PBRG Sub-project Completion Report (PCR)

A. Sub-project Description

1. **Title of the PBRG sub-project:** Transformation of Agriculture for Food Security and Poverty Reduction.

2. **Implementing organization (s):**Bangladesh Agricultural University, Mymensingh And Prottasha Foundation, Dhaka.

3. **Name and full address with phone, cell and E-mail of Coordinator, Associate Coordinator, PI/Co-PI (s):**

Coordinator	:	**Dr. Md. Abdul Awal** Member Director Bangladesh Agricultural Research Council (BARC) Farmgate, Dhaka-1215 Email: maawal@yahoo.com; maawal70@gmail.com; Mobile: 01713516217
Principal Investigator	:	**Dr. M. Zulfikar Rahman** Professor, Dept. of Agricultural Extension Education Bangladesh Agricultural University (BAU), Mymensingh Mobile :01714074313; Email: Zulfikarbau64@gmail.com **Md. Ruhul Amin** Executive Director Prottasha Foundation House # 19/18, Tajmahal Road, Block- C Mohammadpur, Dhaka- 1207. Bangladesh. Phone: 01733-172814; Email:prottashafoundation.bd@gmail.com
Co-Principal Investigator(s)	:	**Dr. Md. Golam Farouque** Professor, Dept. of Agricultural Extension Education Bangladesh Agricultural University, Mymensingh Mobile: 01731420685; E-mail: farouque25@bau.edu.bd **Dr. Md. AsaduzzamanSarker** Professor, Dept. of Agricultural Extension Education Bangladesh Agricultural University, Mymensingh Mobile:01712156488; Email. masarker@bau.edu.bd **Md. Asheque Hossain Siddique** Prottasha Foundation House # 19/18, Tajmahal Road, Block- C Mohammadpur, Dhaka- 1207. Bangladesh. Phone: 01711-943002; Email:heds1994@gmail.com

4. Sub-project budget (Tk.):

4.1 **Total (in Tk. as approved):** 1,95,00,000/-

4.2 **Latest Revised (if any):**1,95,00,000/-

5. Duration of the sub-project:

5.1 **Start date (based on LoA signed):** 15 October 2019

5.2 **End date:** 15 May 2022

6. Background of the sub-project:

Bangladesh Agricultural Research Council coordinated a PBRG sub-project entitled "Transformation of Agriculture for Food Security and Poverty Reduction" with association of Bangladesh Agricultural University (BAU), Mymensingh and Prottasha Foundation, Dhaka under Financing and Monitoring of Project Implementation Unit (PIU), BARC, NATP Phase- II Project, Bangladesh Agricultural Research Council (BARC). The main objective of the project is to identify causes behind shifting of agriculture land into divers crop enterprises (fruit, maize and flower)towards livelihood improvement of farm household in diferent locations of Bangladesh. General objectives of the study are: to analyze the nature and extent of agricultural transformation; to identify the drivers of changes in agricultural transformation and livelihood pattern /status; to estimate the effect of agricultural transformation on food security and poverty reduction; andto find out the emerging opportunities and challenges for Bangladesh agriculture in the course of transformation. Target beneficiaries of the study are marginal, small and medium farmers.Total cost for all components of the sub-project is estimated at Tk 19500000. Duration of the project as per project proposal is October 2019 to May 2022. But, according to letter of agreement, the implementation of the project has been effective from 15 October 2019.

7. Sub-project general objective (s):

- To analyze the nature and extent of agricultural transformation;
- To identify the drivers of changes in agricultural transformation and livelihood pattern /status
- To estimate the effect of agricultural transformation on food security and poverty reduction
- To find out the emerging opportunities and challenges for Bangladesh agriculture in the course of transformation.

8. Sub-project specific objectives (component wise):

BARC Component	• To coordinate and monitor the overall tasks/each activity as carried out by the involved institutes. • To establish linkages with stakeholders of project implementation. (Transformation of cropland into litchi orchards and HYV maize cultivation)
BAU Component	• To analyze the nature and magnitude of land transformation and its effects on the farming practices. • To identify the drivers of changes in agricultural transformation and identify the factors that influence the changes in livelihood pattern. • To estimate the effects of agricultural transformation on food security and poverty status. • To find out the emerging opportunities and challenges for Bangladesh agriculture with respect to ongoing transformation (Transformation of cropland into mango and flower orchards).
Prottasha Foundation Component	• To analyze the nature, extent and effects of agricultural transformation onfarming practices. • To identify the drivers of changes in agricultural transformation and livelihood improvement. • To estimate the effects of agricultural transformation on food security and poverty status.(Transformation from local rice into HYV rice).

9. Implementing location (s): Dinajpur Sadar, Lalmonirhat Sadar, Panchagarh Sadar,Shibgonj and Gomostapur Upazilas of Chapainawabganj, Porsha and Sapahar Upazilas of Naogaon, Jhikargasa Upazila of Jashore, Tala and Kolaroa Upazilas of Satkhira, Narail sadar Upazila of Narail and Bakerganj Upazila of Barisal district.

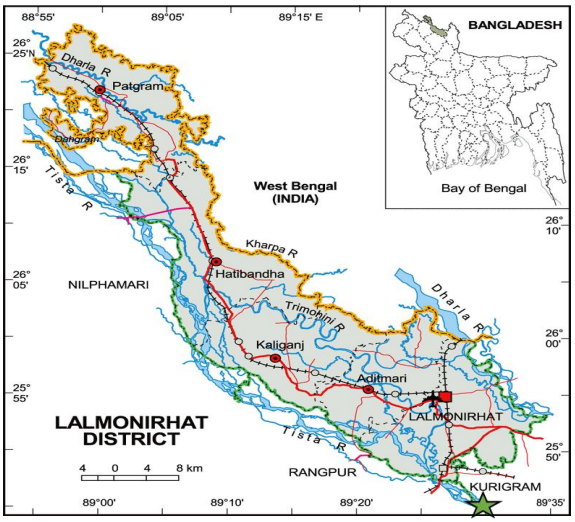
10. Methodology in brief:

Study locations

The study was conducted in some selected areas where transformation of agriculture i.e., from field crops to litchi, HYV maize, mango, flower and HYV rice production was very high. In this case, for all the selected crops several villages consisting of one or more unions were identified from each upazila in a district. For litchi data were collected from Dinajpur Sadar, Dinajpur and for HYV maize, the locations were Sadar upazilas of Panchagarh and Lalmonirhat district. Again, for BAU component mango data were collected from Chapainawabgonj, Naogaon and Satkhira district while for flower, data were collected from Jashore district. Shibgonj and

Gomostapurupazilas from Chapainawabgonj district, Tala and Kolaroa upazilas from Satkhira district and Porsha and Sapahar upazilas from Naogaon district were selected for gathering data from the mango farmers. However, Jhikargasa upazila under Jashore district was selected for getting primary data related to flower transformation. Moreover, for Prottasha Foundation component,a detail survey was conducted among the HYV rice farmers at Narail sadar Upazila of Narail district and Bakerganj upazila of Barisal district.

Fig 10.1: Map of the study area for transformation of land into litchi orchard



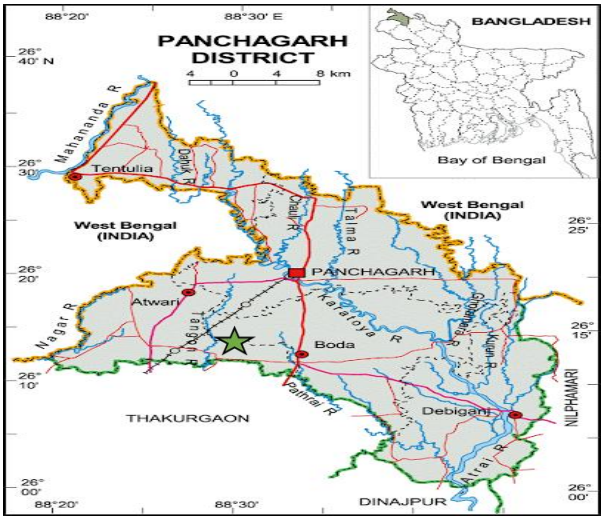


Fig 10.2: Map of the study area for land transformation into HYV Maize

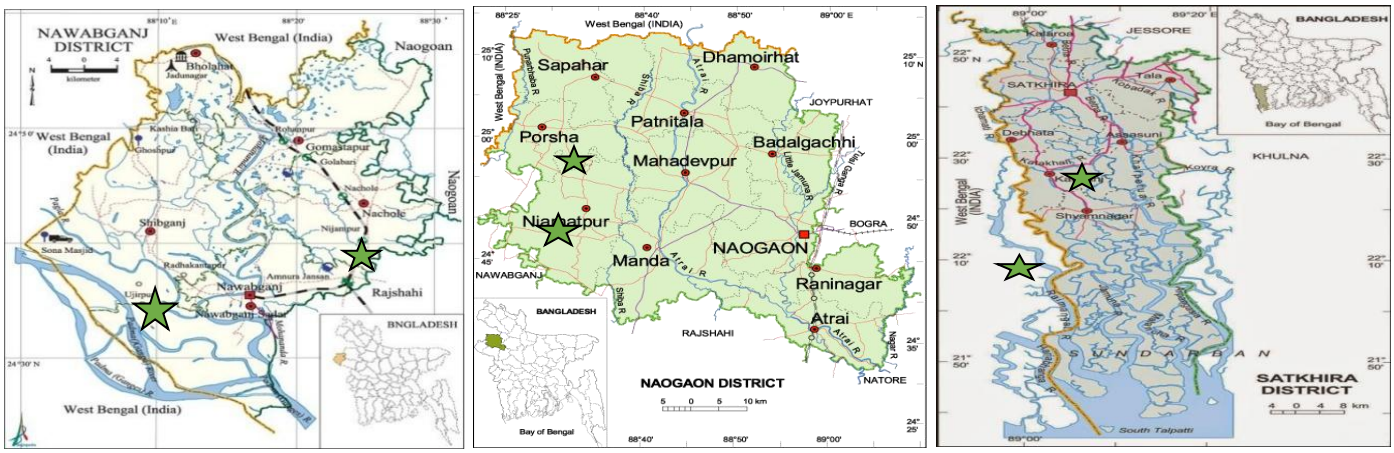


Fig 10.3: Map of the study area for transformation of crop land into mango.

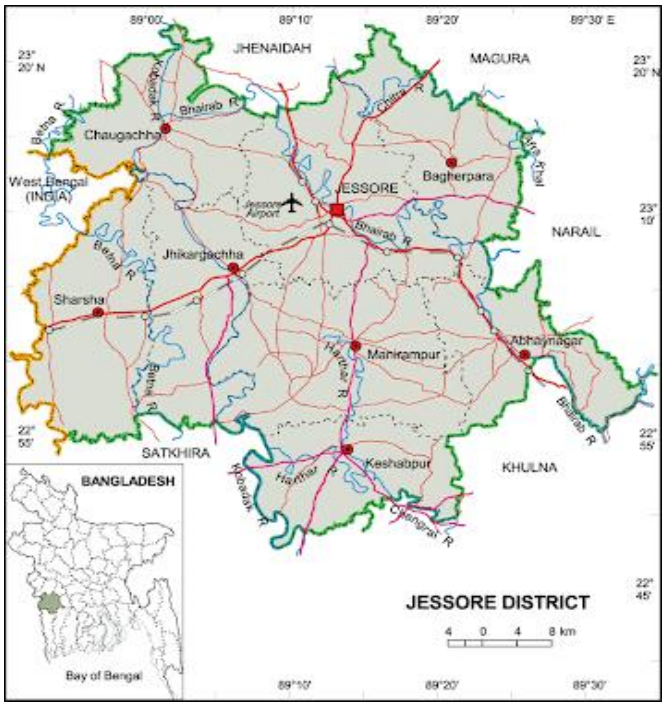


Fig10.4: Map of the study area for transformation of crop land into flower.

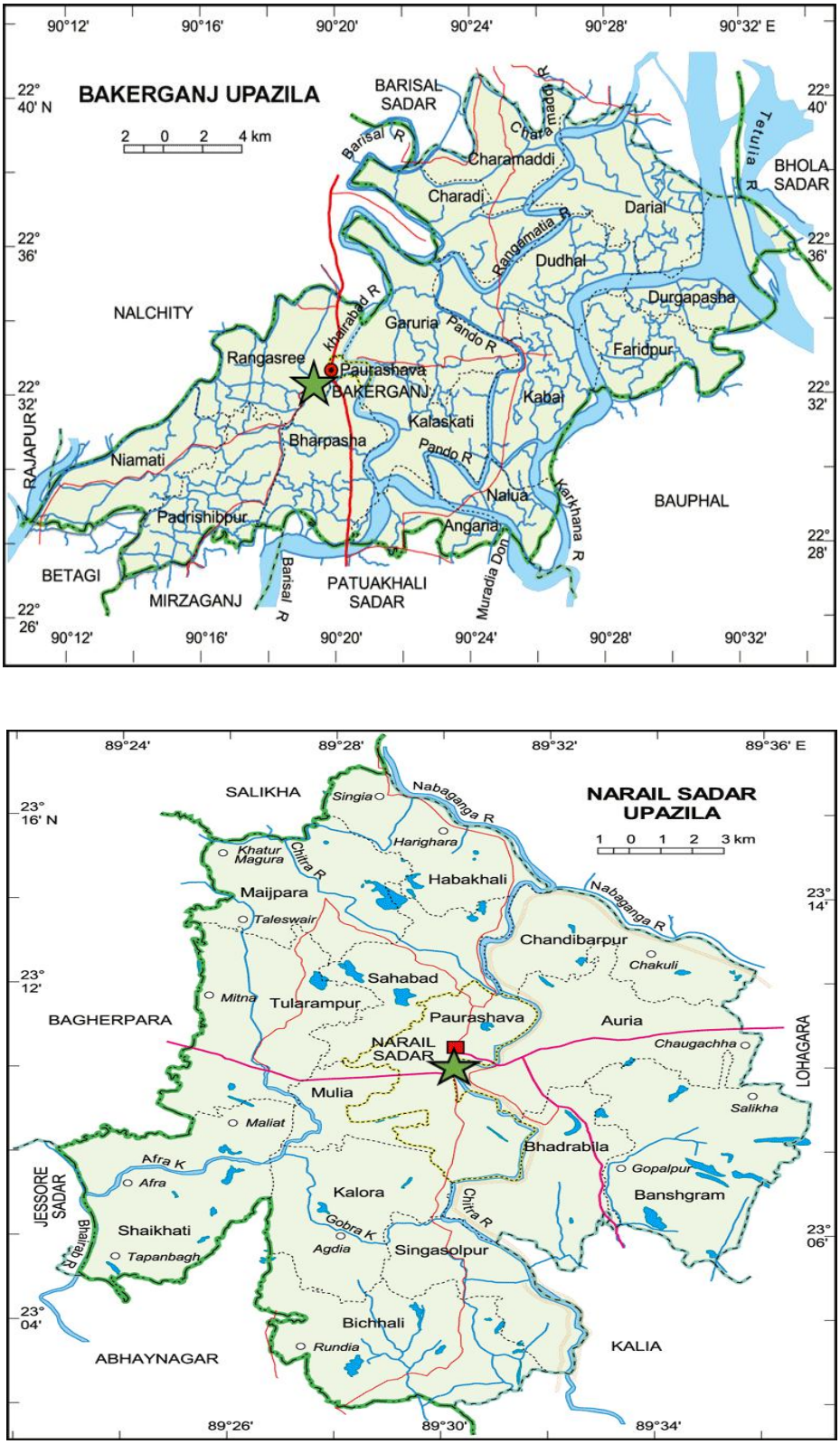


Fig 10.5: Map of the study areas for transformation of crop land into HYV rice.

Population and sample

An appropriate number of sample farmerswereselected based on the preliminary visit in the study areas. Both male and female respondents were selected in the study areas. Both purposive and random sampling techniques were used in selecting locations and respondents respectively. For the selection of respondents, random sampling method was followed. A complete list of respondents was prepared for each selected districts with the help of Researchers/Scientists, Department of Agricultural Extension (DAE), local leaders, NGO personnel. Location-wise population and samples of the study are summarized in Table 10.1.

Table 10.1.Sampling distribution for the study

Farmer types	District	Upazila	Pertinent farms	No. of Sample
Litchi growers	Dinajpur	Sadar	600	200
Total litchi growers				200
HYV Maize producers	Panchagarh	Sadar	700	200
	Lalmonirhat	Sadar	800	200
Total maize producer				400
Mango growers	Chapainawabganj	Shibganj	355	50
		Gomostapur	348	50
	Naogaon	Porsha	327	50
		Sapahar	338	50
	Satkhira	Kalaroa	312	50
		Tala	299	50
Total mango growers				300
Flower growers	Jashore	Jhikargacha	713	100
Total flower growers				100
HYV rice growers	Narail	Narail	1450	200
	Barisal	Bakerganj	1400	200
Total HYV rice farmers				400
Grand Total (Litchi grower-200; maize producers-400; mango growers-300; flower growers-100 and HYV rice growers-400).				1400

For selection of populations and sample size of the selected cropping transformation, several field visits were made and a preliminary survey was conducted in all the study areas. Necessary step was taken so that male and female respondents were selected proportionately. Data were collected from the selected one union of each upazila (Shibganj,Gomostapur, Porsha,Sapahar, Kalaroa, Tala) for mango orchad. From each Upazila, data were collected from 50 mango farmers randomly. Thus, a total of 300 mango farmers were treated as the sample of the study.

On the other hand, for flower transformation, 100 flower growers taking 50 growers from each of the two selected upazilas under Jashore district.

Data collection

For the collection of reliable data, structured interview schedules were designed and open-ended questions were used for getting their opinions and suggestions. Scales were developed for computing suitable scores in respect of extent, reasons and effects of transformation and also socio-economic characteristics of the respondents and other several focus issues related to the study.

Collection of primary data

Primary data were collected from the respondents through face-to-face interview, Focus Group Discussion (FGD), Key Informant Interview (KII) and other appropriate tools. Before going for an actual interview, a brief introduction of the aims and objectives of the study were explained to each respondent. The questions were asked systematically in a very simple manner and information was recorded on the interview schedules. Quantitative data were collected in local units. To have greater accuracy of collected data, frequent field supervisions weremade by the team members.

Collection of secondary data

The secondary data were collected from Bangladesh Bureau of Statistics (BBS), Bangladesh Economic Reviews (BER), FAO, BARC, IFPRI, DAE, Newspapers and internet. The time series data on different crop production, rainfall, temperature, humidity were also obtained mainly from meteorology department, BBS, various reports and relevant journals.

Processing of data

Field editing and central editing were done as soon as possible to detect errors and omissions of the data. Qualitative data were converted into quantitative data by means of suitable scoring whenever necessary. The local units were converted into standard units. The data were compiled on a master sheet and then tabulated and analyzed with keeping the objectives of the study in mind. The primary data were edited and coded. All the collected data were summarized and scrutinized carefully. For data entry and analysis software SPSS16 was used. Finally, relevant tables were prepared in order to fulfill the objectives of the study.

Measurement of the Variables

This objective contains procedures for measurement of both characteristics of the respondents and the focus issue of the study. Twelve characteristics of the respondents in transforming crop land into mango & litchi orchard, hybrid maize cultivation, flower cultivation and local rice to HYV rice were considered for the study.The procedures followed for measuring each of these characteristics is described below.

Age: The age of a respondent referred to the period of time from his birth to the time of interview. The age was measured in complete years as reported by the respondents. A score of one (1) was assigned for each year of their age (Kuri, 2013).

Year of schooling*:* Education was defined as the ability of an individual to read or write or formal education received from educational institutions for a period. Education was measured based on the year of schooling. If a respondent did not attain formal education, his score was assigned as zero (0). A score of one (1) was assigned for each year of schooling completed (Islam, 2011).

Family size: The family size of a respondent was measured in terms of actual number of members in his family including himself, his wife, children, brothers, sisters, parents and person who jointly live and eat together during interview (Rakib, 2002).

Farm size: The farm size referred to the total area of land on which the farm owner/respondent carried out various farming operations. The farm size was measured in hectares for each respondent using the following formula:

$$FS = (A_1 + A_2 + A_3 + A_4) - (A_5 + A_6)$$

Where,

FS= Farm Size
A_1= Homestead area
A_2= Own land under own cultivation
A_3= Land taken from others on lease
A_4= Land taken from other on borga
A_5= Land given to others on borga
A_6= Land given to others on lease

The total farm size in hectare was considered as farm size score of the respondents.

Farming experience: Farming experience means theexperience gained by an individual from active farming and it was expressed in year i.e. score 1 was assigned for each year of farming. Kuri (2013) used the same procedure in his study.

Annual family income*:* This referred to the total earnings in taka of all family members of a respondent from all agriculture activities, off farm and nonfarm activities, employment and other sources. A score of one (1) was assigned for each Taka one thousand (Rakib, 2002).

Training exposure: Training exposure was determined by total number of days of training received by the respondent from any organization in his entire life. If a respondent took 3 days training on any aspect from GOs, NGOs or any other organization, then his training received score was 3 and so on.

Credit received: Credit received by the respondent was measured in terms of the amount of money received by him/her as loan from different sources of credit. It was expressed in Thousand (000') taka.

Extension media contact: Extension media contact of the respondents was measured based on the frequency of contact with Individual contact, Group contact and Mass contact information sources. Each of the respondent was asked to indicate the frequency of contact with a particular information source with a specified time frame.

Organizational participation: Organizational participation of a respondent was measured by computing an organizational participation score according to the nature of involvement and duration of participation in different organizations up to the time of interview. The similar methodology was used by Hoque (2011). The organizational participation score of a respondent (No participation: 0; Participation as ordinary member: 1; Participation as executive member: 2; Participation as president/secretary: 3) This was measured by using the following formula:

Organizational participation score = Σ PXD

Where, P= Participation score, D= Duration score.

Innovativeness: Innovativeness is the degree to which an individual adopts an innovation relatively earlier than other members in a social system (Rogers, 2003). In measuring the innovativeness of respondents related to improved agricultural practices were selected.

Knowledge on Farming:For measuring knowledge on farming of respondents, revised Bloom's Taxonomy technique developed by the Anderson and Krathwohl (2001) was followed. For measuring the extent of transformation of cropland into mango & flower cultivation, production data of these enterprises were collected from the year 2000 to 2019. Year wise percentage of land conversion in last 19 years was calculated by using the following formula. For example;

$$\text{Transformation in 2000-2001} = \frac{\text{Total transformation of land in the year 2000-2001 X 100}}{\text{Total area of land in the year 2000 - 2001}}$$

Exploring reasons for transformation of cropland into selected enterprises cultivation

Reasons for transformation of cropland and within the crops were investigated based on the opinion of the farmers involved in transforming their cropland within the crop lands. As such the respondents were supposed to give their opinion about the reasons for transformation.For determining the reasons for individual item rank order was made based on Cumulative Reasons Score (CRS) of the individual item. The CRS was computed by using the following formula:

$$CRS = N_1 \times 3 + N_2 \times 2 + N_3 \times 1 + N_4 \times 0$$

Where,

CRS = Cumulative Reasons Score

N_1 = Number of the respondents perceived the reason as strongly agree

N_2 = Number of the respondents perceived the reason as agree

N_3 = Number of the respondents perceived the reason as moderately agree.

N_4 = Number of the respondents perceived the reason as donot agree.

Tools used for data collection

To detect and analyse the drivers of agricultural land transformation, PRA, FGD, KII and other participatory tools were used.

Exploring the effect of transformation

Effect of land transformation into agricultural cropwere investigated based on the opinion of the farmers involved in transforming their cropland into selected enterprise. The farmers provided their opinions about the effects of transformation.

For determining the effect of individual item, rank order was made based on Cumulative Effects Score (CES) of the individual item. The CES was computed by using the following formula:

$$CES = N_1 \times 3 + N_2 \times 2 + N_3 \times 1 + N_4 \times 0$$

Where,

CES = Cumulative Effects Score

N_1 = Number of the respondents perceived transformation effect as strongly agree

N_2 = Number of the respondents perceived transformation effect as agree

N_3 = Number of the respondents perceived transformation effect as moderately agree.

N_4 = Number of the respondents perceived transformation effect as not agree.

11. Results and discussion

A. Transformation of Crop land into Litchi Orchard

Total cultivated area and production of litchi in Bangladesh during last 12 years (from 2007-08 to 2018-19) are shown in table 11.1 while figure 11.1 Shown trends of the production.

Table 11.1: Cultivated area and production of litchi during 2007/08-2018/19 in Bangladesh

Serial No.	Year	Area under garden (Acres)	Total production in inside and outside gardens (Metric Tons)
1	2007-2008	578	43767
2	2008-2009	397	55288
3	2009-2010	425	64995
4	2010-2011	461	55538
5	2011-2012	1382	56687
6	2012-2013	1463	68582
7	2013-2014	474	67371
8	2014-2015	705	73257
9	2015-2016	564	77705
10	2016-2017	713	90297
11	2017-2018	4088	94160
12	2018-2019	4390	79834

Source: Agricultural Year Book, BBS

Fig.11.1: Litchi marketing in Dinajpur Sadar

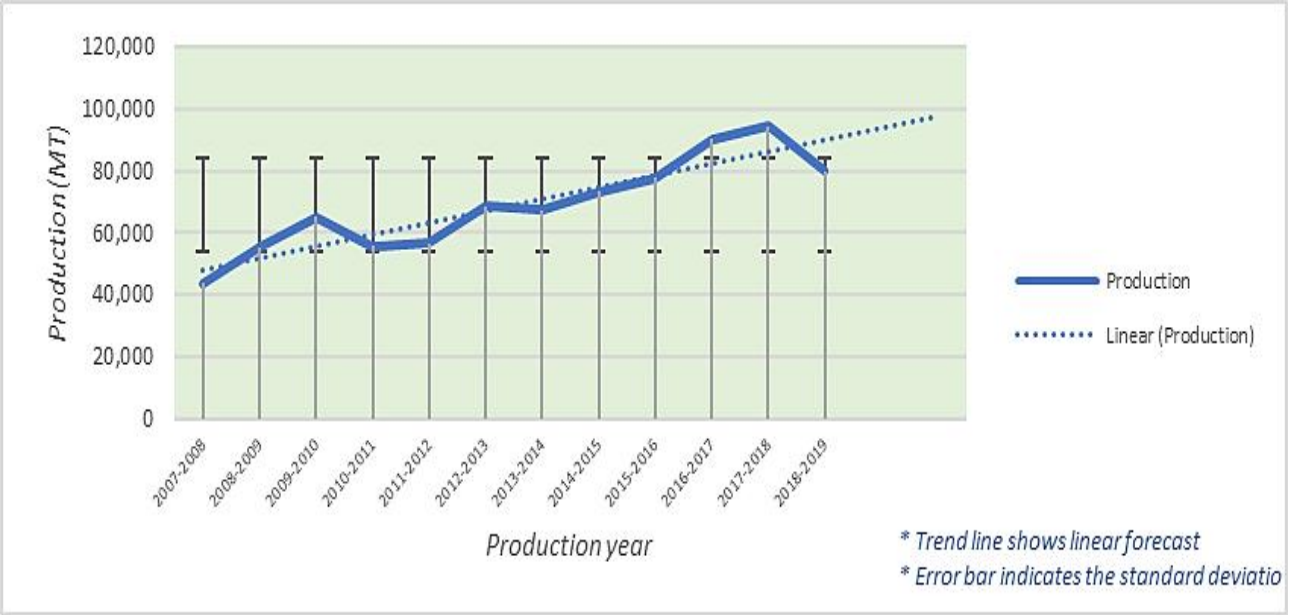


Fig.11.2: Trends of litchi production in inside and outside gardens

Data in Table 11.1 and Fig 11.2 show that litchi production increased gradually in Bangladesh over the years. Though litchi grows more or less all over the country, it has higher production in Dinajpur district because of the fact that the geographical location, soil condition and rainfall in Dinajpur area are suitable for litchi production (BBS, 2019). The litchi growers are interested in litchi production for its more economic benefit. Dinajpur area has an average elevation of 37 meters above the sea level. The study areas were belonging to the old Himalayan piedmont plain of Agro Ecological Zones (AEZ-27) (BBS, 2019).

There are several studies on litchi production, but no comprehensive study was conducted on transformation of litchi cultivation from other crops production and profitability of litchi production in Bangladesh. For that reason, it is felt that a study on profitability of litchi could be much more important. It is hoped that the findings and specific suggestions from the study will help the producers, traders, consumers, extension workers and researchers in their efforts for the improvement of production and marketing of litchi in Bangladesh. Thus, the study aims to determine the economic return of producing litchi compared with other crops.

A detail survey was conducted among the litchi farmers at Dinajpur sadar*upazila* of Dinajpur district under Transformation of Agriculture for Food Security and Poverty Reduction Project to know the transformation pattern of crop land to litchi cultivation from 2000 to 2020 and socio-economic status of the farmers who are involved in this conversion process.

11.1.1 Socio-economic Characteristics of Litchi Farmers

In Table 11.1.1.1 it is shown that total farm size of 200 farm families is 301.94 hectares with average farm size of 1.51 hectares. Total large farm families are 37 and their average farm size is 3.01 ha. The number of medium farm families is 105 and their average farm size is 1.44 ha. The number of small farm families is 58 which owned average 0.68 ha. The total areas under litchi orchard of the selected farmers stands at 105.72 ha which is 35.01 % of their total land. Large, medium and small farmers cultivated litchi in 33, 57.02 and 15.70 ha land, respectively.

Age

Performance of litchi production varied significantly with the variation of farmers' age (Table 11.1.1.1). Age of farmers is categories into five age groups, such as 18-30, 32-40, 41-50, 51-60 and above 60 years. The highest number of small farmers is in 41-50 years' age group (32.76%) and the lowest in 18-30 and 31-40 age categories (8.62%). For medium farmers, the highest and lowest numbers of farmers are in 51-60 years (46.67%) and in 18-30 years, respectively. In case of large farmers, the highest and lowest age groups are 51-60 years (32.43%) and 18-30 years (0%), respectively.

Schooling

Performance of litchi production depends significantly on the farmers' education (Table 11.1.1.1). Schooling of farmers was categorized into seven groups, such as illiterate, primary level, secondary level, higher secondary, graduate, post graduate and others. The highest number of 92 farmers (46%) obtained secondary level education, of which 26, 47 and 19 are small, medium and large farmers.

Farming Experience

Farming experience influences greatly the performance of litchi production in the study area (Table 11.1.1.1). Effect of farming experience on performance of litchi production was measured by categorizing seven groups like 1-5, 6-10, 11-15, 16-20, 21-25, 26-30 and above 30 years.

Occupation

Litchi farming performance depends largely on types of occupations (Table 11.1.1.1). Farmers have two types of occupations: main and secondary. Agriculture is the main occupation for majority of farmers (77%). Among the different groups of farmers, 14% large, 41.5% medium and 21.5% small farmers are involved in agriculture as their main occupation. In case of secondary occupation, maximum farmers (28%) are engaged in agriculture, followed by business (24%).

Gender, marital status and religion

Among the selected farmers, almost all farmers (97%) are male in the study area. Regarding marital status, all farmers except one are married. In respect of religion, 98% farmers are Muslim and the rest are Hindu (Table 11.1.1.1).

Table 11.1.1.1: Social status of the farmers that influences transformation of crop land into litchi orchard

Major factors	Category of factors	Distribution of farmers as per category			
		Small	Medium	Large	All
Age	18- 40 years	-	10	3.5	6.75
	41 – 60 years	8.5	31	10	24.75
	Above 61 years	6	11.5	5	11.25
	Total	14.5	52.5	18.5	42.75
	Average (Year)	29	105	37	85.5
	SD (Year)	4.37	19.94	6.76	16.17
Schooling	Illiterate	0.5	-	-	0.5
	Primary	3	7	1	5.5
	Secondary	13	23.5	9.5	46
	Higher secondary	5.5	12.5	4	22
	Graduate	4	6	2	12
	Post graduate	3	3.5	2	8.5
	Other (informal)	-	-	-	-
Farming experience	1 – 5 years	1.5	0.5	-	2
	6 – 10 years	3.5	2		5.5
	11 – 15 years	2.5	3	2	7.5
	16 – 20 years	1	3.5	1	5.5
	21 – 25 years	4	5	1.5	10.5
	26 – 30 years	4.5	3.5	-	8
	Above 30 years	12	35	14	61
	Average (Year)	4.14	7.50	4.63	14.29
	SD (Year)	3.69	12.21	6.26	20.77
Main occupation	Agriculture	21.5	41.5	14	77
	Housewife	1	0	0	1
	Business	1.5	4	2	7.5
	Service	5	7	2.5	14.5
	Wage labor	-	-	-	-
	Others	-	-	-	-
	Average	7.25	13.13	4.63	20
	SD	9.67	19.13	6.34	25.28
Secondary occupation	Agriculture	7	17.5	3.5	28
	Housewife	0	0.50	0	0.50
	Business	6.5	10	7.5	24
	Service	2.5	2.5	1	6
	Wage labor	-	-	-	-
	Others	1	0.50	-	1.5
	None	12	21.5	6.5	40
	Average	4.83	8.75	3.70	16.67
	SD	4.52	9.12	3.29	16.32
Gender	Male	27.5	51	18.5	97
	Female	1.5	1.5	-	3
Marital status	Married	29	52	18.5	99.5
	Unmarried	-	1	-	1
Religion	Muslim	27.5	52	18.5	98
	Hindu	1.5	0.50	-	2
	Other	-	-	-	-

Source: Field Survey (2020)

Size of household

Average member per family was found 5.26 persons, of which the large, medium and small farm family sizes were 5.57, 5.30 and 4.91 respectively. Income earning members were 2.83% for all categories of farmers with 4.59%, 1.48% and 2.41% for large, medium and small farm family, respectively. Average farm sizes were 3.01 hectare, 1.44 hectares and 0.68 hectares considering large, medium and small farm family, respectively. Average annual household income was estimated at Tk. 311.00 thousand per family which is positively related with farm size. This income was calculated after considering all farm activities like homestead garden, field crops, fruits (litchi), livestock and aquaculture. It is observed that highest farm income 50.94% comes

Table 11.1.1.2: Socio-economic status of litchi producing farmers

Major factors	Factor category	Unit	Small Farm	Medium Farm	Large Farm	All Mean (SD)
Size of household	Average member	No.	4.91	5.3	5.57	5.26 (0.33)
	Income earning member	%	2.41	1.48	4.59	2.83 (1.6)
	Dependent member	%	6.07	3.57	10.43	6.69 (3.47)
Farm size	Per household	ha	0.68	1.44	3.01	1.71 (1.19)
Annual household income	Total income ('000)	Tk.	97.93	87.99	125.22	311 (19.28)
	Homestead	%	1.72	3.58	0.26	1.85 (1.66)
	Crops	%	34.37	29.37	34.95	32.9 (3.07)
	Fruits	%	50.62	52.52	49.67	50.94 (1.45)
	Livestock/poultry	%	7.88	9.95	11.68	9.84 (1.9)
	Aquaculture	%	5.41	4.58	6.02	5.34 (0.72)
	Sub-total of on-farm income	%	100	100	100	100 (0)
	Small business	%	54.4	48.71	49.32	50.81 (3.12)
	Service	%	30.37	46.66	45.78	40.94 (9.16)
	Remittance	%	9.6	3.25	4.32	5.72 (3.4)
	Others	%	5.63	1.39	0.58	2.53 (2.71)
	Sub-total of off farm income	%	100	100	100	100 (-)
Training experience	Farmers' received training	%	50	54.29	81.08	61.79 (16.84)
	Famers' training exposure	days	3	3	3	3 (-)
Organizational participation	Farmers in participation	%	55.17	56.19	81.08	64.15 (14.67)
	Farmers'score in participation	%	53.17	58.6	87.6	66.46 (18.51)

Source: Field Survey (2020); SD = Standard Deviation

from litchi cultivation for all farmers and it was 49.67%, 52.52% and 50.62% of the total income for large, medium and small farm, respectively. Secondary income sources are considered as small business, service, remittance and others. It is found that small business is the highest source of secondary income (50.81%) for all farmers which is more or less same for all categories of farmers (Table 11.1.1.2)

Training experience and organizational participation

About 62% farmers received three day's training on litchi cultivation which is the highest for large farmers followed by medium and small farmers. Around 64% farmers participate in different organizations, which is also highest (81%) for large farmers.

11.1.2 Farmers' Access to Credit

Litchi farmers got credit from banks and NGOs. Table 11.1.2.1 exhibits that only 2% and 40% litchi farmers received loan from bank and NGOs worth ranging Tk. 10000-20000 and Tk. 12000-100000, respectively. Farmers had to pay interest rate ranging 12-15% and 20-30% for bank and NGO credit, respectively. This credit was provided only on the condition of crop sale to them just after harvest. It is worth mentioning that interest rate of bank loan was lower than that of NGOs loan but only the 2% of farmers received credit from bank which was much lower than that of credit received from NGOS (40%). It was informed by the respondants that due to its complex procedure of bank credit, farmers are less interested to receive loan from bank (Table 11.1.2.1).

Table 11.1.2.1: Use of formal or informal credit by litchi farmers in the study area

Particulars			
Sources of credit (%)	Minimum	Maximum	Average
Banks	-	-	2
NGOs	-	-	40
Amount of credit received (Tk)			
Banks	10000	20000	-
NGOs	12000	100000	-
Interest rate of credit (%)			
Banks	12	15	-
NGOs	20	30	-

Source: FGD (June 2020)

11.1.3 Innovativeness of Farmer for Transformation of land to Litchi Orchard

Innovative technology was not well adopted in the area because of non-availability of modern and innovative technologies (Table 11.1.3.1). It is found that, about 15% farmers practiced IPM technology which is higher for large farmers meaning that larger farmers used more IPM technology compared to others. Only 9% of farmers applied Urea Super Granule (USG). Among the farmers category, large farmers used highest (15%) of this fertilizer. Only 12% farmers used Sex Pheromone to control insects in the study area. Hybrid maize was cultivated by 30.43% farmers in the study area. On the contrary, majority farmers (97%) practiced line sowing method in HYV maize cultivation. A few farmers (3.40%) reportedly used vermin-compost fertilizer for

crop production. No farmers in the area practiced techno-compost for crop production. Regarding mechanization, about 40% farmers used power tiller for land preparation. It is revealed that majority of farmers used innovated technologies after one or two years of planting litchi trees.

Table 11.1.3.1: Farmers' Innovation for transformation of crops lands into litchi gardening in the study area (% of farmers)

Major factors	Factor category	% farmers used			
		Small Farm (n=58)	Medium Farm (n=105)	Large Farm (n=37)	All
IPM	Never use	90.63	91.38	73.63	85.21
	After 1 year	4.30	3.32	9.10	5.57
	After 2 years	2.10	3.05	10.00	5.05
	After 3-4 years	1.76	1.12	4.24	2.37
	After 5 years or more	1.22	1.13	3.02	1.79
Granular urea	Never use	93.75	93.10	85.45	90.77
	After 1 year	1.24	2.30	8.15	3.90
	After 2 years	2.20	2.90	3.07	2.72
	After 3-4 years	1.55	0.87	1.22	1.21
	After 5 years or more	1.26	0.83	2.11	1.40
Sex pheromone	Never use	87.50	91.37	84.55	87.81
	After 1 year	4.50	2.30	8.24	5.01
	After 2 years	5.00	1.95	4.10	1.91
	After 3-4 years	1.30	2.32	2.10	1.91
	After 5 years or more	1.70	2.06	1.01	1.59
Hybrid maize cultivation	Never use	84.38	70.69	53.64	69.57
	After 1 year	7.40	13.60	9.30	10.10
	After 2 years	4.50	12.35	23.67	13.51
	After 3-4 years	2.20	2.10	10.20	4.83
	After 5 years or more	1.52	1.26	3.19	1.99
Vermi- compost	Never use	96.88	96.55	96.36	96.60
	After 1 year	-	1.15	2.08	1.08
	After 2 years	2.10	1.30	0.76	1.39
	After 3-4 years	1.02	-	0.48	0.50
	After 5 years or more	0	1.00	0.32	0.44
Techno-compost	Never use	100	100	100	100
	After 1 year	-	-	-	-
	After 2 years	-	-	-	-
	After 3-4 years	-	-	-	-
	After 5 years or more	-	-	-	-
Line sowing of HYV maize	Never use	4.00	3.50	3.00	3.50
	After 1 year	89.00	91.00	93.00	91.00
	After 2 years	5.00	4.00	1.00	3.33
	After 3-4 years	1.00	1.00	2.00	1.33
	After 5 or more	1.00	0.50	1.00	0.83
Use of power tiller	Never use	65.63	63.79	50.91	60.11
	After 1 year	25.00	31.00	41.00	32.33
	After 2 years	5.00	3.00	6.00	4.67
	After 3-4 years	3.37	1.75	2.00	2.37
	After 5 years or more	1.00	0.46	0.09	0.52

Source: Field survey 2020

11.1.4 Extent of Cropland Transformation into Litchi Production

Farmers in the study area are transforming crop land into litchi cultivation because of getting more profit from litchi cultivation (Table 11.1.4.1). Twenty years' data from 2000-2001 to 2019-2020 showed that, average 20 farmers in a year transformed crop land into litchi orchard. Among the different categories of farmers, highest480 decimal landtranformated small farmers in 2005-2006 , 915 decimal land medium farmers in 2002-2003 and 850 decimal land transformated large farmers in 2016-2017 were involved in transforming crop land into litchi orchard indicating that large farmers were more involved in this transformation followed by medium and small farmers. This implies that economic solvency is an important factor setting up litchi orchard.

Table 11.1.4.1: Trend of Transformation of Cropland into Litchi Orchard in the study area (Land in dec.)

Year	Change of cropland into litchi production					
	Small	Medium	Large	All	Mean	SD
2000 - 2001	240	841	543	1624	541.33	300.50
2001 - 2002	235	497	631	1363	454.33	201.42
2002 - 2003	245	915	250	1410	470.00	385.39
2003 - 2004	150	905	0	1055	351.67	485.03
2004 - 2005	167	670	470	1307	435.67	253.25
2005 - 2006	480	504	250	1234	411.33	140.23
2006 - 2007	170	790	300	1260	420.00	326.96
2007 - 2008	394	675	150	1219	406.33	262.72
2008 - 2009	308	704	370	1382	460.67	213.00
2009 - 2010	371	710	298	1379	459.67	219.85
2010 - 2011	182	856	320	1358	452.67	356.05
2011 - 2012	175	680	530	1385	461.67	259.34
2012 - 2013	50	740	355	1145	381.67	345.77
2013 - 2014	90	594	510	1194	398.00	270.02
2014 - 2015	89	765	385	1239	413.00	338.87
2015 - 2016	170	945	200	1315	438.33	439.04
2016 - 2017	120	505	875	1500	500.00	377.52
2017 - 2018	127	867	190	1184	394.67	410.26
2018 - 2019	35	380	835	1250	416.67	401.26
2019 - 2020	80	545	690	1624	541.33	300.50

Source: Field Survey (2020), SD= Standard Deviation

11.1.5 Reasons for crop transformation in litchi orchard

Situational Factors

A total of 118 farmers (59%) mentioned (Table 11.1.5.1) that, litchi cultivation is much easier and profitable because of favorable climatic condition in the area, of which 30 were small farmers, 72 were medium farmers and 16 were large farmers. A total of 173 farmers (86.5%) consisting 55 small, 84 mediums and 34 large farmers mentioned that they diverted other crop land to litchi cultivation owing to suitable soil condition for litchi production in the area. In total 132 farmers (66%) consisting of 34 small, 72 mediums and 26 large farmers opined that, litchi was less vulnerable to insect and pests compare with other field crops. One hundred fifty farmers (75%) which accounting for 44 small, 81 mediums and 25 large farmers stated that yield of other field crops became lower because of cultivating same crops year after year on the same plot. Eighty-five percent farmers (170) expressed that they preferred litchi cultivation as it requires less water compared to other field crop. They also mentioned that as Dinajpur area is dry or less humidity condition, more irrigation is needed for crop production.

Economic Factors

Eighty eight percent farmers have mentioned that litchi production needs less cost compare to other crops (Table 11.1.5.1). Almost all farmers (97%) have stated that yield potentiality of litchi is higher than other crop production and demand for litchi is higher compared to other crops. About 97% farmers have opined that it is very easy to sell as there are lots of buyers to purchase litchi from the farm. Ninety-eight percent farmers have expressed that they prefer litchi cultivation because of its higher profitability compared to any other crops in the area. All farmers but two of them have mentioned that they can get cash instantly at a time after selling litchi. They also mentioned that litchi cultivation required less laborer compare to other crops.

Socio-cultural factors

It is found that 91.5% farmers became interested in litchi cultivation after seeing neighbours' litchi cultivation (Table 11.1.5.1). On the other hand, 65%, 69.5% and 56% farmers have motivated to cultivate litchi by change agents, family members and farmer's co-operatives, respectively. While, 82 % of them have encouraged due to availability of processed fruits.

Table 11.1.5.1: Farmers stated reasons for land transformation into litchi orchard

Reasons for transformation	% of farmers in favour of stated reason			
	Small (n=58)	Medium (n=105)	Large (n=37)	All (n=200)
Situational				
Cropping with climate change situation	51.7 (30)	68.6 (72)	43.2 (16)	59 (118)
Soil suitability	94.8 (55)	80 (84)	91.9 (34)	86.5 (173)
Highly vulnerable to insects and diseases	58.6 (34)	68.6 (72)	70.3 (26)	66 (132)
Lower yield due to long-term mono cropping	75.9 (44)	77.1 (81)	67.6 (25)	75 (150)
Less water required crop	84.5 (49)	85.7 (90)	83.8 (31)	85 (170)
Economical				
Lower cost of production	93.1 (54)	86.7 (91)	83.8 (31)	88 (176)
Higher yield	98.3 (57)	95.2 (100)	100 (37)	97 (194)
Higher market demand	93.1 (54)	98 (103)	100 (37)	97 (194)
Easy to sell	93.1 (54)	97.1 (102)	100 (37)	96.5 (193)
Higher profitability /return	98.3 (57)	97.1 (102)	100 (37)	98 (196)
Can get the cash at a time	100 (58)	99 (104)	97.3 (36)	99 (198)
Can manage with minimum labor	100 (58)	99 (104)	97.3 (36)	99 (198)
Socio-Cultural				
Neighboring farmers' transforming	84.5 (49)	96.1 (101)	89.2 (33)	91.5 (183)
Motivation by the change agents	55.1 (32)	69.5 (73)	67.6 (25)	65 (130)
Family pressure	58.6 (34)	79 (83)	59.5 (22)	69.5 (139)
Decisions of the farmers' cooperative	56.9 (33)	57.1 (60)	51.4 (19)	56 (112)
Availability of processed fruits	79.3 (46)	85.7 (90)	75.7 (28)	82 (164)

Source: Field Survey (2020), Figures in the parenthesis indicate the number

11.1.6 Effects on Farming Practices due to Transformation of Cropland into Litchi Production

Analysis further attempted to know the impact of litchi cultivation on farming practices. A total of 19 factors were considered for that purpose. They are: labor use, ease in land preparation, manage of seeds/saplings, irrigation, weeding, use of farm machinery, fertilizer application, scope of using IPM, use of insecticides, use of pesticides, easy in harvesting, easy of sorting, easy of grading, easy in packaging, easy in storing, cost of production, farm output, easy saale of farm produces and net profit from farming (Table 11.1.6.1). It is found that laborer used, ease in land preparation, managing seeds/saplings, use of farm machinery, fertilizer application, scope of using IPM, easy in harvesting, easy in sorting, easy in grading, easy in packaging, easy in storing, farm output, easy sale of farm produces and net profit from farming parameters increased as 69%, 90.5%, 82%, 80%, 90%, 78%, 92%, 87%, 88.5%, 81.5%, 84%, 92.5%, 93% and 92% farmers mentioned them, respectively. Conversely, 84%, 75%, 92%, 91.5% and 93% farmers remarked that, irrigation, weeding, insecticides use, pesticides use and cost of production reduced owing to transforming crop land into litchi cultivation.

Table 11.1.6.1: Consequence of Transformation of Cropland into Litchi orchard

Factors	Small Farm			Medium Farm			Large Farm			All			Percentage share in n=200		
	Increased	Unchanged	Decreased	Increased	Unchanged	Decreased	Increased	Unchanged	Decreased	Increased	Unchanged	Decreased	Increased	Unchanged	Decreased
Labor use	0	7	51	7	28	70	11	9	17	18	44	138	9	22	69
Ease in land preparation	54	4	0	97	8	0	30	4	3	181	16	3	90.5	8	1.5
Manage of seeds/saplings	49	9	0	87	16	2	28	7	2	164	32	4	82	16	2
Irrigation	0	6	52	1	11	93	5	9	23	6	26	168	3	13	84
Weeding	0	7	51	2	26	77	6	9	22	8	42	150	4	21	75
Use of farm machinery	47	11	0	86	11	8	27	5	5	160	27	13	80	13.5	6.5
Fertilizer application	0	6	52	5	4	96	2	3	32	7	13	180	3.5	6.5	90
Scope of using IPM	50	8	0	93	10	2	13	12	12	156	30	14	78	15	7
Use of insecticides	0	4	54	1	3	101	5	3	29	6	10	184	3	5	92
Use of pesticides	0	7	51	1	3	101	3	3	31	4	13	183	2	6.5	91.5
Easy in harvesting	54	4	0	100	3	2	30	3	4	184	10	6	92	5	3
Easy of sorting	52	6	0	96	7	2	26	9	2	174	22	4	87	11	2
Easy of grading	52	6	0	100	3	2	25	11	2	177	20	4	88.5	10	2
Easy in packaging	46	12	0	100	4	1	17	16	4	163	32	5	81.5	16	2.5
Easy in storing	51	7	0	96	7	2	21	14	2	168	28	4	84	14	2
Cost of production	0	3	55	3	4	98	2	2	33	5	9	186	2.5	4.5	93
Farm output	51	7	0	100	4	1	34	2	1	185	13	2	92.5	6.5	1
Easy sale of farm produces	50	8	0	101	3	1	35	2	0	186	13	1	93	6.5	0.5
Net profit from farming	52	6	0	99	4	2	33	3	1	184	13	3	92	6.5	1.5

Source: Field Survey (2020) Note: n- number of respondents

11. 1.7 Effects of Agricultural Transformation on Household Food Security

Food Availability

Ten parameters were considered to measure food availability in the farmers' household (Table 11.1.7.1). About 84% farmers reported that all necessary food items are available in the regional market as well as in the local growth center and this food items are steadily available in the local market round the year. Moreover, rice and vegetables are sufficiently available in local growth centre as mentioned by 86% and 88% farmers, respectively. About 85% to 90% farmers responded that fish, meat, egg, fresh fruits including mangoes are sufficiently available in the local market.

Food Access

In case of food access, 8 parameters were considered to measure food access in the farmers' household (Table 11.1.7.1). Seventy-nine percent farmers shared their ideas that they have sufficient financial ability to purchase cereals (rice/wheat flour) for all the family members, while 19% mentioned that they had moderately ability to purchase cereals. About 82% farmers told that they had ability to purchase fish for all the family members, but 15% said they had moderately ability to purchase fish. In case meat, 84.5% farmers had sufficient ability and 9.5% moderately capable. Eighty-four percent farmers opined that they had financial ability to purchase egg but 11% expressed moderately ability. A lion's share of farmers (83.5%) shared that they have financial capacity to store food grains in lean period, whereas 11% are moderately capable. Average 83.5% farmers opined that, they have sufficient financial capacity to purchase processed fruit items and 11% farmers mentioned having moderately capacity in such parameter. Average 85.5% farmers stated that they had sufficient sources to borrow necessary food items during crisis moments from neighbours/friends and ability to purchase processed fruits items. Finally, 82% farmers had equally access of nutritious foods to women, children and elderly members.

Food Utilization

Six parameters were taken into account to measure food utilization in farmers' household (Table 11.1.7.2). Average 82.5% farmers mentioned that they had sufficient knowledge and skill to prepare healthy diets with available food items and 12% of them could do it moderately. While 85% farmers were sufficient capable to distribute food among all family members as per requirements. It is reported that 83% famers have sufficient facilities of storing surplus cooked food in refrigerator and 11.5% of them had moderately scope. A lion's

share (82.5%) of farmers expressed that they had sufficient and better knowledge and skill to store vegetables for using in off season and 12.5% of them had moderately knowledge and skill. It is observed that 82% and 84% farmers had better knowledge and skill to store fruits for using in off season and to make dry and store fish for using in off season, respectively.

Income

For measuring family income, 9 parameters were considered to reduce household poverty (Table 11.1.7.2). Average 82.5% farmers mentioned that their income from crop production was sufficient to reduce household poverty while 77%, of them indicated that income from livestock was sufficient in this regard. On the other hand, 83%, 81.5%, and 80.5% farmers' income from fisheries, service and small business were reportedly sufficient, respectively. It is found that, 84%, 10% and 5% farmers' income from wage earning was sufficient, moderate and poor to reduce their household poverty respectively. Finally, It is revealed that, 84%, 79.5%, 83% and 88% farmers' income from wage earning, in-country remittance, out-country remittance and on-farming activities were sufficient to reduce their household poverty, respectively.

Food Consumption

In case of food consumption, 9 parameters were selected (Table 11.1.7.3). Average 81% farmers stated that their required carbohydrate consumption ability was sufficient. On the other hand, 78.5%, 76%, 72.5%, 78% and 78% farmers' fish, meat, egg, fresh vegetables and fresh fruits consumption were sufficient. Average 81.5% farmers remarked that their consumption of tea and coffee were sufficient. Finally, 82.5% and 88% farmers said that they had sufficient ability to eat two meals and three meals in a day.

Wellbeing

A total of 12 parameters were considered to measure wellbeing of farmers after setting up litchi orchard (Table 11.1.7.3). Average 72.41%, 17.24% and 10.34% small farmers owned tin made house, half building house and full building house, respectively. The corresponding figures for medium and large farmers were 88.57%, 5.71% and 5.71% and 67.57%, 13.51% and 18.92%, respectively. Overall, 28.57%, 36.46% and 34.97% farmers owned tin made, half building and full building houses, respectively. Average 78.5% and 88% farmers had sufficient sanitary/modern toilet facilities and electricity supply, respectively. It is observed that, 88%, and 11.5% litchi farmers had electricity supply sufficiently and moderately respectively. Only 0.50% famers had no connection with electricity. Out of surveyed 200

litchi farmers, no one used solar electricity because of the availability of electricity supply. It is found that, 80.5%, 16% and 3.5% farmers had tube-well for family water supply as sufficient, moderate and poor respectively. It is mentioned that, 90.33% farmers had no water supply by water pump and only 9.67% farmers used water pump for water supply. Average 76.5%, 16% and 7.5% farmers' family had sufficient, moderate and poor ability for better clothing of their family members respectively. A total of 76.5%, 17.5% and 6% farmers mentioned that, they are sufficiently, moderately and poorly able to provide required cost for better education for the children, respectively. It is also mentioned that, 86.5%, 9.5% and 3.5% farmers use ICT facilities sufficiently, moderately and poorly, respectively. It is found that, 77%, 15% and 8% farm families are participating in different social events sufficiently, moderately and poorly, respectively.

Table 11.1.7.1: Level of Food Availability and Access for Household Food Security through Transformation for the Litchi Production

Issues	% of farmer wise																			
	Small (n= 58)				Medium (n= 105)				Large (n= 37)				All				Mean			
	No change	Poor	Moderate	Sufficient	No change	Poor	Moderate	Sufficient	No change	Poor	Moderate	Sufficient	No change	Poor	Moderate	Sufficient	No change	Poor	Moderate	Sufficient
Food Availability																				
Availability of all necessary food items in regional market	-	1.5	5	22.5	-	1	5	46.5	-	1	3	14.5	-	3.5	13	83.5	-	1.17	4.33	27.33
Available of all necessary food items at local growth centre	-	-	3	26	-	2	7	43.5	-	1.5	3	14	-	3.5	13	83.5	-	1.17	4.33	27.33
Availability of the necessary food items steady in the local market round the year	-	-	3.5	25.5	-	-	7.5	45	-	1	3.5	13.5	0.50	1	14.5	84	0.17	0.33	4.83	28.00
Only rice is available at local growth centre	-	1.5	2	25.5	-	0.50	6	46	-	0.50	3.5	14.5	-	2.5	11.5	86	-	0.83	3.83	28.67
Only vegetable is available at local growth centre	-	1	2	26	-	0.50	5.5	46.5	-	0.50	2.5	15.5	-	2	10	88	-	0.67	3.33	29.33
Fish is available at local market	-	0.50	2	26.5	-	1	7	44.5	-	-	2.5	16	-	1.5	11.5	87	-	0.50	3.83	29.00
Meat is available at local market	-	0.50	2	26.5	-	1	8	43.5	-	-	3.5	15	-	1.5	13.5	85	-	0.50	4.5	28.33
Egg is available at local market	-	0.50	1.5	27	-	1	5.5	46	-	-	2	16.5	-	1.5	9	89.5	-	0.50	3	29.83
Fresh fruits are available at the local market	-	0.50	1.5	27	-	0.50	5	47	-	-	3.5	15	-	1	10	89	-	0.33	3.33	29.67
Fresh mangoes are availability at local market	-	0.50	1.5	27	-	1.5	5.5	45.5	-	-	2.5	16	-	2	9.5	88.5	-	0.67	3.17	29.5
Food Access																				
Financial ability to purchase cereals (rice/wheat flour)	-	0.50	3	25.5	-	1	8.5	43	-	0.50	7.5	10.5	-	2	19	79	-	0.67	6.33	26.33
Financial ability to purchase fish	-	1	2	26	-	1.5	7	44	-	1	6	11.5	-	3.5	15	81.5	-	1.17	5	27.17
Financial ability to purchase meat	-	0.50	2	26.5	-	2.5	4	46	-	3	3.5	12	0.50	6	9.5	84.5	0.17	2	3.17	28.17
Financial ability to purchase egg	-	1.5	2.5	25	-	1.5	4.5	46.5	-	2	4	12.5	-	5	11	84	-	1.67	3.67	28.00
Financial capacity to store food grains	-	1.5	2.5	25	-	0.50	5.5	46.5	-	3	3	12	0.50	5	11	83.5	0.17	1.67	3.67	27.83
Financial capacity to purchase processed fruit items	-	1.5	2.5	25	-	2	4	46.5	-	2	4.5	12	-	5.5	11	83.5	-	1.83	3.67	27.83
Borrow/lend necessary food items during crisis moments from neighbours/friends	-	0.50	2	26.5	-	1	4	47.5	-	2	3	11.5	2	3.5	9	85.5	0.67	1.17	3	28.50
Equal access of the women, children and elderly family members to nutritious food	-	1	3	25	-	1.5	6.5	44.5	-	3	3	12.5	-	5.5	12.5	82	-	1.83	4.17	27.33

Source: Field Survey (2020)

Table 11.1.7.2: Status of Food Utilization in relation to Household Food Security through Transformation of Cropland into Litchi Orchard

Issues	% of farmers as per ideas																			
	Small (n= 58)				Medium (n= 105)				Large (n= 37)				All				Mean			
	No change	Poor	Moderate	Sufficient	No change	Poor	Moderate	Sufficient	No change	Poor	Moderate	Sufficient	No change	Poor	Moderate	Sufficient	No change	Poor	Moderate	Sufficient
Food Utilization																				
Having sufficient knowledge and skill to prepare healthy diets with available food items	-	2	4	23	-	2	4.5	46	-	1.5	3.5	13.5	-	5.5	12	82.5	-	1.83	4	27.5
Better management to distribute food among all family members as per requirements	-	2	3	24	-	1.5	3.5	47.5	-	2	3	13.5	-	5.5	9.5	85	-	1.83	3.17	28.33
Scope of storing surplus cooked food in refrigerator	-	1.5	3	24.5	-	1	6	45.5	2.5	0.50	2.5	13	2.5	3	11.5	83	0.83	1	3.83	27.67
Better knowledge and skill to store vegetables for using in off season	-	1.5	3	24.5	-	1.5	6.5	44.5	0.50	1.5	3	13.5	0.50	4.5	12.5	82.5	0.17	1.5	4.17	27.5
Better knowledge and skill to store fruits for using in off season	-	1	3	25	-	1.5	5.5	45.5	0.50	2	4.5	11.5	0.50	4.5	13	82	0.17	1.5	4.33	27.33
Better knowledge and skill to dry and store fish for using in off season	-	2.5	2.5	24	-	2	4.5	46	0.50	1.5	2.5	14	0.50	6	9.5	84	0.17	2	3.17	28
Source of Income																				
Crop production	-	1	3.5	24.5	-	2	5	45.5	-	1	5	12.5	-	4	13.5	82.5	-	1.33	4.5	27.5
Livestock	-	1.5	3	24.5	-	3	5	44.5	2	4.5	4	8	2	9	12	77	0.67	3	4	25.67
Fisheries	-	1	2.5	25.5	-	3	5	44.5	1	1	3.5	13	1	5	11	83	0.33	1.67	3.67	27.67
Services	-	0.50	3	25.5	-	3.5	6	43	1.5	1.5	2.5	13	1.5	5.5	11.5	81.5	0.50	1.83	3.83	27.17
Small business	-	2	3.5	23.5	-	4	6	42.5	1	0.50	2.5	14.5	1	6.5	12	80.5	0.33	2.17	4	26.83
Wage earning	-	1	2	26	-	3	6.5	43	1	1	1.5	15	1	5	10	84	0.33	1.67	3.33	28
In-country remittance	-	2	3.5	23.5	-	5.5	7	40	-	1	1.5	16	-	8.5	12	79.5	-	2.83	4	26.5
Out-country remittance	-	1.5	2.5	25	-	3.5	5	44	-	0.50	4	14	-	5.5	11.5	83	-	1.83	3.83	27.67
On-farming activities	-	1.5	3	24.5	-	4.5	7	41	-	1	3	14.5	-	7	13	80	-	2.33	4.33	26.67

Source: Field Survey (2020)

Table 11.1.7.3: Effect of Transformation on Household Poverty Reduction due to Litchi Production

Issues	% of farmers agree to the ideas																Mean			
	Small				Medium				Large				All							
	No change	Poor	Moderate	Sufficient	No change	Poor	Moderate	Sufficient	No change	Poor	Moderate	Sufficient	No change	Poor	Moderate	Sufficient	No change	Poor	Moderate	Sufficient
Food Consumption																				
Carbohydrate	-	2	2	25	-	2	8.5	42	1	1.5	2	14	1	5.5	12.5	81	0.33	1.83	4.17	27
Fish	-	1.5	2.5	25	-	2.5	8.5	41.5	0.50	2	4	12	0.50	6	15	78.5	0.17	2	5	26.17
Meat	-	2	3.5	23.5	-	4.5	7	41	0.50	2	4.5	11.5	0.50	8.5	15	76	0.17	2.83	5	25.33
Egg	-	2.5	5.5	21	-	3.5	9	40	0.50	1.5	5	11.5	0.50	7.5	19.5	72.5	0.17	2.5	6.5	24.17
Fresh vegetables	-	1.5	5	22.5	-	2.5	6.5	43.5	0.50	1.5	4.5	12	0.50	5.5	16	78	0.17	1.83	5.33	26
Fresh fruits	-	2	2.5	24.5	-	4	6.5	42	0.50	2	4.5	11.5	0.50	8	13.5	78	0.17	2.67	4.5	26
Tea and coffee	-	2.5	3	23.5	-	3.5	4.5	44.5	1	1	3	13.5	1	7	10.5	81.5	0.33	2.33	3.5	27.17
3-meal per day	-	1.5	2	25.5	-	1	4.5	47	-	0.50	2.5	15.5	0.00	3	9	88	-	1	3	29.33
2-meal per day	-	2	1.5	25.5	-	4	5.5	43	-	1.5	3	14	0.00	7.5	10	82.5	-	2.5	3.33	27.5
Wellbeing																				
Tin made house	-	-	-	72.41	-	-	-	88.57	-	-	-	67.57	-	-	-	28.57	-	-	-	86.18
Half building house	-	-	-	17.24	-	-	-	5.71	-	-	-	13.51	-	-	-	36.46	-	-	-	12.15
Full building house	-	-	-	10.34	-	-	-	5.71	-	-	-	18.92	-	-	-	34.97	-	-	-	11.66
Sanitary/modern toilet and wash facilities	-	2.5	2.5	24	-	1	9	42.5	-	-	6	12	-	4	17.5	78.5	-	1.33	5.83	26.17
Electricity supply	-	-	2	27	-	-	6	46.5	0.50	-	3.5	14.5	0.50	-	11.5	88	0.17	-	3.83	29.33
Solar electricity	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-
Tube-well	0.00	2	2.5	24.5	-	1	9	42.5	-	0.50	4.5	13.5	0.00	3.5	16	80.5	-	1.17	5.33	26.93
Water supply by own pumping	94.8	-	-	5.17	92.3	-	-	7.62	83.7	-	-	16.22	271	-	-	29	90.33	-	-	9.67
Better clothing for family members	-	1.5	2.5	25	-	4	7	41.5	-	2	6.5	10	-	7.5	16	76.5	-	2.5	5.33	25.5
Better education for the children	-	2	4	23	-	3	8	41.5	-	1	5.5	12	-	6	17.5	76.5	-	2	5.83	25.5
ICT use	-	1	2	26	-	2.5	4.5	45.5	-	-	3	15	-	3.5	9.5	86.5	0.17	1.17	3.17	28.83
Participation in social events	-	1.5	2	25.5	-	4.5	8.5	39.5	-	2	4.5	12	-	8	15	77	-	2.67	5	25.67

Source: Field Survey (2020)

11.1.8 Problems and Suggestions for Promotion of the Transformation of Cropland into Litchi Orchard

11.1.8.1 Problems

A total of 34 problems identified during the survey of 200 litchi farmers (Table 11.1.8.1.1). The identified problems are categorized as production related problems, management related problems, pest and diseases related problems, social problems, and climate related problems and marketing problems.

Production Related Problems

The selected litchi farmers mentioned several productions related problems which are high mortality rate of sapling, lack of technology about mulching by quick growing leguminous crop, high price of litchi saplings, lack of credit support from GO and NGO, lack of knowledge about impact of inter-cropping on litchi yield and high price of fertilizers. The highest 63.5% farmers mentioned lack of technology for mulching by quick growing leguminous crop as a problem followed by high mortality rate of sapling (59.5%) and high price of litchi saplings (58.5%).

Management Related Problems

The largest 92.5% farmers identified scarcity of training as a problem followed by storage and processing problem (77%), high primary and management cost (68%) and scarcity of knowledge and skill about proper pruning (61.5%).

Pest and Disease Related Problems

Five pest and disease related problems were identified by litchi farmers. They are: Cancer Disease of Litchi (Pachon rog), Insect and Disease Infestation, Higher cost of Pesticide, Litchi GutiPocha rog and high dropout and Lower Quality of Chemical. Sixty-six % farmers stated Litchi GutiPocha rog and high dropout as the major problem followed by Cancer Disease of Litchi (Pachon rog) (62.5%) and Insect and Disease Infestation (53%).

Social Problems

The social problems identified are: investment of high capital, plant damage by public, loss occurred by cattle and goat and absent of litchi farmers association. The major problem identified as absent of litchi farmers' association mentioned by 73% farmers. Next to this problem are investment of high capital and loss occurred by cattle and goat identified by 73% and 62.5% farmers, respectively.

Climate Related Problems

The interviewed farmers mentioned six climate related problems. They are: irrigation and drainage problem, fall down of stem from plant due to natural calamities (Storm, Heavy rain), changes of cultivation method, adverse climatic condition, yield loss due to rainfall at the flowering stage and humid weather cause low quality litchi. The greatest 67% farmers identified yield loss due to rainfall at the flowering stage as a problem followed by irrigation and drainage problem (64%) and fall down of stem from plant due to natural calamities (63%).

Marketing Related Problems

A total of 6 marketing related problems are identified which are wholesalers' tyranny, limitation of harvesting time, higher weight count (50 kg for a maund), high price variation in some year, absence of large numbers of paikers and low price of litchi in some year. The highest 93.5% farmers mentioned limitation of harvest time as a problem followed high weight count (88%) and high price variation in some year (61%). Among all types of problems, limitation of harvesting time ranks first. The other problems in descending order are scarcity of training, absent of litchi farmers' association, higher weight count, storage and processing problem, investment of high capital, high primary and management cost and so on.

Table 11.1.8.1.1: Problems Encountered by the sample Litchi Farmers

Problems	% of farmers opined	Weighted rank
Production Related Problems		
High mortality rate of Sapling	59.5	17
Lack of technology about mulching by quick growing leguminous crop	63.5	11
High price of litchi sapling	58.5	16
Lack of Credit Support from GO/NGO	31.5	27
High price of fertilizers	45	22
Management Related Problems		
Scarcity of Knowledge and Skill about proper pruning	61.5	13
Lack of quality bag	43.5	21
Labour Scarcity	32	26
High Cost of Fencing Setting	59	15
Scarcity of Training	92.5	2
Storage and Processing Problem	77	5
High Primary and management Cost	68	7
Pest and Disease Related Problems		
Canser Disease of Litchi (Pachon rog)	62.5	12
Insect and Disease Infestation	53	18
Higher cost of Pesticide	38	24
Litchi GutiPocha rog and high drop out	66	9
Lower Quality of Chemical	47.5	20
Social Problems		
Investment of High Capital	73	6
Plant Damage by Public	35	25
Loss Occurred by Cattle and Goat	62.5	12
Absentee of litchi farmers Association	89.5	3
Climate Related Problems		
Irrigation and Drainage Problem	64	10
Fallen down of Stem from Plant due to Natural Calamity (Storm, Heavy rain)	63	11
Changes of Cultivation Method	60	15
Adverse Climatic Condition	41	23
Rainfall in the flowering season occurred yield loss	67	8
Humid weather occurred low quality litchi	56	17
Marketing Related Problems		
Wholesaler Tyranny	42	22
Limitation of Harvesting Time	93.5	1
Higher Weight Count (50 kg/Mon)	88	4
Price Variation in some year	61	14
Marketing Problems due to less paikers	47.5	20
Lower Price of litchi in some Year	49.5	19

Source: Field Survey (2020)

11.1.8.2 Suggestions

The selected litchi producer advocated 23 suggestions for solving the current problems identified by them (Table 11.1.8.2.1). Among the different suggestions, subsidy from government ranks first (89%) followed by reduction of sapling price (88.5%), developing fair weight system (87.5%) and no binding in harvest time. The other suggestions in descending order are: increase GOs and NGOs support (87%), supply of good quality bag at lower price (83.5%), building cold storage/processing unit (87.5%), establishment of juice processing plants (81%), alternate/digital marketing (81%), Govt. support in price management (78.5%), development of marketing system (77.5%), reduction of cost (77%), availability of easy credit from by Govt. bank (76.5%), monitoring chemical quality (74%), more training on pest management and other (74%),export facility (71.5%), inter crop cultivation (71.5%) and so on.

Table 11.1.8.2.1: Suggestions Provided by the Farmers for Progress of land Transformation to Litchi

Suggestions	% of farmers	Weighted rank
Subsidy from Govt.	89	1
Reduction of Sapling Price	88.5	2
No binding in Harvesting Time	87.5	3
Fair Weight System	87.5	3
Increase GOs and NGOs Support	87	4
Supply of Good Quality Bag at lower Price	83.5	5
Building Cold Storage/Processing Unit	82	6
Alternate/Digital Marketing	81	7
Development of Juice Processing Plants	81	7
Govt. Support in Price Management	78.5	8
Development of Marketing System	77.5	9
Reduction of Cost	77	10
Availability of Easy Credit System by Govt. Bank	76.5	11
More Training on Pest Management and others	74	12
Chemical Quality Monitoring	74	12
Export Facility	71.5	13
Inter crop Cultivation	71.5	13
Fencing Setting	70	14
Replanting of Sapling	70	14
Change of Variety	64	15
Timely Irrigation and Drainage	61.5	16
Creating Awareness	48.5	17
Use of Good Quality Pesticide	26.5	18

Source: Field Survey (2020)

Recommendations for further study

The following suggestions are made for further study:

- The present study was conducted in Sadar upazila of Dinajpur district. So, similar studies may be undertaken in other parts of the country to verify the findings of the present study.
- Relationships of selected characteristics of the litchi farmers in relation to the land with their transformation and adoption of litchi cultivation have been investigated in this study. Future research should be conducted to investigate other characteristics of the farmers in transformation and adoption of other crop cultivation.
- The study was confined among the litchi farmers only. Further study needs to be conducted among the general farmers.

B. Transformation of crops land into HYV maize cultivation

Production of HYV maize is one of the major sources of income earning and employment generation at the farmers' level of Lalmonirhat and Panchagargh. In this case, socio-economic characteristics of HYV maize cultivators as driving factors and nature, extend, effects as resulting factors were identified for transformation of land for HYV maize cultivation. Overall, three category farmers such as small, medium and large were identified for the study. The identified factors related to land transformation are discussed below under several headings.

11.2.1 Socio-economic characteristics of HYV maize producers in Lalmonirhat and Panchagargh

For understanding socio-economic status of HYV maize farmers some important factors i.e. age, schooling, farming experience, occupation, gender, marital status, religion, household size, farm size, annual income, training exposure, access to credit, extension media contact, organizational participation, and agricultural knowledge were determined. All these factors are detailed under sub-headings of performance profile, socio-economic factors and innovativeness of the farmers in the following section.

11.2.1.1 Performance profile of HYV maize growers

Some eligible factors like age, education, farming experience, occupation, gender, marriage and religion were considered as performance indicators of maize farmers. Performance factors with respect to land transformation towards HYV maize cultivation are mentioned below.

Age

The age range of all types of farmers were categorized into five groups which are 18– 30 years, 31- 40 years, 41 – 50 years, 51- 60 years and above 61 years respectively. Moreover, average of age and standard deviation of age and t staistics were also calculated for all the categories of farmers (Table 11.2.1.1.1).

Table 11.2.1.1.1: Status of HYV Maize Farmers Based on Age Level in Lalmonirhat and Panchagarh

Study areas	Age group	Distribution of farmers as per category			
		Small	Medium	Large	Average
Lalmonirhat	18– 40 years	27.38	27.42	38.77	31.19
	41- 60 years	70.24	61.29	59.19	63.58
	61 and above	2.38	11.29	2.04	5.24
	Total	100	100	100	100
	Average (year)	47.80 (2.14)**	48.87 (2.17)**	44.59 (1.95)	47.09 (2.65)***
	SD (year)	8.90	12.14	8.09	9.71
Panchagarh	18– 40 years	36.13	54.23	31.82	40.73
	41- 60 years	59.66	42.37	63.64	55.22
	61 and above	4.20	3.39	4.55	4.05
	Total	100	100	100	100
	Average (year)	44.93 (1.91)	40.64 (1.97)**	44.55 (2.31)**	43.37 (2.34)**
	SD (year)	10.19	11.67	12.61	11.49

Source:Field Survey (2020), SD=Standard Deviation,(Values in parentheses indicate t-value) (**and ***indicate significance at 5% and 1% level)

In Table 11.2.1.1.1 it is revealed that in Lalmonirhat the lowest percent of farmers were belonged to in age group of 61 and above years that were 2.38%, 11.29%, 2.04% and 5.24%, respectively for small, medium, large and average farmers group. But, the highest farmers for small (70.24%), medium (61.29%), large (59.19%) and average (63.58%) were identified in 41-60 age group. In Panchagarh, lowest percentage of small, medium, large percentage of respondents were under 61 and above year age groups and the highest percentage; small (59.66%), medium (42.37%), large (63.64%) and average (55.22%) were identified in 41-60 age group. Therefore, it is revealed that 41-60 years aged farmers were involved in transformation of crop land into HYV maize cultivation. Standard deviations of years were 8.90 to 12.14 in Lalmonirhat and 10.19 to 12.61 in Panchagarh meaning that the farmers are closely related to decision making to the transformation of crops land into the HYV maize cultivation. In Lalmanirhat small (t value 2.14) and medium (t valu 2.17) farmers' and Panchagarh medium (t value 1.97) and large (t value 2.31) farmer were significantly influenced the transformation crop land to HYV maize cultivation.

Education

Education of HYV maize farmers was considered a prime factor for transformation of crops land into HYV maize cultivation in the study areas. Therefore, as per year of schooling, six education levels were classified which was illiterate, primary, secondary, higher secondary, graduate and post graduate. In Table 11.2.1.1.2 it was found that in Lalmonirhat, illiterate farmers were 1.19 % to 1.61% but there is no illiterate was found for large farmers. The highest percentages of educated farmers were medium (59.68%) and lowest for large farmer (38.78%) farmers. The secondary education level was highest for large farmer (51.02%) and lowest for medium farmers (30.65%). Among the all type of farmers, only 4.08% of large farmers were educated at graduate level and no farmers were found in post-graduate level.

In Panchagarh illiterate farmers was lowest (5.88%) in small category of farmers and the highest (22.73%) in large category of farmers. The secondary education level was highest (52.10%) in small farmers and lowest (40.68%) in medium type of farmers. Graduate farmers were found 7.56%, 3.39% and 4.55% in small, medium and large category farmers, respectively and only 0.84 % of small farmers were post graduate. It is revealed that most of the HYV maize farmers are educated in primary, secondary, and higher secondary levels. So, primary and secondary education could be considered as a key factor to motivate the transformation crop land into HYV maize cultivation. Moreover, standard deviations in Lalmonirhat were lowest (16.68%) for small farmers and for the medium farmers it was the highest (26.26%) and in Panchagarh the lowest (15.51%) for medium farmers and the highest (21.44%) for large farmers. In consequences, standard deviations of education show more variations of from respondents'. In Lalmanirhat medium (t value 1.98) and lagre group of educated farmer (t value 2.01) and in Panchagarh, small (t value 1.97) and large (t value 2.61) group of educatedfarmer were influenced the transformation crop land to HYV maize cultivation.

Table 11.2.1.1.2: Distribution of HYV Maize Farmers according to Education level in Lalmonirhat and Panchagarh

Study areas	Education level	% of farmers			
		Small	Medium	Large	Average
Lalmonirhat	Illiterate	1.19	1.61	0.00	0.93
	Primary	50.00	59.68	38.78	49.49
	Secondary	32.14	30.65	51.02	37.94
	Higher secondary	16.67	8.06	6.12	10.28
	Graduate	0.00	0.00	4.08	1.36
	Post graduate	0.00	0.00	0.00	0
	Total	100	100	100	100
	Average	32.94 (1.66)	32.80 (1.98)**	25 (2.01)**	30.25 (2.64)***
	SD	18.11	16.04	11.53	15.23
Panchagarh	Illiterate	5.88	22.03	22.73	16.88
	Primary	14.29	25.42	4.55	14.75
	Secondary	52.10	40.68	50.50	47.76
	Higher secondary	19.33	8.47	18.18	15.33
	Graduate	7.56	3.39	4.55	5.17
	Post graduate	0.84	0.00	0.00	0.28
	Total	100	100	100	100
	Average	16.67 (1.97) **	16.67 (1.83)	19.32 (2.61)***	17.55 (2.73)***
	SD	22.06	9.15	4.10	11.77

Source: Field Survey (2020), SD=Standard Deviation, *(*Values in parentheses indicate t-value) (** and *** indicate significance at 5% and 1% level)

Farming experience

Farming experience is one of major strength to build-up inspirations and proficiencies for transformation of crop land to HYV maize cultivation. The study based on the farming experiences were considered into 7 groups: 1-5 years, 6-10 years, 11-15 years, 16- 20 years, 21-25 years, 26-30 years and 31 years and above, respectively. Table 11.2.1.1.3 shows that in Lalmonirhat, 1–5-year farming experience was found 1.19 % to 4.08 % and 25 % of the farmers having farming experience 31 years and above. Again, in Panchagarh, 1-5 years farming experience was 3.39% to 4.55% whereas the highest was found 31.82 % in 21-25 farming experience years. So, the study found that young farmers of Panchagarh have more influence to transform crop land for maize cultivation compared to farmers of Lalmonirhat. Moreover, standard deviations ranges were 8.47 to 14.14 in Lalmonirhat and 8.93 to 11.14 in Panchagarh meaning that there is no significant difference between two locations for decision making of to the transformation of crops land into the HYV maize cultivation. In Lalmanirhat small (t value 1.97) and lagre farmer (t value 2.61) and Panchagarh all categoried of farmer' experiences were influenced the transformation crop land to HYV maize cultivation (Table 11.2.1.1.3).

Table 11.2.1.1.3: Level of Farming Experience of the Sample Farmers in Lalmonirhat and Panchagarh

Study areas	Experience level	% of farmers as per category			
		Small (n=85)	Medium (n=65)	Large (n=50)	**All**
Lalmonirhat	1 – 5 years	1.19	3.23	4.08	2.83
	6 – 10 years	4.76	11.29	2.04	6.03
	11 – 15 years	15.48	9.68	10.20	11.79
	16 – 20 years	16.66	11.29	24.49	17.48
	21 – 25 years	21.43	14.52	24.49	20.15
	26 – 30 years	15.48	19.35	18.37	17.73
	31 and above	25.00	30.64	16.33	23.99
	Total	100	100	100	100
	Average (year)	24.08 (1.97)**	27.32 (1.88)	23.10(2.61)***	24.83(2.64)***
	SD (year)	9.11	14.14	8.47	10.57
Panchagarh	1 – 5 years	0.00	3.39	4.55	2.65
	6 – 10 years	5.88	13.56	4.55	7.10
	11 – 15 years	15.97	25.42	9.09	16.83
	16 – 20 years	31.09	23.73	22.73	25.85
	21 – 25 years	21.01	13.56	31.82	22.13
	26 – 30 years	15.97	3.39	18.18	12.51
	31 and above	10.08	16.95	9.09	12.04
	Total	100	100	100	100
	Average (year)	22.37 (2.11)**	20.88 (2.45)**	23.77 (1.99)**	22.34(2.71)***
	SD (year)	8.93	10.89	11.14	10.32

Source: Field Survey(2020), SD=Standard Deviation,(Values in parentheses indicate t-value)(**and *** indicate significance at 5% and 1% level)

Occupation

In the study areas, occupations were categorized as agriculture, housewife, business, service, wage labor and others. It is revealed from Table 11.2.1.1.4 that main occupation ranges, in Lalmonirhat were 75.51% to 93.55% farmers involved in agriculture while in Panchagarh agriculture were 86.36% to 94.96%. Again, for secondary occupation in Lalmonirhat only 2.38% to 8.16% farmers were engaged in agriculture and 73.47% to 92.86% were not involved in any secondary occupation. In Panchagarh, secondary occupation 3.36% to 13.64% farmers were engaged in agriculture, 15.25% to 19.33% were in business, 45.45% to 63.87% farmers had no secondary occupation respectively. So, it is observed that all the farmers engaged in land transformation adopted agriculture either main or secondary occupation.

Table 11.2.1.1.4: Scenario of Occupation of the Farmers Involved in Land Transformation toward HYV Maize

Occupation		% of farmers as per category			
		Lalmonirhat (n=200)			
		Small (n=85)	Medium (n=65)	Large (n=50)	Average
Main	Agriculture	88.10	93.55	75.51	85.72
	Housewife	9.52	6.45	16.33	10.77
	Business	2.38	0.00	6.12	2.83
	Service	0.00	0.00	2.04	0.68
	Wage labor	0.00	0.00	0.00	0
	Others	0.00	0.00	0.00	0
	Total	100	100	100	100
	Mean (No.)	28	31	12.25	23.75 (2.43)**
	SD (No.)	39.95	38.18	16.76	31.63
Secondary	Agriculture	2.38	3.23	8.16	4.59
	Housewife	0.00	4.84	2.04	2.29
	Business	2.38	1.61	4.09	2.69
	Service	2.38	1.61	6.12	3.37
	Wage labor	0.00	3.23	6.12	3.12
	Others	0.00	0.00	0.00	0.00
	No occupation	92.86	85.48	73.47	83.94
	Total	100	100	100	100
	Mean (No.)	2	1.8	2.6	2.13(2.61)***
	SD (No.)	1.30	0. 84	1.14	0.57
		Panchagarh (n=200)			
Main	Agriculture	94.96	88.14	86.36	89.82
	Housewife	0.84	1.69	0.00	0.84
	Business	3.36	1.69	4.55	3.20
	Service	0.84	3.39	9.09	4.44
	Wage labor	0.00	5.08	0.00	1.70
	Others	0.00	0.00	0.00	0.00
	Total	100	100	100	100
	Mean (No.)	29.75	9.83	7.33	15.64 (1.99)**
	SD (No.)	55.52	20.68	10.12	28.78
Secondary	Agriculture	3.36	8.47	13.64	8.49
	Housewife	0.84	1.69	(4.55	2.36
	Business	19.33	15.25	18.18	17.59
	Service	0.84	1.70	0.00	0.85
	Wage labor	11.76	10.70	13.64	12.03
	Others	0.00	1.70	4.55	2.08
	No occupation	63.87	61.01	45.45	56.78
	Total	100	100	100	100
	Mean (No.)	17	8.43	3.67	9.70 (2.54)**
	SD (No.)	27.37	12.54	3.33	14.41

Source: Field Survey (2020),SD=Standard Deviation,(Values in parentheses indicate t-value)(**and *** indicate significance at 5% and 1% level)

Gender

Gender issue is one of crucial social factors in agriculture sector of Bangladesh. In respect of gender issue for agricultural transformation, the respondents of HYV maize cultivation were divided into two groups i.e. male and female, percentages, average, t-statisties and standard deviation of respondents were estimated on the basis of individual group Table 11.2.1.1.5.

Table 11.2.1.1.5: Status of HYV Maize Farmers According to Gender in Lalmonirhat and Panchagarh

Study areas	Farmer Category	% of farmers as per category			
		Small (n=85)	Medium (n=65)	Large (n=50)	Average
Lalmonirhat	Male	94.05	82.26	87.76	88.02
	Female	5.95	17.74	12.24	11.98
	Total	100	100	100	00
	Mean (No.)	42 (1.91)**	31 (2.62)***	24.50 (2.34)**	32.50 (2.81)***
	SD (No.)	52.33	28.28	26.16	35.59
Panchagarh	Male	99.16	86.44	90.91	92.17
	Female	0.84	13.55	9.09	7.83
	Total	100	100	100	100
	Mean (No.)	59.50(2.73)***	29.50 (1.89)**	11 (2.39)**	33.33 (2.92)***
	SD (No.)	82.73	30.41	12.73	41.96

Source: Field Survey (2020), SD=Standard Deviation,(Values in parentheses indicate t-value)(**and ***indicate significance at 5% and 1% level)

It is shown in Table 11.2.1.1.5 that in Lalmonirhat the male farmers were 88.02% and female was 11.98%. Again, in Panchagarh male farmers were 92.17% and 7.83% female. The standard deviation in Lalmonirhat was 35.59 and in Panchagarh 41.96. From the t statistics was observed that both areas farmers were positively influenced transformation crops land into HYV maize cultivation.

Marital status

Table 11.2.1.1.6 indicates that in Lalmonirhat, 98.78 % respondent were married and only 1.22 % was unmarried and in Panchagarh married farmers were 92.08% and 7.92% was unmarried. It is concluding that as most of the respondents were married and also engaged in transformation of HYV maize production for earning more income and ensuring food and nutritional secuirity of their family members.

Table 11.2.1.1.6: Distribution of Farmers Based on Marital Status in Lalmonirhat and Panchagarh

Study areas	Category of factors	% of farmers' as per category		
		Small (n=85)	Medium (n=65)	Large (n=50)
Lalmonirhat	Married	100	98.39	97.96
	Unmarried	0.00	1.61	2.04
	Total	100	100	100
Panchagarh	Married	96.64	93.22	86.37
	Unmarried	3.36	6.78	13.64
	Total	100	100	100

Source: Field Survey (2020); Note: Total number of samples = 200; n - number of respondents

Religions

The respondents' religions were defined as three groups like Muslim, Hindu and other. In Table 11.2.1.1.7 found that religion of respondents was calculated 70.42% Muslim and 29.58% Hindu in Lalmonirhat while 94.73% Muslim and 5.27% Hindu, respectively in Panchagarh. So, majority respondents were Muslim in the study areas. It was experienced that no religious barier in study areas for transformation of crop land into HYV maize cultivation.

Table 11.2.1.1.7: Distribution of Farmers as per Religions in Lalmonirhat and Panchagarh

Study area	Category of religions	% of farmers as per category		
		Small (n=85)	Medium (n=65)	Large (n=50)
Lalmonirhat	Muslim	72.62	77.42	61.22
	Hindu	27.38	2.58	38.78
	Other	0.00	0.00	0.00
	Total	100	100	100
	Mean (No.)	42	31	24.50
	SD (No.)	12.74	24.04	7.78
Panchagarh	Muslim	94.96	98.31	90.91
	Hindu	5.04	1.69	9.09
	Other	0.00	0.00	0.00
	Total	100	100	100
	Mean (No.)	59.50	29.50	11
	SD (No.)	75.66	40.31	12.73

Source: Field Survey (2020)

11.2.2 Socio-economic Factors for HYV Maize Farmers in Lalmonirhat and Panchagargh

Household size, farm size and annual income, training experience, access to credit, organizational participation, extension media contact, agricultural knowledge and innovativeness were considered as household factors for transformation land to HYV maize cultivation are individually discussed below:

Household size

Household size of respondents are consisting of family members who live and eat together under same management of a household head which was highly influenced by family size for shifting their cropland into HYV maize cultivation. Therefore, family member of the respondents was classified into two groups like earning member and dependent member. Table 11.2.2.1 indicated that in Lalmonirhat, the lowest family size (4 members) was estimated for small farmers and the highest (6 members) for medium farmers. The earning member was highest (32.78%) in Lamonirhat and the lowest (21.67%) in Panchagarh. The dependent member was highest (78.33%) in Panchagarh and lowest in Lamonirhat (67.22%).

Table 11.2.2.1: Household Size and Farm Size of HYV Maize farmers in Lalmonirhat and Panchagarh

Factors	Factors category	Unit	Status of factors as per farmer category			
			Small (n=85)	Medium (n=65)	Large (n=50)	Average
			Lalmonirhat			
Family size	Total member	no.	5	6	4	5
	Earning member	%	40	33.33	25	32.78
	Dependent member	%	60	66.67	75	67.22
	Mean	no.	2.5 (1.98)**	3.00 (2.41)**	2.00 (2.35)**	2.50 (2.08)**
	SD	no.	0.70	1.41	1.41	1.17
Farm size	Per household	ha	0.79	1.29	3.40	1.83
	Mean	ha	0.79 (2.81)***	1.29 (2.19)**	3.40 (2.57)**	1.83 (2.68)***
	SD	ha	0.12	0.20	0.41	0.24
			Panchagarh			
Household size	Total member	no.	5	4	5	5
	Earning member	%	20	25	20	21.67
	Dependent member	%	80	75	80	78.33
	Mean	no.	2.50 (2.65)***	2.00 (2.41)**	2.50 (2.54)**	2.50 (2.83)***
	SD	no.	2.12	1.41	2.12	2.12
Farm size	Per household	ha	0.65	1.40	2.43	1.49
	Mean	ha	0.65 (1.98)**	1.40 (2.34)**	2.43 (2.44)**	1.49 (2.87)***
	SD	ha	0.29	0.12	0.32	0.24

Source: Field Survey (2020), **Note:** Total number of samples = 200; SD=Standard Deviation, *(*Values in parentheses indicate t-value) (** and *** indicate significance at 5% and 1% level).

Farm size

For measuring farm size of the respondents, homestead area, cultivable land under own ownership and also under share/mortgaged/leased in and out was considered. In Table 11.2.2.1 it is shown that the estimated farm size of small, medium, large and average farm size were 0.79, 1.29, 3.40 and 1.83 hectare, in Lalmonirhat, respectively. In Panchagarh, the calculated farm sizes (mean values) were 0.65, 1.40, 2.43 and 1.49 hectares for small, medium, large and average farm size, respectively. The standard deviations were smaller than the mean values which indicate close variation among farm sizes of the respondents individually.

Income

It is known that crop production is the main source of farmer household income and for increasing household food security and poverty reduction through earning more income; the respondents were highly convinced to agricultural transformation. For this reason, different sources of farmer household annual income for small, medium, large and average farmers were identified in the study. All the sources of annual income were defined under on-farm income and off-farm income. The on-farm incomes are: homestead, crops, fruits, livestock/poultry, aquaculture and others and off-farm incomes are: small business, service, remittance and others. Total annual income of respondent household was estimated from the summation of the income gaining from all the sources and percentages of all the sources in total income were calculated. Table 11.2.2.2 depicted that in Lalmonirhat, the annual income of the respondent household for small (Tk. 202.32 thousand) medium (Tk. 204.20 thousand) large (Tk. 430.58 thousand) and average income was (Tk. 279.00 thousand) were calculated, respectively. In Table 11.2.2.2it is also revealed that in Panchagarh annual income was earned Tk. 140.33, Tk.173.19, Tk 191.18 and Tk.168.23 thousand for small, medium, large and average all farmers, respectively. The largest income of Tk. 191.18 thousand was gained for large farmers and the lowest of Tk. 140.33 thousand was for small farmers.

Table 11.2.2.2: Annual Household Income of HYV Maize farmers in Lalmonirhat and Panchagarh

Study areas	Factor category	Unit	Share of income by sources			
			Small (n=85)	Medium (n=65)	Large (n=50)	Average
Lalmonirhat	Total income ('000)	Tk.	202.32	204.20	430.58	279.00
	Homestead	%	0.00	0.16	0.10	0.09
	Crops	%	76.30	79.81	92.04	82.72
	Fruits	%	2.65	0.87	0.14	1.22
	Livestock/poultry	%	7.06	4.98	1.74	4.59
	Aquaculture	%	3.68	2.31	0.81	2.27
	Sub-total of on farm income	%	89.69	88.13	94.83	90.88
	Small business	%	1.44	2.76	1.24	1.81
	Service	%	0.00	1.58	1.90	1.16
	Remittance	%	0.00	0	0	0.00
	Others	%	4.84	7.53	2.04	4.80
	Sub-total of off farm income	%	10.31	11.87	5.17	9.12
	Mean	Tk	202.32 (2.84)***	204.20 (2.41)**	430.58 (2.78)***	279.00 (2.82)***
	SD	Tk	767.61	886.33	513.51	722.50
Panchagarh	Total income ('000)	Tk.	140.33	173.19	191.18	168.23
	Homestead	%	0.00	0.00	0.00	0
	Crops	%	69.48	79.45	69.33	72.75
	Fruits	%	1.44	0.00	0.00	0.48
	Livestock/poultry	%	3.33	1.76	2.38	2.49
	Aquaculture	%	1.20	0.00	0.00	0.4
	Sub-total of on farm income	%	75.45	81.21	71.71	76.12
	Small business	%	8.56	10.28	8.80	9.21
	Service	%	4.07	1.96	16.88	7.63
	Remittance	%	1.25	0.00	0.00	0.41
	Others	%	10.66	6.56	2.62	6.61
	Sub-total of off farm income	%	24.55	18.79	28.29	23.87
	Mean	Tk	140.33 (2.45)**	173.19 (2.34)**	191.18 (2.68)***	168.23 (2.79)***
	SD	Tk	120.05	131.62	81.67	111.12

Source: Field Survey (2020),Note:Total number of samples = 200; SD=Standard Deviation, *(*Values in parentheses indicate t-value), (** and *** indicate significance at 5% and 1% level)

Training exposure

Performance and skill of farmers are vital factors for agricultural transformation and training is one major source for achieving the performance and skill. In respect of training, the respondent

farmers were classified under two categories such as training receipent farmers and non-trained farmers and number and percentage were calculated based on two groups. In table 11.2.2.3 it is revealed that in Lalmonirhat percentage range of the farmer received training was computed at 30.61% to 38.10% and in Panchagarh was 23.73% to 44.54% which was not sufficient for transformation of crops land into HYV maize cultivation.

Access to credit

Access to credit for farmers is an important factor of financial support for transformation HYV maize cultivation. As per access to credit, the respondents were categorized into two groups like credit farmers and non-credit farmers. It appears in Table 11.2.2.3 that 58.13% farmers were credit user and 41.87% farmers did not receive any credit in Lalmonirhat whereas in Panchagarh 49.21% and 50.79%, respectively. Therefore, it is realized from the above information that 53.67% respondents received credit from the banks, NGOs, local money lenders and input sellers and 46.33% respondents were credit non-user.

Table 11.2.2.3 Status of Training, Credit and Knowledge of HYV Maize farmers' in Lalmonirhat and Panchagarh

Major factors	Factor category	% of farmers as per category			
		Lalmonirhat			
		Small (n=85)	Medium (n=65)	Large (n=50)	Avearge
Training exposure	Training farmer	38.10	32.26	30.61	33.66
	Non- training farmer	61.90	67.74	69.38	66.34
	Mean (day)	0.80(2.64)***	0.73(2.47)**	0.45(2.71)***	0.66(2.93)***
	SD (day)	1.99	2.14	0.79	1.64
Access to credit	Credit user	57.14	58.07	59.18	58.13
	Credit non-user	42.86	41.94	40.82	41.87
	Mean (%)	50 (2.89)***	50(2.91)***	50(2.94)***	50.00(2.87)***
	SD (%)	10.10	11.40	12.99	11.50
Agricultural knowledge	Achievement score (total score -57)	21.47	23.06	18.94	21.16
		Panchagarh			
Training exposure	Training farmer	44.54	23.73	31.82	33.36
	Non- training farmer	55.46	76.27	68.18	66.64
	Mean (day)	0.77 (2.96)***	0.46 (2.78)***	0.64 (2.84)***	0.62(2.92)***
	SD (day)	1.66	1.04	1.26	1.32
Access to credit	Credit user	51.26	37.29	59.09	49.21
	Credit non- user	48.74	62.71	40.91	50.79
	Mean (%)	50.00(2.81)***	50.00(2.73)***	50.00(2.69)***	50.00(2.94)***
	SD (%)	1.78	17.98	12.86	10.87
Agricultural knowledge	Achievement score (total score-57)	40.70	36.07	35.09	37.29

Source: Field Survey (2020),Note**:** Total number of samples = 200; SD=Standard Deviation, *(*Values in parentheses indicate t-value) (** and *** indicate significance at 5% and 1% level)

Agricultural knowledge

Agricultural knowledge of farmers means practical ideas about farming & marketing activities, inputs, varieties, technologies & methods, machineries & instruments, pest & disease control, irrigation, etc. and these factors are very essential for involvement of farmers in commercial agriculture as well as transformation of agricultural. So, farmers' agricultural knowledge about these factors was identified under some major issues and these issues are remembering, understanding, applying, analyzing and creating. Again, several knowledge factors were mentioned under individual issue for transformation crops land into HYV maize cultivation. Therefore, *knowledge factorsunder remembering issue* are name of three modern varieties, two diseases and three harmful insects; factors under understanding issue are concept and considerable points of cultivation and suitable sowing/planting time of crop; *factors under applyingissue* are type of soil, suitable application time of fertilizer and type of fertilizers using before sowing/planting; *factors under analyzing issue* are causes of land preparation before sowing/planting, causes of crop dropout by transformation crop land and necessary of training & pruning practices; *factors under evaluation issue* are role of transformation crop land in Bangladesh economy, opinion about present marketing system of transformation crop and name of insects and pests cause a greater damage to transformation crop; and *factors under creating issue* are ways of seed germination increase, procedure followed for increasing quality of transformation crop and techniques for protecting biotic damage of transformation crop seeds/seedlings.

Total score of farmers' agricultural knowledge under all the knowledge issues of remembering, understanding, applying, analyzing, evaluation and creating were estimated 57 (Table 11.2.2.4). In Lalmonirhat achievement score of farmers' agricultural knowledge in total score of 57 was calculated at the highest of 23.06% for medium farmers followed by small farmers (21.47, large farmers (18.94%) and average (21.16%) But in Panchagarh achievement score of agricultural knowledge was 57 estimated. The highest was 40.70% for small farmers and the lowest was 35.07% large farmers. The medium farmers of Panchagarh is more skill than small famers of Lalmanirhat. So, it is revealed that medium farmers of Panchagarh encouraged transformation of crops land into HYV maize cultivation. The mean value was 10.80 to 13.15 in Lalmonirhat and Panchagarh was 20 and 23.20 that indicating huge variation of the respondents to making decision towards transformation of land into HYV maize cultivation.

Organizational participation

Organizational participations of farmers develop progressive mind, cooperative relation, knowledge and performance in farmers' society to accept and adopt a new society and also changing agriculture. For this cause, organizational participations of the respondents were discussed in the study. Table 11.2.2.4shows that in Lalmonirhat, organizational participation of respondents was computed the highest (52%) for small farmers followed medium farmers (24%) and 16% for large farmers while for 27% for large farmers and 22% for medium farmers, respectively. So, it was found that all respondents' were involved in CIG, IPM/ICM Club, Farmers' Cooperatives, Youth Club, Producers' Association but low variation existed among their organizational participation. But it is resulted from the study, farmers were gained inspiration through organizational participations for shifting crop land into HYV maize cultivation in the both areas. The non-organizational participation of the respondents in Panchagarh (80%) and Lamanirhat (69%) predicting that Panchagarh farmers acquired more agricultural knowledge than Lalmanirhat farmers.

Extension media contract

Extension media contract of HYV maize farmers is one of the major sources for collection of information and achievement of knowledge about transforming crops land into HYV maize cultivation. Mainly three types of extension media contact i.e. individual media, group media and mass media contact were considered for extension media contract. The sources of individual media contacts were progressive farmers, friends and relatives, neighbours, SAAOs, AEO, UAO, PPS, NGO workers, input dealers were estimated. Again, sources of group media contact are participation in group discussion, group meeting and training program were considered and mass media contact are reading farm magazine, watching agricultural related program in TV and listening agricultural related program in radio. Extension media contact of the respondents was measured based on the frequency of contact performed within a specified time frame of week, month and year. So, contact number of 3 for 'frequently', 2 for 'occasionally' and 1 for rarely' done in week/month/year were considered while no contact ('0' contact) was defined as 'not at all'. In Table 11.2.2.4 it is depicted that in Lalmonirhat and Panchagarh achievement score of contact with all the extension media was estimated and in Lalmonirhat based on total frequently contact score of 45, achievement score was calculated at the 2% to 18%, for occasionally contact score (30) was 2% to 27% and for rare contact score (15) it was 5% to 54% for all the farmers.

But, in Panchagarh achievement score of frequently contact range was calculated at 20% to 30%, for occasionally contact was 38% to 44% and for rare contact were 75% to 89%.

Table 11.2.2.4: Status of Organizational Participation and Extension Media Contact by HYV Maize farmer in Lalmonirhat and Panchagarh

Major factor	Factor category	% of farmers adopted/Opined			
		Small (n=85)	Medium (n=65)	Large (n=50)	Average
		Lalmonirhat			
Organizational participation	Organizational participation	52	24	16	31
	Non-organizational participation	48	76	64	69
	Mean (no.)	42 (2.41)**	31 (1.95)	25(2.34)**	33(2.81)***
	SD (no.)	3	23	23	16
Extension media contract	Score of frequently contract (total score - 45)	18	2	18	12
	Score of Occasionally contract (total score- 30)	27	2	27	19
	Score of rare contracts(total score - 15)	54	5	53	37
	Mean (times)	8(2.11)**	8 (2. 67)***	8(2.32)* *	8(2.73)***
	SD (times)	2	2	2	2
		Panchagarh			
Organizational participation	Organizational participation	10	22	27	20
	Non-organizational participation	90	78	73	80
	Mean (no.)	60(1.98)**	30(2.67)***	11(2.43)**	33(2.85)***
	SD (no.)	67	23	7	33
Extension media contract	Score of frequently contract (total score- 45)	25	20	30	25
	Score of Occasionally contract (total score-30)	38	39	45	41
	Score of rare contracts (total score -15)	75	79	89	81
	Mean (times)	11(1.45)	12(2.12)**	13(1.91)	12(2.61)***
	SD (times)	5	5	4	5

Source: Field Survey (2020), Note: Total number of samples = 200; SD=Standard Deviation, *(*Values in parentheses indicate t-value) (** and *** indicate significance at 5% and 1% level)

It is understood from above discussion that frequently and occasionally media contact is not satisfactory and rare contact were achievable. Moreover, in Panchagarh extension media contact number 12 times and Lalmonirhat was 8 times. DAE has been provided more traning in Panchagarh farmers due to huge potentiality to adopt HYV maize cultivation than Lamanirhat areas.

11.2.3 Innovativeness

In the study, innovativeness of the farmers was identified as one kind of strong eligibility for acceptance and adaptation of new and changing agriculture. In this situation, some innovation factors and adoption status were determined. Moreover, adoption status of innovation factors was defined as never use, adoption after 1 year, after 2 years, after 3-4 years and after 5 or more years. In Table 11.2.3.1 found that several innovation factors like sex pheromone, vermi-compost and trico-compost were never used by both Lalmonirhat and Panchagarh. Besides, granular urea was never used Panchagarh whereas only 51% of small farmers and 16% of farmers in Lalmonirhat applied granular urea only in 1st year. IPM was never adopted by medium farmers (100%) in Lalmonirhat and by small farmers (100%) in Panchagarh. For small, large and all farmer groups was 44%, 10% and 51%, respectively never used IPM in Lalmonirhat but in Panchagarh these percentages were 73%, 68% and 80% for medium, large and all farmer classes, respectively.

Moreover, the rest of the farmers in both Lalmonirhat and Panchagarh applied IPM (Integrated Pest Management) generally from after 2 years to after 3-4 years. Again, only 6% to 8% farmers in Lalmonirhat and 2% to 10% farmers in Panchagarh never cultivated HYV maize and the rest of the farmers generally involved within 1st year to 5th year. It is also found for never applied line sowing method for HYV maize cultivation was 6% to 10% farmers in Lalmonirhat and 8% to 10 % farmers in Panchagarh and other farmers used the line sowing method from 1st year to 5th year. Moreover, in Lalmonirhat 95% to 98% farmers in all the groups used power tiller in 1st year while for Panchagarh 10% to 14% farmers never used power tiller and the rest of the farmers used generally in 1st year (42% to 78%) to 2th year (23% to 36%).

Table 11.2.3.1: Farmers' Adaptation of Improved Agrilcultural Technologies related to HYV Maize Cultivation in Lalmonirhat and Panchagarh

Improved technologies	Adaptation years	Farmers' acceptance level (% famers opined)							
		Lalmonirhat				Panchagarh			
		Small (n=85)	Medium (n=65)	Large (n=50)	Average	Small (n=85)	Medium (n=65)	Large (n=50)	Average
IPM	Never use	44	100	10	51	100	73	68	80
	After 1 year	56	0	18	25	0	8	18	9
	After 2 years	0	0	39	13	0	10	13	8
	After 3-4 years	0	0	27	9	0	7	0	2
	After 5 or more	0	0	6	2	0	2	0	1
Granular urea	Never use	51	100	100	84	100	100	100	100
	After 1 year	49	0	0	16	0	0	0	0
	After 2 years	0	0	0	0	0	0	0	0
	After 3-4 years	0	0	0	0	0	0	0	0
	After 5 or more	0	0	0	0	0	0	0	0
Sex pheromone	Never use	100	100	100	100	93	100	100	98
	After 1 year	0	0	0	0	3	0	0	1
	After 2 years	0	0	0	0	0	0	0	0
	After 3-4 years	0	0	0	0	3	0	0	1
	After 5 or more	0	0	0	0	0	0	0	0
Hybrid Maize cultivation	Never use	6	8	8	8	10	2	9	7
	After 1 year	15	3	18	12	20	31	41	31
	After 2 years	42	44	41	42	0	2	5	2
	After 3-4 years	25	39	27	30	0	8	5	4
	After 5 or more	12	6	6	8	67	58	41	55
Vermi- compost	Never use	100	100	100	100	98	100	100	100
	After 1 year	0	0	0	0	0	0	0	0
	After 2 years	0	0	0	0	0	0	0	0
	After 3-4 years	0	0	0	0	0	0	0	0
	After 5 or more	0	0	0	0	2	0	0	1
Trico-compost	Never use	100	100	100	100	100	100	100	100
	After 1 year	0	0	0	0	0	0	0	0
	After 2 years	0	0	0	0	0	0	0	0
	After 3-4 years	0	0	0	0	0	0	0	0
	After 5 or more	0	0	0	0	0	0	0	0
Line sowing of HYV Maize	Never use	6	10	10	9	5	10	9	8
	After 1 year	18	3	30	13	20	29	50	34
	After 2 years	36	42	39	39	8	5	5	5
	After 3-4 years	32	39	15	32	13	6	0	6
	After 5 or more	8	6	6	7	54	50	36	47
Use of power tiller	Never use	2	5	5	4	12	10	14	12
	After 1 year	98	95	95	96	78	42	50	57
	After 2 years	0	0	0	0	0	36	23	20
	After 3-4 years	0	0	0	0	0	12	9	7
	After 5 or more	0	0	0	0	10	0	4	5

Source: Field Survey (2020)

It is found that most of all types of farmers were involved in HYV maize cultivation, power tiller use and line sowing of HYV maize within 1st to 5th years after introducing. Finally, it is realized that the respondents were sufficient supported by their innovativeness to transform their crop land toward HYV maize cultivation (Table 11.2.2.5).

11.2.4 Extent of Transformation for HYV Maize Production in Lalmonirhat and Panchagargh

For understanding actual status of numerical transformation extent of different crop land into HYV maize cultivation were measured to estimate the extent of transformation, different crops like boro rice, tobacco, pulse, potato and wheat shifting to HYV maize cultivation was collected for the period of 2000-2001 to 2019-2020 crop years**.** Then, changing rate of crop land into HYV maize production in investigated areas was calculated based on land of respondents' and also land on drop out crops.

11.2.5 Transformation Extent of Crop Land to HYV Maize Production in Lalmonirhat

For transformation of land to HYV maize cultivation, change rate of land was the lowest (8%) in 2010-2011 and highest was 25% in 2019-2020. It is evident from 11.2.5.1 that the rate of expansion of hybrid maize cultivation from crops land from 2000-2001 to 2006-2008 has increased at a positive rate, which is highly statistically significant. But from 2006-2007 to 2019-2020, hybrid maize cultivation has been increasing significantly. One of the reasons is that the hybrid maize yield, price and demand is higher compare to competitive crops, the government are also properly implementation of 7thFive Year Plan,Agricultural Policy 2018, Perpestive Plan 2020, Delta plan 2100, MDGs and SDGs and formulation of 8th Five Years' Plan (FYP).

Table 11.2.5.1: Transformation Level of Cropland into HYV Maize Cultivation in Lalmonirhat

Period/year	Change rate of crop land (%)		
	Change of household land	Change of previous crop land	Significance level (t value)
2000 - 2001	1.83	11.91	1.98**
2001 - 2002	1.42	9.34	1.81
2002 - 2003	1.96	10.86	1.74
2003 - 2004	1.34	8.38	1.92
2004 - 2005	1.93	10.08	2.34**
2005 - 2006	1.65	10.41	2.71***
2006 - 2007	1.39	9.84	1.85
2007 - 2008	1.33	8.03	2.21**
2008 - 2009	0.99	9.22	2.33**
2009 - 2010	1.64	11.63	2.78***
2010 - 2011	0.90	7.81	2.65***
2011 - 2012	1.40	9.20	2.74***
2012 - 2013	1.56	11.36	2.57**
2013 - 2014	1.79	12.37	2.81***
2014 - 2015	2.88	13.44	2.94***
2015 - 2016	3.27	14.90	2.67***
2016 - 2017	2.42	19.36	2.58**
2017 - 2018	4.37	25.98	2.84***
2018 - 2019	3.08	16.52	2.69***
2019 - 2020	4.35	25.02	2.64***

Source: Field Survey (2020) (** and *** indicate significance at 5% and 1% level)

11.2.6 Transformation Extent of HYV Maize Production in Panchagarh

To transform into HYV maize cultivation, change rate of household land was computed the lowest at 7% in 2006-2007 and 27% in 2019-2020, respectively. Moreover, shifting rate of dropout crop land was measured in 12% to 27% in 2012-2013 to 2019 to 2020, respectively (Table 11.2.6.1). Table 11.2.6.1 shows that in 2000-2001 in Panchagarh area the rate of land transfer from crop to hybrid maize was 8% to 13% but in 2000-2005 to 2005-2008 the rate of land transfer was not increased significantly because lack of positive initiative of agricultural policy implementation. But from 2006-2007 to 2019-2020 the rate of crop land transfer is 5% to 26% which is statistically significant. In this period farmers have been transformation of their crops land into hybrid maize cultivation becouse of Bangladesh government has been implemented 7thFive Year Plan, perspective plan 2020, agricultural policy 2018, MDGs, SDGs and formulated 8thFive Year Plan (Table 11.2.6.1).

Table 11.2.6.1: Transformation Level of Cropland into HYV Maize Cultivation in Panchagarh

Period/year	Change rate of crop land (%)		
	Change of household land	Change of previous crop land	Significance level (t value)
2000 - 2001	1.86	12.48	2.21**
2001 - 2002	1.77	11.81	1.78
2002 - 2003	1.84	9.43	1.84***
2003 - 2004	1.09	7.50	2.01**
2004 - 2005	1.95	8.50	1.94
2005 - 2006	1.77	11.63	1.81
2006 - 2007	1.25	6.8	2.18**
2007 - 2008	1.5	9.64	2.31**
2008 - 2009	1.16	10.00	2.71***
2009 - 2010	1.32	8.39	2.58**
2010 - 2011	0.78	5.23	2.69***
2011 - 2012	1.50	9.10	2.58**
2012 - 2013	1.72	11.62	2.27**
2013 - 2014	1.76	12.60	2.68***
2014 - 2015	3.13	14.29	2.81***
2015 - 2016	3.58	15.74	2.74***
2016 - 2017	2.20	16.02	2.47**
2017 - 2018	4.20	27.13	2.71***
2018 - 2019	2.97	14.88	2.68***
2019 - 2020	4.66	24.97	2.63***

Source: Field Survey (2020), (** and *** indicate significance at 5% and 1% level)

11.2.7 Reasons for Transformation of Crops in Lalmonirhat and Panchagarh

Some reasons were determined for transformation of cropland into HYV maize cultivation under three issues i.e. situational, economic and socio-economic. Therefore, all the reasons under three issues are discussed below.

Situational

Reasons identified under situational issue are: cropping with climate change situation, soil suitability, highly vulnerable to insect and disease, lower yield due to long-term mono cropping and less water required crop. It is indicated that four reasons of situational issue like cropping with climate change situation (92), soil suitability (95%), lower yield due to long-term mono cropping (63%) and less water required crop (96%) were supported with 'yes' agree in Lalmonirhat (Table 11.2.7.1) and 57%, 64%, 59%, 60% and 57% respondents in Panchagarh (Table 11.2.7.2) in all the types of farmer classes. But in Lalmonirhat only reason of highly vulnerable to insects and diseases was agreed as 'yes' by 63% respondents of all the farmers (Table 11.2.7.1).

Economical

Reasons identified under economic issue are: lower cost of production, higher yield, higher market demand, easy to sell, higher profitability/return, getting cash at a time andmanaging with minimum labor. It is revealed that 72% to 100% respondents in Lalmonirhat (Table 11.2.7.1) and 56% to 61% respondents in Panchagarh (Table 11.2.7.2) farmer expressed agree with 'yes' under economic issue are higher yield, higher market demand, easy to sell in the local market, higher profitability/return, getting cash at a time andmanaging with minimum labor. Moreover, only reason of lower cost of production than competive crops was accepted by 73% in Lalmonirhat and 57% respondents in Panchagarh.

Table 11.2.7.1: Stated Reasons for Cropland Transformation into HYV Maize Production in Lalmonirhat

Reasons for transformation	% of farmers as per opinions (N=200)							
	Small		Medium		Large		Avearge	
	Yes	No	Yes	No	Yes	No	Yes	No
Situational								
Cropping with climate change situation	88	12	97	3	90	10	92	8
Soil suitability	96	4	100	0	90	10	95	5
Highly vulnerable to insects and diseases	60	40	66	34	63	37	63	37
Lower yield due to long-term mono cropping	94	6	95	5	94	6	94	6
Less water required crop	99	1	97	3	94	6	96	4
Economical								
Lower cost of production than competitive crop	76	24	74	26	65	35	72	28
Higher yield	100	0	100	0	100	0	100	0
Higher market demand	95	5	95	5	92	8	94	6
Easy to sell in local market	100	0	100	0	100	0	100	0
Higher profitability /return	99	1	97	3	94	6	96	4
Can get the cash at a time	96	4	95	5	100	0	97	3
Can manage with minimum labor	87	13	82	18	92	8	87	13
Socio-cultural								
Neighboring farmers' transforming	79	21	84	16	90	10	84	16
Motivation by the change agents	61	39	65	35	69	31	65	35
Family pressure	74	26	77	23	76	24	76	24
Decisions of the farmers' cooperative	87	13	79	21	82	18	83	17
Availability of processed fruits	52	48	53	17	51	49	52	48

Source: Field Survey (2020)

Socio-cultural issues:

Reasons identified under socio-cultural issue are neighboring farmers' transforming, motivation by the change agents, family pressure, decisions of the farmers' cooperative and availability of processed fruits. It is revealed in Table 11.2.7.1 that in Lalmonirhat three reasons were neighboring farmers' transforming and decisions of the farmers' cooperative were agreed as 'yes' by 54% to 84% respondents. But, 65% respondents supported the reasons of motivation by the change agents and availability of processed fruits. On the other hand, all the socio-cultural issues were supported by 48% to 57 % farmers of all the classes in Panchagarh (Table 11.2.7.2).

Table 11.2.7.2: Stated Reasons for Cropland Transformation into HYV Maize Productionin Panchagarh

Reasons for transformation	% of farmers as per opinions (N=200)							
	Small		Medium		Large		Average	
	Yes	No	Yes	No	Yes	No	Yes	No
Situational								
Cropping with climate change situation	71	29	49	51	50	50	57	43
Soil suitability	86	14	51	49	55	45	64	36
Highly vulnerable to insects and diseases	73	27	53	47	50	50	59	41
Lower yield due to long-term mono cropping	71	29	51	49	59	41	60	40
Less water required crop	70	30	51	49	50	50	57	43
Economical								
Lower cost of production	70	30	51	49	50	50	57	43
Higher yield	72	28	51	49	55	45	59	41
Higher market demand	73	27	51	49	59	40	61	39
Easy to sell	66	34	53	47	55	45	58	42
Higher profitability /return	70	30	47	53	50	50	56	44
Can get the cash at a time	71	29	51	49	50	50	57	43
Can manage with minimum labor	71	29	49	51	59	41	60	40
Socio-cultural								
Neighboring farmers' transforming	71	29	49	51	50	50	57	43
Motivation by the change agents	47	53	53	47	45	55	48	52
Family pressure	57	33	51	49	55	45	54	42
Decisions of the farmers' cooperative	67	41	49	51	50	50	55	47
Availability of processed fruits	41	59	53	47	55	45	49	51

Source: Field Survey (2020)

So, it is resulted that most of the reasons were supported almost by 48% to 84% respondents in both Lalmonirhat and Panchagarh. As a result, it is understood that all the reasons identified under situational, economical and socio-cultural issues influenced the transformation of crops land into HYV maize cultivation as a major drivers and motivational factors.

11.2.8 Effects of Transformation of Crops on Farming Practices in Lalmonirhat and Panchagargh

Some components of farming practices for agricultural transformation were identified in the study. So, these farming practice components are: labor use, easy in land preparation, manager of seeds/saplings, irrigation, weeding, use of farm machinery, fertilizer application, scope of using IPM, use of insecticides, use of pesticides, easy in harvesting, easy of sorting, easy of grading, easy in packaging, easy in sorting, cost of production, farm output, easy sale of farm produces and net profit from farming. Moreover, to determine change in farming practices due to transformation, three indicator factors such as increased, unchanged and decreased were used.

Data in Table 11.2.8.1 indicate that in Lalmonirhat 83% to 99% respondents of farmer groups expressed their opinions about farm activities i.e. easy in harvesting, less cost of production compare to competitives crops, farm output, easy product sale and farm net profit were increased due to transformation into HYV maize cultivation. Again, in Panchagarh 44% to 76% farmers of small, medium and all groups also supported the aforesaid farm activities excluding cost of production (Table11.2.8.2). So, it is indicated that all the above stated farm activities were increased due to transformation of crop land into HYV maize cultivation and it was minimized by increased farm net profit.

In Lalmonirhat several farm activities like easy of sorting, grading, packaging and storing were supported by about 47% to 68% (Table 11.2.8.1) whereas 13% to 74% in Panchagarh (Table 11.2.8.2) respondent provided ‘increased’ or ‘unchanged’ comments but ‘no negative’ opinioned were not found due to the transformation of HYV Maize cultivation. Besides, easy land management preparation, management of seedlings and irrigation were agreed by the respondents based on ‘increased *(*41% to 48%’) or ‘decreased’ (48% to 51%) opinions and meaning positive or negative effects on the transformation. Again, use of insecticides and pesticides were opined as ‘increased’ *(*40% to 71%’) respondents while 19% to 40% respondents expressed as ‘unchanged’ or ‘decreased’ (10% to 20%) comments but ‘no negative’ opinioned were not found due to the transformation of HYV Maize cultivation.

Table 11.2.8.1: Effect of Cropland Transformation into HYV maize on Farming Practices in Lalmonirhat

Components of farming practices	% of farmers as per opinions											
	Small			Medium			Large			Average		
	Increased	Unchanged	Decreased	Increased	Unchanged	Decreased	Increased	Unchanged	Decreased	Increased	Unchanged	Decreased
Labor use	7	25	68	8	29	63	4	43	53	6	32	61
Easy land management	49	2	49	39	49	56	51	6	43	46	4	49
Management of seedling	50	2	48	40	5	55	53	6	41	48	4	48
Use of irrigation	43	4	54	32	10	58	49	10	41	41	8	51
Weeding	23	23	54	19	23	58	24	29	47	22	25	53
Farm machinery use	26	20	54	24	19	56	35	22	43	28	21	51
Fertilizer application	35	19	46	31	16	53	41	18	41	35	18	47
Scope of using IPM	35	18	48	37	11	52	47	12	41	40	14	47
Easy use of insecticides compare to others crops	50	20	30	47	16	37	43	27	31	47	21	32
Easy use of pesticides compare to competitive crops	65	24	11	66	19	15	55	29	16	62	24	14
Easy in harvesting	82	12	6	84	11	5	84	10	6	83	11	6
Easy of sorting	67	31	2	63	32	5	76	20	4	68	28	4
Easy of grading	51	48	1	53	44	3	47	47	6	50	46	4
Easy in packaging	45	46	8	52	45	3	43	51	6	47	47	6
Easy in storing	48	48	4	52	49	2	43	55	2	47	50	3
less cost of production compare to competitive crops	89	9	1	85	13	17	90	8	2	88	10	2
Farm output	98	2	0	98	2	0	100	0	0	99	1	0
Easy product sale	98	2	0	98	2	0	100	0	0	99	1	0
Farm net profit	96	4	0	97	3	0	98	2	0	97	3	0

Source: Field Survey (2020)

Farm activities such as weeding, use of farm machinery, fertilizer application and scope of using IPM were commented with 'decreased' opinions by about 47% to 51% respondents but about 14%-21% respondents expressed as 'unchanged'. At last, labor use is opined with 'decreased' comments by 21% respondents, 'unchanged' by 36% respondents and 'increased' by about 43% respondents (Table 11.2.8.1). On the other hand, same opinions about aforesaid factors of farming practices were overall expressed by the respondents of all the farmer classes in Panchagarh (Table 11.2.8.2).

Table 11.2.8.2: Effect of Cropland Transformation into HYV Maize on Farming Practice in Panchagarh

Components of farming practices	% of farmers as per opinions											
	Small			Medium			Large			Average		
	Increased	Unchanged	Decreased	Increased	Unchanged	Decreased	Increased	Unchanged	Decreased	Increased	Unchanged	Decreased
Labor use	68	19	13	24	49	27	36	41	23	43	36	21
Easy land management	66	33	2	27	37	36	27	50	23	40	40	20
Management of seedling	72	28	0	97	2	2	45	27	27	71	19	10
Use of irrigation	45	55	0	90	7	3	32	32	36	56	31	13
Weeding	81	0	19	81	15	3	9	50	41	57	22	21
Farm machinery use	64	8	29	58	41	2	32	45	23	51	31	18
Fertilizer application	66	2	33	76	17	7	18	41	41	53	20	27
Scope of using IPM	6	71	24	12	36	53	18	32	50	12	46	42
Easy use of insecticides compare to others crops	36	2	62	90	2	8	32	41	27	53	15	33
Easy use of pesticides compare to competitive crops	99	1	0	90	5	5	27	41	32	72	16	12
Easy in harvesting	98	2	0	93	5	2	2	18	41	77	8	14
Easy of sorting	19	76	4	37	61	2	23	41	36	26	59	14
Easy of grading	3	96	1	14	85	2	41	41	18	19	74	7
Easy in packaging	2	98	1	10	88	2	27	36	36	13	74	13
Easy in storing	17	28	55	42	58	0	27	41	32	29	42	29
Less cost of production compare to competitive crops	31	14	55	73	20	7	27	41	32	44	25	31
Farm output	94	6	0	95	4	2	14	41	45	68	17	16
Easy product sale	97	3	0	93	5	2	32	27	41	74	12	14
Farm net profit	98	2	0	97	3	0	32	41	27	76	15	9

Source: Field Survey (2020)

it is realized from the above results that effects of transformation of crops land into HYV maize cultivation were positive due to variation of seasons, climate change, shortage of land, input, variety(es), technology, available of machinery in maize cultivation, farmer experience, etc.

11.2.9 Effects of Agricultural Transformation on Household Food Security in Lalmonirhat and Panchagarh

Effects of agricultural land transformation on household level food security were identified under three major issues: food availability, food accesss and food utilization. Again some factor for measuring contributions of transformation to household food security were considered under three major issues. All the factors are discussed under major issues in following section.

Effects on Food availability in household level due to transformation of HYV maize cultivation

Identified factors under food availability issue are: availability of all necessary food items in regional market, available of all necessary food items at local growth centre, availability of the necessary food items steady in the local market round the year, only rice is available at local growth centre, only vegetable is available at local growth centre, fish is available at local market, meat is available at local market, egg is available at local market, fresh fruits are available at the local market and fresh mangoes are availability at local market. In Table 11.2.9.1 it is shown that in Lalmonirhat all the indicators of food availability issue were supported by 51% to 54% respondents of all the farmer groups with their 'moderate' opinion while other farmer of same % (41% to 45%) agreed the factors with their comments of 'sufficient'. Moreover, cumulative effect score limit of individual factor was estimated the highest of 199 to 204 for small farmers whereas the highest score followed by all farmers (155 to 157), medium farmers (149 to 151) and large farmers (118), respectively. On the other hand, in Panchagarh (Table 11.2.9.1) 61% to 98% respondents of small, medium and all farmer classes supported the mentioned food availability issues with 'sufficient' comments while the 'sufficient' comment was expressed by 23% to 41% large farmers. Besides, all the issues of food availability were agreed almost by 20% to 40% respondents of small, large and all farmer groups with 'moderate' opinions in Panchagarh. Again, cumulative effect scores were calculated the highest of 308 to 323 for small farmers and the highest score followed by all farmer (174 to 181), medium farmer (173 to 175) and large farmer (36 to 46). In consequences, it is resulted that transformation of HYV maize production contributed to food availability in the respondents' household level but the contribution was the highest for small farmers (as per cumulative effect score) compare to medium farmers and large farmers.

Table 11.2. 9.1: Food Availability at the household level due to land Transformation to HYV Maize Cultivation in Lalmonirhat and Panchagarh

Issues	Small farmers					Medium farmers					Large					Average				
	% of farmers as per ideas				Cumulative effect score	% of farmers as per ideas				Cumulative effect score	% of farmers as per ideas				Cumulative effect score	% of farmers as per ideas				Cumulative effect score
	No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient	
Food Availability	***Lalmonirhat***																			
Availability of all necessary food items in regional market	00	0	58	42	203	0	2	53	45	151	0	4	51	45	118	0	2	54	44	157
Available of all necessary food items at local growth centre	0	5	54	42	199	0	5	50	45	149	0	4	51	45	118	0	5	51	44	155
Availability of the necessary food items steady in the local market round the year	0	0	58	42	203	0	2	53	45	151	0	4	51	44	118	0	2	54	44	157
Only rice is available at local growth centre	0	0	58	42.	203	0	2	53	45	151	0	4	51	44	118	0	2	54	44	157
Only vegetable is available at local growth centre	0	0	58	42	203	0	2	53	45	151	0	4	51	45	118	0	2	54	44	157
Fish is available at local market	0	0	58	42	203	0	2	53	45	151	0	4	51	45	118	0	2	54	44	157
Meat is available at local market	0	0	58	42	203	0	2	53	45	151	0	4	51	45	118	0	2	54	44	157
Egg is available at local market	0	0	58	42	203	0	2	53	45	151	0	4	51	45	118	0	2	54	44	157
Fresh fruits are available at the local market	0	0	57	43	204	2	2	52	45	149	0	4	51	45	118	1	2	53	44	157
Fresh mangoes are availability at local market	0	0	58	42	203	0	2	53	45	151	0	4	51	45	118	0	0	54	44	157
Food Availability	***Panchagarh***																			
Availability of all necessary food items in regional market	3	2	28	68	311	0	2	0	98	175	18	27	27	27	36	7	10	18	65	174
Available of all necessary food items at local growth centre	0	0	27	73	325	2	2	2	97	173	0	32	37	32	44	1	11	22	67	181
Availability of the necessary food items steady in the local market round the year	0	3	36	61	308	2	0	0	98	174	5	27	45	23	41	2	10	27	61	174
Only rice is available at local growth centre	0	8	21	71	312	0	169	2	97	174	5	32	27	36	43	2	70	17	67	176
Only vegetable is available at local growth centre	0	0	27	73	325	0	2	2	97	174	5	27	36	32	43	2	10	22	67	181
Fish is available at local market	0	0	36	64	314	0	2	0	98	175		32	32	36	45	0	11	23	66	178
Meat is available at local market	0	0	36.	64	314	2	2	2	97	173	0	41	32	27	41	1	14	23	63	176
Egg is available at local market	0	0	36	64	314	2	0	2	97	173	0	27	40	32	45	1	9	26	64	177
Fresh fruits are available at the local market	0	0	34	66	316	0	2	0	98	175	14	27.	27	33	39	5	10	21	65	176
Fresh mangoes are availability at local market	0	0	29	71	323	2	0	2	0	173	0	32	27	41 1	46	1	10	19.17	70	180

Source: Field Survey (2020)

Effects on food access in household level due to transformation of HYV maize cultivation

Identified factors under food access issue are: financial ability to purchase cereals (rice/wheat flour) fish, meat, egg for all the family members, financial capacity to store food grains for lean period, fruit items, borrow/lend necessary food items during crisis moments from neighbours/friends and equal access of the women, children and elderly family members to nutritious food.

Table 11.2.9.2 reveals that four factors like financial ability to purchase fish, meat, egg for all the family members and financial capacity to store food grains for lean period were accepted by about 79% respondents of all the farmer groups in Lalmonirhat through expression 'poor' opinion. So, it is found out that cumulative effect score fish (76), meat (78), egg (77) and food gain (74) increased through transformation into HYV maize cultivation but the increased financial ability was achieved in low level. So, the achievement scores indicate that the largest effects of transformation were made for small farmers (64% to139%) and the largest effect (47 to 104) followed by average farmer, respectively.

Again, indicator factor of financial ability to purchase cereals (rice/wheat flour) for all the family members was supported with 'moderate' comment by 59% respondents but 41% respondents of Lalmonirhat supported the financial ability as per opinion of 'poor'. Therefore, it is indicated that the financial capacity of cereal food purchase was developed in medium level in most of the respondents' households compared to the households of low level improvement. So, it is realized that some respondents were not benefited from the transformation in aspect of three factors.

In Panchagarh almost all the issues of food access were agreed with opinion 'moderate' by 18% to 65% of small farmers while the issues 32% to 61% were supported as 'sufficient' comments by the respondents. Again, 59% to 93% of medium farmers, and 27% to 64% of both large farmers and all farmers expressed 'poor' comments about the issues. Besides,13% to 49% of all farmers agreed the issues through 'moderate' comments. Therefore, all the farmers in Panchagarh were directly benefited by the transformation of crop land to HYV maize production but the benefits were not sufficient to most of them. On the other hand, the cumulative effect scores due to the transformation of HYV maize production were estimated the highest for small (202 to 308) farmers followed by the medium (41 to 80) farmers' and large (27 to 44) farmers. As a result, it is understood from the information that transformation of HYV maize cultivation provided the largest contribution to small farmers and then as per sequence to all, medium and large farmers.

Table 11.2.9.2: Changes in the Access to Food Security through Land Transformation to HYV Maize cultivation in Lalmonirhat and Panchagarh

Issues	Small farmers					Medium farmers					Large farmers					Average				
	% of farmers as per ideas				Cumulative effect score	% of farmers as per ideas				Cumulative effect score Sufficient	% of farmers as per ideas				Cumulative effect score	% of farmers as per ideas				Cumulative effect score
	No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient	
Food Access	***Lalmonirhat***																			
Financial ability to purchase cereals (rice/wheat flour) for all the family members	0	35	65	0	139	0	40	60	0	99	0	47	53	0	75	0	41	59	0	104
Financial ability to purchase fish for all the family members	0	82	18	0	99	0	79	21	0	75	0	88	12	0	55	0	83	17	0	76
Financial ability to purchase meat for all the family members	0	79	21	0	102	0	77	23	0	76	0	88	12	0	55	0	81	19	0	78
Financial ability to purchase egg for all the family members	0	79	21	0	102	0	77	23	0	76	6	82	12	0	52	2	79	19	0	77
Financial capacity to store food grains for all family members for lean period	4	75	21	0	99	6	71	23	0	72	10	78	12	0	50	7	75	19	0	74
Financial capacity to purchase processed fruit items	21	60	19	0	82	24	53	23	0	61	33	55	12	0	39	26	56	18	0	61
Borrow/lend necessary food items during crisis moments from neighbours/friends	48	33	19	0	60	39	39	23	0	52	49	39	12	0	31	45	37	18	0	48
Equal access of the women, children and elderly family members to nutritious food	43	38	19	0	64	34	44	23	0	55	43	45	12	0	34	40	42	18	0	51
Food Access	***Panchagarh***																			
Financial ability to purchase cereals (rice/wheat flour) for all the family members	0	0	6	35	280	0	63	36	2	80	0	27	45	27	44	0	31	49	21	135
Financial ability to purchase fish for all the family members	0	3	65	33	274	0	93	5	2	62	0	64	23	9	30	0	53	31	14	122
Financial ability to purchase meat for all the family members	0	0	46	54	302	15	75	8	2	55	14	50	23	14	30	10	42	26	23	129
Financial ability to purchase egg for all the family members	0	0	40	61	310	3	86	8	2	62	0	64	27	9	32	1	50	25	24	135
Financial capacity to store food grains for all family members for lean period	0	11	44	55	301	8	86	3	2	56	9	64	18	9	28	6	51	22	22	128
Financial capacity to purchase processed fruit items	0	0	41	59	308	19	76	3	2	50	14	59	18	9	27	11	45	21	23	128
Borrow/lend necessary food items during crisis moments from neighbours/friends	0	0	52	48	295	36	59	5	0	41	14	60	18	9	27	16	40	25	18	121
Equal access of the women, children and elderly family members to nutritious food	18	29	18	34	202	24	69	5	2	48	14	59	18	9	27	18	53	14	15	92

Source: Field Survey (2020)

Effects on food utilization in household level due to Land transformationto HYV Maize Cultivation

The food utilization issufficient knowledge and skill to prepare healthy diets with available food items, better management to distribute food among all family members as per requirements, scope of storing surplus cooked food in refrigerator, better knowledge and skill to store vegetables for using in off season, better knowledge and skill to store fruits for using in off season and better knowledge and skill to dry and store fish for using in off season.

In Table 11.2.9.3 it is mentioned that in Lalmonirhat two effect factors of sufficient knowledge and skill to prepare healthy diets with available food items and better management to distribute food among all family members as per requirements were agreed by respondents of about 80% to 90% with 'poor' comment, 5% to 15% with 'moderate' comment and 3% to 5% with 'no' comment. As a result, it is understood that most of the respondents were affected through two factors of food utilization in poor level but the remaining respondents gained in medium level. On the other hand, three factors of better knowledge and skill to store vegetables for using in off season, better knowledge and skill to store fruits for using in off season, and better knowledge and skill to dry and store fish for using in off season were expressed with 'no', 'poor' and 'moderate' opinions by all farmer group respondents of about 40% to 70%, 20% to 40% and 5% to 15%, respectively that indicating that most of the respondents did not achieved knowledge and skill about store of vegetable, fruit and fish and the small part of the respondents was gained the knowledge and skill in poor and medium level. Besides, the all types of respondents of 80% to 90%, 10% to 15% and 2% to 10% supported the factor of scope of storing surplus cooked food in refrigerator by comments of 'no', 'moderate' and 'poor', respectively which identify most of the respondents have no capacity to store food in refrigerator and a smaller number of the respondents hold the refrigerator capacity.

In all the effect factors, for factor of sufficient knowledge and skill to prepare healthy diets with available food items, the highest cumulative effect score of 90, 66, 52 and 69 were achieved for small, medium, large and all farmers, respectively but for factor of better management to distribute food among all family members as per requirements, the second highest score of 88, 65, 51 and 68 were earned for same types of farmers, respectively. Again, the second highest score was followed by small farmer with the scores of 48, 37, 33, 24, medium farmer with the scores of 46, 38, 31, 23, large farmer with the scores of 28, 20, 18, 13 and all farmer with the scores of 41 , 32 , 27 and 20 for factors of betterknowledge and skill to store vegetables for using in off season, better knowledge and skill to store fruits for using in off season, better knowledge

and skill to dry and store fish for using in off season and scope of storing surplus cooked food in refrigerator, respectively. So, it is resulted that food utilization in household level was influenced by all the effect factors but the effect levels were difference among the factors.

In Panchagarh all the factors of food utilization issues were generally supported by 30% to 85% respondents of all the farmer classes with 'poor' opinion whereas 'moderate' opinions were agreed overall by 20% to 40% respondents. So, all the farmers were benefited due to the transformation of HYV maize production. Moreover, cumulative effective score range were estimated as per descending order were 38 to 194, 39 to 118, 35 to 117 and 42 to 43 for small, all, medium and large farmers that indicate after all effects on food utilization of the farmers and show the highest effects to small farmers and then followed by all, medium and large farmer groups in Panchagarh.

Table 11.2.9.3: Contribution to Food Utilization for Household Food Security through Transformation land to HYV Maize Cultivation

Issues	Small farmers					Medium farmers					Large farmers					Average				
	% of farmers as per ideas				Cumulative effect score	% of farmers as per ideas				Cumulative effect score	% of farmers as per ideas				Cumulative effect score	% of farmer as per idea				Cumulative effect score
	No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient	
Food Utilization	***Lalmonirhat***																			
Sufficient knowledge and skill to prepare healthy diets with available food items	5	83	12	0	90	6	81	13	0	66	0	94	6.	0	52	4	86	10	0	69
Better management to distribute food among all family members as per requirements	5	86	10	0	88	8	79	13	0	65	2	92	6	0	51	5	86	10	0	68
Scope of storing surplus cooked food in refrigerator	83	5	12	0	24	79	6	13	2	23	88	2	6	4	13	83	4	10	2	20
Better knowledge and skill to store vegetables for using in off season	51	40	8	0	48	37	52	11	0	46	49	45	6	0	28	46	46	9	0	41
Better knowledge and skill to store fruits for using in off season	67	23	11	0	37	53	32	15	0	38	65	29	6	0	20	62	28	10	0	32
Better knowledge and skill to dry and store fish for using in off season	70	20	10	0	33	63	24	13	0	31	70	24	6	0	18	68	23	10	0	27
	Panchagarh																			
Food Utilization																				
Sufficient knowledge and skill to prepare healthy diets with available food items	10	45	18	28	194	2	86	10	2	117	0	36	36	27	42	4	56	22	19	118
Better management to distribute food among all family members as per requirements	5	43	22	30	211	7	88	5	0	110	0	32	46	23	42	4	54	24	18	121
Scope of storing surplus cooked food in refrigerator	24	22	26	29	190	47	49	2	2	63	0	32	36	32	44	24	34	21	21	99
Better knowledge and skill to store vegetables for using in off season	22	25	24	29	191	46	49	3	2	65	0	36	32	32	43	23	37	20	21	100
Better knowledge and skill to store fruits for using in off season	57	39	0	4	61	69	25	3	2	37	0	27	50	23	43	42	30	18	10	47
Better knowledge and skill to dry and store fish for using in off season	69	30	1	0	38	71	24	3	2	35	0	32	40	27	43	47	29	15	10	39

Source: Field Survey (2020)

11.2.10 Effects of Agricultural Transformation on Household Poverty Reduction

For measuring the effect of agricultural transformation on household poverty reduction, three important issues were considered and these issues are income, food consumption and wellbeing. Again, some effect indicator factors were considered under three issues: income, food consumption and wellbeing.

Effects on income at household level due to transformation

For determining effects of cropland shifting to HYV maize cultivation, the factors defined were crop production, livestock, fisheries, service, small business, wage earning, in-country remittance, out-country remittance, on-farming activities, off-farm activities. These factors were also considered as income sources of family members. Table 11.2.10.1 shown that in Lalmonirhat farmers earned income from crop production and the income level were defined as 'poor', 'moderate' and 'sufficient' by 39%, 50% and 11% respondents of the farmer groups, respectively. But, 76% respondents did not gain income from livestock source and only 20%, 10% and 2% respondents were generally identified their income from livestock as 'poor', 'moderate' and 'sufficient', respectively. In addition, the respondents of 82% of all the farmer groups received no income from the sources of fisheries, services (85%), small business and wage earning (84%), in-country remittance, out-country remittance, on-farming activities and off-farming activities are (87%). Lastly, it was observed that crop production is the main sources of the respondents' income. Furthermore, the cumulative effect scores on the respondents' income due to transformation of land to HYV maize cultivation were estimated the highest for small farmer, (14 to 143) and the second highest for for medium farmer (18 to 111), for large (9 to 82 and average was 14 to 112, respectively.

Table 11.2.10.1: Effects of Land Transformation on Income Generation for Household Poverty Reduction in Case of HYV Maize Production in Lalmonirhat and Panchagarh

Issues	Small farmers					Medium farmers					Large farmers					Average				
	% of farmers as per ideas				Cumulative effect score	% of farmers as per ideas				Cumulative effect score	% of farmers as per ideas				Cumulative effect score	% of farmers as per ideas				Cumulative effect score
	No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient	
Income source	***Lalmonirhat***																			
Crop production	0	39	51	10	143	0	34	53	13	111	0	43	47	10	82	0	39	50	11	112
Livestock	68	20	8	4	40	69	15	13	3	31	63	27	10	0	23	67	20	10	2	31
Fisheries	83	7	10	0	22	81	6	11	2	21	82	12	6	0	12	82	9	9	1	18
Services	88	6	6	0	15	81	5	13	2	22	86	6	8	0	11	85	6	9	1	16
Small business	86	2	12	0	22	84	0	15	2	21	82	10	8	0	13	84	4	12	1	19
Wage earning	88	5	7	0	16	81	5	13	2	22	84	6	10	0	13	84	5	10	1	17
In-country remittance	90	2	7	0	14	84	0	15	2	21	88	4	8	0	10	87	2	10	1	15
Out-country remittance	90	2	7	0	14	84	3	11	2	19	88	6	6	0	9	87	4	8	1	14
On-farming activities	90	2	7	0	14	84	5	10	2	18	88	6	6	0	9	87	4	8	1	14
Off-farming activities	88	4	8	0	17	84	5	10	2	18	88	6	6	0	9	87	5	8	1	15
Income source	***Panchagarh***																			
Crop production	0	8	40	51	289	2	25	20	53	132	0	27	50	23	43	1	80	37	42	155
Livestock	31	12	29	28	183	88	10	0	2	9	0	27	45	27	44	40	49	25	19	79
Fisheries	56	42	1	1	55	95	2	2	2	6	0	36	36	27	42	50	36	13	10	34
Services	25	29	33	14	160	93	2	2	3	9	0	27	41	32	45	40	25	25	16	71
Small business	0	42	38	20	212	80	8	7	5	22	0	18	41	41	49	27	125	29	22	94
Wage earning	0	45	38	18	207	90	5	3	2	10	0	23	45	32	46	30	83	29	17	88
In-country remittance	9	22	33	36	233	95	3	0	2	5	0	32	32	36	45	35	35	22	25	94
Out-country remittance	1	30	36	33	239	97	2	0	2	4	0	36	32	32	43	32	29	23	22	95
On-farming activities	0	30	45	24	231	97	2	0	2	4	0	27	36	36	46	32	26	27	21	94
Off-farming activities	0	37	41	22	220	90	8	0	2	8	0	27	41	32	45	30	114	27	18	91

Source: Field Survey (2020)

In Panchagarh all the factors of income issues except livestock, fisheries and services were positive influenced due to the transformation and the influences were supported by the respondent farmers of 49%, 36 % and 25% with 'poor' opinion and 25%, 12% and 25% with 'moderate' comments. Consequently, the transformation of HYV maize production created positive effects on income of all the growers. Again, cumulative effect scores of the transformation were calculated the largest for small farmers (55 to 289) and the second highest was (34 to 155) for all farmers. But, for medium farmers the highest score (132) was achieved for crop production and the smallest scores (43 to 47) were found large farmers. In conclusion that small farmer was habitually benefited for income earning due to transformation of crops lnd into HYV maize cultivation, but all the farmers were contributed from the HYV maize transformation.

Effects on food consumption at household level due to land transformationto maize cultivation

To measure effects of agricultural transformation on food consumption in household level, consumption levels of some food items were considered under food consumption issue. These food items are carbohydrate, fish, meat, egg, fresh vegetables, fresh fruits, tea and coffee, threemeal per day and twomeal per day.

Table 11.2.10.2 indicates that in Lalmonirhat 36%-40% respondents observed no effect of transformation of HYV maize cultivation on consumption of carbohydrate, fish, meat, egg and fresh vegetables while no effect on consumption of tea and coffee, three meals per day and two meals per day were maintained by 74%- 77% respondents of same farmer classes. Again, 1%, 38% and 24% respondents agreed the effects of the transformation on taking of carbohydrate as 'poor', 'moderate' and 'sufficient', respectively while effects on taking of 3-meal per day were supported as 'moderate' and 'sufficient' ideas by 9% and 91% respondents, respectively. Moreover, effects of the transformation on taking of fish (42%, 12% and 7%), meat (45%, 9% and 7%,) egg (45%, 9% and 7%) and fresh vegetables (44%, 9% and 7%) were identified as 'poor', 'moderate' and 'sufficient' levels. In addition, overall, respondents articulated their opinions about consumption of and two meals per day as no change (74%) 'poor' (11%) 'moderate' (12%) and 'sufficient' (1%) level. In conclusion that some farmers alleged that no effect of transformation of HYV maize cultivation on food consumption of their household while some far ers agreed positive effects on the food consumption.

Table 11.2.10.2: Changes in Food Consumption in Relation to Poverty Reduction due to HYV Maize Cultivation in Lalmonirhat and Panchagarh

Issues	Small farmers					Medium farmers					Large farmers					Average				
	% of farmers as per ideas				Cumulative effect score	% of farmers as per ideas				Cumulative effect score	% of farmers as per ideas				Cumulative effect score	% of farmers as per ideas				Cumulativeef fect score
	No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient	
Food Consumption	***Lalmonirhat***																			
Carbohydrate	32	2	40	25	133	37	0	35	27	95	39	2	41	18	68	36	1	397	24	99
Fish	39	43	12	6	71	42	35	13	10	56	37	49	10	4	40	39	42	12	7	56
Meat	39	45	10	6	69	42	37	11	10	55	37	54	6	4	38	39	45	9	7	54
Egg	39	45	10	6	69	42	37	11	10	55	37	53	6	4	38	39	45	9	7	54
Fresh vegetables	39	45	10	6	69	42	37	11	10	55	39	51	6	4	37	40	44	9	7	54
Fresh fruits	68	20	6	6	42	71	10	10	10	36	76	14	6	4	19	71	15	7	7	32
Tea and coffee	77	8	6	8	38	74	5	10	11	36	80	10	6	4	17	77	80	7	80	30
3-meal per day	0	0	8	92	245	0	0	8	92	181	0	0	10	90	142	0	0	9	91	189
2-meal per day	79	10	10	2	30	71	13	13	0	39	73	10	12	0	17	74	11	12	1	54
Food Consumption	***Panchagarh***																			
Carbohydrate	18	0	77	5	37	69	2	20	8	40	18	0	77	5	37	35	1	58	6	38
Fish	23	18	5	55	42	69	22	5	3	25	23	18	5	55	42	38	19	5	38	36
Meat	41	9	0	50	35	85	10	2	3	14	41	9	0	50	35	56	9	1	34	28
Egg	18	23	0	59	44	69	22	5	3	25	18	23	0	59	44	35	23	2	40	38
Fresh vegetables	23	18	0	59	43	71	22	5	2	22	23	18	0.	59	43	39	19	2	40	36
Fresh fruits	27	0	73	0	32	88	7	2	3	12	27	0	73	0	32	48	2	49	1	25
Tea and coffee	32	0	0	68	45	86	7	0	7	16	32	0	0	68	45	50	2	0	48	35
3-meal per day	45	0	14	41	33	27	2	20	51	115	45	0	14	41	33	39	1	16	44	60
2-meal per day	86	91	77	91	37	54	20	2	24	56	32	5	0	64	43	57	39	26	59	45

Source: Field Survey (2020)

The cumulative effect scores of HYV maize production on the respondents' household food consumption were calculated the highest and the second highest for three meals per day and carbohydrate, respectively and the highest scores for small (245 and 133), medium (181 and 95), large (142 and 68). Then, the estimated cumulative score with consumption factors as per descending order for small farmer were fish (71), meat, egg and fresh vegetables (same figure of 69), fresh fruits (42), tea & coffee (38) and two meal per day (the lowest of 30) whereas for medium farmer were fish (56), meat, egg and fresh vegetables (same score of 55), two meal per day (39), fresh fruits and tea & coffee (same and the lowest score of 36), for large farmer were fish (40), meat and egg (same score of 38), fresh vegetables (37), tea & coffee and two meal per day (same and the smallest figure of 17) and at last for all farmer were fish (56), meat, egg and 2-meal per day (same score of 54), fresh vegetables (54), fresh fruits (32) and tea & coffee (the minimum of 30). So, it is indicated that all the factors of household food consumption were affected through transformation of HYV maize cultivation but the effect levels among the consumption factors were revealed highly variation.

In Panchagarh almost of small farmers were benefited in moderately for consumption of carbohydrate (77%), fresh food (5%) and 2-meal per day (77%) due to HYV maize production whereas the sufficient effects on consumption of fish (54%), meat (50%), egg fresh vegetables (59%), and tea-coffee (68%), and 3-meal per day were agreed from 40% of the farmers. Once more, almost of medium farmers were benefited in moderately for consumption of carbohydrate (20%), fish (5%) and 2-meal per day (2%) due to HYV maize production whereas the sufficient effects on consumption of carbohydrate (8%), fish (3%), meat and egg (3%), fresh vegetables (2%), and tea-coffee (7%), and 3-meal per day were agreed from 51% of the farmers.

Again all the farmers replied that no change for consumption of carbohydrate (35%), fish (38%), meat (56%) eggs (35%), freash vegetable (39%), 2-meal per day (57%) 3-meal per day (39%) due to HYV maize cultivations.

Finally, almost 58% to 60% of all farmers were influenced moderately or sufficiently for all the factors of food consumption due to the transformation. In consequences, after all the whole of farmer society in Panchagarh was affected for their food consumption through HYV maize cultivation.

Effects on wellbeing in household level due to transformation of HYV Maize Cultivation

To determine effects on wellbeing of household for transformation of crops land into HYV maize cultivation, there are some factors were identified. These factors are: tin shade house, half building house, full building house, sanitary/modern toilet and wash facilities, electricity supply, tube-well, water-supply by own pumping, better clothing for family members, better education for the children, ICT use and participation in social events. Table 11.2.10.3 depicted that in Lanmonirhat the respondents of farmers agreed no ownership of half building house (83%) and full building house (96%) and no involvement in ICT house (95%) and no effect of HYV maize cultivation to these matters, but generally respondents agreed the effects of transformation for making half (10%, 47% and 28%) and full building house (2%,3% and 0%) and ICT use (3%, 2% and 0%) with comments of 'poor' or 'moderate' or 'sufficient'.

Again, overall commented about no use of solar electricity (3%, 42% and 32%), water supply by own pumping (74%, 14% and 5%) and participation in social events (45%, 45% and 0%) while the rest of the respondents' agreed contributions of the transformation for uses of these machineries and social participation according to their opinions of 'poor' or 'moderate' or 'sufficient'. Finally, it is resulted that overall of the farmers were supported from transformation of HYV maize cultivation for wellbeing through their family poverty reduction in small scale or large scale.

It is also found in Table 11.2.10.3that the highest cumulative effect scores were achieved for use of electric supply for all the farmer groups of small farmers (173), medium farmer (120), large farmer (98) and all farmers (130) whereas the lowest score of 4 for all the farmer classes. Then the second highest cumulative effect scores were estimated for use of made tin shade house for small, medium, large and all farmer with the scores of 168, 115, 87 and 123, respectively while the third highest scores were for use of tube-well for same famer classes with the score levels of 162, 108, 92 and 120, respectively. Again, the third highest cumulative score followed by small farmer wellbeing factors of sanitary/modern toilet and wash facilities (81), better clothing for family members (71), better education for the children (63), solar electricity (62), participation in social events (49), water supply by own pumping (37), half building house (24) and full building house (5) while for medium farmer were sanitary/modern toilet and wash facilities (68), better clothing for family member (50), better education for the children (45), participation in social events (41), solar electricity (36), water supply by own pumping and half building house (same score of 21) and full building house (6); but for large farmer were sanitary/modern toilet & wash facilities and better clothing for family members (same score of 52), better education for

the children (44), participation in social events (35), solar electricity (33), water supply by own pumping (27), half building house (20) and full building house; lastly for all farmer were sanitary/modern toilet and wash facilities (67), better clothing for family member (58), better education for the children (51), solar electricity (44 , participation in social events (42), water supply by own pumping (28), half building house (22) and full building house (4). As a result, it is realized that all the wellbeing factors of the respondents' family poverty reduction were improved due to transformation of Land to HYV maize production but the cumulative effect scores of the wellbeing factors show far difference among their scores.

In Panchagarh respondents were contributed moderately to wellbeing of made tin shade house (64%), sanitary/modern toilet and wash facilities (67%), solar electricity (36%), tube-well (48%), better clothing (53%) and education (54%) and participation in social events (45%). Again small farmers and large farmers were sufficiently supported advantages of the transformation for half building house (64% and 19 %), full building house (50% and 7%), electricity supply (77% and 78%) and ICT use (73% and 5%), respectively. Besides, poor effects of the transformation were agreed by overall 1% to 30% farmers of all the classes. Finally, it is resulted that all the farmers were benefited for achieving their wellbeing through transformation of crops land into HYV maize cultivation in Panchagarh.

Table 11.2.10.3: Effects on Wellbeing in Terms of Poverty Reduction due to HYV Maize cultivation in Lalmonirhat and Panchagarh

Issues	Small farmers					Medium farmers					Large farmers					Average				
	% of farmers as per ideas				Cumulative effect score	% of farmers as per ideas				Cumulative effect score	% of farmers as per ideas				Cumulative effect score	% of farmers as per ideas				Cumulative effect score
	No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient		No change	Poorly done	Moderate	Sufficient	
Wellbeing	***Lalmonirhat***																			
Made tin shade house	13	8	44	35	168	15	11	48	26	115	18	10	47	24	87	15	10	46	28	123
Half tin made building house	86	2	10	2	24	82	3	13	2	21	80	2	16	2	20	83	3	13	2	22
Full building house	96	1	2	0	5	97	2	2	0	6	94	2	4	0	5	96	2	3	0	4
Sanitary/modern toilet and wash facilities	30	49	17	5	81	21	53	21	5	68	22	51	24	2	52	24	51	21 1	4	67
Electricity supply	1	26	38	35	173	0	29	48	23	120	2	24	44	29	98	1	27	44	29	130
Solar electricity	63	17	4	17	62	66	19	5	10	36	61	18	6	12	33	63	18	5	13	44
Tube-well	2	40	19	38	162	3	45	26	26	108	2	41	24	33	92	3	42	23	32	121
Water supply by own pumping	75	12	7	6	37	77	14	10	0	21	69	14	8	8	27	74	14	8	5	28
Better clothing for family members	26	64	8	1	71	27	65	8	0	50	10	76	12	2	52	21	68	10	1	58
Better education for the children	35	57	7	1	63	37	56	8	0	45	22	67	8	2	44	31	60	8	1	51
ICT use	96	2	1	0	4	95	3	2	0	4	94	4	2	0	4	95	3	2	0	4
Participation in social events	50	42	8	0	49	44	47	10	0	41	41	47	12	0	35	45	45	10	0	42
Wellbeing	***Panchagarh***																			
Made tin shade house	18	5	68	9	37	24	7	54	15	95	18	5	68	9	37	10	5	64	11	56
Half tin madebuilding house	14	5	18	64	51	47	14	20	19	65	14	5	18	64	51	11	8	19	49	56
Full building house	18	5	27	50	46	73	7	14	7	32	18	5	27	50	46	10	5	23	36	41
Sanitary/modern toilet and wash facilities	5	18	73	5	39	7	24	56	14	104	5	18	73	5	39	15	20	67	8	61
Electricity supply	5	0	18	77	59	5	0	17	78	158	5	0	18	77	59	2	0	18	78	92
Solar electricity	14	14	50	23	40	69	3	8	19	45	14	14	50	23	40	10	10	36	21	42
Tube-well	5	18	55	23	43	7	25	34	34	115	5	18	55	23	43	16	20	48	26	67
Water supply by own pumping	55	5	5	36	27	68	7	14	12	41	55	5	5	36	27	22	5	8	28	32
Better clothing for family members	9	27	59	5	35	12	36	41	12	90	9	27	59	5	35	24	30	53	7	53
Better education for the children	14	23	59	5	34	19	22	44	15	92	14	23	59	5	34	19	23	54	8	53
ICT use	27	0	0	73	48	90	3	2	5	13	27	0	0	73	48	10	1	1	50	36
Participation in social events	36	14	50	0	25	47	15	34	3	55	36	14	50	0	25	22	14	45	1	35

Source: Field Survey (2020)

11.2.11 Problems in Crops Land Transformation into HYV Maize Cultivation

Some problems encountered by farmers for transformation of HYV maize cultivation were identified as per opinions of the respondents. All the problems were defined under several major issues. These major issues are input related problems, pest and disease related problems, production and cost related problems, climate and disaster related problems, financial related problems, marketing related problems, farmers' performance related problems and support and social related problems. So, all the problems are discussed under the major issues as follows in Table 11.2.11.1 and Table 11.2.11.2.

Input related problems

Input related problems are high price and low quality of seed; scarcity of quality seed; unavailability and higher price of fertilizers in peak season; high price and low quality of product packing bags; high cost of irrigation; and high price an & low quality of pesticides.

Pest and disease related problems

Several problems related to pest and disease control for cultivation of HYV maize cultivation are unknown and uncontrolled of pest/disease attack; cancer (pochan) disease of plant; firing damage of plant leaf by pest attack; uncontrolled insects- local named 'bold mocha'; and lower quality of pest & disease control chemical.

Production and cost related problems

Production and cost related problems for HYV maize cultivation are considered as: transformation of crop land into non-crop farm and social infrastructural development; highly production cost occurred by high prices of all inputs and services; changes of cultivation method, technology, instrument and machinery; high mortality of seedlings; lacking of irrigation and drainage management system; and high cost of fencing setting surrounding crop land. Table 11.2.11.1indicates that the largest of about 89% respondents of all types of farmer classes mentioned the problem of high production cost occurred by high prices of input and services whereas the rest of problems were supported 68% to 77% respondents of all the farmer groups.

Climate and disaster related problems

Several crises were determined as climate and disaster related problems and these problems are created adverse climatic conditions of production in sometimes in seasons; falling/breaking down of plant stem by heavy storm and rainfall; damage plant by flood; andcrises of irrigation in heavy drought of peak season.

Financial related problems

Capital and credit related problems were considered as financial problems. Some financial problems are lack of bank credit support; complex long-term procedure and legal & illegal condition for bank credit; high capital investment for production; serious capital crises of farmers; and high interest, service cost and pressure for NGO and private loan.

Marketing related problems

Problems related to processing, storage and selling of products were defined as marketing problems. So, some marketing problems are short duration of crop harvesting time; non-facility of proper processing and storage of crop; price variation of products in a season and different markets; tyranny of wholesalers for product selling; higher weight count for selling of products (50 kg/mound) and absence of linkage between farmers and outside buyers and markets. All the problems may be identified as important issues for product marketing and almost 81% of respondent farmers agreed absence of linkage between farmers and outside

Farmers' performance related problems

The problems regarding farmers' weakness and eligibility were determined as farmers' performance problems. These problems are absent of farmers' association; scarcity of farmers' appropriate knowledge & skill about production and marketing; absent of proper leadership and awareness in farmers' society; farmers' fear and non-interest about outside buyers and markets; and no knowledge of farmers on value addition to products.

Support and social related problems

The problems were created from institutional and social lacking was considered as support and social problems. So, these problems are: damage of seedlings/plants occurred by public and cattle/goat; taking sowing seeds by birds; scarcity of labor in society; non-available training for farmer; lacking of GOs and NGOs supports and services; non-availability of government subsidy; and no special government supports for crop transformation.

Table 11.2.11.1: Problems Encountered by HYV Maize Farmers in Lalmonirhat

Problems	*% of farmers as per opinion*			
	Small	*Medium*	*Large*	*Average*
Input related problems				
High price and low quality of seed	75	66	67	70
Scarcity of quality seed	79	74	86	79
Unavailability and higher price of fertilizers in peak season	68	63	71	67
High price and low quality of product packing bags	66	60	65	64
High cost of irrigation	76	81	86	81
High price and low quality of pesticides	66	65	63	65
Pest and disease related problems				
Unknown and uncontrolled of pest/disease attack	77	60	78	72
Cancer (pochan) disease of plant	77	63	72	71
Firing damage of plant leaf by pest attack	80	75	68	74
Uncontrolled insects- local named 'bold mocha'	83	80	82	82
Lower quality of pest & disease control chemical	66	65	71	67
Production and cost related problems				
Transformation of crop land into non-crop farm and social infrastructural development	77	76	65	73
High production cost occurred by high prices of input and services	91	89	88	89
Changes of cultivation method, technology, instrument and machinery	77	74	78	76
High mortality of seedlings	66	71	69	69
Lacking of irrigation and drainage management system	76	76	80	77
High cost of fencing setting surrounding crop land	76	79	69	75
Climate and disaster related problems				
Prevent adverse climatic conditions of production sometimes in seasons	56	79	69	68
Falling/breaking down of plant stem by heavy storm and rainfall	57	65	67	63
Damage occurs due to flood	59	63	65	62
Crises of irrigation in heavy drought of peak season	52	73	79	68
Financial related problems				
Lack of bank credit support	65	63	67	65
Complex illegal condition for bank credit	87	68	71	75
High capital investment for production	58	63	76	66
Serious capital crises of farmers	81	69	78	76
High interest, service cost and pressure for NGO and private loan	95	91	92	93
Marketing related problems				
Low price in harvesting time	50	63	61	58
Non-facility of proper processing and storage of crop	69	61	67	66
Price variation of products in a season and different markets	75	80	65	73
Tyranny of wholesalers for product selling	58	60	65	61
Higher weight count for selling of products (50 kg/mound)	52	52	63	56
Absence of linkage between farmers and outside buyers and markets	79	81	83	81
Farmers' performance related problems				
Lack of farmers' association	55	55	73	61
Lack of appropriate knowledge and skill about production and marketing	62	68	73	68
Absence of proper leadership and awareness in farmers' society	65	55	63	61
Outside buyers force them to sell products	69	67	72	69
Lack of value addition knowledge to products	65	58	68	64
Support and social related problems				
Damage of seedlings/plants occurred by public and cattle/goat	61	56	69	62
Taking sowing seeds by birds	56	67	63	62
Scarcity of labor	78	55	59	64
Non-available training for farmer	58	63	69	63
Lack of GOs and NGOs supports and services	55	60	69	61
Non-availability of government subsidy	64	73	67	68

Source: Field Survey (2020); (Number of sample farmers, n=200)

In Panchagarch all the problems related to inputs were agreed by the all respondents' groups with 57% to 82%, but lack of quality seed and high cost of irrigation were supported by the highest respondents of 75% to 79% Table 11.2.11.2. In all the problems of pest and disease, uncontrolled insects- local named 'bold mocha' was identified more than 77% respondents. Incase of production and cost related problems, the highest 80% respondents of all types of farmers' mentioned the problem of highly production cost occurred by high prices of all inputs and services whereas the rest of problems were supported 64% to 71% respondents of all the farmer groups. Moreover, Climate and disaster problems were also supported by respondents (64% to 75%) of all the farmers.

In Panchagarch the problems of finance, high interest, service cost and pressure for NGO and private loan was accepted by above 81% respondents of all and others categories farmers were also agreed by respondents of 78 to 85%. All the problems of marketing may be identified as important issues for HYV maize transformation and almost 72% of respondent farmers agreed lack of linkage between farmers and outside buyers and markets as major problems. In conclusion, overall, 58% to 73% respondents expressed their opinions about their performance and 60% to 76% for support and social problems and considered as an important issue for promotion of agricultural transformation.

Table 11.2.11.2 Problems Encountered by HYV Maize Farmers in Panchagarh

Problems	*% of farmers supporting the issue*			
	Small	*Medium*	*Large*	*Average*
Input related problems				
High price quality of seed	73	86	86	82
Lack of quality seed	55	85	87	75
Unavailability and higher price of fertilizers in peak season	52	56	64	57
High price and low quality of packing bags	63	71	64	66
High cost of irrigation	72	75	91	79
High price and low quality of pesticides	61	73	86	73
Pest and disease related problems				
Unknown and uncontrolled pest/disease	58	83	91	77
Cancer (pochan) disease of plant	66	63	73	67
Firing damage of plant leaf by pest attack	65	78	68	70
Uncontrolled insects- local named 'bold mocha'	72	57	68	66
Lower quality of pest & disease	72	78	73	74
Production and cost related problems				
Highly production cost occurred by high prices of input and services	70	90	82	80
Changes of cultivation method, technology, instrument and machinery	61	85	68	71
High mortality of seedlings	72	54	77	68
Lackof irrigation and drainage management	68	71	64	68
High cost of fencing setting surrounding of crop	68	66	60	64
Climate and disaster related problems				
Create adverse climatic conditions of production in sometimes in seasons	70	78	77	75
Falling down of plant stem by heavy storm and rainfall	67	75	60	67
Damage plant by flood	58	75	59	64
Financial related problems				
Lack of bank credit supply	66	73	82	74
Complex long-term procedure and legal & illegal condition for bank credit	81	61	65	69
High capital investment for production	81	76	64	74
Serious capital crises of farmers	91	80	90	87
High interest, service cost and pressure for NGO and private loan	81	85	78	81
Marketing related problems				
Low price of crop in harvesting time	53	80	59	64
Non-facility of proper processing and storage of crop	60	59	73	64
Price variation of products in a season and different markets	67	70	82	73
Tyranny of wholesalers for product selling	67	69	77	71
Higher weight count for selling of products (50 kg/mound)	55	54	64	58
Lack of linkage between farmers and outside buyers and markets	78	69	68	72
Farmers' performance related problems				
Lack of farmers association	60	54	59	58
Scarcity of farmers' appropriate knowledge and skill about production and marketing	59	63	64	62
Lack of proper leadership and awareness in farmers' society	63	79	74	72
Farmers' fear and non-interest about outside buyers and markets	62	65	72	66
No knowledge of farmers on value addition to products	83	63	73	73
Support and social related problems				
Damage of seedlings /plants by public and cattle/goat	55	69	59	61
Taking sowing seeds by birds	79	76	73	76
Scarcity of labor in peak time	59	58	64	60
Non-available training for farmer	63	64	68	65
Lacking of GOs and NGOs supports and services	60	61	68	63
Non-availability of government subsidy				
Lack of government supports for crop transformation	72	57	81	70

Source: Field Survey (2020)

11.2.12 Farmers' Suggestions for Promotion of Land Transformation toward HYV Maize Production

For overcoming the problems for transformation crops land into HYV maize cultivation, there are some important suggestions provided by the respondents. In Lalmanirhat, there are some suggestion provided by the respondents. These are development and appropriate varieties considering adverse climate (84%); provide available training to farmers about pest & disease management and Increase GOs and NGOs supports and services (81%); Ensure availability of good quality seed and pesticides (83%), establish easy credit system by both government, private bank and Introduce digital marketing for products, Building cold storage/processing facilities in research areas/clusters, Increase export facility from government and non-government organizations (82%), Increase monitoring quality and prices of all inputs (81%), Available government support in management of fair price and weight system of product (83%), Taking steps for quality packing of products (84%), Developing market structure, conduct and performance (87%), Creating awareness of farmers/entrepreneurs (85%), Take effective steps for reducing price of all inputs and irrigation costs (89%), Developed HYV maize variety (ies) (80%) Table 11.2.12.1. In the Panchagarh the respondents provided the following suggestion like is,creating awareness in all farmers/entrepreneurs (72%), establish easy credit system by both government and private bank, taking steps for supplying good quality packing bags of products in lower price, available government support in management of fair price and weight system of product (74%), Building cold storage/processing unit in study areas/clusters (75%),monitoring quality and prices of all inputs, provide available training to farmers about pest & disease management (76%), development of appropriate varieties considering adverse climate and Introduce digital marketing as alternative marketing for products (77%),develop scientific methods for packaging, processing and storage of products and Increase subsidy and monitoring of subsidy delivery to farmers from government (78%), increase export facility from government and non-government organizations and Increase GOs and NGOs supports (79%),developing market structure, conduct and performance and Developed management facilities for irrigation and drainage system (81%), Take effective steps for reducing price of all production and marketing related inputs (83%),ensure availabiliy of quality seed and pesticides (85%), Developing appropriate HYV maize variety(ies) (86%) (Table 11.2.12.1).

Table 11.2.12.1: Suggestions Provided by the Farmers for Further Progress in Transformation of Land in Lalmonirhat and Panchagarh

Suggestions	*% of farmers as per supports*			
	Small	*Medium*	*Large*	*Average*
	Lalmonirhat			
Development of appropriate varieties considering adverse climate	81	84	88	84
Provide available training to farmers about pest & disease management	80	84	80	81
Ensure availability of good quality seed and pesticides	82	84	82	83
Establish easy credit system by both government and private bank	86	84	78	82
Monitoring quality and prices of all inputs	79	85	78	81
Available government support in management of fair price and weight system of product	82	82	86	83
Taking steps for quality packing of products	82	87	82	84
Introduce digital marketing for products	82	81	84	82
Developing market structure, conduct and performance	83	85	92	87
Creating awareness of farmers/entrepreneurs	83	88	84	85
Develop scientific methods for packaging, processing and storage of products	85	82	73	80
Building cold storage/processing facilities in research areas/clusters	87	80	78	82
Increase subsidy and monitoring of subsidy delivery to farmers from government	80	87	82	83
Increase export facility from government and non-government organizations	86	85	76	82
Increase GOs and NGOs supports and services	83	77	84	81
Take effective steps for reducing price of all inputs and irrigation costs	93	85	88	89
Increase management and facilities for timely and properly irrigation and drainage system	81	87	84	84
Developed HYV maize variety (ies)	85	79	76	80
	Panchagarh			
Development of appropriate varieties considering adverse climate	81	78	72	77
Provide available training to farmers about pest & disease management	79	80	68	76
Ensure availabiliy of quality seed and pesticides	84	88	82	85
Establish easy credit system by both government and private bank	81	76	64	74
Monitoring quality and prices of all inputs	81	78	68	76
Available government support in management of fair price and weight system of product	82	76	64	74
Taking steps for supplying good quality packing bags of products in lower price	81	75	68	74
Introduce digital marketing as alternative marketing for products	81	73	77	77
Developing market structure, conduct and performance	81	76	86	81
Creating awareness in all farmers/entrepreneurs	82	71	64	72
Develop scientific methods for packaging, processing and storage of products	82	72	81	78
Building cold storage/processing unit in study areas/clusters	85	78	64	75
Increase subsidy and monitoring of subsidy delivery to farmers from government	81	80	73	78
Increase export facility from government and non-government organizations	82	76	77	79
Increase GOs and NGOs supports	83	85	68	79
Take effective steps for reducing price of all production and marketing related inputs	81	83	86	83
Developed management facilities for irrigation and drainage system	84	76	82	81
Developing appropriate HYV maize variety(ies)	87	81	91	86

Source: Field Survey (2020), (Farmer number, n =200)

C. Transformation of Cropland into Mango Orchard

11.3.1 Socio-economic profile of the mango growers

Age and education of the mango growers

Data in Table 11.3.1.1 represent the age of mango growers in three different study areas. In all of the three areas, the highest proportion of the respondents were found with middle aged category (36-55yrs) followed by old aged except Naogaon.

Table 11.3.1.1 Distribution of respondents based on their age and education

Category (years)	Chapainawabgonj			Naogaon			Satkhira			All Districts		
	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
	Age											
Young (18-35)	30.0			46			17			31	43.1	11.76
Middle aged (36-55)	48.0	44.0	12.3	47	38.8	10.57	61	46.5	11.1	52		
Old (>55)	22.0			7			22			17		
	Education											
Illiterate (0)	1			7			0			2.7		
Primary (1-5)	41			21			16			26		
Secondary (6-10)	31	8.2	4.9	36	9.17	5.13	52	9.63	3.37	39.7	9.03	4.59
Higher Secondary (11-12)	5			12			20			12.3		
Bachelor (13-16)	16			17			10			14.0		
Postgraduate (>16)	6			7			2			2.7		

Source: Field Survey (2020)

The growers having middle aged to older ones with long term experience usually involved in mango cultivation as it is almost commercial in nature. The Table 11.3.1.1 depicted the information about the situation of formal education of the mango growers in three different study areas. It is understandable from the Table 11.3.1.1 that the significant proportion of mango growers having education to the extent of primary to secondary level in all three areas though lion share of mango growers were found with secondary level of education at Satkhira region. Since education facilities are not equal in the areas under investigation, the mango growers in Satkhira regions may be equipped with a bit more educational facilities compare to Chapainawabgonj and Naogaon regions.

Farming experience of the mango growers

Data presented in Table 11.3.1.2 shown the situation of farming experience of the mango growers in all the three study areas. For the mango growers of Chapainawabgonj and Satkhira regions, the highest proportion of them had medium to long term experience, while mongo growers in Naogaon had short to medium level of farming experiences.

Fig 11.3: A view of validation workshop at BAU, Mymensingh

Table 11.3.1.2: Distribution of respondents based on their farming experience

Category	Chapainawabgonj			Naogaon			Satkhira			All Districts		
	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
Short (up to 5)	6			37.0			3.0			15.3		
Medium (6-10)	22	19.78	11.63	49.0	8.07	5.36	36.0	14.54	5.98	35.7	14.13	9.44
Long (>10)	72			14.0			61.0			49.0		

Source: Field Survey (2020)

Fig 11.4: FGD session with mango growers at Tala, Satkhira

During several field visits and discussion meetings with the mango growers in these three mangoes growing regions, the researchers observed that the mango growers of Chapainawabgonj and Satkhira had long term farming experience, while Naogaon's case was a bit different. The growers of Naogaon region were found with a bit short term of farming experience compare to other two regions but their rate of expansion of mango growing areas was tremendous.

Major occupation of the mango growers

Table 11.3.1.3 represents the aspects/areas of major occupation of based on which the respondents run their livelihoods in three different study areas. In all of the three regions under investigation, the major occupation of the respondents had agriculture which was mentioned by the lion share of them and the second aspect was business though not remarkable.

Table 11.3.1.3: **Distribution of respondents based on their main occupation**

Category	Chapainawabgonj			Naogaon			Satkhira			All Districts		
	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
Primary occupation												
Agriculture	87	-	-	91	-	-	91	-	-	89.67	-	-
Housewife	0			0			0			0		
Business	10			4			6			6.66		
Service	2			5			2			3.0		
Wage labour	1			0			1			.67		
Others	0			0			0			0		
Secondary occupation												
Agriculture	11	-	-	9	-	-	9	-	-	0	-	-
Housewife	0			0			0			9.7		
Business	44			36			34			38.0		
Service	3			3			5			3.7		
Wage labour	1			1			1			1.0		
Others	0			0			0			0		

Source: Field Survey (2020)

It is obvious that people living in rural areas of Bangladesh depend on agriculture for their livelihoods. Hence, the findings in Table 11.3.1.3 are just a scenario of the ever recognized importance of agriculture as an occupation for the members of farming communities.

The findings in Table 11.3.1.3 shown the scenario of aspects/areas of secondary occupation in three different regions studied for this project work. In all the three regions, the respondents' secondary occupation was business and it is very normal for the rural areas in Bangladesh.

Fig 11.5: Data collection from mango growers at Kalaroa, Satkhira

The people who could manage their jobs want to prefer living either in urban or semi-urban areas. For running a business in the rural areas as a secondary occupation is a bit easier than urban or semi-urban areas. So, the data in Table 11.3.1.3 simply support the above assumption.

Family size of the mango growers

The data in Table 11.3.1.4 represents the scenario of family size of the respondents interviewed in three different mango growing areas. In all of the three areas, the significant proportion of respondents was reported with small to medium size having up to 8 members in a single family.

Table 11.3.1.4: Distribution of respondents based on their family size

Category	Chapainawabgonj			Naogaon			Satkhira			All Districts		
	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
Small (up to 4)	33.0	5.91	2.92	47	5.41	2.66	53	4.8	1.41	44.3	5.4	2.58
Medium (5-8)	53.0			41			46			46.7		
Large (>8)	14.0			12			1			9.0		

Source: Field Survey (2020)

The percentage of large families having more than 8 members in a single family was higher in Chapainawbgonj and Naogaon than Satkhira region. This may be because of the higher number of collective families in Chapainawbgonj and Naogaon regions than Stakhira.

Dependency of the mango growers

The findings in Table 11.3.1.5 shown the status of dependent and earning members in each of the families in three different mango growing regions considered as study areas for this project. It is easily understandable from the Table 11.3.1.5 for both the categories the mean values of dependent and earning members in each family for both Chapainawabgong and Naogaon was higher than that of Satkhira region.

Table 11.3.1.5: Distribution of respondents based on their dependency

Category	Chapainawabgonj			Naogaon			Satkhira			All Districts		
	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
Dependent members	-	4.31	0.91	-	3.75	2.1	-	3.38	1.05	-	3.63	1.82
Earning members	-	1.6	2.27	-	1.66	.93	-	1.42	.68	-	1.58	.86

Source: Field Survey (2020)

Since the higher %age of families in Satkhira region was found with small family size, their dependency was a bit lower than Chapainawabgonj and Naogaon. The avenues for income earnings, on the other hand, were a bit better in both Chapainawabgonj and Naogaon region than Satkhira region which reflects in Table 11.3.1.5

Fig 11.6: View of mango growers training at Shibganj, Chapainawabganj

Farm size of the mango growers

Data in Table 11.3.1.6 depicted the status of farm size of the mango growers in three different study areas. The highest proportion of respondents was found having small to medium farm size followed by large ones in all the three regions under investigation though the percentage of large farmers were reported high in Satkhira region compare to other two regions.

Table 11.3.1.6: Distribution of respondents based on their farm size

Category	Chapainawabgonj			Naogaon			Satkhira			All Districts		
	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
Landless (0.002-.02)	0	2.06	2.14	0	2.56	3.29	0	3.04	3.45	0	2.55	3.03
Marginal (0.021-0.2)	2.0			3.0			1.0			2.0		
Small (0.21-0.99)	41.0			30.0			23.0			31.0		
Medium(1.0-3.0)	39.0			45.0			44.0			43.0		
Large(>3.0)	18.0			22.0			32.0			24.0		

The farm size of an area mostly depends on the available area under cultivation and the density of the population of that particular area. For Satkhira region, the existence of higher percentage of large farmers may be because of the fact that mentioned in the previous sentence.

Annual family income of the mango growers

The findings in Table 11.3.1.7 represent the scenario of status of annual family income of the respondents participated in interview in three different mango growing regions considered for this project. For all the regions, the overwhelming majority of respondents were found with medium to high annual family income categories.

Table 11.3.1.7: **Distribution of respondents based on their total annual family income**

Category	Chapainawabgonj			Naogaon			Satkhira			All Districts		
	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
Low income (up to 100)	11	51.4	890	12	64.9	725	3	51.9	451	8.7	56.0	692.3
Medium income (101-300)	45			29			33			35.7		
High income (>300)	44			59			64			55.7		

The data in Table 11.3.1.7 also depicted that the percentage of mango grower's annual family income in Satkhira region was a bit higher than that of Chapainawabgonj and Naogaon regions. It may be because of the large farm size under each family and availability of income earning avenues in Stakhira region compare to Chapainawabgonj and Naogaon regions.

Training experiences of the mango growers

The data in Table 11.3.1.8 represents the status of training experience of respondents studied in three different mango growing areas. It is easily observable from the Table 11.3.1.8 that the highest proportion of mango growers in Naogaon district did not have any training experience, while nearly two-third of the respondents in Chapainawabgonj were reported with no experience of training. The training situation of respondents interviewed at Satkhira region was found comparatively better than that of Chapainawabgonj and Naogaon regions.

Table 11.3.1.8: Distribution of respondents based on their training experience

Category	Chapainawabgonj			Naogaon			Satkhira			All Districts		
	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
No training (0)	63	3.19	8.59	81	0.83	2.52	32	4.32	6.35	58.7	2.78	6.48
Short duration training (up to 3)	22			11			22			13.3		
Medium duration training (4-7)	3			7			31			13.7		
Long duration training (>7)	12			1			15			9.3		

Source: Field Survey (2020)

The availability of the training for the members of a farming community depends on many issues such as the project activities, funding, frequency of training conducted, no of farmers in an area, etc. The framers of Satkhira got more training opportunities than that of farmers of Chapainawabgonj and Naogaon regions due to higher involvement of donor agencies in Satkhira region.

Access to credit of the mango growers

Data in Table 11.3.1.9 shown the status of respondents' access to credit in three different mango growing regions considered as the study areas for this project. It is easily observable from the Table 11.3.1.9that the highest proportion of mango growers in all areas did not have access to credit. Although the situation in all three areas was reported more or less similar, access to credit situation for the mango growers in Chapainawabgonj and Naogaon regions was found a bit better than that of Satkhira region.

Table 11.3.1.9: Distribution of respondents based on their access to credit

Category	Chapainawabgonj			Naogaon			Satkhira			All Districts		
	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
No access (0)	71	67.71	261.0	72	66.69	174.82	73	65.8	191.85	72	66.73	211.8
Poor access (up to 3)	17			15			11			14.3		
Average access (4-7)	8			6			11			8.3		
Good access (>7)	4			7			5			5.3		

Source: Field Survey (2020)

The above findings may be explained in such a way that some financial organizations/associations in Chapainawabgonj and Naogaon regions usually come forward to provide credit support to the mango growers, while such organizations/institutions may be very few in Satkhira region.

Nature of extension contacts of the mango growers

Data in Table 11.3.1.10 depicted that the nature of extension contacts by the mango growers in three different regions. The significant proportion of respondents in all the three regions were found with low level of contact with extension media followed by medium level though the situation was slightly better for the respondents in Satkhira region than other two regions.

Table 11.3.1.10: **Distribution of respondents based on the extent of their extension contact**

Category	Chapainawabgonj			Naogaon			Satkhira			All Districts		
	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
No contact (0)	3	11.0	6.51	0	11.0	4.05	0	12.83	3.95	1	11.82	5.02
Low contact (up to 15)	80			88			79			82.3		
Medium contact (16-30)	16			12			21			16.3		
High contact (>30)	1			0			0			.3		

During field survey, it was observed that mango growers in Satkhira region were found a bit more communicative and extrovert in nature than the mango growers in Chapainawabgonj and Naogaon regions in one hand, and the extension service providers were found very enthusiastic at Satkhira region on the other. These could be the reasons for such findings in Table 11.3.1.10.

Organizational participation of the mango growers

Data presented in Table 11.3.1.11 **s**hown that the scenario of how much the mango growers participated in different social organizations in their locality. The majority (more than two-third) of the respondents in Naogaon and Satkhira regions were found with no participation in social organization, while a slightly more than half (51%) of the respondents in Chapainawabgonj region was found with no participation followed by low level of participation. The situation of respondents in Naogaon region was reported a bit worse than that of Chapainawabgonj and Satkhira regions.

Table 11.3.1.11: Distribution of respondents based on their nature of organizational participation

Category	Chapainawabgonj			Naogaon			Satkhira			All Districts		
	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
No participation (0)	51	3.50	7.51	71	0.92	1.89	71	1.51	2.78	64.3	1.99	4.82
Low participation (up to 5)	31			26			20			25.7		
Medium participation (6-10)	9			3			8			6.7		
High participation (>10)	9			0			1			3.3		

Source: Field Survey (2020)

Participation in social organization by an individual mostly depends on his educational background, attitude, social status, the availability of social organization, the eagerness of the individual etc. for doing something good for the betterment of the community he belongs to. The respondents in Chapainawabgonj and Naogaon regions were found a bit prompt than that of Satkhira region.

Innovativeness of the mango growers

Data presented in Table 11.3.1.12represents the respondents' status of innovativeness. An overwhelming majority of respondents in all three areas under investigation was found with low level of innovativeness.

Table 11.3.1.12: Distribution of respondents based on their innovativeness

Category	Chapainawabgonj			Naogaon			Satkhira			All Districts		
	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
Low innovativeness (up to 10)	97	5.36	2.75	98	2.18	2.05	99	2.81	2.22	98	3.45	2.72
Medium innovativeness (11-20)	3			2			0			1.7		
High innovativeness n (>20)	0			0			1			.3		

Source: Field Survey (2020)

Since the study areas were dominated with mango production and the mango growers have been cultivating mango since many years, the new crops and their production practices could not attract them very much. That's why their level of innovativeness was low.

Knowledge of the mango growers

Data presented in Table 11.3.1.13 **s**hown the scenario of knowledge of mango growers concerning mango cultivation. It is easily understandable from the table that the highest proportion of respondents in all the three study areas had fair knowledge. The situation of knowledge of mango growers was reported a bit better in Chapainawabgonj region than that of Satkhira and Naogaon regions.

Table 11.3.1.13: **Distribution of respondents based on their knowledge**

Category	Chapainawabgonj			Naogaon			Satkhira			All Districts		
	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
Poor knowledge (up to 19)	1	31.76	6.78	2	30.58	4.32	3	30.81	5.13	2.0	31.05	5.51
Fair knowledge (20-38)	84			94			90			89.3		
Good knowledge (>38)	15			4			7			8.7		

Since long, the people of Chapainawabgonj have been cultivating mango and their involvement with mango related activities usually start from their childhood. Hence, it is obvious that their level of knowledge would be higher than the mango growers of Satkhira and Naogaon regions.

Fig. 11.7: Mango market at Kansat, Shibganj upazila

Food Security Status of the Mango Growers

Data in Table 11.3.1.14 represents the status of food security of the respondents in three different mango growing regions under investigation. The respondents in Satkhira were found more secure than that of respondents in Naogaon and Chapainawabgonj.

Table 11.3.1.14: Distribution of respondents based on their food security status

Category	Chapainawabgonj			Naogaon			Satkhira			All Districts		
	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
Low food security (up to 24)	0	41.54	5.39	0	44.24	5.92	0	49.5	3.83	0	45.14	6.16
Medium food security (25-48)	89			71			23			60.7		
High food security (>48)	11			29			77			39.3		

Source: Field Survey (2020)

Though food security of an individual and an area depends on many issues, agricultural project interventions among others may play important role. We know that a good number of projects have been implementing in Satkhira region since last decades. Those projects frequently provide training support, organize awareness building campaign, develop resilient to climate change mitigation issues, and provide micro credit facilities to people living in rural areas. These interventions cumulatively effect on ensured food security status of people in Satkhira region more than that of Chapainawabgonj and Naogaon regions.

Dimension wise food security status of the mango growers

Data in Table 11.3.1.15depicted the scenario of dimension-wise food security status in three different regions. From the data in Table 11.3.1.15it is observable that the status of different dimensions of food security was more or less similar in all three regions.

Table 11.3.1.15: Distribution of respondents based on their dimension-wise food security

Category	Chapainawabgonj		Naogaon		Satkhira		All Districts	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Food availability	24.62	3.77	26.05	4.40	29.47	2.85	26.71	4.24
Food access	16.92	2.92	18.19	2.98	20.03	2.02	18.38	2.96
Food utilization	11.21	4.78	13.12	3.96	13.49	3.5	12.60	4.22
Overall food security status	41.54	5.39	44.24	5.92	49.5	3.83	45.14	6.16

Source: Field Survey (2020)

The ‘food utilization dimension’ of food security mostly depends on individual’s knowledge and capacity. Hence, the initiative that may improve individual’s knowledge and capacity is very important to handle his dimension effectively. For Satkhira region, the score of this dimension was reported slightly high which might be supported by the above statement.

Poverty Reduction of the Mango Growers

The findings of the study presented in Table 11.3.1.16represent the respondents' poverty reduction status in three different regions. Although the highest proportion of respondents in Chapanawabgonj and Naogaon regions were found with moderate to high poverty reduction status, the overwhelming %age of respondents in Satkhira region were noticed as high poverty reduction status.

Table 11.3.1.16: Distribution of respondents based on their poverty reduction

Category	Chapainawabgonj			Naogaon			Satkhira			All Districts		
	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
Less poverty reduction (up to 29)	0	60.28	7.26	0	60.5	6.71	0	69.22	5.38	0	63.33	7.70
Moderate poverty reduction (30-58)	41			40			4			28.3		
High poverty reduction (>58)	59			60			96			71.7		

Source: Field Survey (2020)

This may be because of interventions of different projects in Satkhira which were lack in Chapainawabgonj and Naogaon regions.

Dimension-wise status of Poverty reduction of the mango growers

Data presented in Table 11.3.1.17 shown that the dimension-wise status of poverty reduction of respondents in three different mango growing areas considered for this study. Although, the situation of dimensions of poverty reduction was reported more or less similar in three different regions, Satkhira region was found a bit better.

Table 11.3.1.17: **Distribution of respondents based on their dimension-wise poverty reduction**

Category	Chapainawabgonj		Naogaon		Satkhira		All Districts	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Income	13.0	3.7	13.5	3.5	16.99	3.14	14.5	3.87
Food consumption	21.54	3.09	22.94	2.63	23.22	3.58	22.57	3.20
Wellbeing	25.74	3.93	24.06	4.15	29.01	3.06	26.27	4.26
Overall poverty reduction status	60.28	7.26	60.5	6.70	69.22	5.37	63.33	7.70

Source: Field Survey (2020)

This may be also because of interventions of different projects in Satkhira which were lack in Chapainawabgonj and Naogaon Regions.

11.3.2 Transformation of mango from different crops

Data in Table 11.3.2.1 represents the scenario of mango transformation occurred from different crops in three different regions. Though the process of transformation started in 2001, it's got a momentum during 2005-10. The highest amount of transformation was reported during 2011-2015 in all regions. Only for Naogaon region, the rapid positive transformation was remarkable until 2015. Although some transformation occurred in Chapainawabgonj and Satkhira regions, those were not too high. It is understandable from the Table that mostly rice was replaced by mango in all the regions followed by sugarcane until 2015. In recent past (since 2016), it was reported that rice was solely replaced by mango in all study areas.

Table 11.3.2.1: **Transformation of land from other crops to mango orchard**

Years	Crop	Chapainawabgonj			Naogaon			Satkhira			All Districts		
		Farmers (%)	Total Area (ha)	Mean Area (ha)	Farmers (%)	Total Area (ha)	Mean Area (ha)	Farmers (%)	Total Area (ha)	Mean Area (ha)	Farmers (%)	Total Area (ha)	Mean Area (ha)
2001-05	Rice	25	23.71	0.95	4	11.75	2.94	29	63.47	2.19	19.33	98.93	1.71
	Sugarcane	6	2.85	0.48	-	-	-	-	-	-	2.0	2.85	0.48
	Rice + Sugarcane	5	4.35	0.87	-	-	-	-	-	-	1.66	4.35	0.87
	Jute	-	-	-	-	-	-	2	14.82	7.41	0.66	14.82	7.41
	Vegetables	-	-	-	-	-	-	3	15.23	5.08	1.0	15.23	5.08
2005-10	Rice	16	13.69	0.86	10	18.73	1.88	26	44.74	1.72	17.33	77.16	1.488
	Sugarcane	5	4.55	0.91	-	-	-	3	3.34	1.11	2.66	7.89	0.99
	Rice + Sugarcane	1	.27	0.27	-	-	-	-	-	-	0.33	0.27	0.27
2011-15	Rice	13	6.50	0.5	57	143.02	2.51	31	49.16	1.59	33.66	198.68	1.97
	Sugarcane	4	1.22	0.30	-	-	-	-	-	-	1.33	1.22	0.30
	Rice + Sugarcane	2	2.14	1.07	-	-	-	-	-	-	0.66	2.14	1.07
	Jute	-	-	-	-	-	-	2	0.93	0.47	0.66	0.93	0.47
	Vegetables				1	0.33	0.33	4	7.03	1.76	1.66	7.36	1.47
	Watermelon				1	2.67	2.67	-	-	-	0.33	2.67	2.67
2016-20	Rice	9	4.81	0.53	26	29.19	1.12	1	0.4	0.4	6.0	34.4	0.96
	Rice + Sugarcane	1	.33	0.33	-	-	-	-	-	-	0.33	0.33	0.33

Source: Field Survey (2020)

Since rice is the staple crop in Bangladesh and most of the cropping patterns are rice dominated, the three study regions were not exception of this fact. So, sacrificing the area used for rice cultivation is a must to introduce a new crop(s) in any cropping season and this very normal what the researchers observed during field survey.

11.3.3 Trend of Land Transformation to Mango

Data in Table 11.3.3.1represents the status of trend of transformation opined by the respondents in three different mango growing regions. In Chapainawabgonj and Naogaon regions, about three-fourth of the respondents opined that positive transformation has been occurred, while two-third of the respondents of Satkhira region was found with opinion with positive transformation. It is observable from the Table 11.3.19 that though some negative transformation occurred in both Chapainawabgonj and Satkhira regions; the land transformation remains unchanged in Naogaon region.

Table 11.3.3.1: Trend of land transformation to mango

Category	Chapainawabgonj			Naogaon			Satkhira			All Districts		
	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
Unchanged (0)	17.0	1.08	1.79	25	2.01	1.03	66	0.1	0.8	52.7	0.43	1.7
Increased transformation (+ve)	74.0			75			22			36.7		
Decreased (-ve)	9.0			0			12			10.7		

Source: Field Survey (2020)

During field survey, the researchers observed that huge amount of transformation were on the way in Naogaon region which was not reported in Chapainawabgonj and Satkhira regions. This may be because of profitability, labour availability, market access etc.

11.3.4 Area under mango cultivation according variety

Data in Table 11.3.4.1shown the status of area of mango cultivation, plant density and different varieties cultivated in three different mango growing regions. In Chapainawabgonj, the variety ‘Asshina’ was reported as highest coverage variety for respondents followed by mixed varieties, while in Naogaon and Satkhira regions, the highest area coverage variety was ‘Dwarf variety Amropali’ followed by Mixed and Gobindobhog variety, respectively. The highest plant density was reported in Naogaon region with Amropali variety.

Table 11.3.4.1: Area under mango cultivation according to variety

Varieties	Area (ha)				Number of plants/ha			
	Chapai	Naogaon	Satkhira	All	Chapai	Naogaon	Satkhira	All
Amropali	0.1	1.45	0.64	0.73	43	1264	143	483
Ashina	0.56	0.08	0	0.21	55	26	0	27
BARI 4	0	0.17	0	0.05	0	121	0	40
Fazli	0.6	0.05	0.04	0.23	29	10	2	14
Gourmoti	0.00	0.05	0	0.016	0.15	34	0	11
Gopalvog	0.00	0.00	0.00	0.00	0.43	0.2	0	0.2
Lengra	0.02	0.14	0.3	0.153	2	46	53	34
Catimon	0.01	0.00	0.00	0.003	11	0	0	4
Khirshpat	0.05	0.01	0.6	0.22	4	3	102	36
Mixed	0.21	0.22	0.13	0.186	28	107	19	51
Lakhna	0.11	0.00	0.00	0.036	14	1	0.1	5
Gobindobhog	0	0	0.34	0.113	0	0	59	20

Source: Field Survey (2020)

Among three mango growing regions, the respondents in Chapainawabgonj were found with big mango trees usually dominated with Asshina, Mixed, Fazli and Himsagar/Khirsapat varieties and this type of mango cultivated has been started since long ago in this region. Naogaon and Satkhira region, on the other hand, were found with dominance of Amrapali variety where the trees are small and usually fit for high density cultivation technique which is presently considered as a very profitable technique for mango cultivation.

11.3.5 Reasons for mango transformation

Data in Table 11.3.5.1 shown the scenario of reasons of transformation has been occurring in three different mango growing regions. Through Focus Group Discussions (FGDs) with mango growers, and discussion with stakeholders and extension personnel, the researchers identified three broad areas of major reasons (situational, economic and socio-cultural) that foster transformation.

Table 11.3.5.1: Reasons for land transformation towards mango production

Sl. No.	Reasons	% of farmers opined				Rank Order
		Chapai	Naogaon	Satkhira	All	
Situational						
1	*Coping with climate change situation*	59	51	19	43	12
2	*Soil suitability*	73	69	58	67	7
3	*Highly vulnerable to insects and diseases*	45	58	7	37	13
4	*Lower yield due long-term mono-cropping*	55	70	24	50	11
5	*Less water required crop*	65	75	78	73	6
Economic						
6	*Lower cost of production*	66	66	30	54	10
7	*Higher yield*	100	96	93	96	4
8	*High market demand*	100	96	100	99	2
9	*Easy to sell*	79	96	100	92	5
10	*Higher profitability/return*	97	99	100	99	3
11	*Can get the cash at a time*	98	100	100	99	1
12	*Can manage with minimum labor*	79	73	44	65	8
Soc*io-cultural*						
13	*Neighboring farmers have already transformed*	76	63	29	56	9
14	*Motivation by the change agents*	4	2	2	3	14
15	*Family pressure*	3	0	1	1	15
16	*Decisions of the farmers' cooperative*	1	0	0	0.33	16
17	*Availability of processed fruits*	0	0	0	0	17

Source: Field Survey (2020)

It is easily observable from the data in Table 11.3.5.1 that among three broad areas of reasons, the economic issue got the highest priority area that mango growers considered with due importance. The aspect such as ‘can manage cash at a time’, ‘high market demand’ and ‘higher profitability/ return’ received the rank order 1, 2 and 3, respectively and all those were related with economic areas of reasons of transformation in all regions. The issues that are highly considered by the commercial farmers in any country include- cash in hand without any delay, high market demand of the produces and high profitability/return. The above table is not exception of that. For the case of mango transformation in the areas investigated, the mango growers put highest priority on economic issue that foster them to replace rice with mango and cultivate mango (Amropali) along with rice.

11.3.6 Effect of land transformation for mango on farm practices

Data presented in Table 11.3.6.1 represents the scenario of farm practices which has been taken place due to transformation in three different mango growing areas. The study identified 19 farm practices through FGDS with mango growers in three regions. The farm practice such as use insecticides and pesticides increased significantly in all of the regions, while easy selling of produces and net profit and farm output were increased in Naogaon and Satkhira regions. Regarding decrease in farm practices, 'ease in storing' was reported by the mango growers more in Satkhira region than that of Naogaon region

Table 11.3.6.1: Effect of land transformation to mango on farm practices

Component	% of farmers opined											
	Chapainawabgonj			Naogaon			Satkhira			All districts		
	Incr	Unch	Dec	Incr	Unch	Dec	Incr	Unch	Dec	Incr	Unch	Dec
Labor use	68	14	18	94	5	1	67	12	21	76	10	13
Ease in land preparation	76	16	9	65	35	0	73	21	6	71	24	5
Manage of seeds/saplings	32	34	36	4	39	57	31	24	45	22	32	46
Irrigation	1	7	92	3	27	70	30	14	56	11	16	73
Weeding	2	6	92	22	18	60	32	21	47	19	15	66
Use of farm machinery	6	17	77	10	38	52	57	34	9	24	30	46
Fertilizer application	70	20	11	65	34	1	62	29	9	66	30	70
Scope of using IPM	30	18	52	13	32	55	57	38	5	33	29	37
Use of insecticides	85	10	5	97	2	1	93	2	5	92	5	4
Use of pesticides	87	9	4	99	0	1	93	2	5	93	4	3
Ease in harvesting	59	32	9	63	33	4	52	27	21	58	31	11
Ease of sorting	42	52	6	60	35	5	50	26	24	51	38	12
Ease of grading	41	51	8	60	35	5	50	26	24	50	37	12
Ease of packaging	40	51	10	60	34	6	47	26	27	49	37	14
Ease in storing	7	33	60	2	30	68	2	3	95	4	22	74
Cost of production	72	20	8	98	2	0	96	0	4	89	7	4
Farm output	67	22	12	99	1	0	100	0	0	89	8	4
Ease in selling farm produce	64	29	9	99	1	0	100	0	0	88	10	3
Net profit from farming	61	11	28	99	1	0	100	0	0	87	4	9

Source: Field Survey (2020) Incr- Increase; Unch- Unchanged; Dec- Decrease

Usually, mango growers use very high quantity of insecticides and pesticides in different times of growing of a season. The data in Table 11.3.6.1 reflects this issue perfectly for all of the mango growing areas. As the mango growers in Naogaon and Satkhira cultivate mango with Amprapali and BARI 4/11 varieties along with mainly rice, their cost of cultivation is comparatively lower and receives higher benefit for their produces than that of Chapainawabgonj region. The marketing situation was reported comparatively better in Naogaon and Satkhira region. This may be because of mango growers in these two regions were found with very united and their strong role with associations gave them proper right with fair price of their produces along with easy access to market.

11.3.7 Correlation between selected characteristics of the mango growers with their household food security and poverty reduction

Table 11.3.7.1represents the relationships between characteristics of mango growers and their status of food security. Out of 12 selected characteristics of mango growers, five characteristics such as farming experience, annual family income, training received, extension media contact and agricultural knowledge were found with significant positive relationships with their food security status. Though the remaining characteristics of the respondents did not show any significant relationships, the characteristics such as age, family size, access to credit and organizational participation showed negative trend with food security status of them.

Table 11.3.7.1: Correlation between food security and characteristics of the mango growers

Variables	Correlation coefficient at 298 df	Level of significance
Age	-.021	NS
Education	.015	NS
Family size	-.077	NS
Farm size	.076	NS
Farming experience	.118*	at 5% level
Annual family income	.130*	at 5% level
Training received	.129*	at 5% level
Access to credit	-.038	NS
Extension media contact	.230**	at 1% level
Organizational participation	-.036	NS
Innovativeness	.026	NS
Agricultural knowledge	.119*	at 5% level

Extension media contact is an important characteristic of a mango grower that can help him get all of the information ranging from seedlings preparation to market access to their produces and even provides storing information even. High agricultural knowledge and sufficient family income along with training experience for mango growers are the prerequisites to run his farm business with a profitable manner that ultimately ensure his food security status. Table 11.3.7.2 represents the relationships between characteristics of mango growers and their status of poverty reduction. Among 12 selected characteristics of mango growers, five characteristics such as farm size, annual family income, training received, extension media contact and agricultural knowledge of the mango growers had significant positive relationships with their status of poverty reduction.

Table 11.3.7.2: Correlation between poverty reduction and individual characteristics of the mango growers

Variables	Correlation coefficient at 298 df	Level of significance
Age	-.018	NS
Education	.064	NS
Family size	-.016	NS
Farm size	.247**	at 1% level
Farming experience	.044	NS
Annual family income	.227**	at 1% level
Training received	.143*	at 5% level
Access to credit	.086	NS
Extension media contact	.214**	at 1% level
Organizational participation	.008	NS
Innovativeness	-.024	NS
Agricultural knowledge	.169**	at 1% level

A mango grower with bigger farm size is considered as a better off member in his community because he can earn more, can take any kind of decision to run his farm, can adopt innovation as he desires. So, we can easily say that the bigger the farm of a mango grower, the higher the ability to reduce his poverty. The characteristics such as family income, training received, extension media contact and agricultural knowledge of a mango grower make him capable to run his business efficiently that increase his farm income which ultimately leads to reduce his poverty status.

D. Transformation of Crops Land into Flower Cultivation

11.4.1 Socio-economic Profile of the Flower Growers

Age and education of the flower growers

Data in Table 11.4.1.1 represents the age and education of flower growers of the study area. The flower growers were classified into three categories based on their age. Findings of the study showed that the mean age of the flower growers was 45.7 years with standard deviation of 9.93.

Table 11.4.1.1: Distribution of the flower growers based on their age

Category	Respondent flower growers (n=100)			
	Number	%	Mean	SD
Age				
Young (18-35)	39	39.0	45.70	9.93
Middle aged (36-55)	51	51.0		
Old (>55)	10	10.0		
Education				
Illiterate (0)	2	2.0	7.85	3.87
Primary (1-5)	34	34.0		
Secondary (6-10)	47	47.0		
Higher Secondary (11-12)	10	10.0		
Bachelor (13-16)	6	6.0		
Postgraduate (>16)	1	1.0		

Source: Field Survey (2021)

Findings of the study showed that more than half (51%) of the flower growers were middle aged. While more than one-third (39%) of them were young. However, only 10% of the respondent flower growers were old. This is very general that flower farming is a unique type of farming that requires huge care and time involvement. Thus, old farmers cannot maintain such kind of special care of flower farming. Due to this special phenomenon relatively young and middle aged farmers are mostly involved in flower farming.

Table 11.4.1.1 depicted the information about the situation of formal education of the flower growers in the study area. It is understandable from the Table 11.4.1.1 that the significant proportion of flower growers having education to the extent of primary to secondary level. Data presented in Table 11.4.1.1 shown that the mean education score of the respondent farmers was

7.85 with standard deviation of 3.87. It is evident from Table 11.4.1.1 that almost half (47%) of the respondent farmers had secondary education and one-third (34%) of them had primary education. However, only 2% of the respondent flower farmers were illiterate. On the contrary 1% of them had post-graduation. It seems that as an aesthetic farming educated farmers are more interested in flower farming.

Fig: 11.8: FGD session with flower farmers at Godkhali, Jhikargacha, Jeshore

Flower farming experience

Data presented in Table 11.4.1.2 shown the situation of farming experience of the flower growers in the study area. Results of the study showed that the mean flower farming experience of the respondent farmers was 17.99 years with standard deviation of 7.14. For the flower growers of Jhikargasa region, majority (94%) of them were reported with medium to long term experience.

Table 11.4.1.2: Distribution of respondents based on their farming experience

Category of framing experience	Respondent flower growers (n=100)			
	Number	%	Mean	SD
Short (up to 5 years)	6	6.0	17.99	7.14
Medium (6-10 years)	13	13.0		
Long (>10 years)	81	81.0		

Source: Field Survey (2021)

During several field visits and discussion meetings with the flower growers in the flower growing regions of Jhikargasa, the researchers observed that the flower growers had long term farming experience. The findings of the study also confirmed that the majority (81 %) of them had long experiences of flower farming. On the other hand, 13 % of them had medium flower farming experiences and 6 % are simply fresher those had only five or less years of flower farming experiences.

Major occupation of the flower growers

Table 11.4.1.3 represents the aspects/areas of major occupation based on which the respondents run their livelihoods in the study areas. It is observed that the major occupation of the respondents was agriculture which was mentioned by the lion share (94%) of the flower growers, followed by business (5%) though not remarkable.

Table 11.4.1.3: Distribution of respondents based on their major occupation

Category	Respondent flower growers (n=100)			
	Number	%	Mean	SD
Primary occupation				
Agriculture	94	94.0	-	-
Housewife	0	0		
Business	5	5.0		
Service	1	1.0		
Wage labour	0	0		
Others	0	0		
Secondary occupation				
Agriculture	6	14.63	-	-
Housewife	1	2.44		
Business	33	80.49		
Service	0	0		
Wage labour	1	2.44		
Others	0	0		

Source: Field Survey (2021)

It is obvious that people living in rural areas almost depend on agriculture for their livelihoods. Hence, the findings are just a scenario of the ever recognized importance of agriculture as an occupation for the members of farming communities.

It is evident from the study that only 41% of the respondent flower growers had secondary occupation along with their major occupation. However, it is shown in Table 11.4.1.3 that the respondents' secondary occupation was business and it is very normal for the rural areas in Bangladesh. It is also found that among the respondents having secondary occupation majority

(80.49%) of them were involved in business and 14% of them had agriculture as secondary occupation. The study also showed that only 2.44% of the respondent flower farmers had secondary occupation as wage labourer.

Fig. 11.9: Data collection from a flower farmer at Jhikargacha, Jeshore

Family size of the flower growers

The data in Table 11.4.1.4 represents the scenario of family size of the respondents interviewed in flower growing areas of Jhikargasa. In the study area, the significant proportion of the respondents was reported with small to medium size family (98 %).

Table 11.4.1.4: **Distribution of the respondent flower growers based on their family size**

Farm size category	**Respondent flower growers (n=100)**			
	Number	**%**	**Mean**	**SD**
Small (up to 4)	41	41.0	5.14	1.54
Medium (5-8)	57	57.0		
Large (>8)	2	2.0		

Source: Field Survey (2021)

The findings of the study show that the mean family size of the respondent flower growers was 5.14 with standard deviation of 1.54. Table 11.4.1.4 shown that more than half (57%) of the respondent farmers had medium family size. While, less than half (41%) of the flower growers had small family and only 2% of the respondent flower growers had large family.

Dependency ratio of the flower growers

The findings of the study shown in Table 11.4.1.5 demonstrate the status of dependent and earning members in each of the families in the flower growing Jhikargasa upazila considered as the study area for this project.

Table 11.4.1.5: Distribution of respondents based on their dependency incase of flower cultivation

Category	Respondent flower growers (n=100)	
	Mean	SD
Dependent members	1.56	0.68
Earning members	3.58	1.30

Source: Field Survey (2021)

Table 11.4.1.5 shown that the mean of dependent member of the respondent flower growers was 1.56 with standard deviation of 0.68. However, the mean score of the income earning family members was 3.58 with standard deviation of 1.3. Thus, it is clear that dependent family members are smaller than earning member which indicates lower dependency ratio of the flower growers.

Farm size and annual income of the flower growers

Table 11.4.1.6 depicted the status of farm size of the flower growers in the study area. Findings showed that the mean farm size of the respondent flower growers was 0.75 ha with standard deviation of 0.46.

Table 11.4.1.6: Distribution of respondent flower growers based on their farm size and annual income

Farm size categories	Respondent flower growers (n=100)			
	Number	%	Mean	SD
Farm size				
Landless (0.002-.02 ha)	0	0	0.75	0.46
Marginal (0.021-0.2 ha)	3	3.0		
Small (0.21-0.99 ha)	75	75.0		
Medium(1.0-3.0 ha)	22	22.0		
Large(>3.0 ha)	0	0		
Annual family income				
Low income (up to 100 thousand BDT)	3	3.0	371.11	220.36
Medium income (101-300 thousand BDT)	42	42.0		
High income (>300 thousand BDT)	55	55.0		

Source: Field Survey (2020)

Three-fourths (75%) of the respondent flower farmers had small farm size and about one-fourth (22%) had medium farm size and 3% of them had marginal farm size. However, there were none among the respondents having marginal and large farm size.

Findings of the study showed that the mean annual family income of the respondent flower growers was 371.11 thousand BDT with standard deviation of 220.36. It is shown in Table 11.4.1.6 that supreme majority (97%) of the respondent flower growers had medium to high annual family income. It is demonstrated that more than half (55%) of the respondents had high income and less than half (42%) of them had medium income. However, only 3% of them had low income. The findings of the study really confirmed the higher economic return from flower cultivation in the study area.

Training experiences and credit received of the flower growers

Table 11.4.1.7 represents the status of training experience of respondents from the study area. It is observed that the mean training experience of the respondent flower farmers was 5.52 with the standard deviation of 10.09.

Table 11.4.1.7: Distribution of respondents based on their training experience and credit received

Category	Respondent flower growers (n=100)			
	Number	%	Mean	SD
Training experience				
No training (0)	45	45.0	6.52	10.09
Short duration training (up to 3)	12	12.0		
Medium duration training (4-7)	14	14.0		
Long duration training (>7)	29	29.0		
Credit received				
No access (0)	72	72.0	70.84	201.27
Poor access (up to 3)	21	21.0		
Average access (4-7)	5	5.0		
Good access (>7)	2	2.0		

Source: Field Survey (2021)

A little less than half (45%) of the respondent flower growers had no training experiences. Almost a quarter (26%) of the respondents had short to medium duration training. On the other hand, more than a quarter (29%) of them had long duration training experience. This finding found a bit contradictory that a significant portion of the flower farmers had long duration training experiences.

It is easily observable from Table 11.4.1.7 that the mean score on access to credit by the respondents was highest proportion flower growers in all areas did not have access to credit was 70.84 with a standard deviation of 201.27.

Fig 11.10 : Flower farmer's training session at Jhikargacha, Jeshore.

The findings of the study showed that the majority (72%) of the respondent flower growers had no access to credit facilities. However, among the respondent flower growers less than a quarter (21%) of them had poor access to credit facilities. On the contrary, 5% of them had average access and only 2% of them had good access to credit facilities.

Extension media contact of the flower growers

Data presented in Table 11.4.1.8 depicted that the nature of extension media contacts by the flower growers in the study area. The mean extension media contact score of the flower farmers was 12.21 with standard deviation of 4.42.

Table 11.4.1.8: Distribution of respondents based on their extension media contact

Category	Respondent flower growers (n=100)			
	Number	%	Mean	SD
No contact (0)	0	0	12.21	4.42
Low contact (up to 15)	85	85.0		
Medium contact (16-30)	14	14.0		
High contact (>30)	1	1.0		

Source: Field Survey (2021)

Data presented in Table 11.4.1.8 shown that the majority (85%) of the respondent flower growers had low extension media contact. However, a small portion (14%) of them had medium extension media contact and only 1% had high extension media contact.

Organizational participation of the flower growers

Table 11.4.1.9 shown that how much of the flower growers were participated in different organizations in their locality. Findings of the study show that the mean organizational participation score of the respondents' flower growers stood at 5.60 with standard deviation of 9.05.

Table 11.4.1.9: Distribution of respondents based on their nature of organizational participation

Category	Respondent flower growers (n=100)			
	Number	%	Mean	SD
No participation (0)	54	54.0	5.60	9.05
Low participation (up to 5)	15	15.0		
Medium participation (6-10)	16	16.0		
High participation (>10)	15	15.0		

Source: Field Survey (2021)

More than half (54 %) of the respondent farmers had no organizational participation. However, almost equal proportion (15%) of the respondents had either low or medium or high extent of organizational participation. This finding is logical as the majority of the rural people are not affiliated with any organization.

Innovativeness of the flower growers

Table 11.4.1.10 indicates that the mean innovativeness score of the respondent flower growers was 2.87 with the standard deviation of 1.09.

Table 11.4.1.10: Distribution of respondents based on their innovativeness

Level of farmers' innovativeness	Respondent flower growers (n=100)			
	Number	%	Mean	SD
Low innovativeness (up to 10)	100	100	2.87	1.09
Medium innovativeness (11-20)	0	0		
High innovativeness n (>20)	0	0		

Source: Field Survey (2021)

All (100%) respondent flower growers had low innovativeness. It is really absurd that the respondent farmers had low level innovativeness, however they are continuing an innovative farming like flower farming.

Knowledge on flower cultivation of the flower growers

Data presented in Table 11.4.1.11 demonstrate the scenario of flower cultivation knowledge of the flower growers from the study area. Observed score of flower cultivation knowledge of a flower grower ranged between 6 to 41; against the possible score of 0-57. The mean flower cultivation knowledge of the flower grower was 27.35 with standard deviation of 5.62

Table 11.4.1.11: Distribution of respondents based on their knowledge on flower cultivation

Level of farmers' knowledge	Respondent flower growers (n=100)			
	Number	%	Mean	SD
Poor knowledge (up to 19)	8	8.0	27.35	5.62
Fair knowledge (20-38)	90	90.0		
Good knowledge (>38)	2	2.0		

Source: Field Survey (2021)

Table 11.4.1.11 exhibited that majority (90%) of the respondent flower growers had fair knowledge. While, 8% of them had poor knowledge and only 2% had good knowledge on flower cultivation.

Household food security status of the flower growers

Data presented in Table 11.4.1.12 shown the scenario of household food security status of the flower growers from the study area. Observed score of household food security status of a flower grower ranged between 26-70; against the possible score of 0-72. Table 87 also demonstrates that the mean household food security status of the flower grower was 63.46 with standard deviation of 6.88.

Table 11.4.1.12: Distribution of respondents based on their food security status

Category	Respondent flower growers (n=100)			
	Number	%	Mean	SD
Low food security (up to 24)	0	0	63.46	6.88
Medium food security (25-48)	6	6.0		
High food security (>48)	94	94.0		

Source: Field Survey (2021)

Data presented in Table 11.4.1.12 displays that the supreme majority (94 %) of the respondent flower growers had high food security status. While, only 6 % of them had medium household food security. However, among the respondents there were none having low household food security. This is due to the reason that the flower growers enjoy better income from flower farming that actually ensure better household food security.

Dimension-wise household food security status

Data in Table 11.4.1.13 depicted the scenario of dimension-wise household food security status in the study area. From the data in Table 11.4.1.13 it is observable that the status of different dimensions of household food security was found diverse. The mean of overall household food security score was 63.46.

Table 11.4.1.13: Distribution of respondents based on their dimension-wise household food security

Dimensions of food security	Respondent flower growers (n=100)	
	Mean score	SD
Food availability	29.16	2.57
Food access	22.11	2.91
Food utilization	12.19	3.39
Overall food security status	63.46	6.88

Source: Field Survey (2021) n- number of respondents

Table 11.4.1.13 depicted that among the three dimensions of household food security the mean score of food availability score was 29.16 and food access score was 22.11 which was quite good. However, the mean score of food utilization was 12.19, which was relatively poor as the 'food utilization dimension' of food security mostly depends on individual's knowledge and capacity. Hence, the initiative that may improve individual's knowledge and capacity is very important to handle this dimension effectively.

Fig 11.11 : Rain water harvest for flower and other crop cultivation.

Poverty reduction of the flower growers

Data presented in Table 11.4.1.14 depicted the scenario of poverty reduction status of the flower growers in the study area. Observed score of poverty reduction status of a flower grower ranged from 21-79 against a possible score of 0-87. The mean poverty reduction status of the flower grower was 66.27 with standard deviation of 5.38.

Table 11.4.1.14: Distribution of respondents based on their overall poverty reduction

Level of farmers' poverty reduction	Respondent flower growers (n=100)			
	Number	%	Mean	SD
Low poverty reduction (up to 29)	0	0	66.27	5.38
Medium poverty reduction (30-58)	6	6.0		
High poverty reduction (>58)	94	94.0		

Source: Field Survey (2021)

The supreme majority (94%) of the respondent flower growers had high poverty reduction. While, only 6% of them had medium poverty reduction. However, among the respondents there were none having low poverty reduction. This is due to the fact that the flower growers enjoy better income from flower farming that actually contributed in reducing their poverty.

Dimension-wise poverty reduction of the flower growers

Table 11.4.1.15 depicted the scenario of dimension-wise poverty reduction status in the study area. The status of different dimensions of poverty reduction was found diverse. It is evident from Table 11.4.1.15 that the mean of overall poverty reduction score was 66.27.

Table 11.4.1.15: Distribution of respondents based on their dimension-wise poverty reduction

Dimensions of food security	Respondent flower growers (n=100)	
	Mean score	SD
Income	14.47	2.87
Food Consumption	23.74	1.51
Wellbeing	28.06	3.41
Overall poverty reduction status	66.27	5.38

Source: Field Survey (2021) n- number of respondents.

Among the three dimensions of poverty reduction, the mean score of income (14.47) and food consumption (23.74) was quite moderate. However, the mean score of wellbeing (28.06) was relatively quite good.

11.4.2 Land Transformation from Other Crops to Flower

Flower transformation started in the study area since 2001 and still the transformation is going on (Table 11.4.2.1).

Table 11.4.2.1: Transformation from other crops to flower

Year	Previous field crops	Respondent flower growers (n=100)		Total area transferred (ha)	Average area (ha)
		Number	%		
2001-05	Rice	49	49.0	17.67	0.36
	Jute	4	4.0	1.76	0.44
	Rice+Wheat	1	1.0	0.20	0.20
	Vegetables	4	4.0	1.67	0.41
2005-10	Rice	10	10.0	3.97	0.39
	Rice+Vegetable	1	1.0	0.61	0.61
	Rice+Mustard	1	1.0	0.46	0.46
	Jute	1	1.0	0.27	0.27
2011-15	Rice	9	9.0	2.57	0.28
	Papaya	1	1.0	0.19	0.19
	Rice+Jute	1	1.0	0.33	0.33
	Vegetables	1	1.0	0.40	0.40
2016-20	Rice	10	10.0	2.15	0.21
	Rice+Jute	4	4.0	0.86	0.21
	Papaya	2	2.0	1.13	0.56
	Jute	1	1.0	0.22	0.22

Source: Field Survey (2021)

Data presented in Table 11.4.2.1 shown that during 2001-2005, 49% of the farmers transformed into flower from rice. It is also shown that a total of 17.76 ha of land under rice were transformed into rice with a mean area of 0.36 ha. Apart from rice a little amount of land under vegetables and jute had also been transformed into flower in the study area. However, not only in 2001-2005, but up to recent time (2020) the majority area was transformed from rice to flower. However, it is clear that the recent rate of transformation from rice to flower has slowed down to some extent.

11.4.3 Trend of Land Transformation to Flower

Data presented in Table 11.4.3.1 shown that a bit higher than half (51%) of the respondent opined that the flower transformation in the study area was in a positive trend.

Table 11.4.3.1: Trend of land transformation for flower

Category	Respondent flower growers (n=100)			
	Number	%	Mean	SD
Unchanged (0)	39	39	-	-
Increased transformation (+ve)	51	51		
Decrease transformation (-ve)	10	10		

Source: Filed survey 2021

However, more than one-third (39%) of the flower farmers had the perception that flower transformation remained unchanged while only 10% of them had the perception that flower transformation has decreased.

11.4.4 Area under flower cultivation according to variety (es)

It is observed from the investigation as well as project area visits that different varieties of flowers have been cultivated by the flower growers of Jhikargasa upazila and necessary data are presented in Table 11.4.4.1.

Table 11.4.4.1: Area under flower cultivation according to variety

Variety(es)	Area (ha)
Gladiolus	13.85
Rose	4.49
Tuberose	5.94
Marigold	4.39
Gerbera	2.81
Jhau	0.44
Bhutta	0.93
Chrysanthemum	0.34
Others	0.42

Source: Filed survey 2021

Table 11.4.4.1 clearly shown that among different varieties Gladiolus was widely cultivated by the majority of the farmers and the area under Gladiolus was the highest (13.85 ha). However, next to Gladiolus, tuberose (5.94 ha) and rose (4.94 ha) ranked 2nd and 3rd position based on area under cultivation. On the other hand, area under Chrysanthemum cultivation was lowest by the flower growers in the study area.

11.4.5 Reasons for transformation of crops land into flower cultivation

The study team had an intention to understand the reasons for transformation from other crops into flower. Based on the highest percent of the flower farmers mentioned a reason for transformation, a rank order was also made and presented in Table11.4.5.1. The reasons were classified into situational, economic and socio-cultural.

Table 11.4.5.1: Reasons for land transformation towards other crops

Sl. No.	Reasons	Flower growers opined (n=100)		Rank Order
		Number	%	
Situational				
1	*Coping with climate change situation*	4	4.0	12
2	*Soil suitability*	56	56.0	5
3	*Highly vulnerable to insects and diseases*	2	2.0	13
4	*Lower yield due long-term mono-cropping*	10	10.0	10
5	*Less water required crop*	24	24.0	9
Economic				
6	*Lower cost of production*	10	10.0	11
7	*Higher yield*	52	52.0	6
8	*High market demand*	99	99.0	3
9	*Easy to sell*	100	100	2
10	*Higher profitability/return*	100	100	1
11	*Can get the cash at a time*	99	99.0	4
12	*Can manage with minimum labor*	44	44.0	7
Socio-cultural				
13	*Neighboring farmers have already transformed*	40	40.0	8
14	*Motivation by the change agents*	1	1.0	14
15	*Family pressure*	0	0	15
16	*Decisions of the farmers' cooperative*	0	0	16
17	*Availability of processed fruits*	0	0	17

Source: Filed survey 2021

It is evident from Table 11.4.5.1that the cent-% (100 %) of the farmer transformed land under flower cultivation due to its higher profitability compared to rice, vegetables and jute that the local farmers were used to with cultivating before transforming into flower. Next to higher profitability, easy to sell and high market demand ranked 2nd and 3rd position, respectively. However, it is evident from Table 11.4.5.1 that among all the reasons, economic reasons were considered as crucial to all the respondent flower farmers. While among other reasons, soil suitability ranked 5th position based on perception of the respondents.

11.4.6 Effect of land transformation to flower on farm practices

Table 11.4.6.1 represents the scenario of effect transformation of flower on farm practices which in the different flower growing areas of Jhikargasa upazila under Jashore district. The study identified 19 farm practices through FGDS with flower growers in the study area. Responses against each of the 19 components were sought from the respondents against a 3-point rating scale like unchanged, increased or decreased and data are presented in Table 11.4.6.1.

Table 11.4.6.1: Effect of land transformation to flower on farm practices

Sl. No.	Components	Respondent flower growers opined (n=100)		
		Increased	Unchanged	Decreased
01	Labor use	87	5	8
02	Ease in land preparation	21	33	46
03	Manage of seeds/saplings	57	36	7
04	Irrigation	41	37	22
05	Weeding	77	19	4
06	Use of farm machinery	50	44	6
07	Fertilizer application	72	23	5
08	Scope of using IPM	41	43	16
09	Use of insecticides	93	4	4
10	Use of pesticides	95	2	3
11	Ease in harvesting	50	27	23
12	Ease of sorting	12	27	61
13	Ease of grading	9	27	64
14	Ease of packaging	5	27	68
15	Ease in storing	0	7	93
16	Cost of production	97	0	3
17	Farm output	99	0	1
18	Ease in selling farm produce	100	0	0
19	Net profit from farming	100	0	0

Source: Filed survey 2021

Data presented in Table 11.4.6.1 shown that the farm practice such as net profit from farming, ease in selling produces and use of insecticides and pesticides had increased significantly due to land transformation into flower. However, ease in sorting, grading, packaging and storing has decrease effect on farm practices.

11.4.7 Correlation of selected characteristics of the flower growers on food security and poverty reduction

Data presented in Table 11.4.7.1 represent the relationships between characteristics of flower growers and their status of food security. Out of 12 selected characteristics of flower growers, three characteristics such as age, extension media contact and flower cultivation knowledge was found significant positive relationships with their food security status. Though the remaining characteristics of the respondents did not show any significant relationships, the characteristics such as education, family size, access to credit and organizational participation showed negative trend with food security status of them.

Table 11.4.7.1: Correlation between the selected characteristics of the flower growers and their level of food security

Variables	Correlation coefficient at 98 df	Level of significance
Age	0.292**	at 1% level
Education	0.074	NS
Family size	-0.035	NS
Farm size	0.112	NS
Farming experience	0.174	NS
Annual family income	0.173	NS
Training experience	0.110	NS
Access to credit	0.094	NS
Extension media contact	0.251*	at 5% level
Organizational participation	0.156	NS
Innovativeness	-0.033	NS
Flower cultivation knowledge	0.327**	at 1% level

Extension media contact is an important characteristic of a flower grower that can help him get all of the information ranging from seedlings preparation to market access to their produces and even provides storing information even. Good knowledge on flower cultivation is the prerequisites to run his flower farm business with a profitable manner that ultimately ensure his/her better household food security status through better farm income.

Table 11.4.7.2: Correlation between poverty reduction and individual characteristics of the flower growers

Variables	Correlation coefficient at 98 df	Level of significance
Age	0.183	NS
Education	0.220*	at 5% level
Family size	0.161	NS
Farm size	0.383**	at 1% level
Farming experience	-0.065	NS
Annual family income	0.356**	at 1% level
Training received	0.103	NS
Access to credit	0.147	NS
Extension media contact	0.355**	at 1% level
Organizational participation	-0.032	NS
Innovativeness	-151	NS
Flower cultivation knowledge	0.435**	at 1% level

Table 11.4.7.2 represents the relationships between characteristics of flower growers and their status of poverty reduction. Among 12 selected characteristics of flower growers, five characteristics such as education, farm size, annual family income, training experience, extension media contact and flower knowledge of the mango growers had significant positive relationships with their status of poverty reduction. A flower grower with bigger farm size is considered as a better off member in his community because he can earn more, can take any kind of decision to run his farm, can adopt innovation as he desires. So, we can easily say that the bigger the farm of a grower, the higher the ability to reduce his poverty. The characteristics such as family income, training received, extension media contact and agricultural knowledge of a flower grower make him capable to run his business efficiently that increase his farm income which ultimately leads to reduce his poverty status.

E. Transformation of Cropland into HYV Rice Cultivation

11.5.1 Socio-economic profile of the HYV rice growers

Age

Table 11.5.1.1 represents the age of HYV rice growers in the different study areas. In both areas, the highest proportion of the respondents were found with middle aged category (36-55yrs).

Table 11.5.1.1: Distribution of respondents based on age

Factor	Category	Narail			Barisal			All Districts		
		%	Mean (t-value)	SD	%	Mean (t-value)	SD	%	Mean (t-value)	SD
Age	Young (18-35 yrs)	45	46.2 (-.94)	12.8	37	45.1 (.43)	11.3	41	45.6 (1.21)	12.1
	Middle aged (36-55 yrs)	49			54			51.5		
	Old (>55 yrs)	6			9			7.5		

Source: Field survey 2021 *values in parentheses indicate t-values, *** indicates significant at 5% level

Education

The Table 11.5.1.2 depicted the information about the situation of formal education of the respondents in the study areas. It is understandable from the Table 11.5.1.2 that the significant proportion of growers having education to the extent of primary to secondary level in all the areas. Since education facilities are not equal in the areas under investigation, growers in Narail regions may be equipped with a bit more educational facilities compared to Barisal regions.

Table 11.5.1.2: Distribution of respondents based on education

Factor	Category	Narail			Barisal			All Districts		
		%	Mean (t-value)	SD	%	Mean (t-value)	SD	%	Mean (t-value)	SD
Education	Illiterate (0)	1	9.2 (1.21)	6.3	4	8.97 (1.34)	3.89	2.5	9.1 (1.47)	5.25
	Primary (1-5)	33			38			35.5		
	Secondary (6-10)	41			45			43		
	Higher Secondary (11-12)	14			10			12		
	Bachelor (13-16)	7			3			5		
	Postgraduate (>16)	0			0			0		

Source: Field survey 2021 *values in parentheses indicate t-values, *** indicates significant at 5% level

Farming experience

Table 11.5.1.3 shown the situation of farming experience of the HYV rice growers in all the study areas. For the growers of Narail and Barisal regions, the highest proportion of them were reported with long term experience. During several field visits and discussion meetings with the HYV rice growers in these growing regions, the researchers observed that the HYV rice growers of Narail and Barisal had long term farming experience.

Table 11.5.1.3: Distribution of respondents based on farming experience

Factor	Category	Narail			Barisal			All Districts		
		%	Mean (t-value)	SD	%	Mean (t-value)	SD	%	Mean (t-value)	SD
Farming experience (yrs)	Short (up to 5)	7	20.6 (1.91)***	14.7	8	21.5 (1.97)***	13.0	7.5	21.1 (2.24)***	13.9
	Medium (6-10)	24			31			30.5		
	Long (>10)	69			61			62		

Source: Field survey 2021 *values in parentheses indicate t-values, *** indicates significant at 5% level

Major occupation

Table 11.5.1.4 represents the categories of major occupation based on which the respondents run their livelihoods in the different study areas. In all of the regions, the major occupation of the respondents had agriculture which was mentioned by the majority share of them.

It is obvious that people living in rural areas of Bangladesh, they almost dependent on agriculture for their livelihoods. Hence, the findings are just a scenario of the ever recognized importance of agriculture as an occupation for the members of farming communities.

Secondary occupation

Table 11.5.1.4 shown the scenario of categories of secondary occupation in three different regions studied for this project work. In all the three regions, the respondents' secondary occupation was business and it is very normal for the rural areas in Bangladesh.

Table 11.5.1.4: Distribution of respondents based on occupation

Factor	Category	Narail			Barisal			All Districts		
		%	Mean (t-value)	SD	%	Mean (t-value)	SD	%	Mean (t-value)	SD
Main Occupation (persons)	Agriculture	94	-	-	96	-	-	95	-	-
	Housewife	0			0			0		
	Business	4			2			3		
	Service	2			1			1.5		
	Wage labour	0			1			0.5		
	Others	0			0			0		
Secondary occupation (persons)	Agriculture	6	-	-	4	-	-	5	-	-
	Housewife	2			3			2.5		
	Business	0			0			0		
	Service	0			0			0		
	Wage labour	0			0			0		
	Others	0			0			0		

Source: Field survey 2021 *values in parentheses indicate t-values, *** indicates significant at 5% level

Family size

Table 11.5.1.5 shown the scenario of family size of the respondents interviewed in the selected areas. In all of the areas, the significant proportion of respondents was reported with small to medium size having up to 8 members in a single family.

Table 11.5.1.5: Distribution of respondents based on family size

Factor	Category	Narail			Barisal			All Districts		
		%	Mean (t-value)	SD	%	Mean (t-value)	SD	%	Mean (t-value)	SD
Family Size (persons)	Small (up to 4)	34	5.63 (0.73)	1.81	37	5.99 (.26)	2.48	35.5	5.81 (0.99)	2.17
	Medium (5-8)	55			49			52		
	Large (>8)	11			14			12.5		

Source: Field survey 2021 *values in parentheses indicate t-values, *** indicates significant at 5% level

Dependency

The findings in Table 11.5.1.6 shown the status of dependent and earning members in each of the families in the different regions considered as study areas for this project. It is easily understandable from the Table 104 for both the categories the mean values of dependent and earning members in each family for both Narail and Barisal regions.The dependency in the case of Barisal region was a bit higher than Narail. The avenues for income earnings, on the other hand, were a bit better in Narail region than Barisal region.

Table 11.5.1.6: Distribution of respondents based on dependency of family members

Dependency (persons)	Dependent members	-	4	1.52	-	4.53	2.03	-	4.26	1.81
	Earning members	-	1.6	0.75	-	1.47	0.84	-	1.55	0.8

Source: Field survey 2021 *values in parentheses indicate t-values, *** indicates significant at 5% level

Farm size

Table 11.5.1.7 depicted the status of farm size of the HYV rice growers in the different study areas. The highest proportion of respondents was found having small to medium farm size in all the regions under investigation. The farm size of an area mostly depends on the available area under cultivation and the density of the population of that particular area. For Barisal region, the existence of higher percentage of large farmers may be because of the lower density of population.

Table 11.5.1.7: Distribution of respondents based on farm size

Factor	Category	Narail			Barisal			All Districts		
		%	Mean (t-value)	SD	%	Mean (t-value)	SD	%	Mean (t-value)	SD
Farm size (ha)	Landless (0.002-.02)	-	0.86 (2.12)***	0.71	-	1.17 (2.23)***	1.35	-	1.01 (2.38)***	1.08
	Marginal (0.021-0.2)	6.5			11.5			9		
	Small (0.21-0.99)	69.5			55			62.25		
	Medium (1.0-3.0)	21			31			26		
	Large(>3.0)	3			2.5			2.75		

Source: Field survey 2021 *values in parentheses indicate t-values, *** indicates significant at 5% level

Annual family income

The findings in Table 11.5.1.8 represent the scenario of status of annual family income of the respondents participated in interview in two different rice growing regions considered for this project. For all the regions, the overwhelming majority of respondents were found with medium to high annual family income categories. The data in Table 100 also depicted that the percentage of annual family income in Narail region was higher than that of Barisal region. It might be because of the higher price of produce and availability of income earning avenues in Narail region compared to Barisal region.

Table 11.5.1.8: Distribution of respondents based on family income

Factor	Category	Narail			Barisal			All Districts		
		%	Mean (t-value)	SD	%	Mean (t-value)	SD	%	Mean (t-value)	SD
Annual family income (‘000 Tk.)	Low income (up to 100)	51	221.1 (2.87)***	691.8	58	167.6 (2.68)***	203.4	54.5	194.4 (2.75)***	509.9
	Medium income (101-300)	33			25			29		
	High income (>300)	16			17			16.5		

Source: Field survey 2021, *values in parentheses indicate t-values, *** indicates significant at 5% level

Training experiences

It is easily observable from the Table 11.5.1.9that the majority proportion of respondents in both regions had some sort of training experience. The training situation of respondents interviewed at Narail region was found slightly better than that of Barisal region. The availability of the training for the members of a farming community depends on many issues such as the project activities, funding, frequency of training conducted, no of farmers in an area etc. The farmers of Narail got more training opportunities than that of framers of Barisal region may be due to higher involvement of Government agencies.

Table 11.5.1.9: Distribution of respondents based on training experience

Factor	Category	Narail			Barisal			All Districts		
		%	Mean (t-value)	SD	%	Mean (t-value)	SD	%	Mean (t-value)	SD
Training experience (days)	No training (0)	7	11.1 (1.64)**	8.78	9	9.7 (1.71)**	23.5	8	10.4 (1.66)**	17.7
	Short duration training (up to 3)	24			49			36.5		
	Medium duration training (4-7)	9			16			12.5		
	Long duration training (>7)	60			26			43		

Source: Field survey 2021 *values in parentheses indicate t-values, ** indicates significant at 10% level

Access to credit

Data in Table 11.5.1.10 shown the status of respondents' access to credit in the different regions considered as the study areas for this project. It is easily observable from the Table that the highest proportion of rice growers in all areas did not have access to credit. The access to credit situation in Narail region was found much better than that of Barisal region. The higher number of financial organizations/associations in Narail region and their better activity than those of in Barisal region may cause the above findings.

Table 11.5.1.10: Distribution of respondents based on access to credit

Factor	Category	Narail			Barisal			All Districts		
		%	Mean (t-value)	SD	%	Mean (t-value)	SD	%	Mean (t-value)	SD
Access to credit	No access (0)	54	234 (1.18)	125.6	51	17.23 (0.83)	58	52.5	125.7 (1.28)	894.7
	Poor access (up to 3)	0			25			12.5		
	Average access (4-7)	0			0			0		
	Good access (>7)	46			24			35		

Source: Field survey 2021

Extension Media Contact

Table 11.5.1.11depicted the nature of extension contacts by the HYV rice growers in the different regions. The significant proportion of respondents in the Narail and Barisal regions were found with high and medium level of contact with extension media respectively.

During field survey, it was observed that the extension workers in Narail region were a bit more communicative and active in nature than those in Barisal region, which could be the reasons for such findings

Table 11.5.1.11: Distribution of respondents based on extension contact

Factor	Category	Narail			Barisal			All Districts		
		%	Mean (t-value)	SD	%	Mean (t-value)	SD	%	Mean (t-value)	SD
Extension Contact (days/month)	No contact (0)	0	32 (2.06)**	7.52	0	25.1 (1.77)**	6.99	0	28.5 (2.84)**	8.05
	Low contact (up to 15)	2			3			2.5		
	Medium contact (16-30)	38			72			55		
	High contact (>30)	60			25			42.5		

Source: Field survey 2021 *values in parentheses indicate t-values, ** indicates significant at 5% level

Organizational participation

Table 11.5.1.12 shows that the scenario of how much respondents participated in different social organizations in their locality. The majority of the respondents in Narail region were found with low participation in social organization, while almost half (44%) of the respondents in Barisal region was found with high level of participation. Participation in social organization by an individual mostly depends on his educational background, attitude, social status, the availability of social organization, the eagerness of the individual etc. for doing something good for the betterment of the community he belongs to. The situation was found to be much better in Barisal region than that of Narail region.

Table 11.5.1.12: Distribution of respondents based on organizational participation

Factor	Category	Narail			Barisal			All Districts		
		%	Mean (t-value)	SD	%	Mean (t-value)	SD	%	Mean (t-value)	SD
Organizational participation	No participation (0)	20	2.82 (0.68)	2.73	4	7.26 (.78)	4.9	12	5.04 (2.41)***	4.54
	Low participation (up to 5)	60			32			46		
	Medium participation (6-10)	20			20			20		
	High participation (>10)	0			44			22		

Source: Field survey 2021 *values in parentheses indicate t-values, *** indicates significant at 5% level

Innovativeness

Table 11.5.1.13 represents the respondents' status of innovativeness. An overwhelming majority of respondents in all tee areas under investigation were found with low level of innovativeness. From the field surveys it could be concluded that due to climatic adversity i.e. lack of irrigation facilities, lack of awareness and very poor mechanization status the innovativeness of the farmers were so poor.

Table 11.5.1.13: Distribution of respondents based on innovativeness

Factor	Category	Narail			Barisal			All Districts		
		%	Mean (t-value)	SD	%	Mean (t-value)	SD	%	Mean (t-value)	SD
Innovative-ness (score)	Low innovativeness (up to 10)	91	5.26 (2.73)***	2.68	94	2.84 (1.68)***	2.22	92.5	4.05 (2.61)***	2.48
	Medium innovativeness (11-20)	5			6			5.5		
	High innovativeness (>20)	4			0			2		

Source: Field survey 2021 *values in parentheses indicate t-values, *** indicates significant at 5% level

Agricultural Knowledge

Table 11.5.1.14 shows the scenario of knowledge of HYV rice growers concerning cultivation. It is easily understandable from the Table that the highest proportion of respondents in the Narail and Barisal region had fair and good knowledge respectively. The situation was reported quite a bit better in Barisal region than that of Narail region. Since long, the people of Barisal have been cultivating rice and their involvement with production related activities usually start from their childhood. This might be the reason of their higher level of knowledge.

Table 11.5.1.14: Distribution of respondents based on agricultural knowledge

Factor	Category	Narail			Barisal			All Districts		
		%	Mean (t-value)	SD	%	Mean (t-value)	SD	%	Mean (t-value)	SD
Agricultural knowledge (score)	Poor knowledge (up to 19)	1	33.6 (2.92) ***	5.75	0	48.56 (1.44)	9.22	0.5	41.1 (2.74) ***	8.54
	Fair knowledge (20-38)	81			16			48.5		
	Good knowledge (>38)	18			84			51		

Source: Field survey 2021 *values in parentheses indicate t-values, *** indicates significant at 5% level

11.5.2 Correlation between poverty reduction and individual characteristics of the HYV rice farmers

Table 11.5.2.1: Correlation between poverty reduction and individual characteristics of the HYV rice farmers at Narail

Variables	Correlation coefficient at 198 df	Level of significance
Age	-.015	NS
Education	.087	NS
Family size	-.018	NS
Farm size	.212***	at 1% level
Farming experience	.139**	at 5% level
Training received	.118	at 10% level
Access to credit	.075	NS
Extension media contact	.141**	at 5% level
Organizational participation	.007	NS
Innovativeness	.124*	at 10% level
Agricultural knowledge	.181***	at 1% level

Source: Field survey 2021 *values in parentheses indicate t-values, *** indicates significant at 5% level

Table 11.5.2.1 exhibits the relationship between characteristics of HYV rice farmers and their status of food security at Narail. Out of the selected characteristics, the characteristics such as farm size, farming experience, training received, extension media contact, innovativeness and agricultural knowledge were found with significant positive relationships with their annual income. Though the remaining characteristics of the respondents did not show any significant relationships, the characteristics such as age, family size showed negative trend with food security status of them.

Table 11.5.2.2: Correlation between poverty reduction and individual characteristics of the HYV rice farmers at Barisal

Variables	Correlation coefficient at 198 df	Level of significance
Age	-0.012	NS
Education	0.120*	at 10% level
Family size	-0.011	NS
Farm size	0.195**	at 1% level
Farming experience	0.128*	at 10% level
Training received	0.121*	at 10% level
Access to credit	0.083	NS
Extension media contact	0.191***	at 1% level
Organizational participation	0.112	NS
Innovativeness	0.046	NS
Agricultural knowledge	0.142**	at 5% level

Source: Field survey 2021 *values in parentheses indicate t-values, *** indicates significant at 5% level

Table 11.5.2.2 exhibits the relationship between characteristics of HYV rice farmers and their status of food security at Barisal. Out of 11 selected characteristics, the characteristics such as education, farm size, farming experience, training received, extension media contact, agricultural knowledge were found with significant positive relationships with their annual income. Though the remaining characteristics of the respondents did not show any significant relationships, the characteristics such as age, family size showed negative trend with food security status of them.

11.5.3 Regression Analysis

Table11.5.3.1: Multiple regression analysis showing influence of selected individual characteristics on income of the HYV rice farmers at Narail

Variables	t-values at 198 df	Level of significance
Age	0-0.94	NS
Education	1.21	NS
Family size	0.73	NS
Farm size	2.12***	at 5% level
Farming experience	1.91***	at 5% level
Training received	1.64***	at 5% level
Access to credit	1.18	NS
Extension media contact	2.06***	at 5% level
Organizational participation	0.68	NS
Innovativeness	1.73***	at 5% level
Agricultural knowledge	1.92***	at 5% level

Table 11.5.3.1 exhibits the t statistics derived from multiple regression analysis showing influence of selected individual characteristics on income of the HYV rice farmers at Narail.The annual income was considered dependent variable and other characteristics were considered as independent variable. Out of 11 selected characteristics, the characteristics such as farm size, farming experience, extension media contact, innovativeness and agricultural knowledge were found to have significant positive relationships with their annual income.

Table 11.5.3.2: Multiple regression analysis showing influence of selected individual characteristics on income of the HYV rice farmers at Barisal

Variables	t-values at 198 df	Level of significance
Age	0.43	NS
Education	1.34	NS
Family size	0.26	NS
Farm size	2.23***	at 5% level
Farming experience	1.97***	at 5% level
Training received	1.71***	at 5% level
Access to credit	.083	NS
Extension media contact	1.77***	at 5% level
Organizational participation	.78	NS
Innovativeness	1.68***	at 5% level
Agricultural knowledge	1.44	NS

Table 11.5.3.2 exhibits the t statistics derived from multiple regression analysis showing influence of selected individual characteristics on income of the HYV rice farmers at Barisal.The annual income was considered dependent variable and other characteristics were considered as independent variable. Out of 11 selected characteristics, the characteristics such as farm size, farming experience, training received, extension media contact and innovativeness were found to have significant positive relationships with their annual income.

11.5.4 Extent of Cropland Transformation into HYV rice Production

Table 11.5.4.1: Level of land transformation into HYV rice in the study area (ha)

Year	Previous crop	Level of land transformation into HYV rice (ha)								
		Narail			Barisal			All districts		
		Farmer (%)	Total area (ha)	Mean area (ha)	Farmer (%)	Total area (ha)	Mean area (ha)	Farmer (%)	Total area (ha)	Mean area (ha)
2001-05	Rice (local variety)	17	30.6	0.9 (2.28)**	13	4.28	0.16 (2.84)**	30	34.88	0.29 (2.14)**
2005-10	Rice (local variety)	43	88.58	1.03 (2.61)***	38	13.42	0.17 (2.37)**	40.5	102	0.62 (2.65)***
2011-15	Rice (local variety)	68	127.6	0.93 (2.42)***	60	18.10	0.15 (2.68)***	64	145.7	0.56 (1.99)**
2016-20	Rice (local variety)	97	168.4	0.86 (2.13)***	92	24.03	0.13 (2.49)**	94.5	192.4	0.509 (2.54)***

Source: Field survey 2021, *values in parentheses indicate t-values, *** indicates significant at 1% level, ** indicates significant at 5% level

From Table11.5.4.1it is evident that the percentage of farmer transforming from local rice production to HYV rice production has increased over time from the year 2001-05 to 2016-20 for both the study areas. For Narail, the percentage was 17%, 43%, 68% and 97% for the years 2001-05, 2005-10, 2011-15 and 2016-20 respectively. The amount of land brought under HYV rice cultivation from local rice production also increased over the study period which were 30.6, 88.58, 127.6 and 168.45 ha respectively. Again for Barisal, the percentage of farmer transforming from local rice production to HYV rice production has also increased over time from the year 2001-05 to 2016-20. The percentage was 13%, 38%, 60% and 92% for the years 2001-05, 2005-10, 2011-15 and 2016-20 respectively. The amount of land brought under HYV rice cultivation from local rice production also increased over the study period which were 4.28, 13.42, 18.10 and 24.03 ha respectively.

11.5.5 Reasons for Cropland Transformation into HYV Rice Cultivation

Table 11.5.5.1: Causes of cropland transformation into HYV rice cultivation

Reasons for transformation	% of farmers as per opinion					
	Narail		Barisal		All	
	Yes	No	Yes	No	Yes	No
Situational						
Coping with climate change situation	79	21	71	29	75	25
Soil suitability	68	32	67	33	68	33
Highly vulnerable to insects and diseases	56	44	60	40	58	42
Lower yield	100	0	100	0	100	0
Less water required crop	6	94	10	91	8	92
Economical						
Lower cost of production	2	98	2	98	2	98
Higher yield	85	15	76	25	80	20
Higher market demand	99	1	100	0	99	1
Easy to sell	75	25	70	30	73	28
Higher profitability /return	89	11	95	6	92	8
Can get the cash at a time	56	44	60	41	58	42
Can manage with minimum labor	0	100	0	100	0	100
Socio-cultural						
Neighboring farmers' transforming	98	2	99	1	99	2
Motivation by the change agents	94	6	97	3	96	5
Family pressure	67	33	65	35	66	34
Decisions of the farmers' cooperative	70	30	68	32	69	31
Availability of processing	72	28	69	31	71	30

Source: Field survey 2021

Reasons for Cropland Transformation into HYV Rice Cultivation in Narail

Situational Analysis

A total of 158 farmers (79%) mentioned (Table 11.5.5.1) that cultivation is much easier and profitable because of favorable climatic condition in the area. A total of 136 farmers (68%) mentioned that, they have diverted to HYV rice cultivation instead of other crop due to suitable soil condition for litchi production in the area. Out of 200 interviewed famers, total 112 farmers (56%) opined that, cultivation is less vulnerable to insect and pests compare with other field crop production. All farmers (100%) commented that production performance of other field crops became lower because of following same crop production since long but yield potentiality of HYV rice is much higher than traditional cropping. Only a total of 12 farmers (6%) has expressed that, HYV rice cultivation is required less water than other field crop production.

Economic Analysis

A total of 4 farmers (2%) has mentioned that (Table 11.5.5.1) HYV rice production needs less cost compare to other crops. A total of 170 farmers (85%) has mentioned that, yield potentiality is higher than other crop production. A total of 198 farmers (99%) has expressed their opinion that market demand of produce is higher in the country because of its quality. In respect of sale, a total of 148 farmers (74%) has opinioned that, there are lots of buyers to purchase from the farm and it is very easier to sell. A total of 178 farmers (89%) has opinioned that profit obtained from HYV rice is higher than that of any other crops in the area. A total of 112 farmers (56%) has expressed that they can sell on cash.

Socio-cultural Analysis

It is found that, a total of 196 farmers (98%) became interested by following neighboring farmers (Table 11.5.5.1). At the same time, 188, 134 and 140 farmers also transformed to HYV rice cultivation encouraged from change agents, family decision as well as from farmer's co-operatives respectively. It is observed that 144 famers have ability to process HYV rice production.

Reasons for Cropland Transformation into HYV Rice Cultivation in Barisal

Situational Analysis

A total of 143 farmers (71.5%) out of 200 responded mentioned (Table 11.5.5.1) that cultivation of HYV rice is much easier and profitable because of favorable climatic condition in the area. A total of 134 farmers (67%) mentioned that, they have diverted to HYV rice cultivation instead of other crop due to suitable soil condition for HYV rice production in the area. Out of 200 interviewed famers, total 119 farmers (59.5%) opined that cultivation is less vulnerable to insect and pests compare with other field crop production. All farmers (100%) commented that production performance of other field crops became lower because of following same crop production since long but yield potentiality of HYV rice is much higher than traditional cropping. Only a total of 19 farmers (9.5%) has expressed that HYV rice cultivation is required less water than other field crop production.

Economic Analysis

A total of 4 farmers (2%) has mentioned that (Table 11.5.5.1), HYV rice production needs less cost compare to other crops. A total of 151 farmers (75.5%) has mentioned that yield potentiality of HYV rice is higher than that of other crop production. A total of 199 farmers (99.5%) has expressed their opinion that market demand of produce is higher in the country because of its quality. In respect of sale, a total of 140 farmers (70%) has opinioned that there are lots of buyers to purchase from the farm and it is very easier to sell. Almost all farmers (94.5%) has opined that profit of HYV rice is higher than that of any other crops in the area. A total of 119 farmers (59.5%) has expressed their opinion that they can sell on cash and at a time of sale they get cash.

Socio-cultural Analysis

It is found that a total of 198 farmers (94%) became interested by following neighboring farmers (Table 11.5.5.1). At the same time, 194, 130 and 136 farmers also transformed in to HYV rice cultivation encouraged from change agents, family decision as well as farmer's co-operatives respectively. It is observed that 138 famers have ability to process HYV rice production.

11.5.6 Food Security Status

Table 11.5.6.1: Level of food availability and access to food for household food security

Items	Percentage of farmers opined											
	Narail				Barisal				All			
	No change	Poorly done	Moderate	Sufficient	No change	Poorly done	Moderate	Sufficient	No change	Poorly done	Moderate	Sufficient
Food Availability												
Availability of all necessary food items in regional market	0	0	22	78	0	0	53	47	0	0	37	63
Available of all necessary food items at local growth centre	0	2	20	78	0	1	53	47	0	1	36	63
Availability of the necessary food items steady in the local market round the year	0	2	23	75	0	1	54	46	0	1	38	61
Only rice is available at local growth centre	0	0	22	78	0	0	53	47	0	0	37	63
Only vegetable is available at local growth centre	0	2	20	78	0	1	53	47	0	1	36	63
Fish is available at local market	0	0	22	78	0	0	53	47	0	0	37	63
Meat is available at local market	0	0	22	78	0	0	53	47	0	0	37	63
Egg is available at local market	0	0	22	78	0	0	53	47	0	0	37	63
Fresh fruits are available at the local market	0	3	19	79	0	3	50	47	0	3	35	63
Fresh produce are availability at local market	0	0	22	79	0	0	53	47	0	0	37	63
Food Access												
Financial ability to purchase cereals	0	0	98	2	0	0	100	1	0	0	99	1
Financial ability to purchase fish	0	13	86	2	0	6	94	1	0	9	90	1
Financial ability to purchase meat	0	19	81	0	0	9	92	0	0	14	86	0
Financial ability to purchase egg	0	21	80	0	0	9	91	0	0	15	85	0
Financial capacity to store food grains	0	94	6	0	0	94	6	0	0	94	6	0
Financial capacity to purchase processed fruit items	11	51	39	0	6	58	37	0	8	54	38	0
Borrow/lend necessary food items during crisis	0	97	3	0	0	95	5	0	0	96	4	0
Equal access of the women, children and elderly to nutritious food	0	0	47	53	0	5	95	0	0	3	71	27

Source: Field survey 2021

Food availability

A total of 10 parameters were considered to measure food availability during the survey (Table-11.5.6.1). As per data analysis, in Narail Sadar, Narail, 157 farmers answered that all necessary food items are sufficient in the regional market and all necessary food items are available in the local growth center. In case of availability of the necessary food items steady in the local market round the year, 152 farmers responded sufficient. Only vegetable is available at local growth centre where no farmers agreed with this. Egg, fresh fruits are sufficient in the local market where 157 farmers responded sufficient. Again in Bakerganj, Barisal; 94 farmers answered that all necessary food items are sufficient in the regional market and all necessary food items are available in the local growth center. In case of availability of the necessary food items steady in the local market round the year, 92 farmers responded sufficient. Only vegetable is available at local growth centre where no farmers agreed with this. Egg, fresh fruits are sufficient in the local market where 94 farmers responded sufficient.

Food Access

A total of 8 parameters were considered to measure food access. (Table 11.5.6.1). In Narail Sadar, Narail, 197 famers shared their ideas and they have moderate financial ability to purchase cereals (rice/wheat flour) for all the family members. A total of 172 farmers told that they have moderate capacity and financial ability to purchase fish for all the family members. In case of financial ability to purchase meat for all the family members where 162 farmers are moderately capable. 159 farmers opined that, they have moderate financial ability to purchase egg for all the family members. Only 77 farmers opined that, they have moderate financial capacity to purchase processed fruit items. In Bakerganj, Barisal, 199 farmers shared their ideas and they have moderate financial ability to purchase cereals (rice/wheat flour) for all the family members. A total of 187 farmers told that, they have moderate capacity and financial ability to purchase fish for all the family members. In case of financial ability to purchase meat for all the family members where 183 farmers are moderately capable. Ninety one percent farmers opined that; they have moderate financial ability to purchase egg for all the family members. Only 73 farmers opined that, they have moderate financial capacity to purchase processed fruit items.

Table 11.5.6.2: Level of food utilization and income for household food security

Items	% of farmers as per opinion											
	Narail				Barisal				All			
	No change	Poorly done	Moderate	Sufficient	No change	Poorly done	Moderate	Sufficient	No change	Poorly done	Moderate	Sufficient
Food utilization												
Sufficient knowledge and skill	0	0	90	10	0	0	75	25	0	0	82	18
Better management	0	0	89	11	0	10	72	19	0	5	81	15
Scope of storing surplus cooked food	26	25	39	11	39	15	47	0	32	20	43	5
Better knowledge and skill to store vegetables	50	47	4	0	48	47	5	0	49	47	4	0
Better knowledge and skill to store fruits	52	45	4	0	49	46	5	0	50	46	4	0
Better knowledge and skill to dry and store fish	44	43	13	1	49	46	5	0	47	44	9	0
Income												
Crop production	5	40	55	0	2	24	75	0	3	32	65	0
Livestock	93	2	6	0	92	3	6	0	92	2	6	0
Fisheries	96	0	5	0	96	0	4	0	96	0	4	0
Services	65	1	35	0	87	1	12	0	76	1	24	0
Small business	77	5	19	0	68	8	24	0	73	6	21	0
Wage earning	93	4	3	0	95	5	1	0	94	4	2	0
In-country remittance	100	0	0	0	100	0	0	0	100	0	0	0
Out-country remittance	97	1	3	0	96	1	4	0	96	1	3	0
On-farming activities	93	3	4	0	92	4	5	0	93	3	5	0

Source: Field survey 2021

Food Utilization

A total of 6 parameters were considered to measure food utilization during the survey (Table 11.5.6.2). In Narail Sadar, among 200 farmers, 21 farmers mentioned that, they have sufficient knowledge and skill to prepare healthy diets with available food items and 89.5% farmers have moderately. Twenty one farmers are sufficient capable to better management to distribute food among all family members as per requirement. Seven of them shared their idea that they have sufficient and better knowledge and skill to store vegetables for using in off season. It is observed that 7 farmers have better knowledge and skill to store fruits for using in off season. Also 7 farmers have sufficient and better knowledge and skill to dry and store fish for using in off season. In Bakerganj, 49 farmers mentioned that they have sufficient knowledge and skill to prepare healthy diets with available food items and 75.5% farmers have moderately.

Thirty seven (18.5%) farmers are sufficient capable to better management to distribute food among all family members as per requirement. Ten of them shared their idea that they have sufficient and better knowledge and skill to store vegetables for using in off season. It is observed that, 10 farmers have better knowledge and skill to store fruits for using in off season. Likewise,10 farmers have sufficient and better knowledge and skill to dry and store fish for using in off season.

Income

A total of 9 parameters were considered to measure family income to reduce household poverty reduction for this study (Table 11.5.6.2). In Narail Sadar, 110 farmers' income from crop production is on moderate level to reduce household poverty reduction. It is found that' only 11 farmers' income from livestock sector is moderate to reduce household poverty reduction. It is observed that, only 9 farmers' income from fisheries is moderate to reduce their household poverty reduction. Only 70 and 37 farmer expressed that they had moderate income from services and small businesses respectively to reduce poverty. Again in Barisal, 149 farmers' income from crop production is moderate to reduce household poverty reduction. It is found that, only 11 farmers income from livestock sector is moderate to reduce household poverty reduction. It is observed from the study that, only 8 farmers' income from fisheries is moderate to reduce their household poverty reduction. Only 24 and 48 farmers expressed that they had moderate income from services and small businesses respectively to reduce poverty.

11.5.7 Consequence of Transformation of Cropland into HYV rice cultivation

Table 11.5.7.1: Consequence of Transformation of Cropland into HYV rice cultivation

Factors	% of farmers as per opinion								
	Narail			Barisal			All		
	Inc.	Unch.	Decr.	Inc.	Unch.	Decr.	Inc.	Unch.	Decr.
Labor Use	100	0	0	100	0	0	100	0	0
Ease in land preparation	0	100	0	0	100	0	0	100	0
Management of seeds	0	100	0	0	100	0	0	100	0
Irrigation	49	51	0	37	64	0	43	57	0
Weeding	18	82	0	22	78	0	20	80	0
Use of machinery	24	76	0	21	79	0	23	78	0
Fertilizer Application	93	7	0	97	4	0	95	5	0
Scope of IPM	38	62	0	44	56	0	41	59	0
Use of Insecticides	38	62	0	44	56	0	41	59	0
Use of Pesticides	37	63	0	43	57	0	40	60	0
Ease in harvesting	4	75	20	2	70	28	3	73	24
Ease of sorting and grading	3	96	1	0	100	1	2	98	1
Cost of production	97	3	0	99	2	0	98	2	0
Farm Outputs	100	0	0	100	0	0	100	0	0
Easy sale	99	1	0	99	1	1	99	1	0
Net profit	99	1	0	100	1	0	99	1	0

Source: Field survey 2021 ; (Inc. = Increased, Unch.= Unchanged, Decr. Decreased)

Survey was done to know the impact on farming practices due to transform into HYV rice cultivation (Table 11.5.7.1). A total of 19 factors were considered at the time of survey. The mentioned factors are labor use, ease in land preparation, management of seeds/saplings, irrigation, weeding, use of farm machinery, fertilizer application, scope of using IPM, use of insecticides, use of pesticides, ease of harvesting, ease of harvesting grading and sorting, cost of production, farm output, easy sale of farm produces and net profit of farming. It is found from data analysis that, in Narail Sadar, Narail; labor use, ease in irrigation, weeding, fertilizer application, cost of production, easy sales of farm produces and net profit of farming parameters increased as mentioned by 200, 98, 36, 186, 194, 198 and 198 farmers respectively. In Bakerganj, Barisal; labor use, ease in irrigation, weeding, fertilizer application, cost of production, easy sales of farm produces and net profit of farming parameters increased as stated by 200, 127, 156, 193, 197, 198 and 199 farmers, respectively.

Table 11.5.7.2: Level of household food consumption and wellbeing of the farmers due to land transformation to HYV rice

Factors	% of farmers as per opinion											
	Narail				Barisal				All			
	No change	Poorly done	Moderate	Sufficient	No change	Poorly done	Moderate	Sufficient	No change	Poorly done	Moderate	Sufficient
Food consumption												
Carbohydrate	0	0	54	47	0	0	55	46	0	0	54	46
Fish	0	1	89	11	0	1	96	4	0	1	92	7
Meat	0	52	46	3	0	78	21	1	0	65	33	2
Egg	0	31	63	7	0	41	58	2	0	36	60	4
Fresh vegetables	0	11	60	29	0	18	59	24	0	14	59	27
Fresh fruits	0	41	45	15	0	69	23	9	0	55	34	12
Tea and coffee	10	33	54	4	6	41	37	1	8	37	46	2
3-meal per day	0	5	90	5	0	11	88	2	0	8	89	3
2-meal per day	0	2	94	5	0	5	94	2	0	3	94	3
Wellbeing												
Tin made house	35	8	58	0	25	5	71	0	30	6	64	0
Half building house	82	1	18	0	89	1	11	0	85	1	14	0
Full building house	83	2	14	2	87	2	11	1	85	2	13	1
Sanitary/modern toilet	1	12	86	2	2	24	74	1	1	18	80	1
Electricity supply	0	0	99	2	0	0	100	1	0	0	99	1
Solar electricity	86	4	11	0	92	3	6	0	89	3	8	0
Tube-well	9	11	80	2	7	28	65	1	8	19	72	1
Water supply by own pumping	44	1	56	0	47	1	52	0	45	1	54	0
Better clothing for family members	1	7	93	0	2	15	83	0	1	11	88	0
Better education for the children	1	13	87	0	2	26	72	0	1	20	79	0
ICT use	34	40	25	2	51	39	10	1	42	40	17	1
Participation in social events	5	0	59	37	2	0	57	42	3	0	58	39

Source: Field Survey (2021)

Food Consumption

A total of 9 parameters were considered to measure family food consumption to reduce household poverty reduction (Table 11.5.7.2). The parameters were Carbohydrate, Fish, Meat, Egg, Fresh vegetables, Fresh fruits, Tea and coffee, 3-meal per day and 2-meal per day. In Narail majority of the farmers expressed that the consumption of carbohydrate and fish were moderate to sufficient. But the consumption of meat, fresh fruits and tea or coffee was poor to moderate. Only 5% farmers consumed a sufficient level of 3 meals per day. In Barisal majority of the farmers expressed that the consumption of food items were moderate. But the consumption of meat, fresh fruits were poor for the majority of them. Only 1.5% farmers consumed a sufficient level of 3 meals per day.

Wellbeing

A total of 12 parameters were considered to measure family wellbeing to reduce household poverty reduction (Table 11.5.7.2). The parameters were tin made house, half building house, full building house, sanitary/modern toilet and wash facilities, electricity supply, solar electricity, tube-well, water supply by own pumping, better clothing for family members, better education for the children, ICT use and participation in social events. Due to the transformation, in Narail most of the farmers had moderate tin made house and 83% farmer had no full building house. 86% farmer household had moderate sanitary toilets and 79.5% of them used tube wells. 59% farmers opined for moderate social events participation. But almost no, 86%, farmers didn't have any type of solar energy. Again, in Barisal most of the farmers had moderate tin made house and 87% farmer had no full building house. 74% farmer household had moderate sanitary toilets and 64.5% of them used tube wells. 57% farmers opined for moderate social events participation. But almost no, 92%, farmers had any type of solar energy. So, in a nutshell, (from Table 11.5.7.2) due to transformation the overall change in household food consumption and wellbeing has been moderate. But some factors like consumption of meat protein, eggs, fresh fruits still is to be improved more. Well-being factors like better housing and toilet, better education for children, use of ICT etc. has a lot to be improved, especially in Bakerganj, Barisal.

11.5.8 Problems towards and suggestions for promoting the transformation to HYV rice cultivation

The problems encountered by farmers towards the Transformation to HYV rice cultivation and necessary solutions/suggestions are documented in Table 11.5.8.1 respectively. In Narail Sadar, Nararil, the highest number of farmers identified problem as Lack/Higher cost of Irrigation (59%), followed by Lower quality/unavailability of seeds (47%), whereas in Bakerganj, Barisal the highest mentioned problem was Insect/Disease (39%), followed by higher price of seed (37.5%).

Table 11.5.8.1: Problems encountered by and suggestions of farmers towards land transformation to HYV rice cultivation in Narail and Barisal

Problems/ Suggestions	Percentage of farmers opined		
	Narail	Barisal	All
Problems			
Adverse climatic condition	2.5	28	15
Insect/Disease	46	39	43
Higher cost of production	19	32	25
Higher price of seed	8	38	22
Lower quality/unavailability of seeds	47	16	32
Lower Quality of Rice	3	14	9
Lower price of rice	8	14	11
Fertilizers unavailability /higher price	18	23	20
Lack of credit support	9	10	9
Lack/Higher cost of Irrigation	59	3	31
Lack of Training/Technical Knowledge	15	21	18
Lack of Mechanization	19	4.5	9
Suggestions			
Better Variety/Higher quality seed	58	42	50
To reduce price of seed	14	40	26
Necessary farmer Training	29	34	32
Good quality pesticide use	18.5	27	23
Easy credit system by Govt. Bank	16	14	15
Lower irrigation cost	17	6	11
Higher Price of Rice	12	11	11.5
Better Irrigation facilities	63	5	34
Better Marketing Facilities	11	12	12
Storage/Processing Facilities	17	26	21
Better mechanization	7	8	8
Subsidy from Government	13	13	13

Source: Field survey 2021

11.5.9 Comparison of profitability of HYV Rice and Local Rice Production

Mainly land rent, input cost, machinery cost, labor cost, marketing cost and operating capital cost were considered for production of HYV and local rice in the study area. So, all relevant costs included in the main costs are mentioned details in Table 11.5.9.1. It is found in Table 118 that total production cost/hectare of HYV rice was estimated at Tk. 73463 and total production cost/hectare of local rice was estimated at Tk. 69067.

Table 11.5.9.1: Cost of Production for HYV and Local Rice

Cost category	Local rice (TK/hectare)	HYV rice (TK/hectare)
Variable cost		
Power tiller cost	8879	8879
Labor cost	14827	15827
Seed cost	1375	1375
Fertilizer cost	5111	7873
Manure cost	1414	1218
Insecticides	1263	2304
Irrigation cost	5294	8294
Others	19550	16211
A. Total variable cost	57713	62014
Fixed cost		
Land use cost	9342	9342
Interest on operating capital	2012	2140
B. Total fixed cost	11354	11482
C. Total cost (A+B)	69067	73463

Source: FGD 2020

Again from table 111 it is evident that the gross return for local and HYV rice was estimated at Tk. 86328 and Tk. 130845 respectively.

Table 11.5.9.2: Production and Return for Production of HYV and Local Rice

Items	Local rice	HYV rice
Rice production (kg/ha)	2616	3965
Return from rice (Tk./ha)	73248	111020
Straw production (kg/ha)	2616	3965
Return from straw (Tk./ha)	13080	19825
D. Gross Returns	86328	130845

Source: FGD 2020

Table 11.5.9.3: BCR for HYV and Local Rice Production

Items	Local rice	HYV rice
Gross Returns (Tk.)	86328	130845
Total Production Cost (Tk.)	69067	73463
Net Returns (Tk.)	17261	57382
BCR	1.25	1.78

Source: FGD 2020

Finally, from Table 11.5.9.3 it can be concluded that the Benefit-Cost Ratio (BCR) for per hectare local rice and HYV rice was 1.25 and 1.78, respectively. So, per hectare HYV rice cultivation is much more profitable than per hectare local rice cultivation.

***Policy suggestions*:**

- Mass awareness should be created among the farmers about the better productivity and profitability of HYV rice.
- Women should also be encouraged to cultivate HYV rice instead of local varieties.
- Seed of HYV rice should be made easily available in local markets and better marketing campaigns should be initiated.
- The price of HYV rice seeds should be determined by the government.
- Demonstration plots should be created to highlight the higher productivity of HYV rice varieties.
- Farmers who already cultivate HYV rice should be instructed to encourage their peers to do so by highlighting the better productivity.
- An efficient marketing campaign should be initiated with the assistance of Government agencies like the DAE for the acceptance of HYV rice varieties among the farmers.
- The higher productivity and profitability from cultivating HYV rice should be publicized among the farmers and encourage them to shift from local varieties to HYV varieties etc.

12. Research highlights (title of the sub-project, background, objectives, methodology, key findings, and key words):

Bangladesh Agricultural Research Council is implementing a coordinated PBRG sub-project entitled "Transformation of Agriculture for Food Security and Poverty Reduction" with association of Bangladesh Agricultural University (BAU),Mymensingh and Prottasha Foundation, Dhaka under Financing and Monitoring of Project Implementation Unit (PIU), BARC, NATP Phase- II Project, Bangladesh Agricultural Research Council (BARC). Target beneficiaries of the study are marginal, small and medium farmers of crops and total cost for all components of the project is estimated at Tk. 19500000. Duration of the project as per project proposal is September 2019 to May 2022. But, according to the letter of agreement the implementation of the project has been effective from 15 October 2019.

A significant shift from traditional farming to commercial one has been observed as a major change in farming of Bangladesh. A major transformation has been occurred in case of high-value crops like fruits, vegetables, fish and flowers. But their economic returns and consequent effects on food security and poverty reduction remain as major matters of concern. Thus, the study intended to assess the agricultural transformation towards livelihood improvement through farming practices as the major purpose of the study.

The crops under the present investigation are litchi, HYV maize, flower, mango and HYV rice. The investigated areas for litchi was Dinajpur, for HYV maize was Lalmonirhat and Panchagarh, for mango was Chapainawabgonj, Naogaon and Satkhira, for flower was Jashore and lastly for HYV rice was Narail and Barisal. Five types of checklists for Focus Group Discussions (FGDs) were prepared for 5 categories of crop farmers for each and FGDs were implemented in respective crop areas with participation of the selected crop farmers/entrepreneurs and stakeholders. For the selection of sample respondents purposive and random sampling techniques were followed. Total 200 samples were selected for litchi growers from Dinajpur while for samples of HYV maize were 400 of which each 200 samples were from Lalmonirhat and Panchagarh. Again, for HYV rice production survey was conducted among the HYV rice farmers at Narail Sadar Upazila of Narail district and Bakerganj upazila of Barisal district under Transformation of Agriculture for Food Security and Poverty Reduction sub-project to know the transformation pattern of crop land to HYV rice cultivation from the year 2000 to year 2021 and socio-economic status of the farmers those converted their land to HYV rice cultivation.

A total number of 400 farmers were interviewed for the primary data collection. In Narail sadar of Narail district 200 farmers were interviewed and in Bakerganj upazila of Barisal district 200 farmers were interviewed.

Analytical results obtained from the data and information in the study, the driving factors of agricultural transformation were identified as farmers' age, education, farming experience, occupation, marriage, gender, religion, house hold size, farm size, annual income, access to credit, training exposure, extension media contract, innovativeness and agricultural knowledge. Reasons for agricultural transformation as determined are; coping with climate change situation, soil suitability, less vulnerable to insects and diseases, higher yield, higher market demand, etc. Moreover, factors of farmers' farming practices through agricultural transformation are farm output, easy sale of farm produces and net profit from farming etc. Again, major influencing factors of farmers' household level food security by the transformation are food availability, food access and food utilization whereas the affected factors for household level poverty reduction are farmers' household income, food consumption and wellbeing. COVID-19 pandemic situation has been encountered as the major problem against proper implementation of the project.

Some major problems encountered by farmers are low quality and high price of input, uncontrolled pests and diseases, high production cost, unfavorable climate and natural disaster, capital crises, lack of bank credit, lack of proper processing, storage, scarcity of farmers' knowledge about proper production and marketing activities and non-availability of government and non-government supports, etc. Finally, for overcoming the problems and promotion and sustaining the agricultural transformation in Bangladesh, some important suggestions provided are: development and innovation of appropriate varieties, provide available training to farmers, ensuring quality seed, pesticides and other inputs at cheaper price, establishing easy credit system, monitoring quality and prices of all inputs, increase subsidy, enhancement of government supports etc. In the consequences, government and non-government organizations should come forward with necessary programs and action plans of implementation for development and advance of the agricultural transformation in Bangladesh.

B. Implementation Status

1. Procurement (component wise):

Table B.1.1: Procurement of BARC component

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No.)	Financial (Tk.)	Physical (No.)	Financial (Tk.)	
(a) Office equipment:	2	40000	2	40000	Target achieved 100% as per plan
Executive Table	2	20000	2	20000	
Executive Chair	2	40000	2	40000	
File Cabinet	2	48000	2	48000	
Steel Almira	10	40000	10	40000	
Visitor/Front Chair	3	15000	3	15000	
Computer Table	3	10500	3	10500	
Computer Chair	2	40000	2	40000	
(b) Lab &field equipment:					Target achieved 100% as per plan
Desktop Computer	3	180000	3	180000	
Laser Printer	3	60000	3	60000	
UPS (offline)	3	30000	3	30000	
Laptop	2	120000	2	120000	
Scanner	1	10000	1	10000	
Digital Camera	1	25000	1	25000	
Colour photocopy machine	1	350000	1	350000	
(c) Other capital items:					Target achieved 100% as per plan
Small Transport (Two wheeler: Motor cycle/ Bicycle)	1	170000	1	170000	

*** PP- Project Proposal**

Table B.1.1: Procurement of BAU component

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No.)	Financial (Tk.)	Physical (No.)	Financial (Tk.)	
(a) Office equipment:	2	40000	2	40000	Target achieved 100% as per plan
Executive Table	2	20000	2	20000	
Executive Chair	2	40000	2	40000	
File Cabinet	1	24000	1	24000	
Steel Almira	5	20000	5	20000	
Visitor/Front Chair	2	10000	2	10000	
Computer Table	2	7000	2	7000	
Computer Chair	2	40000	2	40000	
(b) Lab &field equipment:					Target achieved 100% as per plan
Desktop Computer	2	120000	2	120000	
Laser Printer	1	20000	1	20000	
UPS (offline)	1	10000	1	10000	
Laptop	1	60000	1	60000	
Scanner	1	10000	1	10000	
Digital Camera	1	25000	1	25000	
(c) Other capital items:					-
Small Transport (Two wheeler: Motor cycle/ Bicycle)	-	-	-	-	

*** PP- Project Proposal**

Table B.1.1: Procurement of Prottasha Foundation component

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No.)	Financial (Tk.)	Physical (No.)	Financial (Tk.)	
(a) Office equipment:	2	40000	2	40000	Target achieved 100% as per plan
Executive Table	2	20000	2	20000	
Executive Chair	2	40000	2	40000	
File Cabinet	1	24000	1	24000	
Steel Almira	5	20000	5	20000	
Visitor/Front Chair	2	10000	2	10000	
Computer Table	2	7000	2	7000	
Computer Chair	2	40000	2	40000	
(b) Lab &field equipment:					Target achieved 100% as per plan
Desktop Computer			-	-	
Laser Printer			-	-	
UPS (offline)			-	-	
Laptop			1	60000	
Scanner			-	-	
Digital Camera			1	25000	
(c) Other capital items:					-
Small Transport (Two wheeler: Motor cycle/ Bicycle)	-	-	-	-	

*** PP- Project Proposal**

2. Establishment/renovation facilities: Not applicable

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	
	-	-	-	-	-

3. Training/study tour/ seminar/workshop/conference organized:

Table B.3.1: Information on training/workshop/FGD organized by BARC component

Description	Number of participants			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training					
Farmers Training (Uttar Shibpur, Sundarban, Dinajpur Sadar, Dinajpur)	14	6	20	1 Day	Completed
Total	14	6	20		
(b) Workshop					
Inception Workshop (Seminar room BWMRI, Nashipur Dinajpur)	30	10	40	1 Day	Completed
Focus Group Discussion (FGD) (Uttar Shibpur, Sundarban, Dinajpur Sadar, Dinajpur)	15	5	20	1 Day	Completed
Focus Group Discussion (FGD) (Rajpur, Maraihat, Sadar, Lalmonirhat)	15	5	20	1 Day	Completed
Total	60	20	80		
(c) Others (if any)	-	-	-	-	-

Table B.3.2:Information on training/workshop arranged by BAU component

Description	Number of participants			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training					
Training on Skill Development for Fieldwork of Enumerators	04	01	05	1 Day	Completed
Farmers Training (Shibgonj, Chapainawabgonj)	20	0	20	1 Day	Completed
Farmers Training (Jhikargacha, Jashore)	17	03	20	1 Day	Completed
Farmers Training (Kalaroa, Satkhira)	20	0	20	1 Day	Completed
Total	61	04	65		
(b) Workshop					
Stakeholder Workshop (Shibgonj, Chapainawabgonj)	10	0	10	1 Day	Completed
Stakeholder Workshop (Jhikargacha, Jashore)	09	01	10	1 Day	Completed
Stakeholder Workshop (Kalaroa, Satkhira)	10	0	10	1 Day	Completed
Stakeholder Workshop (Shibgonj, Chapainawabgonj)	10	0	10	1 Day	Completed
Stakeholder Workshop (Porsha, Naogaon)	10	0	10	1 Day	Completed
(c) Others (if any)	-	-	-	-	-

Table B.3.3: Information on training/ FGD organized by Prottasha Foundation component

Description	Number of participants			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training					
Farmers Training (Vill.:Charikhada, Union:Maizpara, Upazilla: NarailSadar, Dist.:Narail)	27	13	40	1 Day	Completed
Farmers Training (Vill.:Nandapara, Union:Rangasree Upazilla:Bakerganj, Dist.:Barisal)	25	15	40	1 Day	Completed
Total	52	28	80		
(b) Workshop					
Focus Group Discussion (FGD) (Vill.:Nandapara, Union:Rangasree Upazilla:Bakerganj, Dist.:Barisal)	10	5	15	1 Day	Completed
Focus Group Discussion (FGD) (Vill.:Boalia, Union:Rangasree, Upazilla:Bakerganj, Dist.:Barisal)	12	8	20	1 Day	Completed
Focus Group Discussion (FGD) (Vill.:Charikhada, Union:Maizpara, Upazilla: NarailSadar, Dist.:Narail)	13	7	20	1 Day	Completed
Total	35	20	55		
(c) Others (if any)	-	-	-	-	-

C. Financial and Physical Progress (combined & component wise)

Table C.1 Combined Financial and Physical Progress

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (percent)	Reasons for deviation
a. Contractual staff salary	5515109	5515109	5515109	0	100.00	Not applicable
b. Field research/lab expenses and supplies	5354883	5354883	5354883	0	100.00	
c. Operating expenses	2346092	2346092	2346092	0	100.00	
d. Vehicle hire and fuel, oil & maintenance	2550689	2550689	2550689	0	100.00	
e. Training/workshop/seminar etc.	1128722	1128722	1128722	0	100.00	
f. Publications and printing	365000	365000	365000	0	100.00	
g. Miscellaneous	430865	430865	430865	0	100.00	
h. Capital expenses	1808640	1808640	1808640	0	100.00	
Total	19500000	19500000	19500000	0	100.00	

Table C.2: Financial and physical progress of BARC Component

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (percent)	Reasons for deviation
a. Contractual staff salary	2244244	2244244	2244244	0	100.00	Not applicable
b. Field research/lab expenses and supplies	2086400	2086400	2086400	0	100.00	
c. Operating expenses	982282	982282	982282	0	100.00	
d. Vehicle hire and fuel, oil & maintenance	997469	997469	997469	0	100.00	
e. Training/workshop/seminar etc.	332700	332700	332700	0	100.00	
f. Publications and printing	350000	350000	350000	0	100.00	
g. Miscellaneous	186615	186615	186615	0	100.00	
h. Capital expenses	1158500	1158500	1158500	0	100.00	
Total	8338210	8338210	8338210	0	100.00	

Table C.3: Financial and physical progress of BAU component

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (percent)	Reasons for deviation
a. Contractual staff salary	1508863	1508863	1508863	0	100.00	Not applicable
b. Field research/lab expenses and supplies	1669483	1669483	1669483	0	100.00	
c. Operating expenses	645634	645634	645634	0	100.00	
d. Vehicle hire and fuel, oil & maintenance	800500	800500	800500	0	100.00	
e. Training/workshop/seminar etc.	496100	496100	496100	0	100.00	
f. Publications and printing	15000	15000	15000	0	100.00	
g. Miscellaneous	50000	50000	50000	0	100.00	
h. Capital expenses	404140	404140	404140	0	100.00	
Total	5589720	5589720	5589720	0	100.00	

Table C.4: Financial and physical progress of Prottasha Foundation component

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (percent)	Reasons for deviation
a. Contractual staff salary	1762002	1762002	1762002	0	100.00	Not applicable
b. Field research/lab expenses and supplies	1599000	1599000	1599000	0	100.00	
c. Operating expenses	718176	718176	718176	0	100.00	
d. Vehicle hire and fuel, oil & maintenance	752720	752720	752720	0	100.00	
e. Training/workshop/seminar etc.	299922	299922	299922	0	100.00	
f. Publications and printing	0	0	0	0	100.00	
g. Miscellaneous	194250	194250	194250	0	100.00	
h. Capital expenses	246000	246000	246000	0	100.00	
Total	5572070	5572070	5572070	0	100.00	

D. Achievement of Sub-project by Objectives (Tangible form): Technology generated/developed: Not applicable

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output(i.e. product obtained, visible, measurable)	Outcome(short term effect of the research)

E: Information/Knowledge generated/Policy generated: Not applicable

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (short term effect of the research)

F. Materials Development/Publication made under the Sub-project:

Publication	Number of publications		Remarks (e.g., paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/ booklet/leaflet/flyer etc.			
Journal publication	01	Submitted	● Socio-economic profile of HYV Maize farmers in Lalmonirhat and Panchagarh district. ● Submitted Bangladesh Journal of Agriculture.
Video clip/TV program			
News Paper/Popular Article			
Other publications, if any			

G. Description of generated Technology/Knowledge/Policy

i. Technology Factsheet :

Not Applicable for this sub-project

ii. Effectiveness in policy support (if applicable)

Context

Production of food grains and other agricultural commodities have increased. Increase in production of food grains was substantial during the last four decades. Total production of foodgrains (rice and wheat) has increased by 3.2 times and average annual production increased from 10.96 million tons in the early seventies to 35.60 million tons in the mid- 2010s (Deb, 2016). During the same period, total rice production has increased by 3.2 times (from 10.85 to 34.30 million metric tons). Bangladesh has experienced a structural shift in its rice production and weather influenced crop, which is much more sensitive to the public policy and governance than the vagaries of nature (Deb, 2002). Now, Boro rice contributes about 55% to the total foodgarins production against only 18% in the early seventies. Wheat production increased from a low base (1.09 lakh MT) until 2000 (17.06 Lakh MT) and then started to decline. In the recent years, wheat production increased to 11 lakh MT (BWMRI, 2019).Maize was not an important crop until the ninetie. Maize production increased from about 3000 metric tons in the seventies and eighties to 26000 metric tons in the early 2000s. In 2010-11, the average production of maize was 15.52 lakh MT, 21.78 lakh MT in 2012-13, 27. lakh MT in 2015-16 and 38.18 lakh MT in 2017-18. Increase in maize production is possible due to increased demand for maize for poultry feed and multiple use of maize, new Hybrid maize which also were marketed mainly through the

private companies and NGOs which provide higher profitr (BWMRI 2019).Transformation of agricultural land is due to below-optimum use of agricultural land, poorly constructed road networks, improper land cultivation, government land acquisition, brick making, gas station, rural settlements, riverbank erosion and water-logging, etc. (Islam, 2011). The study areas were mainly famous fortransformationcropsland into litchi and mango orchard,crops land into flowers cultivation,traditional rice variety shift into HYV rice variety. About 80% of the people directly or indirectly dependent on crop based agro-economy twenty years ago, but now their lives primarily dependent on high value crops cultivated activities .Weather and congenial atmosphere of the study area is very much suitable for selected enterprises. On the other hand, it is very much profitable than competitivescrops. Farmers are not getting long time profit from growing different competitives crops. But it is possible to get morereturn for several years from the selected enterprises. It requires low cost of production and an environment friendly farming activity.

General knowledge

Crops Land Transformation into Litchi Orchard

Farmers in study area are transforming crop land into litchi cultivation because of getting more profit from litchi cultivation. Twenty years' data from 2000-2001 to 2019-2020 showed that, average 20 farmers in a year transformed crop land into litchi orchard. Among the different categories of farmers, highest 480 decimal land tranformated small farmers in 2005-2006, 915 decimal land medium farmers in 2002-2003 and 850 decimal land transformated large farmers in 2016-2017 were involved in transforming crop land into litchi orchard indicating that large farmers were more involved in this transformation followed by medium and small farmers. This implies that economic solvency is an important factor setting up litchi orchard. A total of 59% farmers mentioned that, litchi cultivation is much easier and profitable because of favorable climatic condition, 66% consisting farmers opined that, litchi was less vulnerable to insect and pests compare with other field crops. About 75% stated that yield of other field crops became lower because of cultivating same crops year after year on the same plot. About 170% expressed that they preferred litchi cultivation as it requires less water compared to other field crop. They also mentioned that as Dinajpur area is dry or less humidity condition, more irrigation is needed for crop production. Again 88% farmers have mentioned that litchi production needs less cost compare to other crops. Almost all farmers 97% have stated that yield potentiality of litchi is higher than other crop production and demand for litchi is higher compared to other crops. About 97% farmers have opined that it is very easy to sell as there are lots of buyers to purchase litchi

from the farm, 98% farmers have expressed that they prefer litchi cultivation because of its higher profitability compared to any other crops in the area. All farmers but two of them have mentioned that they can get cash instantly at a time after selling litchi. They also mentioned that litchi cultivation required less laborer compare to other crops. It is found that 91.5% farmers became interested in litchi cultivation after seeing neighbours' litchi cultivation. On the other hand, 65%, 69.5% and 56% farmers have motivated to cultivate litchi by change agents, family members and farmer's co-operatives, respectively. While, 82 % of them have encouraged due to availability of processed fruits.

Transformation Extent of Crop Land to HYV Maize Cultivation

For transformation of land to HYV maize cultivation in Lalmonirhat, change rate of land was the lowest (8%) in 2010-2011 and highest was 25% in 2019-2020. It is evident that the rate of expansion of hybrid maize cultivation from crops land from 2000-2001 to 2006-2008 has increased at a positive rate, which is highly statistically significant. But from 2006-2007 to 2019-2020, hybrid maize cultivation has been increasing significantly. One of the reasons is that the hybrid maize yield, price and demand is higher compare to competitive crops, the government are also properly has been implementation of 7thFive Year Plan,Agricultural Policy 2018, Perspective Plan 2020, Delta plan 2100, MDGs, SDGs and 8th Five Years' Plan (FYP).

To transform into HYV maize cultivation, change rate of household land was computed the lowest at 7% in 2006-2007 and 27% in 2019-2020 respectively. Moreover, shifting rate of dropout crop land was measured in 12% to 27% in 2012-2013 to 2019 to 2020 respectively. In 2000-2001 in Panchagarh area the rate of land transfer from crop to hybrid maize was 8% to 13% but in 2000-2005 to 2005-2008 the rate of land transfer was not increased significantly because lack of positive initiative of agricultural policy implementation. But from 2006-2007 to 2019-2020 the rate of crop land transfer is 5% to 26% which is statistically significant. In this period farmers have been transformation of their crops land into hybrid maize cultivation because of Bangladesh government has been implemented 7thFive Year Plan, perspective plan 2020, agricultural policy 2018 and MDGs.Situational reasons identified under situational issues of HYV maize cultivation are coping with climate change situation, soil suitability, highly vulnerable to insect and disease, lower yield due to long-term mono cropping and less water required crop. It is indicated that four reasons of situational issue like cropping with climate change situation (92), soil suitability (95%), lower yield due to long-term mono cropping (63%) and less water required crop (96%) were supported with 'yes' agree in Lalmonirhat and 57%, 64%, 59%, 60% and 57% respondents in Panchagarh in all the types of farmer classes. But in

Lalmonirhat only reason of highly vulnerable to insects and diseases was agreed as 'yes' by 63% respondents of all the farmers. Economical reasons identified under economic issue are lower cost of production, higher yield, higher market demand, easy to sell, higher profitability/return, getting cash at a time andmanaging with minimum labor. It is revealed that 72% to 100% respondents in Lalmonirhat and 56% to 61% respondents in Panchagarh farmer expressed agree with 'yes' under economic issue are higher yield, higher market demand, easy to sell in the local market, higher profitability/return, getting cash at a time andmanaging with minimum labor. Moreover, only reason of lower cost of production than competive crops was accepted by 73% in Lalmonirhat and 57% respondents in Panchagarh.Reasons identified under socio-cultural issue are neighboring farmers' transforming, motivation by the change agents, family pressure, decisions of the farmers' cooperative and availability of processed fruits. It is revealed that in Lalmonirhat three reasons were neighboring farmers' transforming and decisions of the farmers' cooperative were agreed as 'yes' by 54% to 84% respondents. But, 65% respondents supported the reasons of motivation by the change agents and availability of processed fruits. On the other hand, all the socio-cultural issues were supported by 48% to 57 % farmers of all the classes in Panchagarh.

Transformation Extent of Crop Land to Mango Orchard

Though food security of an individual and an area depends on many issues, agricultural project interventions among others may play important role. We know that a good number of projects have been implementing in Satkhira region since last decades. Those projects frequently provide training support, organize awareness building campaign, develop resilient to climate change mitigation issues, and provide micro credit facilities to people living in rural areas. These interventions cumulatively effect on ensured food security status of people in Satkhira region more than that of Chapainawabgonj and Naogaon regions. The 'food utilization dimension' of food security mostly depends on individual's knowledge and capacity. Hence, the initiative that may improve individual's knowledge and capacity is very important to handle his dimension effectively. For Satkhira region, the score of this dimension was reported slightly high which might be supported by the above statement. The scenario of mango transformation occurred from different crops in three different regions. Though the process of transformation started in 2001, it's got a momentum during 2005-10. The highest amount of transformation was reported during 2011-2015 in all regions. Only for Naogaon region, the rapid positive transformation was remarkable until 2015. Although some transformation occurred in Chapainawabgonj and Satkhira regions, those were not too high. It is understandable that mostly rice was replaced by

mango in all the regions followed by sugarcane until 2015. In recent past (since 2016), it was reported that rice was solely replaced by mango in all study areas.

Since rice is the staple crop in Bangladesh and most of the cropping patterns are rice dominated, the three study regions were not exception of this fact. So, sacrificing the area used for rice cultivation is a must to introduce a new crop(s) in any cropping season and this very normal what the researchers observed during field survey.

It is easily observable that among three broad areas of reasons, the economic issue got the highest priority area that mango growers considered with due importance. The aspect such as 'can manage cash at a time', 'high market demand' and 'higher profitability/ return' received the rank order 1, 2 and 3, respectively and all those were related with economic areas of reasons of transformation in all regions. The issues that are highly considered by the commercial farmers in any country include- cash in hand without any delay, high market demand of the produces and high profitability/return. For the case of mango transformation in the areas investigated, the mango growers put highest priority on economic issue that foster them to replace rice with mango and cultivate mango (Amropali) along with rice.

Out of 12 selected characteristics of mango growers, five characteristics such as farming experience, annual family income, training received, extension media contact and agricultural knowledge were found with significant positive relationships with their food security status. Though the remaining characteristics of the respondents did not show any significant relationships, the characteristics such as age, family size, access to credit and organizational participation showed negative trend with food security status of them.

Transformation of Crop Land into Flower Cultivation

The study depicted that among the three dimensions of household food security the mean score of food availability score was 29.16 and food access score was 22.11 which was quite good. However, the mean score of food utilization was 12.19, which was relatively poor as the 'food utilization dimension' of food security mostly depends on individual's knowledge and capacity. Hence, the initiative that may improve individual's knowledge and capacity is very important to handle this dimension effectively. The scenario of poverty reduction status of the flower growers in the study area.Observed score of poverty reduction status of a flower grower ranged from 21-79 against a possible score of 0-87. The mean poverty reduction status of the flower grower was 66.27 with standard deviation of 5.38. The supreme majority (94%) of the respondent flower growers had high poverty reduction. While, only 6% of them had medium poverty reduction. However, among the respondents there were none having low poverty reduction. This is due to

the fact that the flower growers enjoy better income from flower farming that actually contributed in reducing their poverty.

The crops land transformation in 2001-2005, 49% of the farmers transformed into flower from rice. It is also shown that a total of 17.76 ha of land under rice were transformed into rice with a mean area of 0.36 ha. Apart from rice a little amount of land under vegetables and jute had also been transformed into flower in the study area. However, not only in 2001-2005, but up to recent time (2020) the majority area was transformed from rice to flower. However, it is clear that the recent rate of transformation from rice to flower has slowed down to some extent. However, more than one-third (39%) of the flower farmers had the perception that flower transformation remained unchanged while only 10% of them had the perception that flower transformation has decreased.

It is evident that 100 % of the farmer transformed land under flower cultivation due to its higher profitability compared to rice, vegetables and jute that the local farmers were used to with cultivating before transforming into flower. Next to higher profitability, easy to sell and high market demand ranked 2nd and 3rd position, respectively. However, it is evident that among all the reasons, economic reasons were considered as crucial to all the respondent flower farmers. While among other reasons, soil suitability ranked 5th position based on perception of the respondents. Among 12 selected characteristics of flower growers, five characteristics such as education, farm size, annual family income, training experience, extension media contact and flower knowledge of the mango growers had significant positive relationships with their status of poverty reduction. A flower grower with bigger farm size is considered as a better off member in his community because he can earn more, can take any kind of decision to run his farm, can adopt innovation as he desires. So, we can easily say that the bigger the farm of a grower, the higher the ability to reduce his poverty. The characteristics such as family income, training received, extension media contact and agricultural knowledge of a flower grower make him capable to run his business efficiently that increase his farm income which ultimately leads to reduce his poverty status. Extension media contact is an important characteristic of a flower grower that can help him get all of the information ranging from seedlings preparation to market access to their produces and even provides storing information even. Good knowledge on flower cultivation is the prerequisites to run his flower farm business with a profitable manner that ultimately ensure his/her better household food security status through better farm income.

Transformation of Crop Land into Traditional Rice Cultivation to HYV Rice Cultivation

The relationship between characteristics of HYV rice farmers and their status of food security at Narail. Out of the selected characteristics, the characteristics such as farm size, farming experience, training received, extension media contact, innovativeness and agricultural knowledge were found with significant positive relationships with their annual income. Though the remaining characteristics of the respondents did not show any significant relationships, the characteristics such as age, family size showed negative trend with food security status of them. Again the relationship between characteristics of HYV rice farmers and their status of food security at Barisal. The characteristics such as education, farm size, farming experience, training received, extension media contact, agricultural knowledge were found with significant positive relationships with their annual income. Though the remaining characteristics of the respondents did not show any significant relationships, the characteristics such as age, family size showed negative trend with food security status of them.

The study exhibits the t statistics derived from multiple regression analysis showing influence of selected individual characteristics on income of the HYV rice farmers at Narail.The annual income was considered dependent variable and other characteristics were considered as independent variable. Out of 11 selected characteristics, the characteristics such as farm size, farming experience, extension media contact, innovativeness and agricultural knowledge were found to have significant positive relationships with their annual income. Again the t statistics derived from multiple regression analysis showing influence of selected individual characteristics on income of the HYV rice farmers at Barisal.The annual income was considered dependent variable and other characteristics were considered as independent variables were found to have significant positive relationships with their annual income.

The study found that the percentage of farmer transforming from local rice production to HYV rice production has increased over time from the year 2001-05 to 2016-20 for both the study areas. For Narail, the percentage was 17%, 43%, 68% and 97% for the years 2001-05, 2005-10, 2011-15 and 2016-20 respectively. The amount of land brought under HYV rice cultivation from local rice production also increased over the study period which were 30.6, 88.58, 127.6 and 168.45 ha respectively. Again for Barisal, the percentage of farmer transforming from local rice production to HYV rice production has also increased over time from the year 2011-20.

The percentage was 13%, 38%, 60% and 92% for the years 2001-05, 2005-10, 2011-15 and 2016-20 respectively. The amount of land brought under HYV rice cultivation from local rice production also increased over the study period which were 4.28, 13.42, 18.10 and 24.03 ha

H. Technology/Knowledge generation/Policy Support (as applied)

i. **Immediate impact on generated technology**: Not applicable

ii. **Generation of new knowledge that help in developing more technology in future:**

Transformation of agricultural land into selected profitable crops was documented in the farmers field level of the study. The attaining knowledge from the study, the policy makers would be implemented 8th Five Year Plan, perspective plan 2030, SDGs,Vision 2030, and Delta plan 2100 successfully.

iii. **Technology transferred that help increased agricultural productivity and farmers'income:**Not Applicable

iv. **Policy Support**

- As majority of the farmers had transformation and adoption of litchi cultivation, agricultural extension agencies especially the DAE and relevant NGOs should be strengthen their extension services to the litchi farmers and train them for proper transformation and adoption of litchi cultivation.
- Since age is an important factor for transformation and adoption of litchi cultivation, DAE should target young farmers to increase extend and adoption of litchi cultivation.
- Education had a positive relationship with the transformation and adoption of litchi cultivation. Therefore, it was recommended that step should be taken by the government to increase level of education for increasing transformation and adoption of commercial cultivation of litchi.
- Cosmopolitenss had positive relationship with the transformation and adoption of litchi cultivation. Therefore, it was recommended that steps should be taken to increase the cosmopoliteness of the farmers for increasing commercial transformation and adoption of litchi cultivation.
- Knowledge had a positive relationship with land transformation and adoption of litchi cultivation. Therefore, it was recommended that DAE and other extension agencies should take necessary action to increase the knowledge of the farmers for enhancing land transformation toward adoption of litchi cultivation.

- Attitude had a positive relationship with the transformation and adoption of litchi cultivation. Therefore, it was recommended that DAE and other extension providing organizations should arrange motivational campaigning to develop favorable attitude for increasing transformation and adoption of commercial litchi cultivation.
- Farmers income increased due to land transformation into litchi cultivation in the area. So, proper training, credit support, good variety, processing scope should be arranged so that they get maximum profit from litchi cultivation.
- Proper technology about inter-cropping in litchi orchards is essential to get more profit from the litchi cultivation.
- Develop appropriate Hybrid maize varieties;
- Develop stress tolerant maize varieties for the southern region of Bangladesh.
- Developed short duration variety of maize of the farmers.
- Ensuring quality HYV maize seed to the farmers.
- Strengthening of research-extension- farmers- market linkage.
- Improvement of present maize marketing system in the maize growing areas.
- Provide Bank loan to the maize farmers.
- Introduction of high-density mango on large scale to replace the high canopy varieties.
- Popularizing the dwarf mango varieties as a component of mixed crops.
- Improvement of marketing issues and add value to mango products.
- Control of transformation to mango in Naogaon region should be considered.
- Arrangement of credit facilities for the flower growers with low interest rate.
- Introduction of strong and functional flower growers' association.
- Development of effective linkage for easy access of growers to flower markets.
- Introduction of modern transportation by adding more vehicles with cool chain.
- Mass awareness should be created among the HYV rice farmers.
- Women should also be encouraged to cultivate HYV rice instead of local varieties.
- Seed of HYV should be made easily available at local markets and better marketing campaigns should be initiated.
- The price of HYV rice seeds should be fixed at reasonably price.
- Demonstration plots should be highlight the higher productivity of HYV rice varieties.
- Programs has been taken to popularized HYV Rice in Southern part of Bangladesh .

- An efficient marketing campaign should initiated with the assistance of Government agencies among the HYV rice farmers.
- The higher productivity of HYV rice should be publicized among the farmers.

I. Information regarding Desk and Field Monitoring

i. Desk Monitoring (description & output of consultation meeting, monitoring workshops/seminars etc.)

ii) Field Monitoring (date& no. of visit, name and addresses of team visit and output)

BARC component:

Date of Field Monitoring	:	21 January 2020
Team Member (s) & address	:	1. Dr. Nowsher Ali Sardar, M&E Specialist, PIU-BARC, NATP-2 2. Kbd. Dipok Kumar, Monitoring Associate, PIU-BARC, NATP-2 3. Kbd. Md. Abdur Rahman, Monitoring Associate, PIU-BARC, NATP-2
Date of Field Monitoring	:	24 June 2021
Team Member (s) & address	:	1. Dr. M. N. Ali Sardar, Monitoring Specialist, PIU-BARC, NATP-2 2. Md. Asaduzzaman, Manager (Financial Management) , PIU-BARC, NATP-2 3. Kbd. Md. Abdur Rahman, Monitoring Associate, PIU-BARC, NATP-2 4. Kbd. Dipok Kumar, Monitoring Associate, PIU-BARC, NATP-2

BAU component:

Date of Field Monitoring	:	11 September 2021
Team Member (s) & address	:	1. Dr. Md. Harunur Rashid, Director, PIU-BARC, NATP-2 2. Mr. Mohammad Shahidul Islam, Procurement Specialist 3. Dr. Mohammad Abdullah Al Faroque, Assistant Manager (Administration) 4. Mr. Md. Ashequar Rahman, Assistant Manager (Accountants)

Prottasha Foundation Component:

Date of Field Monitoring	:	24 June 2021
Team Member (s) & address	:	1. Dr. M. N. Ali Sardar, Monitoring Specialist, PIU-BARC, NATP-2 2. Md. Asaduzzaman, Manager (Financial Management) , PIU-BARC, NATP-2 3. Kbd. Md. Abdur Rahman, Monitoring Associate, PIU-BARC, NATP-2

iii. Weather data, flood/salinity/drought level (if applicable) and natural calamities:

Not applicable

J. Sub-project Auditing (covers all types of audits performed):

Table J.1: Sub-project auditing information of BARC component

Types of audit	Major observation/ issues/ objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
NATP Phase II	No objection raised, found all relevant documents updated as per guideline	2398711	Financial management of the component found running smoothly.	Financial management & project performance found satisfactory
FAPAD	No objection raised, found all relevant documents updated as per guideline	4447626		Financial management & project performance found satisfactory

Table J.2: Sub-project auditing information of BAU Component:

Types of audits	Major observation/ issues/ objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
FAPAD	No objection raised, found all relevant documents updated as per guideline	849655	Financial management of the component found running smoothly.	Submitted satisfactory audit report in all cases
MI Chowdhory& Co.	No objection raised, found all relevant documents updated as per guideline	849655		Submitted satisfactory audit report in all cases
FAPAD	No objection raised, found all relevant documents updated as per guideline	3914045		Submitted satisfactory audit report in all cases

Table J.3: Sub-project auditing information of Prottasha Foundation Component:

Types of audit	Major observation/ issues/ objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
FAPAD	No objection raised, found all relevant documents updated as per guideline	4596675	Financial management of the component found running smoothly.	Submitted satisfactory audit report in all cases

K. Lessons Learned:

- Farmers shifted their land towards profitable enterprise.
- .Rapid shift of mango cultivation from Chapainawabganj to Naogaon district was really amazing.
- A potential mango production hub has been created in Satkhira region and good production has been observed.
- Rapid transformation may not be encouraging if not done with understanding the environment and societal considerations.
- Transformation of farmers' crop land into high value crops due to preferences from subsistence farming to commercial agriculture as well as agribusiness.
- Farmers are interested to shift their cropland into high value/ gross returnable crop cultivation.
- Market linkage of farmers-local buyers is usually found but farmers-outside buyers' linkage is fully absent.

- Market structure, conduct and performance of the selected commodities should be improved.
- HYV maize is considered as a human food as well as poultry and fish feed. So, HYV Maize is profitable enterprise among the farmers.

L. Challenges :

- The one primary challenge for the studyteam during pendemic COVID-19 situation is the hampare collection of primary and secondary data.
- It was a treble experience of handling the huge data set to obtain the finding of the study
- Delayed fund release of the NATP-2 Project

M. Suggestions for Future Planning :

The following areas are to be considered for the future planning:

- Development of market structure conduct and performance of high value crops.
- Development Hybrid maize seed production technology.
- Transformation nature and extent of mango should be studied more in other parts of Bangladesh.
- Environmental and edaphic consequences of transformation determined.
- Research and extension initiatives may be needed further to expand the flower cultivation in other parts of Bangladesh.
- Safe production of mango must be ensured to attract export to foreign countries. Supportive policy and advisory supports are mandatory for this.
- Mass awareness should be created among rural farmers about the better productivity and profit of HYV rice.
- Women should also be encouraged to cultivate HYV rice instead of local varieties.
- Determined HYV rice seed price to the farmers.
- Provide government subsidy of HYV rice seeds.

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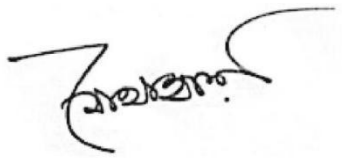
Signature of the Coordinator	**Counter signature of the Head of the organization/authorized representative**
	
(Dr. Md. Abdul Awal) ***Member Director(Fisheries)*** ***Bangladesh Agricultural Research Council*** **Date: 28.04.2022**	**(Dr. Shaikh Mohammad Bokhtiar)** ***Executive Chairman*** ***Bangladesh Agricultural Research Council*** **Date: 28.04.2022**