



## Comparison of food security among watermelon and rice production farmers in Bhola district

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### ABSTRACT

This study was carried out to make a comparison between watermelon and rice production on food security of farmers from Tajumoddin and Charfasson upazilas of Bhola district considering the objectives-to identify food Security status of watermelon and rice farmers, to determine the role of watermelon and rice production on food security of the farmers and to determine the major problems associated with watermelon and rice cultivation. The data was collected between July to September, 2018 from 60 farmers who were selected using stratified random sampling method. In total 60 farmers, at the rate of 15 farmers from Kazikandi, 15 farmers from Sayesthakandi, 15 farmers from Badurah and 15 farmers from Hindupara were randomly selected. Here, 30 farmers were watermelon producers and 30 farmers were rice producers. To collect data, a questionnaire was administered through face-to-face interviews. The collected data were manually edited and coded. Then all collected data were summarized and scrutinized carefully. Data entry was made in computer and analyses were done using the concerned software Microsoft Excel and Statistical Package for Social Science (SPSS). The result of the study revealed that the average total income of watermelon and rice farmers were Tk. 2,84147.00 and Tk. 1,75400.00, in Tajumoddin and Tk. 2,79519.00 and Tk. 2,27790.00 in Charfasson and annual expenditure were Tk. 219733.00 and Tk. 160213.00 in Tajumoddin where Tk. 210616.00 and Tk. 162280.00 in Charfasson, respectively. The results of profitability analysis of the watermelon and rice cultivation clearly indicated that watermelon production was profitable. Watermelon farmers obtained higher profit than rice farmers in both upazilas. The results of the study revealed that the watermelon farmers in Tajumoddin and Charfasson upazilas are more food secured than rice farmers. It was checked by using recommended minimum calorie requirement (i.e. 2122 kcal). The average per capita calorie intake of watermelon farmers and rice farmers were 2423.18kcal and 2311.07 kcal in Tajumoddin, where 2394.61 kcal and 2338.12 kcal in Charfasson, respectively. Economic, Social, natural, technical and marketing problems.

### INTRODUCTION

In Bangladesh, a good number of fruits are grown throughout the year both in winter and summer seasons. In view of increase in income, population and nutritional consideration, there is a great need for fruits cultivation. In many countries, where adverse weather condition prevails fruits are grown under artificially controlled environment,

which is costly whereas the weather, climate and soil of Bangladesh are very much suitable for growing of fruits round the year.

Watermelon (*Citrullus lanatus*) is a native of tropical Africa, where it has long been used by the wild tribes. It came to India by the fourth century AD. The sweet juicy pulp of the ripe fruit is eaten fresh. Watermelon is valuable alternative to

drinking water in desert areas. The dried parched seeds are chewed, particularly in Southern China. Watermelon is made up of almost 95 percent water. The remaining 5 percent comprises fiber, proteins, fat and minerals. The fruit has juicy, pink, red or yellow flesh with numerous small black seeds. Watermelon is grown largely in China, Turkey, India and Iran in Asia. Bangladesh is also watermelon growers. It is a fast-growing cash crop for poor and marginal farmers with little acreage of their own. Watermelon cultivation is an aristocratic and traditional culture. The direction of the watermelon cultivation is downward in spite of the sufficient possibilities for the development of the watermelon cultivation in the country. In 2016-2017, watermelon cultivations were used 9198 acres land and productions were 54827 MT in Bhola district (BBS, 2017). The future of the watermelon cultivation in our country is totally dependent upon the coordinated efforts of the government, non-government organizations and the watermelon cultivators.

There are many opportunities for employment in watermelon and rice cultivars and most people make a living from growing crops, raising cattle, harvesting fish and day laborer work. Watermelon and rice cultivars have significant roles for the agricultural productive activities but they are backward from modern technology and suffer from lack of capital. Sometimes they take loan from the international and national organization; NGOs and banks to fulfill the requirement of credit. Agricultural credit is important to watermelon and rice cultivars in achieving the food security. Institutional credit and various training are important for the improvement of the watermelon cultivars food security.

To assess the food security status, one needs to look into the matter of how watermelon and rice cultivars households generate and maintain their livelihoods. If one wants to understand livelihood closely people's perspective, then he has to know dynamics of the rural livelihood system and the strategies that have been developed overtime. There will be different types of livelihood strategies in different situations. People develop their livelihood strategies according to the situation they encounter. They use their assets, such as livestock or savings, and they use social

capital, i.e. their kinship and social relations, to handle or overcome critical situations. Role of watermelon and rice production on food security helps for achieving the food security of the farmers but there are some problems associated with watermelon cultivation which is faced by the farmers. Hence, the researcher tried to find out answers of the following research questions.

- What is the food security status of watermelon farmers and Rice farmers?
- What is the role of watermelon production and rice production on food security of the farmers?
- What is the major problem associated with watermelon cultivation and rice cultivation?

To address these questions the study was undertaken with the aims to identify the food security status of farmers producing watermelon and rice. To determine the role of watermelon production and rice production on food security of the farmers and to determine the major problems associated with watermelon cultivation and rice cultivation.

## METHODOLOGY

### Selection of the study area

The study was conducted in Tajumoddin and Charfasson upazilas in Bhola district. Main crops of the study area are paddy, wheat, potato, pulse, mustard, sugarcane, and ground nut. Extinct or nearly extinct crops local varieties of paddy, vegetables. Main fruits mango, jackfruit, litchi, banana, papaya, olive, coconut, shaddock, betel nut, watermelon.

### Selection of sample and sampling technique

A simple stratified random sampling technique was followed in the present study for minimizing cost, time and to achieve the ultimate objectives of the study. In total 50 farmers (15 from Kazikandi and 15 from Sayestakandi, 10 from Badura and 10 from Hindupara) were randomly selected to achieve the ultimate objectives of the study. Of them 30 farmers were watermelon producer and 20 farmers were rice producer.

### Preparation of the survey schedule

A preliminary interview schedule was developed, pre-tested on few respondents. Then some parts of interview schedule were improved, rearranged and modified in the light of the experience gained from the field. Finally, the final interview schedule was prepared to solicit information. The questions were properly structured so that even the most reluctant informant could have no hesitation in passing on the necessary information. The final schedule included the identification, family size, diet composition, cost and return of watermelon and rice production, problems and constraints in farming of the respondent farmers.

### Data collection and analysis

The present study covered the whole summer seasons. However, formal data were collected during the period from July to September, 2018. Data were collected from the selected farmers through face to face interview. Before taking actual interviews the main purpose of the study was clearly explained to the sample farmers. Initially, the farmers hesitated to answer the question; but when they were assured that the study was purely an academic one and it would not affect them adversely then they were cooperative with the researcher. At the time of interview, the researcher asked questions systematically and explained the questions whenever it was felt necessary. Farmers were requested to provide correct information as far as possible. After each interview was over, the interview schedule was checked so as to ensure that information to each of the items had properly been recorded. If there were such items, which were overlooked or contradictory, were corrected by another interview. In order to minimize the errors, data were collected in local unit, but later those were converted into standard international units.

The collected data were manually edited and coded. Then all collected data were summarized and scrutinized carefully. Data entry was made in computer and analyses were done using the concerned software Microsoft Excel and Statistical Package for Social Science (SPSS).

### Determination of household level food security

In order to measure food security, a household food security index was constructed by defining a minimum level of nutrition necessary to maintain a healthy living. It also indicates the „ food security line“ for the population under study (Omotesho et al., 2006).

Any household above this line was classified as food-secure. The food security line used in this study was measured using average recommended level of calorie intake of 2122 kcal as the desirable and cut off point. The calorie content of both the produced and purchased food items were used to estimate the dietary energy availability in the household. The food security index was calculated using the following formula. Food security Index (Ko) = X/Z

Where,

X = Household daily per capita calorie intake

Z = Household daily per capita calorie (Z) required

Thus, for a household to be food-secure Ko must be greater than or equal to one ( $Ko \geq 1$ ) otherwise, the household is considered food-insecure.

### Profitability of watermelon and rice production

In this study, costs and returns analysis were done total cost basis. The following profit equation was developed to measure the profitability of the respondent.

$$= (P_{mi} \cdot Q_{mi} + P_{bi} \cdot Q_{bi}) - TC$$

Where,

= Profit per hectare per year;  $P_{mi}$  = Per unit price of output (Tk. /unit);  $Q_{mi}$  = Quantity of output (kg);

$P_{bi}$  = Per unit price of by product (Tk. / unit);  $Q_{bi}$  = Quantity of by product (kg);  $i = 1, 2, 3$  -n crops grown in study area; TC = Total cost.

### Major cost items

The input items were valued at the existing market price in the area during survey period or the prices at which the farmers really bought the inputs. Human labor, Power tiller; Seeds; Fertilizer, Manures, Pesticides, Irrigation water, Fencing items and Interest on operating capital and land use cost were estimated.

## RESULTS

### Socioeconomic characteristics of the farmers

#### Age distribution

From the study it was seen that in Tajumoddin upazila about 66.67% and 26.27% of the selected farmers were in the age group of 18-35 years; 13.33 and 20% were in 36-45 years; 20% and 53.33% were above 45 years, for watermelon farmers and rice farmers, respectively (Table 1). On the other hand in Charfasson upazila about 46.67% and 26.67% were in 18- 35 years; 40% and 6.67% were in 36-45 years, 13.33% and 66.67% were in above 45 for watermelon and rice farmers, respectively (Table 1).

#### Educational Status

In Tajumoddin upazila about 13.33% and 66.67% farmers were illiterate, 53.33% and 13.33% of farmers were belong to can sign only, 33.33% and 20% of the selected farmers were educated primary to above for watermelon and rice farmers, respectively. On the other hand in Charfasson upazila about 6.67% and 26.67% farmers were illiterate, 60% and 66.66% farmer were can sign only and about 33.33% and 6.67% farmers were primary to above stage in watermelon and rice farmers, respectively (Table 2).

**Table 1:** Age distribution, Literacy level, Family size and Farmer's categories of watermelon and rice farmers from Tajumoddin & Charfasson upazilas (N=60).

Age group (Years)	Tajumoddin upazila				Charfasson upazila			
	Watermelon farmers		Rice farmers		Watermelon farmers		Rice farmers	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
18-35 Years	10	66.67	4	26.67	7	46.67	4	26.67
36-45 Years	2	13.33	3	20	6	40	1	6.66
Above 45 Years	3	20	8	53.33	2	13.33	10	66.67
<b>Total</b>	15	100	15	100	15	100	15	100
<b>Literacy level</b>								
Illiterate	2	13.33	6	66.67	1	6.67	4	26.67
Can Sign Only	8	53.33	7	13.33	9	60	10	66.66
Primary To Above	5	33.34	2	20	5	33.33	1	6.67
<b>Total</b>	15	100	15	100	15	100	15	100
<b>Family size</b>								
1-4 Members	8	53.33	3	20	6	40	4	26.67
5-7 Members	5	33.33	7	46.67	6	40	9	60
Above 7 Members	2	13.34	5	33.33	3	20	2	13.33
<b>Total</b>	15	100	15	100	15	100	15	100
Average Family Size	5		5		5		5	
<b>Land use pattern (Small farmer: 0.20-1.01 ha, Medium farmer: 1.02-3.03 ha and Large farmer: &gt;3.03 ha)</b>								
Small Farmers	13	86.67	14	93.33	13	86.67	13	86.67
Medium Farmers	1	6.66	1	6.67	2	13.33	2	13.33
Large Farmers	1	6.67	0		0	0	0	0
<b>Total</b>	15	100	15	100	15	100	15	100

#### Family size

A family size has been defined as the total number of persons of either sex living together and taking

meals from the same kitchen under the administration of a single head of the family. Family size was found to be varied in the study area with total number of members within a

household as low as 3 persons to as high as 10 persons. The observed average family size of watermelon and rice farmers in Tajumoddin upazila was 5 and in Charfasson upazila the observed average family size was 5 for both watermelon and rice farmers, respectively.

### Land use pattern

In Tajumoddin upazila 86.67% and 93.33% small farmer, 6.66% and 6.67% medium farmers and 6.67% and 0% were large farmers for watermelon and rice farmers, respectively. In Charfasson upazila 86.67% and 86.67% small farmers,

13.33% and 13.33% medium farmers and 0% and 0% were large farmers for watermelon and rice farmers, respectively (Table 1).

In Tajumoddin upazila the households under watermelon farmers and rice farmers had an average farm size of 0.73 and 0.66 ha, respectively. Whereas in Charfasson upazila households under watermelon farmers and rice farmers had an average farm size of 0.51 and 0.71 ha, respectively (Table 2). Farm size was measured using the following formula: Farm size = Homestead area + Own cultivable land + Cultivable land leased in + Area under pond.

**Table 2:** Land ownership pattern of watermelon and rice farmers from Tajumoddin & Charfasson upazilas (ha)

Categories	Tajumoddin upazila				Charfasson upazila			
	Watermelon farmers		Rice farmers		Watermelon farmers		Rice farmers	
	Area(ha)	(%)	Area(ha)	(%)	Area(ha)	(%)	Area(ha)	(%)
Homestead Area	0.24	32.66	0.14	20.76	0.11	22.02	0.18	25.14
Own Cultivable Land	0.32	43.60	0.41	62.27	0.21	41.28	0.42	60.15
Cultivable Land Leased In	0.10	13.99	0.04	6.05	0.12	23.77	0.05	6.87
Area Under Pond	0.07	9.75	0.07	10.92	0.07	12.93	0.06	7.84
Total	0.73	100	0.66	100	0.51	100	0.71	100

**Table 3:** Average farm household income of watermelon and rice farmers from Tajumoddin & Charfasson upazilas

Items of income	Tajumoddin upazila				Charfasson upazila			
	Watermelon farmers		Rice farmers		Watermelon farmers		Rice farmers	
	Income	(%)	Income	(%)	Income	(%)	Income	(%)
<b>Agricultural Sector</b>								
Watermelon/Rice Production	104400	36.74	38400	21.89	108800	38.92	49533	21.75
Crops and Vegetable Production	29666	10.44	13000	7.41	27400	9.80	35400	15.54
Livestock and Poultry	43214	15.21	19200	10.95	41785	14.95	23857	10.47
Fish Production	13533	4.76	16000	9.12	13533	4.84	14333	6.29
Total	190814	67.15	86600	49.37	191519	68.51	123123	54.05
<b>Non-Agricultural Sector</b>								
Service	6666	2.35	7466	4.26	6666	2.39	0	0
Business	26666	9.38	29333	16.72	20000	7.16	47333	20.78
Daily Labor	60000	21.12	52000	29.65	61333	21.94	57333	25.17
Total	93333	32.85	88800	47.63	88000	31.49	104666	45.95
Total Income	284147	100	175400	100	279519	100	227790	100

### Farm household income

Most of the household in the study area had income from both agricultural and non-agricultural sources. In Tajumoddin upazila average agricultural sector income of watermelon farmers and rice farmers were Tk.190814.00 and Tk.86600.00, respectively, which contributed 67.15% and 49.37% of total income, where in Charfasson upazila average agricultural sector income of watermelon farmer and rice farmer were Tk.191519.00 and Tk.123123.00, respectively, which contributed 68.51% and 54.05% of total income respectively (Table 3). On the other hand in Tajumoddin upazila average non- agricultural sector income of watermelon farmers and rice farmers were Tk.93333.00 and Tk.88800.00, respectively, which contributed 32.85% and 47.63% of total income, respectively, where in Charfasson upazila average non- agricultural sector income of watermelon farmers and rice farmers were Tk.88000.00 and Tk.104666.00, respectively, which contributed 31.49% and 45.95% of total income respectively. In Tajumoddin, average annual income of watermelon farmers and rice farmers were Tk.284147.00 and Tk.175400.00, respectively where in Charfession average annual income of watermelon farmers and rice farmers were Tk.279519.00 and Tk.227790.00 (Table 3).

### Farm household expenditure

In Tajumoddin upazila, average agricultural sector expenditure of watermelon farmers and rice farmers were Tk. 89900.00 and Tk. 52233.00

respectively, which contributed 40.92% and 32.61% of total expenditure, where in Charfasson upazila, average agricultural sector expenditure of watermelon farmers and rice farmers were Tk. 87933.00 and Tk. 52093.00, respectively, which contributed 41.75% and 32.11% of total expenditure, respectively (Table 4).

Again in Tajumoddin, average food items expenditure of watermelon farmers and rice farmers were Tk. 97646.00 and Tk. 81000.00, respectively, which contributed 44.44% and 50.56% of total expenditure, where in Charfasson, average food items expenditure of watermelon farmers and rice farmers were Tk. 90996.00 and Tk. 81733.00, which contributed 43.20% and 50.37% of total expenditure, respectively (Table 4).

Average annual expenditure of watermelon farmers and rice farmers were Tk. 219733.00 and Tk. 160213.00, respectively in Tajumoddin upazila where in Charfasson average annual expenditure of watermelon farmers and rice farmers were Tk. 210616.00 and Tk. 162280.00, respectively (Table 4).

In Tajumoddin, average annual savings of watermelon farmers and rice farmers were Tk. 64414.00 and Tk. 15186.00, respectively and in Charfasson it was Tk. 68902.00 and Tk. 65510.00 for watermelon and rice farmers, respectively (Table 4). In both Tajumoddin and Charfasson upazila savings of watermelon farmers was higher than rice farmers.

**Table 4:** Average farm household expenditure of watermelon and rice farmers from Tajumoddin & Charfasson upazilas

Items of expenditure	Tajumoddin upazila				Charfasson upazila			
	Watermelon farmers		Rice farmers		Watermelon farmers		Rice farmers	
	Exd.(Tk)	(%)	Exd.(Tk)	(%)	Exd.(Tk)	(%)	Exd.(Tk)	(%)
<b>Agricultural Sector</b>								
Crops Production	34466	15.69	32013	19.98	31933	15.16	30533	18.82
Vegetable Production	27400	12.47	7080	4.43	17733	8.42	13293	8.19
Fisheries	4000	1.82	5406	3.37	4533	2.15	3466	2.14
Livestock and Poultry	24033	10.94	7733	4.83	33733	16.02	4800	2.96
<b>Total</b>	<b>89900</b>	<b>40.92</b>	<b>52233</b>	<b>32.61</b>	<b>87933</b>	<b>41.75</b>	<b>52093</b>	<b>32.11</b>
Food Items	97646	44.44	81000	50.56	90996	43.20	81733	50.37
<b>Non-Food Items</b>								

Cloths	9700	4.41	10000	6.24	8400	3.99	10000	6.16
Housing	5366	2.44	9313	5.81	4920	2.34	7986	4.92
Education	11300	5.14	3200	1.99	12333	5.86	5000	3.08
Health Care	5820	2.65	4466	2.79	6033	2.86	5466	3.36
Total	32186		26980		31686		28453	
Total Expenditure	219733	100	160213	100	210616	100	162280	100
Annual Savings	64414		15186		68902		65510	

**Table 5:** Livelihood standard of watermelon and rice farmers from Tajumoddin & Charfasson upazilas

Indicator	Tajumoddin upazila				Charfasson upazila			
	Watermelon Farmers		Rice Farmers		Watermelon Farmers		Rice Farmers	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Half Building House	5	33.33	8	53.33	5	33.33	8	53.33
Tin Shed House	7	46.67	6	40	8	53.33	8	53.33
Medical Facility	12	80	3	20	11	73.33	6	40
Own Cultivable Land	15	100	14	93.33	15	100	14	93.33
Using Electricity	11	73.33	15	100	10	66.67	11	73.33
Drink Tube Well Water	15	100	15	100	15	100	15	100
Training Experience	3	20	3	20	2	13.33	1	6.67
Mobile Phone	14	93.33	12	80	15	100	11	73.33
Involved in Social Group	4	26.67	5	33.33	4	26.67	5	33.33
Fridge	1	6.67	3	20	1	6.67	2	13.33
Use Sanitary Latrine	14	93.33	11	73.33	15	100	12	80
Credit Facility	4	26.67	4	26.67	5	33.33	5	33.33
Send Child to School	6	40	3	20	7	46.67	3	20
Political Involvement	1	6.67	1	6.67	2	13.33	3	20
Livestock and Poultry	7	46.67	4	26.67	7	46.67	4	26.67
Savings	5	33.33	3	20	4	26.67	3	20
Ornaments	10	66.67	10	66.67	8	53.33	7	46.67
Bicycle/Motor Cycle	4	26.67	4	26.67	4	26.67	4	26.67

### Livelihood standard

Livelihood standards were measured by indicators such as: Half building house/muddy house, use of sanitary latrine, drinking of tube well water, use of electricity, savings, opportunity for medical facilities, schooling of children, involved in social group, housing condition etc. Higher the users of these facilities higher were their standard of living. The study shows that in Tajumoddin about 33.33% and 53.33% farmers had half building house, 46.67% and 40% farmers had tin shed house, 73.33% and 40% of farmers had medical facilities, 67.67% and 73.33% were using electricity, 100% and 100% of farmers were drinking tube well water, 100% and 80% farmers were using sanitary

latrine, 13.33% and 6.67% had training experience, 26.67% and 20% had savings in NGOs and Banks, 33.33% and 33.33% had credit facilities, 46.67% and 20% farmers were sending their children to the school, 13.33% and 20% farmers were involved in politics, 26.67% and 33.33% farmers involved in social group, 46.67% and 26.67% farmers had livestock and poultry, 6.67% and 13.33% farmers had fridge, 26.67% and 26.67% farmers had bicycle/motorcycle, in watermelon farmers and rice farmers (Table 5). On the other hand, in Charfasson about 33.33% and 53.33% farmers had half building house, 53.33% and 53.33% farmers had tin shed house, 80% and 20% of farmers had medical facilities, 73.33% and 100% were using electricity, 100% and 100%

of farmers were drinking tube well water, 93.33% and 73.33% farmers were using sanitary latrine, 20% and 20% had training experience, 33.33% and 20% had savings in NGOs and Banks, 26.67 and 30% had credit facilities, 40% and 20% farmers were sending their children to the school, 10% and 10% farmers were involved in politics, 26.67% and 33.33% farmers involved in social group, 46.67% and 26.67% farmers had livestock and poultry, 6.67% and 20% farmers had fridge, 26.67% and 26.67% farmers had bicycle/motorcycle, in watermelon farmers and rice farmers (Table 5).

### **Profitability of watermelon and rice production**

#### *Variable cost*

#### **Cost for preparation of land**

In Tajumoddin, average cost for preparation of land amounted to Tk. 5787.00 and Tk. 4213.00 per hectare in watermelon and rice production respectively; those covered 15.62% and 20.68% of the respective total cost of production where in Charfasson average cost for preparation of land amounted to Tk. 8120.00 and Tk. 4818.00 per hectare in watermelon and rice production respectively; those covered 18.21% and 14.07% of the respective total cost of production (Table 6).

#### **Cost of seeds /seedlings**

In the study area, it was found that farmers used both home supplied and purchased seeds. In Tajumoddin average cost of seeds amounted to Tk. 3153.00 and Tk. 1416.00 per hectare in watermelon and rice production, respectively; those covered 8.51% and 6.95% of the respective total cost of production and in Charfasson average cost of seeds amounted to Tk. 2125.00 and Tk. 2196.00 per hectare in watermelon and rice production, respectively; those covered 4.77% and 6.41% of the respective total cost of production (Tables 6).

#### **Cost of human labor**

Human labor was considered the most important and largely used input in production. It shared a large portion of total costs of watermelon and rice production. In Tajumoddin average cost of human

labor amounted to Tk. 9281.00 and Tk. 8000.00 per hectare in watermelon and rice production, respectively; those covered 25.06% and 39.27% of the respective total cost of production (Tables 4.9). In Charfasson average cost of human labor amounted to Tk. 9428.00 and Tk. 7180.00 per hectare in watermelon and rice production, respectively; those covered 21.14% and 20.96% of the respective total cost of production (Tables 6).

#### **Cost of fertilizers and manure**

In case of watermelon and rice production, the per hectare average cost of fertilizer and manure were Tk. 9350.00 and Tk. 2820.00, in Tajumoddin and Tk. 12642.00 and Tk. 5346.00 in Charfasson, respectively (Tables 6).

#### **Cost of pesticides**

In the study area, farmers applied pesticides to protect their products from the attack of pests and diseases. The average cost of pesticides amounted to Tk. 4987.00 and Tk. 1933.00 per hectare in Tajumoddin, Tk. 6578.00 and Tk. 3293.00 in Charfasson for watermelon and rice production (Tables 6).

#### **Cost of irrigation water**

Irrigation is an important input in watermelon and rice cultivation. In Tajumoddin per hectare average cost of irrigation water in watermelon and rice were Tk. 2462.00 and Tk. 1193.00, respectively which represented 6.65% and 5.86% of their respective total costs. Again in Charfasson per hectare average cost of irrigation water in watermelon and rice were Tk. 3050.00 and Tk. 1740.00, respectively which represented 6.84% and 5.08% of their respective total costs (Tables 6).

#### **Cost of fence**

In the study area farmers made fence to protect their crops from the attack for domestic animal for better production of crops. In case of watermelon production, fence average cost was Tk. 537.00 and 728.00 per hectare in Tajumoddin and Charfasson upazilas respectively. In Tajumoddin, there was no fence cost in case of rice production but in

Charfasson average fence cost in case of rice production was Tk. 186.00.

### Total variable cost

Summation of the costs of variable inputs gave the total variable costs which was Tk. 37040.00 and Tk. 20370.00 per hectare for watermelon and rice production in Tajumoddin, Tk. 44595.00 and Tk.25962.00 per hectare for watermelon and rice production in Charfasson, respectively (Tables 6).

### Fixed costs

#### Land use cost

If farmers would lease out their land, they might have received money for it. The money they might have received per hectare was considered as the opportunity cost of land use. The land use cost in Tajumoddin per hectare was Tk. 13343.00 for watermelon and Tk. 17800.00for rice production which covered 78.29% and 89.73%of total costs. On the other hand the land use cost in Charfasson per hectare was Tk. 13464.00 for watermelon and Tk. 17433.00for rice production which covered 75.12% and 87.04%of total costs.

### Interest on operating cost

In production practice, per hectare interest on operating cost was Tk. 3704.00and Tk. 2037.00for watermelon and rice production, respectively in Tajumoddin. In percentage term, this cost covered 21.73%and 10.27% of total costs for watermelon and rice production, respectively (Tables 6).

Again in Charfasson, per hectare interest on operating cost was Tk. 4459.00 and Tk. 2596.00 for watermelon and rice production, respectively. In percentage term, this cost covered 24.88%and 12.96% of total costs for watermelon and rice production, respectively (Tables 6).

### Total fixed cost

Summation of the costs of fixed inputs made total fixed costs. Total average fixed costs were Tk. 17047.00and Tk. 19837.00 per hectare in Tajumoddin for watermelon and rice production, respectively where in Charfasson it was 62518.00 and 45991.00 for watermelon and rice production, respectively (Tables 6).

**Table 6:** Cost needed for watermelon and rice production

Items of cost	Tajumoddin upazilla				Charfession upazilla			
	Watermelon farmers		Rice farmers		Watermelon farmers		Rice farmers	
	Cost	(%)	Cost	(%)	Cost	(%)	Cost	(%)
Preparation of Land	5787	15.62	4213	20.68	8120	18.21	4818	14.07
Seeds	3153	8.51	1416	6.95	2125	4.77	2196	6.41
Fertilizer	9350	25.24	2820	13.84	12642	28.35	5346	15.61
Pesticides and Insecticides	4987	13.46	1933	9.49	6578	14.75	3293	9.62
Labor Cost	9281	25.06	8000	39.27	9428	21.14	7180	20.96
Irrigation Cost	2462	6.65	1193	5.86	3050	6.84	1740	5.08
Transportation	1481	3.99	793	3.89	1921	4.31	1200	3.50
Fence	537	1.45	0	0	728	1.63	186	0.55
Variable Cost	37040		20370		44595		25962	
Land Use Cost	13343	78.29	17800	89.73	13464	75.12	1743	87.04
Interest on Operating Capital	3704	21.73	2037	10.27	4459	24.88	2596	12.96
Fixed Cost	17047		19837		17923		20029	
Gross Cost	54088		40207					
	62518		45991					

## Food security status of watermelon and rice farmers

### Food availability of the respondents

The study indicated that 100% of watermelon and rice farmers had sufficient food for 10 to 12 months in a year both in Tajumoddin and Charfasson upazilas (Table 7).

### Access to food (meals per day)

Usually in Bangladesh a food secured individual receives three round meals per day, but it varies in case of food insecure individual. The watermelon farmers and rice farmers take 3 meals per day both in Tajumoddin and Charfasson upazilas.

### Food consumption by the respondents

The study shows that in Tajumoddin upazila the average per capita calorie intake of watermelon farmers and rice farmers were 2423.18kcal and 2318.47, respectively which is higher than the

recommended daily calorie intake 2122 kcal per day.

The study also shows that in Charfasson upazila the average per capita calorie intake of watermelon farmers and rice farmers were 2394.61 kcal and 2338.12, respectively which is also higher than the recommended daily calorie intake 2122 kcal per day.

The study revealed that in Tajumoddin, 64.49% and 56.45% of the total daily calorie consumed by a watermelon and rice farmers were supplied from rice followed by edible oil 13.74% and 17.85%, vegetables 3.28% and 4.62%, milk 1.52% and 1.09%, meat 2.73% and 2.71% and fish 8.13% and 8.27%, respectively.

On the other hand in Charfasson upazila 60.53% and 59.81% of the total daily calorie consumed by watermelon and rice farmers were supplied from rice followed by edible oil 13.53% and 15.06%, vegetables 4.71% and 4.52%, milk 0.56% and 1.43%, meat 2.6% and 1.14%, egg 0.35% and 0.86% and fish 6.30% and 9.32%, respectively (Table 4.12).

**Table 7:** Food availability of the respondents

Area	Type of farmers	Food Availability over the year (Months)					Total
		None	1-2 months	3-6 months	7-9 months	10-12 months	
Tajumoddin & Charfasson	Watermelon	0	0	0	0	30 (100%)	30(100%)
	Rice	0	0	0	0	30 (100%)	30 100%)

**Table 8:** Contribution of food items in supply calorie for watermelon and rice farmers

Food items	Tajumoddin upazila						Charfasson upazila					
	Watermelon farmers			Rice farmers			Watermelon farmers			Rice farmers		
	Qty In.(g/Ca p/d)	Cal. In.(kcal/ Cap/d)	% Cal. Supp	Qty. In.(g/Ca p/d)	Cal. In.(kcal/ Cap/d)	% Cal. Sup.	Qty. In.(g/Ca p/d)	Cal. In. (kcal/Cap /d)	% Cal. Supp.	Qty. In.(g/Cap/ d)	Cal. In. (kcal/Cap /d)	% Cal. Sup.
Rice	451.07	1562.95	64.49	377.73	1308.85	56.45	418.3	1449.2	60.3	403.6	1398.47	59.81
Wheat	1.33	4.55	0.19	3.33	11.37	0.49	0	0	0	0	0	0
Meat	57.73	62.93	2.6	57.6	62.78	2.71	83.86	91.41	3.82	24.4	26.59	1.14
Fish	164.13	196.96	8.13	159.8	191.76	8.27	125.8	150.9	6.30	181.5	217.8	9.32
Milk	54.67	36.63	1.52	37.73	25.28	1.09	20	13.4	0.56	50	33.5	1.43
Egg	4.93	8.53	0.35	20	34.6	1.49	8	13.84	0.58	11.67	20.18	0.86
Pulse	32.98	113.13	4.67	40.47	138.80	5.99	55.73	191.2	7.98	46.53	159.6	6.83
Vegetables	166	79.68	3.28	222.93	107.01	4.62	234.7	112.7	4.71	220.2	105.7	4.52
Fruit	27.47	29.94	1.24	22.2	24.19	1.04	45.53	49.63	2.07	22.2	24.19	1.03
Oil	37.13	327.89	13.53	46.87	413.83	17.85	36.47	322.0	13.45	39.87	352.1	15.06
Total	997.45	2423.18	100	988.67	2318.47	100	1028.4	2394.61	100	1000	2338.12	100

## **Problems of the farmers**

### ***Economic and technical problems***

It was observed that 80% and 66.67% farmers were facing lack of land, respectively in watermelon and rice cultivation from both Tajumoddin and Charfasson upazila. 100% farmers were facing lack of operating capital in watermelon and rice cultivation from both Tajumoddin and Charfasson upazila. 40% and 6.67% farmers were facing lack of irrigation facility, respectively in watermelon and rice cultivation from Tajumoddin upazila. Whereas 53.33% watermelon farmers were facing lack of irrigation facility and no rice farmer have faced it in Charfasson upazila.

In the study areas, farmers complained that they did not get fertilizer in time and with the government approved price. Table 4.13 indicates that 73.33% and 80% farmers were facing higher prices of fertilizers problems, respectively in watermelon and rice productions in Tajumoddin. On the other hand about 66.67% and 80% farmers were facing higher prices of fertilizers problems, respectively in watermelon and rice productions in Charfasson.

High price of pesticide was one of major problems. It was found that 80% and 93.33% farmers were facing higher prices of insecticides problems, respectively in watermelon and rice productions in Tajumoddin, also 73.33% and 93.33% watermelon and rice farmer were facing higher prices of pesticides problems, in Charfasson upazila.

100% and 66.67% of watermelon and rice farmers reported that they were lack of scientific knowledge & technology in Tajumoddin also in Charfasson about 86.67% and 53.33% watermelon and rice farmers, respectively (Table 9).

### ***Social and natural problems***

Farmers producing watermelon and rice mentioned that considerable amount of yield of their products

were lost by the attack of pests and diseases. In the study area, about 80% and 80% of watermelon farmers and rice farmers reported this problem in Tajumoddin upazilla. About 53.33% and 80% of watermelon farmer and rice farmers reported this problem in Charfasson upazila. Farmers gathered an experience that in the early stage the plants were affected by the cattle and goats. About 73.33% and 53.33% of watermelon and rice farmers reported this problem in Tajumoddin and about 73.33% and 46.67% of watermelon and rice farmers reported this problem in Charfasson. During the harvesting period, stealing of vegetables was a common phenomenon. In Tajumoddin, about 20 and 26.67 percent of watermelon farmers and rice farmers reported that their products were often stolen and in Charfasson about 26.67 and 20 percent of watermelon farmers and rice farmers reported that their products were often stolen (Table 9).

### ***Marketing problems***

**Inadequate storage facilities:** In Tajumoddin upazilla about 33.33% and 26.67% of watermelon and rice farmers reported this problem. In Charfasson upazila about 40% and 20% of watermelon and rice farmers reported this problem (Table 10)

**Lack of marketing facilities:** Lack of market facilities such as tin shed, drainage, water supply were mentioned as problems by sample farmers. About 66.7% and 53.33% of watermelon farmers and rice farmers reported this problem in Tajumoddin. About 86.67% and 46.67% of watermelon farmers and rice farmers reported this problem in Charfasson (Table 10).

### ***Lower price of product***

About 100% of watermelon farmers and rice farmers reported this problem both in Tajumoddin and Charfasson upazila (Table 10).

**Table 10:** Major problems and constraints in producing and marketing of watermelon and rice farmers

Nature of problems	Tajumoddin upazila				Charfasson upazila			
	Watermelon farmers		Rice farmers		Watermelon farmers		Rice farmers	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
<b>Economic and Technical Problems</b>								
Lack of land	12	80	10	66.67	12	80	10	66.67
Lack of capital	15	100	15	100	15	100	15	100
Lack of irrigation facility	6	40	1	6.67	8	53.33	0	0
Higher price of fertilizer	11	73.33	12	80	10	66.67	12	80
Higher price of Pesticide	12	80	14	93.33	11	73.33	14	93.33
Lack of scientific knowledge & technology	15	100	10	66.67	13	86.67	8	53.33
<b>Social and Natural problems</b>								
Product damage by domestic animal	11	73.3	8	53.33	11	73.33	7	46.67
Loss of production due to theft	3	20	4	26.67	4	26.67	3	20
Attack by pests and diseases	12	80	12	80	8	53.33	12	80
<b>Marketing problems</b>								
Inadequate storage facilities	5	33.3	4	26.67	6	40	3	20
Lack of marketing facilities	10	66.7	8	53.33	13	86.67	7	46.67
Lower price of product	15	100	14	93.33	15	100	14	93.33

## DISCUSSION

### Socioeconomic characteristics of the sample farmers

From the socio-economic results, it is clear that there were large variations in socio-economic characteristics of watermelon farmer and rice farmer in both Tajumoddin and Charfasson upazilas. There are substantial indications suggesting that watermelon farmers were progressive. The majority of the selected farmers belonged to the age group of above 18-35 years for both watermelon farmers and rice farmers. The observed average family size of watermelon farmers and rice farmers were considerably higher

than the national average of 4.5 (BDHS, 2014) and lower than the national average, respectively.

Literacy has an important impact on decision making processes of agricultural production. The level of literacy is generally considered as important measuring rod for progressive attitude of the farm households in adopting modern technology. Literacy has its own merits and it contributes to economic and social development. It plays an important role in agricultural modernization. Literacy helps a person to have day to day information on the modern techniques together with technological scarce resources and maximizing profit. In Tajumoddin upazila, the educational status of watermelon farmers was better than rice farmers and in Charfasson upazila

the educational status of watermelon farmers was better than rice farmers.

Households under watermelon farmers had more average farm size than rice farmers in Tajumoddin. But households under watermelon farmers had less average farm size than rice farmers in Charfasson. Average annual income of watermelon farmers was higher than rice farmers in both Tajumoddin and Charfasson upazila. In the study area it was found that the annual expenditure on food items and non- food items was relatively higher for watermelon farmers and lower for rice farmers in both Tajumoddin and Charfasson upazilas. However, Average annual expenditure and Savings of watermelon farmers was higher than rice farmers. It also visible that livelihood Standard of watermelon farmers was higher than rice farmers. As watermelon farmer's annual savings and livelihood standard is higher so their food security status should be better.

#### **Profitability of watermelon production**

From the profitability Tables 4.7, it is clear that the net return was quite high for watermelon production. It means watermelon production is highly profitable for farmers. Thus, it could cautiously be concluded that the watermelon farming can contribute to earn a substantial amount household income of the rural farmers. Therefore, it can help the farmers to increase and improve their livelihoods and overall standard of living than ever before.

#### **Food security status of sample farmers**

On the food security status results, it could cautiously be concluded that the food security status of watermelon farmer in was better than rice farmer in both Tajumoddin and Charfasson upazilas. Food availability of watermelon farmer and the rice farmer were mostly same. Both farmers took three meals per day in the study area. Table 4.12 shows that daily per capita calorie intake from different food items were highest in watermelon farmers compared to rice farmers. As watermelon farmers income was higher than the rice farmers, so their food accessibility and utilization of food were more.

#### **Problems of the farmers**

From the results presented in Table 4.12 indicates that watermelon farmers and rice farmers in the study area have currently been facing some major problems in conducting their farming. These are the major constraints for the watermelon farmer and rice farmers in the study area. Economic and technical problems; and marketing problems were highly faced by the watermelon farmers in compared to rice farmers in both Tajumoddin and Charfasson upazilas. Social and natural problems were also highly faced by the watermelon farmers compared to the rice farmers. It is clear that the problems were quite high for watermelon production.

From the above discussion it could cautiously be concluded that there is an important role of watermelon production on food security of the farmers. To be more food secured, farmers should start watermelon production especially who has limited land.

#### **CONCLUSION**

The results of the study revealed that the watermelon farmers in Tajumoddin and Charfasson upazila are more food secured than rice farmers. It was checked by using recommended minimum calorie requirement (i.e. 2122 kcal). The average per capita calorie intake of watermelon farmers and rice farmers were 2423.18 kcal and 2311.07 kcal in Tajumoddin, where 2394.61 kcal and 2338.12 kcal in Charfasson, respectively.

Food availability of watermelon farmer and the rice farmer were mostly same. Both farmers took three meals per day in both Tajumoddin and Charfasson upazilas. Daily per capita calorie intake from different food items were highest in watermelon farmers compared to rice farmers. As watermelon farmers income was higher than the rice farmers, so their food accessibility and utilization of food were more.

The study shows that the food security status of watermelon farmer was better than the rice farmers because watermelon farmer's income was higher than the rice farmers in both study area.

The study indicates that watermelon farmer and rice farmers in both study area have currently been facing some major problems in conducting their farming. These are the major constraints for the watermelon farmers and rice farmers in the study area. Economic and technical problems; and marketing problems were highly faced by the watermelon farmers in compared to rice farmers. Social and natural problems were also highly faced by the watermelon farmers compared to the rice farmers. It is clear that the problems were quite high for watermelon production.

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