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Crop Management Practices in Rural Riverine Islands of Bangladesh

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ABSTRACT

This study focused on farmers' crop management practices in selected rural riverine islands (*Char* lands) of Sariakandi Upazila, Bogura district, Bangladesh. Disproportionate stratified sampling was adopted to select the respondents. The data were elicited using an interview schedule and analyzed via Statistics 10 software. Results revealed that, on average, there was moderate knowledge on crop management practices, and the attitude towards the practices was favorable. But, in deviance from what is habitually obtained on mainland Bangladesh where rice cultivation dominates, jute (35.84%) and chili (28.4%) covered the majority in *Char* Ghagua and *Char* Shaluka, respectively. In *Char* Tengrakura, rice and chili covered a little above half (52.7%) of the crops cultivated by the respondents. In terms of the management practices, the lion's share (81.7%, 74.7%, and 77.0%) of soil management practices was covered by chemical fertilizers in all the *Char* lands. Similarly, the use of chemicals dominated when handling pests and diseases. Triple cropping was foremost across the *Char* lands and had high mean coverage in *Char* Tengrakura (63.6%). The mean coverage of irrigation water management practices was virtually shallow tube well in the *Char* lands. Generally, there was moderate knowledge and a positive attitude towards crop management practices. That crop management practices (use synthetic materials and underground water) employed in the *Char* lands are unsustainable, tending to induce degradation of land and water resources.

Introduction

Crop management denotes a group of agricultural practices to improve crop growth, development, and yield. These practices include crop-related, soil, pest and disease, and water management practices. The whole aim is to maximize productivity and, ultimately, nutrition and income. Crop management practices are indispensable for the survival of countries like Bangladesh. This is because the country is traditionally and predominantly an agriculture-based country, and about 75.7 percent of its population are engaged in agriculture for their livelihood (BBS, 2012). But, from the colonial period Char (riverine islands) areas have been recognized as a 'zone of the anomaly' mostly in terms of their isolation (Ahmed, 1999). In contrast, in postcolonial discourse, Char has been represented as a periphery of settlement, a landscape, an economic resource for the country, and a food source for the landless who may work to bring it under cultivation (Baqee, 1993; Sarker, 2008). It is against this that the Char land constitutes the principal resource source to the char dwellers.

The majority of people living in the char lands of Bangladesh are involved in crop cultivation (Islam, 2000; BBS, 2007), agriculture labor, operating boats, and fishing; hence, they are said to be frequently unemployed due to tidal flooding and other natural disasters common to the riverine islands. The situation makes them poor and degraded. In that vein, poverty and degradation have been cited as significant problems that affect agricultural production (Nkoya et al., 2008). So, because Char dwellers were landless primarily from the mainland and could not move to areas where resources were still plentiful, they would have to increase the amount and the predictability of the food they produced on the Char lands. In the past, crop management practices were employed, which mainly encompassed natural fallowing, shifting cultivation, and slash and burn. Today, many technologies have been adopted by the Char land farmers. In addition, diversified livelihood practices counter challenges posed by declining output from agricultural production, which is the principal livelihood activity in Char lands and most Bangladesh rural areas. However, Char land soils are easily cultivable (Vadivelu et al., 2005), but crop yield has been reported low (Islam et al., 2018). Perhaps, due to annual inundation from the flood that causes much damage to the standing crops, low water holding capacity and poor soil nutrients, recurring erosion, or limited/no access to the desired modern agricultural technologies by the farmers (SRDI, 2001; Karim, 2014). Besides, Char land farmers cultivate local varieties of different crops following indigenous crop production practices. As a result, yield usually turns out to be low. In addition, they mostly practice native crop production management techniques, which could have been contributing to the low yield in the Char areas (Islam et al., 2016). Besides, Karim et al. (2017) reported other fundamental problems related to the technology transfer, inputs and credit availability, storage facility, irrigation facility, poorly organized marketing system, etc.

Although it is increasingly acknowledged that Char land areas need assistance to alleviate poverty, efforts are yet to focus on sustainable development strategies. This might be fundamentally due to little or no consideration of the areas' felt needs and unique requirements. In this regard, the present study was borne out of a lack of specific studies or a single comprehensive report on crop management practices in the Char lands of Banglades exists are is no research, intervention, or effort that reflects the real felt needs (which could guide participatory bottom-up development efforts) of the Char land dwellers, especially farmers regarding their crop management practices. Nevertheless, intervention projects and random adaptive research (Aziz et al., 2016; Islam et al., 2015; Islam et al., 2016, etc.) have been conducted by different individuals and organizations in the Char land areas of Bangladesh. Even at that, the respective scope of the intervention projects and random adaptive research was broad such that crop management practices were given limited and superficial attention despite agriculture being the main livelihood activity of the Char land inhabitants. It is seldom obtained that the programs/projects and researches take technology (out of the felt needs of the Char land inhabitants) to farmers. Instead, they usually try technologies in the Char areas or empower the Char land farmers in various ways, ultimately affecting their crop management practices due to the multiplier effect. Consequently, this research was prompted to enquire about some relevant questions that include Char land farmers crop management practices, their knowledge, and attitude towards the crop management practices with a whole view of laying the foundation upon which sustainability of crop management could be achieved through bringing to limelight the existing situation.

Materials and Methods

The study was carried out in Char Ghagua, Char Tengrakura, and Char Shaluka of Sariakandi sub-district (coordinates: 24°53′N 89°34′E) in Bogura district, Bangladesh. Char Ghagua and Char Tengrakura share a border. They are located northeast of the Sariakandi Sadar Upazila, off the eastern bank of the Jamuna river, while Char Shaluka is located on the western bank of the Jamuna river. The Char lands were selected due to their level of vulnerability (Islam et al., 2014), relative ease of accessibility to the researcher, and cooperation of the inhabitants in conducting the study. For more clarity on the locale of this study, a map of the Sariakandi sub-district representing a rough location of the respective Char lands with thick blue arrows is presented in Figure 1.

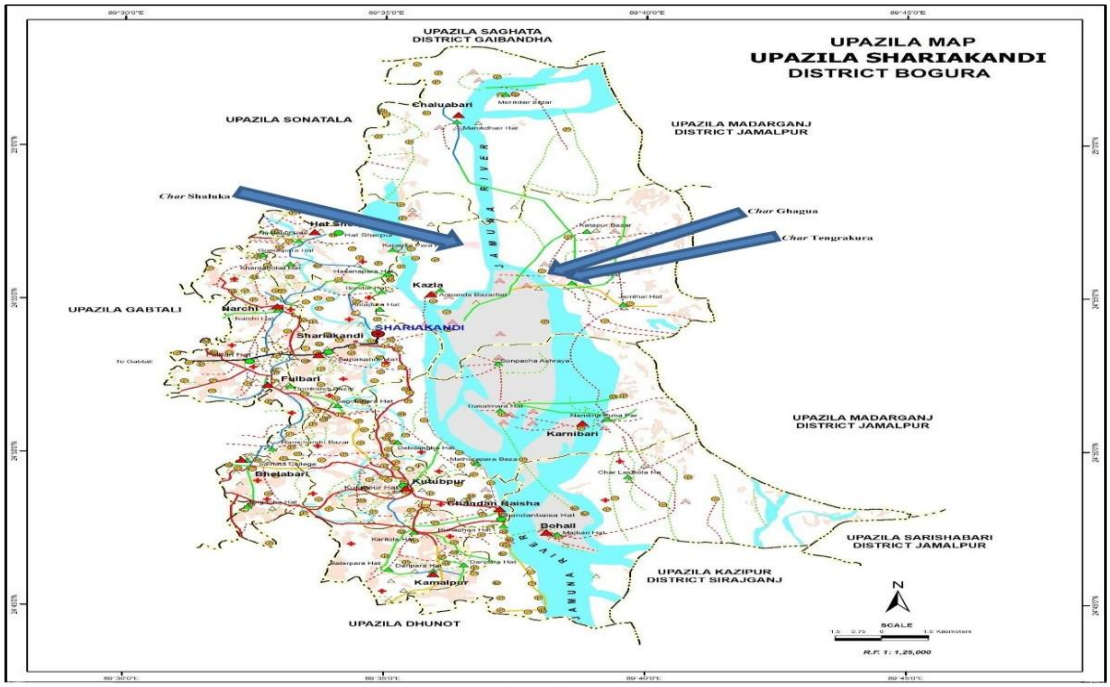

Figure 1. Map of Sariakandi Upazila (sub-district) presenting a rough location of the respective *Char* lands studied

The study population included *Char* Ghagua, *Char* Tengrakura, and *Char* Shaluka, while the target population was all the farmers in the *Char* lands. The total number of farm households in the *Char* lands was estimated at 330, 750, and 155, in *Char* Ghagua, *Char* Tengrakura, and *Char* Shaluka, respectively. Fifty (50) respondents, approximately equivalent to 15.0, 7.0, and 25.0 percent of the farming households in the respective *Char* lands, were selected through disproportionate stratified sampling as the study sample. Thus, the study sample comprised 150 respondents from whom the required data were collected. Selection of the respondents was made following disproportionate stratified sampling technique for ease of comparison. The *Char* lands were first stratified based on their location. Subsequently, the respondents were drawn. A pre-designed interview schedule was used as a data-gathering instrument through face-to-face interviews. The data collected was processed and analyzed via the Statistix 10 computer package.

To assess the respondents' knowledge of crop management practices, fourteen questions were asked, with two marks allotted for each. Total marks obtained by a respondent were added to evaluate their knowledge level. For the correct answer, the respondent was given two spots and one mark for a partial answer. In case of an incorrect answer, a score of '0' was given. The knowledge level was thus categorized adapting Naznin (2018), as indicated in the results. Attitude towards crop management practices was measured using a three-point Likert-type scale of agree (2), undecided (1), and disagree (0). The scale was prepared with nineteen constructs reflecting both positive and negative aspects of crop management practices. Total scores were calculated by adding each respondent's scores for all the

statements. The attitude towards crop management practices was categorized following Ali (2013). The crop management practices were measured based on the coverage of some listed soil, crop, pest, diseases, and water management practices. The respondents were asked to indicate the extent of coverage (%) of those items in their farmlands. Responses were later aggregated into mean for each of the practices.

Results and Discussion

This sub-section encompasses all those practices related and executed by the respondents to attain maximum output from their cultivation. Items that include soil type, type of crops cultivated, knowledge on crop management practices, attitude towards crop management practices, soil management practices, crop-related management practices, water (irrigation) practices, and, pest and disease management practices are presented and discussed hereunder were cut to a smaller size of about 0.3-0.5 cm before drying (Fig. 1b).

Soil Type

Soil type refers to the group or taxonomic unit shared by soils based on their common distinguishing properties. The *Char* land farmers might not know the scientific classification of the grounds. Still, they are very much aware of the physically distinctive features the soils possess, the crop suitable, and their likely effect on specific crops. Owing to this background, the description offered by all the respondents in the *Char* areas unanimously symbolizes loamy sand.

Crop Type

The type of crop cultivated forms an integral component of crop production. It partly regulates production cost, sales income, and food intake nutrition. The mean coverage (%) of the type of crops cultivated by the respondents is revealed in Table 1.

In deviance from what habitually obtains where rice dominates, jute (35.84%) and chili (28.4%) averagely covered the majority in *Char* Ghagua and *Char* Shaluka, respectively. But, rice came second with 25.96 percent and 34.26 percent in the latter and former, respectively. In *Char* Tengrakura*,* rice and chili notably covered a little above half (52.7%) of the crops cultivated by the respondents. Crop found with least mean coverage were mustard (0.1%) and groundnut (0.2%) in *Char* Ghagua, groundnut (0.2%) and millet (0.4%) in *Char* Tengrakura and, millet (0.06%) and potato (0.5%) in *Char* Shaluka. Out of the cultivated crops, ten each were cultivated in *Char* Tengrakura and *Char* Shaluka, while nine were cultivated in *Char* Ghagua. The results imply a considerable diversity of the cultivated crops coverage in the areas. Therefore, it is submitted that the relative number of crops under cultivation in the areas

could pave the way for more adoption when introduced to the respondents. Nasim et al. (2017) reported similar findings.

Table 1. Distribution of the mean coverage (%) of crop type cultivated in *Char* lands

	Types	Char Ghagua	Char Tengrakura	Char Shaluka
		Mean coverage (%)	Mean coverage (%)	Mean coverage (%)
1	Rice	25.96	29.80	34.26
2	Wheat	1.84	3.20	3.00
3	Maize	11.18	11.82	2.36
4	Millet	0.00	0.40	0.06
5	Mustard	0.10	0.50	0.00
6	Chili	28.40	22.90	13.30
7	Groundnut	0.20	0.20	2.50
8	Potato	0.60	1.70	0.50
9	Sweet potato	0.00	0.00	0.54
10	Vegetables	13.90	16.90	7.64
11	Jute	17.82	12.58	35.84

Knowledge of Crop Management Practices

Knowledge of crop management practices is very important in the present study. It tells how much the *Char* land farmers vis-à-vis the respondents know about crop management practices principles, know-how, and application. The respondents were assessed in respect of that through fourteen questions, with each carrying two, one, and zero marks for a complete answer, partial answer, and no answer, respectively. Subsequently, according to their scores, the respondents have been categorized into low, moderate, and high knowledge (Table 2).

Table 2. Distribution of the respondents according to their knowledge of crop management practices

Categories	*Char* Ghagua		Mean	*Char* Tengrakura		Mean	*Char* Shaluka		Mean
	No.	%		No.	%		No.	%	
Low (up to 10)	16	32.0		4	8.0		8	16.0	
Moderate (11 - 20)	34	68.0	12.24	46	92.0	13.38	41	82.0	13.75
High (> 20)	0	0.0		0	0.0		1	2.0	
Total	**50**	**100.0**		**50**	**100.0**		**50**	**100.0**	

On average, all the respondents in the three *Char* lands had moderate crop management practices. Their mean scores (12.44, 13.38, and 13.75) fell between 11 and 20. Equally, the majority (68.0%, 92.0% and 82.0%) in the individual areas. In comparison, 2.0 percent in *Char* Shaluka had high knowledge with a score above 20, whereas no respondent had high knowledge in Char Ghagua and Char Tengrakura. The respondents' knowledge buttressed by the present results signifies the need to train them on crop management

practices. Perhaps, the multiplier effect of the training improves their livelihood. In a similar study by Khapayi and Celliers (2016) in the rural area of King William's Town of the Eastern Cape Province, South Africa, it was found that the respondents lacked adequate knowledge and skills on management of crop production. That was indicated to be a key factor limiting emerging farmers from progress in farming. Also, in the *Char* lands, especially *Char* Ghagua and *Char* Tengrakura, the respondents stated that management was one of the key challenges they faced, which threatened their livelihood sustenance.

Attitude towards Crop Management Practices

Attitude, which is the mental disposition towards or away from something, impacts the action of an individual. When it comes to crop management practices, a farmer defines what and how crop production activities are handled to maximize output and ultimately sustain livelihood. Considering this importance, the attitude of the respondents was measured. Table 3 displays the categorization of the respondents into unfavorable, favorable, and highly favorable based on their scores from the measurement.

Table 3. Distribution of the respondents according to their attitude towards crop management practices

Categories	*Char* Ghagua		Mean	*Char* Tengrakura		Mean	*Char* Shaluka		Mean
	No.	%		No.	%		No.	%	
Unfavorable (up to 15)	2	4.0		2	4.0		3	6.0	
Favorable (16 - 30)	47	94.0	21.04	48	96.0	21.16	47	94.0	21.90
Highly favorable (> 30)	1	2.0		0	0.0		0	0.0	
Total	**50**	**100.0**		**50**	**100.0**		**50**	**100.0**	

Averagely, all the respondents from the *Char* areas had a favorable attitude towards crop management practices. This is so because the respondents disclosed that experience had taught them that good management output increases, thereby more income. When the three *Char* lands are contrasted, in both *Char* Tengrakura and *Char* Shaluka, no respondent had a highly favorable attitude towards crop management practices. In contrast, in *Char* Ghagua, 2.0 percent did have. On a positive note, generally, only 4.0, 4.0, and 6.0 percent in *Char* Ghagua, *Char* Tengrakura, and *Char* Shaluka, respectively, had unfavorable attitudes towards crop management practices. Contrary to the present findings, a study conducted by Fanadzo et al. (2010) in rural South Africa reported poor attitudes towards crop production management practices resulting from lacking necessary basic skills. Thus, the present results are encouraging and could imply the tendency to adopt crop management practices when introduced to the *Char* land farmers, specifically the respondents.

Soil Management Practices

Soil management practices are employed on the farm to ensure sound health of soil such that mineral elements are made available to the plants and same move into the food chain. Good soil management practices enhance agricultural productivity, the environment, and even human and animal health. The mean coverage (%) of the soil management practices engaged by the respondents is presented in Table 4.

Table 4. Distribution of the mean coverage (%) of soil management practices in the selected *Char* lands

	Categories	*Char* Ghagua	*Char* Tengrakura	*Char* Shaluka
		Mean coverage (%)	Mean coverage (%)	Mean coverage (%)
1	Chemical fertilizer	81.70	74.70	77.00
2	Crop residue incorporation	1.00	3.40	0.30
3	Vermicompost	0.00	0.00	0.10
4	Cow dung	0.00	9.48	12.10
5	Household waste	0.00	0.40	0.00
6	Standard organic fertilizer	0.00	0.00	0.00
7	Quick compost	0.00	0.00	0.00
8	Poultry manure	0.00	0.00	0.00
9	Green manure	0.00	0.00	0.50
10	Biochar	0.00	0.00	0.10
11	Ash	5.00	5.30	6.50
12	Mulching	4.00	9.40	3.24

The lion's share (81.7%, 74.7%, and 77.0%) was covered through chemical fertilizers by the respondents in all the Char lands to enhance soil nutrient availability. Additionally, 1, 5, and 4 percent were covered by incorporated crop residue, applied ash, and mulching, respectively, in *Char* Ghagua. In *Char* Tengrakura, 9.48, 0.4, 5.3, and 9.4 percent were covered by cow dung, household waste, ash, and mulching, respectively. In Char Shaluka, 0.3 percent was covered by incorporated crop residue, 0.1 by vermicompost, 12.1 percent by cow dung, 0.5 percent by green manure, 0.1 by biochar, 6.5 percent by ash 3.24 percent by mulching. When compared across, the number of soil management practices carried out by the respondents goes in the decreasing order of *Char* Shaluka, *Char* Tengrakura, and *Char* Ghagua. Unfortunately, despite the quick release of nutrients by the chemical fertilizers, they are non-renewable and their long-term use destroys soil health. Chemical fertilizers are commonly used by rural farmers in Bangladesh with very little emphasis attached to their negative effects. In line with this, Faroque et al. (2011) opined that in Bangladesh the sustainability of conventional agriculture is at risk of continuous degradation of land and water resources.

Crop-related Management Practices

The management practices of the crops in a typical rural area of Bangladesh such as the *Char* land mostly revolve around cropping patterns, rotation and rarely cover cropping. The respondents' crop-related management practices mean coverage (%) in the studied *Char* lands is expressed in Table 5.

Table 5. Distribution of the mean coverage (%) of crop management practices in the selected *Char* lands

	Categories	***Char* Ghagua**	***Char* Tengrakura**	***Char* Shaluka**
		Mean coverage (%)	**Mean coverage (%)**	**Mean coverage (%)**
1	Single cropping	8.76	5.30	10.30
2	Double cropping	32.10	2.60	37.40
3	Triple cropping	44.84	63.60	38.60
4	Fallow	11.00	4.00	10.20
5	Crop rotation	3.00	6.80	4.30
6	Cover cropping	0.00	0.00	0.00

In *Char* Ghagua, on average, double and triple cropping patterns mainly covered 44.84 and 32.1 percent, respectively, while fallow covered 11.0 percent, single cropping 8.76 percent, and crop rotation 3 percent. As for *Char* Tengrakura, triple cropping covered around 2/3 (63.6%), followed by 6.8 percent crop rotation, 5.3 percent single cropping, 4.0 percent fallow, and 2.6 percent double cropping. The distribution seems to be better in *Char* Shaluka, where it goes in the decreasing order of 38.6 percent covered by triple cropping pattern, 37.4 percent double cropping, 10.3 percent single cropping, 10.2 percent fallow, and 4.3 percent crop rotation. However, in none of the *Char* lands was cover cropping found. For the cropping patterns (triple, double, and single) the order was usually cereals+vegetables+cereals/fibre/fallow/spices. Having cereals appearing twice is not a deviation from the normal in Bangladesh. Nasim et al. (2017) in a study on the distribution of crops and cropping patterns across the whole of rural Bangladesh stated that the cropping patterns of Bangladesh are usually cereals-based (rice).

Water Management Practices (Irrigation)

Both the quantity and quality of irrigation water could significantly affect the management of crops during production. It is so important that a farmer takes this into cognizance to minimize if not overcome loss. The irrigation practices carried out by the respondents are specified in Table 6.

Table 6. Distribution of the mean coverage (%) of water (irrigation) management practices in the selected *Char* lands

S#	Categories	*Char* Ghagua	*Char* Tengrakura	*Char* Shaluka
		Mean coverage (%)	**Mean coverage (%)**	**Mean coverage (%)**
1	Shallow tube well	98.00	100.00	100.00
2	Hand tube well	0.00	0.00	0.00
3	Deep tube well	0.00	0.00	0.00
4	Surface water irrigation	0.00	0.00	0.00
5	Motorized pump	0.00	0.00	0.00

A visit to the studied *Char* lands noticeably shows how common shallow tube well obtains there, on the farm and in the house. Not surprising that the mean coverage of irrigation water management practices was entirely shallow tube well in both *Char* Tengrakura and *Char* Shaluka. But, in *Char* Ghagua although approximately all (98.0%) was shallow tube well, a negligible 2.0 percent depended on rainfall. Nahian et al. (2018) found that in coastal areas of Bangladesh (predominantly *Char* lands) the inhabitants solely depended on groundwater from shallow tube well for a water source.

Pest and Disease Management Practices

Pest and diseases are inevitable in crop production, but economic loss sets in when they transcend beyond the threshold levels. So, the management of pest and diseases safeguards crops and save the farmer from losing out. Results in Table 7 illustrate the mean coverage (%) of pest and disease management practices performed by the respondents.

Table 7. Distribution of the mean coverage (%) of pest and disease management practices in the selected *Char* lands

	Categories	*Char* Ghagua	*Char* Tengrakura	*Char* Shaluka
		Mean coverage (%)	**Mean coverage (%)**	**Mean coverage (%)**
1	Crop rotation	8.30	10.80	6.20
2	Use of a resistant variety	1.20	0.00	0.00
3	Cultural practices	0.50	1.20	4.20
4	Physical management	0.00	0.80	0.20
5	Biological management	0.00	0.20	0.40
6	Mechanical management	4.10	1.20	0.60
7	Chemical management	85.90	84.70	86.20
8	Integrated pest management (IPM)	0.00	0.00	1.40
9	Integrated disease management (IDM)	0.00	0.00	0.80
10	Regulatory methods	0.00	0.00	0.00

Akin to what obtains in Table 4, mostly (85.9%, 84.7%, and 86.2%) on average, use of chemicals dominates in all the *Char* lands. The mean coverage of other pest and disease management practices included crop rotation (8.3%), mechanical management (4.1%), use of resistant variety (1.2%), and cultural practices (0.5%) in *Char* Ghagua. In *Char* Tengrakura, others were crop rotation (10.8%), cultural practices and mechanical management (1.2% each), physical management (0.8%) and biological management (0.2%). The remaining average coverage in *Char* Shaluka was crop rotation (6.2%), cultural practices (4.2%), IPM (1.4%), IDM (0.8%), mechanical management (0.6%), biological management (0.4%) and physical management (0.2%). In contrast, the mean coverage of chemical management was slightly high in *Char* Shaluka so also the spread of the practices. This might be the effect of both ease and closer access to the point of purchase, unlike the other *Char* lands. Faroque et al. (2011) narrated a similar situation across rural Bangladesh.

Conclusion

Crop management practices ensure crop productivity and minimize losses. The management practices of crops have evolved with new research findings and subsequent expansion of agricultural knowledge. However, the study focused specifically on those crop management practices obtained in a typical Bangladesh *Char* land (riverine islands). Hence, the present findings infer that the respondents' knowledge of crop management practices was moderate, but *Char* Shaluka was better. The attitude towards crop management practices was greatly appealing owing to predominantly favourable responses in all the *Char* lands, equally, *Char* Shaluka was averagely better. The moderate nature of the respondents' knowledge suggests the need for training on crop management practices. That would certainly go a long way to improve the livelihood of the *Char* landers being predominantly dependent on agriculture. The training could be highly welcomed having obtained a highly favourable attitude from the respondents. On the other hand, the soil management practice was mostly by chemical management, but *Char* Shaluka was better in terms of the number of practices. Crop-related management practices employed by the respondents were widely single cropping, double cropping, and triple cropping in all the *Char* lands, with *Char* Shaluka having an edge in terms of a number of the practices. The number of crops cultivated was ten in *Char* Tengrakura and *Char* Shaluka, and nine in *Char* Ghagua. Irrigation water management practice was through tube well, while chemicals were mainly used for pest and disease management. However, *Char* Shaluka was comparatively better in terms of a number of pest and disease management practices.

The prevalence of synthetic chemicals' usage in the management of crops and use of underground water is a call for concern in the *Char* lands because while the former degrades

the environment the latter sinks the islands gradually (if at all they last) through subsidence. Thus, the government needs to as a matter of immediate concern design a comprehensive research-based sustainability plan for the *Char* lands (relative to their peculiarities) given the number of people occupying them and their continuous formation and deformation. Similarly, there is a need to realize and take necessary measures towards ensuring that whatever development effort is going to be carried out in the *Char* lands emerge from the felt needs of the inhabitants. This goes a long way towards creating 'we feeling' and participatory governance of the areas.

Conflict of interest

The authors declare that there is no competing interest (e.g., financial, professional, or personal relationships relevant to the work).

Contribution of Authors

AA (PhD Agricultural Extension and Rural Development) designed the study, analysed data, and made the interpretations. MSI (Professor of Agricultural Extension and Rural Development), AH (Professor of Agricultural Extension), GKM (Professor of Soil Science), and MEH (Professor of Agricultural Extension and Rural Development) co-developed the methodology and corrected the manuscript. All authors read and approved the final version of the manuscript.

References

Ahmed, Z. (1999). *Risk, knowledge and power: agriculture and development discourse in a coastal village in Bangladesh*. (Unpublished doctoral thesis), University of Sussex, UK.

Ali, M. A. (2013). *Impact of seed production project on changing knowledge, attitude, practice and livelihood status of the beneficiaries*. (Unpublished doctoral thesis), Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh.

Aziz, M. A., Prodhan, J. H., & Akhter, A. (2016). Validation and dissemination of intercropping technologies at farm levels in the *Char* land area. In: Aziz, M. A., Mondal M. R. I. and Rahman, M. H. H. (Eds.), *Unfavorable eco-system: crop production under Char land eco-system*. Agronomy Division, Bangladesh Agricultural Research Institute Joydebpur, Gazipur-1701, Bangladesh, pp. 22-24.

Baqee, M. A. (1993). *The settlement process in the Char lands*. (Unpublished doctoral thesis), University of Dhaka, Bangladesh.

BBS. (2012). *Statistical year book of Bangladesh*. Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.

BBS. (2007). *Statistical year book of Bangladesh*. Statistics Division, Ministry of Planning,

Government of the People's Republic of Bangladesh.

Fanadzo, M., Chiduza, C., Mnkeni, P. N. S., Van der Stoep, I. and Stevens, J. (2010). Crop production management practices as a cause for low water productivity at Zanyokwe irrigation scheme. *Water SA, 36*(1), 27 - 36.

Faroque, M. A. A., Kashem, M. A., & Bilkis, S. E. (2011). Sustainable agriculture: a challenge in Bangladesh. *International Journal of Agricultural Research, Innovation and Technology, 1*(1-2), 1 - 8.

Islam, M. M., Ali, S. Ali, M. M., Ali, M. Y., & Hossain, M. B. (2018). Jute fiber yield and economics in *Char* land areas of Bangladesh. *Research in: Agricultural & Veterinary Sciences, 2*(1), 59-65.

Islam, M. N., Rahman, M. S. Alom, M. S. and Akhteruzzaman, M. (2015). Performance of different crops productivity enhancement through adaptation of crop varieties at *Char* land in Bangladesh. *Bangladesh Journal of Agricultural Research, 40*(4), 629-640.

Islam, M. N., Rahman, M. S., Mian, M. A. K., Islam, M. R., Mohiuddin, M., & Hossain, M. A. (2016). Fertilizer management of HYV mustard in *Char* land areas. In: Aziz, M. A., Mondal M. R. I. and Rahman, M. H. H. (Eds.), *Unfavorable eco-system: crop production under Char land eco-system*. Agronomy Division, Bangladesh Agricultural Research Institute Joydebpur, Gazipur-1701, Bangladesh.

Islam, M. S., Sultana, S., & Miah, M. A. (2014). Adaptation of *Char* livelihood in flood and river erosion areas through indigenous practice: a study on Bhuapur riverine area in Tangail. *Journal of Environmental Science and Natural Resources, 7*(1), 13 - 19.

Islam, S. N. (2000). *Char* people, living with the Padma river and fragile environment: *Char* study report (unpublished). *Gono Unnayan Prochesta* (GUP), Dhaka, Bangladesh, pp. 1-53

Karim, M. A., Haque, M. M., & Hamid, A. (2014). Concern, opportunity and strategic research in crop sector under climate change context in Bangladesh. In: *Rising atmospheric CO_2 and crop response*. A compendium of published works at Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, Bangladesh.

Karim, M. A., Quayyum, M. A., Samsuzzaman, S., Higuchi, H., & Nawata, E. (2017). Challenges and opportunities in crop production in different types of *Char* lands of Bangladesh: Diversity in crops and cropping. *Tropical Agricultural Development, 61*(2), 77-93.

Khapayi, M., & Celliers, P. R. (2016). Factors limiting and preventing emerging farmers to progress to commercial agricultural farming in the King William's Town area of the Eastern Cape Province, South Africa. *South African Journal of Agricultural Extension, 44* (1), 25 – 41.

Nahian, M. A., Ahmed, A., Lázár, A. N., Hutton, C. W., Salehin, M., & Streatfield, P. K. (2018). Drinking water salinity associated health crisis in coastal Bangladesh. Elementa Science of the Anthropocene, *6*(2), 1 – 14. doi: 10.1525/elementa.143

Nasim, M., Shahidullah, S. M., Saha, A., Muttaleb, M. A., Aditya, T. L. Ali, M. A., & Kabir, M. S. (2017). Distribution of crops and cropping patterns in Bangladesh. *Bangladesh Rice Journal, 21*(2), 1 - 55.

Naznin, M. (2018). *Farmers' knowledge and perception on pesticide use for vegetable*

production in selected areas of Narsingdi district (Unpublished masters thesis), Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh.

Nkoya, E., Pender, J., Kaizzi, C., Kato, E., Mugarura, S., Ssali, H., & Muwonge, J. (2008). *Linkages between land management, land degradation and poverty in sub*

Saharan Africa: The case of Uganda. International Food Research Policy Research Institute (IFPRI). Research Report.

Sarker, M. H. (2008). *Morphological response of the Brahmaputra-Padma-lower Meghna river system to the Assam earthquake of 1950* (Unpublished doctoral thesis), University of Nottingham, UK.

SRDI. 2001. *Land and soil resource utilization guide*. Soil Resource Development Institute, Dhaka, Bangladesh.

Vadivelu, S., Baruah, U., Bhaskar, B. P., Thampi, J., Sarkar, D., & Butte, P. S. (2005). Evaluation of soil-site suitability to rice-based cropping system in the river island of Majuli, Assam. *Journal of the Indian Society of Soil Science, 53*(1), 35-40.