Original Research Article

DETERMINANT FACTORS OF FARMERS' PERFORMANCE REGARDING FERTILIZER APPLICATION: AN OVERVIEW FROM BANGLADESH

ABSTRACT

Aims: Farmers of Bangladesh use a less amount of urea fertilizer compared to the nutrient requirement and soil fertility status. Hence, a significant gap between actual and recommended doses of fertilizers used by farmers have been reported in many instances. Therefore, this study assessed farmers' performance towards fertilizer application, and explored the contribution of selected characteristics on that performance.
Study design: This study employed a cross-sectional survey method using a correlational and descriptive research design.
Place and Duration of the Study: The study was conducted in twenty-one villages of Gaibandha district in Bangladesh during 17 July, 2017 to 20 September, 2017.
Methodology: A total of 355 farmers were selected as sample using multistage random sampling. Data, collected using structured questionnaire, were subjected to descriptive analysis, Pearson correlation and multiple linear regression for describing the level of selected variables, their relationships and their contributions on farmers' performance, respectively.
Results: Most (45.9%) of the farmers had high level of performance regarding fertilizer application. Farmers' age, household size, educational level, farm size, training received, extension media contact, knowledge and attitudes of farmers had positive and significant relationship with their fertilizer application performance. Regression model explained 45.3% of variance of farmers' performance where age, household size, farm size, training received, extension media contact, knowledge and attitudes of farmers were found significant predictors of farmers' fertilizer application performance. Knowledge was found to be the most contributing factor followed by age and training received.
Conclusion: The study concludes with recommendations that are expected to improving fertilizers application scenario of Bangladesh.

Key words: Fertilizer application, rice, farmers' performance, knowledge, attitudes.

1. INTRODUCTION

In the crop sector, rice is a dominant crop occupying about 75% of the total cropped area of Bangladesh [1]. Rice plays a vital role in contributing one-half of the agricultural GDP and one-sixth of the national average income in Bangladesh contributed by rice sector [2]. Despite having a suitable agro-climatic conditions to grow rice round the year, the national average rice yield of Bangladesh is much lower (2.94 t/ha) than that of other top rice-growing

countries [3]. Moreover, about 27.26 million tons of rice will require to feed its up growing population for the year 2020 [4]. Hence, there is a need to increase yield of rice from the present 2.74 to 3.74t/ ha [5]. Nevertheless, rice yield growth has slowed considerably in recent years and has failed to keep up with population growth [6]. Besides, unbalanced use of fertilizers is one of the main reasons that has favored the emergence of nutrient deficiency in Bangladesh soils [7]. Intensification of agricultural land use without proper replenishment of plant nutrients has caused depletion of fertility especially in the smallholder farms [8].

In Bangladesh, farmers were found to apply a less amount of urea fertilizer compared to nutrient requirements and soil fertility doses [9, 10]. Furthermore, the rates and times of applying nitrogenous fertilizer by farmers was not well matched to the needs of the crop for supplemental N [11]. Moreover, majority of farmers rarely apply fertilizer according to the recommendation from concern organizations such as Soil Resource Development Institute (SRDI) and Dept. of Agriculture Extension (DAE). Yield gap between research stations and farmers' fields is therefore effectively minimized through farmers' performance improvement in balanced fertilizer management [12, 13].

Several factors might affect farmers' performance to towards their use of agricultural practices such as farmers' attitudes, knowledge and support services and so on [14, 15]. Farmers' knowledge on Soil Testing and Fertilizer Recommendation Facilities (STFRF) was reported to be a significant determinants of farming performance [16]. In the context of fertilizer, farmers' local knowledge about soil fertility and management strategies play a vital role [17]. For any technological and management interventions, users' knowledge and attitude were found to be critical [18, 19]. Studies showed that a number of characteristics of individual affect the quality and quantity of his farming performance [20, 21]. Elsewhere it was reported that farmers' socioeconomic factors along with their knowledge on the subject matter affect their of soil fertility management [22, 23].

A number of studies have been performed on farmers' fertilizer management in Bangladesh however those mainly focused on impact of excessive use of fertilizer [24,25, 26]. On the contrary, other studies reported farmers' less use of fertilizers compare to their recommended dozes due to resources constraints [16, 27, 8]. Furthermore, rural farmers lack of knowledge regarding the importance of applying recommended doses of fertilizer for better production. Research is very rare to study the extent of farmers' performance regarding fertilizer application and what psychological and socio-economic factors are in fact influence that performance. Measurement of farmers' performance in farming practices has already been gained attention in academic research such as Sayang [28] analyzed work performance of paddy farmers in Gambia; Hassan [29] studied paddy farmers' personality traits in Malaysia, Nkari et al. [30] determined commercial farmers' performance in Kiambu County, Kenya. A wide range of factors including farmers' demographical, psychological and economical characteristics [31] however so far no research was reported in the context of Bangladesh. This study was therefore designed to study farmers' current level of performance to fertilizer management and to identify the factors and their contribution to farmers' performance to fertilizer application in rice cultivation. Therefore, the following objectives were formulated:

i. To determine the level of farmers' performance towards fertilizer application;
ii. To assess the selected characteristics (age, educational level, household size, farm size, annual income, extension media contact, training received, knowledge and attitudes) of the farmers towards fertilizer application;
iii. To investigate the relationship among the selected characteristics of the farmers with their performance towards fertilizer application;
iv. To explore the contributions of the selected characteristics of the farmers on their performance towards fertilizer application;

UNDER PEER REVIEW

2. MATERIAL AND METHODS

A cross-sectional survey method was used to administer this research. In order to collect relevant data for a pre-determined sample a structured interview schedule was carefully prepared included both open and closed form questions.

2.1 Location, Population and Sample

To identify the study location and determine the study sample, a multi-stage sampling procedure was adopted [32]. First, Gaibandha one of the major rice growing districts of Bangladesh was purposively selected. Second, three (3) upazilas (Sub-district) namely Gobindho Gonj, polash Bari and Shadulla Pur out of five (5) upazillas (Sub-district) of Gaibandha district were chosen randomly. Third, seven (7) villages from each upazila were randomly selected. Thus, a total of twenty one (21) villages were constituted the locale of this study. All the rice farmers from the identified villages was comprised the population of the study which constituted a total of 3762, 355 farmers. Based on Krejcie-Morgan [33] Table, 355 farmers were represented as the study sample. Respondents were selected from each village using proportionate random sampling technique.

2.2 Validity and Reliability Analysis

To ensure the content validity, initial pool of items for interview schedule were sent to a group of experts from representing different universities. Based on their responses, the questionnaire was finalized and sent to 20 non-sampled rice farmers who were randomly selected for pre-testing. Cronbach's Alpha test is utilized to measure the items under each construct in the questionnaire. In the current study, the Cronbach's for the statements of work performance, knowledge and attitudes was 0.862, 0.830, and 0.770, respectively. According to rule of thumb given by the researchers [34, 35], if Cronbach's Alpha value is > 0.9 means Excellent, >0.8 means Good, >0.7 means Acceptable > 0.6 means Questionable, >0.5 means poor, and <0.5 means Unacceptable. Based on rule of thumb, the Cronbach's Alpha values of the items were found reliable.

2.3 Measurement of Dependent Variable

The dependent variables of the study was farmers' work performance towards fertilizer application. Fourteen (14) statements related to fertilizer application in rice were employed for judging the work performance of farmers. The Likert scale is highly applicable technique to measure work performance [28]. For this research, the researcher employed five points Likert scale [36] and farmers were requested to specify their degree of agreement and disagreement against fourteen (14) statements. The scores were assigned as 5 for strongly agree, 4 for agree, 3 for not sure, for disagree and 1 for strongly disagree. Shah [37] employed similar technique to measure the work performance among potential paddy farmers in Malaysian granary areas.

2.4 Data Collection and Statistical Analysis

Data were collected from respondent farmers in face-to-face setting during July to September, 2017. Statistical Package for Social Science (SPSS) v_ 23 was employed for analyzing data. To achieve the objectives of the study, descriptive statistics including frequency count, percentage, mean and standard deviation was computed. Data were classified in to different groups for better understanding and interpretation of the

UNDER PEER REVIEW

phenomenon of interest. Besides, Pearson correlation and multiple regression with 0.05 and 0.01 level of probabilities were performed for exploring the inter-relationship and determining the contribution of the selected characteristics of farmers to their performance towards fertilizer application respectively. The multiple regression works with the following formula:

$Y = b_o + b_1 x_1 + b_2 x_2 + \cdots + bk\ xk + \epsilon$ ---------- (1)

Here, Y is the probability of farmers' performance as the dependent variable, X1, X2 ….. Xk indicate the independent variables such as age, educational level, household size, farm size, annual income, extension media contact, training received etc., while b1, b2… bk are the regression coefficients of independent variables and b0 is the constant.

3. RESULTS AND DISCUSSION

This section is organized as follows. First sub-section deals with farmers' selected characteristics. Second sub-section discusses farmers' performance towards fertilizer application while third and last sub-sections describe interrelationships and contribution of farmers' selected characteristics towards their performance.

3.1 Level of Selected Characteristics of Farmers

Table 1 depicts farmers' selected characteristics. It showed that the highest percent (25.9%) of the respondents fall in to 41-50 years of age category while the lowest portion (12.1%) of them belonged in the group of up to 30 years. Age is recognized as an important factor to adopt any technology including fertilizer application by several researchers. Chakrabarty et al.'s [38] study mentioned major portion (50%) of the farmers fall in between 41 - 50 years of aged group in using fertilizer and pesticide for crop production in Bangladesh. Majority (62.5%) of the respondents had small house hold size consisting of 4 to 6 members whereas the lowest percentage (9%) of respondents had large household size having 10 or more family members. Due to the increased awareness among the people about birth control, increased livelihood expenses and increased women involvement with income generating activities, the average household size in in Bangladesh is gradually decreasing [39]. A considerable portion (40.3%) of farmers were illiterate which is lower than the average literacy rate of Bangladesh [40]. A little above one-fourth of the farmers (26.8%) had secondary education and 4.2% of them completed graduation. Concerning annual income, majority (57.7%) of the respondents had less than 100 thousand BDT (1 USD= 84 BDT). The results are consistent with Kabir's [39] findings reported that highest percentage of farmers were illiterate (52.3%) and had annual income (36.9%) of less than 100 thousand BDT. The highest portion (71.3%) of the respondents had marginal farm size having less than 0.6 hectare of land (based on classification of the Ministry of Agriculture, Bangladesh) which is in line with the previous research conducted by Akanda et al. [41] on rice farming system in Bangladesh and indicated the highest number of farmers had less than 1 ha of land.

Regarding training, 47% of farmers didn't received any kind of training while 33.8% and 3.75% of them received short duration and long duration training, respectively. Among the respondents 53% of farmers had participated in various agricultural training programs. Receiving of training enhances farmers' knowledge on new techniques of handling higher agricultural production. Besides, major portion (50.7%) of respondents had moderate extension media contact. This findings are supported by Debashish et al. [42] who explained that most of the farmers received short duration training and had moderate level of media contact. About half of the farmers had moderate level of knowledge (51.8%) and favorable attitudes (52.4%) on fertilizer application. A farmer having adequate knowledge can judge a situation more clearly and understand what technology should apply in his field. This finding is supported by Basak et al. [43] who stated that highest portion of the farmers had moderate

UNDER PEER REVIEW

level of knowledge (47.62%) and showed favorable attitudes (57.14%) on granular urea application in rice cultivation.

Table 1. Distribution of farmers according to their socio-economic characteristics

Variables	Level	Frequency	%	Mean	SD
Age (years)	≤30	43	12.1	48.12	13.62
	31-40	72	20.3		
	41-50	92	25.9		
	51-60	83	23.4		
	>60	65	18.3		
Household size (No. of persons)	Very small (1-3)	58	16.3	5.27	1.76
	Small (4-6)	222	62.5		
	Medium (7-9)	66	18.6		
	Large (≥10)	9	2.5		
Educational level (yrs. of schooling)	Illiterate (0)	143	40.3	5.09	4.63
	Primary (1-5)	79	22.3		
	Secondary (6-10)	95	26.8		
	Higher secondary (11-12)	23	6.5		
	Graduation (≥13)	15	4.2		
Annual income ('000' BDT)	>100	205	57.7	106.04	76.02
	100-150	73	20.6		
	>150-200	34	9.6		
	>200-250	21	5.9		
	>250	22	6.2		
Farm size (Hectare)	Marginal (<0.6 ha.)	253	71.3	0.50	0.38
	Small (0.6-<1 ha.)	73	20.6		
	Medium (1-<3 ha.)	26	7.3		
	Large (≥3 ha.)	3	.8		
Extension media contact (Score)	Low (≤2.33)	142	40.0	2.45	0.72
	Moderate (2.34-3.66)	180	50.7		
	High (≥ 3.67)	33	9.3		
Training received (No. of days)	No training (0 days)	167	47.0	5.09	6.35
	Short duration (1-10 days)	120	33.8		
	Medium duration (11-20 days)	55	15.5		
	Long duration (>20 days)	13	3.7		
Knowledge on fertilizer application (Score)	Low (≤2.33)	42	11.8	3.34	0.70
	Moderate (2.34-3.66)	184	51.8		
	High (≥ 3.67)	129	36.3		
Attitude towards fertilizer application (Score)	Highly Unfavorable (≤2.00)	31	8.7	3.13	0.63
	Unfavorable (2.01-3.00)	117	33.0		
	Favorable (3.01-4.00)	186	52.4		
	Highly Favorable (≥4.01)	21	5.9		

3.2 Level of Performance of Farmers towards Fertilizer Application in Rice Cultivation

Table 2 innumerate farmers' level of performance towards fertilizer application in rice cultivation. The mean (M) and standard deviation score was 3.39 and 0.737 respectively. Highest portion (45.9%) of the respondents experienced a high level of performance, 38.3%

UNDER PEER REVIEW

considered a moderate level and only 15.8% indicated low level of performance. This findings is supported by Syang [28] who found that highest portion (51%) of paddy farmers had high level of performance in Central River Region in Gambia. However, Nkari et al. [30] found that most of the commercial farmers had low level of performance in Kenya. Khalil et al. [44] explained that highest portion (60.7%) of the extension workers had medium performance level in Yeamen.

Table 2. Distribution of farmers according to their performance towards fertilizer application

Level	Frequency	%	Mean	SD
Low (≤2.33)	56	15.8	3.29	0.74
Moderate (2.34-3.66)	136	38.3		
High (≥ 3.67)	163	45.9		

3.3 Relationship between Farmers' Selected Characteristics and their Performance towards Fertilizer Application

The calculated and tabulated correlation coefficient values (r) at 1% and 5% level of significance has presented in Table 3. The result revealed that age, household size, educational level, farm size, training received, extension media contact, knowledge and attitudes of farmers had positive significant relationship with farmers' performance towards fertilizer application. This result implies that higher of these eight selected characteristics of farmers will result to higher the level of their performance and vice versa. According to Oluwatusin and Shittu [45], the main determinants of yam production performance were age and educational level of the farmers which had positive coefficients as well as statistically significant. Household size has positive relation with adoption of improved technology of soil fertility [46]. Farm size of farmers was positive and significantly related with the farmers' output in Nigeria [47]. Factors like extension contact and training of farmers showed significant positive relation with ISFM adoption [48]. Similarly, Wei and Chu [49] performed a survey on individuals in the service industry and found that attitude towards work had a positive relation on performance. That means better work attitude leads to better performance. In addition, knowledge and individuals' performance significantly related [50]. Despite annual income of farmer is important for crop production especially for input cost like fertilizer [51], this study found relationship between annual income of farmers and their performance regarding fertilizer application was not significant. This result is in line with Bremmer et al. [52] reported non-significant relationship between farmers' income and their farm development activities in Netherland.

Table 3. Relationships among the selected characteristics of the farmers with their performance towards fertilizer application

Dependent variable	Independent variables	Pearson correlation coefficient (r) value with 353 d.f.	Tabulated value of 'r'	
			0.05 level	0.01 level
Farmers' Performance towards fertilizer application	Age	.350**	.105	.137
	Household size	.227**		
	Educational level	.106*		
	Annual Income	.034		
	Farm size	.248**		
	Extension media contact	.255**		
	Training received	.202**		
	Knowledge on fertilizer	.571**		

UNDER PEER REVIEW

	application			
	Attitude towards fertilizer application	.291**		

**Significant at 0.05 level of probability, and **Significant at 0.01 level of probability*

3.4 Estimation of Identifying the Contributing Factors on Farmers' Performance towards Fertilizer Application

Table 4 shows the multiple regression coefficients (R) value is .701, which indicates that there is high deal of variance exist in between the selected characteristics of farmers and their performance. R2 value is .479 indicates 45.3% of the variance of farmers' performance is explained by the selected characteristics of farmers in the model. The F-ratio (37.129) was significant at 1% implying goodness of fit of the model.

As depicted in Table 4, seven characteristics of farmers i.e., age (P = .000), household size (P = .005), Farm size (P = .046), training received (P = .000), extension media contact (P = .000), knowledge (P = .000) and attitudes (P = .011) towards fertilize application are statistically significant predictors in explaining performance of farmers. On the other hand, annual income (P = .793) and educational level (P = .052) of farmers appear as statistically not significant to the variation of farmers' performance.

Table 4: Linear multiple regression model showing coefficients of performance of farmers with the contributing characteristics

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-.102	.213		-.481	.631
(X1) Age	.009	.002	.174	4.207	.000
(X2) Household size	.047	.017	.113	2.839	.005
(X3) Educational level	.013	.007	.081	1.954	.052
(X4) Annual Income	.000	.000	.011	.262	.793
(X5) Farm size	.165	.083	.086	2.003	.046
(X6) Extension media contact	.146	.041	.143	3.586	.000
(X7) Training received	.020	.005	.172	4.398	.000
(X8) Knowledge on fertilizer application	.507	.043	.479	11.821	.000
(X9) Attitude towards fertilizer application	.121	.047	.104	2.571	.011

R =.701; R^2 =.492; Adjusted R^2= .479; Std. Error of the Estimate = .532; F = 37.129; Sig. =0.000

Y (Farmers' performance) = -.102+ .009 X1 + .047 X2 + .000 X3 + .013 X4 + .165 X5 + .020 X6 + .146 X7 + .507 X8 + .121 X9 + e

The equation shows the probability of farmers' performance towards fertilize application. The summarized findings of the model explain 47.9% of the variance of the performance of farmers towards fertilize application. Hence, it can be said that the regression model fit the data and explanatory power of the model is significant. This finding is in line with Shah [37] who stated that coefficients farmers' performance model explained 44% variation on farmers' performance in rice cultivation in Malaysia.

UNDER PEER REVIEW

Moreover, the result explains that the highest Beta Coefficient (Standardized coefficient β) is .479 which is for knowledge on fertilizer application. It indicates that knowledge makes the highest contribution to explain farmers' performance on fertilizer application and change of one standard deviation in knowledge of farmers is followed by change of .295 standard deviation in their performance. The β value for age of farmers is the second highest .174, followed by training received, extension media contact, household size and attitudes of farmers in the third level .172, fourth level .143, fifth level .113 and sixth level .104 respectively. The β value for farm size is the seventh level .086. Hence, it was found that farmers who had one or more of these characteristics at the higher level, had the higher level of performance towards fertilizer application and it also encourage to farmers to apply fertilizer in rice cultivation.

This results showed the positive contribution of selected socio-economic and psychological characteristics of farmers to their performance towards fertilizer application. Previous research also support this findings such as Knowledge has a positive influence on individual work performance [53]. Bekele et al. [54] explained that individuals' work performance is significantly influenced by their attitudes. Oluwatusin and Shittu [45] found that yam production in Nigeria was positively influenced by age of the farmers. Training also had an influence on competency level of the farmers so that an individual can apply the acquired knowledge and skills from the training [55]. Farouque et al. [56] identified farm size and media contact of farmers as significant predictors producing positive regression coefficients on the perception to use integrated soil fertility and nutrient management for crop production in Bangladesh. Besides, Jackline et al. [57] provided supportive results that training and household size of farmers had been found to influence the decision to adopt improved technologies of soil fertility in Uganda.

Annual income and educational level are expected to be important predictors for fertilizer application, yet they were found to be statistically non-significant to farmers' performance regarding fertilizer application in this study. Similar trend is found from the study on performance of Agro-tourism farms in South Africa by Barbieri and Mshenga [58] who established that characteristics like entrepreneur's education level were found not to have a significant impact on performance of these farms. Debashish et al. [42] supported that annual family income of the farmers was not significant on problem faced by them during training in Bangladesh.

From the overall discussion it is clear that selected characteristics of farmers influenced their ability to achieve superior performance.

4. CONCLUSION

Farmers' high level of performance is very essential for improving rice production through effective and efficient fertilizer application. The results revealed that the major portion (45.9%) of the farmers had high level of performance regarding fertilizer application in rice that proved an opportunity for better production and a possible room for improvement. The finding indicated that, age, household size, educational level, farm size, training received, extension media contact, knowledge and attitudes of farmers had positive and significant relationship with their performance regarding fertilizer application. Therefore, these characteristics should be given greater attention in improving farmers' farming performance. Moreover, age, household size, farm size, training received, extension media contact, knowledge and attitudes of farmers were statistically significant as predictors in explaining performance of farmers. Hence, these selected characteristics of farmers are crucial to clarify the performance of farmers in applying fertilizer in rice cultivation. Knowledge is

UNDER PEER REVIEW

highlighted as most contributing factor on farmers' performance. Therefore, should give more emphasis to improve knowledge level of farmers to achieve superior performance towards fertilizer application. Farmers' estimate coefficients performance model explained 45.3% of the variance in farmers' performance. This study provides practical evidence on contributions of selected characteristics of farmers to their performance as well as knowledge that could motivate farmers in applying fertilizer effectively and efficiently to improve rice production in Bangladesh.

Adopting suitable agricultural policies and strategies might enhance farmers' performance towards fertilizer application. Therefore, the ministry of agriculture of Bangladesh should takes steps to impart fertilizer related training to farmers. Moreover, Department of Agriculture Extension (DAE), Bangladesh should arrange effective extension services to enhance farmers' performance by providing updated knowledge related to fertilizer application in rice.

COMPETING INTERESTS

The authors have no conflicts of interest to disclose. All authors have approved the Manuscript and agree for its submission to Asian Journal of Agricultural Extension, Economics & Sociology.

REFERENCES

1. BBS (Bangladesh Bureau of Statistics). Yearbook of Agricultural Statistics of Bangladesh, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh; 2014.
2. Shelley IJ, Takahashi-Nosaka M, Kano-Nakat M, Haque MS, Inukai Y. Rice Cultivation in Bangladesh: Present Scenario, Problems, and Prospects. J Intl Cooper Agric Dev. 2016; 14: 20–29.
3. BBS (Bangladesh Bureau of Statistics). Statistical Year Book of Bangladesh. Ministry of Planning, Government of the People's Republic of Bangladesh; 2012; 33–36.
4. Masum MF, Islam MM, Jannat A, Dhar AR. Economics of Boro Rice Production in Rangpur District of Bangladesh: Comparative Assessment of Urea Super Granule and Traditional Urea Application. Agricultural Research & Technology: Open Access Journal (ARTOAJ). 2018; 18 (3). DOI: 10.19080/ARTOAJ.2018.18.556059
5. BER (Bangladesh Economic Review). Ministry of Finance, Government of the Peoples' Republic of Bangladesh. 2013.
6. Pandey S, Byerlee D, Dawe D, Dobermann A, Mohanty S, Rozelle S, Hardy B. Rice in the global economy: strategic research and policy issues for food security. Los Baños (Philippines): International Rice Research Institute. 2010; 477 p.
7. Jahiruddin M, Satter MA. Agricultural Research Priority: Vision-2030 and beyond. Final Report. Bangla¬desh Agricultural Research Council, Farm gate, Dhaka; 2010.
8. Jahiruddin M., M. R. Islam and M. A. Momen Miah. Constraints of Farmers' Access to Fertilizer for Food Production. Final Report CF # 3/08, this study was carried out with the support of the National Food Policy Capacity Strengthening Programme; 2010.
9. Basak JK. Fertilizer Requirement for Boro Rice Production in Bangladesh. Unnayan Onneshan-The Innovators, Bangladesh; 2012. http://www.unnayan.org/reports/Livelihood/Fertilizer_Requirement_for_Boro_Rice_Production_in_Bangladesh.pdf

UNDER PEER REVIEW

10. Shah AL, Rahman MS, Aziz MA. Outlook for Fertilizer Consumption and Food Production in Bangladesh. Bangladesh J. Agric. and Environ.2008; 4: 9-26.
11. Roland JB, Timsina J. Implementing Field-Specific Nutrient Management in Rice-Based Cropping Systems, Bangladesh J. Agric. and Environ. 2008; 4: 39-49.
12. Amegnaglo C. Determinants of maize farmers' performance in Benin, West Africa, Kasetsart Journal of Social Sciences. 2018; xxx: 1-7. https://doi.org/10.1016/j.kjss.2018.02.011
13. Audibert M. Technical inefficiency effects among paddy farmers in the villages of the 'Office du Niger', Mali, West Africa. Journal of Productivity Analysis. 1997; 8: 379-394. https://doi.org/10.1023/A:1007767508848
14. Sadati SA, Hosain SF, Ali A, Sadati SA. Farmer's attitude on sustainable agriculture and its determinants: a case study in Behbahan County of Iran. Research Journal of Applied Sciences, Engineer and Technology. 2010; 2(5), 422-427.
15. Wheeler SA. The barriers to further adoption of organic farming and genetic engineering in Australia: Views of agricultural professionals and their information sources. Renewable Agriculture and Food System. 2008; 23:161-170. http://dx.doi.org/10.1017/S1742170507002128.
16. Sunny F, Huang Z, Karimanzira T. Investigating Key Factors Influencing Farming Decisions Based on Soil Testing and Fertilizer Recommendation Facilities (STFRF)—a Case Study on Rural Bangladesh. Sustainabilit. 2018; 10(11): 4331.
17. Dawoe EK, Quashie-Sam J, Isaac ME, Oppong SK. Exploring farmers' local knowledge and perceptions of soil fertility and management in the Ashanti Region of Ghana. Geoderma. 2012; 179-180:96-103.
18. Shrestha P, Sinclair FL, McDonald M. Bridging gaps between farmers' and scientists' soil classification: revisiting the methodology used in documentation and analysis of farmers' knowledge. Paper presented in the International Conference on "Bridging Scales and Epistemologies: Linking Local Knowledge with Global Science in Multi-Scale Assessments" in Alexandria, Egypt; 2004.
19. Niemeijer D, Mazzucato V. Moving beyond indigenous soil taxonomies: local theories of soils for sustainable development. Geoderma. 2003; 111: 403–424.
20. Wilson, P. Decomposing Variation in Dairy Profitability: The Impact of Output, Inputs, Prices, Labor and Management, the Journal of Agricultural Science. 2011; 149:507-517. DOI: 10.1017/S0021859610001176.
21. Vinake WE. Motivation as Complex Problem, In Jones, M.R. (ed.) Nebraska Symposium on Motivation. Lincoln: University of Nebraska; 1962.
22. Bwambale N. Farmers' Knowledge, Perceptions, and Socioeconomic Factors Influencing Decision Making For Integrated Soil Fertility Management Practices in Masaka and Rakai Districts, Central Uganda. Graduate Theses and Dissertations. 15231. 2015. https://lib.dr.iastate.edu/etd/15231
23. Ramisch JJ. Beyond the Invisible: Finding the Social Relevance of Soil Nutrient Balances in Southern Mali. In L. German, J. J. Ramisch & R. Verma (Eds.), Beyond the Biophysical: Knowledge, Culture and Power in Agriculture and Natural Resource Management (pp. 25-48). London New York: Springer; 2010.
24. Rahman KMA, Zhang D. (2018). Effects of Fertilizer Broadcasting on the Excessive Use of organic Fertilizers and Environmental Sustainability. Sustainability. 2018; 10:759. doi: 10.3390/su10030759
25. Rahman KMA, Zhang D. Socio-economic Factors Affecting Fertilization Sustainability in Bangladesh: Effects of Traditional Way of Fertilization and Rental Land Farming. Preprints 2017, 2017110078 doi: 10.20944/preprints201711.0078.v1.
26. Tilman, D.; Reich PB, Knops J, Wedin D, Mielke T, Lehman C. Diversity and productivity in a long-term grassland experiment. Science. 2001; 294, 843–845. [CrossRef] [PubMed]
27. Kashem MA, Faroque MAA. A country scenarios of food security and governance in Bangladesh. J. Sci. Found. 2011; 9:41–50. [CrossRef]

UNDER PEER REVIEW

28. Sanyang D. Personality Traits and Work Performance for Paddy Farmers in Central River Region, the Gambia. Thesis for Master of Science, the School Of Graduate Studies, Universiti Putra Malaysia; 2017.
29. Hassan S. Personality Traits for the Majority of Paddy Farmers, in Mada, Kedah, Malaysia Faculty of Agriculture. 2015; 2(1): 146–151.
30. Nkari DIM, Kibera PFN. The Influence of Farmer Characteristics on Performance of Commercial Farmers in Kiambu County, Kenya. European Journal of Business and Social Sciences. 2016; 5 (03): 63 – 78.
31. Woldegebrial Z, Huylenbroeck CV, Tesfay G, Speelman S. Smallholder farmers' behavioral intentions towards sustainable agricultural practices. Journal of Environmental Management. 2017; 187: 71-81.
32. Maiangwa MG, Ogungbile AO, Olukosi JO, Atala TK. Adoption of Chemical Fertilizer for Land Management in the North-West Zone of Nigeria. Tropical Agricultural Research & Extension. 2007; 10: 33-46.
33. Krejcie RV, Morgan DW. Determining Sample Size for Research Activities. Educational and Psychological Measurement.1970; 30: 607-610.
34. DeVellis R. F. Scale development: Theory and applications. Los Angeles: Sage, USA; 2012; 109–110.
35. George D, Mallery P (2003). SPSS for Windows step by step: A simple guide and reference. 11.0 update (4th Ed.). Boston: Allyn & Bacon, UK; 2003.
36. Hasan, SS, Ghosh MK, Arefin MS, Sultana S. Farmers' Attitude towards Using Agro-Chemicals in Rice Production: A Case in Laxmipur District of Bangladesh. The Agriculturists.2015; 13(2): 105-112.
37. Shah SBSK. Relationship between Personality Traits and Work Performance among Potential Paddy Farmers in Malaysian Granary Areas MASTER OF SCIENCE Thesis, Department of Agriculture Technology, Faculty of Agriculture, Universiti Putra Malaysia;2016..
38. Chakrabarty, T, Akter S, Saifullah ASM, Sheikh MS, Bhowmick AC. Use of Fertilizer and Pesticide for Crop Production in Agrarian Area of Tangail District, Bangladesh. Environment and Ecology Research. 2014; 2(6): 253-261. DOI: 10.13189/Eer.2014.020605
39. Kabir MH. Factors Influencing Adoption of Integrated Pest Management (IPM) By Vegetable Farmers of Narsingdi District, Bangladesh. Phd Thesis, Department Of Geography, the School Of Humanities, Universiti Sains Malaysia (USM); 2015.
40. BBS (Bangladesh Bureau of Statistics). Population and Housing Census Report, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh; 2017.
41. Akanda MAI, Isoda H, Ito S. Problem Of Sharecrop Tenancy System In Rice Farming In Bangladesh: A Case Study On Alinapara Village In Sherpur District. Journal of International Farm Management. 2008; 4(2): 1-13.
42. Debashis SD, Hoque MJ, Miah MAM. Problems Faced By the Participant Farmers in the Training Process: A Case of Climate Risk Management Training in Agriculture. IJSS. 2017; 6(2): 143-151. DOI: 10.5958/2321-5771.2017.00016.3
43. Basak NC, Pandit JC. Farmers' attitude towards the use of USG in rice cultivation in three selected villages of Netrakona district. J. Bangladesh Agril. Univ. 2011; 9(2): 179–185.
44. Khalil PDAHO, Ismail PDM, Suandi PDT, Silong PDA. Extension Worker as a Leader to Farmers: Influence of Extension Leadership Competencies and Organizational Commitment on Extension Workers' Performance in Yemen. The Journal of International Social Research. 2008; 1(4):368-387.
45. Oluwatusin F, Shittu G. Effect of Socio-economic Characteristics on the Farm Productivity Performance of Yam Farmers in Nigeria. Research on Humanities and Social Sciences. 2014; 4 (6): 31-37.

UNDER PEER REVIEW

46. Mugonola B, Deckers J, Poesen J, Isabirye M, Mathijs E. Adoption of Soil and Water Conservation Technologies in the Rwizi Catchment of South Western Uganda. Int. J. Agri. Sus. 2013; 11(3):264- 281.
47. Julius A, Chukwumah AF. Socio-economic Determinants of Small-scale Rice Farmers' Output in Abuja, Nigeria. Asian Journal of Rural Development. 2014; 4: 16-24.
48. Geta E,Bogale A, Kassa B, Elias E. Determinants of Farmers' Decision on Soil Fertility Management Options for Maize Production in Southern Ethiopia. American Journal of Experimental Agriculture. 2013; 3(1): 226-239.
49. Wei W, Chu SH. Empirical Study on the Correlation among Personality Traits, Work Attitudes, Service Quality, Job Performances and Customers' Satisfaction – A Financial Holding Company in Taiwan. Int. J. Lisrel. 2008; 1(2): 1-24.
50. Mahbobeh T, Farahani A, Baharvand M. Relationship between Knowledge Management with Employees' Performance and Innovation. Kuwait Chapter of Arabian Journal of Business and Management Review. 2014; 3 (11).
51. Mugwe J, Mugendi D, Mucheru-Muna M, Merckx R, Chianu J, Vanlauwe B. Determinants of the decision to adopt integrated soil fertility management practices by smallholder farmers in the central highlands of Kenya. Experimental agriculture. 2009; 45(01): 61-75.
52. Bremmer J, Alfons GJM, Lansink O, Olson KD, Baltussen HM, Huirne RBM.(2002). Analysis of Farm Development in Dutch Agriculture and Horticulture. Paper prepared for presentation at the 13th International Management Congress, Wageningen, The Netherlands, July 7-12, 2002. https://ageconsearch.umn.edu/record/7025/files/cp02br02.pdf
53. Kang Y, Kim S, Chang G. The Impact of Knowledge Sharing On Work Performance: An Empirical Analysis of the Public Employees' Perceptions in South Korea. International Journal of Public Administration. 2008; 31(14):1548-1568.
54. Bekele AZ, Shigutu AD, Tensay AT. The Effect of Employees' Perception of Performance Appraisal on Their Work Outcomes. International Journal of Management and Commerce Innovations. 2014; 2 (1):136-173.
55. Jothilakshmi M, Krishnaraj R, Sudeepkumar NK. Empowering the Members of Women Shgs in Livestock Farming Through Need-Based Trainings. Asia-Pacific Journal of Rural Development. 2009; 19(2): 17–30.
56. Farouque MG, Takeya H. Farmers' Perception of Integrated Soil Fertility and Nutrient Management for Sustainable Crop Production: A Study of Rural Areas in Bangladesh. Journal of Agricultural Education. 2007; 48 (3): 111-122.
57. Jackline BW, Mogoka H, Semalulu O, Kirinya J, Mugonola B. Adoption of Integrated Soil Fertility Management by Groundnut Farmers in Eastern Uganda. Journal of Development and Agricultural Economics. 2016; 8(4):86-94. DOI: 10.5897/JDAE2014-0627.
58. Barbieri C, Mshenga PM. The Role of the Firm and Owner Characteristics on the Performance of Agro-tourism Farms. European Society for Rural Sociology, 2008; 48 (2), 0038–0199. Retrieved 27, August 2015 from Http://Www4.Ncsu.Edu/~Cebarbie/Papers/

UNDER PEER REVIEW