

Farmers' Perception on Environmental Impact of Rice Monoculture in Bangladesh

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ABSTRACT

The main purpose of the study was to assess the farmers' perception on environmental impact of rice monoculture. Data were collected from randomly selected 120 rice growers using pre-tested interview schedule during 15 January to 14 February, 2011. Majority of the respondents were found old aged having no education level, small family size, medium farm size, medium level annual income, medium extension contact, medium organizational participation, low participation in farming and medium innovativeness. The findings revealed that, in case of dependent sub variable production and soil management aspects; farmers education, family size, farm size, annual income, extension media contact, organization participation, direct participation in farming and innovativeness in rice farming had positive significant correlation, but age had negative significant relationship. Moreover, in case of dependant sub-variable environmental aspects; extension media contact, organizational participation, direct participating in farming and innovativeness in rice farming had positive significant relationship. Besides, in case of dependent sub variable economic aspects; direct participation in farming had positive significant relationship. Furthermore, in case of dependent sub-variable socio-cultural aspects; only direct participation in farming had positive significant relationship where farm size had negative significant relationship. Best alternative to rice monoculture may be 'Rabi (potato/ vegetable/ mustard/ pulse) - Maize - T.Aman rice' for medium high land and 'Rabi - Fallow - B. Aman' for medium low land. Though, rice monoculture has negative impact on environment and other selected aspects but farmers are interested to adopt it because of staple food crop, easy to marketing and bringing more benefit than other competing crops.

Keywords: Perception; Environmental impact; Rice monoculture;

Bangladesh is predominantly an agriculture based country with more than 146.1 million people living on 14.84 million hectares of land. The population is expected to increase, by the year 2050, around 200 million. As staple dietary item per capita rice consumption is about 166 kg/year (BBS, 2010). It alone provides 76 per cent of calorie and 66 per cent of total protein requirement of daily food intake (Bhuiyan et al, 2002). It also contributes around 11 per cent of total agricultural GDP and employs about 43.6 per cent of total labor forces.

Rice (*Oryza sativa* L.) belongs to cereal crops under Gramineae family. It is one of the most extensively cultivated cereals of the world, including Bangladesh that feeds half of the total world population. The total area of rice in Bangladesh is about 10.83 million hectares with a production of 28.18 million metric tons (BBS,

2009). AIS (2004) reported that rice is extensively grown in Bangladesh in three season's viz. *Aus*, *Aman* and *Boro* rice, which was 80 per cent of the total cultivable area of Bangladesh.

Since last three decades, food production was raised substantially in Bangladesh. To make such gain in agriculture sector, majority of the cultivated lands were brought under rice production. In many areas farmers are now used to produce rice years after years with no other crop in cropping pattern. This continuous rice cultivation (or rice-rice cropping pattern) has been termed as 'rice monoculture' (Buresh and Haefele, 2010). Monoculture is the agricultural practice of producing or growing one single crop over a wide area year after year. It is widely used in modern industrial agriculture and its implementation has allowed for large

harvests from minimal labor. However, monocultures can lead to the quicker spread of diseases, where a uniform crop is susceptible to a pathogen. 'Rice monoculture' is the practice of growing the same crop year after year (Shipton, 1977).

Moreover, green revolution in rice led to use of modern agricultural technologies such as high yielding varieties, planting system, cropping pattern, irrigation, fertilizers, pesticides etc. Due to introduction of these technologies in rice farming several impacts have appeared to the environment. In recent years, the issue of environmental degradation has caused greater concern both nationally and internationally. Conway (1990) mentioned that agriculture and environment interact in such a way that agricultural growth depends on the proper functioning of the environment process and the same way that environmental soundness depends upon agriculture.

According to McGraw-Hill (2004) - perception is the process of registering sensory stimuli as meaningful experience. The differences between sensation and perception have varied according to how the terms are defined. A common distinction is that sensations are simple sensory experiences, while perceptions are complex constructions of simple elements joined through association. Another thing is that perception is more subject to the influence of learning. Though hearing, smell, touch, and taste perceptions have all been explored, vision has received the most attention. In philosophy, psychology, and cognitive science, perception is the process of attaining awareness or understanding of sensory information.

Nevertheless, the impact of rice monoculture was not assessed until now. Hence a study was conducted to assess and evaluate farmers' perception on environmental impact of rice monoculture in Bangladesh. The main purposes of the study were - to describe socio-economic characteristics of farmers; to assess the farmers' perception on impact by rice monoculture; to explore the relationships between dependent and independent variables. Farmer has also been asked the reason to adopt rice monoculture instead of different cropping pattern. In addition, they given answered what are the benefits obtained from rice monoculture.

METHODOLOGY

The study was conducted in five upazilas namely Chandpur sadar, Faridgonj, Haimchar, Kachua and Matlab dakhin under Chandpur district of Bangladesh.

Total number of farmers in five upazillas was about 5 lacs, of which, 1200 farmer constituted population of the study and 120 farmers (10 % of total population) were selected randomly as the respondents taking 24 from each upazilla. A pre-tested interview schedule was used to collect data from the respondents during 15 January to 14th February 2011. Age, education, family size, farm size, annual income, extension contact, organizational participation, direct participation in farming and innovativeness were considered as independent variable whereas farmers perception on impact of rice monoculture was considered as dependent variable which has four sub-variable namely agricultural production, environmental aspects, economic aspects and socio-cultural aspects. Each sub-variable contained five statements where every statement was evaluated by using a five-point Likert scale (Likert, 1932). The agreements were strongly agree, agree, no opinion, disagree and strongly disagree and weights assigned for different agreement were 5, 4, 3, 2 and 1 respectively.

In case of getting suggestion of different cropping pattern for existing two categories of land types medium high land and medium low land in the study area, respondents provided their opinion regarding possible cropping pattern instead of rice monoculture expressed in percentage as well as in rank order. A few terminologies used in this study were Rabi, B. Aman, and Mixed B. Aus. Aman rice broadcast after rabi crop harvest, while aus rice harvests before aman rice which needs longer to mature, where Rabi-the crops that are sown in the winter season are called rabi crops; B. Aman- Broadcast Aman (B. Aman) rice varieties generally sown in March and April and harvests during November and December. Moreover, farmers' opinion regarding benefits obtained from rice monoculture on 10 selected statements presented in rank order. Also, respondent had been asked to put suggestion regarding adoption of different cropping pattern instead of rice monoculture. Pearsons coefficient of correlation was computed to find out the relationship between dependent and independent variables.

RESULTS AND DISCUSSION

Socio-demographic Characteristics : The data placed in Table 1 revealed that majority (65%) of the respondents were young to middle aged. Their average educational qualification was 8.28 years of schooling and most of them (72%) were literate but 28 percent of the respondents could not exceed primary level, while

rest of them were illiterate. Average family size of the respondents was 4.92 and most of them (68%) were in medium to small category. Average farm size of them was 0.7 ha. and all (98 %) of the respondent had marginal to medium farm size. Their average annual income was 76.18 thousand taka and most of them (72%) had low to medium annual income. Majority of the farmer (69%) had low to medium extension media contact. An overwhelming majority (68%) had low to medium organizational participation. In case of direct participation in farming, majority of the respondents (76 %) had low to medium participation in farming. In addition, majority of the respondents (64%) had low to medium innovativeness on rice farming (Table 1).

Perception of the farmers regarding rice monoculture: The possible perception score of each statement ranged from 120 to 600. All the statements under each sub variable were ranked according to total score. Data contained in Table 2 revealed that due to rice monoculture farmers faced different problems in production and soil management among them major problems was hardening of soil and it was followed by more infestation of disease and insect and decreasing land fertility. Regarding environmental aspects, major problems were poisoning of surface water and it was followed by decreasing beneficial biological organism and causes health hazards. In case of economic aspects, decreasing net profit due to increasing cost of production, decreasing grazing land creates unemployment due to rice monoculture were problems as perceived by the respondents. In case socio economic aspects, malnutrition, conflicts for irrigation and lack of labor in rice cultivation were major problems due to rice monoculture as perceived by he respondents.

Relationship between selected characteristics of respondents and dependent variables : In case of dependent sub variable agricultural production; farmers education, family size, farm size, annual income, extension media contact, organization participation, direct participation in farming and innovativeness in rice farming had positive significant relationship, but age had negative significant relationship (Table 3). These scenarios indicated that educated farmers were efficient enough producing more yield by adopting modern agricultural technology. Besides, more number of family members who involved as farm labour as well as having bigger size of farm provided increased amount of

Table 1. Distribution of the respondents according to their selected socio-demographic characteristics (N-120)

S. No.	Characteristics	Respondents		Mean	SD
		No.	%		
1.	Age (yrs)			46.21	9.33
	Young(up to-30)	39	32.5		
	Middle (>30-45)	39	32.5		
2.	Old(>45)	42	35.0	8.28	3.26
	Education (yrs of schooling)				
	Illiterate (0)	34	28.3		
	Primary(1-5)	33	27.5		
3.	Secondary (6-10)	27	22.5	4.92	1.52
	Higher secondary and above (11-16)	26	21.5		
	Family size (Numbers)				
	Small (up to 4)	50	41.7		
4.	Medium (5-7)	32	26.7	0.70	0.37
	Large (8 and above)	38	31.7		
	Farm size (ha.)				
	Marginal (Up to 0.5)	38	31.7		
5.	Small (0.6-1.0)	38	31.7	76.18	41.66
	Medium (>1.0-2.54)	42	35.0		
	Large (> 2.54)	2	1.67		
	Annual income (*Thousand BD Taka)				
6.	Low (up to-50)	40	33.3	36.98	5.98
	Medium (51-80)	46	38.3		
	High (>80)	34	28.3		
7.	Extensions media contact (Scores-0-45)			20.45	5.31
	Low (up to 15)	40	33.3		
	Medium (16-30)	43	35.8		
8.	High (>30)	37	30.8	17.91	2.31
	Organization participation (Scores-5-30)				
	Low(up to 10)	36	30.0		
9.	Medium (11-20)	45	37.5	30.90	2.48
	High (>20)	39	32.5		
	Direct Participation in Farming (Scores-0-36)				
9.	Low (Up to 15)	46	38.3	30.90	2.48
	Medium (16 to 25)	45	37.5		
	High (>25)	29	24.2		
9.	Innovativeness on rice farming			30.90	2.48
	Low (Up to 30)	34	28.3		
	Medium (31-35)	43	35.8		
	High (>35)	43	35.8		

*1\$ = 75 BD Taka

Table 2. Farmers' perception to individual statement regarding crop production and soil management, environmental, economic as well as socio-cultural aspects

S. No.	Statements	Extent of opinions					PI	Rank Order
		SA	A	NO	D	SD		
<i>A. Production and soil management aspects management aspect</i>								
1.	Soil is hardened because of only rice cultivation and same fertilizer use day after day	46	43	11	15	05	470	I
2.	The land fertility is being decreased because of chemical fertilizer and pesticide use at gradual increased rate as well as less use of organic fertilizer	42	35	18	15	10	444	III
3.	Soil erosion is being more on account of gradually rice cultivation	08	28	43	18	23	340	V
4.	More infestation of diseases and insects are being observed in crops	35	50	12	17	06	451	II
5.	Production is decreased for cultivating same variety rice for few year	38	42	07	20	13	432	IV
<i>B. Environmental aspects</i>								
1.	Bio-diversity is being decreased because of rice mono culture	30	21	17	32	20	369	IV
2.	Water is being poisonous for continuous pesticides and fertilizer use	48	32	20	12	08	460	I
3.	Pure water is lacking because of soil water table being polluted	15	21	38	25	21	344	V
4.	The quantity of beneficial organisms (eg. Earthworm, frog) and useful insects are being decreasing in effect of gradual pesticide use or rice cultivation	45	34	22	13	06	459	II
5.	Health hazards of human and animal in various ways are being appeared as soil and water being polluted	40	28	25	20	07	434	III
<i>C. Economic aspect</i>								
1.	The cost of production or rice cultivation is increasing day by day cause of which the profit is decreasing	44	36	15	20	05	454	I
2.	Market price is decreased for increased production in any season	12	25	28	30	25	329	V
3.	The grazing land is decreasing for gradual rice cultivation as a result rearing of domestic animal is being troublesome	40	38	12	22	08	440	II
4.	Farmers' indebtedness and landlessness cost and less profit	18	28	35	28	11	374	IV
5.	The laborers of rural area are bound to be unemployed or several month for only rice cultivation all the year round	38	35	18	15	14	428	III
<i>D. Socio-cultural aspect</i>								
1.	Indigenous technical knowledge and related folklore are being lost because of gradual rice cultivation	20	25	15	40	20	345	V
2.	Lack of nutrition for decreasing other crops cultivation and production of domestic animal because of rice mono culture	51	40	24	05	0	497	I
3.	There is conflict among villagers for the issue of irrigation water	46	38	26	10	0	480	II
4.	On account of need more labor in rice cultivation farmers use children in it too; as a result children education are hampered	35	32	20	23	10	419	III
5.	The role of women in farming activities is decreasing day by day because of farmers' agriculture being rice cultivation-based	25	30	22	28	15	382	IV

SA = Strongly Agree (05), A = Agree (04), NO = No Opinion (03), D = Disagree (02), SD = Strongly Disagree (01); PI= Perception Index

agricultural production. Having higher amount of annual income, helped to invest more on farming activities provided more crop production. In addition, more extent of direct participation in farming saved using labourer also had a good chance to get efficient farm management resulting in producing more yield. Similarly,

extent of more media contact; organizational participation as well as innovativeness encouraged them to adopt new technology contribute to get increased quantities of farm production. On the other hand, young aged farmer engaged in farming activities got more yield than older aged farmer.

Moreover, in case of dependant sub-variable environmental aspects; farmers extension media contact, organizational participation, direct participating in farming and innovativeness in rice farming had positive significant relationship. It implied that more the extent of direct participation in farming had less chance to pollute environment. In addition, having greater extent of extension media contact; organizational participation as well as innovativeness in rice farming helped to keep environment unpolluted during rice cultivation. Besides, in case of dependent sub variable economic aspects; direct participation in farming had positive significant relationship. It indicated that farmers actually engaged themselves with agricultural activities usually there farming provide economically profitable return. In case of dependent sub-variable socio-cultural aspects; only direct participation in farming had positive significant relationship where farm size had negative significant relationship (Table 3).

Suggestions to adopt different cropping pattern instead of rice monoculture: Data placed in Table 4 indicates that best alternative of rice monoculture can be ‘ Rabi (potato/ vegetable/ Musturd/ pulse)- Maize- T.Aman’ as opined by overwhelming majority (80%) respondents incase medium high land, while, incase of medium low land, ‘ Rabi crops – Fallow – B. Aman ‘ as opined by 68.33 per cent respondents. Cropping pattern of ‘ Boro rice - Maize- T. aman’ remained 2nd rank order according to opined by 75 per cent respondent, in case of medium high land, but, in case of medium low land, ‘ Boro rice- Fallow – T.Aman’ remained 2nd according to opined of 54.17 percent

respondents. Besides, ‘Rabi (wheat) – B. Aus - T. Aman’ ranked 3rd according to 67.50 per cent respondents for medium high land, and in case of medium low land, ‘ Boro rice- fallow-fallow ‘ remained 3rd opined by 50.0 per cent respondents. Moreover, in case of medium high land, ‘Rabi crops - jute- B. Aman, ‘Rabi crops – Mixed B. Aus – B. Aman, and ‘ Mugbean – Fallow – T.Aman rice’ remained 4th, 5th and 6th opined by 62.50 per cent, 50 percent and 37.50 per cent respondent respectively (Table 4).

Farmer’s perceived benefit of rice monoculture: Data furnished in Table 5 indicated that 93 per cent respondents opined ‘rice is staple food crop ‘ ranked 1st among 10 statements. ‘Easy to marketing’ and ‘bringing more benefit than other crops’ remained 2nd and 3rd ranked according to 86 per cent and 84 per cent opinion respectively. This is may be due to the fact that people of Bangladesh intake maximum amount of their calories from this staple food. Also, rice has huge market demand. Farmer can easily sell their product in market for getting cash whenever necessary. Moreover, perhaps production cost of rice is comparatively less than any other crops they are being cultivated. Eighty three percent respondent opined that ‘rice cultivation is matter of prestige ‘ remained 4th in rank order. It might be due to those who have relatively more area under rice cultivation regarded as wealthy as well as dignified farmer. ‘Considering food security for future use ranked 5th with 81 per cent opinion of farmers (Table5). Actually, farmer can store rice for use or consumption in future or any stress condition. Moreover, ‘other crop can not cultivate adjacent to the rice field due to wet

Table 3. Coefficient of correlation between independent and dependent variables (n=120)

Independent variables	Correlation co-efficient (r) with dependent variables			
	Agricultural production	Environmental aspects	Economic aspects	Socio-cultural aspects
Age	-0.198*	0.060	-0.038	-0.110
Education	0.220*	0.200*	-0.100	0.030
Family size	0.195*	0.064	-0.014	0.042
Farm size	0.377**	0.009	0.041	-0.199**
Annual income	0.204**	0.081	0.038	-0.162
Extensions media contact	0.345**	0.189*	0.001	0.016
Organizational participation	0.305**	0.237*	0.055	0.034
Direct participation in farming	0.234**	0.213*	0.191*	0.186*
Innovativeness on rice farming	0.196*	0.262**	-.062	0.005

*Significant at 5 percent level, **significant at 1 percent level, and table value at 0.05 level= 0.183 and at 0.01 level= 0.227 with 118 df

Table 4. Suggestions to adopt different cropping pattern instead of rice monoculture (N= 120)

S. No.	Possible Cropping Pattern	%	Rank
<i>A. Medium High Land</i>			
1.	Rabi (potato/ vegetable/ musturd/ pulse)- Maize- T.Aman	80.00	I
2.	Boro rice - Maize- T. aman	75.00	II
3.	Rabi (wheat) – B. Aus - T. Aman	67.50	III
4.	Rabi crops- jute- B. Aman	62.50	IV
5.	Rabi – Mixed B. Aus – B. Aman	50.00	V
6.	Mugbean – Fallow – T. aman	37.50	VI
<i>B. Medium Low land</i>			
1.	Rabi crops – Fallow – B. Aman	68.33	I
2.	Boro rice- Fallow – T. Aman	54.17	II
4.	Boro rice- fallow-fallow	50.00	III

the land', 'rice can be stored for a long time', 'rice is comparatively short durated crop providing quick yield', 'rice cultivation is comparatively easy', and 'cultivation cost is low than other competing crop' were ranked 6th, 7th, 8th, 9th, and 10th with 76 per cent, 48 percent, 32 per cent, 30 per cent and 25 per cent opinion, respectively.

CONCLUSION

Rice cultivating farmer faced multifaceted problems during rice monoculture including/such as: soil compacting, depletion of same nutrition from soil, recurrence of same disease and insects, adjacent water sources of rice field

Table 5. Benefit obtained from rice monoculture

S.No.	Statement (s)	%	Rank
1.	Rice is staple food crop	93	I
2.	Easy to marketing	86	II
3.	Bringing more benefit than other crops	84	III
4.	Rice cultivation is matter of prestige	83	IV
5.	Considering food security for future use	81	V
6.	Other crop can not cultivate adjacent to the rice field due to wet the land	76	VI
7.	Rice can be stored for a long time	48	VII
8.	Rice is comparatively short duration crop providing quick yield	32	VIII
9.	Rice cultivation is comparatively easy	30	IX
10.	Cultivation cost is low than other competing crop	25	X

are being poisonous, increasing production cost of rice etc. However, farmer used to cultivate rice because it's their staple food crop, easy to marketing and yields were much profitable than any other crops so on so forth. Nevertheless, farmers were ready to incorporate crop diversification (different cropping pattern) instead of rice monoculture on their field.

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