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DETERMINANTS OF SUBMERGENCE-TOLERANT RICE VARIETIES ADOPTION IN A FLOOD-PRONE AREA OF BANGLADESH

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ABSTRACT

Many people of Bangladesh are forced to cultivate in low-lying areas due to population pressure and land insufficiency. To improve the situation, different national and international institutes invented submergence-tolerant rice varieties that can withstand water-logging conditions for up to 1-2 weeks and also provide high yield. This study was undertaken in a flood-prone district named Jamalpur, and the main objective was to determine the factors affecting the adoption of submergence-tolerant rice varieties. To attain the objective, Dewanganj and Islampur upazilas were selected purposively, which are the most flood affected areas under Jamalpur district, and therefore, the intensity of submergence-tolerant rice variety growing farmers are also available there. Prior to data collection, a well-designed semi-structured questionnaire was prepared and converted to ODK app. Data were collected through trained enumerators from randomly selected 222 farmers using a pre-prepared list collected from the office of the Department of Agricultural Extension (DAE), of which 108 were adopters and 114 were non-adopters. Two Focus Group Discussions (FGDs) were also conducted for data supplementation and validation. Apart from descriptive presentation, data were analyzed through t-test and binary logit model. Findings revealed that there is no statistically significant difference between the mean of socioeconomic variables such as experience, age, education, and farm size across adopters and non-adopters. Logit model results explained that farmers' perceptions of the variety as stress-tolerant and seed availability from the dealers significantly positively affect the adoption of stress-tolerant varieties. Besides, land type, access to extension agents, and training positively influence adoption. FGDs also reported that variety demonstrations, information received from the agricultural office, training, and farmers' past experience are the key determinants of adopting new varieties. Therefore, it can be concluded from this study that the aforesaid variables should be emphasized and considered for the expansion of submergence-tolerant rice varieties in Bangladesh.

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I. INTRODUCTION

Flooding, mostly short-term submergence, is a serious challenge for rice production in flood/flash flood-prone areas, and the situation is likely to worsen with climate change. Temperature variations are causing the ecosystem to change at an alarming rate. Our land, water, crop productivity, and weather are all impacted. About 30% of the 7 billion poor people living in rain-fed rice-growing areas in Asia are affected by environmental stressors, which limit the amount of rice that can be produced (IRRI, 2024). The amount of arable land per person globally decreased from 0.42 hectares in 1960 to 0.19 hectares in 2050. Moreover, the area becomes much smaller in underdeveloped nations, dropping from 0.33 to 0.14 hectares per person (Silva, 2018).

In Bangladesh, rice can be cultivated in a variety of environments, from upland areas to flooded lowlands. In areas where irrigation is accessible, rice can yield more per unit of land. Bangladesh is one of the most susceptible countries due to climate change and suffers from floods nearly every year. The proportion of submergence-prone areas is higher (55%) in Bangladesh than in India (17%) and Nepal (9%) (Malabayabas et al., 2014). There are four prominent seasons in Bangladesh, namely, winter (December to February), Pre-monsoon (March to May), Monsoon (June to early October), and Post-monsoon (late October to November). As a result of monsoon and flat topography, floods are annual phenomena, and regular river floods affect about 20% of the country during the monsoon season (Parvin et al., 2015). The rice productivity in the T. Aman season was reduced by 20–40% as a result of erratic rainfall, heightened severity and regularity of droughts, increased salt, tidal surges, floods, storms, the use of indigenous varieties, and greater incidences of pests and diseases (Sultana et al., 2019; Moslehuddin et al., 2015). According to the IPCC Special Report on the Regional Impacts of Climate Change, there would be drastic changes in rainfall patterns in the warmer climate. Bangladesh may experience a 5 to 6 percent increase in rainfall by 2030, which may create frequent significant and prolonged floods (IPCC report, 2007).

Bangladesh, one of the most densely populated nations with a very poor land-to-man ratio and pervasive hunger, likewise followed a program of reforming agriculture by accelerating technical advancements to accommodate the growing population (Radovic et al., 2020). Keeping this in mind, national and international research institutes develop submergence-tolerant rice, such as BRRI dhan51, BRRI dhan52, and Binadhan-11, considering the characteristics of low-lying areas of Bangladesh (Table 1).

Table 1: Submergence-tolerant rice developed by different institutions of Bangladesh within 15 years

Resilient Variety	Season	Release Year	Adoption rate (%)
Binadhan-11	*Aman*	2013	5.05
Binadhan-12	*Aman*	2013	0.77
BRRI dhan51	*Aman*	2010	4.97
BRRIdhan52	*Aman*	2010	5.57
BRRIdhan79	*Aman*	2017	0.03

Source: BRRI & BINA website

These varieties are high-yielding and can tolerate waterlogging up to 1-2 weeks, depending on the variety. However, there is a lack of adoption studies related to factors affecting submergence-tolerant rice varieties, particularly in Bangladesh. Most of the submergence-tolerant rice varieties studies were impact-related (Bairagi et al., 2018; Yamano et al., 2016; Asfaw et al., 2012; Mendola et al., 2007), experimental-related (Arora et al., 2019; Emerick et al., 2016; Malabayabas, 2014), and adaptation-related (Darma, et al., 2025; Basumatary., 2018; Biswas et al., 2015). Adoption-related studies, such as Meher (2022), showed that perceived and actual experiences of climate stress are important parameters influencing the decision to adopt Stress-tolerant rice varieties (STRVs). The main drivers for adopting STRVs or agricultural technologies are information or access to extension workers, sharing knowledge by membership in an organization, and learning from peers (Khanam, 2021; Veettil et al., 2021; Wossen et al., 2017; Ainembabazi et al., 2016; Shiferaw et al., 2015). With such an evaluation of the past literature, there is a research gap that considered all the major submergence tolerant varieties invented by the research organizations. In addition, while the previous studies considered mostly socioeconomic factors as the determinants of adoption, this study covered environmental factors also as the adoption factors. Therefore, the study would support to enhance the understanding of the factors that need to be addressed when a decision of variety adoption is made in practice. The research looked at the socioeconomic characteristics of the sample farmers and if there are any significant differences between key socioeconomic variables. In particular, the research examined the factors influencing the adoption of climate-resilient rice varieties in flood prone area. The findings will guide to draw some policy recommendation for rice production in flood prone areas.

II. MATERIALS AND METHODS

2.1 Study Area

The study areas were selected based on the incidence of natural calamities, such as floods, and the availability of submergence-tolerant rice varieties. Therefore, two upazilas, Dewanganj and Islampur, under Jamalpur district, were selected purposively for the present study (Figure 1).

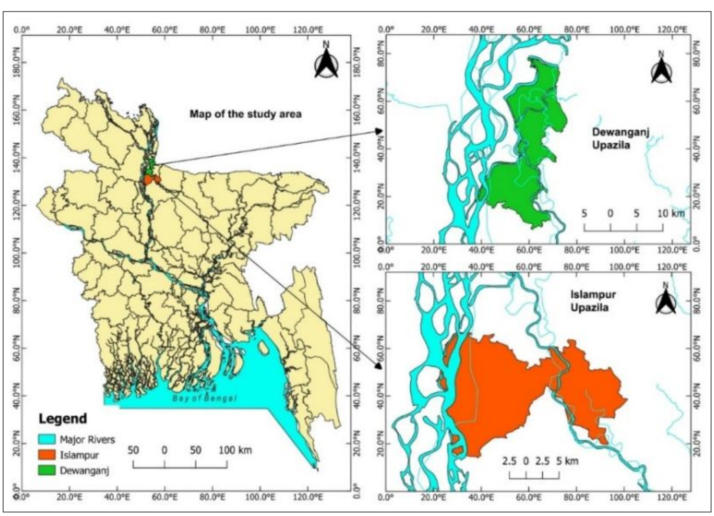

Figure 1: Study locations in Jamalpur district of Bangladesh

2.2 Sample Selection

Both types of rice farmers, i.e., resilient and non-resilient farmers, were considered as samples in the present study. Here resilient farmers were those who cultivate any of the resilient rice varieties such as BRRI dhan51, BRRI dhan52, Binadahn-11, and Binadahn-12 in at least one of their plots in *Aman* season (Ghimire et al., 2015; Wang et al., 2012). On the contrary, non-resilient farmers did not cultivate resilient rice varieties in their any plot at all. Stratified random sampling technique was used for the required sample. A total of 222 farmers were chosen as the sample of this study, where 49% of the sample farmers were adopters who cultivated climate-resilient rice varieties in their land (Table 2).

Table 2: Distribution of sample size

Type	Number of farmers	Share (%)
Adopter	108	49
Non-adopter	114	51
Total	222	100

2.3 Data Collection

In order to collect data, a questionnaire was prepared and pre-tested in the study locations before going for the final survey. Information on the adoption of climate resilient crop varieties along with information on other aspects such as socioeconomic factors, farming practice, input use, production, and household characteristics were collected through the direct interview method. A trained team of enumerators collected data electronically (ODK app) from the sample farmers. Information on the adoption of climate-resilient crop varieties, along with information on other aspects, was collected through a direct interview method. The survey and Focus Group Discussions (FGDs) were done in 2023-24. Prior consent was obtained from each respondent before data collection, and the ethical standard was followed during data collection.

2.4 Analytical Technique

Upon collection of data and performing data cleaning, socioeconomic characteristics were analysed through descriptive statistics. We also examined the distribution of the socioeconomic and demographic variables, both for adopters and non-adopters. In addition, a comparison of the pertinent socioeconomic and demographic characteristics was made between farmers who adopted and those who did not adopt the STRVs. This was done following the t-test technique, which is helpful for examining mean comparison for two independents groups (Asmelash, 2014).

$$t = \frac{(\overline{x_1} - \overline{x_2})}{\sqrt{(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2})}} \qquad (1)$$

characteristic of the non-adopters and adopters, respectively; s_1^2, s_2^2 are the sample variances and n_1, n_2 are the number of observations. The appropriate degrees of freedom (df) for the above t-test are determined by $\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2 / [\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2 - 1}]$. The null hypothesis will be that there is no statistically significant difference between the mean of the socioeconomic variable across adopters and non-adopters.

Ghimire et al. (2015) pointed out that generally, there would be a tendency for a farmer to compare what he may gain from adopting a particular technology. Once he is convinced of its utility, he will adopt the technology. Therefore, to assess what factors underlie farmers' decisions to adopt, it needs to be recognized that a farmer usually adopts a technology only when the farmer's expected utility exceeds a certain threshold, which is unobservable. For studying determinants of adoption, the discrete choice model strategy needs to be referred for assessing the effect of a factor on the likelihood of variety adoption, holding the effect of other variables unchanged.

Technically, the discrete choice model of this proposed research can be written as:

$$U_i^* = X_i'\beta + \varepsilon_i \qquad (2)$$

Where $U_i = 1$ if $U_i^* > 0$; otherwise, 0. The term X_i^* represents explanatory or predictor variables that govern farmers' adoption decisions, β is a vector of parameters to be estimated, and ε_i is the disturbance term. The list of predictor variables includes farmer's age, education, variety perception in relation to yield, variety perception in relation to stress tolerance, variety perception in relation to market demand, farm size, land type, access to extension services, having had training on stress-tolerant variety cultivation, and access to credit/financial resources. Let Pi be the probability of adopting a climate-resilient variety by the i-th farmer. Thus, the specific Logit regression takes the following form:

$$\begin{aligned} ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 &+ \beta_1 fage + \beta_2 education + \beta_3 high\ yielding + \beta_4 stress\ tolerant \\ &+ \beta_5 high\ market\ demand + \beta_6 seed\ source + \beta_7 fsmall + \beta_8 fmedium \\ &+ \beta_9 medium\ high\ land + \beta_{10} medium\ low\ land + \beta_{11}\ low\ land \\ &+ \beta_{12}\ access\ to\ DAE\ + \beta_{13}\ training + \beta_{14} credit + \varepsilon \end{aligned} \qquad (3)$$

Explanatory variables were selected based on earlier literature reviews (Li et al., 2024; Massresha et al., 2021; Milkias & Abdulahi, 2018; Ojoko et al., 2017; Ghimire et al., 2015) and also considering the expert opinions. Accordingly, Equation (3) has been formulated following the Logit regression model. Although we could estimate equation (3) using the probit model, the logit model would be preferred because of the ease of interpretation of the coefficients. The key interest would be to see whether or not the β's are statistically significant in predicting the log of odds in favour of adoption. The significant factors that enhance the likeliness of adoption will be identified through this model estimation. Focus group discussions (FGD) were also performed to explain better and validate the results.

III. RESULTS AND DISCUSSION

Flood is the main hindrance to *Aman* production in the study area. Farmers in the study areas are cultivating different categories of *Aman rice* varieties, which include BRRI dhan51, BRRI dhan52, and Binadhan-11. Farmers have been cultivating these varieties for more than 10 years, indicating effective adoption. In the case of non-resilient varieties, major responses were found for BR 22, Binadhan-7, *Gainja,* and Horidhan, which are locally cultivated varieties. Farmers cultivated different types of rice varieties based on land type; for example, Gainja is grown in char lands after the flood level goes down, whereas Horidhan cannot survive in water-logging conditions. Generally, three crops are grown in those areas where inundation cannot create damage. Otherwise, farmers cultivate two crops in one year, and rice-based cropping patterns dominate the cropping system. Besides rice, they also grow maize, mustard, jute, vegetables, oilseed, sugarcane, and pulses. However, most of the sample farmers cultivate *Aman* paddy during the monsoon season, and there is no rice competitor during this season.

3.1 Soil Type and Land Type in Jamalpur District

In the study areas, soil was categorized as sandy, sandy loam, loam, and silt. Figure 2 shows that 36% of plots were loamy, 31% were sandy loam, and 30% were silt.

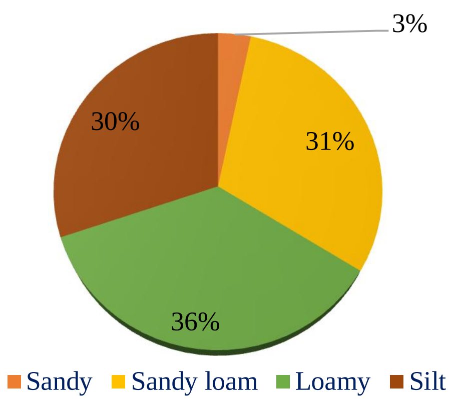

Figure 2: Soil type of the study areas

Similarly, land type was categorized as high, medium-high, medium-low, low, and very low. Results revealed that most of the land was medium-low land (46%), followed by medium-high (23%), and low (22%). Both very low land and high land encompassed the lowest percentage, very low (5%), and the lowest percentage, i.e., 5% (Figure 3).

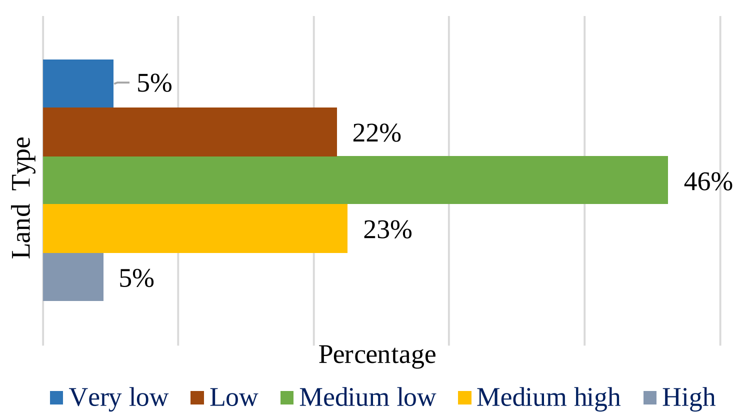

Figure 3: Land type of the study areas

3.2 Socio-demographic Information of the Sample Farmers

Table 3 covered all the major sociodemographic information of the sample farmers. Females were rarely the farm owners in the study area; therefore, not surprisingly, all the surveyed farmers were male. It is also expected that farming is the primary occupation of the respondents (97%). About 27% farmers were within 41 to 50 years age group, and 27% were within 51 to 60 years age group while nearly 19% of the farmers were within 31 to 40 years age group, and others were either above 60 years (21%) or less than 30 years (6%). However, these findings imply that middle-aged farmers were the major contributors to agricultural production. Similar results were shown by Musafiri et al. (2022). A substantial number of farmers have completed SSC or above (24%), about 22% completed the primary level, 15% studied less than the primary level, while about 39% were illiterate. Regarding farming experience, 67% of farmers were in the group greater than or equal to 21 years, while 21% of the respondents were in the 11-20 years group. Only 12% of farmers were in the category of less than or equal to 10 years.

Table 3: Socio-demographic information of the sample farmers (in Percentage)

Particulars		Adopter	Non-Adopter	Total
1. Gender	Male	48	52	100
	Female	0	0	0
2. Marital Status	Married	48	49	97
	Unmarried	0	2)	2
	Widow	0.5	0.5	1
3. Main occupation	Farming	46	51	97
	Farm Labor	0	0.5	0.5
	Day labor	0	0.5	0.5
	Businessman	0	0.5	0.5
	Service	0	1	1
	Other	0	0.5	0.5
4. Secondary occupation	Yes	14	11	25
	No	35	40	75
5. Age	Up to30	2	4	6
	31-40	10	9	19
	41-50	16	13	27
	51-60	14	15	27
	>60	8	13	21
6. Education	Illiterate	18	22	39
	Less than primary	8	7	15
	Primary	11	11	22
	SSC and above	12	12	24
7. Experience	<=10 years	6	6	12
	11-20 years	9	12	21
	>=21 years	33	34	67

Source: Field Survey, 2023.

Farm size was categorized as landless (0.01-0.49), marginal (0.50-0.99), small (1.00-2.49), medium (2.50-7.49), and large farm (7.50 or more) in acres (BBS, 2025).

Table 4: Farm size by category of the sample farmers

Farm size category (Acres)	Number of Farmers	Percent	Average size of land (decimal)
Landless (0.01-0.49)	9	4	34
Marginal (0.50-0.99)	45	20	70
Small (1.00-2.49)	118	53	164
Medium (2.50-7.49)	42	19	382
Large (7.50 or more)	8	4	1162

The data from Table 4 shows that a large portion of farmers in the sample were small, 53% (n=118). The second highest percentage was found under the marginal farm category, 20% (n=45). The next category of farmers was under the medium farm category, 19% (n=42). Only 4% of farmers were both landless and large farmers in the sample.

Table 5: Two-sample t-test with unequal variances in Jamalpur district

Sl.	Variable	Mean		Differences (NA-A)	t-statistic
		Non-adopter	Adopter		
1.	Experience	28.02	27.67	0.34	0.21
2.	Age	51.00	49.35	1.65	1.04
3.	Education	4.41	4.93	-0.53	-0.79
4.	Farm size	202.73	233.01	-30.28	-0.96

A two-sample t-test revealed no statistically significant difference between the means of socioeconomic variables such as experience, age, education, and farm size across adopters and non-adopters (Table 5). This result prompted us to conduct further analysis, where we may explore other factors responsible for adopting STRVs rather than these typical socioeconomic characteristics.

3.3 Factors Influencing the Adoption of Submergence-tolerant Rice Varieties

The logit model was estimated to identify the determinants of adopting submergence-tolerant rice varieties. This Logit model was chosen because it has advantage over other models (LPM, Tobit and Probit) (Asmelash, 2014). Estimates of the logistic regression model have been presented in Table 6, which shows that out of fourteen variables, three variables, such as whether or not a farmer perceives a variety as stress-tolerant, whether seed is available through a dealer source, and land type, significantly affect the probability of adoption of submergence-tolerant rice varieties.

In Table 6, the value of the coefficient of farmers' age is -0.03. The coefficient represents how the likelihood of adoption changes with a change in farmers' age by one year when the remaining variables are constant. Since the coefficient is negative, it can be said that the likelihood of adopting a resilient variety would be decreased when farmers' age increases. However, the relationship between farmers' age and adoption is not statistically significant. Gauchan et al. (2012) found that farmers' age and education have no statistically significant effect on adopting new-generation MVs. Our findings about farmers' education level also have a negative sign, i.e., -0.02. Therefore, it can be said that the probability of adoption of stress-tolerant varieties does not increase with the education level; however, the relationship is not statistically significant. A similar result was found in Gakii (2024), where he showed that education had no significant influence on the adoption of crops. On the contrary, Mawuli (2016) found that education has a higher attitude toward adopting new ideas in the sense that farmers have more capacity to adopt information than uneducated farmers.

Whether a farmer perceives a variety as high yielding has a negative association with the likelihood of adopting the stress-tolerant variety, holding the rest of the factors fixed; however, the effect is not statistically significant. The coefficient of perception about variety, stress-tolerant, is 3.13, and it is statistically significant at the 1 percent level of significance. If the farmers perceive that a variety is tolerant to stress, they would like to adopt it, holding the rest of the variables fixed. The marginal effect of perception about variety, stress-tolerant, is 0.627 indicating that perceiving a variety as stress-tolerant increases the probability of adoption by 62.7 percent compared to those who do not perceive it as stress-tolerant, holding all other variables constant.

Table 6: Factors influencing farmers' adoption of submergence-tolerant rice varieties

Variables	Coefficient	Odds-ratio	Marginal effect
Farmer's age (year)	-0.025	0.976	-0.006
	(0.017)	(0.016)	(0.004)
Farmer's years of education	-0.016	0.984	-0.004
	(0.042)	(0.041)	(0.010)
Variety perception: high yielding =1, otherwise = 0	-0.138	0.871	-0.034
	(0.509)	(0.444)	(0.127)
Variety perception: Stress tolerant =1, otherwise = 0	3.125***	22.764***	0.627***
	(0.440)	(10.017)	(0.058)
Variety perception: has market demand =1, otherwise = 0	0.613	1.847	0.151
	(0.379)	(0.699)	(0.092)
Seed source: Dealer =1, otherwise 0	1.193***	3.297***	0.273***
	(0.438)	(1.445)	(0.089)
Farm type: Small =1, otherwise 0	-1.579	0.206	-0.373*
	(0.981)	(0.202)	(0.202)
Farm type: Medium =1, otherwise 0	-1.374	0.253	-0.299
	(1.024)	(0.259)	(0.184)
Land type: Medium high =1, otherwise 0	-0.734	0.480	-0.172
	(0.805)	(0.387)	(0.177)
Land type: Medium low =1, otherwise 0	-1.934**	0.145**	-0.438***
	(0.765)	(0.111)	(0.149)
Land type: Low =1, otherwise 0	-1.438*	0.237*	-0.322**
	(0.784)	(0.186)	(0.151)
Farmer has access to DAE for advice =1, otherwise 0	0.031	1.032	0.008
	(0.529)	(0.546)	(0.131)
Farmer got training =1, otherwise 0	-0.430	0.651	-0.106
	(0.479)	(0.312)	(0.118)
Farmer has access to credit =1, otherwise 0	0.254	1.289	0.062
	(0.440)	(0.567)	(0.108)
Constant	1.395	4.034	

Variables	Coefficient	Odds-ratio	Marginal effect
	(1.881)	(7.588)	
Observations	222	222	222
LR_chi2	103.5	103.5	103.5
Pseudo_R2	0.337	0.337	0.337

Source: Field Survey, 2022-23
Note1: Figure in the parentheses is the standard errors
Note 2: ***Significant at 1 percent level **Significant at 5 percent level *Significant at 10 percent level
Note 3: High land not found for the district
Note 4: Vif = 1.62<10; indicating there is no multicollinearity among independent variables

The value of the coefficient on the variable, whether a farmer perceives the variety as having high market demand, is 0.61. However, the association did not appear to be statistically significant. The value of the coefficient on whether farmers obtained seed from dealers is 1.19, which is positive and statistically highly significant at the 1% level. Holding other factors fixed, the farmer's likelihood of adopting stress-tolerant varieties tends to be high if they can avail seed from dealers rather than any other source, such as business retailers, research stations, their own source, etc. The marginal effect of seed from dealers is 0.273 indicating that getting seed from a dealer increases the probability of adoption by 27.3 percentage, compared to farmers who source seed from non-dealer sources (e.g., government, NGO, own saved seed). This is an important policy message that the market availability of seeds of a particular variety plays a crucial role in its adoption. Seed source plays as an important factor also found by Ghimire et al., 2015.

Farmers were categorized as small, medium, and large types, where the large type was considered the model's base group. The coefficient values for small and medium farms were -1.58 and -1.37, respectively, which are not statistically significant. Therefore, socioeconomic characteristics can have some effect, they are not the main determinants of agricultural technology adoption (Sheng, 2024, Sadique et al., 2022, Begho., 2022, Ruzzante & Bilton., 2021, Teklewold, 2013,). Similarly, land was categorized as medium-high, medium-low, low, and very low for this district, where very low land was considered as the base group in the model. The value of the coefficient for medium-high land is -0.73, negative but not statistically significant. The coefficient values for medium-low and low land farmers are -1.93 and -1.44, respectively. They also show a negative sign but are statistically significant at the 5 and 10 percent levels. Therefore, it can be said that the likelihood of adopting submergence-tolerant varieties tends to be significantly lower if the farmer’s plot is medium-low land or low land than for farmers with very low land. The marginal effect of medium low land is -0.438 indicating that farmers with medium low land are 43.8 percent less likely to adopt the stress-tolerant variety compared to those with very low land. This result is statistically significant at the 1% level, also indicating strong evidence. The marginal effect of low land farmers is -0.322 is statistically significant at the 5% level indicating that farmers with low land are 32.2 percentage less likely to adopt the variety compared to very low land farmers.

The value of the coefficient on whether a farmer has access to the Department of Agricultural Extension (DAE) is 0.03. This means that holding the other factors fixed, farmers with access to extension services are more likely to adopt the resilient variety compared to the farmers who do not have access to such services. Extension-related variables impact technology adoption the most (Mariano et al., 2012). The value of the coefficient on variable training is 0.43, which is positive, meaning that if other things remain the same, the likelihood of adopting resilient varieties tends to be high for farmers who have received training about the cultivation of resilient varieties compared to the farmers who have not received such training. Nevertheless, the association is not statistically significant. Farmers' access to credit possibly indicates a farmer's insufficient funds, and the coefficient on farmers' access to credit has been found to be negative. However, the association between the likelihood of adoption and access to credit is not statistically significant.

The FGD results show that farmers in the study areas have been cultivating stress-tolerant rice for 5-10 years, depending on the variety. According to the respondents from FGDs, the most influential factor for the adoption of STRVs includes seed subsidies or demonstrations from different projects run by the government. The other factors include information from the agricultural office, farmers' experience, variety traits, higher yield, stress tolerance level, satisfactory price, influential neighbour, and training. However, there is no specific benefit of producing a specific variety in terms of selling. The main reason is that auto-rice mills purchase huge amounts of rice through *Bepari* (25 tons/lot) irrespective of variety and mixes them. *Bepari* collect rice from *Faria*, and *Faria* collect rice from farmers at home or at farm, However, farmers accept this system as they can sell their product at the farm gate. They face some difficulties in selling to the government procurement system or in the market because of marketing cost.

IV. CONCLUSION

One of Bangladesh's main obstacles to rice production is submergence, particularly in the flood-prone areas. If we can overcome this barrier through submergence-tolerant rice varieties, our nation will benefit as more rice will be added to food baskets, and food security will be ensured. This study was an attempt to investigate the factors that are responsible for the adoption of submergence-tolerant rice varieties in a flood-prone area, i.e., Jamalpur district. It was found that adopters and non-adopters do not differ significantly with respect to socioeconomic characteristics such as age, experience, education, and farm size, and hence, these are not the key factors of adoption. On the other hand, the most important factors that greatly influence the adoption of submergence-tolerant varieties is the farmer's perception of the variety; that is, if farmers believe that a particular variety keeps the ability to withstand waterlogging conditions, the likelihood that they will adopt it increases significantly. Yamano et al (2016) found that approximately 1.4 million tons could be saved if the adoption rate of submergence-tolerant rice varieties increases to 75% among farmers who experience short-duration submergence. Therefore, adoption of submergence-tolerant rice can be an important option for farmers to increase rice production as well as the food security of those areas. For this, the information regarding submergence-tolerant rice needs to be disseminated widely through DAE and other research organizations as farmers' perception about the variety is a significant factor. To increase the adoption rate, government motivation and seed distribution programs should be continued through different institutes in Bangladesh. The seed supply system of BADC should be strengthened so that the farmers can buy seeds of the specific variety as their need. In addition, demonstration plots should be increased to show the visible benefits of producing submergence tolerant rice varieties. Overall, farmers can benefit by cultivating submergence tolerant rice varieties if the existing constraints can be addressed by appropriate policy and programmes.

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