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Competitive Research Grant

Sub-Project Completion Report

on

INNOVATION OF FLASHFLOOD COPING RICE TECHNOLOGY FOR *HAOR* AREA THROUGH PARTICIPATORY APPROACH

Project Duration

July 2017 to September 2018

Department of Agricultural Extension Education
Sylhet Agricultural University
Sylhet-3100

Submitted to
Project Implementation Unit-BARC, NATP-2
Bangladesh Agricultural Research Council
Farmgate, Dhaka-1215

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Executive Summary

Flash flood is occurring much earlier than previous ones as the consequences of climate change and has been a serious threat to the life and livelihood of about 20 million people of seven *Haor* districts in North-east Bangladesh as it destroys the entire Boro rice crop leaving the farmers with little or nothing to harvest which was evident in 2016 and 2017. The estimated crop loss was about six lac metric tones grain of *Boro* rice in 2017. Being often victims of such frequent early flash flood hazard, farmers are trying to have safe harvest of *Boro* rice by adjusting their usual farming practices. In this regard some practices like use of shorter duration rice variety, varietal diversification, transplanting of tall rice variety in the deep *Haor*, early harvesting (at 80 % grain maturity), early transplanting, and use of aged seedling were identified primarily through FGD as the flash flood coping *Boro* rice production techniques by the *Haor* farmers. But in most cases the above techniques are being practiced singly or in combination of at best any of the two in order to secure Boro crop from flash flood. So, it has been urgent to innovate flash flood coping technology that can effectively address this severe challenge in *Haor* agricultureto ensure resilient and robust livelihood for the farmers.

In order to assess the extent of coping capacity of the primarily identified techniques in real settings, rigorous experimentations were conducted through integration of three techniques namely shorter duration variety, aged seedlings and time of transplanting in different locations of extreme flash flood prone areas. Amongst the showcased shorter duration rice varieties Binadhan14 was found most promising because of its shorter duration (130 days) with higher yield (6.3 t/ha) which was harvested on 4 April- well ahead from the border line of estimated probable flash flood occurring time. As it is reported that BRRI dhan28 has been highly susceptible to blast disease, it can be replaced by Binadhan 14 for its shorter duration. The Department of Agricultural Extension (DAE) could take necessary steps to popularize the variety. Participating farmers of field level research were found more enthusiastic and confident about the validates technology. Despite having slight longer duration, BRRI dhan 81(147 days) was found very prospectus variety for its tremendous tillering capacity (average 28 tiller/hill) and yield (7.8 t/ha); which could effectively cope flash flood of late May if early transplantation is done with the seedlings of 45 days old.

As most of the *Haor* farmers' education level and attitude have influenced and favored flashflood coping cropping techniques; research, extension and development partners should come forward to spread these techniques in order to mitigate this disaster in a sustainable manner.

CRG Sub-Project Completion Report (PCR)

A. Sub-project Description

1. **Title of the CRG sub-project:** Innovation of flashflood coping rice technology for *Haor* area through participatory approach

2. **Implementing organization:** Department of Agricultural Extension Education, Sylhet Agricultural University

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

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4. **Sub-project budget (Tk):**
   a. Total: 17,98,480/-
   b. Revised (if any): 17,98,480/-

5. **Duration of the sub-project:**
   a. Start date (based on LoA signed): 01 July, 2017
   b. End date: 30 September 2018

6. **Justification of undertaking the sub-project:**
   Being often victims of flashflood, *Haor* farmers might have efforts to innovate location specific rice production technique/practice that can substantially minimize the hazard of flash flood. Proper identification of such practices and their validation in real flash flood context would help in making production packages for flash flood affected *Haor* area.

7. **Sub-project goal:** Increased resilience of *Haor* farmers in rice production against Flashflood

8. **Sub-project objective (s):**

   i. To assess the occurrence time, frequency and duration of flash flood;

   ii. To identify flash flood coping promising rice technologies according to site-specificity; and

   iii. To select and validate the most promising flash flood coping early rice variety.

9. **Implementing location (s)**: Gowainghat upazila of Sylhet, and Biswamvorpur and Tahirpur upazilas of Sunamganj district.

10. **Methodology in brief:**

10.1 Locale of the study

At first, three most flash flood affected *Haor* Upazila namely Tahirpur and Biswamvorpur of Sunamganj district and Gowainghat of Sylhet district were selected purposively to conduct the study. Frequently flash flood affected thirteen villages of the above mentioned upazilas were selected randomly as the locale of the study. The list of the selected villages was as follows:

Table 1. Name of the selected villages, upazila under different *Haor* of Sylhet and Sunamganj districts where study was conducted.

Name of district	Name of upazila	Name of villages	Name of *Haor*
1. Sylhet	Gowainghat	Bolgram Birkooli Fultoij	Shimuler *Haor*
2. Sunamganj	Biswamvorpur	Radhanagar Aungaruli *Haor* Fatehpur Korochar *Haor* Zira Taherpur	Korochar *Haor* Aungaruli *Haor* Korochar *Haor* Korochar *Haor* Korochar *Haor*
	Tahirpur	Vati Taherpur Ujan Tahirpur Sadar Tahirpur Uttar Sri Dakkhin Sri	Shonir *Haor*

10.2 Collection of information

Through FGD, the researchers in collaboration with the UAO of the respective study upazila have collected information on flash flood related rice production issues like occurrence time, frequency and duration of flash flood and extent of crop damage along with opportunities and adaptive practices of the communities against this disaster. Suggestions to the key cause of crop damage in flash flood are analyzed and prioritized.

Figure 1. Conduction of FGD at Biswamvorpur upazila, Sunamganj district

10.3 Selection of cooperator farmers for conducting participatory trials

Farmers of study villages who were found very much enthusiastic to innovate technology against flash flood during Focus Group Discussion (FGD) and willing to conduct experiment at own field subject to fulfilling conditions (what supports are to be provided by the researchers, what not; responsibilities etc.) were selected as cooperator farmers. A total of 27 farmers (Nine farmers from each upazila) were selected as cooperator farmers for the study.

10.4 Training of the farmers

In order to ensure the farmers' active participation in the process of technology innovation 25 flash flood affected farmers among the selected villages of each upazila were provided training on the issues of participatory technology innovation along with flashflood coping modern production techniques of *Boro* rice before establishing the research trials/experiments on their fields.

Figure 2. Training program of the farmers organized at Tahirpur upazila, Sunamganj district

10.5 Technology resourcing

For conducting on-farm trials at the farmers fields against flashflood, some short duration rice varieties such as BRRI dhan 28, BRRI dhan 81, Binadhan 10, Binadhan 14 and Binadhan 18 were showcased at each study location along with others identified practices as farmers through FGD.

10.6 On-farm Evaluation of Some Selected Techniques Against Flash Flood

Among the identified flash flood coping strategies, four techniques were undertaken for evaluation against flash flood. The techniques were use of shorter duration rice varieties, aged seedlings, early transplanting and early harvesting. As short duration high yielding rice varieties are always preferred by the *Haor* farmers to avoid flash flood damage, emphasis was given on it by choosing five high yielding short duration *Boro* rice varieties namely Binadhan 10, Binadha 14, Binadhan 18, BRRI dhan 28, BRRI dhan 81 for validation trials. A total of 27 on-farm validation trials were conducted in three study upazila namely Gowainghat, Biswamvorpur and Tahirpur. All intercultural operations of the trials plots were mainly managed by the respective cooperator farmers as and when necessary; while the researchers provided them technical advices. Crop growth and yield data of the validation plots were also recorded by the respective farmers. Researchers checked the data regularly.

Figure 3. On-farm evaluation of some short duration boro rice varieties against flash flood at Shonir Haor, Tahirpur upazila of Sunamganj district

Title of experiment 1: Evaluation of identified flash flood coping *Boro* rice production practices

***Objective*:** To identify and select suitable practices of *Boro* rice production against flash flood.

Material and method:

Design:	**: RCB with six replications**
Number of variety	:BRRIdhan 28, BRRIdhan 36, Guchi, Lakhai and Bindhan 14
Production methods	: As per recommendations of BRRI and BINA
Location	: Korochar *Haor* (Biswamvorpur) Shonir *Haor* (Tahirpur) and Shialar *Haor* (Gowainghat)
Data to be recorded	:Seedling age, date of transplanting, days of flowering, incidence of disease and insect, date of maturity and harvesting
Statistical analysis	: ANOVA, mean separation using MSTAT software

10.7 Monitoring and Documentation

All stakeholders were involved in monitoring and documentation of all emerged issues. The indicators identified in the experiment were recorded in the experiment diary by farmers with the support of Upazila Agriculture Officer (UAO), Sub-Assistant Agriculture Officer (SAAO) of the respective upazila and researchers. All the project activities were kept and documented carefully in order to use them in future knowledge and technology development. The activities were monitored by the monitoring team of SAURES.

Figure 4. Monitoring of on-farm research plot installed to evaluate flash flood coping ability

10.8 Field Day*:* After each crop season, field day was organized at the site of research plots.

Figure 5. View of Field day organized at Shiala *Haor* under Gowainghat upazila of Sylhet district

10.9 Experiment Evaluation: Through plenary discussion on the basis of the qualitative and quantitative indicators facilitated by the extension personnel about the experiments were evaluated with participation of the other stakeholders and farmers.

10.10 Case Study*:* A few case study was conducted among participatory farmers on the suitability of recommended *Boro* rice production technology/practices against flash flood.

10.11 Organized Workshop*:* At the end of the project, a workshop was organized involving agricultural researchers, extension personnel and participating farmers to share the findings.

10.12 Dissemination of Innovation*:* In order to make the impacts of the experiments training module, booklet, leaflet, poster and photographs in which information is presented concisely and scientifically so that other farmers can apply the tested technology.

10.13 Statistical Analysis:

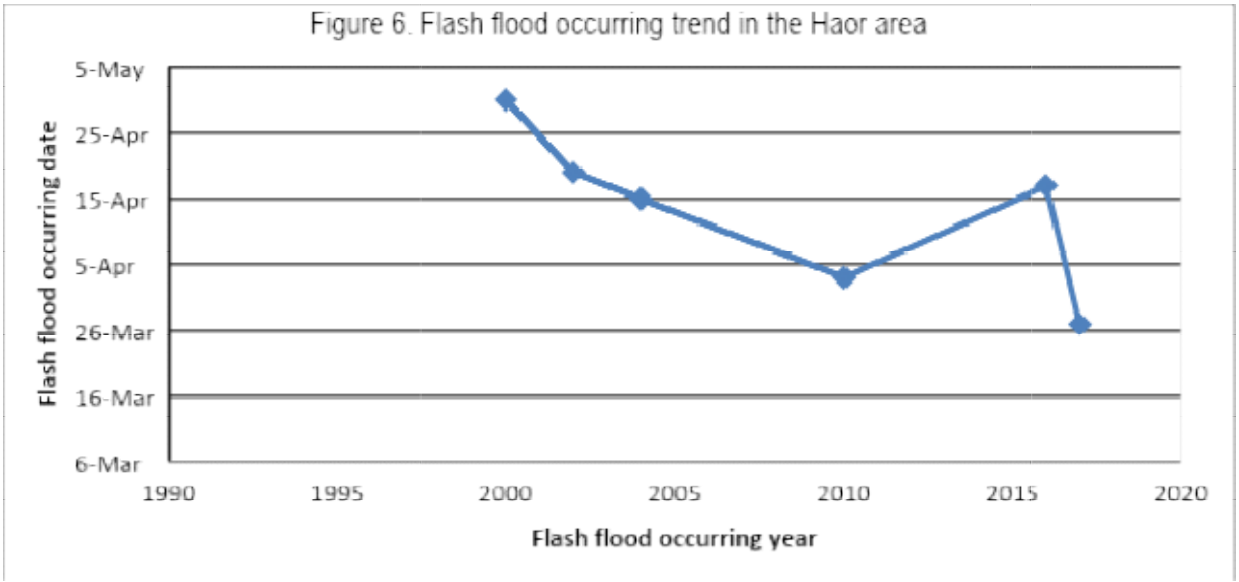
Pearson's product moment correlation coefficient (r) analysis was employed to explore the relationships between socio-economic characteristics of the farmers and their innovated practices in regard to *Boro* rice production against flash flood.

11. Results and Discussion:

Flashflood coping crop production practices are those practices/techniques on which farmers give special emphasis in cultivation of their main crop *Boro* rice in order to secure it from the damage of flashflood. Since flashflood is very frequent in the *Haor* areas - almost in every 2-3 years there is a flashflood, farmers are not only careful in selection of land suitable rice variety but also the entire production procedure such as time of transplanting, seedling age, maturity at harvest etc. in order to reap their crops before flashflood. For this, they grow short duration variety of crops. In the *Haor* area more than 90 percent of the farmers grow rice as single crop. Mustard, sesame, vegetables and some other minor crops are grown by very few farmers in the *Rabi* season.

11.1 Flashflood Occurrence

North east part of Bangladesh is highly vulnerable to flashflood. Flashfloods may occur at this region from the surrounding hilly region at least two or three times a year. *Boro* rice cultivation is severely interrupted during flash flooding. Cultivation of *Aman* rice is also hampered due to flashflood triggered by heavy rainfall in this region.



Source: BWDB

Data reveal that the risk of flash flood is increasing significantly and reduces the available days for rice cultivation is reduced on an average by 10–15 days compared to 30 years back.

In 2000 flash flood occurred on 30 April, most the farmers then already harvested their Boro rice; but in 2002 flash flood visited the Haor areas two weeks earlier on 17 April, damaged the entire paddy fields just before the harvesting. Following the same trend flash flood occurred in 2010 on 03 April. Although a little bit reverse trend was observed in 2016, flash flood again hit the area on 27 March, 2017, left nothing to harvest in most of the *Haor* areas (Figure 6).

Farmers in the FGD reported that crop loss increased with the earliness and duration of flashflood occurred in the month of April. Data presented in the Figure 1 revealed the fact that duration of flashflood in 2014 and 2015 were only for few days. Consequently crop damages of those two years were 11 and 13 percent in Gowainghat, 13 and 14 percent in Biswamvorpur and 12 and 17 percent in Tahirpur Upazila. In 2016, Flashflood first approached the region on 08 April, just after two weeks of the first flashflood, there was second flashflood that inundated the *Haor* areas up to October. It damaged rice of Tahirpur Upazila up to 100 percent in many cases. However, the average yield loss of rice was 87 percent in the surrounding areas of Shonir *Haor* under Tahirpur Upazila. The losses were 82 and 44 percent in Gowainghat and Biswamvorpur upazila, respectively. The loss was significantly less in the surrounding area of Behelir *Haor* under Biswamvorpur Upazila where there is no river passing through this *Haor*.

11.2 Crops Grown in Flash Flood Affected *Haor* Area

Most of the *Haor* areas remain water logged six to seven months in a year. So, there is hardly any scope to grow more crops in the *Haor* area except *Boro* rice in dry season. Different modern varieties of *Boro* rice such as BRRIdhan28 and BRRIdhan29 with some other popular local varieties of rice such as Lakhai, Guchi and Shail are grown. The usual seeding time in seedbed in early November for long duration variety like BRRIdhan29 and mid to end of November for short duration variety like BRRIdhan28. The seedbed preparation depends on the time of the receding of flood water in *Haor* area. If water recedes early i.e. in October, the farmers have to go for seedbed preparation in October. Obviously, they have to transplant their crop early too as their transplanting schedule is adjusted with the time of recession of water. Generally, the October seeded crop has to encounter cold shock at the reproductive phase in late February to early March and resulted in severe sterility as experienced in 2007.

Table 2. Coverage of Boro rice and other crops in the study *Haor* area

Location	Area under *Boro* rice (%)	Other crops (%)
Tahirpur	99	0.6
Biswamvorpur	68	31
Gowainghat	86	13
Average	85	15

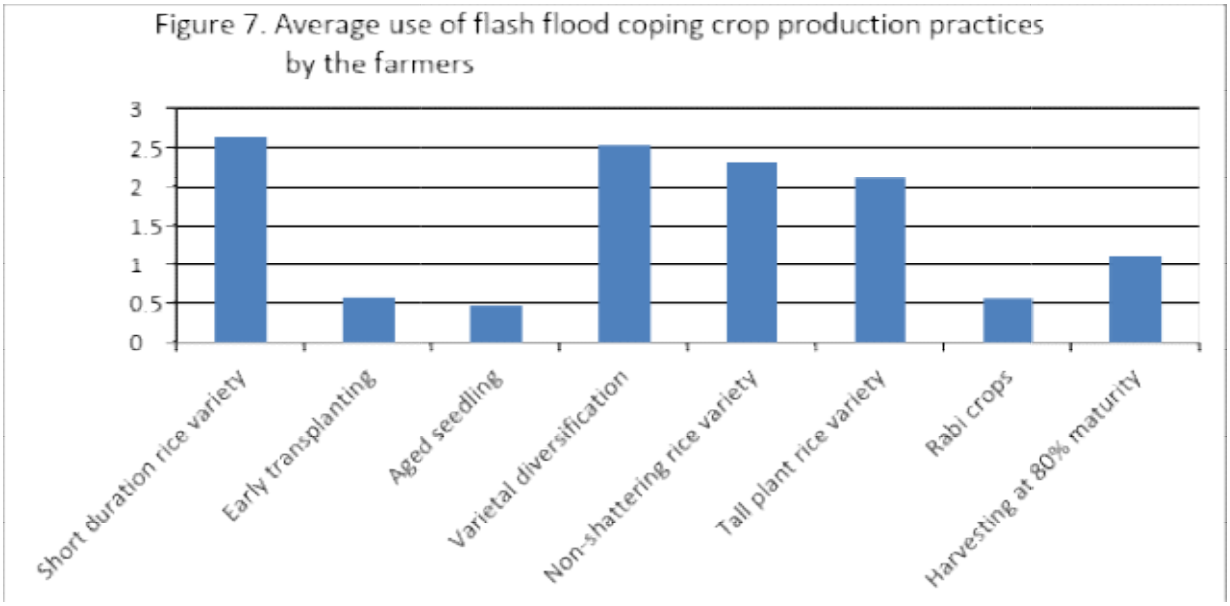
On the other hand, late established crop have the probability to encounter flash flood at the reproductive stage of the crop. So farmers have to play with the wheel of fortune for their survival in the area. However, after drying up of water from the *Haor* in the month of October, bank-side (*Kanda*) lands get available for crop production. Wheat, mustard and different types of vegetables are grown by a very few farmers.

Average area coverage of *Boro* rice in the flashflood affected *Haor* area was 85 percent while 15 percent area was allocated for *Rabi* crops. Almost all farmers of Tahirpur Upazila cultivated *Boro* rice in 99.4 percent area (106 ha) as single crop. In the face of flashflood, the risk of crop production in Tahirpur Upazila is higher among the three Upazilas as there is little or no area to allocate for other crops in the dry season. Flood control measures need to be strengthened in this Upazila to protect the only Boro rice. In case of Biswamvorpur Upazila, nearly one-thirds (31%) of cultivating land was allocated for *Rabi* crops. It indicates the availability of high lands in Biswamvorpur Upazila where cropping intensity can be increased. About 13% of lands were also allocated by the farmers of Gowainghat Upazila for *Rabi* crops.

11.3 Flashflood Coping Crop Production Practices of The Respondent Farmers

As crop damage by different floods and flash flood has been almost common phenomenon in the Haor area, farmers also have their own innovative efforts to adjust cropping time based on ecological- social- economic systems to avert this situation. With their long experience they have learned how a short duration rice variety can be harvested well ahead of flash flood. They used to grow *BRRIdhan28*, a shorter duration high yielding variety of *Boro* rice, as a technique to avoid the flash flood damage. The variety is grown in comparatively low lying *Haor* area and covered almost 29 percent of total cultivable land having the yield of 5.0 t/ha.

In the deep basin area they grow well suited tall plant type traditional rice varieties such as *Guchi, Boro* and *Lakhai* that cover almost twelve percent of *Haor* lands (Islam, 2016). Nonetheless, to avert the risk of crop failure varietal diversification has been a common practice. The other identified flashflood coping practices were harvesting of paddy at 80 percent maturity; early transplanting; use of aged seedling; and cultivation of *Rabi* crops have substantial impact in this regard although those were not used widely and in integration. Besides the above mentioned innovative cropping practices, initiatives were also taken after the devastating flash flood of 2004 to build submergible embankment as a disaster mitigation measure along with rubber dam to protect crops from flash flood (www.carebangladesh.org/publication/Publication_4718927.pdf).



Through FGDs and KIIs conducted at Tahirpur and Biswamvorpur Upazilas of Sunamganj district and Gowainghat Upazila of Sylhet district, eight techniques were identified as the measures against flashflood. These were cultivation of short duration rice variety; early transplanting; aged seedling; varietal diversification; non-shattering rice variety; tall type plant rice variety; other crop varieties in the *Rabi* season in the *Kanda*; and harvesting of rice at the 80 percent maturity. In order to determine the extent of practice of each of the eight measures at farm level, survey was also conducted in the three Upazila from July to September, 2017. Although the farmers of the *Haor* area had deep concern about the

flashflood, the measures taken by them were not integrated and concerted. It is revealed from the Figure 7 that among the eight practices, variety having short duration (average use score 2.64 out of 3.0) was frequently practiced by most of the farmers to cope flashflood in the *Haor* area. BRRI dhan28, Guchi, and Lakhai were widely used in this regard as short duration rice variety. The varietal diversification was recorded as the follower of short duration variety (score 2.53). Since the exact occurrence date of flashflood is very much uncertain, farmers transplant different varieties of rice in the different pieces of land to maximize yield and minimize the risk. For this, they transplanted both high yielding variety like BRRIdhan 29 to get maximum yield and traditional variety like Tepi and Guchi to reap the crop well ahead of flashflood. On the other hand, BRRIdhan 28 and BRRIdhan 29 get preference for comparatively upper land or bank sides of the *Haor*. Non-shattering rice variety ranked third (average use score 2.33) among eight practices. Farmers opined that although BRRIdhan 28 and BRRIdhan 29 had high yield potential with high shattering tendency than local variety that ultimate reduce the yield if there is heavy down pour and stormy wind at the harvest time. For this, famers prefer non-shattering local and traditional rice variety like Tepi, Guchi and lakhai. In the deep *Haor* area farmers had to transplant seedlings in a stagnant water of at least 30 cm height. Seedlings of all high yielding rice could not cope that height of water for its dwarf nature. In order to tackle the situation Guchi, Tepi, and Shail were transplanted in deeper *Haor* area. These are not only suitable for transplanting but also have sustaining ability in the ordinary flashflood. The next practice against flashflood was use of tall plant type rice variety (average use score 2.11). Guchi, shail, Lakhai and Tepi were widely used by the farmers in this regard. It was observed that farmers were very much aware about the maturity of rice. But due to shortage of farm labor and complex harvesting tradition existing in *Haor* area farmers could not reap their rice at 80 percent maturity. In *Haor* area, rice is harvested on share basis. Farm labors get one–eights to one-sixths of harvest as their wage in normal situation. If the situation gets worse due to floods, the contract of wage goes so up that farm owners decide to leave their crops in the fields un-harvested. Early transplanting and use of aged seedling were the least used practice. In most cases *Boro* rice is grown in *Haor* area in rain-fed condition. Naturally there is a rain at the booting stage of paddy in the month of March that ignites synchronized flowering of paddy.

So, early transplantation could not bring any benefits for the farmers. Besides this, inadequate knowledge about seedling raising of the *Haor* farmers hampered this practice that was evident by their average score (0.57). On the other hand, although the aged seedling can shorten the crop duration rice in the farm, it produced lower yield. Farmers practiced it as their last option of crop production (score 0.46) (Figure 7).

Average use score of *Rabi* crops was 0.56 in a scale of 3. To get rid of crop damaged due to flashflood, few farmers emphasized on growing of different short duration *Rabi* crops such as mustard, French bean, potato and faba beans in *Rabi* season in comparatively higher lands (*kanda*).

11.4.1 Performance of short duration *Boro* rice varieties at Gowainghat Upazila

In Gowainghat upazila four short duration high yielding varieties were showcased in nine farmers' fields who were residents of six different flash flood prone villages namely Paikraj, Noapara, Boulgram, Beerkuli, Fultaij and Shimuler *Haor* under this upazila. Seeds were sown in the seedbeds during 20 November to 26 November, 2018.

Transplantation of all demonstration plots was completed within 05 January to 12 January, 2018 which was considered as the normal time of transplanting. Among the demonstrated varieties Binadhan-14 was found most promising as the variety took only 130 days to mature and produced 6.3 t/ha yields. There was no variation between Binadhan 18 and BRRI dhan 28 in terms of their average crop duration (141 days) but the former had little bit higher yield (6.5 t/ha). On the other hand, Binadhan 10 took longer duration (143 days) compared to all demonstrated varieties and produced the lowest grain yield (5.4 t/ha) in Gowainghat upazila.

Table 3. Transplanting and harvesting date, crop duration and yield of some selected short duration *Boro* rice varieties demonstrated at Gowainghat upazila of Sylhet district

Name of variety	Transplanting date	Harvesting date	Crop duration (days)	Yield (t/ha)
Binadhan 14	05 – 09 Jan. 2018	04 – 07 April, 2018	130	6.3
Binadhan 10	08 – 12 Jan. 2018	14 – 19 April 2018	143	5.4
Binadhan 18	07 – 12 Jan. 2018	12 – 15 April 2018	141	6.5
BRRI dhan 28	05 – 08 Jan. 2018	12 – 15 April, 2018	141	6.0

11.4.2 Performance of short duration *Boro* rice varieties at Biswamvorpur Upazila

Although there were no significant variation in transplanting time of the varieties validated in Gowainghat and Biswamvorpur upazila, the yields of those varieties were little bit lower in Biswamvorpur upazila. BRRIdhan 81 produced 7.8 t/ha yield with the growth duration of 147 days. Binadhan 14 and Binadhan 18 produced same yield of 6.2 t/ha; while BRRI dhan 28 and Binadhan 10 produced 5.0t/ha and 4.9 t/ha, respectively (Table 4).

Table 4. Transplanting and harvesting date, crop duration and yield of some selected short duration *Boro* rice varieties demonstrated at Biswamvorpur upazila of Sunamganj district

Name of variety	Transplanting date	Harvesting date	Crop duration (days)	Yield (t/ha)
Binadhan 10	03 – 08 Jan. 2018	20 – 25 April, 2018	144	4.9
Binadhan 14	01 – 6 Jan. 2018	16– 20 April, 2018	132	6.2
Binadhan 18	03 – 08 Jan. 2018	20 – 28 April, 2018	140	6.2
BRRI dhan 28	03 – 08 Jan. 2018	19 – 25 April, 2018	141	5.0
BRRIdhan 81	03 – 08 Jan. 2018	19 – 27 April, 2018	147	7.8

11.4.3 Performance of short duration *Boro* rice varieties at Tahirpur Upazila

Table 5. Transplanting and harvesting date, crop duration and yield of some selected short duration *Boro* rice varieties demonstrated at Tahirpur upazila of Sunamganj district

Name of variety	Transplanting date	Harvesting date	Crop duration (days)	Yield (t/ha)
Binadhan 10	19 – 27 Jan. 2018	20 – 25 April, 2018	144	5.2
Binadhan 14	19 – 27 Jan. 2018	16– 20 April, 2018	132	5.9
Binadhan 18	19 – 27 Jan. 2018	20 – 28 April, 2018	140	5.5
BRRI dhan 28	19 – 27 Jan. 2018	19 – 25 April, 2018	141	5.8
BRRIdhan 81	19 – 27 Jan. 2018	19 – 27 April, 2018	141	7.2

In Tahirpur upazila, Boro rice was transplanted in between 19 to 27 January, because of late recession of stagnant water from the Shanir *Haor* area. Among the demonstrated varieties BRRIdhan 81 produced the highest yield of 7.2 t/ha followed by Binadhan-14 (5.9 t/ha), BRRI dhan 28 (5.8 t/ha), Binadhan 18 (5.5 t/ha) and Binadhan 10 (5.2 t/ha), respectively.

11.5 Survey of Farmers' Cultivated Rice Varieties Against Flash Flood

A total of 200 farmers of three upazila were interviewed about their flash flood coping Boro rice production practices during May to June 2018 using well-structured pre-tested interview schedule. Of which, 61 were from Tahirpur, 54 from Biswamvorpur and 85 were from Gowainghat Upazila.

11.5.1 Farmers cultivated flash flood coping traditional rice varieties in study area

In order to obtain safe harvest of paddy before commencement of flash floods, farmers transplanted short duration various rice varieties. Among them BRRIdhan28 was the highest practiced high yielding variety, the others were traditional or local varieties of rice such as Lakhai, Guchi, Shail and Tepi. The duration required to mature these varieties varied across the locations from 98 days to 153 days with the mean of 144 days. The area allocated for those local varieties was highest in Gowainghat Upazila 17.7% followed by Tahirpur upazila 15.6% and Biswamvorpur upazila 5.7% (Table 6).

Table 6. Duration and coverage of short duration rice varieties across the locations

Name of short duration rice variety	Duration (days)			Area coverage (%) of short duration rice varieties		
	Minimum	Maximum	Mean	Tahirpur	Biswamvorpur	Gowainghat
Lakhai	141	148	146	13.8	5.5	9.6
Guchi/Shail	98	143	129	1.8	0.2	-
Tepi	122	143	134	-		8.1
Total				15.6	5.7	17.7

Lakhai is a traditional popular variety of *Boro* rice. Farmers preferred this variety because of tall plant which can withstand in 3-4 feet water logged condition. It is widely perceived by the farmers that due to reddish grain color, insect and disease infestation were less on this variety. While BRRIdhan 28 was severely infested by the blast disease in *Haor* area in 2018 whereas, Lakhai was found fully free from this disease. The crop duration of this variety ranged from 141 days to 148 days with the mean of 146 days. The coverage of this variety was highest in Tahirpur 13.8% followed by Gowainghat 9.6% and Biswamvorpur 5.5% (Table 6).

Figure 8. Traditional variety *Boro* already harvested while BRRI dhan 28 and other HYV at the flowering stage, Shonir Haor, Sunamganj

On the other hand, traditional variety Guchi/Shail- a low input awn featured *Boro* rice variety which was grown fully rain-fed condition matured in a shortest period of time (129 days) compared to other rice varieties grown in *Hoar* area. But the yield of this variety was only one-third of BRRI dhan 28. However, farmers preferred this variety for its unique taste and shorter duration.

11.5.2 Transplanting time of *Boro* rice in flash flood affected study area

Based on local suitability transplantation of *Boro* rice up to 26 December was considered by the farmers as early transplanting; 27 December to 12 January as normal transplanting; and after 13 January transplantation was considered as late transplanting. It was reported by the respondents that transplantation of *Boro* rice was started from 02 January, 2018 in Gowainghat and continued up to 30 January of 2018 in Tahirpur upazila of Sunamganj district.

Table 7. Percent of *Boro* rice under normal and late transplanting across the locations

Location	Area of rice transplanted at different time of transplanting	
	Normal transplanting (27 Dec. – 12 Jan.)	**Late transplanting (13 Jan – 30 Jan)**
Gowainghat	52 % (55.2 ha)	48% (50.3 ha)
Biswamvorpur	46% (15.8 ha)	54% (18.9 ha)
Tahirpur	38% (22.1 ha)	62% (36.4 ha)

Transplantation commenced little earlier in Gowainghat upazila which is located at the higher elevation that might pave quick recession of stagnant water from the *Haors* of Gowainghat upazila. But none of the respondents could transplant *Boro* rice early in the season this year because of late recession of flood water from the *Haor* areas. However, majority (52%) of the farmers of Gowainghat upazila of Sylhet district completed transplantation with the normal range of transplanting time (27 December to 12 January) followed by 48 percent late transplantation. On the other hand, majority of the respondents of Tahirpur and Biswamvorpur upazila under Sunamganj district had late transplantation. Apart from lower elevation, there were some socio-economic factors which might push the situation in late receding of flood water that ultimately delayed the cropping season of Boro rice. In Tahirpur

Upazila only 38% of the respondents transplanted their Boro rice in normal period of transplantation, while transplantation was completed by 46% of the respondents of Biswamvorpur upazila. Luckily this year there was no hazard of flash flood, all farmers could safely harvest their crops.

11.5.3 Transplanting of aged seedlings in flash flood affected area

The recommended age of seedlings for transplantation of variety BRRIdhan 28 was 20 – 25 days and for the variety BRRIdhan 29 was 30 days. In case of local varieties it was 30 days. Although most of the farmers of the study area already aware about this information and the benefits of using young seedlings, they ignored the recommendation in transplanting BRRIdahn 28 and other local varieties Guchi and Shail; they used more than 50 day's old seedlings in *Haor* lands in order to have a earlier harvest before flash flood. Area covered by old aged seedlings of BRRI dhan 28 was highest 14 % in Biswamvorpur upazila followed by Gowainghat 12% and Tahirpur 8%. In case of Guchi/ Shail, the aged seedlings covered 5% area of traditional varieties in Biswamvorpur upazila and was followed by 4% in Tahirpur and 4% in Gowainghat upazila.

Table 8. Distribution of farmers used older seedlings of *Boro* rice

Location	Coverage of area (%) transplanted with aged seedlings	
	BRRIdhan28	Guchi/Shail
Tahirpur	8	4
Biswamvorpur	14	5
Gowainghat	12	4

11.5.4 Level of use of flash flood coping Boro rice production techniques by the farmers

Farmers were asked to give their opinion about the extent of use of the selected eight flashflood coping crop production practices at their field. In a four-point scale the responses 'frequently use', 'occasionally use', 'rarely use' and 'not at all use'. The weights assigned 3, 2, 1, and 0 for the answers 'frequently use', 'occasionally use', 'rarely use' and 'not at all use', respectively.

Table 9. Level of use of flashflood coping techniques by the percent of farmers in *Boro* rice production

Coping practices	Percent of farmers with their level of use (%)			
	Frequently	Occasionally	Rarely	Not at all
1. Short duration rice variety	79.1	10.8	5.1	5.1
2. Early transplantation	1.3	11.4	30.4	57.0
3. Aged seedlings	0.6	12.0	20.3	67.1
4. Varietal diversification	70.3	17.1	8.2	4.4
5. Non-shattering rice variety	47.5	38.6	13.3	0.6
6. Tall plant type rice variety	55.1	16.5	13.3	15.2
7. Harvesting at 80% maturity	25.9	12.7	8.9	52.5

It is revealed from the Table 9 that 79% farmers across the locations of flashflood affected area frequently used short duration rice variety as a measure against flashflood. Besides BRRI dhan 28, some traditional rice varieties like Guchi/ Shail, Tepi and Lakhai were transplanted as short duration variety. The average duration of BRRI dhan 28 was 144 days while Guchi, Lakhai and Tepi, had average duration of 112, 142, 134 days, respectively.

Varietal diversification on the other hand, ranked second among the eight practices. In order to minimize the risk of crop damage by flashflood, 70 percent of the farmers transplanted multiple rice varieties in their fields. In case of transplanting multiple rice varieties, they choose at least one high yielding rice variety either BRRIdhan28 or BRRIdhan29. BRRIdhan29 is a long duration but top ranked high yielding variety in the country. Farmers minimized the harvesting risk of BRRIdhan28 by opting one short duration variety BRRIdhan28 or any local rice variety.

All the local rice varieties grown in the *Haor* areas are tall plant type and non-shattering but their yield is lower about 2.2 t/ha. The other traits of these varieties are good taste to eat, short duration and flood tolerant to some extent, for which about 55 percent farmers transplanted those varieties in the deep *Haor* area. The high yielding varieties grown in the *Haor* area have a tendency to shattering that ultimately reduced the yield to some extent whereas the local varieties had no such tendency even if the paddy kept un-threshed for a

longer period, grains were not separated from the panicles. For this, 46 percent of the farmers preferred those varieties.

It was observed that about 67 percent of the *Haor* farmers neither transplanted rice with aged seedling nor they cultivated any crop in the *Rabi* season. Farmers opined that although the old seedlings shorten the crop duration of rice, they could not produce better yield. That is why it has been a least used practice at the *Haor* area. But there were huge lands which are termed as bank-side lands, potential for *Rabi* crops. Only little portion of this land is being used for growing *Rabi* crops in the dry season.

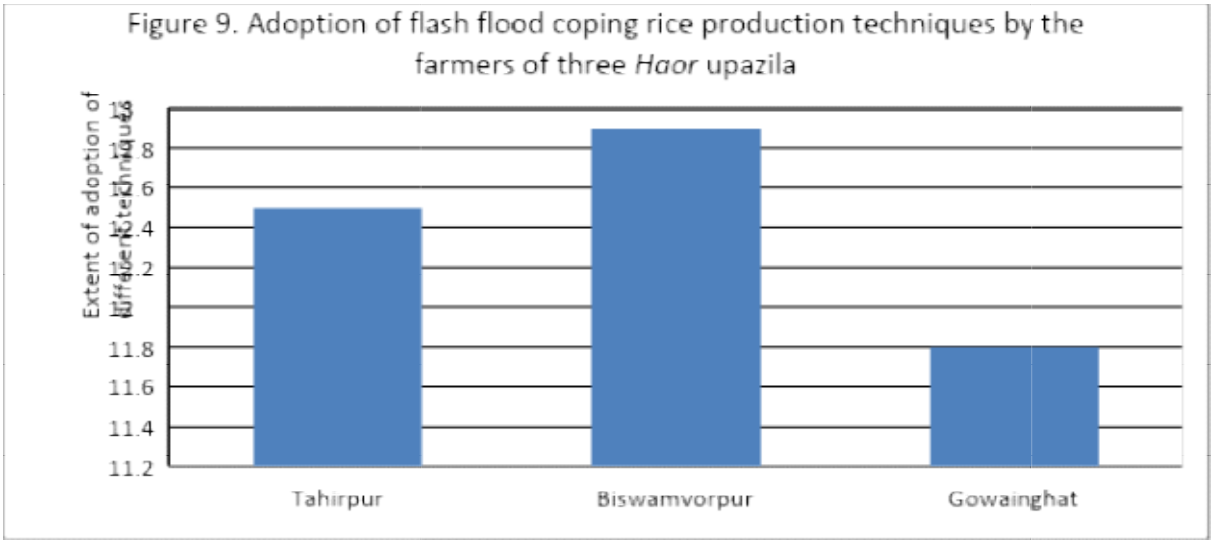
11.6 Categorization of *Haor* Farmers

The total sore of the seven flashflood coping crop production techniques of a farmer varied from 4 to 18 against the possible score 0 to 24 with the mean of 12.32 and standard deviation was 2.87. Based on mean and standard deviation farmers were categorized in to three groups: 'low practicing', 'medium practicing' and 'high practicing' (Table 10).

Table10. Distribution of farmers based on flashflood coping crop production practices across the study locations

Category of practitioner	Respondents		Mean	Standard deviation
	Number	Percent		
Low practicing (4 – 9 score)	29	14.5	12.32	2.87
Medium practicing (10 – 15 score)	144	72.0		
High practicing (16 – 18 score)	27	13.5		
Total	200	100.0		

About three-fourths (72%) of the *Haor* farmers were medium practitioners in applying flashflood coping crop production techniques followed by 14.5% low and 13.5% high practitioners. It indicates that overwhelming majority of the farmers had either low or medium level practice against flash flood. This might have impacted on crop damage by flash floods in 2016 and 2017. Only 13.5% of the respondents had high measures against flashflood, they finally at least could harvest their paddy before commencement of flash flood (Figure 9).



11.7 Socio-economic Features of The Respondents

The selected characteristics of the farmers included age, level of education, family size, farm size, annual income and attitude were taken as the independent variables for the study.

11.7.1 Age

The age of the farmers ranged from 18 to 75 years. The mean age of the farmers was 48.1 years where standard deviation was 12.6. Based on their age, the farmers were classified into three categories: 'young' (up to 35) 'middle aged' (36 to 55) and 'old' (above 55) and presented in Table 11.

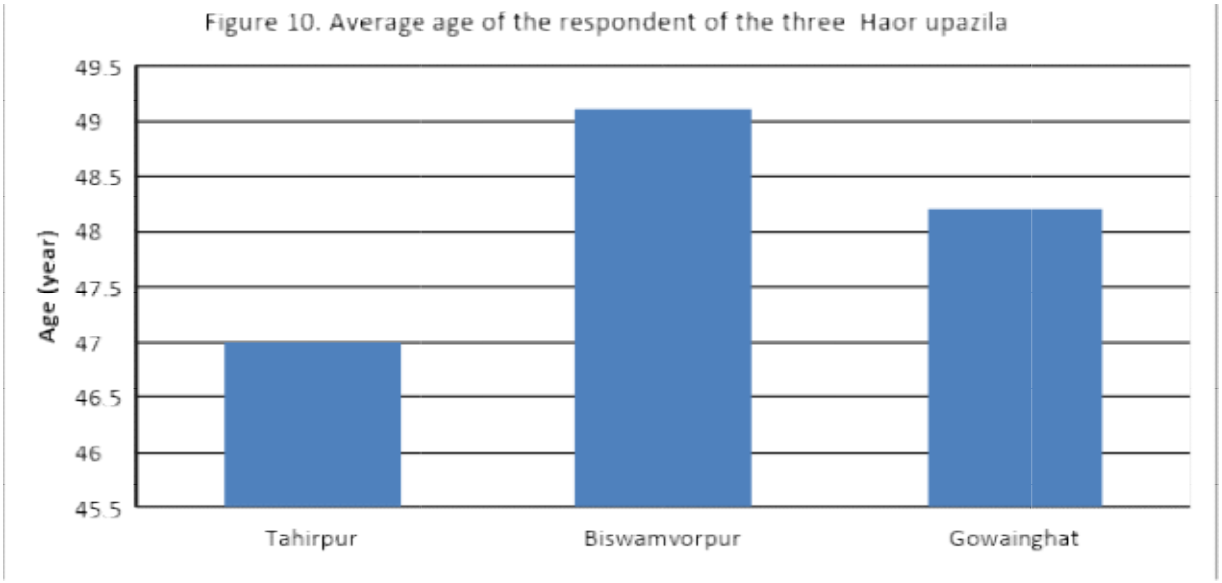
Table 11. Distribution of farmers according to their age

Category of age	**Respondents**		**Mean**	**Standard deviation**
	Number	**Percent**		
Young (18 – 35 years)	42	21.0	48.1	12.6
Middle (36 – 55 years)	76	38.0		
Old (56 – 75 years)	82	41.0		
Total	**200**	**100.0**		

The data presented in Table 11 indicate that the highest portion of the respondents (41%) were old compared to 38.0 percent of the respondents were middle aged and only 21 percent were young. This means that the highest portion (79%) of the farmers were middle aged to old aged group. It is a general assumption that the old aged people are always against change which had been reflected by their low level adoption of flash flood coping practices.

The average age of the respondents of Tahirpur, Biswamvorpur and Gowainghat upazilas were 47.0, 49.1 and 48.2 years, respectively (Figure 10). It indicates there were no significant variations among the sample respondents of these three upazila in respect to their age.

Figure 10. Average age of the respondent of the three Haor upazila



11.7.2 Level of education

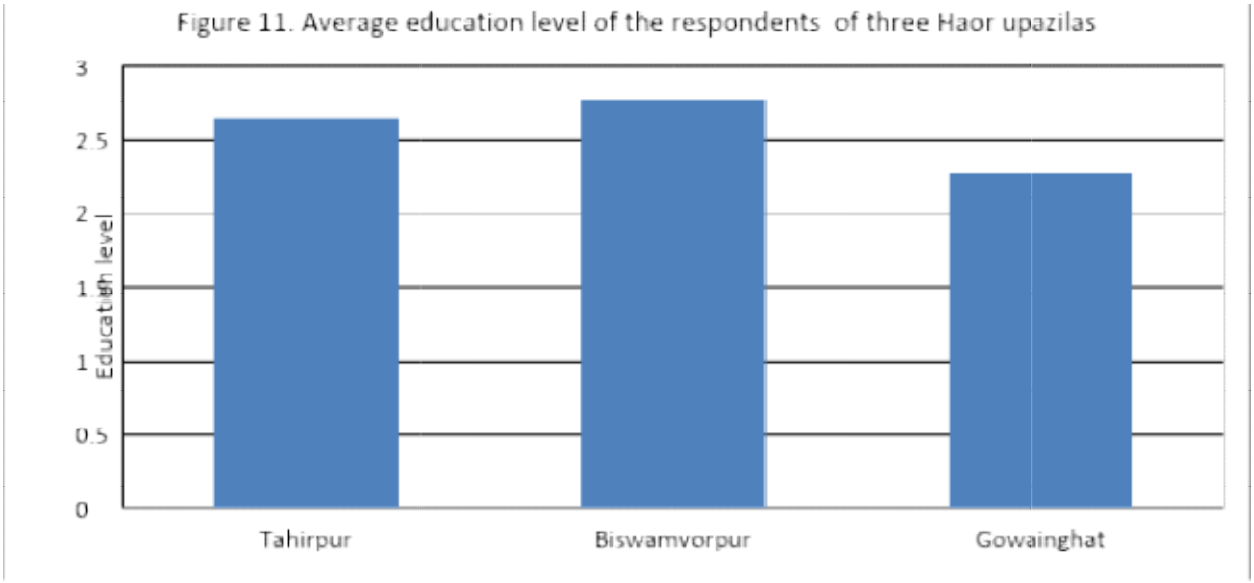
The level of education of the farmers varied from 0 to 8 years of schooling, the average being 2.53 with a standard deviation of 1.6. Based on their years of schooling, the respondents were classified into five categories: 'illiterate (0)', 'primary education (1-5)' and 'secondary education (6-8)' and shown in Table 12. Data furnished in Table 12 show that the highest proportion (87%) of the respondents had primary education followed by 7.0% secondary while the rest 6.0% were illiterate. The results indicated that a large majority (87%) of the farmers has primary education and only (7.0%) of the farmers has education up to grade 8.

Table 12. Distribution of farmers according to their level of education

Category of education level	**Respondents**		**Mean**	**Standard deviation**
	Number	**Percent**		
Illiterate (0)	13	6.5	2.53	1.60
Primary (1 – 5)	173	86.5		
Secondary (6 – 8)	14	7.0		
Total	**200**	**100.0**		

Figure 5 reveals that average education level of the respondents of Biswamvorpur Upazila was the highest (2.77) followed by the respondents of Tahipur Upazila (2.65) and Gowainghat Upazila (2.28), respectively (Figure 11). The higher level of education of the respondents have higher ability to cope and adverse situation that was evident by average flashflood coping score 12.9 (Figure 11) of the respondents of Biswamvorpur upazila .

Figure 11. Average education level of the respondents of three Haor upazilas



11.7.3 Family size

The family size of the farmers ranged from 1 to 14. The average score was 5.84 with the standard deviation 1.94. On the basis of their family size, farmers were classified into three categories as shown in Table 13.

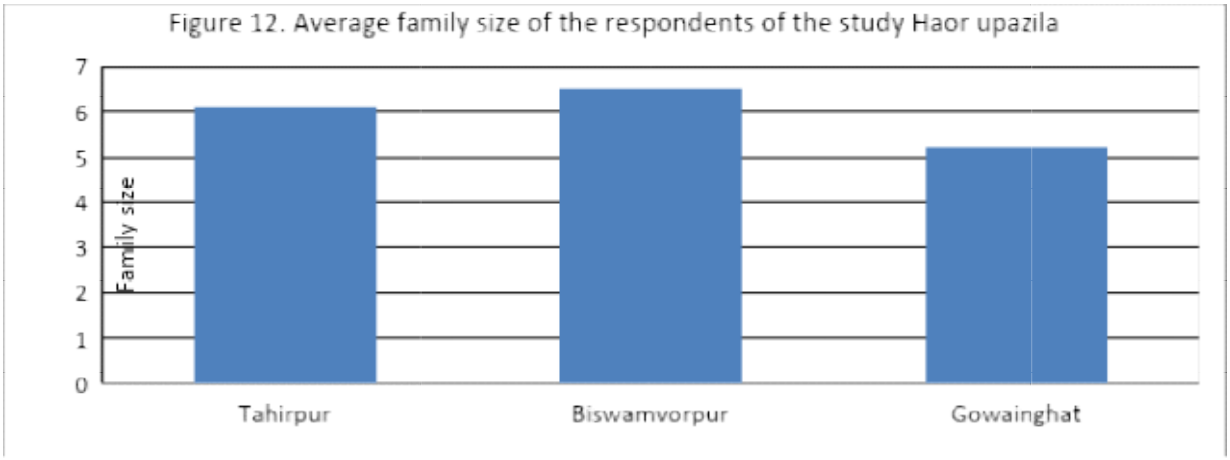
Table 13. Distribution of farmers according to their family size

Category of family	**Respondents**		**Mean**	**Standard deviation**
	Number	**Percent**		
Small family (1 – 4)	37	18.5	5.84	1.94
Medium family (5 – 7)	125	62.5		
Large family (8 – 14)	38	19.0		
Total	200	100.0		

Data presented in Table 13 reveal that the highest proportion (63%) of the farmers fell under the medium category compared to 19 percent large and 18 percent small category, respectively.

These findings indicate that more than 82 percent of the respondents had either medium or large family size. The data also indicate that the average family size (5.8%) of the respondents in the study area was higher than the national average of 4.9 (BBS, 2003). This may be due to the lack of proper adoption of family planning measures and knowledge about family planning among the respondents or the prevalence of joint family planning. Another reason was that the national average of 5.4 persons per family was concerned with rural and urban families, but the present study is concerned with the rural families only. Figure 6 also reveals that the average family size was the highest (6.53) in Biswamvorpur followed by Tahirpur (6.08) and Gowainghat (5.22), respectively (Figure 12).

Figure 12. Average family size of the respondents of the study Haor upazila



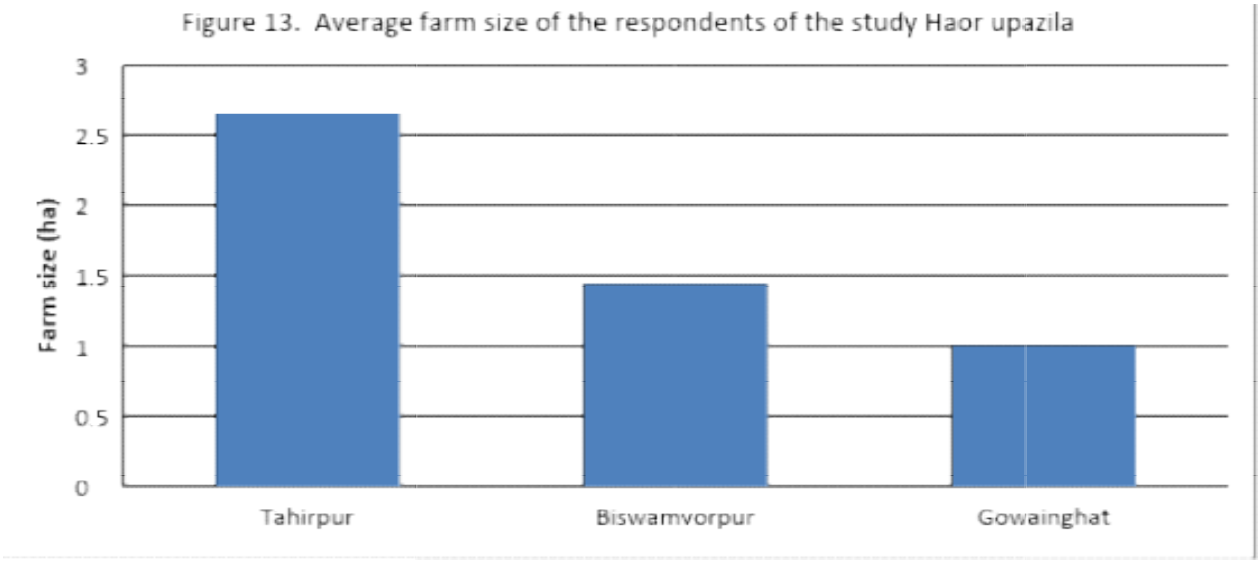
11.7.4 Farm size

The farm size of the farmers in the study area ranged from 0.24 to 14.75 hectares (ha). The average farm size was 1.62 ha with the standard deviation 1.94. Based on their farm size, the farmers were classified into four categories as shown in Table 14.

Data presented in the Table 14 show that the 40 percent respondents had medium farm, 27 percent small farm and 22 percent marginal farm and only 11 percent had large farm. Data also revealed that majority (51%) of the farmers of the study area had medium to large farms. Thus, most of the farmers were in possession of medium and large farms.

Table 14. Distribution of farmers according to their farm size

Category of farm size	Respondents		Mean	Standard deviation
	Number	Percent		
Marginal (0.24 – 0.60 ha)	35	22.2	1.62	1.94
Small (0.61 – 1.00 ha)	42	26.6		
Medium (1.01 – 3.00 ha)	63	39.9		
Large (3.01 – 14.75)	18	11.4		
Total	158	100.0		



The average farm size of the farmers of the Tahirpur, Biswamvorpur and Gowainghat upazilas were 2.65, 1.44 and 1.01 ha, respectively (Figure 13).

11.7.5 Annual family income

Annual income of the farmers ranged from Tk. 45000 to 960000 with the mean of Tk. 192950 thousand and standard deviation of 161600. On the basis of the annual income the farmers were classified into three categories as shown in Table 15.

Table 15. Distribution of the farmers according to their annual family income

Categories	Farmers		Mean	SD
	Number	Percent		
Low(up to 70,000 Tk)	172	86.0	38.59	32.32
Medium(70,001-130,000 Tk)	23	11.5		
High(above 130,000 Tk)	5	2.5		
Total	200	100.0		

Data presented in Table 15 indicate that the highest proportion (86.0%) of the respondents had low annual income compared to 2.6 percent high income and 11.4 percent had medium income. Thus, the overwhelming majority (97%) of the respondents had low to medium annual family income. The average income of the farmers of the study area is much lower than the average per capita income of the country i.e. 1466 US dollar (The Daily Star, 2016).

13.8 Farmers Factors Associated with Flash Flood Coping Boro Rice Production Practices

The results of different statistical methods explaining the factors influencing flashflood coping crop production of the farmers are discussed below.

11.8.1 Pearson's product moment correlation coefficient (r) analysis

Table 16 shows that the positive significant correlation of formal education of the respondents with flashflood coping crop production techniques ($r = 0.720^{**}$, $p > 0.05$) clearly points out that with the increase of the level of formal education of the *Haor* farmers the flash flood coping capabilities will be increased. Sarwar (2008) found that formal education helps a lot in the adaptation of farming practices in response to climate change.

Table16. Correlation coefficient 'r' of farmers socio-economic factors and their flash flood coping crop production techniques in *Haor* area

Variables	**Correlation co-efficient (r)**
Age	0.032
Level of education	0.720**
Family size	0.342**
Farm size	0.092
Annual family income	0.081

** = Significant at 1 percent (0.01) level with 156 degree of freedom

The positive significant correlation of family size of the respondents with flashflood coping crop production techniques (r = 0.342**, $p > 0.05$) reveals large family of *Haor* farmers have increased workforce for timely completion of farming activities that ultimately enhanced coping abilities.

Thus, the correlation analysis in Table 16 indicates some important intrinsic implications of the study. Level of education of the respondents and family size *Haor* farmers play an important role to increase flash flood coping crop production practices in the *Haor* areas.

12 Research highlight/findings:

- Farming of early maturing of short-duration paddy like Binadhan 14 (130 days) could save the crop from the risk of early flood in vast *Haor* region.
- Early transplantation (Before 05 January) could minimize the risk of flash flood if it occurs after 3rd week of April.
- Transplanting of aged seedlings (above 40 days) can shorten crop duration which can play important role in securing crops from flash flood.
- As level of education had significant association with the capability in tailoring flash flood coping overall techniques, training in this regard would have positive impact in minimizing crop damage by flash flood.

- More participatory research need to be conducted to evaluate the intended technology by the intended users. It will enhance level of confidence and know-how of the farmers about the technology.
- BRRI dhan 81 can be adopted in *Haor* areas for its profuse tillering capability (average 28 tiller/hill), moderate duration (147 days) and higher yield (7.5 t/ha) subject to early transplantation.
- Alternative of BRRIdhan 28 need to be explored due its severe susceptibility to blast disease.

B. Implementation Position

1. Procurement:

Description of equipment and capital items	PP Target		Achievement		Remarks
	Phy (#)	Fin (Tk)	Phy (#)	Fin (Tk)	
(a) Office equipment	01 file cabinet	*15000*	01 file cabinet	*15000*	Done
(b) Lab &field equipment					
(c) Other capital items					

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:

Description	Number of participant			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training on flash flood coping rice production practices	87		87	3	Done
(b) Workshop: Flash flood coping modern techniques for production of Boro rice in the Haor areas	39		39	1	done

C. Financial and physical progress

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
A. Contractual staff salary	332943	310943	310943	0	93.39%	Unavailability of fund
B. Field research/lab expenses and supplies	665508	645008	637810	7198	95.79%	
C. Operating expenses	220075	220075	220075	0	100%	
D. Vehicle hire and fuel, oil & maintenance	168656	168656	168656	0	100%	
E. Training/workshop/seminar etc.	296261	296261	296261	0	100%	
F. Publications and printing	62500	15288	15288	0	77%	Unavailability of fund
G. Miscellaneous	37537	37537	37537	0	100%	
H. Capital expenses	15000	15000	15000	0	100%	

D. Achievement of Sub-project by objectives: (Tangible form)

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)
i. To assess the occurrence time, frequency and duration of flash flood	Flash flood related data were reviewed	Trend showed 1st week of April is the occurring time of flash flood in *Hoar* area	Earlier crop can avoid the damage due to the occurrence of flash flood in *Haor* area
ii. To identify flash flood coping promising rice technologies according to site-specificity	Focus Group Discussion (FGD) & Key Informant Interview (KII) were conducted at the study areas.	A total of seven rice production practices of the farmers were identified as flash flood coping techniques	Identified techniques substantially minimize crop loss due to flash flood
ii. To select and validate the most promising flash flood coping early rice variety.	1. A total of 27 on-farm validation trials were conducted with cooperation of the farmers. 2. Training provided to the co-operator farmers. 3. Better suited promising practices of Boro rice production against flash flood were assessed in three locations.	1. Evaluated performance of short duration rice varieties against early flash flood. 1.1 Binadhan14 was assessed as flash flood avoiding variety (harvested on 4 April; well ahead of predicted early flash flood). 1.2 Identified the shortest duration variety (Binadhan14; needed only 130 days to mature). 1.3 Ascertained best suited alternative of BRRI dhan 28 (Binadhan14; produced 6.2 t/ha yield and free from blast disease) in *Haor* condition. 1.4 Figured out BRRI dhan 81 as most prospectus rice variety for Haor area (28 tillers/hill, and yield 7.8 t/ha). 2. Enhanced knowledge and skill of the cooperator farmers to minimize crop damage by flash flood. 3. Enhanced confidence of cooperator farmers about their selected varieties (Binadhan14 and BRRI dhan 81). 4. Empirical observation of research	1. BRRI dhan 28 in *Haor* area can be replaced by Binadhan-14 if the other traits of this variety are well accepted by the farmers. 2. Participatory research farmers were encouraged to cooperate which ultimately strengthened the community to solve problem by themselves. 3. Strengthened fusion capacity of farmers in integrating local as well as technical knowledge 4. Participating farmers have

	4. Organized field days at the on-farm trial plots. 5. Organization of work shop	results by group of farmers. 5. Research findings communicated to cooperator farmers, extension experts and researchers.	enhanced enthusiasm to accept research results. 5. Further research and extension on flash flood coping rice production has been strengthened.

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

Publication	Number of publication		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/ booklet/leaflet/flyer etc.		**Booklet**	কৃষকের অংশগ্রহণে উদ্ভাবিত হাওরে বন্যা মোকাবেলা সক্ষম বোরোধান উৎপাদন প্রযুক্তি
Journal publication	Under preparation		Title: Factors influencing adoption of rice improved production practices by the Haor farmers
Information development			
Other publications, if any		**Thesis:**	Title: Innovativeness of the Haor farmers regarding crop production practices

F. Technology/Knowledge generation/Policy Support (as applied):

i. Generation of technology (Commodity & Non-commodity)

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

iii. Technology transferred that help increased agricultural productivity and farmers' income

iv. Policy Support

G. Information regarding Desk and Field Monitoring

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

One year research is not enough for making any recommendation. Although Binadhan14 was assessed as most promising rice variety in the face of flash flood threat in Haor area. For more authentications, further research need to be carried out suggested by the participating researchers and extension experts at the result dissemination workshop organized at BINA sub-station, Sunamganj.

ii) Field Monitoring (time& No. of visit, Team visit and output):

NATP project monitoring team monitored the research activities on 5 April, 2018. All activities were on the right track commented by the team.

I. Lesson Learned/Challenges (if any)

i) Supervision of on-farm trials of 27 plots located at three different upazilas was bit challenging for the researchers.
ii) Demonstration of identified package might speed up adoption of intended technology.
iii) Early farming of rice mostly depends on early recession of stagnant water. In many cases, interest of some vested quarters play role in late recession that ultimately delayed cropping season.
iv) its shattering tendency was also observed.

J. Challenges (if any): Not applicable

Signature of the Principal Investigator
Date …….

Seal

Counter signature of the Head of the organization/authorized representative
Date …….
Seal

APPENDICES:

A successful farmers who could harvest paddy on 4 April, 2018

Training program organized at Gowainghat of Sylhet district

Field day organized at Shimuler Haor, Gowainghat

Field view of BRRI dhan 81at Aungaralir Haor

Field view of Binadhan-14

Workshop organized at BINA sub-station, Sunamganj