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Article *in* Asian Research Journal of Arts & Social Sciences · June 2018

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Asian Research Journal of Arts & Social Sciences

6(3): 1-8, 2018; Article no.ARJASS.41546
ISSN: 2456-4761

Knowledge Gap of the Haor Farmers in *Boro* Rice Cultivation

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Authors' contributions

This work was carried out in collaboration between all authors. Author MAI designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MEMC and SDB managed the analyses of the study. Author SDB managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/ARJASS/2018/41546
Editor(s):
(1) K. N. Bhatt, Professor, Department of Economics, G. B. Pant Social Science Institute, Allahabad Central University, India.
Reviewers:
(1) Lawal Mohammad Anka, Nigeria.
(2) C. Nwafor Solomon, National Root Crops Research Institute, Nigeria.
(3) Kabi Prasad Pokhrel, Tribhuvan University, Nepal.
Complete Peer review History: http://www.sciencedomain.org/review-history/24956

Original Research Article

Received 7th March 2018
Accepted 16th May 2018
Published 4th June 2018

ABSTRACT

This paper investigates haor farmers' knowledge gap on different yield contributing aspects in *boro* rice production and to explore whether any relationship exists between the selected characteristics of the haor farmers with their knowledge gap. Necessary data were collected during 12 June to 28 August, 2016 using a structured interview schedule from 100 haor farmers covering six villages of Tahirpur Upazila under Sunamganj district. The results revealed that the knowledge gap of the haor farmers varied from 38% to 94% with a mean value of 58 and standard deviation was 11.5 while half (50%) of the respondents had at least 57% of medium to high level of knowledge gap which in turn hampered the adoption of modern *boro* rice cultivation practices and thereby lowering about 58% of the *boro* rice yield. The highest knowledge gap was reported in case of fertilizer and pest management, followed by knowledge gap in harvest and post-harvest management, climatic suitability in the haor areas for *boro* rice production, seedling raising, time of transplanting and spacing while the lowest knowledge gap to be counted for variety and its attributes. The socio-

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economic characteristics of the haor farmers like education, cosmopoliteness, farming experience and attitude towards modern *boro* rice cultivation practices had the significant association with their knowledge gap.

Keywords: Knowledge gap; boro rice; yields gap; haor farmers.

1. NTRODUCTION

Bangladesh is the fourth-largest rice producer in the world [1]. In spite of the decline in the country's arable land since its independence in 1971, the rice area harvested increased from almost 100 lakh ha in 1995 to nearly 120 lakh ha in 2010. The increase in rice yield and area harvested contributed to the growth in rice production, which nearly doubled from over 260 lakh tons in 1995 to 500 lakh tons in 2010 [1]. In case of *boro* rice, both area and production were increased in Bangladesh during 1980-81 to 2007-08. An area under *boro* rice has increased from 11.6 lakh ha in 1980-81 to 46 lakh ha in 2007-08. During of production of *boro* rice increased, from of 26.3 lakh tons to 1 crore 77.6 lakh tons and per hectare yield of *boro* rice increased from 2.27 ton/ha to 3.86 ton/ha [2]. But in the haor areas where *boro* rice is grown as single crop in almost 80 percent of the haor areas [3],the highest yields recorded in 2008 was only 4.3t/ha for high yielding variety i.e. BRRI dhan29 (potential yield 7.5 t/ha) and 5.6 t/ha for hybrid rice variety. The major contributing reasons behind this higher yield gap are the difference existing in the knowledge level of the haor farmers about modern rice cultivation and non-adoption of recommended rice production technology. Because the yield of the contemporary varieties of *boro* rice is very much responsive to a high level of input use and timely crop management, but due to different socioeconomic constraints faced by the haor farmers and their inadequate knowledge about recommended modern *boro* rice production practices that result in lower yields at the farmer level. It was reported that, lack of adequate knowledge on modern rice cultivation often results in considerable yield gap of *boro* rice in farmers' field [4]. This yield gap was estimated as 15% in which farmers' knowledge on modern *boro* rice cultivation contributed 0.8% on this variation [5].

Since our cropped land area is being continuously shrinking over time leading to serious challenge towards increasing productivity and thus to the mission of attaining self-sufficiency in food production for the land scarce economy of Bangladesh; it has become imperative to exploit the crop production potentiality to bridging the present yield gap. The present rice production is not enough to feed the nation and 1.5 million tons annual shortage of food grain exists under current situation [6]. Over the next 20 years, rice yield, therefore, needs to be increased from the present 2.74 to 3.74 t/ha to feed the ever-growing population [7]. Findings from studies reported that there was a significant positive relationship between knowledge of the farmers and their adoption of different modern rice cultivation practices [8,9]. On the other hand, estimation of a knowledge gap in relation to yield gap analysis offers an opportunity to overall the whole production practices at a particular location. Increase production with additional incentives of cost reduction, poverty alleviation, attain improved production target goal, identify the target group to change and improve the efficiency of resource use (land, water, labour and inputs) [10,11,12]. Keeping this in view, the present study was conducted to determine the gap between the recommended knowledge and actual knowledge of the haor farmers regarding modern *boro* rice production practices and to investigate the real causes of variation in this regard and also to ascertain the association between socio-economic factors with knowledge gap of the *boro* rice growers.

2. MATERIALS AND METHODS

2.1 Sampling Method and Data Collection

The study was conducted in six villages of Tahirpur Upazila under Sunamganj district. Data were collected from 100 farmers that were selected randomly from each of the six communities thus forming the target sample population; were interviewed face to face by the researcher with the help of a pre-tested interview schedule during 12 June to 28 August 2016. Six yield contributing aspects of *boro* rice cultivation namely variety and its attributes, seedling raising, time of transplanting and spacing, climatic suitability of the haor areas for *boro* rice

production, fertilizer , pest management and harvest and post-harvest management were taken as the bases to determine the level of knowledge and the knowledge gap of the farmers. Following Blooms taxonomy (2001), six questions were composed covering six levels of understanding foe each aspect. In this way 36 questions were furnished where a score of 2 for correct, 1 for partial and 0 for an incorrect answer were given to each of the issues.

The knowledge gap of a respondent was measured on the basis of a difference between the possible knowledge score for the 36 questions and his actual knowledge score. The formula used in this regard was as follows:

$$KG = K_p - K_a$$

Where,

KG = Knowledge gap
K_p = Potential knowledge score of a farmer
K_a = Actual knowledge score of a farmer

Thus, the Knowledge Gap (KG) of a respondent may range from 0 to 100, where '0' indicating no gap and '100' indicating highest knowledge gap of the farmers in modern *boro* rice cultivation.

3. RESULTS AND DISCUSSION

3.1 Knowledge Gap of the Haor Farmers

Table 1 showed the distribution of the haor farmers depending on their knowledge gap. The knowledge gap of the haor farmers ranged from 38% to 94% against possible range of 0 to 100 while the mean value was 58 and the standard deviation was 11.5. Then based on the mean ± standard deviation; haor farmers were classified into three categories as "low knowledge gap" (38%-56%), "moderate knowledge gap" (57%-75%) and "high knowledge gap" (76% and above).

The findings revealed that half (50 percent) of the respondents had medium to high knowledge gap (58%-94%) on modern *boro* rice production practices. Lack of adequate knowledge of the farmers required for adoption of different current production practices often hampered the production process and thus the yield of *boro* rice. It was revealed that the majority of the farmers did not have adequate knowledge on improved autumn rice production recommendations and more than half of the production recommendations were not known to them [13]. On the other hand, a wide gap was found in the technical knowledge of paddy farmers on various aspects of production [14]. It was also identified that majority of the farmers had profound expertise on high yielding varieties of paddy [15].

3.2 Knowledge Gap of Haor Farmers on Different Yield Contributing Aspects of Modern *Boro* Rice Production

Knowledge gap of the respondent haor farmers' on six yield contributing aspects was determined by deducting the obtained knowledge score from the possible knowledge score of the respondents under each aspect and are shown in Table 2.

It is evident from Table 2 that, haor farmers had the highest knowledge gap (KG = 900) on fertilizer and pest management among all

Table 1. Distribution of haor farmers depending on their knowledge gap

Categories	Respondents		Mean	Standard deviation
	Frequency	Percent		
Low knowledge gap (38%-56%)	50	50.0	58	11.5
Medium knowledge gap (57-75%)	40	40.0		
High knowledge gap (76% and above)	10	10.0		

Table 2. Knowledge gap of the haor farmers under different yield contributing aspects

Yield contributing aspects of modern *boro* rice production	Knowledge gap	Rank
i)Variety and its attributes	151	6th
ii)Seedling raising	470	4th
iii)Time of transplanting and spacing	449	5th
iv)Climatic suitability in the haor areas for *boro* rice production	734	3rd
v)Fertilizer and pest management	900	1st
vi)Harvest and post-harvest management	836	2nd

other yield contributing aspects of *boro* rice production that results in lower yield. The farmers had lest knowledge regarding proper application time and dose of different fertilizers. They usually apply a considerable urea fertilizer in the rice field, but avoid using TSP, MoP, Zypsum or other fertilizers that is essential to maintain a balances fertility status of the soil. As the *boro* rice is highly input responsive crop, imbalanced fertilizer use often leads to poor growth of the rice seedlings and less yield. On the other hand, farmers are unaware about the necessity of disease and pest management in the rice field that resulted in huge yield loss. They do not know about suitable pesticide and insecticide against the specific disease and pests prevailed in the haor areas, the application technique, application time and proper dose of different insecticides and pesticides in their field.

It was followed by harvest and post-harvest management (KG = 836), while haor farmers often lack necessary knowledge on different suitable and modern techniques to minimise the grain and post-harvest yield loss and crop damage. They are unaware about the harvesting rice at 80% maturity technique, lack of suitable storage and transport facility, limited knowledge on better drying, cleaning and grading techniques that severely reduce the rice yield, quality and shelf-life of the produced rice thereby reducing farmers' income.

The next one was the climatic suitability of the haor areas for *boro* rice production (KG = 734). Here, haor farmers have a greater knowledge gap regarding the change in rainfall pattern, sudden rainfall in the pre-monsoon season resulting early flash flood, high summer temperature, fluctuation in the pre-winter temperature causing cold injury to the *boro* rice seedlings, abrupt change in the humidity etc. that in turn hamper the growth and yield of *boro* rice. The changing rainfall pattern and high amount of rainfall in the haor areas result in early flash flood attack and flash flood damage at the mature stage which is the most devastating hazard for haor areas in recent times that cause loss of almost ripen *boro* rice.

It was followed by knowledge gap in seedling raising (KG = 470) as farmers had a significant knowledge gap regarding seedbed preparation, time and technique of seed sowing, maintenance of seedbed, use of raised seedbed, number of seedling/seedbed etc. that affects the yield.

In case of transplanting and spacing (KG = 449), farmers had limited or no knowledge regarding the use of standard plant spacing and a number of tillers, use of raised seedbed, changing planting time etc. that has widened their yield gap in case of *boro* rice production.

The last ranked one having least knowledge gap was the variety and its attributes (KG = 151), because haor farmers had a considerable understanding regarding this aspect but still have limited knowledge on varietal choice, increasing cropping intensity and quality rice seeds that cause considerable yield gap in their own field. Islam (2007) also found the similar results under his investigation in the haor areas.

3.3 Knowledge Gap Level of the Haor Farmers at the Different Cognitive Level

In Fig. 1, distribution of the respondents according to their level and content-wise totals knowledge score on modern *boro* rice cultivation was shown. This figure explains haor farmers' knowledge gap on the selected six yield contributing aspects of *boro* rice production that was assessed into Bloom's six levels of cognitive behaviour [16]. These levels were: i) remembering, ii) comprehending, iii) analysing, iv) applying, v) evaluating, vi) creating. Six questions under each aspect were chronologically arranged to measure the six levels of Bloom's taxonomy. The knowledge gap score of 100 farmers under each aspect was calculated from the deviation of their possible score, while the score under each element could range from 0 to 1200. Here, the total obtained knowledge score of the 100 farmers under each aspect varied from 300 to 1049.

In case of haor farmers' cognitive behaviour regarding their level of knowledge gap; the score varied from 398 to 777 against the possible range of 0 to 1200 for 100 respondents where a great variation was observed between the six levels of cognitive behavior. It was found that, they had lowest knowledge gap score (398) against the "remembering" level following a gradually increasing trend towards the succeeding higher levels of Bloom's taxonomy where final stage "creating" has the highest knowledge gap score (777). It explains the general behaviour of the haor farmers in *boro* rice production practices. They had considered a satisfactory level of understanding regarding different modern, but due to their knowledge

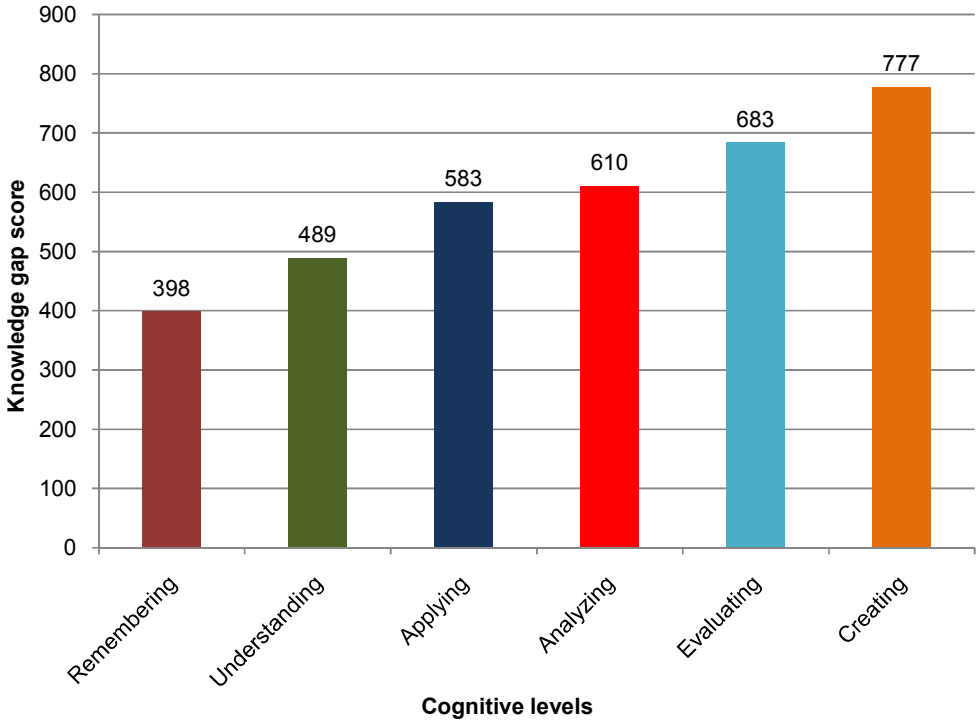

Fig. 1. Knowledge gap level of the haor farmers on modern *boro* rice production at different cognitive levels

gap, they had limited application and adoption of these practices under their field condition. The similar results were found in other investigation which explains the higher yield gap in *boro* rice production as a resultant of the higher knowledge gap existing in the cognitive behavior of the haor farmers [17].

3.4 Relationship between Selected Characteristics of the Farmers with Their Knowledge Gap in Modern *Boro* Rice Cultivation

To explore the relationships between the selected characteristics of the farmers with their knowledge gap in modern *boro* rice cultivation, Pearson's Product Moment Correlation Co-efficient 'r' has been used. The results of the correlation analysis between the selected characteristics of the farmers with their knowledge are shown in the Table 3.

From the observations, it was revealed that haor farmers' education, farming experience and attitude towards modern *boro* rice cultivation practices had a negatively significant relationship with their knowledge gap while their cosmopoliteness had a positive significant relationship.

The negatively significant relationship trend of the farmers level of education with their knowledge gap (r = -0.417**) indicated that; farmers knowledge gap in modern *boro* rice cultivation decreased with increase in their level of education because education helps individuals to gain knowledge and skill in different cognitive contents and develop a positive attitude. Educated farmers are more likely to come in contact with mass media, especially printing materials and gain knowledge and develop a favourable opinion. Thus the education level extends the mind of a person and increases his/her power of observation, analysis, interpretation and decision making. The educated person can judiciously collect relevant information on the production of new *boro* rice and apply similarly in their field. Therefore, it may be concluded that increasing the educational level of the farmers will go a long way to increase the knowledge levels of the farmers in the production of *boro* rice. Education also increases the capability of farmers to communicate with

Table 3. Correlation coefficient between knowledge gap and characteristics of the respondents

Characteristics of the Haor farmers	Correlation of Co-efficient with knowledge gap	Tabulated value significant at		Remarks
		0.05 level	0.01 level	
Age	0.103			Not significant
Education	-0.417**			Negatively significant at 0.01 level
Family size	0.046			Not significant
Farm size	0.047	0.195	0.254	Not significant
Annual income	-0.083			Not significant
Organizational participation	-0.069			Not significant
Cosmopoliteness	0.206*			Significant at 0.05 level
Extension contact	-0.109			Not significant
Farming experience	-0.245*			Negatively significant at 0.05 level
Training experience	0.096			Not significant
Attitude towards modern boro rice cultivation practices	-0.340**			Negatively significant at 0.01 level

*** Significant at P = 0.01 level of probability; * Significant at P = 0.05 level of probability*

various persons and media and to move different unknown places, thus increase the cosmopolites of the farmer.

Here, respondents' cosmopoliteness had a significant positive relationship (r =0.206*) with their knowledge gap in modern *boro* rice cultivation. A cosmopolite farmer is generally believed to be more mobile. When a farmer frequently goes to places other than his own locality, there is a possibility that he comes in contact with more number of progressive farmers to acquire more knowledge on modern *boro* rice cultivation that in turn guides them to develop a more favourable attitude towards different current farming practices.

According to the observations, the negatively significant relationship trend between the attitude of the farmers and their knowledge gap (r = -0.340**) means that, farmers with least favourable attitude towards modern *boro* rice cultivation practices had possessed higher knowledge need. It is quite logical that the knowledge gap of the farmers decreases with the increase of a more favourable attitude towards adopting different modern *boro* rice production practices.

In addition to that, the farming experience of the respondents was also related to their knowledge gap in modern *boro* rice cultivation. The negatively significant relationship trend of farmers experiences with their knowledge gap (r =-0.245*) indicated that farmers knowledge gap decreased with the increase of their farming experience. Experience always develops the knowledge towards a desirable direction. An experienced farmer who is associated with farming for a long time knows about mostly all aspects of agriculture; and as a result he had a very low knowledge gap. Thus**,** farmers with high farming experience had possessed higher knowledge on different modern rice production practices. From the findings above, it can be concluded that adoption of contemporary *boro* rice production practices can be diversified in a desired way through guiding and supporting these identified characteristics of the haor farmers.

4. CONCLUSION AND RECOMMENDA-TIONS

This study evaluates haor farmers' selected socio-economic characteristics as significant factors that influence their adoption of modern *boro* rice production practices while half of the respondents had medium to high knowledge gap. These factors are all non-directly observable variables while taking into account heterogeneity of the haor farmers. As the results revealed that haor farmers' education, cosmopoliteness, farming experience and attitude towards modern

boro rice production practices had a significant correlation with their knowledge gap; adoption of modern *boro* rice production practices can be diversified in a desired way through guiding and supporting these identified characteristics. It was further evidence that illiteracy of farmers, small land holding, less annual income, insufficient availability of input and lack of proper farm equipment, lack of training facility, limited access to information sources and lack of contact between haor farmers and extension personnel were the main reasons behind farmers' adoption gap. To attain the full self-sufficiency in food grain production, it is essential to minimise the knowledge gap between researchers, extension staff and the farmers by developing and using viable mechanisms to transfer new knowledge and techniques from researchers to farmers and by collecting feedback to re-orient research on issues critical to farmers. Therefore, it may be concluded that attainment of highest possible yields in rice and thereby maximising profit may be achieved only when the haor farmers are well equipped with required technical knowledge and skill so that they can apply the knowledge correctly in their fields to secure the maximum benefit.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history/24956