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INNOVATIVENESS OF THE FARMERS OF HAOR AREAS IN ADOPTING FARM TECHNOLOGIES TOWARDS INCREASED BORO RICE PRODUCTION AVOIDING FLASH FLOOD

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Abstract

This study intends to provide an insight about the innovativeness of farmers of *Haor* areas in securing safe and increased production of Boro rice which often faces damage by early flash flood at the harvesting stage. Innovativeness was measured on two factors viz., i) earliness of the newly evolved modern technology to produce Boro rice, and ii) area coverage of the used technology. Data were collected from 250 randomly selected farmers using a pretested well-structured interview schedule during 10 March to 29 April, 2018. Results showed an overwhelming majority (90%) of the farmers of *Haor* areas who had low to medium innovativeness towards adoption of the listed 10 rice farming technologies while only 10% had moderate innovativeness. Depending on innovativeness as categorized by Rogers (1983) 3% of farmers of *Haor* areas were found innovator, 12.5% early adopter, 34.6% early majority, 34.1% late majority and 15.8% laggard. However, the innovativeness towards individual item of 10 technologies, weedicide (*Rifit*) and insecticide (*Virtako*) adoption ranked top two for quick and extensive use by the overwhelming majority of the farmers followed by BRRI dhan28, mechanical harvester, BRRI dhan29, BRRI dhan58, MoP, BRRI dhan64, TSP and BRRI dhan62. It is also revealed that education, annual income, knowledge, training experience, extension contact and attitude of the farmers of *Haor* areas had significant influence on their innovativeness.

Key Words: *Haor, innovativeness, Boro rice, adoption, technology*.

Introduction

The *Haor* areas are naturally more hazardous compared to those of the other irrigated areas of Bangladesh. Most of the *Haor* area remains water logged from May to November in a year (NCVAB, 2018). The region is considered to be highly vulnerable to climate change due to its hydro-physical settings (CARE, 2012). Livelihood opportunities of the households in this region are characterized by restricted access to open water fisheries, lower livestock husbandry and dry season crop cultivation (CARE, 2012). Majority of population derives their livelihood from agricultural production. *Boro* rice is their main crop and it alone occupies about 80% of cultivable lands, while only about 10% area is allotted for *T. Aman* rice (Huda, 2004). As rice is the main crop, any new rice technology seems to offer an opportunity to increase production and thereby substantial increases of income.

The existing socio-economic factors like unskilled human capital; limited access to information; inadequate incentives linked with farm tenure system; inadequate governmental credit; and non-availability of agricultural equipment to relieve labor shortages and inappropriate transportation infrastructure impede the rapid adoption of most of the technologies while some others have come out with tremendous effect.

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Cropping in *Haor* area has some peculiarity. About 60% of land is being cultivated under borga (lease) system. This form of cropping has been evolved three types of households- landlord, peasant and tenant of *Haor* habitats. Landlords usually give borga (lease) up to 60 percent of their lands to the marginal and tenant farmers for a season on condition of share cropping. It has two major forms e.g. (i) a land owner takes Tk. 1500 to Tk. 2000 per kear (1 kear equals 30 decimal) from lessee as the price of produce well ahead of cropping season and he is not bound to bear any expense needed for production of Boro rice and exempted from risk of crop failure by flash flood and (ii) the other system is locally known as *Vagalu*, in which share croppers take land from its owners on condition of equal sharing of the produce after harvesting of crop. In this case, share croppers (usually tenant, landless and marginal farmers) bear all expenses of crop production which included land preparation related various operations like plowing, dike making, laddering; transplanting, intercultural operations and harvesting; and inputs like seeds, fertilizer, insecticide and irrigation. Land owners and sharecroppers may have chance to be looser as there is frequent flash flood that may damage even 100% crop of the Haor. The ratio of sharing of crop sometimes varies depending upon features of leased land such as productivity, availability of irrigation water in nearby beel/ditch and distance from locality.

Peasants are middle category farmers. Besides farming they have other occupation and respected by the members of their community. They are some sort of absentee farmers regarding crop caring. But they have adequate financial ability to purchase inputs required for rice production.

On the other hand, in most cases, agricultural technologies are introduced in packages that include several components like recommended fertilizer doze, seedling age for transplantation and transplanting time for achieving potential yield of a certain variety. While the components of a package may complement each other, some of them can be adopted independently. Sub-sets of the package may not yield the expected outcome of the technology. However, it was observed that, rice production in the *Haor* area has been increased substantially over the years following the introduction of HYV and application of modern agricultural technologies i.e.; machineries (water pump, power tiller, trans-planter, sprayer and harvester), fertilizers, and pesticides. In this context, innovativeness of the farmers of the *Haor* areas has been central issue to understand the adoption trend of various modern technologies required for production of rice and to find out magnitude of relatively earlier/slower adoption of these technologies.

Materials and Methods

Study area, sampling and data collection

Tahirpur and Biswamvorpur upazila under Sunamganj district were selected purposively as the study area and from these two upazilas, six villages were selected randomly. Total number of the farmers in these six villages was 1254; of which 20% were then selected as sample for study following systematic random sampling. In this way, data were collected from 250 selected farmers of *Haor* areas using a structured interview schedule during 10 March, 2018 to 29 April, 2018. Before conducting survey, Key Informant Interview (KII) and Focus Group Discussion (FGD) were conducted in each upazila to gather qualitative information about the crop grown in *Haor* areas, different practices that are adopted by the farmers and the nature of crop damage.

List of most commonly used rice farming technology in Haor area

A total of 19 (nineteen) rice farming technologies were listed down initially through FGD and KII. After critically scrutinized ten (10) technologies were fixed considering economic

Table 1. Technologies evolved for *Boro* rice production in *Haor* area

	Types of technology	Name of technology
i.	Rice variety	BRRI dhan28, BRRI dhan29, BRRI dhan58, BRRI dhan62, BRRI dhan64
ii.	Machineries	mechanical harvester
iii.	Weedicides and pesticides (Chemical)	Virtako-Stem borer, Rifit-Weedicide;
iv.	Fertilizer (inorganic)	TSP, MoP

Benefits, local suitability and contributing against flash flood. Depending upon their features, the technologies were then grouped into four categories namely i) variety, ii) machinery, iii) Pesticide (weedicide and insecticide) and iv) fertilizer. Comparative innovativeness in applying of these technologies at field level was evaluated using appropriate formula and procedure.

Measurement of innovativeness of the farmers of Haor areas

Rogers (1983) defined innovativeness as the degree to which an individual is relatively earlier in adopting new ideas than the other members of his social system. Innovativeness of the *Haor* farmers towards various rice farming technology was computed by considering two factors: i) length of time taken to accept the technology after hearing about it (T) and ii) area covered by particular technology (A). The computation method and assigning weight for each of the two dimensions are discussed below:

a) Time sub-score: Based on length of time taken to accept that technology into practice after hearing about it, the following scoring system was adopted.

Table 2. The scale used for computing the duration taken to accept score

Duration taken to accept	Weight
Accept after 0-1 year of hearing	5
Accept after 2-3 year of hearing	4
Accept after 4-5 year of hearing	3
Accept after 6-7 year of hearing	2
Accept after 8 year of hearing	1

b) Area sub score (A): In computing area score, the following formula is used (Mohammad, 1974 and Muttaleb, 1995).

$$\text{Area coverage} = \frac{Area\ covered\ by\ particular\ technology}{Area\ suitable\ for\ particular\ technology} \times 100$$

The proportion thus calculated was converted into area coverage score by assigning weights as follows.

Table 3. The scale used for computing the area coverage score

Area coverage %	Weight
No coverage	0
1.0-25.0	1
25.1-50.0	2
50.1-75.0	3
75.1-100.0	4

In this way, the highest possible score for each technology was A x T = 5 x 4= 20 and the lowest score was 0. The scores as computed against each of the 10 technologies were summated together to determine the total innovativeness score of an individual farmer. Thus, the maximum innovativeness score of an individual respondent for the 10 selected technologies could be 200 (20 x 10, numbers of selected practices) and the minimum is 0.

Results and Discussion

Overall Innovativeness of the Famers of Haor areas

The hydro-physical features of *Haors* allow agricultural activities especially crop production only for four to five months in a year. To this, the recent un-predicting flash floods have been an additional challenge for *Boro* rice production as it damages the crop just before the harvesting. To adapt with this situation, any new technology suitable to *Haor* farming like short duration variety BRRI dhan28 (can be harvested before occurring of flash flood) or farming machinery (economic benefit and to mitigate labor shortage problem) is supposed to adopt very quickly by the majority of the farmers. However, the innovativeness scores of the farmers of *Haor* areas for the selected 10 technologies ranged from 8.0 to 120.0 with the mean and standard deviation of 89.06 and 18.62 respectively against the possible range 0.0 to 200.0. Data presented in the Table 4 revealed that the overwhelming majority (90.0%) of the *Haor* farmers had low to medium innovativeness while only 10% had high innovativeness. The unavailability of appropriate modern technology at their door step along with socio-economic conditions may be responsible to this poor innovativeness. However, it is expected that if the change agents can approach the farmers with appropriate innovations in a suitable manner, there will be a favorable response from the farmers.

Table 4. Classification of farmers according to their overall innovativeness towards selected technology of Boro rice production

Category	Frequency	Percent	Mean	Standard deviation
Low innovativeness (up to score 70.5)	50	20		
Medium innovativeness (Score 70.6 to 107.7)	175	70	89.1	18.62
High innovativeness (above score 107.7)	25	10		
Total	250	100		

Innovativeness towards Individual Modern Rice Production Technology

Although the overall innovativeness scenario of the *Haor* farmers was not satisfactory, they were found venturesome for full swing use of some particular technologies within the year of its availability in the market contrarily to their usual practices. The degree of innovativeness to each of selected 10 technologies is described below.

Innovativeness towards weedicide and insecticide

In *Haor* area, a number of weedicides and insecticides with various trade names were used by the *Haor* farmers, among which *Rifit* and *Virtako* have been dominated for the years to most of the farmers. The most of the farmers irrespective of their socio-economic-psychological features were seemed much more venturesome to use weedicide in *Boro* fields as manually weed control is time and labor consuming. The other advantages of weedicides use perceived by them were; it could be apply at any time within seven days after completion of transplantation; if the weedicide for any reason failed to suppress growing of weeds, they would go for alternate measures to control it which ultimate quicken decision about weedicide, besides economic benefits. Hence, the use of *Rifit* (weedicide) ranked top (mean use score 15.14 out of 20.0) among all other technologies employed in *Boro* rice production in Haor area (Table 5).

In contrast, a huge pressure of stem borer (*Scirpophaga incertulus*) in the rice fields as this crop mostly grown in rain-fed condition in *Haor*, the mean use of insecticide (*Virtako*) was almost half (score 7.11; ranked 2nd)

compare to weedicide use. The presence of good number of IPM clubs in the *Haor* areas might have impact in lessening indiscriminate use of it at the farmers' level.

Innovativeness towards modern rice variety

No particular rice variety has yet been developed by the research institutes of the country that can fit exactly to the peculiar condition exist in *Haor* area. However, in order to have safe harvest of crop from flash flood hazards, farmers transplanted long duration variety BRRI dhan29 (165 days) in kanda lands (comparatively high elevated area) where risk of flash flood is always low and in the deep *Haor* area they transplanted BRRI dhan28 for its shorter duration (145 days) although the yield of this variety (5.0 t/ha) was much lower than BRRI dhan29 (7.2 t/ha). However, the innovativeness of the farmers towards BRRI dhan28 ranked 3rd (mean use score 2.0 out of 20.0) among the 10 selected technologies (Table 5) and for the other rice varieties like BRRI dhan29, BRRI dhan58, BRRI dhan64 and BRRI dhan62 were 5th, 6th, 8th and 10th, respectively. Although BRRI dhan28 is an old age variety and became susceptible to disease and insect but no other varieties could prove their worth better than this variety regarding secured harvesting.

Table 5. Rank order, mean, highest possible score and actual scores of the 10 selected rice farming technologies

Name of crop production technology	Possible highest score	Observed highest score	Observed mean	Rank order
Rifit	20	20	15.14	1
Virtako	20	20	7.11	2
BRRI dhan 28	20	20	2.00	3
Mechanical harvester	20	10	1.63	4
BRRI dhan 29	20	20	1.01	5
BRRI dhan58	20	20	0.93	6
MoP	20	20	0.81	7
BRRI dhan64	20	10	0.80	8
TSP	20	20	0.75	9
BRRI dhan62	20	20	0.24	10

Table 6. Distribution of the farmers according to the category given by Rogers (1983) based on innovativeness

Selected technology	Innovator (%)	Early adopter (%)	Early majority (%)	Late majority (%)	Laggard (%)
i. Weedicides and pesticides: *Rifit* and *Virtako*	8.0	22.5	36.0	22.5	11.0
ii. Variety: BRRI dhan 28, BRRI dhan29, BRRI dhan58, BRRI dhan62, BRRI dhan64	2.0	12.5	34.0	37.5	14.0
iii. Fertilizers: TSP and MoP	1.0	8.5	36.5	36.0	18.0
iv. Machinery: Harvester	1.0	6.5	32.0	40.5	20.0
Average	3.0	12.5	34.6	34.1	15.8

Innovativeness towards fertilizers

Despite having substantial contribution of urea in yield and growth of paddy this chemical fertilizer was discarded from this study since all of the respondents applied this fertilizer in adequate amount to grow their

crop. The innovativeness of the farmers to two important fertilizers like MoP and TSP ranked 7th and 9th, respectively. A few numbers of farmers were found to apply MoP fertilizer below the recommended doze while most of them were reluctant about TSP fertilizer.

Innovativeness towards machinery

Likewise the use of urea fertilizer in the study area, all of the respondents had plowed their lands with power tiller. So, it was also discarded from the list of technology on which the innovativeness was measured. The other mechanical equipment was harvester on which innovativeness ranked 4th, the mean use score was 1.63 out of 20. In labor scarce *Haor* area farmers had strong urge about this machine for relatively quicker and cheap way to harvest their paddy. But they could not afford it because of high price. Recently government is providing up to 70% subsidy in purchasing power tiller for the *Haor* farmers but the allocation is negligible compare to demand.

Conformity of Innovativeness of Farmers of Haor Areas with Category Given By Rogers (1983)

The Table 6 revealed that *Rifit* (weedicide) and *Virtako* (insecticide) were adopted by the highest proportions (8%) of the farmers under innovator category compare to other rice production technologies. The other users were 22.5% early adopter, 36% early majority, 22.5% late majority and 11% laggard. Farmers under innovator category were the most venturesome and took the risk of using new chemicals in their paddy fields within the year available in the market. However, increased use of pesticides, especially weedicide in *Haor* area though proved its worth as cost effective to rice production; it might have adverse impact on flora and fauna that is being ignored. However, farmers of study area preferred weedicide mainly due to the relatively quick action, cost effectiveness and relief from the labor crisis in *Haor* area.

Innovator

In contrast, adopting new modern rice variety, recommended dose of TSP and MoP and farm operation machineries they were only 2%, 1% and 1%, respectively. However, the average account for using all selected 10 technologies for rice production, 3% respondents were found innovator. Rogers (1983) in this regard revealed that only about 2.5% of the farmers were under innovator category in adoption of agricultural technology.

Early adopter

The innovators take quickly decision towards new technologies and ideas but the farmers under this group were more concerned about their reputation and propelled the trend of mass adoption of rice farming technologies. However, their average innovativeness score was 12.5% which is slightly deviated of the finding of indicated by Rogers (1983) that 13.5% farmers are early adopters in using agricultural technologies.

In case of individual technology adoption, the Table clearly indicates that more number of respondents (22.5%) were under early adopter category regarding use of both *Rifit* (weedicide) and *Virtako* (pesticide) while the use of other technologies like modern rice variety (12.5%), recommended dose of fertilizer (8.5%)) and farm operation machinery (6.5%) were significantly lower. This is due to the fact that, a considerable portion of farmers needed training, input supply, capital and efficient extension contact before making up their mind for adopting these practices that results in a adoption gap of two to three year time period. When they became capable of adopting these practices and known to their relative advantages; a larger number of farmers were identified as early adopter regarding adoption of these technologies.

Early majority

The farmers under this group (34.6%) made their decision about the listed technologies based on their utilities and practical benefits in a coolness manner but before long. The corresponding data against each type of technology adopted by the farmers under early majority category presented in the Table 5 had more or less conformity of the findings reported by Rogers (1983) that about 34% of the farmers showed those features in adoption of new agricultural technology.

Late majority

Despite having similarity with the farmers of early majority group, the farmers (34.1%) under late majority group were more cautious before committing; needing more hand-holding as they had already adopted. But for the particular case for instance pesticide use; a good number of them were hurried to adopt this technology because of its immediate results which was evident by poor corresponding figure (22.5%) against this technology. On the contrary, more number of farmers (40%) was found under this category in case of adopting mechanical harvester. This might be the result of low economic ability of farmers for which they could not afford such high price implement in rice farming.

Laggard

Laggards were slow to adapt the modern technologies which were noticed in this study. Economic inability and ignorance about the benefits of the technologies might push them in delayed adoption. To this, considerable numbers of them were still skeptical and had a traditional mindset against adoption of a new practice; they were the last in adopting the technologies. In addition to that, because of the relative unavailability and higher price of the fertilizers, limited market access and lack of extension contact of the farmers and their ignorance about the necessity of fertilizer use in the rice field; they often left behind in adopting this practice than others that indicates a larger percentage of laggard farmers than the result of Rogers (1983) that 16% were laggard. However, about 15.8% of the respondents were under this category. In case of innovativeness towards individual technology use, they were found more innovative in adopting pesticides as well as recent modern variety of rice that far less farmers were under these technologies (11% and 14%, respectively) compared to the finding indicated by Rogers (1983).

Relationship between the selected characteristics of the Haor farmers with their innovativeness

The innovativeness of an individual is generally influenced by his personal, social, psychological and economic characteristics. Pearson's Product Moment Co-efficient of Correlation (r) was employed to determine if there exists any relationship between the innovativeness of the farmers with their characteristics.

Table 7. Co-efficient of Correlation (r) between selected characteristics of the farmers and their innovativeness regarding adoption of farming technology.

Selected characteristics				Co-efficient of correlation (r) with 248 df		
	Mean	Range		Calculated value	Tabulated value	
		Minimum	Maximum		0.05 level	0.01 level
Age (year)	44.8	22.0	72.0	0.122^{NS}		
Education (grade)	3.4	0.0	12.0	0.169^{**}		
Family size (number)	7.5	3.0	16.0	-0.048^{NS}		
Farm size (acre)	1.5	0.4	6.7	0.112^{NS}		
Annual income (unit Tk.10,000')	15.3	6.5	50.0	0.190^{**}	0.124	0.162
Farming experience (year)	25.0	10.0	50.0	0.018^{NS}		
Training experience (days)	2.8	0.0	7.0	0.145^{*}		
Extension contact (frequency with different media/year)	22.3	6.0	46.0	0.188^{**}		
Agricultural knowledge (score)	25.6	20.0	38.0	0.177^{**}		
Attitude towards modern production practices (score)	18.5	3.0	22.0	0.148^{*}		

***** Correlation is significant at the 0.05 level, ** Correlation is significant at the 0.01 level

Results from Table 7 indicated that, respondents' age, family size, farm size and farming experience had no significant relationship with their innovativeness regarding adoption of various technologies in Boro rice production. Similar findings were revealed by Karim (1973), Sobhan (1975), Hossain (1981) and Gangadharappa (1981) in their respective studies. On the other hand, farmers' education, annual income, training experience, extension contact, agricultural knowledge and their attitude towards modern production

practices had significant relationship with their innovativeness. The average formal education of the farmers of *Haor* areas was primary level (3.4). However, it might have significant influence on understanding a new idea or technology and broaden their outlook and horizon of knowledge. So they become interested about any innovation and rational thinking about adopting the technology in their own fields. Similar findings were revealed by Reddy and Kivlin (1968), Mannan (1972) and Karim (1973) in their respective studies. The average annual income of Haor farmers was BDT 1,50300. The higher the annual income of the respondents the more is their innovativeness. Farmers of solvent families are more able to take risks as they can invest more money in their farm practices and can afford the required inputs, fertilizers and mechanical and man power requirements. Similar findings were reported by Reddy and Kivlin (1968), Hossian (1971) and Mannan (1972) in their respective studies.

Training experience of the respondents also had significant relationship with their innovativeness such as higher the training experience, the more the innovativeness of the farmers as understanding power of a trained individual about new idea or technology is more than the untrained ones. Thus, training changed their outlook and broaden the horizon of knowledge. So, they become interested about any innovation and want to adopt them in their field condition. Similar findings were revealed by Reddy and Kivlin (1968), Hossian (1971), Mannan (1972) and Karim (1973) in their respective studies.

The extension contact also had significant relationship with their innovativeness as the farmers having high extension contact can change their understanding by sharing ideas and views with other person. So steps should be taken to increase the farmer's extension contact for better agricultural practice. Budihal (1983), Haque (1984) and Bavalatti and Sundaraswamy (1990) revealed similar findings in the respective studies.
Respondents' agricultural knowledge also had significant relationship with their innovativeness regarding crop production practices. To adopt a new practice in agriculture require a clear conception on various agricultural techniques and procedures and a farmers with required knowledge can remove the hesitation to adopt the practice by utilizing the modern agricultural knowledge gained from their neighbors, friends, relatives, progressive farmers, result demonstration etc. Budihal (1983), Haque (1984) and Bavalatti and Sundaraswamy (1990) revealed similar findings in the respective studies.

In addition, the attitude of the farmers towards modern crop production practices also had significant relationship with their innovativeness regarding crop production practices. The farmers having the higher attitude towards modern agricultural practices generally have the higher innovativeness as well as have positive tendency to the new technologies.

The overall innovativeness of the farmers of *Haor* areas towards securing safe and increased production of Boro rice was not at all satisfactory in terms of technology employed, especially rice varieties and dozes of TSP and MoP fertilizers applied in Boro rice production which was evident by slower rate of adoption of BRRI dhan58, BRRI dhan62 and BRRI dhan64. But to some technology like weedicide, the innovativeness seemed to be much quicker and higher because of its immediate economic benefits and efficacy to control weed. Hence, it may be concluded that *Haor* farming is still lacking of appropriate technology; availability of technologies appropriate to *Haor* context might impact on quickening farmers' decision to make them use in their fields. As farmers training and extension contact had significant influence on innovativeness, improvement of these two variables could upgrade the present situation. Mass program on hand-on training for the farmers about the available technologies of modern rice production would certainly increase their skill and thereby the production and income; and information about the potential farming technology need to make available at the farmers' premises for their better option. Farmers' education, annual income, agricultural knowledge and attitude towards modern crop production practices had a positively significant relationship with their innovativeness suggests that these factors could act as a major facilitator to develop a more enthusiastic and innovative mindset among the farmers of *Haor* areas.

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