PROFITABILITY AND TECHNICAL EFFICIENCY OF ONION CULTIVATION IN SOME SELECTED AREAS OF PABNA DISTRICT IN BANGLADESH

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CERTIFICATE

This is to certify that thesis entitled, ***"PROFITABILITY AND TECHNICAL EFFICIENCY OF ONION CULTIVATION IN SOME SELECTED AREAS OF PABNA DISTRICT IN BANGLADESH"*** *submitted to the Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of* ***MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS,*** *embodies the result of a piece of bona fide research work carried out by* ***MD. NAZMUS SHAKIB****, Registration No.* ***12-05137*** *under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

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

Dated: 1 December, 2019
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DEDICATED
TO
MY BELOVED
PARENTS

ABSTRACT

The present study was designed to measure the profitability and technical efficiency of Onion farmers in selected areas of two area in Sadar Upazila and Sujanagar Upazila under Pabna District. Primary data were collected from randomly selected 100 farmers in study area form selected village. Both tabular and functional analyses were applied in this study. The major findings of the study reveal that Onion production is profitable. Total cost of production was Tk. 216352.58 per hectare. Gross returns was Tk. 413808 per hectare and Net returns was Tk. 197455.42 per hectare. Benefit Cost Ratio (BCR) was found to be 1.91 which implies that one taka investment in Onion production generated Tk. 1.91. The Cobb-Douglas stochastic frontier production function was used for this study to measure technical efficiency of Onion farmers. The coefficients of parameters like deviation of a farmer from the best-practice frontier. The regression coefficients of Human labor, Seed, Urea, TSP, MoP, DAP, Zinc and Irrigation were positive but the coefficient of Magnesium and Irrigation was negative. Where human labour was found positive and significance at 5 percent level of significant and urea was significance at 1 percent level of significant. In the technical inefficiency effect model years of education, credit service, experience, member of social organization and training have expected (negative) coefficients. Coefficients indicating that this helps in reducing technical inefficiency of Onion farmers. The study revealed that a considerable improvement took place to increase household income of the farmers in the study area and to improve the socioeconomic conditions with the introduction of large-scale commercial Onion production. The study also identified some problems and constraints faced by the Onion farmers and suggested some recommendations to improve and would possible be increased.

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Md. Nazmus Shakib

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ABBREVIATIONS AND ACRONYMS

BRRI	: Bangladesh Rice Research Institute
BBS	: Bangladesh Bureau of Statistic
BCR	: Benefit Cost Ratio
BDT	: Bangladeshi Taka
BER	: Bangladesh Economic Review
DAE	: Department of Agricultural Extension
et al.	: and others (at elli)
GR	: Gross Return
Gm	: Gram
Ha	: hectare
HIES	: Household Income and Expenditure Survey
HYV	: High Yielding Variety
IOC	: Interest on Operating Capital
Kg	: Kilogram
MoP	: Muriate of Potash
Mt	: Metric Ton
NGO	: Non-Government Organization
SRC	: Spices Research Center
T	: Ton
TC	: Total Cost
TFC	: Total Fixed Cost
Tk.	: Taka
TSP	: Triple Super Phosphate
TVC	: Total Variable Cost
US	: United States
USDA	: United States Department of Agriculture
$	: Dollar

CHAPTER-1

INTRODUCTION

1.1 General Background

Bangladesh predominantly is an agricultural country. Most inhabitants of the country are involved directly or indirectly to agriculture for their livelihood. The sector contributed to 14.23% share of the national Gross Domestic Product (GDP). In earlier decades, the sector contribute more than 50% of GDP. Due a gradual transformation of the economy from agriculture to industry and service sectors, this sector decreases gradually around 50% in 1970 to 14.23% in 2018-19. Still it is the single largest sector of manpower engaged in the economy as it plays supplementary role in supplying raw materials of different industries, such as jute & jute products, food & food products and so on.

Bangladesh has inherited very fertile land in which diversified crops are grow very easily. Various types of crops are produced in the country. Onion is one of the major spices in Bangladesh. It ranks first in production among the spice crops and is used as salad while its stalk becomes green. Onion is cooked in many ways in preparing curries and other delicious foods which are important ingredient in the list of spices. Moreover, has been used as a common ingredient in various dishes since past in different cultures in the South East Asia. There are many different varieties of onion, red, yellow, white, and green. Each has its own unique flavor for its own far its strong & mildly sweet essence.

Yellow onion is particularly hardy, and its flavor is complex and spicy. Yellow onion has more sulfur compared to other onion varietals, so that it is much more pungent, difficult to eat in raw, and more cases it makes one's tear up. Among all spice crops, onion has great significance for its diversified use. It can be eaten raw, cooked, fried, dried or roasted. It is commonly used for flavor dips, salads, soups, spreads, stir-fry and in preparing other dishes. It contains vit-A, vit-C, iron and calcium. Onion also reduces blood sugar and is seen wide uses.

Onion is the most essential and important spices crop. The production of onion largely depends on the use of seeds, fertilizers, irrigation, pesticide etc. The Government of Bangladesh has, therefore, provided priority to the agriculture sector to increase the production of onion by giving subsidy to the farmers and inputs support such as seeds, fertilizer, irrigation, pesticide etc. to achieve self-sufficiency of agricultural crops including onion production.

Production of crops, cost of production and market price of crops are directly interrelated. Government has to give proper attention on these three factors as stated, so that the farmer will get fair price of the crop to be produced during the harvest time. Generally, government has to declare procurement price at the harvesting time of the crop so that producers may get proper price. Procurement price of the crop has to be fixed considering all these matters. If procurement price is lower than the production cost, producers get looser and will be discouraged to produce more crops and if selling price is higher than the production cost, producers will show keen interest to continue production. Due to importance of onion and it's widely uses in the country as spice, it was essential to BBS to conduct the Productivity Survey of Onion like eight other productivity surveys among all agricultural crops.

1.2 Production of the Onion

Onion is grown much in the fertile land where no water logging exists. Sandy loams are also good for its production as they contain low in sulphur. Onion is generally are grown from seeds or from sets. Onion seeds are short lived and fresh seed germinates better. The seeds sown thinly with shallow drills or plant not densely by stages. In suitable climates, sometimes cultivators may sow in late autumn to winter in the ground and produce early crops in the following year. Agro-ecological conditions may influence greatly to its seed production. Basically, onion crop needs cool weather during its early development of bulb and early growth of seed stalk. It is necessary to fertilize it for few weeks applying nitrogen to get the big bulbs.

The bulbs can be gathered when needed to eat fresh, but it is required keep in store, for further harvest while the leaves are dried back naturally. In dry weather, onion may keep on the surface of the ground for a few days to dry them properly. Then dried onion may keep hanging in nets or rope them with strings in a open and dry place. Even it should be stored in a well-ventilated, cool place under shed.

About 170 countries of the world cultivate onions for domestic use while some also grow onions for trade. About 9.2 million acres of onions are harvested each year on a global scale and 8% of this harvest is internationally traded. China, India, and the US are the world's leading onion producing countries.

Table 1.1: Area and Production of Onion in Different Countries in 2018

Rank	**Country**	**Onion Production(Metric ton)**
1	China	20,507,759
2	India	13,372,100
3	United States	3,320,870
4	Egypt	2,208,080
5	Iran	1,922,970
6	Turkey	1,900,000
7	Pakistan	1,701,100
8	Brazil	1,556,000
9	Russia	1,536,300
10	Republic of Korea	1,411,650
	World Total	**74,250,809**

Source: worldatlas.com

Farmers of Bangladesh grow onion following indigenous methods with a poor yield rate. The reasons behind the low yield occur due to lack of high yielding variety and follow the improper production practices. About 426157 acres of land in the country is under onion cultivation and the production is about 1802868 M ton (BBS 2019). In Bangladesh, onion is commercially cultivated in the greater districts/regions of Faridpur, Pabna, Rajshahi, Kushtia, Jessore, Dhaka and Rangpur (BBS, 2019). It is grown extensively during winter season in Bangladesh, at its maximum level both in area and production (BBS, 2019). It is grown more or less in all the districts of the country. However, the average yield rate is 4.23 M ton per acre, which is lower as compared to many other onion producing neighboring countries.

At present, total production of onion in Bangladesh cannot meet the country requirement. In each year the country has a shortfall around 6-7 lac tons of onion. Bangladesh has to import onion every year at the cost of its hard earned foreign currency. The possibility of further expansion of area under onion cultivation seems unlikely because of intense crop competition during dry season. One option is that onion production could be to expand during summer months.

Although the area and production have been raised compared to earlier period, still per unit yield rate of onion is comparatively lower. The yield of onion can be increased by following improve production technology like proper plant spacing. Although onion is one of the major spice crops of Bangladesh, but its production technologies has not been standardized from the scientific and economic point of view. Therefore, more research is needed to bring the improvement of onion production using modern technologies as well for obtaining between considering economic return.

Table 1.2: Area and Production of Onion by Division 2016-17 to 2018-19

Sl. No.	Division Name	2016-17		2017-18		2018-19	
		Area (acres)	Production (M. Ton)	Area (acres)	Production (M. Ton)	Area (acres)	Production (M. Ton)
1	Barishal	2177	3463	2267	3669	2413	3839
2	Chattogram	4890	9977	3720	8379	4533	9757
3	Dhaka	191750	711822	178936	641002	163731	594144
4	Khulna	71206	372316	67618	349650	66135	404689
5	Mymensing	7383	20130	7193	20344	7264	20565
6	Rajshahi	159322	159322	159322	159322	159322	159322
7	Rangpur	21489	21489	21489	21489	21489	21489
8	Sylhet	752	1750	767	1772	677	1683
BANGLADESH		**458969**	**1866502**	**441105**	**1737714**	**426157**	**1802868**

Source: BBS 2019

1.3 Nutritive, Medical Value of Onion

Onion has many medicinal properties. It is diuretic and is applied on bruises and wounds. It also relieves head sensation and insect bites. Onion is very rich spice because it contains appreciable amount of various nutrients, which are readily available by human body. Onion contains vitamin B and a trace of vitamin C and also trace of iron and calcium. The outstanding characteristics of onion are its pungency which is due to a volatile oil known as allylpropyl-disulphide (Yawalkar 1985). An edible portion of 100 gm onion bulb contains 1.10 gm protein, 9.34 gm carbohydrate, 23 mg calcium and 40 kilocalories energy. Table 1.4 displays that the edible portion furnishes different kinds of bio-chemical substances (USDA, 2015).

Table 1.3: Biochemical Substances of Onion (Value per 100 gm)

Name of substances	Quantities
Water	89.11 gm
Energy	40 kcal
Protein	1.10 gm
Total lipid (fat)	0.10 gm
Carbohydrate	9.34 gm
Fiber, total dietary	1.7 gm
Sugars	4.24 gm
Calcium, Ca	0.023 gm
Potassium, K	0.146 gm
Iron, Fe	0.00021 gm
Vitamin C, total ascorbic acid	0.0074 gm
Vitamin B1, Thiamin	0.000046 gm
Vitamin B2, Riboflavin	0.000027 gm

Source: USDA, 2015

1.4 Statement of the Problem

Agriculture plays a vital role in the economic development of the country. Agricultural development is considered to be a prerequisite for the economic development of most Asian countries. In Bangladesh, agricultural (mainly crop) production has remained constant over the past few years whereas population increased several times. At present, the Government of Bangladesh has to import some major crops and industrial goods. Although Bangladesh exports many agricultural products, the export earnings from these products are unable to pay the import costs. Consequently, balance of trade is always negative. The excess import costs are paid by foreign currency retained in the country and by foreign loans. Production of agricultural crops including onion will have to increase to boost the economy.

As agriculture evolves, several factors ranging from institutional to economic, and from physical to natural calamities can limit agricultural development. An increase in onion production by increasing area is not possible since total cultivable area is decreasing day by day due to the increased use of land for non-agricultural purposes. Production can be increased by increasing the technical efficiency of onion using existing technology. If farmers are found to be technically inefficient, production can be increased to a large extent using the existing level of inputs and available technology. A decline in agricultural production could also be caused by sub-optimal utilization of the existing technology or due to productive inefficiency. Several studies in other countries have shown that there is significant potential for raising agricultural output or profitability by improving productive (technical and allocative) efficiency using existing resources. Moreover, these studies have also indicated that there may be significant efficiency differentials between different groups of farms and between different regions among all farms and it should be possible to improve the performance of the less efficient farms or regions without major investment from outside at least in the short run.

The possibilities of economic growth solely through the more efficient use of existing resources will obviously be exhausted when an efficient production technology is reached. In other words, the process of increasing output only by improving efficiency cannot continue indefinitely, since under perfect technically efficient conditions the frontier output level will be reached. Thus, other growth promoting strategies need to be considered when it is not possible to increase output only through efficient utilization of existing resources. The use of modern technology in agriculture to raise output per unit of input is one such strategy. In the case of technically efficient farmers, production can also be increased by substituting existing technology with more advanced technology. A sound and realistic agricultural policy is one of the most important instruments through which agricultural production can be increased.

1.5 Objectives of the Study

- To assess the present socio-demographic profile of onion farmers.
- To estimate the profitability of onion production.
- To investigate the technical efficiency of onion cultivation.
- To identify constraints and suggest some policy guidelines for efficient onion cultivation.

1.6 Justification of the Study

The economic growth of an agro-based country like Bangladesh mainly depends on the development of agriculture sector. The agro-climatic conditions of Bangladesh are suitable for the cultivation of a wide variety of crops but 80 percent of the gross cropped areas are at present confined to the production of cereal crops mainly rice. Due to increasing population, demand for cereal food increased significantly. In 50 decades spices were exported outside the country. But their production and per capita availability had been decreasing from 80 decades. To mitigate this demand, the land of spices is being diverted to cereal food crop cultivation. Bangladesh is endowed with a favorable climate and soil for the production of spices. Onion is an important spice crop of Bangladesh widely grown in winter. Recently, Spices Research Centre (SRC, BARI, Bogra) has released two new varieties of onions, which are grown in summer season. They hoped that onion production in the region would continue to increase due to the new impetus being given to the sector by various organizations and the crop is being cultivated twice a year during the summer and winter seasons in place of only once during the winter in the past.

The area of cultivable land for crop production as well as onion production is decreasing day by day. The demand for onion is increasing but production cannot meet up the existing demand. For meeting the deficit, the government of Bangladesh has to import a large volume of onion and some major crops at the cost of hard earned foreign currency. To lessen the pressure on the foreign currency, the spices production must be increased to meet up the country's demand. Prior to giving emphasis on the production

of onion, it requires relevant and adequate information on different aspects of production at the farm level.

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 onion production have been undertaken by the government or private organizations in order to satisfy the demand of extension worker, policy makers, research personnel and the farmer. There are several factors like institutional, economic, physical and natural calamities that can limit agricultural production.

Production of onion can be increased by increasing the technical efficiency of onion using existing technology. It is generally assumed that farmers are inefficient at producing onion crop and there are significance inefficiency differences among farm groups. Agriculture production policy in Bangladesh is concerned by lack of information about the relative profitability of different agricultural production. In the past so far the author's knowledge is concerned, there was no study on the technical efficiency or inefficiency as well as factors affecting the level of technical efficiency or inefficiency of onion producers. For this reason, the present study makes an attempt to analyze the profitability of onion production and to estimate the technical efficiency of onion producing farmers which depends on the different socio-economic variables like farm size, age, education, experience and training of the farmers. The study may be informative in this field and may serve as a foundation for the further research to the researchers. Finally, it is expected that the findings of the study will be helpful for the individual farmers for increasing the productive efficiency by effective operation and management of their farms through pointing drawbacks and policy makers and extension workers to frame out a useful policy.

1.7 Organization of the Study

The study consists of 9 chapters. Chapter 1 describes introduction of the study. Relevant review of literature, methodology, description of the study area, socioeconomic characteristics of the sample farmers, results and discussion, major factors affecting to the production processes of onion, problems of onion growers and summary, conclusion and recommendations are presented in Chapter 2, Chapter 3, Chapter 4, Chapter 5, Chapter 6, Chapter 7, Chapter 8 and Chapter 9, respectively.

CHAPTER-2

REVIEW OF LITERATURE

This chapter aims at represent some review of the past research works that are related to the present study. Only a few studies have so far conducted related to technical efficiency and profitability of onion in Bangladesh. Again, some of these studies may not entirely relevant to the present study, but their findings, methodology of analysis and suggestions have a great influence on the present study. Review of some research works relevant to the present studies, which have been conducted in the recent past, are discussed below.

Haile (2015) explained the determinants of technical, allocative and economic efficiencies among small scale onion growers in the irrigation agriculture of Ethiopia. He found that land related factors described much of technical efficiencies and the socio-economic characteristics of the farmers (age, market access, training access, experience, farm income, responsibility and field visit) significantly and positively effect on both the technical and productive efficiencies. Age of households, plot distance, fertility, source of irrigation water, experience of the farmers, farm income and land fragmentation, and extension visit were treated as the major determinants of economic efficiency.

Umar and Abdulkadir (2015) investigated the determinants of technical efficiency in tomato production among small scale farmers in Ghana. Descriptive statistics was used to present the characteristics of tomato producing households and the stochastic frontier analysis was used to estimate the determinants of technical efficiency and the inefficiency effect models. The analysis suggests average technical efficiency of 85.4%.In addition, factors such as extension services, land, frequency of weeding and fertilizer positively influenced technical efficiency of tomato farmers. Conversely, factors such as pesticide, labor and the frequency of pesticide application had negative effects on technical efficiency**.**

The average production of tomato was approximately 3975.03 kg per household, which translates to a mean yield of approximately 1967.84 kg ha-1. Tomato output was highly variable, ranging from 260 kg to a maximum of 17940.0 kg per household. Average fertilizer use was 69.5 kg ha -1. The empirical results show that from the estimates of the Cobb-Douglas production function model, the estimated elasticity's of mean tomato output with respect to land, labour, fertilizer, pesticide and seed at mean input values, are 0.130, -0.052 , 0.124, -0.001 and - 0.376, respectively, at the mean input value.

Asodiya el al. (2014) conducted a study to measure input use, cost structure, return and resource use efficiency in wheat production of South Gujarat division of Gujarat, India. A sample of 240 wheat farmers was selected from study area which input-output data collected based on *rabi* cropping season with a view to examine the input use, cost structure and returns in production and marketing of wheat and the resource use efficiency of wheat growers in year 2013-14. The studies used the log linear type Cobb-Douglas production function. The results of study revealed that the average total cost of cultivation of wheat was ` 45784.31. It was the highest on large farms followed by 45720.79 on medium farms, and 39016.69 on small farms. The average net profit per hectare over (Cost-C2) was ` 20017.55 and it increased with the increase in size of farms. The overall input-output ratio was 1:1.44 on the basis of total cost of cultivation. It was the highest (1: 1.48) on large farms, followed by medium farms (1:1.43), and small farms (1:1.35).The elasticity of production (Ep) of all the variables summed up to 0.66 meaning decreasing return to scale, implying that, if these resources are increased by 1%, the output would increases by less than 1%.

Janailin et al. (2014) conducted a study on cultivation of turmeric in Meghalaya that provides supplementary income to the farmers. The average yield of fresh turmeric in the study area was 49q/ha which on drying gives an approximate yield of about 14.5q/ha of semi-processed (dried) turmeric. The share of variable cost was about 98 % of the total cost. The total costs of cultivation (cost C2) for turmeric was estimated at `77,012/ha whereas the net income was worked out to be `6,475/ha for fresh turmeric and `28,109/ha for dried turmeric. About `12,719/ha of additional expenditure is incurred on post-harvest management of turmeric. It is observed that a higher net

income is obtained when the farmers disposed off the product after drying which also gives the farmers the capacity to hold/store their product to avoid distress sale. The cost of production of turmeric is 15.68/kg, 60.93/kg and 70.17/kg for fresh, semi-processed and processed (powdered) form, respectively. Lack of knowledge about pest management is the major constraint faced by farmers in production whereas the fluctuation indisposal price of turmeric ranks first among the marketing constraints faced by farmers.

Janailin et al. (2014) found that the cost of production of turmeric is 15.68/kg, 60.93/kg and 70.17/kg for fresh, semiprocessed and processed (powdered) form, respectively. Lack of knowledge about pest management is the major constraint faced by farmers in production whereas the fluctuation in disposal price of turmeric ranks first among the marketing constraints faced by farmers. Cultivation of turmeric in Meghalaya provides supplementary income to the farmers. The average yield of fresh turmeric in the study area is 49q/ha which on drying gives an approximate yield of about 14.5q/ha of semi-processed (dried) turmeric.

Joshi et al. (2014) conducted a study to find out the yield gap through FLDs on wheat crop. Krishi Vigyan Kendra, JAU, Amreli (Gujarat) conducted 100 demonstration on wheat since 2006-07 to 2009-10 in different seven adopted villages. Prevailing farmers' practices were treated as control for comparison with recommended practices. The average four year data observed that an average yield of demonstrated plot was obtained 43.26 q/ha over control (36.59q/ha) with an additional yield of 6.67 q/ha and the increase average wheat productivity by 18.22 per cent. The average technology gap and index were found to be 6.74 and 13.48 percent. The extension gap ranging between 5.34 to 8.12 q/ha. During the period of study emphasis the need to educate the farmers through various techniques for adoption of improved agricultural production reverse the trend of wide extension gap.

Mahawar and Grover (2014) estimated the economics of turmeric cultivation for different categories of producers in Hoshiarpur, Nawashahar (Shaheed Bhagat Singh Nagar) and Gurdaspur districts of Punjab. The results revealed that on an overall basis the total cost incurred on use of physical input, machine labour and human labour use was 74438, 5227 and 29556 per hectare, respectively. The total variable cost was '121720, '108357 and '103569 per hectare for small, medium and large producers, respectively. On an overall basis returns over variable cost per hectare was 45380 which was highest for large producers (68604) followed by medium producers ('48660) and small producers (30822). Similarly, B-C ratio was also highest for large producers (1.66) followed by medium producers (1.45) and small producers (1.25). The overall benefit-cost (B-C) ratio was 1.40 denoting turmeric cultivation a profitable enterprise. The results of the study on economics of turmeric cultivation showed that the net returns per hectare received were quite high for all the categories of the farmers which clearly indicate the financial worthiness of turmeric crop.

Rahman et al. (2014) studied about the technical efficiency of fresh water golda (Macrobrachium rosenbergii) farming in the coastal empoldered area of Bangladesh. The study used frontier production function and inefficiency model to analyze the cross-section data. The result showed that the inefficiency factors among the golda farmers were level of education, training and farm size.

Solomon and Korede (2013) used a cross sectional data obtained through a multistage sampling technique and estimated the technical efficiency of Ginger crop production in Jaba Local Government Area, Kaduna State, Nigeria and further examined the factors that determined the differential in efficiency index. A total of 78 Ginger crop farmers in the study area were randomly selected for the study. The stochastic frontier production model was used in the analysis to determine the relationship between output and the level of input used in the study area. The empirical results revealed that farm size, Planting materials, fertilizers and hired labour were statistically significant at 5% level while chemicals and family babour were not statistically significant. The estimated gamma parameters (γ) of 0.37 indicated that 37% of the total variation in total output was due to technical inefficiencies of the respondents. The mean technical efficiencies (χ) level was 0.68.

It was therefore concluded that there is scope for increasing the technical efficiency of ginger crops production by 0.68% with the present technology. Therefore the study confirmed that increased land, planting material, fertilizer and hired labour can be used in the area by the farmers in ginger production.

Baree (2012) was conducted a study on measuring technical efficiency of onion (*Allium cepa* L.) farms in Bangladesh. The elasticity of output with respect to land, labour, and capital cost was estimated to be positive values of 0.3026, 0.0718, and 0.0442, respectively, and also significant. With respect to seed and irrigation, it was found to be insignificant with negative values of 0.0045 and 0.0007. The coefficients of age, experience, and farm size were significant with expected negative signs, which means that the inefficiency effects in onion production decreases with increase in age, experience, and farm size. The technical efficiency of onion farms varied from 58 percent to 99 percent with mean value of 83 percent. It denotes that there is a scope to increase output per hectare of onion farm by 17 percent through the efficient use of production technology without incurring any additional costs.

Hireematha and Hilli (2012) conducted frontline demonstrations in Haveri district of Karnataka with objective of study on yield gap analysis in onion production technology. Onion is one of the important commercial crops in Karnataka, which plays a major role in supplementing the income to small and marginal farmers of Haveri district in Northern Karnataka. One of the major constraints to traditional onion farming is low productivity due to non-adoption of recommended package of practices and inferior seeds. To solve these problems frontline demonstrations on onion were conducted in adopted villages of Krishi Vigyan Kendra, Hanumanamatti in Haveri district. The impact of varieties on yield data indicates the Byadagi kaddi and Byadagi dabbi varieties recorded 22.80 and 19.91 per cent increased yield over local, respectively. The technology gap (5.77) and technology index (92.77) was highest in Byadagi dabbi compared to Byadagi kaddi. While the extension gap (1.60) was maximum in Byadagi kaddi. The higher gross returns, net returns and B: C ratio were recorded in both varieties compared to their respective local/check plots.

Baree *et al.* (2011) were conducted a study on comparative study of technical efficiency of onion producing farms in Bangladesh. The coefficients of experience were significant with negative sign in small and medium farms. The coefficients of education were negative in small and medium farms and it was positive for large farm. The farm-specific technical efficiencies of onion producing small, medium and large farms varied from 55 percent to 99 percent, 57 percent to 99 percent and 56 percent to 99 percent with a mean technical efficiency of 77 percent, 87 percent and 84 percent respectively, which meant that without incurring any additional costs there was a scope to increase output per hectare of onion by 23 percent, 13 percent and 16 percent for small, medium and large farms respectively through the efficient use of existing production technology.

Haque *et al.* (2011) were conducted a study on profitability of onion cultivation in some selected areas of Bangladesh. The yield of onion was found 9869 metric tons per hectare. The gross margin and net return were found to be Tk. 85308 and Tk. 79487 per hectare, respectively. The benefit cost ratio was found 1.85. Inputs like human labour, seedling, manures, urea, TSP, irrigation, and insecticide had positive effect on the yield of onion. The profit obtained from onion cultivation was found higher than that of other competitive crops like mustard, groundnut, and cabbage. Non-availability of HYV onion seed at proper time, lack of technical knowledge, high price and non-availability of fertilizer in time, lack of appropriate storage facility were the major problems of onion cultivation in the study areas and needs immediate attention to solve these problems.

Ibrahim *et al* (2011) were conducted a study on evaluation of herbicides on weed control, performance and profitability of onion (*Allium cepa*) in the forest zone of Nigeria. The results revealed that all the weed control methods significantly ($P<0.05$) decreased weed population. Similarly, survival percentage of onion was affected by the use of chemical. Bulb diameter, number of bulbs and onion yield were affected by the application of chemicals. The use of oxyflorfen gave the best performance in all the parameters measured.

Islam et al. (2011) determined the productivity, profitability and resource use efficiency of four promising spices crops such as garlic, onion, ginger and turmeric. The data were collected from 480 farm households in the crop year 2010-2011. Productions of all the crops were profitable as estimated by net returns and benefit cost ratios**.**The average estimated technical efficiencies for garlic, oniones, ginger and turmeric were 88, 80, 69 and 79% respectively which indicated that garlic production could be increased by 12%, onion by 20%, ginger by 31% and turmeric by 21% with the same level of inputs without incurring any additional cost**.**

Mohammad (2011) stated the concept of yield gaps originated from the studies conducted by IRRI in the seventies. The yield gap discussed in this paper is the difference between the potential farm yield and the actual average farm yield. In Bangladesh, yield gaps exist in different crops ranging up to 60%. According to the recent study conducted by BRRI, the yield gap in rice was estimated at 1.74 t/ha. The existence of yield gaps was as well observed in rice, mustard, wheat and cotton in India. In India, yield gap varied from 15.5 to 60% with the national average gap of 52.3% in irrigated ecosystem.

Shah *et al.* (2011) were conducted a study on onion production potential, limitations and its prospects for improvement in the farming system of Punjab, Pakistan. Area under onion crop has been increasing even up-to 17 percent of jump from the previous year but the productivity is declining monotonically due to number of threats including pest and diseases attack, lack of improved varieties and quality seed and in conjunction of high costs of all purchased inputs. The main reasons appraised in yield reduction were low quality seed, insects/pests and diseases attack, water stress, marketing and costly inputs (Urea, DAP) in order of priority ranking. All these reasons have adverse impact on the quality and profitability of the onion due to which Pakistan has not been able to earn significant foreign exchange and exploit full export potential.

Hasan (2010) was conducted an economic study on onion production in selected area of Bangladesh. The major findings of the study reveal that onion production is profitable. Gross returns for small, medium and large farmers were Tk. 218989, Tk. 189880 and Tk. 164129 respectively and their corresponding net returns were Tk. 94350, Tk. 78098 and Tk. 67545 respectively. Per hectare yields of onion bulb those of produced were 14217 kg, 12202 kg and 10637 kg respectively. Per hectare human labour was used 292 man-days. Compared to other farmers BCR was highest in the case of small farmers and it was 1.77.The coefficients of parameters like cropped area, seed, inorganic and inorganic fertilizer and training of the farmers were significant and indicated positive effect on onion production. In the technical inefficiency effects model farm size was significant and showed negative sign which mean that farmers with larger farm holdings are technically more efficient than farmers with smaller farm holdings.

Haque *et al.* (2009) were conducted a study on economic assessment of onion and garlic under zero tillage and traditional methods of cultivation in major growing areas 18 of Bangladesh. The study revealed that the cost of onion cultivation was Tk. 93517, Tk. 87696 and Tk. 72001 per hectare on full cost, variable cost and cash cost basis. The net return of onion cultivation was Tk. 64236 per hectare. The benefit cost ratio was 1.68, 1.80 and 2.19 for full cost, variable cost and cash cost basis, respectively. Human labor, seed/seedling, manures, urea, TSP irrigation and insecticide for onion and garlic had positive effect on yield. Non-availability of HYV seed at proper time, lack of technical knowledge, high price and non- availability of fertilizer in time, infestation of insects and diseases, low market price and lack of appropriate storage facility were the major problems of onion and garlic cultivation.

Hasan *et al.* (2009) were conducted a study on returns to investment in summer onion research and extension in Bangladesh. The results revealed that the growth of area and production of onion increased manifolds due to farm level adoption of summer onion. The summer onion adoption rate was found increasing trend over the period. The yield of summer onion was 57.04 percent higher than the local variety. The internal rate of return (IRR), net present value (NPV), and benefit cost ratio (BCR) were estimated to

be 25 percent, Tk. 35.29 million and 3.09 respectively. Sensitivity analysis revealed that under various assumptions IRR ranged from 20 percent to 41 percent, NPV from Tk. 18.37 to Tk. 64.05 million, and BCR from 2.31 to 5.95. The results indicated that investment in research and development of summer onion was a good investment.

Ullah (2008) carried out experiments at the Regional Agricultural Research Station, Rahmatpur, Barisal to study the impact of different sulphur levels on bulb yield, storability and economic return of onion. The highest bulb yields (19.75 t/ha and 19.88 t/ha) were obtained from sulphur levels between 60 kg/ha and 75 kg/ha in two consecutive years. Both the cumulative weight and rotten loss were significantly influenced by sulphur fertilization. The highest (9146 percent) marginal rate of return (MRR) with gross margin of Tk. 181844/ha was obtained from the sulphur level S60 kg/ha.

Alam (2007) examined the effects of planting time on vegetative growth, yield contributing traits, yield and quality of onion seed. Planting on October 30 gave the highest seed yield of 462.33 kg/ha compared to 443.00, 405.58 and 331.75 kg/ha obtained from October 15, November 15 and December 30 plantings, respectively. The highest seed yield per hectare was obtained from the second closest spacing 25x10 cm2 (465.42 kg/ha), followed by that of the closest spacing 20x10 cm2 (454.06 kg/ha).

Islam *et al.* (2007) were conducted a study on growth and yield response of onion (*Allium cepa* L.) genotypes to different levels of fertilizers. The study showed the influence of four levels of fertilizers viz. 0:0:0, 60:65:80, 120:130:160 and 240:260:320 kg/ha (N:P:K) on growth, yield and yield contributing characters of six onion genotypes viz. Thaherpuri Brown, BARI Onion 1, Faridpuri Bhati, Suksagar, Nasirbala and Pusa Red. The fertilizers at 120:130:160 kg/ha produced the maximum bulb yield (14.9 t/ha). Correlation studies revealed that bulb yield was positively related with different yield components, but it showed non-significant negative relation with bulb dry matter content (%).

The regression analyses showed that the rate of change of bulb yield was dependent upon the rate of change of plant height, number of leaves and roots, and root length. Increase in number of roots per plant appears very important in increasing the yield.

T.S. Hyuha et al. (2007) analyzed the inefficiency in Uganda using stochastic profit and inefficiency function. The result showed that the rice farmers in Uganda were not in the profit frontier. The causes of inefficiency were low education and limited access to extension services.

Haque (2005) conducted a comparative economic analysis of onion and garlic production in a selected area in Santhia upazila of Pabna district. Both onion and garlic were profitable. Onion cultivation was more profitable than garlic cultivation. Per 17 hectare average yield of onion and garlic was 8412 kg and 4510 kg respectively. Per hectare total cost of production, gross margin and net return of onion were Tk. 49437, Tk. 101230 and Tk. 93567, respectively. On the other hand, the corresponding figures for producing garlic were Tk. 49386, Tk. 43693 and Tk. 36304 respectively.

Rahman (2004) studied effect of growth regulators on growth and yield of three varieties of onion grown from sets. The Taherpuri produced the highest bulb yield (14.99 t/ha). Application of all the growth regulators increased plant highest, number of leaves per plant, bulb diameter, mean bulb weight, and bulb yield compared to control plants of onion.

Alam (2003) carried out an experiment to study the effects of planting time and nitrogen on growth, yield and storability of summer onion. The highest yield of 11.32 t/ha was obtained from 11 April planting. Nitrogen also showed significant effect on the yield of summer onion. The highest percentage of weight loss (40.72 percent), rotting (19.13 percent), and sprouting (4.72 percent) were recorded from 12 May planting. The treatment combination of 11 April planting time x BARI Piaz-3 x 0 kg N/ha showed the lowest percentage of weight loss (22.89 percent), rotting (8.17 percent) and sprouting (1.33 percent).

Rahman (2003) conducted a study to measure the profit among Bangladesh rice farmers. The analysis was done by using a stochastic profit frontier and inefficiency effect model. The results showed that there was 23% level inefficiency in modern rice cultivation. The efficiency differences were explained largely by infrastructure, soil fertility, experience, extension services, tenancy and share of non-agricultural income.

Awal *et al.* (2001) were undertaken a study to examine the effect of various input uses and to determine the resource use efficiency in the production of onion. The results of the study indicated that the return of onion was positively related with the inputs, family labour, hired labour, ash, TSP, MP and irrigation except seeds, animal labour, cowdung, urea and insecticides. The findings also revealed that onion growers are not efficient in terms of resource allocation. Further, farmers have the scope to increase output by efficient utilization of family labour, cowdung, insecticides irrigation in the onion cultivation.

Saha (1999**)** examined comparative profitability of different varieties of onion in selected area of Pabna District. All the varieties studied were found profitable. But Faridpuri variety was found more profitable than other varieties. Gross returns per hectare for the taherpuri, Indian and Faridpuri varieties of onion were Tk. 112389.00, Tk. 106570.00, Tk. 135640.89, respectively; net returns were Tk. 46756.28, Tk. 50405.65 and Tk. 67945.41, respectively. It was found that variation in net returns was greatly influenced by the use of human labour, tillage, seed, fertilizer, insecticides and irrigation water.

Rahman (1998) conducted an economic study of onion production in selected areas of Rajbari district. Gross returns for the corresponding farmers were Tk. 118765.50, Tk. 157606.75, Tk. 155627.25 and Tk. 145360.50 respectively and their net returns were Tk. 81280.15, Tk. 115376.84, Tk. 111553.04 and Tk. 103637.30, respectively. Per hectare yields of small, medium, large and all farmers were 9501.24 kg, 12608.54 kg, 12450.18 kg and 11628.84 kg. Per hectare human labour was used 309.65 man-days constituting 40.82 percent of total cost for all farmers which was the highest of all cost items. Compared to other farmers, resource use efficiency was higher in the medium size farmers and its BCR was 3.73.

Variation in yield was greatly influenced by the number and magnitude of human labour, ploughing, manuring, irrigation and timely date of sowing, planting and harvesting.

Shrivastava (1998) studied on economics of agro-forestry in Indo-Gangetic alliums of Uttar Pradesh in India. Total profit from the first and second cycles was predicted as Rs.28363125 and Rs.75548135, respectively with cost/benefit ratio of 4.0 and 7.2. The system generated 112960 man-days of employment in the first rotation. The second was found to be more efficient in terms of better returns to the producer. Farmers faced some production problems such as inadequate water availability, lack of technical assistance and untimely supply of inputs.

Hossain (1997) studied effect of intercropping groundnut with onion at varying planting arrangement at agricultural research station, Shyampur, Rajshahi, Bangladesh during the Rabi season of 1993-94 and 1994-95. Six treatment viz., sole groundnut (1:0), sole onion (0:1), one row of onion in two rows of groundnut (1:1), two rows of groundnut altered with two rows of onion (2:2), three rows of groundnut altered with two rows of onion (3:2) and four rows of groundnut altered with two rows of onion were studied. The highest groundnut yield and onion bulb yield were obtained from their respective sole crop.

Mahmood (1995) examined the relative profitability of selected spices, compared with their competing crops. Among all competing crops onion was the most profitable crop with net profit of Tk. 26673, which was followed by potato (Tk. 25875.30), lentil (Tk. 20652.1) and garlic (Tk. 16755.49) in respect of net return per hectare.

CHAPTER 3
METHODOLOGY

3.1. Introduction

Farm management research depends on the proper methodology of the study. Proper methodology is a prerequisite of a good research. The design of any survey is predominantly determined by the nature, aims, and objectives of the study. It also depends on the availability of necessary resources, materials and time. There are several methods of collecting data for farm management research. A farm business study usually involves collection of information from individual farmers; collection of data for farm business analysis involves judgment of the analyst in the selection of data collection methods within the limits imposed by the resources available for the work (Dillon and Hardaker 1993). In this study, "survey method" was employed mainly due to two reasons:

i. Survey enables quick investigations of large number of cases; and

ii. Its results have wider applicability.

The major disadvantage of the survey method is that the investigator has to rely upon the memory of the farmers. 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 design of the survey for the present study involved the following steps.

3.2. Selection of the Study Area

Selection of the study area is an important step for farm management study. The selection of an area fulfilled the particular purpose which was set for the study and also the possible cooperation from the farmer. Although onion is grown all over Bangladesh, the district Pabna is one of the important districts where it is grown quite extensively. So, on the basis of higher concentration of onion production some selected village under two big upazila namely Sadar and Sujanagar, in Pabna district were purposively selected for the study.

The main reasons in selecting the study area were as follows:

a) Availability of a large number of Onion growers in the study area;

b) These villages had some identical physical characteristics like topography, soil and climatic conditions for producing onion.

c) Easy accessibility and good communication facilities in these villages; and

d) Co-operation from the respondents was expected to be high so that the reliable data would be obtained.

3.3. Sampling Technique and Sample Size

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 manageable within the limitation imposed by physical, human and financial resources (Mannan 2001). However, because of diversity in the technical and human environment, it is necessary to sample 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 2000).

It was not possible to include all the farmers of the study area due to limitation of time, money and personnel. In total 100 farmers were randomly selected. A purposive random sampling technique was followed in the present study for minimizing cost, time and to achieve the ultimate objectives of the study.

3.4 Data Collection

As data collection has a noteworthy impact on the quality of survey results, it is treated as a significant part of a survey. Considering its importance, the following measures were taken during the preparation of questionnaire as the tool of data collection:

3.4.1. Questionnaire Design

A questionnaire is a powerful evaluation tool that allows the collection of data through the use of multi-dimensional questions. A questionnaire written without a clear goal and purpose is inevitably going to overlook important issues and waste enumerators' as

well as respondents' time by asking and responding useless questions. All these matters were addressed to the extent possible for developing the questionnaire of survey.

3.4.2. Pre-testing the Questionnaire

The questionnaire was pre-tested to examine the time necessary to complete the interview, test the reliability i.e. whether it captured the information desired, and also investigated the consistency whether the information gathered by it was related to the whole purpose of the survey. The test had also targeted to check the logistics required for successful operation of the survey. In order to ensure the best performance of the questionnaire in respect of data collection, processing and analyzing, the pre-testing was carried out during the month of December 2018 and January 2019 prior to the survey at rural area of Sadar upazila and Sujanagar upazila under Pabna District. My supervisor and Co-supervisor had gone to the two places mentioned to take part in testing the questionnaire. They had chosen some of the farmers at random as the respondents.

3.4.3. Finalization of the Questionnaire and Method of Data Collection

After addressing all the changes following the recommendations evolved from the pre-test, the questionnaire was placed to my supervisor. My supervisor also put notable contribution to the questionnaire. Eventually, the questionnaire had been finalized with the approval. Face to face interview had been carried out following Paper and Pencil (PAPI) method.

3.4.4. Data Editing and Coding Data Editing and Coding

Data Editing and Coding Data editing and coding were other vital phases of the survey, which were indispensable for data processing. It should be completed before data processing. In case of this survey coding had been done along with questionnaire development so that the enumerator could easily and accurately mark the right answers. Data editing referred to the activity of checking and cleaning data that had already been collected from the field.

3.5. Data Processing

Data processing involved many steps that were very important because it affected survey results according to the involved steps. During data processing following steps had been taken.

- Data entry
- Appending and Merging files
- Data validation (further computer checking, editing, and imputation)
- Final decision on errors
- Completion of data processing and generation of data files
- Final documentations
- Conversion of data files to another software.
- Storage of all files.

3.6. Processing, Tabulation and Analysis of Data

The collected data were manually edited and coded. Then all the collected data were summarized and scrutinized carefully. Moreover, data entry was made in computer and analyses were done using the concerned software Microsoft Excel and Frontier 4.1. It may be noted here that information was collected initially in local units. After necessary checking it was converted into standard international units.

3.7 Analytical Techniques

Data were analyzed with a view to achieving the objectives of the study. Several analytical methods were employed in the present study. Tabular method was used for a substantial part of data analysis. This technique is intensively used for its inherent quality of purporting the true picture of the farm economy in the simplest form. Relatively simple statistical techniques such as percentage and arithmetic mean or average were employed to analyze data and to describe socioeconomic characteristics of onion growers, input use, costs and returns of onoin production and to calculate undiscounted benefit cost ratio (BCR).

In order to estimate the level of technical efficiency in a manner consistent with the theory of production function, Cobb-Douglas type stochastic frontier production function was used in the present study.

3.7.1 Profitability Analysis

The net returns of onion were estimated using the set of financial prices. The financial prices were market prices actually received by farmers for outputs and paid for purchased inputs during the period under consideration in this study. The cost items identified for the study were as follows-

- ✓ Land preparation
- ✓ Human labor
- ✓ Seedlings
- ✓ Urea
- ✓ TSP
- ✓ DAP
- ✓ MoP
- ✓ Zinc
- ✓ Magnesium
- ✓ Insecticide
- ✓ Irrigation
- ✓ Interest on operating capital
- ✓ Land use

The returns from the crops were estimated based on the value of main products. In this study variable cost, fixed cost and total cost had been described. Total variable cost (TVC) included land preparation, human labor, seedlings, organic manure, urea, TSP, MoP, insecticides, irrigation and interest on operating capital. Fixed cost (FC) included only rental value of land. Total cost (TC) included total variable cost and fixed cost.

Cost of Land Preparation

Land preparation considered one of the most important components in the production process. Land preparation for onion production included ploughing, laddering and other activities needed to make the soil suitable for planting seedling. It was revealed that the number of ploughing varied from farm to farm and location to location.

Cost of Human Labor

Human labor cost was considered one of the major cost components in the production process. It is generally required for different operations such as land preparation, sowing and transplanting, weeding, fertilizer and insecticides application, irrigation, harvesting and carrying, threshing, cleaning, drying, storing etc. In order to calculate human labor cost, the recorded man-days per hectare were multiplied by the wage per man-day for a particular operation.

Cost of Seed

Cost of seed varied widely depending on its quality and availability. Market prices of seeds of respected onion were used to compute cost of seed. The total quantity of seed needed per hectare was multiplied by the market price of seed to calculate the cost of seeds for the study areas.

Cost of Urea

Urea was one of the important fertilizers in onion production. The cost of urea was computed on the basis of market price. In order to calculate cost of urea the recorded unit of urea per hectare were multiplied by the market price of urea.

Cost of TSP

The cost of TSP was also computed on the basis of market price. In order to calculate cost of TSP the recorded unit of TSP per hectare were multiplied by the market price of TSP.

Cost of MoP

Among the three main fertilizers used in onion production, MoP was one of them. To calculate the cost of MoP per hectare, the market price of MoP was multiplied by per unit of that input per hectare for a particular operation.

Cost of DAP

The cost of DAP was also computed on the basis of market price. In order to calculate cost of DAP the recorded unit of DAP per hectare were multiplied by the market price of DAP.

Cost of Zinc

Zinc was one of the minor fertilizers in onion production. The cost of zinc was computed on the basis of market price. In order to calculate cost of zinc the recorded unit of zinc per hectare were multiplied by the market price of zinc.

Cost of Magnesium

Magnesium was one of the minor fertilizers in onion production. The cost of magnesium was computed on the basis of market price. In order to calculate cost of magnesium the recorded unit of magnesium per hectare were multiplied by the market price of magnesium.

Cost of Insecticides

Farmers used different kinds of insecticides for 2-3 times to keep their crop free from pests and diseases. Cost of insecticides was calculated based on the market price of the insecticides which was used in the study areas per hectare.

Cost of Irrigation

Water management helps to increase onion production. Cost of irrigation varies from farmers to farmers. It was calculated based on how many times irrigation was needed per hectare and what was its cost.

Interest on Operating Capital

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. The cost was incurred throughout the whole production period.

Hence, at the rate of 6 percent per annum interest on operating capital for four months was computed for onion. Interest on operating capital was calculated by using the following formula:

IOC= AIit

Where,

IOC= Interest on operating capital

i= Rate of interest

AI= Total investment / 2

t = Total time period of a cycle

Land Use Costs

Land use cost was calculated on the basis of opportunity cost of the use of land per hectare for the cropping period of four months. So, cash rental value of land has been used for cost of land use.

Calculation of Returns

Gross Return

Per hectare gross return was calculated by multiplying the total amount of product and by-product by their respective per unit prices.

Gross Return= Quantity of the product * Average price of the product + Value of by- product.

Gross Margin

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

Per hectare gross margin was obtained by subtracting variable costs from gross return. That is,

Gross margin = Gross return – Variable cost

Net Return

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

Net return = Total return – Total production cost.

Undiscounted Benefit Cost Ratio (BCR)

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

BCR = Total return (Gross return)/ Total cost

3.7.2 Technical Efficiency Analysis

Technical efficiency refers to the ability of a firm to produce the maximum possible output from a given set of inputs and given technology. A technically efficient farm will operate on its frontier production function. Given the stated relationship the firm is technically efficient if it produces on its outer-bound production function to obtain the maximum possible output which is feasible under the current technology. Putting it differently a firm is considered to be technically efficient if it operates at a point on an isoquant rather than interior to the isoquant. The homogeneity of inputs is a vital factor for achieving technically efficient output.

No one would dispute that the output produced from given inputs is a genuine measure of efficiency, but there is room for doubt whether, in a particular application, the inputs of a given firm are really the same as those represented by the corresponding point on

the efficient isoquant. But it is important to note that mere heterogeneity of factors will not matter, as long as it is spread evenly over firms, it is when there are differences between firms in the average quality (or more strictly, in the distribution of qualities) of a factor, that a firm's technical efficiency will reflect the quality of its inputs as well as the efficiency of its management.

3.8.2.1 The Stochastic Frontier Models

The most widely discussed, theoretically reasonable and empirically competent method of measuring efficiency is the stochastic frontier model. It is an improvement on the traditional average production function and on all types of deterministic frontiers in the sense that it introduces in addition to one-sided error component a symmetric error term to the model. This permits random variation of the frontier across farms, and captures the effects of measurement error, other statistical noise arid random shocks outside the firm's control. A one-sided component captures the effects of inefficiency relative to the stochastic frontier. The stochastic frontier model is also called the 'composed error' model introduced by Aigner, Lovell and Schmidt (1977). It was later extended and elaborated by Jondrow *et al*. (1982).

The notion of a deterministic frontier shared by all farms ignores the very real possibility that a farm's performance may be affected by factors entirely outside its control (such as poor machine performance, bad weather, input supply breakdowns, and so on), as well as by factors under its control (inefficiency). But stochastic frontiers consider all the factors while estimating the model and accordingly it separates firm-specific efficiency and random error effect. Thus the efficiency measurements as well as the estimated parameters are unbiased.

3.8.2.2 The Stochastic Frontier with Cobb-Douglas Production Function

The Cobb-Douglas production function is probably the most widely used form for fitting agricultural production data, because of its mathematical properties, ease of interpretation and computational simplicity (Heady and Dillion, 1969; Fuss and Mcfadden, 1978). The Cobb-Douglas function has convex isoquants, but as it has unitary elasticity of substitution; it does not allow for technically independent or competitive factors, nor does it allow for Stages I and III along with Stage II. That is,

MPP and APP are monotonically decreasing functions for all X- the entire factor-factor space is Stage II-given 0 < b < 1, which is the usual case. However, the Cobb-Douglas may be good approximation for the production processes for which factors are imperfect substitutes over the entire range of input values. Also, the Cobb-Douglas is relatively easy to estimate because in logarithmic form it is linear in parameters; it is parsimonious in parameters (Beattie and Taylor, 1985).

A stochastic Cobb-Douglas production frontier model may be written as

Yi = f (Xi,β) exp.(Vi-Ui) i = 1, 2, 3, ……., N

Where the stochastic production frontier is f(Xi,β)exp.(Vi), Vi having some symmetric distribution to capture the random effects of measurement error and exogenous shocks which cause the placement of the deterministic kernel f(Xi,β) to vary across firms.
The technical inefficiency relative to the stochastic production frontier is then captured by the one-sided error component Ui > 0.

3.8.2.3 Specification of Production Model

We have specified the Cobb-Douglas Stochastic Frontier Production Function in order to estimate the level of technical efficiency. The functional form of stochastic frontier is as follows:

$$_i = \alpha \; {}^{\beta 1}_{1i} \; {}^{\beta 2}_{2i} \; {}^{\beta 3}_{3i} \; {}^{\beta 4}_{4i} \; {}^{\beta 5}_{5i} \; {}^{\beta 6}_{6i} \; {}^{\beta 7}_{7i} \; {}^{\beta 8}_{8i} \; {}^{\beta 9}_{9i} \; {}^{\beta 10}_{10i} e^{\; i - \; i}$$

The above function is linearized double-log form:

$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + + \beta_7 \ln X_7 +$

$\beta_8 \ln X_8 + \beta_9 \ln X_9 + \beta_{10} \ln X_{10} +$ Vi-Ui

Where,

Y = Output (kg/ha)

X_1 = Human labour cost (Tk/ha)

X_2 = Seed (Kg/ha),

X_3= Urea (kg/ha)

X_4 = TSP (kg/ha)

X_5 = MOP (kg/ha)

X_6= DAP (kg/ha)

X_7 = Zinc (kg/ha)

X_8 = Magnesium (kg/ha)

X_9 = Irrigation cost (Tk./ha).

X_{10} = Cost of insecticide (Tk./ha)

The model of the technical inefficiency effects in the stochastic production frontier equation is defined by

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + W_i$$

Where,

Z1…….. Z6 are explanatory variables.

The equation can be written as:

$U_i = \delta_0 + \delta_1$ Years of education + δ_2 Family size + δ_3 Credit service + δ_4 Experience+ δ_5 Member of social organization+ δ_6 Training + W_i

V is two-sided uniform random variable beyond the control of farmer having N (0, σ 2) distribution, U is one-sided technical inefficiency effect under the control of farmer having a positive half normal distribution {Ui∼|N (0, σu2)|} and W_i is two-sided uniform random variable. Wi is unobservable random variable having a positive half normal distribution. The model was estimated simultaneously using Frontier 4.1.

CHAPTER 4
DESCRIPTION OF THE STUDY AREA

4.1 Introduction

This chapter presents a brief description of the study area. Knowledge of the study area is very essential to understand the location, physical features and topography, soil type, temperature, rainfall, agricultural and economic condition, population, education and other socioeconomic infrastructure available in the area. This chapter aims at present the above-mentioned characteristics of the study area.

4.2 Location

The study was conducted on some villages of two Upazila namely Sadar upazila, and Sujanagar upazila under pabna district. Pabna, one of the oldest districts of Bangladesh, was established in 1832. Pabna Sadar sub-division of the greater Pabna district was up-graded to a district in 1984. Nothing is definitely known about the origin of the district name. According to Cunningham, a renowned archaeologist, the name Pabna might have been derived from the old kingdom Pundra. The popular belief is that the district might have originated its name from the name of a stream Pabnaee which was flowing by the southern side of this land towards the Ganges. It is bounded on the North by Natore and Sirajganj districts, on the east by Manikganj district and the river Jamuna on the south by Rajbari and Kushtia districts and the river Padma and on the west by Natore districts. It lies between 23°48" and 24°21" north latitudes and between 89°00" and 89°44" east longitudes. The total area of the district is 2,376.13 sq. km.

4.3 Physical Features, Topography and Soil Type

The Pabna district is consist of two agro-ecological zones: High Ganges River Floodplains (11) and Lower Ganges River Floodplains (12).The soil of the district is mainly covered with recent and sub-recent sediments consisting of sandy clay and sand along the course of rivers. The Jamuna and the Padma influence to make the soil alluvium.

The southern region of the district is dominated by the very young and actual meander floodplains. The floodplains contain the silty clay alluviums, which is calcareous. The eastern part of the district is covered by the Jamuna alluviuns, which are alkaline. In the northern areas karotoya floodplanis are mixed with dark grey silty clay loams and the soils are chemically Non-calcareous.

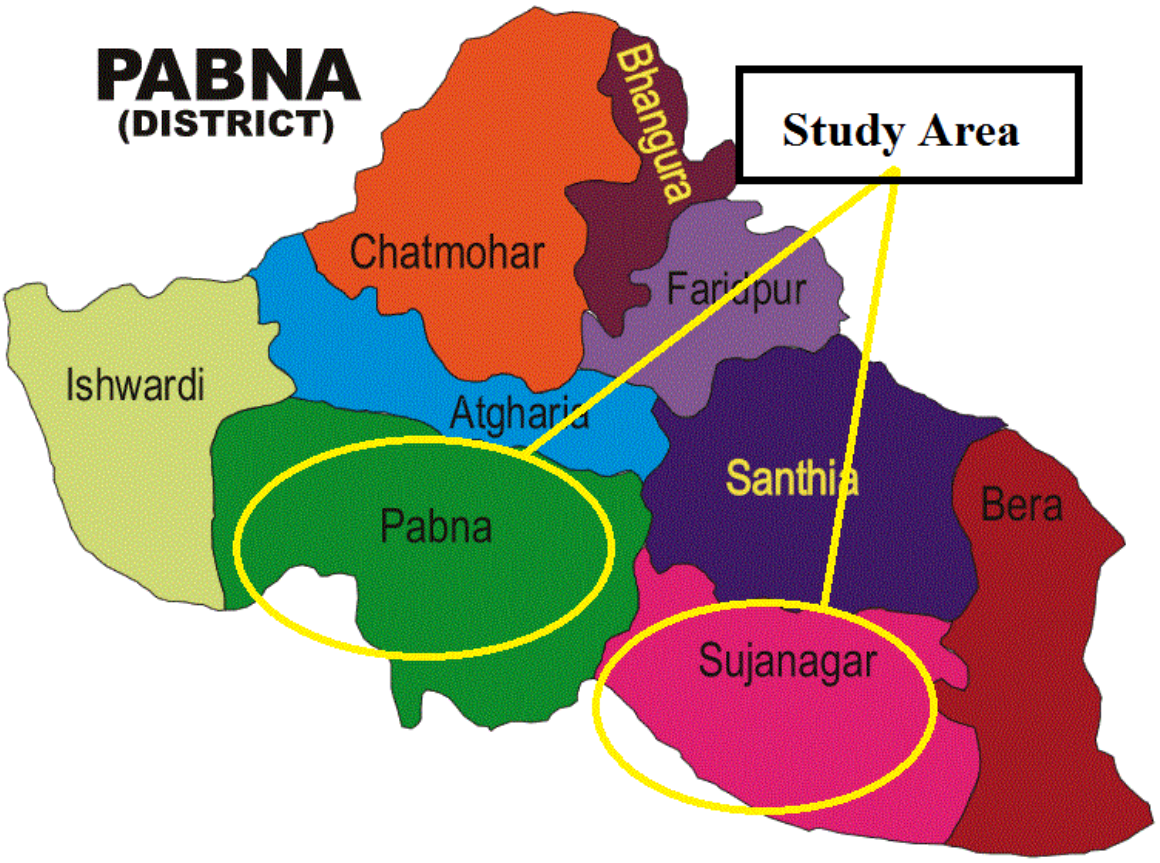

Figure 4.1: Map of Pabna District

4.4 General Information of study area

Table 4.1: Broad classification of Study area (In sq. km.)

Upazila	Total area	Land area
Pabna Sadar	439.30	392.58
Sujanagar	338.65	315.00

Table 4.2: Number of household, population and density of study area

Upazila	House Hold	Population (000)			Sex ratio (M/F)	Average size of household	Density per sq. km
		Male	Female	Total			
Pabna Sadar	138839	297	294	591	101	4.21	1345
Sujanagar	63676	139	140	279	99	4.36	821

Table 4.3: Population and literacy rate of study area

Upazila	Population (000)			Literacy rate (%)		
	2001	2011	2018	2001	2011	2018
Pabna Sadar	432	477	591	29.1	48.2	51.4
Sujanagar	224	251	279	26.7	36.7	41.9

4.5 Climate

The district bears a moderate and pleasant climate. The temperature, humidity and coldness of the district are not high. The summer season commences from April and continues up to the end of June. The rainy season comes at the end of June and stays up to September. The winter season starts from the middle of November and lasts up to the end of February. The minimum and maximum mean temperature during winter varies from 16.5° c to 19.0° c. During summer the minimum and maximum mean temperature, vary from 25.5°c to 37.7° c. The rainfall is heavy during July to

September. The annual rainfall of the district recorded in 2011 was 1736 millimeters. The level of humidity was about 76.8% in April and about 85% in July.

Table 4.4: Temperature, rainfall, humidity of Pabna

Years	Temperature (centigrade		Rainfall (millimeter)	Humidity (%)
	Maximum	Minimum		
2016	35.18	9.4	1371	78.0
2016	36.5	11.6	1239	75.0
2017	37.7	9.2	678	61.3
2018	34.2	8.4	1736	76.8

Source: Bangladesh Meteorological Department

4.6 Agriculture and Economic Condition

The economy of Pabna district is predominantly agricultural and cottage industry based (weaving and thread work). Weaving and thread work is the important source of income of the people of the district. In Pabna district out of 533,209 holdings 53.06% holdings are farm, which produce varieties of crops, namely, local and HYV aus, aman, boro, wheat, pulses, oil seeds, sugarcane, spices and condiments, vegetables and other minor crops. Livestock farming is another important source of income of the people of Pabna district. Various fruits like mango, jackfruit, litchi, jam, palm, banana, guava, watermelon etc are grown in Pabna district. Varieties of fish are caught from rivers, beels and paddy fields during rainy season. The most common fishes are ruhi, katal, mrigel, magur, singi, koi, puti, shoil, gozar, boal etc. There are some other varieties of fish are pangas, airh, chingri, batasi, bacha, kholisha, rita etc. All these fishes are economically valuable. Besides crops, livestock and weaving are also the main sources of household income of the people of Pabna district.

Main Crops: Paddy, jute, wheat, sugarcane, oil seeds, onion, garlic, betel leaf, pulses. Extinct or nearly extinct crops Indigo, sesame, linseed, kaun, china and arahar.

Main Fruits: Mango, jackfruit, banana, litchi, coconut, guava and papaya.

4.7 Transportation

Dhaka is about five hours by road, through the Jamuna Bridge. Cities and towns of Dhaka Division, Chittagong Division and Sylhet Division are connected through it. Kushtia District and other parts of Khulna Division and Barisal Division is connected through Lalon Shah Bridge.River crossing (*ferry ghaat*) at Nogorbari on the Jamuna River is the old route to Dhaka and the eastern part of Bangladesh. It takes three to four hours to cross only the Jamuna from Nogorbari to Aaricha river port in Manikgonj District. Najirgonj river crossing on the Padma River connects Pabna city with neighbouring Rajbari District as well as Faridpur, Madaripur, Shariatpur and Gopalganj Districts, and Barisal Division.

Pabna is well connected to all the districts and towns of Bangladesh by road. Pabna city has connected with a new railway network. Pabna Railway Station is in Shalgaria near Pabna Central Bus Terminal, opened 14 July 2018. A nearby railway station was in Tebunia, 10 kilometers (6.2 mi) from city center. The nearby airport is at Ishwardi upazila.

4.8 NGO Activities

Operationally important NGOs are BRAC, CARE, ASA, Grameen Bank, Caritas, Proshika, Shomota, Thengamaara Mohila Shobuj Shongho (TMSS) and Polli Progoti, ASEAB, BOSS.

4.9 Concluding Remarks

From the above discussions it is found that the location of the study area near to the district. Physical features and topography, soil type, temperature and rainfall are favourable for cultivating onion. This district is well transport system over marketing to others Bangladesh. Therefore, various types of agricultural crops were cultivated in the study area. Communication are good for marketing of agricultural crops.

CHAPTER –5

SOCIO-ECONOMIC PROFILE OF HOUSEHOLD POPULATION

5.1 Introduction

The point of this part is to present a brief description of the socio-economic characteristics of the growers delivering onion. Socioeconomic parts of the growers can be viewed from various perspectives relying on various factors identified with their degree of living, the financial condition where they live and the nature and the degree of the growers ' support in national advancement exercises. It was impractical to gather all the data with respect to the financial attributes of the example growers because of confinement of time and assets. Financial state of the example growers is significant in the event of research arranging in light of the fact that there are various interrelated and constituent qualities describes an individual and significantly impacts advancement of his/her conduct and character. Individuals contrast from each other for the variety of financial perspectives. Nonetheless, for the present research, a couple of the financial qualities have been contemplated for exchange.

5.2 Composition of the Family Size

Family size is significant in connection to generation of enough nourishment grain for ranch family. In this study family has been characterized as the all-out number of people living respectively and taking meals from a similar kitchen under the influence of one leader of the family. The relatives considered as spouse, children, unmarried little girl, father, mother, sibling and different relatives who live for all time in the family.

Table 5.1: Average Family Size and Distribution of Members According to Sex of the Sample Farmers

Particulars	Sadar Upazila		Sujanagar Upazila		All Farmers		National Average Family Size
	Number	Percent	Number	Percent	Number	Percent	
Male	3.24	60	2.87	53.54	3.06	56.88	4.06
Female	2.16	40	2.49	46.46	2.32	43.12	
Total	5.4	100	5.36	100	5.38	100	

Source: Field Survey, 2018

5.3 Age of the Respondent Farmers by Study Area

Age of respondent onion farmers was calculated from their birth to the time of the interview. Farmers were grouped into three categories according to their ages (Table 5.2). In case of Sadar upazila, it can be seen from the table that only 8 percent farmers belonged to the age group below 30 years, 70 percent farmers were in the age group between 31-59 years and only 22 percent of the farmers were above 59 years of age. In case of Sujanagar upazila, it can be seen from the table that only 6 percent farmers belonged to the age group below 30 years, 74 percent farmers were in the age group between 31-59 years and only 20 percent of the farmers were above 59 years of age. In both Sadar and Sujanagar, the highest number of farmers were in the age group between 31 to 59 years and the lowest number of farmers belonged to the age group of below 30 years (Table 5.2).

Table 5.2: Age of the Respondent Farmers by Study Area

Particulars	**Sadar Upazila**		**Sujanagar Upazila**		**All Farmers**	
	Number	Percent	Number	Percent	Number	Percent
Below 30	4	8	3	6	7	7
31-59	35	70	37	74	79	79
Above 59	11	22	10	20	21	21
Total	50	100	50	100	60	100

Source: Field Survey, 2018

5.4 Educational Status of Farm Families

Education has its own merits and it contributes to economic and social development, as education is the backbone of a nation. It plays a vital role in the acquisition of information about the innovation in various production processes of agriculture. It helps person to make right decision regarding his farm business. It makes a man more capable of managing scarce resource and hence to earn maximum profit (Miah, 1990). The educational status of Sadar upazila and Sujanagar upazila farm family members is given in Figure 5.1.

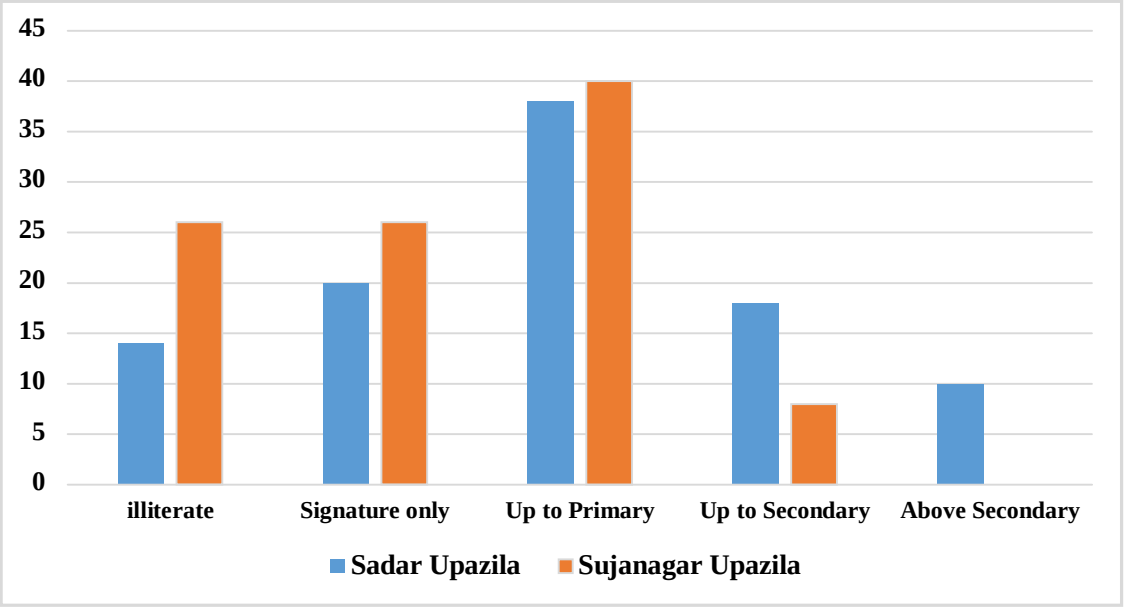

Figure 5.1: Educational Status of the Farm Families
Source: Field Survey, 2018

In case of Sadar families, it can be seen from the figure 5.1, that 14 percent family members were illiterate, 20 percent were capable to sign, 38 percent had primary education, 18 percent had secondary education and 10 percent had higher secondary education and above. In case of Sujanagar families, it can be seen from the above figure that 26 percent family members were illiterate 26 percent were capable to sign, 40 percent had primary education, 8 percent had secondary education and no found had higher secondary education and above.

5.5 Occupational Status of the Sample Farmers Family

The occupation of the study population aged 16 years or more showed that, in Sadar upazila, about 59 percent were engaged in agriculture as a main occupation and about 25 percent were engaged in agriculture as a subsidiary occupation.

On the other hand, Sujanagar, about 68 percent were engaged in agriculture as a main occupation and about 12 percent were engaged in agriculture as a subsidiary occupation (Figure 5.2**)**. Household activities and study are not directly included in Gross Domestic Product (GDP).

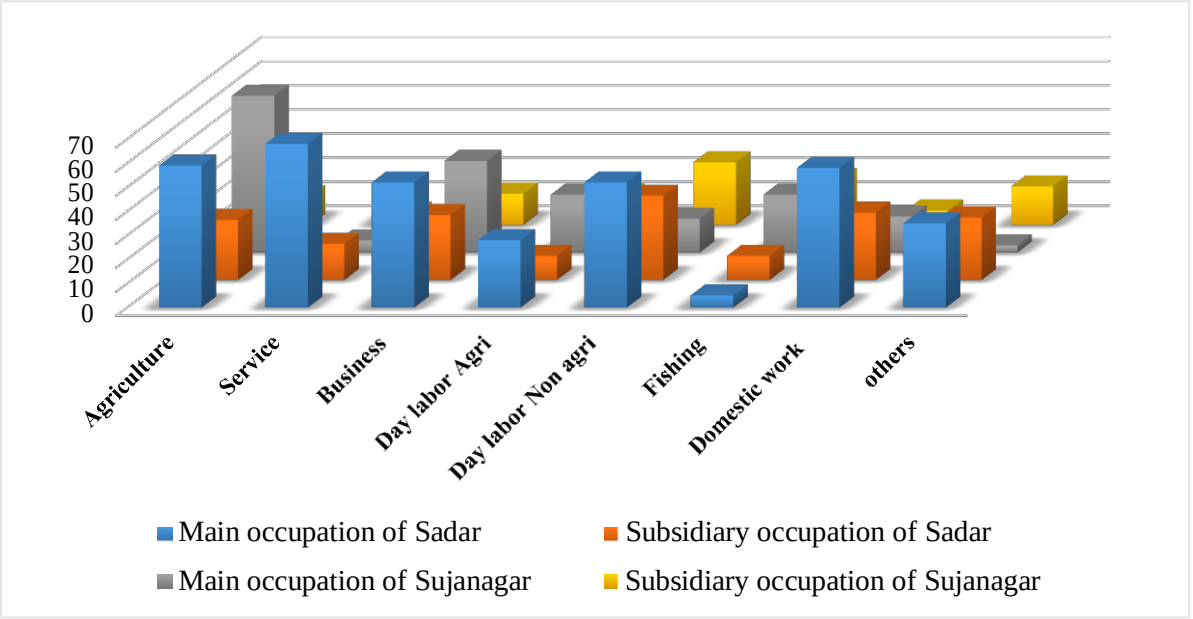

Figure 5.2: Occupation of the Household Members by Occupational Category

Source: Field Survey, 2018

5.6 Agricultural Training

Among the respondent farmers of Sadar upazila, only 34 percent farmers' got training on different agricultural technologies of onion whereas, 66 percent farmers have no idea about training on different agricultural technologies. On the other hand, 50 percent of respondent farmer got training on onion in Sujanagar upazila whereas, (Table 5.3). These training have improved their perceptions of good seed use, use of resistant varieties, application of insecticides and pesticides, water management, and so on.

Table 5.3: Agricultural Training of the Respondent Farmers by area

Training received	Sadar upazila		Sujanagar upazila	
	No.	%	No.	%
Yes	17	34	25	50
No	33	66	25	50
Total	50	100	50	100

Source: Field survey, 2018.

5.7 Membership

Among the respondent farmers, 26 percent onion growers in Sadar upazila were found to have membership in different NGOs and/or farmers' organizations whereas 46 percent of Sujanagar upazila had membership in different NGOs and/or farmers' organizations (Table 5.4).

Table 5.4: Membership of the Respondent Farmers by area

Membership in any organization	Sadar Upazila		Sujanagar Upazila	
	No.	%	No.	%
Yes	13	26	23	46
No	37	76	27	54
Total	50	100	30	100

Source: Field survey, 2018.

5.8 Variety adaptation

Among the respondent of 100 farmers, they adapted local and hybrid both variety. It was found that 58 percent farmers of that sample were adapted local variety and 42 percent of farmer were adapted hybrid variety. Mainly three seed name were found namely king, lal teer 20 and metal under hybrid variety. From those 30 percent of farmers adapted hybrid seed king and rest of the adapted others.

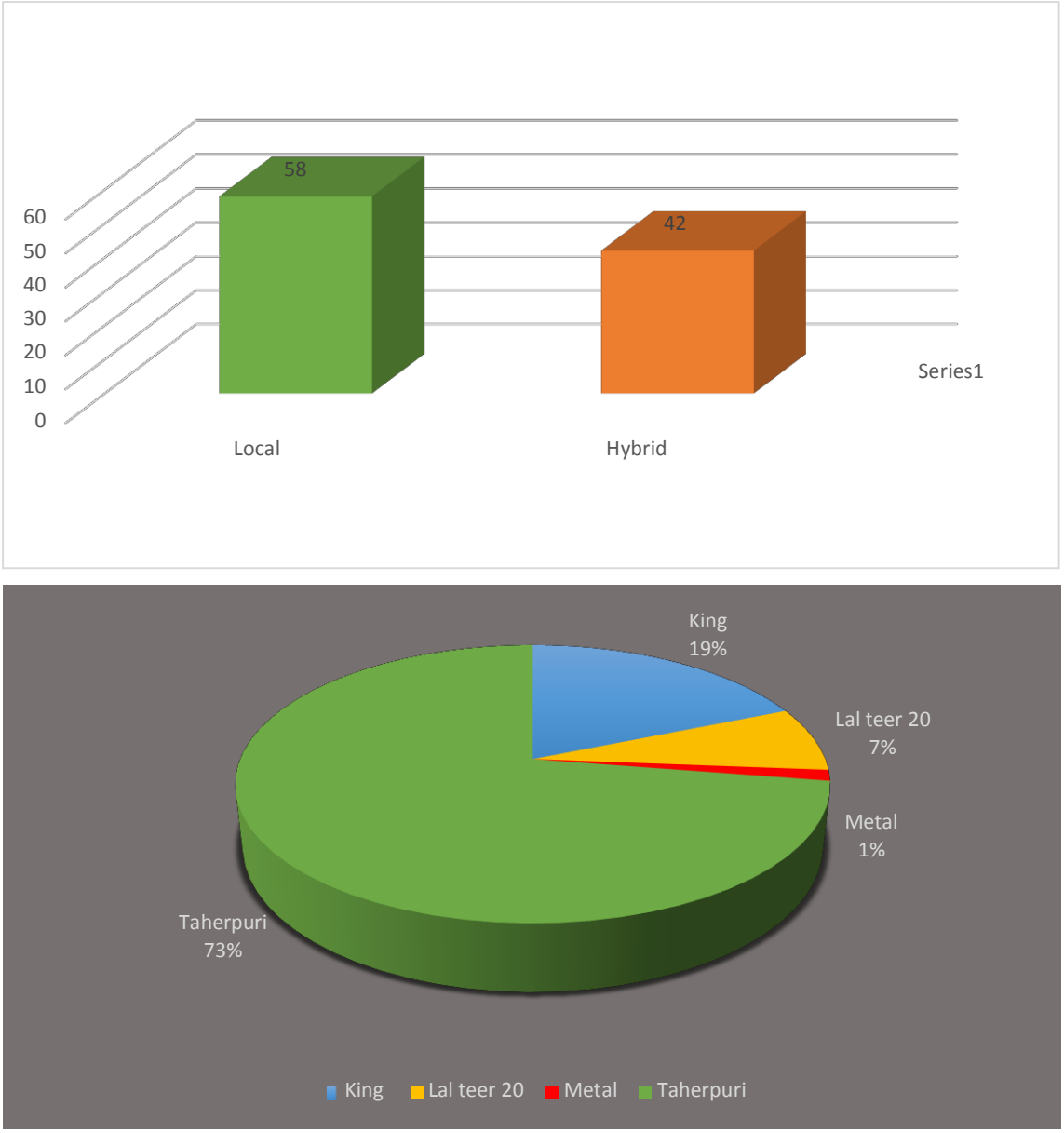

Figure 5.3: Variety adaptation of the Farm Families
Source: Field Survey, 2018

5.9 Concluding Remarks

From the above discussions it is clear that there are some variations in socioeconomic characteristics between the Sadar upazila and Sujanagar upazila onion growers. But the magnitude of the variations was not large. There are substantial indications suggesting that both Sadar upazila and Sujanagar upazila onion growers were progressive.

CHAPTER –6

PROFITABILITY OF ONION PRODUCTION

6.1 Introduction

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

6.2 Profitability of Onion Production

6.2.1 Variable Costs

6.2.1.1 Cost of Land Preparation

Land preparation is the most important components in the production process. Land preparation included ploughing, laddering and other activities needed to make the soil suitable for Onion cultivation. For land preparation in Onion production, no. of tiller was required 3 with Tk. 2573 per tiller. Thus, the average land preparation cost of Onion production was found to be Tk. 7719 per hectare, which was 3.57 percent of total cost (Table 6.1).

6.2.1.2 Cost of Human Labour

Human labour cost is one of the major cost components in the production process. It is one of the most important and largely used inputs for producing Onion. It is generally required for different operations such as land preparation, sowing, weeding, fertilizer and insecticides application, irrigation, harvesting and carrying, threshing, cleaning, drying, storing etc. The quantity of human labour used in Onion production was found to be about 263 man-days per hectare and average price of human labour was Tk. 400 per man-day. Therefore, the total cost of human labour was found to be Tk. 105200 representing 48.62 percent of total cost (Table 6.1).

6.2.1.3 Cost of Seed

Cost of seed varied widely depending on its quality and availability. Per hectare total cost of seed for Onion production were estimated to be Tk. 12740, which constituted 5.89 percent of the total cost (Table 6.1).

6.2.1.4 Cost of Urea

In the study area, farmers used different types of fertilizers. On an average, farmers used urea 259 kg per hectare. Per hectare cost of urea was Tk. 4662, which represents 2.15 percent of the total cost (Table 6.1).

6.2.1.5 Cost of DAP

Among the different kinds of fertilizers used, the rate of application of DAP (258 kg/ha). The average cost of DAP was Tk. 6966 which representing 3.22 percent of the total cost (Table 6.1).

6.2.1.6 Cost of MoP

The application of MoP per hectare (199 kg) was lower to DAP. Per hectare cost of MoP was Tk. 3184, which represents 1.47 percent of the total cost (Table 6.1).

6.2.1.7 Cost of Zinc

The average application of Zinc per hectare was found 5 kg. Per hectare cost of Zinc was Tk. 700, which represents 0.32 percent of the total cost (Table 6.1).

6.2.1.8 Cost of Magnesium

The average application of magnesium per hectare was 4 kg. Per hectare cost of magnesium was found Tk. 156, which represents 0.07 percent of the total cost (Table 6.1).

6.2.1.9 Cost of Insecticides

Farmers used different kinds of insecticides to keep their crop free from pests and diseases. The average cost of insecticides for Onion production was found to be Tk. 17571 per hectare which was 8.12 percent of the total cost (Table 6.1).

Table 6.1: Per Hectare Cost of Onion Production

Items of Cost	**Quantity (Kg/ha)**	**Price Per Unit (Tk.)**	**Costs/Returns (Tk./ha)**	**% of Gross Return**
Main product	13396	28	375088	90.64
By-product	2420	16	38720	9.36
A. Gross Return			**413808**	**100**

Items of Cost	**Quantity (Kg/ha)**	**Price Per Unit (Tk.)**	**Costs/Returns (Tk./ha)**	**% of Total Cost**
Land Preparation			7719	3.57
Seed	7	1820	12740	5.89
Irrigation	3 times	7138	21414	9.90
Human labour	263 man-days	400	105200	48.62
Urea	259	18	4662	2.15
DAP	258	27	6966	3.22
MoP	199	16	3184	1.47
Zinc	5	140	700	0.32
Magnesium	4	39	156	0.07
Insecticides	3 times	5857	17571	8.12
B. Total Variable Cost			**180312**	**83.34**
Land Use Cost			32434.34	14.99
Interest on operating capital @6%			3606.24	1.67
C. Total Fixed Cost			**36040.58**	**16.66**
D. Total Costs (B + C)			**216352.58**	**100**

Source: Field survey, 2018

6.2.1.10 Cost of Irrigation

Cost of irrigation is one of the most important costs for Onion production. Production of Onion largely depends on irrigation. Right doses application of irrigation water help to increase bulb diameter, number of cloves, and number of leaves and plant height. As a result yield per hectare is being increased. The average cost of irrigation was found to be Tk. 21414 per hectare, which represents 9.90 percent of the total cost (Table 6.1).

6.2.1.11 Total Variable Cost

Therefore, from the above different cost items it was clear that the total variable cost of Onion production was estimated Tk. 180312 per hectare, which was 83.34 percent of the total cost (Table 6.1).

6.2.2 Fixed Cost

6.2.2.1 Rental Value of Land

Rental value of land was calculated on the basis of opportunity cost of the use of land per hectare for the cropping period of three months. Cash rental value of land has been used as cost of land use. On the basis of the data collected from the Onion farmers the land use cost was found to be Tk. 32434.34 per hectare, and it was 14.99 percent of the total cost (Table 6.1).

6.2.2.2 Interest on Operating Capital

It may be noted that the interest on operating capital was calculated by taking in to account all the operating costs incurred during the production period of Onion. Interest on operating capital for Onion production was estimated at Tk. 3606.24 per hectare, which represents 1.67 percent of the total cost (Table 6.1).

6.2.3 Total Cost (TC) of Onion Production

Total cost was calculated by adding all the cost of variable and fixed inputs. In the present study per hectare total cost of producing Onion was found to be Tk. 216352.58 (Table 6.1).

6.2.4 Return of Onion Production

6.2.4.1 Gross Return

Return per hectare of Onion cultivation is shown in table 6.2. Per hectare gross return was calculated by multiplying the total amount of product and by product (Onion flower) with respective per unit price. It is evident from table that the average yield of Onion per hectare was 13396 kg and the average price of Onion was Tk. 28 and total price of Onion was calculated Tk. 375088. The total price of Onion by-product was calculated Tk. 38720. Therefore, the gross return calculated by addition of main product and by product was found to be Tk. 413808 per hectare (Table 6.2).

Table 6.2: Per Hectare Cost and Return of Onion Production

Cost Item	**Cost/Returns (Tk/ha)**
A. Gross Return	413808
B. Variable Cost	180312
C. Fixed Cost	36040.58
D. Total costs	216352.58
E. Gross Margin (A-B)	233496
F. Net Return (A-D)	197455.42
G. Undiscounted BCR	**1.91**

Source: Field survey, 2018

6.2.4.2 Gross Margin

Gross margin is the gross return over variable cost. Gross margin was calculated by deducting the total variable cost from the gross return. On the basis of the data, gross margin was found to be Tk. 233496 per hectare (Table 6.2).

6.2.4.3 Net Return

Net return or profit was calculated by deducting the total production cost from the gross return. On the basis of the data the net return was estimated as Tk. 197455.42 per hectare (Table 6.2).

6.2.5 Benefit Cost Ratio (Undiscounted)

Benefit Cost Ratio (BCR) is a relative measure, which is used to compare benefit per unit of cost. Benefit Cost Ratio (BCR) was found to be 1.91 which implies that one taka investment in Onion production generated Tk. 1.91 (Table 6.2). From the above calculation it was found that Onion cultivation is profitable in Bangladesh.

6.3 Concluding Remarks

From the above discussion it is easy to understand about the different cost items and their application doses of farmers, yields and returns per hectare of Onion cultivation. Onion production is a labour intensive enterprise. It is most essential to use modern inputs such as seeds, fertilizers, human labour, power tiller, pesticides and irrigation efficiently. Timely and efficient use of these inputs are the most important to increase production and profitability. On the basis of above discussions it could cautiously be concluded here that cultivation of Onion is a profitable. Cultivation of Onion would help farmers to increase their income earnings.

CHAPTER 7

MAJOR FACTORS AFFECTING AND TECHNICAL EFFICIENCY OF ONION PRODUCTION

7.1 Introduction

The estimation of efficiency with the help of production function has been a popular area of applied econometrics. Technical efficiency reflects the ability of a farmer to obtain the maximum possible output from a given level of inputs and production technology. It is a relative concept, since each farmers production performance is compared to a best-practice input-output relationship or production frontier. A farmer is technically inefficient in the sense that if it fails to produce maximum output from a given level of inputs. Technical inefficiency is then measured as the deviation of a farmer from the best-practice frontier. The main objective of this chapter is to estimate the technical inefficiency as well as frequency distribution of onion farmers through technical efficiency analysis. The technical efficiency in production was estimated by using the stochastic frontier production. The primary advantage of a stochastic frontier production function is that it enables one to estimate U, (non-negative random variable which is under the control of the farmers).

Since the pioneering work on technical efficiency by Farrell in 1957, which drew upon the works of Debreu (1951) and Koopmans (1951), considerable effort has been directed at refining the measurement of technical efficiency. Empirical studies suggest that farmers in developing countries fail to exploit the potential of technology perhaps due to inefficient decision making due to various reasons of which management capacity is important one.

7.2 Interpretation of ML Estimates of the Stochastic Frontier Production Function:

Maximum likelihood estimation begins with writing a mathematical expression known as the Likelihood Function of the sample data. The likelihood of a set of data is the probability of obtaining that particular set of data, given the chosen probability distribution model. This expression contains the unknown model parameters. The values of these parameters that maximize the sample likelihood are known as the Maximum Likelihood Estimates or MLE's.

The maximum likelihood estimates for parameters of the Cobb-Douglas stochastic frontier production function and technical inefficiency effect model for onion production for all farmers are presented in Table 7.1.

Table 7.1: ML Estimates for Parameters of Cobb-Douglas Stochastic Frontier Production Function and Technical Inefficiency Model for onion Farmers.

Variables	Parameter	Coefficients	T-ratio
Stochastic Frontier:			
Constant (X_0)	β_0	4.5797**	2.6081
Human Labour (X_1)	β_1	0.2990**	2.2122
Seed (X_2)	β_2	0.2769*	1.7076
Urea (X_3)	β_3	0.1138***	3.2186
TSP (X_4)	β_4	0.0009	0.2549
MoP (X_5)	β_5	0.0010	0.2270
DAP (X_6)	B_6	0.0066	1.2649
Zinc (X_7)	B_7	0.0043*	1.6815
Magnesium (X_8)	B_8	-0.0021	-0.8548
Irrigation (X_9)	B_9	-0.0264	-0.3448
Insecticide (X_{10})	B_{10}	0.0697	1.5203
Inefficiency Model			
Constant	δ_0	0.6869***	8.0496
Years of Education (Z_1)	δ_1	-0.0091	-1.0368
Family Size (Z_2)	δ_2	0.0040	0.5755
Credit S e r v i c e (Z_3)	δ_3	-0.0087	-0.3320
Experience (Z_4)	δ_4	-0.0136***	-6.6531
Member of Social Organization (Z_5)	δ_5	-0.0293	-0.9302
Training (Z_6)	δ_6	-0.0635*	-1.8498
Log-likelihood Function		87.32	

Note: *, ** and * indicates significant at 1, 5 and 10 percent level respectively**.

Source: Field survey, 2018.

Human Labour (X_1)

The regression coefficient of Human Labour (X_1) was positive and significant at 5 percent level of significance. The regression coefficient of Human Labour (X1) was 0.2990, which implied that other factors remaining the same if expenditure on human labour was increased by 1 percent then the yield of onion would be increased by 0.2990 Percent (Table 7.1).

Seed (X_2)

The regression coefficients of Seed (X_2) was positive and significant at 10 percent level of significance. The regression coefficient of Seed (X_2) was 0.2769, which implied that other factors remaining the same if amount of seed was increased by 1 percent then the yield of onion would be increased by 0.2769 Percent (Table 7.1).

Urea (X_3)

The regression coefficient of Urea (X_3) was positive and significant at 1 percent level of significance. The regression coefficient of urea ($X_{3)}$ was 0.1138. The result indicated that if amount of Urea was increased by 1 percent then the yield of onion would be increased by 0.1138 percent, other factors remaining constant (Table 7.1).

TSP (X_4)

The regression coefficient of TSP (X_4) was positive and the value of regression coefficient was 0.0009, which was not significant. Therefore, TSP had no statistically significant effect on onion cultivation (Table 7.1).

MoP (X_5)

The regression coefficient of MoP (X_5) was positive and the value of regression coefficient was 0.0010, which was not significant. Therefore, MoP had no statistically significant effect on onion cultivation (Table 7.1).

DAP (X_6)

The regression coefficient of DAP (X_6) was positive and the value of regression coefficient was 0.0066, which was not significant. Therefore, DAP had no statistically significant effect on onion cultivation (Table 7.1).

Zinc (X_7)

The regression coefficient of Zinc (X_7) was positive and significant at 10 percent level of significance. The regression coefficient of Zinc (X_7) was 0.0043. The result indicated that if the amount of Zinc was increased by 1 percent then the yield of onion would be increased by 0.0043 percent, other factors remaining constant (Table 7.1).

Magnesium (X_8)

The regression coefficient of Magnesium (X_8) was negative and the value of regression coefficient was -0.0021, which was not significant. Therefore, Magnesium had no statistically significant effect on onion cultivation (Table 7.1).

Irrigation (X_9)

The regression coefficient of Irrigation (X_9) was negative and the value of regression coefficient was -0.0264, which was not significant. Therefore, Irrigation had no statistically significant effect on onion cultivation (Table 7.1).

Insecticide (X_{10})

The regression coefficient of Insecticide (X_{10}) of onion production was positive and the value of regression coefficient was 0.0697, which was not significant. Therefore, Insecticide had no statistically significant effect on onion cultivation (Table 7.1).

7.3 Interpretation of Technical Inefficiency Model

In the technical inefficiency effect model years of education, credit service, experience, member of social organization and training have expected (negative) coefficients. The negative coefficient of experience implies that experienced farmers are technically more efficient than non-experienced farmers and negative coefficient of experience is significant at 1 percent level of significance. (Table 7.1)

The negative coefficient of years of education postulates that educated farmers are technically more efficient than uneducated. Although this coefficient is not statistically significant. (Table 7.1)

The negative coefficient of credit service postulates that farmers taking loan for producing onion are technically more efficient than others. Although this coefficient is not statistically significant (Table 7.1).

The negative coefficient membership of social organization postulates that farmer's social membership for producing onion are technically more efficient than others. Although this coefficient is not statistically significant (Table 7.1).

The negative coefficient of training postulates that trained farmer are more efficient than others and negative coefficient of training is significant at 10 percent level of significance (Table 7.1).

The coefficient of family size is positive meaning that these factors have no impact on the technical inefficiency. That is, this factor do not reduce or increase technical inefficiency of producing onion (Table 7.1).

Table 7.2: Frequency Distribution of Technical Efficiency of Onion Farms

Efficiency (%)	No. of farms	Percentage of farms
0-60	6	6.00
61-70	27	27.00
71-80	29	29.00
81-90	25	25.00
91-100	13	13.00
Total number of farms	100	100
Minimum	0.45	
Maximum	0.97	
Mean	0.77	
Standard Deviation	11.11	

7.4 Technical Efficiency and Its Distribution

Table 7.2 shows frequency distribution of farm-specific technical efficiency for onion farmers. It reveals that average estimated technical efficiencies for onion are 77 percent which indicate that onion production could be increased by 23 percent with the same level of inputs without incurring any further cost. Increase of only managerial skills result a substantial increase of output for onion. It was observed that about 56 percent of sample farmers were found to have received outputs which were very close to the maximum frontier outputs maintaining the efficiency level. On the other hand, 38 percent of sample farmers obtained up to 80 percent technical efficiency level. The minimum and maximum technical efficiencies were observed to be 45 and 97 percent respectively, where standard deviation was maintained at 11.11.

CHAPTER 8

PROBLEMS AND CONSTRAINTS TO ONION PRODUCTION

8.1 Introduction

The focus of this chapter is to identify the extent of problems encountered by the Onion farmers. Farmers faced a lot of problems in producing Onion. The problems were social and cultural, financial and technical. This chapter aims at represent some socioeconomic problems and constraints to producing Onion. The problems and constraints faced by the farmers were identified according to opinions given by them. The major problems and constraints related to Onion cultivation are discussed below:

8.2 Poor Storage Facilities in House

Usually most of the fanners used to store their Onion in their house. Lack of trained manpower was a great deal of spoilage of Onion in the harvest and the post-harvest period. For this, they had to face some losses like losing weight and rotten of Onion. It appears from Table 8.1 that only 90 percent of sample farmers faced the problem of poor storage facilities highly.

8.3 Low Price of Output

Most of the farmers had to sell a large portion of their product at the harvesting period to meet various obligations like, household's expenditure and repayment of loan. But harvest time price of Onion remained low because of ample supply. So they could not get reasonable return for their products. It can be seen from Table 8.1 that 88 percent Onion growers reported this as high problem.

8.4 Lack of Operating Capital

The farmers of the study area had capital constraints. For cultivation of Onion, a huge amount of cash money was needed to purchase various inputs like, human labour, seed, fertilizers, pesticides, etc. About 85 percent Onion farmers reported that they did not have sufficient amount of money for purchasing the required quantity of inputs for the relevant enterprises and marked this as high problem. (Table 8.1).

8.5 High Cost of Irrigation Water

Irrigation is the leading input for crop production. Yield of Onion varies with the application of irrigation water. Most of the farmers had no shallow tube well or deep tube well of their own in the study areas and for this they had to pay a higher amount of money to the water supplier. But farmers reported that they had to pay higher charge for irrigation water. Table 8.1 shows that about 75 percent Onion growers reported this as high problem. (Table 8.1).

8.6 High Price of Quality Seed

High price of quality seed was also one of the most important limitations of producing Onion in the study area. From Table 8.1 it is evident that about 70 percent Onion growers reported this as high problem.

8.7 Shortage of Human labour

Most of the human labour is being used during seed/seedling plantation and harvesting period of Onion. Onion are labour intensive spices. Non-availability of human labour was found in different stages of production such as planting, intercultural operations and harvesting. Table 8.1 shows that near 70 percent of Onion growers reported this as high problem.

8.8 Attack of Pest and Disease

The growers of Onion were also affected by the problem of attack of pests and diseases. Pests and diseases attack reduce crop yield and increase cost of production. About 66 percent Onion growers reported this as high problem (Table 8.1).

8.9 Lack of Quality Seed

Lack of quality seed was one of the most important limitations of producing Onion in the study area. From Table 8.1 it is evident that about 59 percent Onion growers reported this as high problem. Farmers in both upazilas told that they were cheated by buying so called hybrid seeds from the local markets and from the seed dealers.

8.10 Lack of Scientific Knowledge of Farming

Although modern agricultural technologies have been using in the study area, a large number of farmers have no adequate knowledge of right doses and methods of using modern inputs and technologies of producing their enterprises. Near 55 percent Onion growers were encountered this problem. (Table 8.1).

8.11 High Price of Fertilizers

Farmers claimed that non-availability of fertilizers at fair price was a problem in the way of producing enterprise. It appears from the table 8.1 that about 52 percent Onion growers reported this as high problem.

8.12 Inadequate Extension Service

During the investigation some farmers complained that they did not get any extension services regarding improved method of Onion cultivation from the relevant officials of the Department of Agricultural Extension (DAE). As an agricultural extension personnel block supervisor, the main advisor of technical knowledge to the farmers about their farming problems. About 45 percent Onion growers reported this as high problem (Table 8.1). Farmers of both areas marked that they hardly ever got help from the block supervisor and Agricultural Extension Officer.

8.13 Natural Calamities

It was found that Onion growers faced some acute problems relating to the nature in their production process. Natural calamities like drought, hailstorm, excessive rainfall, caused substantial damage to the crop in the field. Farmers said that excessive rainfall during the harvesting period reduces both the quantity and storability of Onion. Table 8.1 shows that almost 40 percent Onion growers in reported this as high problem.

8.14 Adulteration of Fertilizer, Insecticide, and Pesticide

Chemical fertilizers, insecticides and pesticides are the most important inputs of Onion production. They were being intensively used in Onion production in the study area. Many farmers reported to have been cheated by applying adulterate fertilizers and pesticides in their crop field. It can be seen from Table 8.1 that near 24 percent Onion growers faced this problem highly.

Table 8.1: Problems and Constraints of Onion Production by no. of Farmers

Type of Problems	No. of farmers	Percentage of farmers	Rank
Poor storage facilities in house	90	90	1
Low price of output	88	88	2
Lack of operating capital	85	85	3
High cost of irrigation water	75	75	4
High price of quality seed	70	70	5
Shortage of human labour	70	70	6
Attack of pest and disease	66	66	7
Lack of quality seed	59	59	8
Lack of scientific knowledge of farming	55	55	9
High price of fertilizers	52	52	10
Inadequate extension service	45	45	11
Natural calamities	40	40	12
Adulteration of fertilizer, insecticide, and pesticide	24	24	13
Lack of quality tillage	15	15	14

Source: Field survey, 2018

8.15 Lack of Quality Tillage

Deeply ploughing is essential for successful crop production. Most of the farmers, who use hired power tiller, reported that hired power tiller owners did not till deeply. Never the less, they did not use all the tines when they till others land. Table 8.1 shows that 15 percent Onion growers reported this as high problem.

8.16 Concluding Remarks

The above-mentioned discussions as well as the results presented in Table 8.1 indicates that Onion growers in the study area have currently been facing some major problems in conducting their Onion farming. These are the major constraints for the producers of Onion in the study area. Public and private initiatives should be taken to reduce or eliminate these problems for the sake of better production of Onion.

CHAPTER-9

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

9.1 Summary

Onion is one of the most important spices and commercial crops of Bangladesh; it is a crop of tropical and sub-tropical regions and requires a warm humid climate. Number of varieties of Onion are grown, which can be used as vegetable, condiments and pickles. Onion occupies an important place in Bangladeshi diet and it is an indispensable item in the kitchen, as it is consumed daily as a condiment in one or other form. Onion is rich in vitamin A and C and has many medicinal properties. Bangladesh leads in the context of maximum area covered under Onion cultivation.

In Bangladesh, Onion are grown in almost all districts of the country and the major growing district in terms of production is Pabna. The total area under spices is 92769 hectares in the Pabna district with a production of 632031 metric tons. Onion is the important vegetable, spice crop of the Pabna district with area and production of 42474.18 hectares and 446410 metric tons respectively and productivity was 10.51 metric tons (Onion) per hectare during 2018-19.

Onion are grown all over Bangladesh, not only for a huge home market but also for export purposes. Production of Onion plays an important role in improving the economic conditions of farmer's specially marginal and small farmers and meeting the nutritional requirements of the people of Bangladesh. The present study will give the answers of some of the important questions regarding the aspects like growth of this crop, cost of cultivation, returns from this crop and constraints to its production and marketing. Therefore, a systematic research work was required to carry out for this crop in order to make available complete information to the farmers who want to grow this crop.

The sampling frame for the present study were selected purposively as to select the area where the Onion cultivation was intensive. On the basis of higher concentration of Onion crop production some selected village under two upzilas namely Sadar and Sujanagar in Pabna was selected. A sample size of 100 is generally regarded as the minimum requirement for larger population that will yield a sufficient level of certainty for decision-making (Poate and Daplyn, 1993).

In this case, who were cultivating different varieties of Onion in the selected areas were selected as samples. Farmers generally plant Onion from mid- December to January and harvest after three months. Data for the present study have collected during the period of December 2018 to January 2019. Primary data were collected from primary producers. Selected respondents were interviewed personally with the help of pre-tested questionnaires. The collected data were checked and verified for the sake of consistency and completeness. Editing and coding were done before putting the data in computer. All the collected data were summarized and scrutinized carefully to eliminate all possible errors. Data entry was made in computer and analysis was done using the concerned software Microsoft Excel and Frontier 4.1.

Economic profitability is a major criterion to make decision for producing any crop at farm level. It can be measured based on net return, gross margin and ratio of return to total cost. The average land preparation cost of Onion production was found to be Tk. 7719 per hectare. The quantity of human labor was found to be about 263 (43 family labour and 220 hired labour) used in per hectare Onion production and average price of human labor was Tk. 400 per man-day. Therefore, the total cost of human labour was found to be Tk. 105200 representing 48.62 percent of total cost. Per hectare total cost of seed for Onion production was estimated to be Tk. 12740. On average, farmers used Urea, DAP, MoP, Zinc and Magnesium was 259 Kg, 258 kg, 199 kg, 5 kg and 4 kg respectively, per hectare. The average cost of insecticides for Onion production was found to be Tk. 17571. Whereas the average cost of irrigation was found to be Tk. 21414 per hectare. The total variable cost of Onion production was Tk. 180312 per hectare, which was 83.34 percent of the total cost.

The average yield of Onion per hectare was 13396 kg and total price of Onion was calculated Tk. 375088 at Tk. 28 per kg. The total price of Onion by-product was calculated Tk. 38720. The gross return of onion production was found Tk. 413808. The gross margin and net return were found to be Tk. 233496 and Tk. 197455.42 per hectare. Benefit Cost Ratio (BCR) was found to be 1.91 which implies that one-taka investment in Onion production generated Tk. 1.91.

Technical efficiency reflects the ability of a farmer to obtain the maximum possible output from a given level of inputs and production technology. Technical efficiency is then measured as the deviation of a farmer from the best-practice frontier. The regression coefficients of Human labour (X_1), Seed (X_2), Urea (X_3). TSP (X_4), MoP (X_5), DAP (X_6), Zinc (X_7), and Irrigation (X_{10}) were positive but the coefficient of Magnesium (X_8) and Irrigation (X_9) was found negative. It indicates that if Human labour (X_1), Urea (X_3) and Zinc (X_7) were increased by one percent, the production of Onion would be increased by 0.2990, 0.1138, 0.0043, percent of sample farmers respectively.

In the technical inefficiency effect model years of education, credit service, experience, member of social organization and training have expected (negative) coefficients. The negative coefficient of experience implies that experienced farmers are technically more efficient than non-experienced farmers. The negative coefficient of education postulates that farmers having educated farmers are technically more efficient than uneducated. The negative coefficient of credit service postulates that farmers taking loan for producing onion are technically more efficient than others. The negative coefficient membership of social organization postulates that farmer's social membership for producing onion are technically more efficient than others. The negative coefficient of training postulates that trained farmer are more efficient than others. The coefficients of family size is positive meaning that these factors have no impact on the technical inefficiency.

Average estimated technical efficiencies for Onion are 77 percent which indicate that Onion production could be increased by 23 percent with the same level of inputs without incurring any further cost. Increase of only managerial skills result in a substantial increase of output for Onion.

Farmers faced a lot of problems in producing Onion. The problems were social and cultural, financial and technical. Lack of quality seed was one of the most important limitations of producing Onion in the study area.

Storage, lack of operating capital, high price of quality seed, high cost of irrigation water, shortage of human labour and lack of quality tillage, high input cost but lower output cost were the major problems faced by farmers.

These are the major constraints for the producers of Onion in the study area. Public and private initiatives should be taken to reduce or eliminate these problems for the sake of better production of Onion.

9.2 Conclusion

Onion is one of the important cereal crops grown by farmers mainly for market purpose. The study areas have tremendous potential for Onion cultivation. The findings of the present study indicate that Onion production is highly profitable and it would help to improve the socioeconomic condition of sample farmers in the study areas. As Onion is a labour intensive crop, it would help to create employment opportunities. In Bangladesh, it is difficult to increase Onion production by increasing the area of land under cultivation due to the limitation of land. But, there is an opportunity to increase production of Onion by improving the existing production technology. Farmers are relatively inefficient due to land fragmentation, less experience, illiteracy, etc. The present study indicate that farmers are technically efficient that means there is an opportunity to increase production to a large extent using the existing level of agricultural inputs, the agricultural extension services and the available technology.

If the modern inputs could be made available to the farmers in time, production of this crop might be increased which could help them in alleviating rural poverty in many areas. Onion are only produced in winter season. But now the BARI and SRC introduced some hybrid verities of Onion. However, farmers in the study areas, to some extent have started to produce summer Onion. Farmers were not known about the application of inputs in right time with right dose. Thus, well-planned management training in accordance with their problems, needs, goals and resources base may lead to viable production practices and sustainable income from Onion cultivation.

9.3 Suggestion

On the basis of the finding of the study it was evident that Onion was profitable enterprises and it can generate income earnings and employment opportunity to the rural people of Bangladesh.

But some problems and constraints bared to attain the above mentioned objectives. The policy makers should, therefore, take necessary measures. According to the findings of the study; some policy recommendations may be advanced which are likely to be useful for policy formulation. The following specific recommendation may be made for the development of Onion sector.

As most of the Onion farmers are technically efficient at present production technology, improved method of production technology with sufficient storage ability should be introduced.

- As Onion is a profitable enterprise, government and concern institutions should provide adequate extension programmed to expand its area and production.
- Onion based cropping pattern should be developed and disseminated to those areas of Bangladesh where their production is suitable.
- Government should take necessary measures to lower the price of inputs which have positive significant impact on yield. It will increase the net benefit of Onion producers.
- Adequate training on recommended fertilizer doses, insecticides, use of good seed, intercultural operations, etc., should be provided to the Onion farmers which will enhance production as well as technical efficiency by improving the technical knowledge of the farmers.
- Onion farmers had to sell their product at low price during harvesting or just after harvest. An appropriate storage scheme should be developed so that the farmers are not forced to sell their product at low price during the harvest period.

9.4 Limitations of the Study

There are some limitations of the study thus are indicated below.

a. Most of the data were collected through interview of the farmers and sometimes they did not well-cooperate with the interviewer.
b. The information were gathered mostly through the memories of the farmers which were not always correct.
c. Due to resource and time constraints, broad based and in-depth study was hampered to some extent.

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