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Original Article

Role of e-Agriculture in Developing Agricultural Sector of Bangladesh as Perceived by the Coastal Farmers

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ABSTRACT

Electronic Agriculture (e-Agriculture) is part and parcel of global agricultural development. This study was conducted to know the role of e-Agriculture in developing agriculture sector of Bangladesh as perceived by the coastal farmers. Data were collected from 90 randomly selected farmers from Dacope upazila under Khulna district in March, 2020 with the objectives to identify the available e-Agricultural practices adopted by the coastal farmers and to know the role of e-Agriculture in developing agricultural sector, and to find out the constraints in adopting e-Agricultural practices. The role of e-Agriculture was measured by Likert type rating scale with **an** assigned score, and the farmers' Perception Index was used to explain the relative proportion of the statements related to perception regarding the role of e-Agriculture. Based on citation score, the findings of the study revealed that the mostly adopted e-Agricultural tool was television (75.56%) followed by smartphone (57.78%), social media (47.78%), cell phone (43.33%), climate smart agriculture (40%), etc. The majority of the respondents (41.1%) had perceived the high role of e-Agriculture in developing agriculture sector, followed by 38.9% for medium and 20% for low role of e-Agriculture. It was found that a large portion (80.0%) of the farmers had faced medium to high constraints, and only 20% faced low constraints in adopting e-Agricultural practices. Correlation analysis indicated that among the selected twelve socio-economic characteristics, the respondent's level of education, communication exposure, agricultural training received, innovativeness, knowledge and attitude showed a positive and significant relationship with the role of e-Agriculture, while age, household assets, annual family income, credit received, farming experience and organizational participation had no significant relationship with the role of e-Agriculture in developing the agricultural sector.

Introduction

Electronic Agriculture (e-Agriculture) is a widely accepted technique, which is a global community of practice, where people from all over the world exchange information, ideas, and resources related to the use of information and communication technologies (ICTs) for sustainable agriculture and rural development (FAO, 2010). Globally, the development of e-Agriculture has proven its potential for enhancing development efforts and virtually reduced the distance and turned the world into a global village (O'Farrell, 2003). All over the world, ICT-based agriculture plays a vital cross-cutting role in addressing many problems of agriculture and achieving Millennium Development Goals (MDGs) appropriately (Castells et al. 2008). Bangladesh is an agro-based country, and about 40.60% of its livelihood is derived directly from the agricultural sector, contributing 13.02% to its GDP (BBS, 2020). At present, in Bangladesh, farmers produce food for their families and sell their agricultural products at the market on a commercial basis. The coastal region covers almost 20% of the country and more than 30% of the cultivable lands, where cropping intensity is much lower than the country's average land use intensity (BBS, 2015). Although this area is affected by various natural calamities, the farmers are trying to adopt various modern technologies in their farming practices, and among them, e-Agriculture is a pioneer one and for utilizing the vast coastal land for crop production, considerable success may be achieved by efficiently applying of e-Agricultural tools in their farming practices (NICTP, 2002). The launching of e-Agriculture in farming activities is one of the new techniques for developing the agricultural sector of Bangladesh (Azad et al. 2017). Such a revolution in the agricultural

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industry made easy and convenient access to information of the coastal farmers. Bangladesh is one of the most densely populated countries in the world and due to the intense growth of population in last three decades; countries are now under pressure for cultivable land (BBS, 2011). However, the coastal area of Bangladesh has a huge uncultivable land that can be taken under cultivation by using e-Agricultural tools and techniques effectively and efficiently. Considering the present scenario, the study was conducted to know the role of e-Agriculture in developing agricultural sector of Bangladesh as perceived by the coastal farmers. Therefore, the objectives of the current research were to identify the available e-Agricultural practices adopted followed by the determination of the role of e-Agriculture in developing agricultural sector as perceived by the coastal farmers of Bangladesh. Additionally, the constraints faced by the coastal farmers in adapting e-Agricultural practices for agricultural development is determined.

Materials and Methods

Location of the study area

The study was conducted in three unions namely Tildanga, Chalna and Bajua of Dacope upazila (Figure 1) under Khulna district of Bangladesh. These unions were selected purposively because farmers of this area are coastal and comparatively contemporary method followers (BBS, 2020). Prior to selecting of these unions, a thorough discussion with the concerned authorities was conducted by the researcher in order to contact with the targeted respondents.

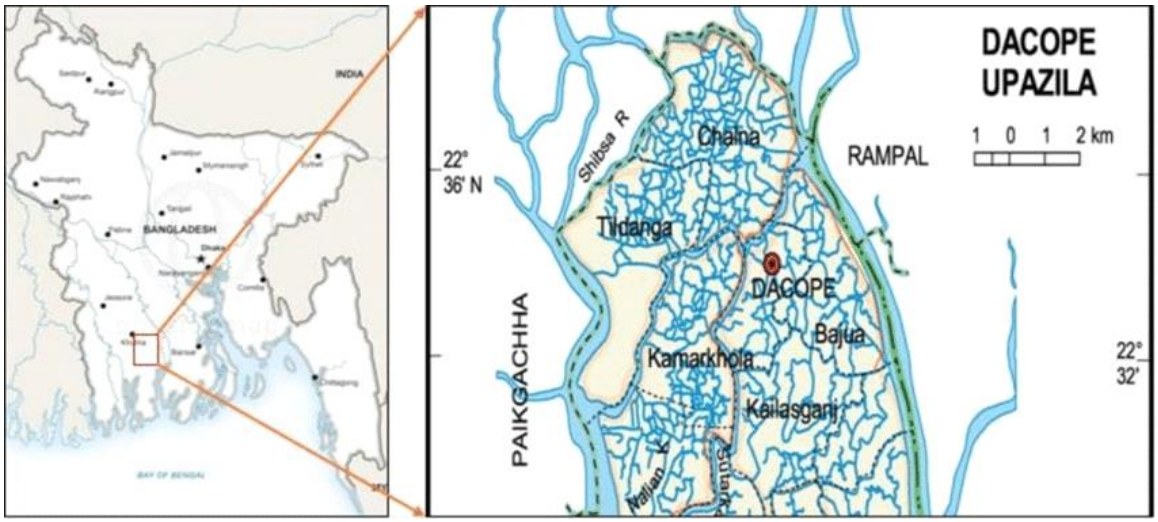

Figure 1. Map showing the study area

Population and Sampling

A multistage sampling strategy was used to identify the study's participants. Most of the respondents in Dacope upazila are coastal farmers whose livelihoods depend on agriculture-based farming activities (Billah et al. 2019). From the aforesaid unions, a total of six villages; two from each were selected purposively and 15 farmers from each village were selected randomly and the total sample size was ninety (90).

Data collection

Prior to data collection with interview method, three Focus Group Discussions (FGDs) were done; each group consisted of 15 participants having farmers, local leader and Sub Assistant Agriculture Officers (SAAOs). With a view to getting in-depth information, three Key Informant Interviews (KIIS) with UP members, model farmer and Upazila Agriculture Officer (UAO) were also conducted in the study area. The qualitative data helped the researcher to design interview schedule for the study. A personal interview was conducted with the 90 respondents through the interview schedule in March 2020.

Selection and measurement of variables of the study

The role of e-Agriculture in developing agricultural sector of Bangladesh perceived by the coastal farmers was treated as a dependent variable. At the same time, selected characteristics of the respondents were considered as independent variable. With a view to measuring dependent variables a number of 20 statements like, introduction of modern technology, easy and quick access to information, increase production, increase income, instant solution, improve yield quality, access to market etc. were included. A 4-point Likert type scale such as strongly agree,

moderately agree, somewhat agree, not at all agree was employed against the rating scale, respectively and score assigned the rating scale were 3,2,1,0, correspondingly (Likert, 1932). The perception score of the respondents ranged from 0-60. Based on the perception score, the respondents were classified on the following categories.

Categories	Score
Low role perceived	≤20
Medium role perceived	21-40
High role perceived	>40

Besides, A Farmers Perception Index (FPI) was calculated using the following formula (Shiduzzaman et al. 2018) to understand the relative proportion of the statements related to perception regarding the role of e-Agriculture in developing agricultural sector of Bangladesh.

$FPI = N_1 \times 3 + N_2 \times 2 + N_3 \times 1 + N_4 \times 0$

Where,

FPI = Farmers Perception Index

N_1 = No of respondents rated the role of e-Agriculture as strongly agree,

N_2 = No of respondents rated the role of e-Agriculture as moderately agree,

N_3 = No of respondents rated the role of e-Agriculture as somewhat agree,

N_4 = No of respondents rated the role of e-Agriculture as not at all agree,

The FPI score ranged from 0-270, where 0 indicate no role while 270 indicate the highest role of e-Agriculture as perceived by the coastal farmers in developing agricultural sector of Bangladesh.

Data Analysis

The collected data were coded, categorized, tabulated and analyzed as per requirement. The local units were converted into standard units. The qualitative data were transferred into quantitative data by appropriate scoring techniques. The Statistical Package for the Social Science (SPSS) computer program (version 20) was used for analyzing the data. Various descriptive statistical measures such as range, frequency, number, percentage, mean, standard deviation (SD) were used for categorization and describing the variables. Pearson's product moment correlation coefficient (r) was utilized to explore the relationship between the selected characteristics of the respondents and their perception regarding the role of e-Agriculture in developing agricultural sector of Bangladesh.

Results and Discussion

Socio-demographic characteristics of the respondents

The study's findings indicate that most (94.5%) of the respondents were young to middle aged while over half (57.8%) of them had secondary education. The majority (68.9%) of the farmers had medium household assets and almost half (47.8%) of them had low annual income, while 88.9% did not receive any credits. The study also reveals that about two-third (76.7 %) of the respondents had poor communication exposure. The findings also explore that about two-third (71.1%) of the respondents received no agricultural training while nearly half (43.3%) of them had medium farming experience. In addition, one-third (32.2%) of the respondents is early adopters, and most of them (88.9%) had no organizational participation. The results also expose that about two-third (72.2%) of the respondents had medium knowledge on e-Agricultural practices whereas about half (48.9%) of them had highly favorable attitudes towards the role of e-Agriculture in developing agricultural sector of Bangladesh (Table 1).

Many authors (World Bank, 2011, Billah et al., 2019, Rao, 2007) observed almost similar types of socio-demographic features of the respondents in their research work. The research report of FAO (2010) explored that the young, educated, well skilled and innovator farmers are more adaptable to ICT based farming initiatives in addressing climate variability.

Adoption of e-Agricultural practices by the respondents in farming activities

The respondents in the study area were exposed to various e-Agricultural tools and techniques to develop the agricultural sector. Based on citation score, the findings reveal that among the selected e-Agricultural practices, majority of the respondents (75.56%) were exposed to television as e-Agricultural tool to get up-to-date farming information, followed by smartphone (57.78%), social media (47.78%), cell phone (43.33%), newspaper (40%), internet (37.78%), smart agriculture (31.11%), poster/leaflet (23.33%), agricultural apps (14.44%) and so on but none of the respondents exposed to satellite (Figure 2).

Table 1. Salient features of the selected characteristics of the respondents

Socio-economic variables	Percent (%)	Respondents (N=90)			
		Mean	SD	Min.	Max.
Age (years)	---				
Young (≤35)	47.8				
Middle (36-55)	46.7	38.79	9.67	22	60
Old (>55)	5.5				
Level of education	---				
Illiterate (0)	4.4				
Primary (l-5)	34.5	6.01	2.24	0.0	12
Secondary (6-10)	57.8				
Higher secondary (11-12)	3.3				
Higher education (>12)	0.0				
Household assets (“000” BDT)	---				
Low asset (≤ 200)	17.8				
Medium asset (201-400)	68.9	384.0	213.0	80.0	1480.0
High asset (>400)	13.3				
Annual family income (“000” BDT)	---				
Low (≤150)	47.8				
Medium (151-300)	32.2	187.0	85.20	35.00	450.00
High (> 300)	20.0				
Credit received (“000” BDT)	---				
No credit (0)	88.9				
Low credit (≤ 35)	3.3	47.22	18.17	10.00	100.00
Medium credit (36-70)	5.6				
High credit (>70)	2.2				
Communication exposure (scale score)	---				
Poor exposure (≤15)	76.7				
Medium exposure (16-30)	23.3	10.67	6.61	4.0	30.0
High exposure (>30)	0.0				
Agril. training received (scale score)	**---**				
No training (0 days)	71.1				
Short duration training (1 -7 days)	25.6	0.96	2.11	0	10
Medium duration training (8-14 day)	3.3				
Long duration training (> 14 days)	0.0				
Farming experience (Years)	---				
Low experience (≤10 years)	34.4				
Medium experience (11-20 years)	43.3	15.84	8.14	2.0	35
High experience (>30 years)	2.3				
Innovativeness (scale score)	----				
Innovator (1)	8.9				
Early adopter (2)	32.2				
Early majority (3)	23.3	3.0	1.22	1	5
Late majority (4)	21.1				
Laggard (5)	14.4				
Organizational participation (scale score)	----				
No participation (0)	88.9				
Low participation (up to 7)	10.0	0.4	1.34	0.00	8.00
Medium participation (8-14)	1.1				
High participation (>14)	0.0				
Knowledge (scale score)	---				
Poor knowledge (≤ 4)	3.3				
Medium knowledge (5-8)	72.2	7.48	1.62	4.0	12
High knowledge (> 8)	24.5				
Attitude (scale score)	-----				
Less favorable attitude (≤ 26)	4.4				
Moderate favorable attitude (27-52)	46.7	51.87	9.35	22	65
Highly favorable attitude (> 52)	48.9				

Source: Field survey (2020), SD= standard deviation

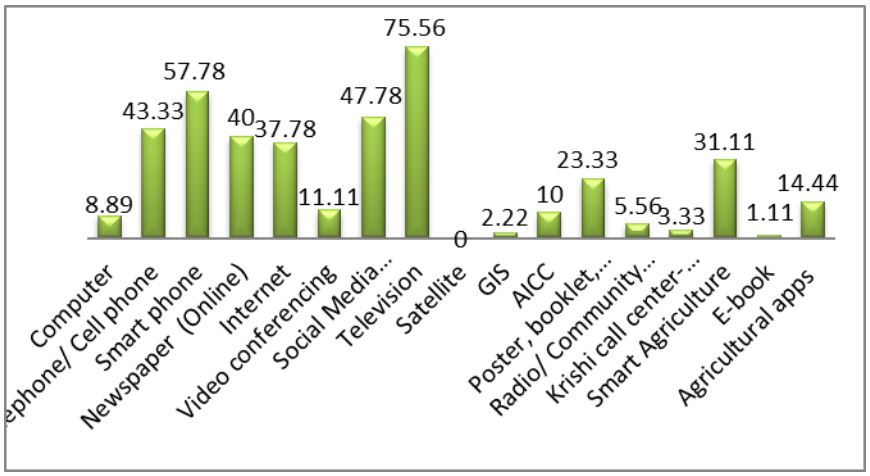

Figure 2. Available e-Agricultural practices adopted by the coastal farmers

Bwalya et al. (2012) reported that alike types of ICT based agricultural tools are being used by the smallholder farmers at various degree resulted from findings of their research work entitled "Promoting ICT based agricultural knowledge management: to increase production and productivity of smallholder farmers in Ethiopia" while a research finding of Asenso and Mekonnen (2012) reported that there is no alternative to adopt ICTs in agricultural farming activities for increasing cropping intensity and developing rural communities. One the contrary, Chhachhar et al. (2012) noted that television is the main source of updated farm information to the farmers.

Extent of perceived role of e-Agriculture in developing the agricultural sector

The farmer's perception related to the role of e-Agriculture score ranged from 0 to 60 with a mean of 37.27 and standard deviation of 11.34. The distribution of respondent's access to their perception related to the role of e-Agriculture is presented in Figure 3. The data presented in the above figure indicate that majority of the respondents (41%) opined e-Agricultural implements played high role in developing the agricultural sector, followed by medium role (39%) and low role (26%) respectively.

Rao (2007) explored that ICTs play medium to high role in developing agriculture sector of India in his research work; "A framework for implementing information and communication technologies in agricultural development in India". On the other hand, Freeman and Mubichi (2017) exposed that the smallholder farmers in rural Mozambique experienced moderate to high role of ICTs in farming activities. For clear understanding of the extent of perceived role of e-Agricultural tools in developing agricultural sector a Farmers Perception Index (FPI) is presented in Table 2.

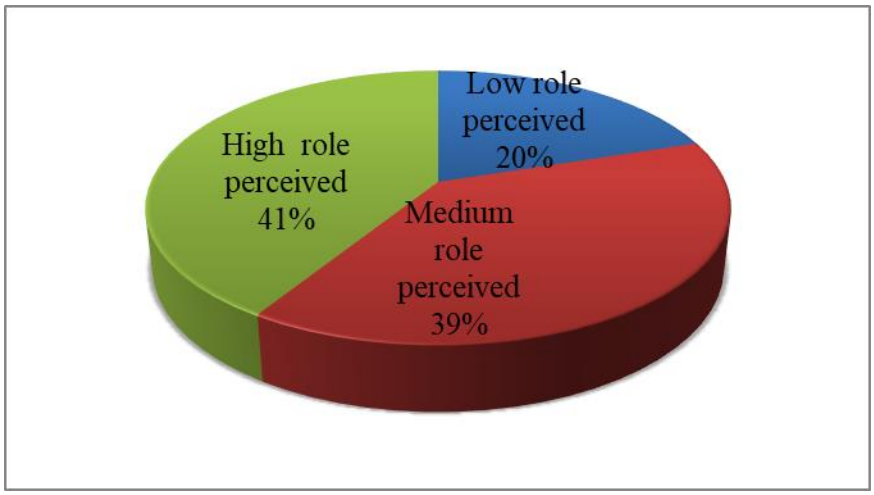

Figure 3. Perceived role of e-Agriculture by the respondents

Table 2. Extent of perceived role of e-Agriculture by the respondents

Perceived role of e-Agriculture	Farmers Perception Index (FPI)	
	Percent (%)	Rank order
Introduce modern technology	91.8	1
Easy & quick access to information	87.7	2
Easy access to market	84.1	3
Increase crop yield	83.3	4
Increase family income	78.8	5
Increase yield quality	77.7	6
Provide instant solutions	75.9	7
New management techniques	72.2	8
Increase the standard of living	70.3	9
Increase capacity building	69.6	10
Reduce labor demand	69.2	11
Reduce insect- pest infestation	67.7	12
Reduce production cost	65.5	13
Improve soil health	64.4	14
Protective step against adverse climate	61.8	15
Enhance online conference	61.1	16
Ensure sustainable farming	59.2	17
Enhance empowerment	57.7	18
Increase cropping diversity	56.3	19
Increase food safety	53.7	20

Source: Field survey (2020)

Data presented in the above table indicate that among the 20 statements perceived as the role of e-Agriculture by the coastal farmers in developing agricultural sector; most of the respondents (91.85%) agreed that e-Agriculture play high role in introducing modern technologies followed by easy & quick access to information (87.78%), easy access to market (84.07%), increase crop yield (83.33%), increase family income (78.89%) etc. In contrast, about half (53.7%) of them observed that it a played low role in increasing food safety. According to Lio and Liu (2006), ICT-based demonstration and information is very important in adopting agricultural innovations while Mwakaje (2010) reported that rural farmers access to market as well as inputs are highly influenced by adoption of ICTs in farming practices.

Relationship between perceived role and selected characteristics of the respondents

Karl Pearson's product moment correlation coefficient was estimated for finding out the relationship between the perceived role of e-Agriculture and selected characteristics of the respondents. The analysis indicate that among the twelve selected characteristics of the respondents; level of education, communication exposure, agricultural training received, innovativeness, knowledge and attitude were positively correlated with the perceived role of e-Agriculture while there is no significant relationship of age, household assets, annual family income, credit received, farming experience and organizational participation with the perceived role of e-Agriculture in developing agricultural sector (Table 3).

Table 3. Correlation coefficient of the perceived role and selected characteristics

Independent variables	Dependent variable	Correlation coefficient (r)
Age	**Role of e-Agriculture**	-0.020
Level of education		0.447**
Household assets		-0.022
Annual family income		0.125
Credit received		-0.011
Communication exposure		0.741**
Agricultural training received		0.519**
Farming Experience		-0.065
Innovativeness		-0.607**
Organizational Participation		0.049
Knowledge		0.833**
Attitude		0.300**

**= Significant at 1percent level of significance (0.01) level (2-tailed)

A research work of Ali & Kumar (2011) revealed that there is a relation between farmers' socio-economic characteristics and decision-making ability in adopting ICT based technologies in farming practices whereas Aker et al. (2016) revealed that adoption of ICTs in agricultural practices is influenced mainly by education, cosmopolitanism, innovativeness and positive attitude towards innovations.

Constraints faced by the respondents in adapting e-Agricultural practices

The respondents in the study area are suffering from numerous constraints in adapting e-Agricultural tools for the developing the agricultural sector properly. The findings exposed that about half (46.67%) of the respondents faced medium constraints while 33.3 percent and 20.0 percent faced high and low constraints respectively with a mean of 37.27 and standard deviation of 11.34 (Figure 4).

A research report by Aker (2011) exposed that the farmers from developing nations face more problems than developing one in adapting agricultural innovations. For clear understanding of the severity of constraints faced by the coastal farmers in adapting e-Agricultural tools; a Constraints Index (CI) is presented in Table 4. The results indicate, majority (76.67%) of the respondents opined that lack of skill in using e-Agricultural practices as rigorous constraints followed by illiteracy (76.22%), lack of information (74.44%), language barrier (73.56%), lack of electricity (72.89%) etc. while over half of the respondents (56.67%) observed lack of supervision as low constraints in adapting e-Agricultural tools for developing agricultural sector.

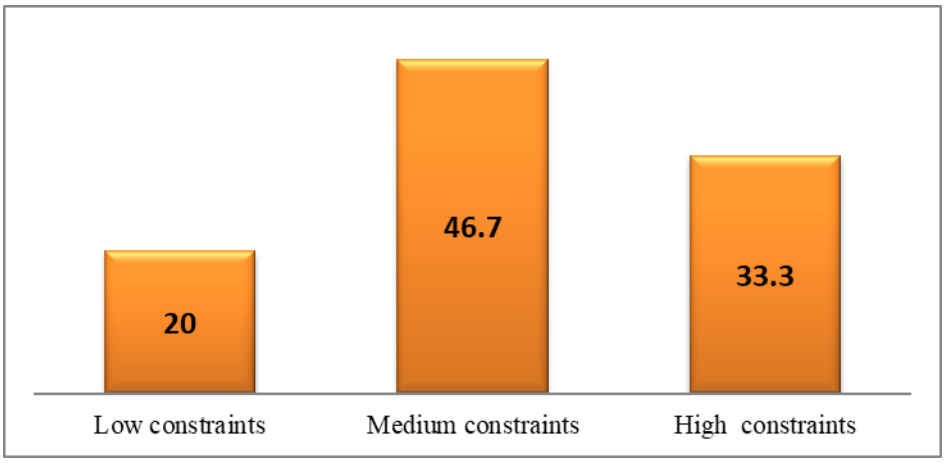

Figure 4. Constraints in adapting e-Agricultural practices

Table 4. Severity of constraints in adapting e-Agricultural tools by the respondents

Constraints faced by coastal farmers	Constraints Index (CI)	
	Percent (%)	Rank order
Lack of skill in using e-Agriculture tools	76.7	1
Illiteracy	76.2	2
Lack of information	74.4	3
Language barrier	73.5	4
Lack of electricity	72.8	5
Lack of training	71.3	6
Poor extension services	70.0	7
Poverty	69.3	8
Lack of network supply	68.2	9
Lack of motivation	67.3	10
Lack of credit/money	65.5	11
Poor communication	63.1	12
Lack of awareness	61.1	13
High cost of productivity	58.7	14
Lack of supervision	56.6	15

Source: Field survey (2020)

Sofia et al. (2011) observed almost allied type of barriers in adapting ICT technologies for agricultural production in their research work entitled "ICT adoption and development: issues in rural accommodation" whereas Francis and Godfred (2018) identified that the three main barriers that hinders the effective usage of ICT namely attitudinal, accessibility and technical.

Conclusion

The study explored that the coastal farmers are mainly practicing particular types of e-Agricultural tools and techniques in their farming activities and among them mass media play the vital role in maintaining sustainability in developing agricultural sector while most of the respondents in the study area observed high to medium role of e-Agriculture in developing this dynamic sector and they considered that this innovation accelerate the cropping intensity as well as productivity. Majority of the respondents faced medium to high constraints in adapting e-Agricultural innovations for farming activities due to lack of skills, information, illiteracy etc. So, concerned authorities should take appropriate strategies, in upgrading the situation for achieving the Sustainable Development Goals (SDGs) properly.

Authors Contributions

This research work was carried out in collaboration among all authors.

M.M.B.: Design, formulation and supervision of experiment, statistical analysis and writing of manuscript. S.A.: Searching literature, performing field work, collection and analysis of data and M.B.A.: Supervision of experiments and review of manuscript. All authors read and approved the final manuscript.

Competing Interests

The authors have declared that no competing interests exist

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