INTERNATIONAL JOURNAL OF ENVIRONMENT
Volume-4, Issue-4, Sep-Nov 2015 ISSN 2091-2854
Received:29 August *Revised:8 September* *Accepted:12 November*

SUBMERGENCE RICE CULTIVATION IN SOUTHERN BANGLADESH: FARMERS OPINION AND ADAPTATIONS PRACTICES

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Abstract
Rice productivity in coastal Bangladesh is lower than the national average and total coastal area is considered to be submergence-prone and higher vulnerable in July to January cropping season. The selected study areas are Kalapara and Patuakhali Sadar Upazila that are too vulnerable to agriculture practices. Field survey was conducted during 01st June to 30th July, 2015 to investigate the impact of submergence on Aman rice cultivation (ARC), existing adopted local adaptation practices with impacts and options to address the submergence problem. Primary data was collected through Focus Group Discussion (FGD), Individual Interview and Key Informant Interview methods and secondary data was collected from different secondary sources. A well-structured pretested questionnaire schedule was developed keeping in mind the objectives and variables under this study. After cyclone SIDR and AILA devastation, the rate of traditional ARC is decreasing every year and in 2015 it was 26.51%. Recently farmers have adopted new cropping practices and strategies like modern ARC in Aman season as single crop; Boro-Aus-Aman season as triple crop and Aus-Aman season as double crop are practicing. Approximately all farmers have adopted to grow stress tolerant rice varieties (STRV); farmer's curiosities to familiar with and to have the STRV are encouraging. Farmers were fully adopted BRRIdhan52 rice cultivation with positive perceptions of higher yield and lower production cost. Therefore it can be concluded that the intensity of adoption of adaptation and mitigation measures are significantly influenced positively by the STRV yield capability; farmer's participation in intervention programs; livelihood diversification; frequency of extension personnel contact; submergence and inundation characteristics; tolerance attributes of STRV and availability of STRV cultivation information.
Keywords: Adaptation, farmers, mitigation, rice, tolerant and submergence.

Introduction

By the year 2030, estimates based on global climate models, suggest that annual mean temperature in Bangladesh will increase by 1°C, accompanied by a 5% increase in annual precipitation and a 14 cm in Sea Level Rise (SLR). These climatic changes will likely affect more than 70 million people because of Bangladesh's geographic location, low elevation, high population density, poor infrastructure, high levels of poverty, absence of technological provisions and high dependency on natural resources (MoEF, 2009).The landscape of the present study area is too fragile as the area is under storm surge due to tropical cyclone, SLR, tidal excursion and back water effect. Therefore, exploring the best adaptation practices is time demanded with the prevention and mitigation of water logging in the region (Awal, 2014). But the way of water logging prevention and mitigations to date have received little attention. The problem is very much location specific. In the present research production STRV in the coastal area due to concerns of SLRs in the study areas was focused. Because about 22% of Bangladesh's rice producing area is in the coastal region, which produces 18% of national rice output (BBS, 2009-10). This productivity in coastal Bangladesh is lower than the national average, partially because of the limited use of modern varieties of seed, modern cultivation technology, good agronomic practices etc. More than half of the total rice area is considered to be submergence-prone during the kharif (July-January) season. The proportion of submergence-prone area is higher (55%) in Bangladesh than in India (17%) and Nepal (9%). The scenario of the study areas make it too vulnerable to agriculture practices due to the regular submergence, tidal excursion, back water effect, water logging and storm surge etc. To mitigate yield and crop losses due to submergence, the International Rice Research Institute (IRRI) and Bangladesh Rice Research Institute (BRRI) recently released two STRVs -BRRIdhan51 and BRRIdhan52 can survive full submergence up to 15 days (BRRI, 2014).Therefore, as the time demand and for the exploration of the best rice cultivation adaptation practices with the prevention and mitigation of water logging in this region, present research activities were conducted to achieve the following objectives-

a. To study the impact of SLR on submergence Aman rice cultivation
b. To identify the local adaptation practices to SLR and their impacts on rice cultivation
c. To explore the options to address the challenges to adaptation in agriculture sector

Materials and methods

Selection of the study area

The study was conducted in three upazilla's (small administrative unit)- Kalapara and Patuakhali Sadar Upazila under Patuakhali District and Amtoli Upazila under the district of Barguna (Figure 1). These upazila's are crisscrossed by many rivers and sub-rivers and cannels linked with Bay of Bengal and local communities face submergence, water logging, back water effect and salinity intrusion due to heavy monsoon rains, high tides and cyclonic storm surges. That's why these areas were selected for this study.

Description of the study area

Patuakhali Sadar Upazila occupies an area of 362.46 sq.km. It lies between 22º14´ and 22º29´ north latitudes and between 90º12´ and 90º28´ east longitudes. Total number of population is 3,16,462, population density is 873/sq. km and total number of household is 68,813. Annual average temperature and rainfall are maximum 33.3°C, minimum 12.1°C and

rainfall 2506 mm. Rivers are Andharmanik, Agunmukha, Payra, Lohalia, Patuakhali and Tentulia. Main crops are paddy, jute, mug, mustard, watermelon, vegetables etc. Literacy rate is 53.3%. Main sources of income are agriculture 45.44%, agricultural land owner is 70.99% and landless 29.01%. The region having been close to the sea frequently and falls victim to cyclone and tidal bore. Main disasters are cyclone, flood, flash flood, river bank erosion, saline water intrusion etc **(**BBS, 2015).

Kalapara Upazila occupies an area of 491.89 sq. km. It is located between 21º48´ and 22º05´ north latitudes and between 90º05´ and 90º20´ east longitudes. The total population is 2,37,831. Literacy rate is 52.0%. Main sources of income are agriculture 57.23%. Households owning agriculture land are 57.23%. The remaining 42.77% are either landless or lands not used for agriculture. Major disasters are cyclone, flood, flash flood, river bank erosion, saline water intrusion etc **(**BBS, 2015).

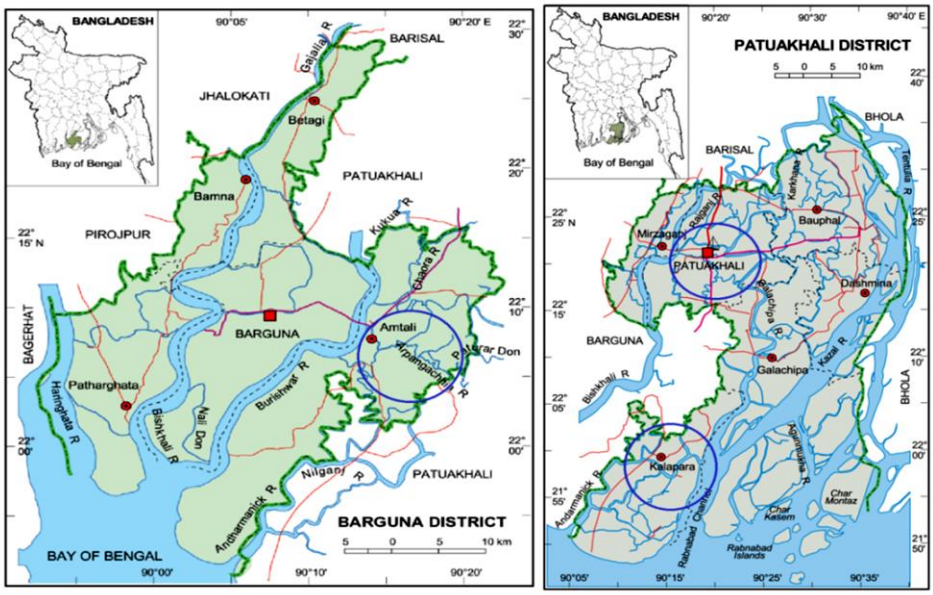

Figure 1. Map of Patuakhali Sadar and Kalapara Upazila of Patuakhali and Amtoli Upazila of Barguna district (blue circled) (Maps of Bangladesh, 2015)

Amtoli Upazila occupies an area of 720.75 sq.km of which 51.64 sq.km is under forest. It is located between 21º51' and 22º18' north latitudes and between 90º00' and 90º23' east longitudes. Total number of population is 2,70,802, population density is 376/sq. km and total number of household is 63,212. Annual average temperature is maximum 33.3°C, minimum 12.1°C and rainfall is 2506 mm. Main rivers are Payra, Bishkhali and Baleshwar. Main sources of income are agriculture 70.46. Main crops are paddy, mug, gram, mustard, pumpkin etc. Major disasters are tidal bore, cyclone, flood, river bank erosion, saline water intrusion etc (BBS, 2015).

Determination of sample size

A total of 06 Focus group Discussion (FGD), 02 FGD (30-35 farmers) from each upazila was done and 105 (one hundred five) households' individual farmers (35 farmers from each upazila) were randomly selected from three study areas.

Research design

Combinations of quantitative and qualitative research methods were used. A qualitative research is in-depth analysis of the problem, directed towards discovering new insights, meanings in order to understand the 'what' and 'why' of human behavior (Cresswell, 1994). Exploratory research is the exploration of unknown research area in order to gain new insight into the phenomenon being studied (Brink and Wood, 1998). Therefore adopted an exploratory approach through employing participant observations through physical visit, in-depth semi-structured open ended questionnaire for individual interviews and FGD to explore the development of farmer's perception on submergence rice cultivation in the context of submergence, water logging, inundation etc and existing vulnerability in agriculture sector. Quantitative method - questionnaires, surveys and structured observation was used to address questions that were primarily formulated based on the objectives of the study.

Methods of data collection

The data was collected carefully to ensure that the people who participated volunteered and were not forced to be interviewed. The methods of data collection included completion of the FGD, semi-structured individual interviews (questionnaire survey) with the community members, direct field observation and Key Informant Interviews (KII). Additional information as secondary data was pertaining to the study was attained by accessing the relevant information from media such as journal articles, research thesis, recorded data, data from different local government administrative offices-Union and Upazila Parishad. KII was done with various organizations personnel, local leaders and elites working with this issue. During data collection the following questions were focused to get the information—i) types of problem raised due to submergence condition; ii) farmer's activities to solve the problem; iii) change and trend in the present rice cultivation as compared with the past and iv) best practices adopted according to the farmers opinions about the submergence rice variety.

Data processing method, statistical tools and techniques

After the completion of data collection, tabulation work including editing, coding and tabulation manually. In order to process and analyze the data, simple mathematical tools like average, percentage and tables, graphs were used to present the research findings in a meaningful ways.

Limitations of the study

Data were mostly collected by recall method. To have more accurate data farmers were interviewed two times in each subject/question. Sometimes farmers felt bore in answering the questions.

Results and discussion

Farmer's rice cultivation experience and submergence

Under this section it was consider the cropping season and farmer's past experience in ARC. Ismail et al. (2010) reported that more than one million hectare of rice fields in the coastal areas of Bangladesh suffer from prolonged partial flooding during the wet season. Haque and Jahan (2013) commented that the widely grown Aman variety of rice faced an average of 09 days of submergence in 2010 in the Barisal division.

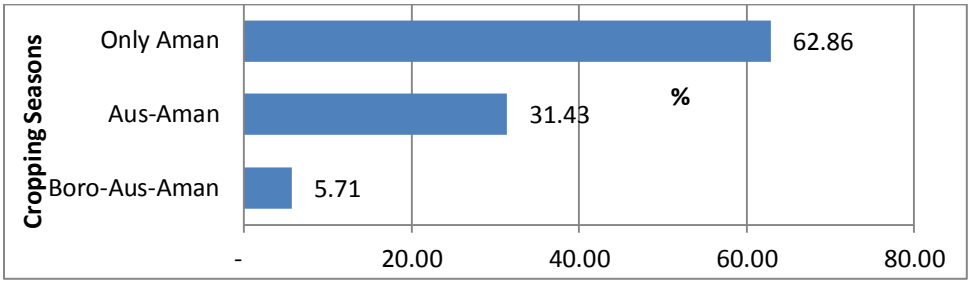

Figure 2. Rice growing seasons and % of farmer's cultivation practices in coastal area

Result showed that inundation and submergence in Patuakhali Sadar, Kalapara and Amtoli are common phenomenon during ARC season. In the study area there are three rice cropping seasons- Aman: July to January season, Aus: April to August and Boro: December to May are found. Aman rice is grown during the monsoons from July to January (Kharif II), irrigated Boro rice is grown from December to May (Robi), and Aus is grown from April to August (Kharif I). BBS, (2005) also revealed same result. Regular inundations and submergence in these research areas make these seasons vulnerable throughout the year. Research also found that in the study area 63% farmers grow modern Aman rice in only Aman Season, 6% Boro-Aus-Aman season and 31% Aus-Aman season (Figure 2). Study also revealed that the farmers have changed their cropping practices after devastating SIDR and AILA. The low-lying deltaic geo-hydrology made vulnerable to SLR would make rice production very vulnerable to climate change in future.

According to rice cropping practices by local farmers, study found that before five years ago 85.72% farmers were growing local Aman, in 2015 it is only 63% and 14.28% BR11rice variety in Aman season (Table 1). It means local Aman harvest area has decreased by 26.51% in 2015 year. BBS (2013-14) also commented that recently local T. Aman crop area has decreased by 15.95% and HYV crop area has increased by 0.67% in 2013-14 year.

Table 1. Cultivation of Aman rice variety in the past five years at the study areas

Aman Rice Variety	**%**
BR11	14.28
Local	85.72
-	-

Table 2. Inundation hampered for rice cultivation

Inundation hampered	%
Low	0
Medium	17.14
High	82.86

Barriers of Aman Rice Cultivation (ARC)

As the Barriers of ARC-stress of inundation and submergence study showed that 17.14% farmers were faced medium and 82.86% faced high inundation (Table 2). Haque and Jahan (2013) found that during 2010 around 37% plots were highly inundated, 57 % medium and 26% low inundated. Availability of suitable STRV during submergence condition was studied. Result showed that 27.62% farmers were faced medium and 72.38% high lack of suitable STRV (Figure 3). It is due to the lack of timely assistance from GO, NGOs working in the study area, farmer's lack of knowledge about STRV. Biswas and Biswas (2014) also commented that all farmers were faced lacking in STRV in submergence condition.

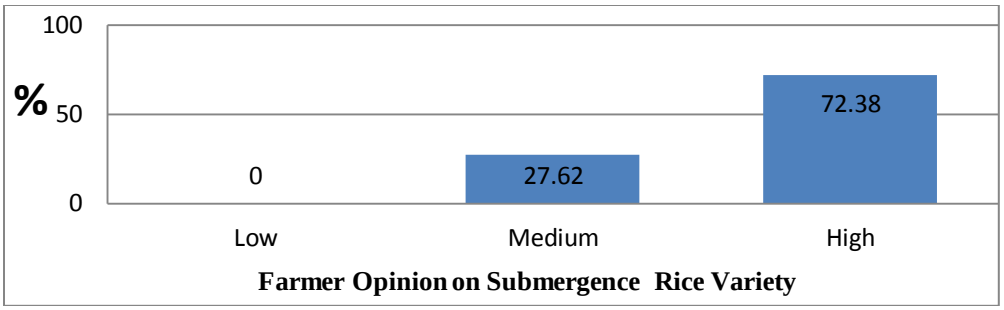

Figure 3. Lack of submergence tolerance variety in coastal area

Non-availability of good quality seed in the study area was studied and found that maximum farmers (73.33%) were high lack of quality seed (Figure 4). There were no pure quality seed or seedling sources or trusted pure quality seed suppliers were found in the study areas. Rahman (2012) in his research commented lacking of good quality seeds during submergence condition as the major challenges.

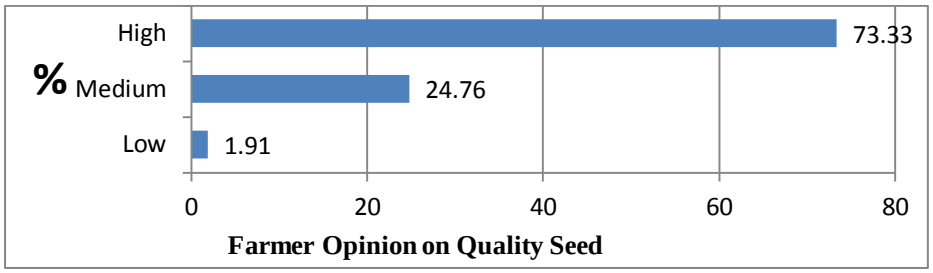

Figure 4. Lack of Quality Seed in coastal region

Lack of knowledge on modern rice cultivation was investigated and found that 35.24% farmers have higher (Figure 5); 32.38% have lower or medium lack of knowledge. This result might be due to lack of different interventional activities organized by GO and NGOs -was the routine scenario in the study areas commented by farmers.

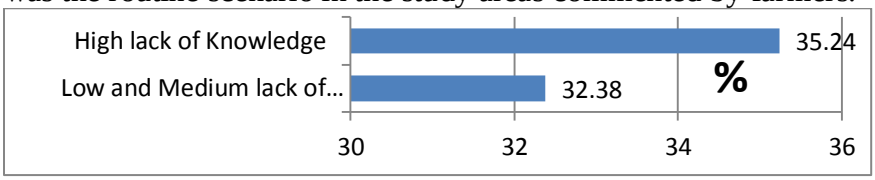

Figure 5. Lack of knowledge on modern rice cultivation

Barrier of financial crisis was studied and (Table 3) shows that 34.29% farmers faced high financial crisis, 40.95% medium and 24.76% low. Due to financial constraints they cannot buy timely suitable seed, fertilizers etc. These results reinforced by earlier studies by Wassmann and Dobermann (2007) and Razzaque and Rafiquzzaman (2007) and they reported that the inherent problems in the agricultural sector are lack of finances, poor irrigation infrastructure; high cost of fertilizer, quality seed, lack of credit, insect and disease problem etc.

Table 3. Financial crisis on rice cultivation

Financial Crisis	Frequency	%
Low	26	24.76
Medium	43	40.95
High	36	34.29

Table 4. Time and duration of inundation take place

Inundation Time / season	Frequency	Duration (average)	%
One Time	80	5.57 Day	76.2
Two Time	25	5.92 Day	23.8
-	--	-	-

Time and Duration of Inundation

Investigations of the time and duration of inundation found maximum 06 days in the farmer's field and occurrence in a season was one time-76.2%farmers and two times-23.8% farmers (Table 4). This result reinforced by an earlier study by Haque and Jahan (2013), who have reported that the coastal Barisal division almost 50% of fields faced an average of 3-7 days long inundation in 2010, while around 37% plots were submerged for more than one week.

Previous Experience on yield or damage of Aman rice cultivation due to disaster

On the basis of farmer's statement and previous experience on ARC investigation revealed that 60% farmer's crop was partially damaged, 28.8% was poor yield and 4.8% got their investment return and 0.95% farmer found completely damaged of their crop. However, 5.7% farmers got no profit (Figure 6). Paul and Rashid (1993) from their research revealed that in the riverine flood situation, on average, 4% of total rice production was damaged and lost.

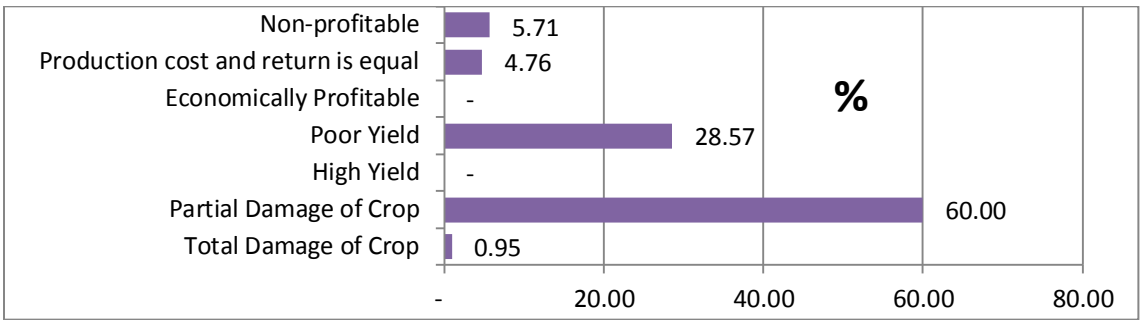

Figure 6. Farmer's previous yield experience on Aman rice cultivation

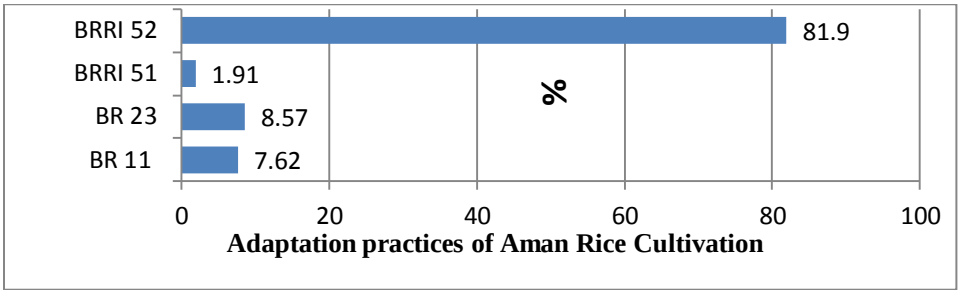

Figure 7. Adaptation of Aman rice variety to mitigate the effect of submergence

Adoption practices to mitigate the effect of submergence

Study showed that farmers in the study areas adopted new strategies to cope with submergence. In most cases (Figure 7), 81.9% farmers are growing BRRIdhan52 Submergence Tolerance Rice Variety (STRV); 8.57% and 7.62% are cultivated BR23 and BR11 rice as their old tradition.

Investigation on source and method of acquaint and collection of Submergence Tolerance Rice Variety (STRV) for farmer's showed that generally all the farmers have interest to familiar with and to have the STRV and they got information from government (2.86%); lion parts of information from NGO (27.62%) and neighbors (69.52%) (Table 5). From Table 6 it is clear that most of farmers (69.52%) became acquainted the STRV from neighbors; during participating field days (19.04%), by receiving training (8.57%) and from implementing demonstrations (2.87%) -organized by NGOs or GO. However these programs were irregular in the study areas.

Table 5. Source of acquainted and collection of the variety

Variety acquainted	%
GO	2.86
NGO	27.62
Neighbor	69.52
-	-
-	-

Table 6. Method of acquainting new stress tolerant rice variety

How the new Variety acquainted	%
Trail	0
Demo	2.87
Training	8.57
Field day	19.04
Neighbor	69.52

Study also found that most of the farmers (52.38%) have been cultivating BRRIdhan52 rice since less than one year, 47.62% since two to three years and no farmers were found for 03 years (Table 7). These findings were not encouraging. Field visit revealed that at the research locality there was no efficient seed delivery systems, even during adopting the research trail with new STRV, there were lack of proper guidelines, logistic support and knowledgeable personnel. Need strengthening of seed systems (FAO, 2013) and regular field day activities (Pokhrel, 1997) to acquaint the farmers with the latest STRV technology.

Table 7. Duration of the cultivation of submergence tolerant variety

Duration of cultivation variety	Frequency	%
less than 1 year	55	52.38
2-3 years	50	47.62
More than 3 years	0	0

Table 8. Selection and adoption of appropriate variety

Appropriate Variety	Frequency	%
Never adopt	0	0
Partial adopt	14	13.34
Adopt	91	86.66

Appropriate agronomic practices adopted by the farmers

In this section the good agronomic practices adopted by the farmers were analyzed. Present study in selection of appropriate rice variety revealed that most of the farmers

(86.66%) ware selected and fully adopted BRRIdhan52 rice as appropriate STRV for their submergence problem (Table 8) and 13.34% partially adopted. Table 9 showed that 68.58% farmers were partially adopted and 13.33% was fully adopted in use of good seedlings. Rate of adoption in use of good seedlings was lower than full adoption due to the lack of seedlings, source of good trusted seed and financial crisis were the root causes commented by respondent farmers.

Table 9. Adoption of appropriate agronomic practices- good Seedlings in the study area

Good Seedlings	%
Never adopt	18.09
Partial adopt	68.58
Adopted	13.33

Table 10. Adoption of appropriate agronomic practices-timely planting

Timely Planting	%
Never adopt	55.23
Partial adopt	36.19
Adopted	8.58

As a non monitory good agronomic practice all the farmers in the study areas were not fully adopted proper timing in plantation or sowing -only 8.58% farmer's use to, 36.19% partially and rest were never adopted timely planting (Table 10) due to their lack of knowledge, unavailability of STRV seed etc. From Table 11 could be summarized that only 15.24% partially adopted line showing, rest were never adopted although this non monetary practice narrowing the yield gap and production cost. Lakpale and Shrivastava (2012) from their research found that the grain yield under line sowing and broadcast remained comparable and net profit under line sowing rice (22.2%) was higher than that of broadcast.

Table 11. Adoption of appropriate agronomic practices-line sowing

Line sowing	%
Never adopt	84.76
Partial adopt	15.24
Adopted	0

Table 12. Adoption of appropriate agronomic practices- fertilizer management

Fertilizer Management	%
Never adopt	34.29
Partial adopt	41.9
Adopted	23.81

Analysis of appropriate fertilizer management at farmer's level showed that (Table 12) 41.9% farmers were partially adopted, 23.81% fully adopted and 34.29% farmers never adopted. Result showed that the highest numbers of farmers fully adopted with irrigation and drainage management were 84.76% and partially adopted were 15.24% (Table 13).

Table 13. Adopted agronomic practices for irrigation and drainage

Irrigation & Drainage	%
Never adopt	0
Partial adopt	15.24
Adopted	84.76

Table 14. Adoption of good agronomic practices for weeding

Weeding	%
Never adopt	0
Partial adopt	44.76
Adopted	55.24

Biswas and Ghosh (2015) commented in their research article that to increase rice production and productivity, hybrid rice is the most suitable technological solution till date. Management of weed is an acute problem in rice cultivation which causes reduction in yield to a great extent. From the Table 14 it is found that fully adopted weeding practice for rice cultivars are

55.24% farmers and partially adopted farmers are 44.76%. Here all farmers are more or less adopted weeding practices technology for rice cultivation as traditional practice. Table 15 shows that no farmers ware fully adopted Integrated Pest Management (IPM) technology for rice cultivation. Among the respondents 84.76% farmers ware never adopted and 15.24% was partially adopted IPM technology due to their lack of knowledge.

Table 15. Good agronomic practices for integrated pest management

Pest Management	%
Never adopt	84.76
Partial adopt	15.24
Adopted	0

Table 16. Submergence and inundation stress tolerant capacity of BRRIdhan52 rice variety

Stress Mitigation	%
Not at all	0
Partial	20.95
Fully	79.05

FAO (2013) suggest and emphasis on appropriate STRV selection, good quality seed, timely planting or sowing, line sowing, appropriate fertilizer management, irrigation and drainage, weeding and IPM are examples of technologies, practices and approaches as important good agronomic practices for building resilient livelihoods for the farmer's community. Siddiq (2000) commented that timely planting, irrigation, weeding, plant protection and harvesting constituting a component and accounting for more than 20 percent of the harvestable yield. These are non-monetary good agronomic practices essential to adapt to increase the productivity, yield and profit suggested by Mitin (2009) from his research. Establishment of 'Field school' as demonstration plot and center for rice seed or seedling; extensive promotion work for farmers to adopt non-monitory adaptations measures (Siddiq, 2000), providing credit facilities with soft loan (Sarwar, 2005) could be helpful to promote the adoption of good agronomic practices. Introduction of low-cost water control technologies (Haque and Jahan, 2013) could reduce the damages and losses due to submergence and inundation and also minimize the cost of water management as adaptation options against climate change.

Submergence stress tolerant capacity of BRRIdhan52 rice variety-farmer's experience

Study found that the farmer's are using BRRIdhan52 rice in the Aman season and experienced that theBRRIdhan52 can mitigate the submergence stress on rice cultivation. Table 16 revealed that 79.05% experienced positive observation that this variety can fully efficient to mitigate the stress of submergence and the inundation and only 20.95% farmers think it can partially mitigate and during stress this rice variety could survive with difficulties. This result of positive observation about BRRIdhan52 is same as BRRI (2014) and stated that up to two weeks submerged condition BRRIdhan52 can yield 4-4.6 t/ha.

Effect of submergence duration on the yield of rice cultivation

Investigation of possible effect of submergence duration on yield potentials of BRRIdhan52 and BR23 rice varieties were analyzed and found that submergence occurred, mostly during seedling and tillering stages, from mid-August to mid-September and the flood water submerged the rice for an average of 13 days. In the Figure 8 BRRIdhan52 as STRV indicates the higher yield at submergence condition. From the questionnaire survey it was found that the average grain yield of BRRIdhan52 rice is 4.89 t/ha and BR23 rice variety is 3.61 t/ha in the study area. This difference was large, 1.2 tons/ha (approximately 36% more),

under the medium-duration submergence. This result is supported by BRRI (2014) and stated that BRRIdhan52 can yield 4-4.6 t/ha even when submerged up to two weeks.

Figure 8. Effect of duration of submergence on the rice yield and yield comparison

Cost-benefit analysis of different HYV rice varieties cultivated in the study areas

Huq and Rabbani (2011) stated that BRRIdhan52 rice can yield 4-4.6 t/ha even when submerged up to two weeks. From the information gathered from the key informant interview (Table 17) it was observed that the average grain yield of BRRIdhan52 rice was 4.89 t/ha and BR23 rice was 3.61t/ha –approximately same as Rahman (2012) where found 4.62 t/ha for HYV rice. But the average total variable cost was approximately same - BRRIdhan52 (39,228.28 taka/ha) and BR23 (37,977.42taka/ha) and also as Rahman (2012) 36,964.00 taka/ha. The gross margin of BRRIdhan52 (35,217.36taka/ha) become higher than the BR23 (17,628.61taka/ha). Difference of average gross margin was 17,588.75 taka/ha between BRRIdhan52 and BR23 rice varieties.

Table 17. Approximate analysis of cost-benefit ratio of different rice varieties in the study areas (Source: KII**).**

Variety	Grain Yield (t/ha)	Total Variable Cost (taka/ha)	Gross Return (taka/ha)	Gross Margin
BRRIdhan52	4.89	39228.28	74446.03	35217.36
BR 23	3.61	37977.42	55606.47	17628.61

Rahman (2012) mentioned that the yield of HYV rice was about 3-4t/ha higher than traditional rice cultivated by the farmers. Present research showed that hybrid and HYV crops like BRRIdhan52 rice are most appropriate and suitable for selected coastal areas may change cropping patterns, cropped area, cropping intensity, yield, production and income.

Conclusion and recommendations

Rice productivity in coastal Bangladesh is lower than the national average and total coastal area is considered to be submergence-prone and higher vulnerable in July to January (Aman, KharifII) cropping season. Present studies revealed that inundation and submergence are common phenomenon during Aman rice cultivation (ARC) and made ARC uncertain in the study areas. After cyclone SIDR and AILA devastation, the rate of traditional ARC decreasing every year and in 2015 it was 26.51% lower than before. Recently farmers have adopted new cropping practices and strategies -growing different new stress tolerant rice varieties (STRV) and in most cases (81.9%) it was BRRIdhan52; 8.57% BR23 as their old tradition, 7.62% BR11 and 1.91% BRRIdhan51 respectively. Research found that in the study areas 63% farmers were growing modern Aman rice in only Aman Season as single crop, only 6% farmers are Boro-Aus-Aman as triple crops and 31% farmers are Aus-Aman

as double crops. Duration of adoption with STRV was 52.38% since less than one year, 47.62% since two to three years. Generally all of the farmers wanted to familiar with and to have the STRV to cope with submergence and had their STRV seeds from neighbors and NGOs. The most parts of information were accessed from neighbors and NGOs and less from GO. Pure STRV seed and trusted sources were lacking; method of acquaint with new varieties were –most cases discussion with neighbor farmers and NGOs; less from GO on the occasion of irregular farmer's day, training and demonstration organized by NGOs or GO. Due to the lack of proper guidelines, logistic support and skilled personnel they get no results during research trail on new variety. Approximately all farmers (86.66%) have adapted to STRV; farmer's curiosities to familiar with and to have the STRV are encouraging. Study also indicated that yield of BRRIdhan52 in the study area was 4.89 t/ha, higher than BR23 rice under the medium-duration submergence. Production cost of BRRIdhan52 was 39,228.28 taka/ha, was approximately same as BR23. The gross margin difference of BRRIdhan52 and BR23 rice was 17,588.75 taka/ha. Present research showed that submergence tolerance rice is suitable for selected coastal areas and might change in cropping patterns, increase in cropped area, intensity and production, narrowing the yield gap and gap of income.

In the study areas barrier for ARC were found as inundation frequency and submergence depth; lack in adoption of good agronomic practices; lack of appropriate STRV and trusted good seed; financial crisis; non-availability of proper guidelines, logistic supports and knowledgeable skilled personnel; irregular in organizing intervention programs -were common in the study areas. But most of the farmers adopted BRRIdhan52 rice cultivation with positive perceptions of higher yield and lower production cost with optimum stress tolerant capability to cope with submergence and inundation. Therefore it can be concluded that the intensity of adoption of adaptation and mitigation measures are significantly influenced in the study area positively by the yield capability; farmer's participation, frequency of organizing intervention programs and farmers participation; intensity of adoption of good agronomic practices; submergence and inundation profile; tolerance attributes of adopted rice variety; availability of STRV etc and current research found these factors have significant influence on the level of adoption of improved adaptation and mitigation practices and continuation of STRV cultivation. For instructing on-farm training to rural farmers on various variety specific recommended packages of cultivation, hence need establishment of 'Farmer's Field School'. This school will serve as center for rice seed or seedlings provider, facilitating farmer to farmer dissemination of technology and location based packages of technologies moving towards 'Prescription Farming'. All of these activities could be establish and made available and popularized to enhance the climate change adaptation and mitigation measures practices in agriculture sector.

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