summation of the coefficients was 0.866. This indicated that the production function showed diminishing returns to scale. That is, if farmers increased 1 percent cost in all of the variable inputs the gross return would be decreased at 0.866 (Table 7.1). That means gross return would be increased at a decreasing rate.

7.5 Measurement of Resource Use Efficiency

From the analysis of the regression equations we can study the ability of farmers to allocate resources in bottle gourd production. It is important to ensure efficient use of resources, because resources are always limited (Majumder e*t al*., 2009). In order to test this efficiency the ratio of Marginal Value Product (MVP) to the Marginal Factor Cost (MFC) for each input in computed and tested for its equality to 1, i.e.

$$\frac{\text{MVPxi}}{\text{MFCxi}}=1$$

In order to test resource use efficiency, it was considered that a ratio equal to unity indicated the optimum use of that factor, a ratio more than unity indicated that the yield could be increased by using more of the resources.

A value of less than unity indicated the unprofitable level of resource use, which should be decreased to minimize the losses because farmers over used this variable. The negative value of MVP indicates the indiscriminate and inefficient use of resource. The estimated marginal value products (MVPs) of different inputs and the ratio between MVPs and MFCs are shown in table7.2.

Table 7.2 show the ratio of MVPxi and MFCxi for human labor, power tiller, seedling, fertilizer and manure, irrigation, insecticides, and fence & mancha.

Table 7.2 Marginal Productivity and Resource Use Efficiency

Variables	GM	Coefficient	MVPs	MFC	MVP/MFC	Comments
Gross return	325520					

Human labor	46880	0.248	1.72	1.00	1.72	Under Utilized
Power tiller	12280	0.136	3.60	1.00	3.60	Under utilized
Seed	4200	0.110	8.52	1.00	8.52	Under utilized
Fertilizer and manure	20576	0.181	2.86	1.00	2.86	Under utilized
Irrigation	22400	0.137	1.99	1.00	1.99	Under utilized
Insecticides	6100	0.09	4.8	1.00	4.8	Under utilized
Fence and mancha	17890	-0.045	-0.80	1.00	-0.80	Over Utilized

Source: Field Survey, 2014

Note: MVP = Marginal Value Product, MFC = Marginal Factor Cost,
GM = Geometric mean.

The ratios of MVPxi and MFCxi for human labor, power tiller, seed, fertilizer and manure, insecticides, and irrigation were positive and greater than one which implied that these inputs in the study area were underused (Table 7.2). It also indicated that these inputs have high productivity in bottle gourd production and more profit can be obtained by increasing investment in these inputs. So, farmers in the study area should increase the use of these inputs to attain efficiency level. But the ratio of MVPxi and MFCxi for fence & mancha was negative (Table 7.2). It indicated indiscriminate and inefficient level of use of this input. So, farmers should decrease the use of this input or adjusted it to bring it closer to unity to attain efficiency level in production of bottle gourd.

7.6 Concluding Remarks

From the estimated value of the production function and the findings it may be suggested that the overall performances of the model for bottle gourd producers were good as indicated by estimated R^2 and F- value. But all the explanatory variables included in the model were not significant as were generally expected. Form the findings of marginal productivity and resource use efficiency in the study, it may be suggested that the farmers of the study area have scope to attain full efficiency by reallocating the resources.

CHAPTER 8
IMPACT ON SOCIO- ECONOMIC STATUS OF BOTTLE GOURD PRODUCERS

8.1 Introduction

Socioeconomic status or position of the farmers influences their farm decision making. Socioeconomic status is an economic and sociological combined total measure of a person's work experience and of an individual's or family's economic and social position in relation to others based on income, education and occupation. The definition helps to understand the importance of respondent's socio-economic status. The socio economic aspects of the respondents are very important to judge their performance of farming and as well as their efficiency and future farming prospects. The social and economic status of small farmers is not so good in rural Bangladesh. However, the aim of this chapter is to present the impact of bottle gourd production on socio-economic status of the farmers.

This study represents the small farmers in selected area of Narayanganj district. In order, to assess the changes in socio economic of status of the selected farmers 9 items or indicators were chosen in this study. These were food and nutrition, housing improvement, health, clothing, education, income, sanitation and drinking water source, household furniture, and mobile & technology. It was found that the average duration of cultivating this selected vegetable by respondents was minimum 3 years.

8.2 Impact on Socio- Economic Status of the Farmer

In this study, Perceived Impact Score formula was used to assess the changes of socio economic status of the selected farmers. In order to know the extent of change that was occurred by bottle gourd cultivation farmers were asked to give their perception by checking any of the four responses, i.e. excellent, moderate, average and constant. For excellent, moderate, average and no change the assigned weights were 3,2,1,0 respectively. Perceived impact score (PIS) was computed for each change item by summing the weights for responses of the respondents against that change item. PIS of a selected change item indicate how much change occured due to bottle gourd production.

8.2.1 Impact on Income

Income is the most important indicator of socio economic status of the people living in rural Bangladesh. In order to determine the impact on socio economic status at first we have to look at the change in income status. According to farmer's perception, it was observed that that the majority of the respondents (50%) had moderate change in income

compared to 11.67% had no change in their income. It was found that highest 23.33 percent respondent's income was changed at excellent level. However, the PIS of this change item was estimated at 111 which was the highest PIS among all the selected socio economic items.

Table 8.1 Impact on Income

Nature of change	Score	No of respondents	Percent
Excellent	3	14	23.33
Moderate	2	30	50.00
Average	1	9	15.00
No chnage	0	7	11.67
Perceived Impact Score (PIS)		**111**	

Source: Field survey, 2014

8.2.2 Impact on Food and Nutrition

Food is the first and most important basic need of human being. The poor people and middle class family spend a large portion of their income on food item. It is revealed from the Table 8.2 that almost 42 percent of the respondents experienced average change in food and nutrition where only 6.67 percent of the respondents had excellent change.

Table 8.2 Impact on Food and Nutrition Status

Nature of change	Score	No of respondent	Percent
Excellent	3	4	6.67
Moderate	2	12	20.00
Average	1	25	41.67
No change	0	19	31.67
Perceived Impact Score (PIS)		**61**	

Source: Field survey, 2014

On the other hand 20 percent of the sampled farmers claimed that moderate level of change had occurred in food and nutrition by cultivating bottle gourd. The PIS of this item was estimated 61.

8.2.3 Relative Impact on Housing Improvement

Housing materials are concrete indicators to reflect a household's economic status. Especially in rural areas it is very common and realistic to determine or evaluate household economic status by its housing condition or concrete materials that are used for building a house. However, it is really tough to improve the housing condition only by the

income of bottle gourd production specially for small farmers. In the study area it was found that, small farmers mainly spend their income for day to day need such as food, education, health, clothing etc. So the impact of bottle gourd cultivation on housing condition was very low.

Table 8.3 Impact on Housing Improvement

Nature of change	Score	No of respondent	Percent
Excellent	3	0	0.00
Moderate	2	4	6.67
Average	1	9	15.00
No change	0	47	78.33
PIS	**17**		

Source: Field survey, 2014

It was found that majority of the respondents almost 78.33 % could not able to improve their housing condition. It was found that only 15 percent of the respondents were able to improve their housing condition. According to farmers perception the estimated PIS of this socio economic item was 17.

8.2.4 Impact on Source of Drinking Water and Sanitation

There was a time when rural areas of Bangladesh were so backward that there were no basic facilities like roads & transportation, sanitation facilities, electricity, education facilities, improved health facilities etc. Now with passage of time the situation has changed. At present most of the rural areas in Bangladesh are facing a tremendous changes in all of these facilities. Safe drinking water is essential for healthy life. For safe drinking water we need safe source of water. On the other hand households without proper sanitation facilities have a risk of incidence of diseases like diarrhoea, dysentery and typhoid. From the study, it was found that farmers spend their income of bottle gourd farming for the improvement of sanitation condition.

Table 8.4 Impact on Water Source and Sanitation Condition

Nature of change	Score	No of respondent	Percent
Excellent	3	10	16.67
Moderate	2	18	30.00
Average	1	12	20.00
No change	0	20	33.33
PIS	**78**		

Source: Field survey, 2014

Table 8.4 revealed that about 16.67% farmers experienced excellent changes or improvement where 30 % moderate change and 20 % had faced average change on their

sanitation and drinking water condition after being involved bottle gourd production. It was found that PIS of this change item represented the second highest score followed by income. The PIS of this socio economic factor was found 78.

8.2.5 Impact on Clothing

Cloth is the second basic need of human. In the study area, almost 47 percent sample farmers claimed that they spend their bottle gourd farming income on clothing. However, about 23.33 % respondents had experienced average change on this item where 6.67 % had excellent change. The perceived impact score of this change item was estimated 46.

Table 8.5 Impact on Clothing

Nature of change	Score	No of respondent	Percent
Excellent	3	4	6.67
Moderate	2	10	16.67
Average	1	14	23.38
No change	0	32	53.33
PIS		**46**	

Source: Field survey, 2014

8.2.6 Impact on Education

Socioeconomic status of household largely depends on education. Besides household head, educational status of family members is also important. From the analysis of farmer's perception it was found that farmer's family had a great positive impact on education.

Table 8.6 Impact on Education

Nature of change	Score	No of respondent	Percent
Excellent	3	8	13.33
Moderate	2	21	35.00
Average	1	9	15.00
No change	0	22	36.67
PIS		**75**	

Source: Field survey, 2014

Table 8.6 reveals that almost 64 % farmers agreed that bottle gourd production had positive impact on education of their family. It was found that, highest 35 % respondents had experienced moderate change on education where 13.33 % had excellent change and 15 % had average. It indicates that now farmers are more cautious or interested to educate

their children and they spend more on education of their children than previous. It has a great positive impact on society as well as their family. PIS of education was found 75.

8.2.7 Impact on Household Furniture

Household furniture is another important indicator of socio economic status of a household. In the study area almost 69 % respondents felt that production of bottle gourd had brought changes on their household furniture or assets.

Table 8.7 Impact on Household Furniture

Nature of change	Score	No of respondent	Percent
Excellent	3	8	13.33
Moderate	2	14	23.38
Average	1	19	35.00
No change	0	19	31.67
PIS	**71**		

Source: Field survey, 2014

Table 8.7 reveals that, 23.38 of the respondents could improve their family asset possession in moderate scale compared to 35 % of them could improve in low scale. On the other hand, 13.33 % of the respondents improved their family asset possession in high scale after their involvement in bottle gourd production. The estimated PIS of household furniture change was 71.

8.2.8 Impact on Health

In the present study, it was found that bottle gourd production had tremendous impact on health status of the producers. By analyzing the respondents perception it was observed that only 28.33 % change was occurred at moderate level, 15 % had excellent level change and 26.67 had average change. The PIS of this selected item was found 77.

Table 8.8 Impact on Health

Nature of change	Score	No of respondent	Percent
Excellent	3	9	15.00
Moderate	2	17	28.33
Average	1	16	26.67
No change	0	18	30.00
PIS	**77**		

Source: Field survey, 2014

8.2.9 Impact on Mobile Phone & Technology

At present time, mobile is the most important media of communication for all stages and all ages of people. In the study area, most of the farmers agreed that bottle gourd production enable them to possess the mobile phone and other telecommunication technology.

Table 8.9 Impact on Mobile Phone & Technology

Nature of change	Score	No of respondent	Percent
Excellent	3	10	18.33
Moderate	2	12	20.00
Average	1	16	21.67
No change	0	22	40.00
PIS	**70**		

Source: Field Survey, 2014

Table 8.9 reveals that, almost 60 % respondents experienced changes on mobile & technology facilities after being involved bottle gourd production. About 21.67 % respondents felt that average change had occurred, where moderate change and excellent change by 20% and 18.33 % respectively. The estimated PIS of this change indicator was 70.

8.3 Impact on Socio Economic Status on the Basis of PIS

In the present study, impact has been measured on the basis of farmers perception about the extent of changes that has been occurred due to bottle gourd production. After analyzing the PIS of a selected change item, now we can explain how much change had occurred due to bottle gourd production. The higher the PIS of a change item, the more is the impact of bottle gourd production. The possible PIS of any change item ranged from a minimum of zero to a maximum of 180 (60 x 3).

Table 8.10 Impact of Perceived Items on the Basis of PIS

Impact	PIS	Standardized PIS	Percent (%)	Rank order
Income	111	61.67	18.32	1
Sanitation & Drinking water	78	43.33	12.87	2
Health	77	42.78	12.70	3
Education	75	41.67	12.38	4
Household Furniture	71	39.44	11.72	5
Mobile & Technology	70	38.89	11.55	6
Food and Nutrition	61	33.88	10.06	7
Clothing	46	25.56	7.60	8
Housing Improvement	17	9.44	2.81	9

Source: Field survey, 2014

Table 8.10 reveals that the highest change had occurred on income with a standardized PIS 61.67 followed by sanitation and drinking water source, health, education, household furniture, and mobile & technology, which had standardized PIS 43.33, 42.78, 41.67, 39.44 and 38.89 percent respectively. It was observed that lowest change was occurred on housing improvent whose standardized PIS was found only 2.81.

8.4 Concluding Remarks

From the above discussion it is clear that significant improvement occurs for all the selected criteria of socioeconomic status of all sampled farmers in the study area. Bottle gourd farming is highly profitable and contributing significantly to improve the status of the farmer in the study area. So it could cautiously be concluded that, commercial cultivation of bottle gourd may be introduced in the study area and other potential areas where land remaining fallow in bottle gourd production season and it may help the farmer to increase their household income and therefore socio economic status.

CHAPTER 9

CONSTRAINTS OF BOTTLE GOURD PRODUCTION

9.1 Introduction

Bangladesh is an agro-based country where agriculture is considered as backbone of her economy. Although agriculture plays a vital role through employment generation, poverty alleviation, food security, and income generation but it has a number of problems particularly in cultivation practices. Farmers in Bangladesh do not get the sufficient quantity of seeds, fertilizers, pesticides, technical supports and finally the desirable price of their products (Awal, 2013). Moreover, the farmers are economically unable to invest the required amount inputs for producing crops due to their low capital base. Farmers generally complain of getting insufficient support from governmental agencies. As a result they fail to achieve their target. However, this chapter is design to identify the major problems and constraints confronted by the bottle gourd growers in the study area. Although bottle gourd production was profitable at the farm level, multiple numbers of constraints were reported by the farmers in the production of bottle gourd in the study area.

9.2 Major Constraints Reported by the Farmers

The respondents were asked to give their opinion regarding the problems and constraints of bottle gourd production. It was observed that the problems were not identical and they were differed from farmer to farmer. However, major problems according to the intensity reported by the farmers are given below:

9.2.1 High Price of Fencing Items

In case of bottle gourd production, fencing and mancha is an essential input. But the cost of fencing items such as rope or special kind of wire, bamboo, dhainhca, wood, jute sticks etc are very costly. About 96.67 percent of the bottle gourd farmers reported that the input cost of fencing and mancha is very high.

9.2.2 High price of Fertilizers and Insecticides

Fertilizer is vital inputs in the production of bottle gourd. Farmers reported that they have to apply fertilizer for vegetative growth of the plants as well as to persuade the production of fruits. It was reported that about 91.67 percent vegetable growers complained about high price rate of fertilizers and insecticides.

9.2.3 High Wage Rate of Labor

Labor is the second most important factor of production. The cultivation practice of bottle

gourd is labor intensive. Especially the land preparation and hilling up, making fence and mancha, weeding and mulching, irrigation are the most labor intensive parts. But the wage rate of labor is very high in the study area. Among all sampled farmers this problem was reported by highest 88.33 percent farmers.

Table 9.1 Major Constraints Faced by Bottle Gourd Farmers

Major Constraints	Percent	Rank
High price of fencing items	96.67	1
High price of fertilizers and insecticides	91.67	2
High wage rate of labor	88.33	3
Non-availability of quality seeds	66.67	4
Least idea about pests and diseases	58.33	5
Low price of product at late harvesting period	48.00	6
Lack of financial capital	43.33	7
Carrying and handling problems	33.33	8
Crop damage by domestic animal	20.00	9
Loss of production due to theft	16.67	10
Problems faced by female family labor	13.33	11

Source: Field Survey, 2014

9.2.4 Non-Availability of Quality Seeds

Seed is another most important input. Production of crops or vegetables are mainly depends on quality of seed or seedling. But non-availability of improved seeds was another limiting factor in producing bottle gourd. In the study area it was found that about 90 percent of bottle gourd farmers used purchased seeds. They reported that in local market HYV seeds were not available at their desired level. Most of the growers purchased seeds from local markets as HYV seed but they opined that in many cases, those seeds were not good quality which ultimately results in low production of vegetables. About 66.67 percent farmers reported this problem as the root cause of low productivity.

9.2.5 Least Idea about Pests and Diseases

Attack by pest and disease was not a serious problem in production of bottle gourd in the

study area. Some incidence of pest and disease attack was noticed. However the main problem is that most of the farmers have no scientific knowledge of production technology and, management of pests and disease. They have to rely on the dealer of the insecticide about what insecticide is for what kind of insects and diseases. Highest 58.33 percent small farmers were reported that they have least idea about pests and diseases.

9.2.6 Low Price of Product at Late Harvesting Period

At the beginning of the season farmers get high price of bottle gourd. But in late season they get low price of the vegetable. About 48.00 percent small farmers reported that they have faced with this problem.

9.2.7 Lack of Financial Capital

Like labor, capital is another important factor of production. However, approximately 43.33 percent farmers' in this study area reported that they faced scarcity of operating capital during production period particularly making fence and mancha, and fertilizer application which require cash money. They were unable to produce bottle gourd commercially in the large scale due to lack of operating capital. They often have to borrow money from relatives or in some cases different institutional and non-institutional sources at a high rate of interest.

9.2.8 Carrying and Handling Problems

About 33.33 percent of the selected vegetable growers treated about carrying and handling as a problem. Due to carrying and handling problem the growers used to sell their product to 'paikar' at farm gate and a few growers sold their products in the local market. As a result most of the growers deprived from their desirable output price.

9.2.9 Crop Damage by Domestic Animal

Crop damage by domestic animals was also a problem in the production of bottle gourd. Bottle gourd growers reported that damage by cow and goat was a considerable problem to them. Farmers gathered an experience that in the early stages the plants were affected by cattle and goats. About 20.00 percent vegetable growers reported that their products were attacked by domestic animals.

9.2.10 Loss of Production due to Theft

As most of the bottle gourd field was near the road or river side and the farmers reported that many people who came to take a bath in the river stolen their vegetable. However, stealing of vegetables from the field was not very common phenomenon. In the study area, about 16.67 reported that their products were stolen.

9.2.11 Problems Faced by Female Family Labor

Vegetables production is a profitable enterprise for small farmers mainly due to its labor intensive characteristic. In the study area most of the small farmers use their home supplied female labor in production. Female labors mainly engaged in seed sowing, hilling up, making fence, and irrigation. But in most cases these female labor face the problems of social criticism and bindings. In most of the society of our country people consider female works outside their home as impertinences. About 13.33 percent of all sample respondents reported this as a problem.

9.3 Probable Solutions of the Identified Problems Suggested by Farmers

The farmers in the rural Bangladesh have been facing a lot of problems during the production circle of different crops. Bottle gourd farmers are not an exception. They also faced a lot of constraints at the time of producing bottle gourd. After identification of different problems and constrains some probable solutions were suggested by the farmer in the study area. They are briefly described below:

i. Government should take necessary steps to decrease the price of fertilizer used in bottle gourd farming
ii. Government should take necessary steps to inform them about insecticides use and provide different insecticides at reasonable prices
iii. Most of the farmers suggested that supply of quality high yielding variety (HYV) seeds should be available in sowing period
vi. Formation of cooperative market for ensuring fair price of bottle gourd and increasing bargaining power of farmers is very important suggested by the farmers in the study area.

From the above discussion it is clear that farmers of the study area are facing numerous problems regarding cultivation practices of bottle gourd. However, in spite of these problems and constraints the farmers in the study area are still producing this vegetable because of its high profitability and easy cultivation process. Moreover, its production is labor intensive. Thus, the idle family labor could be utilized during the production period.

9.4 Concluding Remarks

Bottle gourd can play an important role in earning cash money. Since it is profitable and has huge domestic demand, its production should be expanded. Therefore, it may be concluded that bottle gourd production per hectare as well as its commercial production could possibly be increased to a large extent if the above mentioned problems and

constraints could be solved. Then it could help farmers to increase their income as well as their living standard.

CHAPTER 10
SUMMARY, CONCLUSION AND RECOMMENDATIONS

10.1 Introduction

This chapter highlights the major findings and conclusions of the research. This chapter was summarised on the basis of previously discussed chapter. The findings of the study and farmer's observation and perception on various issues related to production of bottle gourd as well as its impact on their socio economic status are summarized in this chapter. Finally, conclusion and some important policy recommendations of the study were also presented in this chapter.

10.2 Summary of the Study

Bangladesh is predominantly an agricultural country where, rice is the main food item for the people of the country. But rice alone cannot solve the demand for balanced diet. Nutritional deficiency is a very serious problem for the people of Bangladesh today. Vegetables are considered as one of the most important groups of food crops. Nearly 100 different types of vegetable comprising both local and exotic type are grown in Bangladesh. Among winter vegetables bottle gourd is important because of their dietary values and sources of income. In Bangladesh, it is called *laau* or *kaddu.* Bottle gourd is one of the least calorie vegetable, providing just 14 calories per 100gm. It is one of the vegetable recommended by the dieticians in weight-control programs. Therefore, the present study was an attempt to analyze the relative profitability and resource use efficiency of bottle gourd production in selected area of Bangladesh. Besides these, an attempt has made to measure the impact of bottle gourd production on socio economic status of the farmers. The specific objectives of the study were:

1. To identify the socio- demographic profile of sample farm households
2. To measure the profitability of vegetables producing farms
3. To estimate resource use efficiency of selected inputs of bottle gourd farms
4. To examine the impact of bottle gourd production on farmers socio economic status and
5. To identify the major constraints associated with production of bottle gourd.

The present study was conducted in Rupganj upazilla of Naraynagnaj district which was selected purposively. Three villages namely Pitalganj, Jangir, and Shimolia under

Rupganj upazilla were selected for collecting the data. These villages were selected because they possess similar socio-economic attributes and homogeneous physiographic conditions. In this study a purposive random sampling technique was applied. In total 60 farmers were selected to achieve the ultimate objective of the study. To get the desired sample at first the list of bottle gourd producers were collected from the agricultural extension officer of the selected upazilla agricultural office. Out of 200 bottle gourd farmers 100 small farmers (having land 0.05 to 2.49 acres) who cultivated bottle gourd minimum for three years were selected purposively. Then out of 100 total 60 farmers were randomly selected. The field survey was conducted over the period from, 1 March to 15 April, 2015. Tabular technique as well as statistical techniques such as Cobb-Douglas production function, PIS method were used to process and analyze the gathered data.

In analyzing the socio-demographic characteristics of selected bottle gourd farmers multiple numbers of related aspects of the sample households were examined. These were age distribution, composition of family size, dependency ratio, level of education, occupation, household income, farm size and land ownership pattern etc. It was found that, highest 38.33 percent of the respondents belonged to the age group 41-50 year. Highest 36.63 percent of respondents were illiterate, 20 percent completed primary schooling, and only 6.67 % were completed HSC. The total number of family members of 60 sampled farmers was found 278. The average family size of bottle gourd growers was 4.63. It was found that 81.67 percent farmers engaged in agriculture as main occupation and 16.67 percent farmers engaged as secondary occupation. Almost 13.33 % respondent's main occupation was service, 3.34 percent of farmers were operate business as their main occupation. In the study area almost 17.78 percent family members were engaged in agriculture and service, 22.22 percent housewife and 37.04 percent student as their main occupation. The average land holding of bottle gourd growers was 130.29 decimal.

Profitability of a crop depends on yield, price of the product, and cost of inputs as well. Any variation in any of the above factors obviously will change the profitability.
In order to determine the cost of purchased inputs, prevailing market price was used.
In the production process human labor was the most important factor. On an average per hectare human labor required for bottle gourd production was 147 man-days. Per hectare costs of human labor for bottle gourd production was Tk. 48600 which covering 31.71 percent of total cost, respectively. In the study area farmers used power tiller for land

preparation. Per hectare power tiller cost and seed cost was found Tk. 12350 and Tk. 4200 respectively which constituted 8.06 and 2.89 of total production cost. Fertilizer is a major input of bottle gourd production. Per hectare cost of Urea, TSP, MOP and Gypsum were calculated at 6220, 8910, 2565, 480 respectively. Per hectare total cost of fertilizer and manure was Tk. 21255 which shared 14.34 percent of its total cost. Per hectare cost of irrigation and insecticides was estimated at Tk. 23100 and Tk. 6200 for bottle gourd production, which represented 15.57 and 4.05 percent of total cost respectively. Per hectare cost of fence and mancha was estimated at Tk. 19263 which shared 12.57 % of total cost.

Per hectare variable cost of bottle gourd production was Tk. 139539.27 which covered 91.05% of total cost. In this study per hectare gross cost of production was estimated at Tk. 153261.60. Per hectare gross return of bottle gourd production was Tk. 340197and net return was Tk.186935.40. Undiscounted benefit cost ratio of bottle gourd production per hectare was 2.22.

Cobb-douglas production function was applied on the basis of the best fit and significant effects of resources on gross return. Seven explanatory variables were taken into account to explain variations in production. The coefficient of multiple determination, R^2, was 0.91 which indicated that 91 percent of the variation of output of bottle gourd was explained by the explanatory variables included in the model. The summation of the estimated coefficient was 0.866, which implied decreasing return to scale and the enterprise was operating in the second stage. In case of input use efficiency, the coefficients of human labor, power tiller, seed, fertilizer & manure, insecticides, and irrigation appeared to positive and greater than one which implied that these inputs were underutilized and they had high productivity in bottle gourd production and more profit can be obtained by increasing investment in these inputs. But fence & mancha was negative so it indicated indiscriminate and inefficiently used needs to be adjusted to bring it closer to unity.

In order, to assess the impact on socio economic status of farmers 9 indicators such as food and nutrition, housing improvement, health and sanitation, clothing, education, income, drinking water source, household furniture, and mobile & technology were chosen in this study. In this study, Perceived Impact Score formula was used to assess the changes of socio economic status of the selected farmers. It was found that the highest change had occurred on income with a standardized PIS 61.67 followed by water and

sanitation, health, and education which held standardized PIS 43.33, 42.78, 41.67 respectively. It was observed that lowest change was occurred on housing improvement whose standardized PIS was found 2.81.

In the study area farmers were identified some constraints which were faced by them in cultivating of bottle gourd. Some of them were high price of fence & mancha items, high price of fertilizers and insecticides, high wage rate, non availability of HYV seed, low price of product, lack of financial capital, attack by pest and disease, etc. In order to increase the production of these winter vegetables, these problems should be solved as far as possible.

10.3 Conclusion

From the results of the present study, it can be concluded that considerable scope apparently exists in the study area to increase the productivity of bottle gourd and to increase income, employment and nutritional status of the farmers. The management practices of selected vegetable production in the study area were not found efficient enough. Farmers had less idea about the application of inputs in right time with right doses. Consequently, they made over or under use of some inputs. Thus, well planned management training in accordance with their problems, needs, and resource base can lead to viable production practices and sustainable income from bottle gourd production.

10.4 Recommendation

On the basis of the findings of the study, it was evident that bottle gourd production was highly profitable and it can generate income earning and employment opportunity to the rural people of Bangladesh. But some problems and constraints came out into the production of bottle gourd. So, policy recommendations constitute important guidelines for overcoming these constraints and increasing bottle gourd production in Bangladesh. Some policy recommendations based on the findings and conclusion of the study are presented below:

i. Since quality seed played a significant role on bottle gourd yield, both the government and private institutions should take necessary steps to ensure availability of quality HYV seeds at the door steps of farmers at reasonable price

ii. Government should take necessary steps to train the farmer about the proper use of inputs. Department of Agricultural Extension can play an important role in this

case. They can provide training programme to the farmers in rural areas directly through Upazilla Extension officer

iii. Different government agencies like DAE and non-government agencies should continue strong extension programme in order to increase cultivation area in other potential areas where land remaining fallow in bottle gourd producing season

iv. Institutional credit programme should be launched aiming at commercial bottle gourd production particularly for small farmers. The bank should reduce the complexity in getting loans and should be encouraged to provide loans at a reasonable rate of interest. Government should take necessary steps to control the interest rate of bank and NGOs at a reasonable level

v. Government also should take initiatives to search for new markets of bottle gourd besides other agricultural products in abroad to export in large scale. To familiarize Bangladeshi vegetables to the foreigners and foreign super market quality of vegetable has to be improved by different value adding activities like packaging, processing, handling, grading and transportation. Besides this, different promotional activities like vegetable fair can also be arranged.

10.5 Limitations of the Study

This study was based on the profitability and resource use efficiency of bottle gourd production. Though awareness had been taken to eliminate the errors and inconsistency of the study but it is not free from its limitations which are as follows:

i. It was very difficult to convince the respondents to give necessary information relating to such a research work, some of them demanded for money or other financial support for their farming since they thought it was government survey

ii. Most of the respondents initially hesitated to answer questions, since they thought the investigators might use the information against their interest specially they were hesitated to provide their income and land holding data

iii. Most of the farmers were illiterate or quite ignorant and they did not keep any written record of their annual, monthly or daily transaction and activities. It was very difficult to collect actual data. Therefore, the author had to depend on the respondent’s bare memory regarding data generation

iv. Sometimes the interviewees were not available at home, which needed multiple visits to conduct a single interview

v. The present study defined the relationship of some selected variables, but there may be other variables such as farm size, management and weather that have direct or indirect influence on bottle gourd production

vi. Resource such as time, money etc. were limited.

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APPENDICES

Table A. 5.1 Educational Status of the Family Members including Respondents

Education	No.	Percent (%)
Illiterate	55	20.30
Signature only	39	14.39
Up to Primary	68	25.09
Secondary	74	27.31
HSC and Above	35	12.91
Total	271	100

Source: Field survey, 2014

Table A. 5.2 Occupational Status of the Respondents Family including Respondents

Occupational category	Main	Subsidiary
Agriculture	17.78	4.44
Housewife	22.22	0
Service	17.78	4.44
Business	1.48	3.7
Student	37.04	0
Animal rearing	0	18.52
Handicraft	0	18.52
Day labour	3.7	4.44

Source: Field survey, 2014

Table B. 7.1: Analysis of Multiple Linear Regression

Linear Regression

Source	SS	df	MS		Number of obs =	60
					F(7, 52)	75.69
Model	5.83018	7	.832882818		Prob > F	0.000
Residual	0.572227	52	.011004357		R-squared	0.9106
					Adj R-squared	0.8986
Total	6.402406	59	.108515361		Root MSE	0.1049

y	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
x1	0.248060	.0751705	3.30	0.002	.0972195	0.398901
x2	0.136127	.0729337	1.87	0.068	-.0102252	0.282479
x3	0.110336	.0601444	1.83	0.072	-.0103526	0.231024
x4	0.181012	.0575366	3.15	0.003	.0655559	0.296467
x5	0.137711	.0508786	2.71	0.009	.0356152	0.239806
x6	0.099612	.0534859	1.86	0.068	-.0077148	0.20694
x7	-0.045420	.0371632	-1.22	0.227	-.1199969	0.02915
_cons	4.837017	1.054493	4.59	0.000	2.721021	6.953013