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Scope of using ICT for knowledge management on adaptation to climate change in agriculture

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ABSTRACT

The char land of Bangladesh is vulnerable to climate change. There are changes in extreme weather events. Impact of climate change resulted feminization of agricultural practices. Number of development interventions have been taken to skill the rural community to take adaptation action on agriculture. Development interventions taken in the char land of Dimla, Nilphamari were studied from June 2018 to December 2019 to identify the capacity of climate change adaptation interventions using the information and communication technology to empower women. Mobile Phone Use Index study found that nearly three-fourth of rural female farmers were capable to manage knowledge on climate change adaptation if their access to device was ensured. Inclusion of women in the technology playing a very important role towards transformative leadership. Nearly 85% of the women farmers have high environmental awareness; likely to be contributory to adaptation knowledge management. Community themselves identified them more resilient comparing with areas where promotion of technology is not supported. Institutes with the capacity of information technology promotion could be the hub of resilience knowledge management for women, but external supports are required there. Self-motivation supported by project intervention has created notable capacity of a good number of women who could be the mentor of women transformative leadership towards resilience.

Keywords: Climate change, Community resilience, Information technology, Women transformative leadership.

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Introduction

Bangladesh is one of the most vulnerable countries to the impacts of climate change. Cyclones, floods and droughts have long been part of the country's history, but they have intensified in recent years. Climate change is affecting the agriculture of the country. There are number of strategies, which are considered as a means of adaptation to climate change in agriculture. Bradshaw *et al.* (2004) has mentioned a number of adaptation strategy, which includes, crop diversification, mixed crop livestock farming systems, using different crop varieties, changing planting and harvesting dates, drought-resistant varieties and high yielding water sensitive crops. Wang *et al.* (2008) has referred adjusting irrigation practices, crop varieties and livestock species to both temperature and precipitation levels as adaptation strategies. Adaptive capacity is the ability of a system to adjust successfully to climate change that is calibrated to: (a) moderate damages; (b) take advantage of opportunities; and (c) cope with the consequences. Some literatures emphasize the importance of socio-economic factors for the adaptive capacity of a system, especially the role of institutions and governance in determining the ability to adapt to climate change (Williamson *et al.*, 2012; Engle, 2011). Women's adaptive capacity is determined by their ability to cope with and respond to hazard given the environmental and cultural settings. Because of male migration in a huge rate due of climate change and development drive; there is a feminization in agriculture. Moreover, community is now cultivating new crops and new technology of farming in practices. To keep pace with the new form of agriculture which is for adaptation to climate change, women farmers requires new knowledge. The current study determines the potential of mobile phone for climate change adaptation taken by the women farmers.

Methodology

The study was conducted with a community who is using the mobile phone with an aim of adaption in agriculture from a support of an action research project. The project was being implemented by non-government, national and international development organizations along with universities of Bangladesh and abroad. The community is located in the village Daskhin Kharibari under Dimla upazila of Nilphamari district. With a view to extorting the pertinent information from the study area, the study focused specifically on the adaptation measures taken by the farmers for climate change using mobile phone. A set of qualitative methods were used in this study. The practice of climate change adaptation in agriculture was identified from 4 focus group discussions (FGD). Those FGDs had list 20 practices that community assumes as adaptation to climate change in agriculture. Eighty-five farmwomen out of hundred households who are female farmer and own mobile phone set were selected by following simple random sampling techniques for the questionnaire survey and other consultations between the period of June 2018 to December 2019.

Use of mobile phone for climate change adaptation taken by the women farmers were measured by using three points rating scale as 'regularly', 'occasionally', and 'not at all' and the weights were assigned to these responses as 2, 1, and 0, respectively. Adaptation measures taken by the farmers for climate change using mobile phone score could range from 0 to 40 while 0 indicates not using mobile phone for climate change adaptation and 40 indicates mobile phone are highly using responsible for climate change adaptation. However, besides having calculated the 'use of mobile phone for climate change adaptation taken by the women farmers' score for all the 85 women, an effort was also made to compute the role in Mobile Phone Use Index (MPUI) to analyze the use of mobile phone for climate change adaptation. The following formula was used for this purpose:

$$MPUI = N_1 \times 2 + N_2 \times 1 + N_3 \times 0.$$

Where,

MPUI = Mobile Phone Use Index;
N_1 = Number of women who use mobile phone regularly;
N_2 = Number of women who use mobile phone occasionally;
N_3 = Number of women who use mobile phone not at all;
The MPUI for each of the activity can range from 0 to 170.

For exploring the relationships between the selected characteristics of the respondents and adaptation measures taken by them for climate change Pearson's Product Moment Correlation Co-efficient (r) was computed. Data were analyzed by using software named SPSS 22 version.

Results and Discussion

Use of mobile phone for climate change adaptation taken by the women farmers

The computed MPUI of the identified 20 climate change adaptation techniques ranged from 16 to 150 against the possible range from 0 to 170. 'Changing crop variety' was the number one ranked use of mobile phone for climate change adaptation techniques (MPUI = 149). The result might be due to that majority of the women farmers have not enough idea about various crop varieties suitable for climate change adaptation. The farming women need high agricultural production. Mostly they are using high yielding crop varieties. They know about crop varieties by using mobile phone. The second highest use of mobile phone for climate change adaptation techniques was found on 'Changing crop type' (MPUI = 118). This is due to that women farmers get more information about the suitable crop type. They understand that changing of their crop type can get more agricultural production. The third use of mobile phone for climate change adaptation techniques was found on 'High-yielding water sensitive crops' (MPUI = 112). The result might be due to that respondents use this technique because flood is common in the study area. They know this technique via mobile phone either SMS or call. Floating beds for cultivation' was the last ranked use of mobile phone for climate change adaptation techniques i.e. 19^{th} (MPUI = 16).

Table 1. Distribution of the respondents according to use of mobile phone.

Sl. No.	Climate change adaptation techniques	Frequency of mobile phone use			MPUI*	Rank order
		Regularly	Occasionally	Not at all		
1.	Changing crop variety	70	9	6	149	1st
2.	Changing crop type	43	32	10	118	2nd
3.	Practicing crop rotation	21	47	17	89	6th
4.	Short duration crops variety	13	40	32	66	9th
5.	Reducing cultivable land	9	34	42	52	13th
6.	Changing soil and water management techniques	22	23	40	67	8th
7.	Changing field location	23	27	35	73	7th
8.	Shifting from crop to livestock	2	35	48	39	17th
9.	Shifting from livestock to crop	11	23	51	45	16th
10.	Migrating	18	13	54	49	15th
11.	Set community seed banks	13	7	65	33	18th
12.	Shifting to off-farm job	14	32	39	60	12th
13.	Drought tolerant rice varieties	40	18	27	98	5th
14.	Drought tolerant wheat varieties	24	16	45	64	10th
15.	Floating beds for cultivation	5	6	74	16	19th
16.	Raising plinths of houses	15	21	49	51	14th
17.	Moving businesses to safer areas	18	15	52	51	14th
18.	Changing planting and harvesting dates	43	21	21	107	4th
19.	High-yielding water sensitive crops	47	18	10	112	3rd
20.	Integrated rice-fish farming	18	25	42	61	11th

**MPUI= Mobile Phone Use Index*

Use efficiency of mobile phone towards climate change adaptation by women farmers

The use efficiency of the mobile phone set in adaptation knowledge management for various issues were found as below:

Table 2. Women farmers using mobile phone for climate change adaptation.

Use efficiency	Range		Categories	Women farmers		Mean	SD
	Possible	Observed		Number	%		
Use of mobile phone for adaptation	0-40	0-31	Low use (≤13)	25	29.4	16.47	7.44
			Medium use (14-27)	55	64.7		
			High use (>27)	5	5.9		
Organizational participation	0-24	1-5	Low participation (1-2)	73	85.9	1.82	0.98
			Medium participation (3-4)	8	9.4		
			High participation (above 4)	4	4.7		
Participation in Community Activities	0-30	1-24	Low (≤10)	17	20.0	15.42	5.77
			Medium (11-20)	50	58.8		
			High (>20)	18	21.2		
Environmental Awareness	0-40	14-39	Low (≤13)	0.0	0.0	31.33	4.81
			Medium (14-27)	13	15.3		
			High (>27)	72	84.7		
ICT Self-efficacy	0-32	1-28	Low (≤11)	24	28.2	15.73	6.93
			Medium (12-22)	44	51.8		
			High (>22)	17	20.0		

Use of mobile phone for adaptation

Overall use of mobile phone for climate change adaptation score for 20 identified climate change adaptation techniques could theoretically range from 0 to 40, where 0 indicating no use and 30 indicating high use of mobile phone for climate change adaptation. However, the observed use of mobile phone for climate change adaptation scores of the respondents ranged from 0 to 31 with a mean of 16.47 and standard deviation 7.44. The study found that above three-fifths (64.70%) of the women farmers had medium use of mobile phone for climate change adaptation while 29.4% had low and only 5.9% had high use of mobile phone for climate change adaptation. The average mean value of the use of mobile phone for climate change adaptation indicates that the women farmers in average had medium use of mobile phone for climate change adaptation. Unawareness of the respondents about the use of mobile phone in climate change adaptation was observed. Lack of interest and responsiveness on receiving information about climate change adaptation techniques were also noted. Therefore, it was necessary to encourage the women farmers in receiving climate change adaptation information technique through mobile phone.

Organizational participation

Organizational participation scores of the women farmers ranged from 0 to 24 with an average of 1.82 and a standard deviation of 0.98. On the basis of their organizational participation scores, the women farmers were classified into three categories: 'low participation' (1-8), 'medium participation' (9-16) and 'high participation' (above 16)". Study has found that more than four-fifths (85.9%) of the farmers had low participation in different development organizations compared to 9.4 and 4.7% having medium and high organizational participation. The major reasons for such low participation could be existence of few organizations in the study area, lack of awareness and motivation of the respondents to participate in whatever organizations exist.

Participation in community activities (PCA)

Overall use of mobile phone for climate change adaptation score for 20 identified climate change adaptation techniques could theoretically range from 0 to 40, where 0 indicating no use and 40 indicating high use of mobile phone for climate change adaptation. However, the observed use of mobile phone for climate change adaptation scores of the respondents ranged from 0 to 31 with a mean of 16.47 and standard deviation 7.44. The scores of PCA by the women farmers ranged from 1 to 24 with an average of 15.42 and a standard deviation of 5.77. Based on the PCA, the women farmers were classified into three categories such as 'low' (≤10), 'medium' (11-20) and 'high' (>20). Data indicated that the highest proportions (58.8%) of the women farmers have medium PCA, while 21.2 percent have high PCA and 20.0 percent have low PCA. Findings showed that majority (above 70.0%) of the women farmers had medium to high PCA.

Environmental awareness (EA)

The scores of EA by the women farmers ranged from 14 to 39 with an average of 31.33 and a standard deviation of 4.81. Based on the EA, the women farmers were classified into three categories such as 'low' (≤13), 'medium' (14-27) and 'high' (>27). Data indicated that near forth-fifths (84.7%) of the women farmers have medium to high EA, while 15.3% have high EA and none has low EA. Thus, in general the environmental awareness level of the women farmers of the study area was quite satisfactory. Possession of comparatively high environmental awareness is likely to be contributory to understand about climate change adaptation.

ICT self-efficacy

The scores of ICT self-efficacy by the women farmers ranged from 1 to 28 with an average of 15.73 and a standard deviation of 6.93. Based on the ICT self-efficacy, the women farmers were classified into three categories such as 'low' (≤11), 'medium' (12-22) and 'high' (>22). The findings specified that slightly above half (51.8%) of the women farmers had medium ICT self-efficacy, while 28.2% have low ICT self-efficacy and 20.0 percent have high ICT self-efficacy. Findings revealed that just forth-fifths (80.0%) of the women farmers had low to medium ICT self-efficacy.

Relationship between the selected characteristics of the women farmers with their use of mobile phone for climate change adaptation

The point of this section is to explore the relationships between each of the selected characteristics of the women farmers and use of mobile phone in climate change adaptation. The selected characteristics constituted independent variables and the focus issue was considered use of mobile phone in climate change adaptation. Pearson's Product Moment Correlation Co-efficient 'r' was used to test the null hypothesis concerning the relationship between any two variables. The summary results of test of correlation coefficient are as bellow.

Table 3. Correlation between focus issue and selected characteristics of the women farmers.

Selected Characteristics	Correlation Value of 'r' with 83 df
Organizational participation	0.337**
Participation in community activities (PCA)	0.405**
Environmental awareness (EA)	0.261*
ICT Self-efficacy	0.283**

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

Several studies, recently conducted in South Asia and Africa, have shown the transformative potential of modern information and communication technologies (ICTs) in agriculture. Among these, mobile phones have demonstrated their suitability to address the issue of the existing information asymmetry (Mittal, 2012; Mittal and Mehar, 2015).The overall goal of using mobile phone-enabled information delivery mechanisms is to promote inclusive growth by reducing the knowledge gap between both large and small farmers and across gender by creating awareness about the latest technologies and best practices, besides facilitating two-way communication (Mittal and Mehar, 2012). In agricultural sector, the farmer is highly vulnerable to risks because of the high variability in climatic conditions and market uncertainties. The farmer's exposure to the risk and uncertainty is often aggravated by lack of information about weather, inputs, farm management practices, or market prices, which adversely impacts crop production and income (Mittal, 2012; Mittal and Mehar, 2012). Delivery of the latest agriculture-related information is expected to result in (a) an increase in productivity through informed decision making on crop choice, seed varieties, inputs, agronomic practices and plant protection, (b) a reduction in the production costs through the adoption of better-quality inputs and technologies and better management practices, and (c) improved incomes resulting from reduced costs and better price realization for the produce. The process of adoption of mobile-based information delivery systems has been slow and many of the models are still at an early stage of development. The sustainability of these models is also in question as most are still funded externally, and farmers are not paying the cost of receiving information. Mobile-enabled information has the potential to play an important role in improving the adoption of modern technologies, inputs, and best practices (Anderson and Feder, 2007; Bhatnagar, 2008). The increasing penetration of mobile networks and handsets, and the recent introduction of a number of mobile-enabled information services in rural India presents an opportunity to make useful information more widely available (Fischer *et al.*, 2009; Mittal, 2012; Mittal and Mehar, 2015). The finding of this study is also supporting to the findings in India. As the scope of participation in community action and the environmental awareness was found to be significant that means mobile phone use in adaptation knowledge management could also have potential capacity towards transformative leadership.

The problem of the lack of information is even more pertinent among women engaged directly or indirectly in agriculture. Besides facing socio-cultural barriers, women farmers have lower levels of literacy, limited access to assets, and information as compared to their male counterparts, leading to a gender gap (FAO, 2011; Mehar *et al.*, 2016). Knowledge management interventions by different stakeholders could bring the changes in minimizing the gender gap. Because of the feminization in farming, more women are gradually engaging in agriculture including crop production to marketing. A project supported intervention found that only three-fifths of the women farmers have the capacity of medium use of mobile phone towards climate change adaptation where the intervention was dedicated for adaptation knowledge management. Attempt should be taken for increasing extent of use of mobile phone for climate change adaptation purposes through creating awareness and interest among the women farmers. Environmental awareness of the women farmers had significantly positive relationship with the use of mobile phone for climate change adaptation. Therefore, more training and capacity building was recommended by the agricultural extension service providers in and all relevant stakeholders. ICT Self-efficacy of the women farmers had positive relationship with their use of mobile phone for climate change adaptation. Therefore, it may be recommended that attempts should be taken by the concerned authority to build the capacity of ICT use by the women farmers.

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