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Changes of Wetland Agriculture in Bangladesh Experience from Mithamain Union

Muhammad Jahedul Huq*
Mohammad Nayeem Aziz Ansari **
Afia Rahman***

Abstract : *Bangladesh possesses enormous wetland areas and indeed during the rainy season, about half of the country could be classified as wetlands. Wetlands of this country have great ecological, economic, commercial and social importance and values. But the wetland eco-system is already under stress due to both physical and human interferences in and around the wetlands. Increasing human as well as various development activities lead the severe negative impact on wetland's environment. The present paper mainly discusses some changes in wetland agriculture of Bangladesh taking wetland areas of Mithamain union, Kishorgonj district as case study. Both primary and secondary data have been used. The study found that agricultural activities have increased in the recent years. Farmer's dependence on local boro paddy has been shifted towards HYV boro paddy. Besides, excessive use of pesticides in the recent time has increased land and water pollution in the haor areas. Moreover, conversion of wetlands into paddy fields during the Boro season has been destroying the wetlands habitat. Therefore, the study concludes that a capability should be developed to monitor the changes in the environment with a view to ensure sustainable agricultural development and environmental protection in wetlands of Bangladesh.*

Introduction

Agriculture is the single most important sector of the economy in Bangladesh. It is the major source of livelihood in the rural areas, where about 80 percent of the population lives. Approximately two-thirds of the labour force is employed in agriculture and the performance of this sector affects the overall economic growth. Bangladesh has achieved an estimated cropping intensity of about 177.03 percent by 2003/04. Out of the net sown area of 19.84 million acres, about 51.46 percent (10.21 million acres) is double cropped and approximately 12.62 percent (2.5 million acres) triple cropped and about 35.28 percent (7 million acres) is still single cropped (BBS 2005).

Wetland agriculture is a major form of land use and those river valleys, floodplains, and coastal lowlands in particular have frequently been used for agriculture because of their natural suitability and the demands of agriculture for flat, fertile land and a ready supply of fresh water. Bangladesh possesses enormous wetland areas and indeed during the

* MS student, Department of Human Ecology, Vrije University Brussels, Belgium. Email: shovonju@yahoo.com

** Assistant Professor, Department of Geography and Environment, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh. Email: nayeemgeo@yahoo.com

*** Research Officer, Bangladesh Public Administration Training Centre, Savar, Dhaka, Bangladesh.Email: mukta_bpatc@yahoo.com

rainy season, about half of the country could be classified as wetlands. Large areas of wetland are commonly known as beels, baors and haors. The low-lying wetland area is very fertile and suitable for agricultural purpose as they are flooded during the wet season. And cultivation of rice is a major activity in and around the wetlands of the Ganges-Brahmaputra flood plain and Haor Basin. Low-lying lands under private ownership are used almost exclusively for the cultivation of rice and the state-owned margins of beels, baors, haors and rivers are often leased on an annual basis for paddy cultivation. As a result, the total wetlands of Bangladesh are contributing a substantial amount of paddy to our total food grain production (Akonda 1989). But in recent decades, some noticeable changes have been occurred in wetland agriculture in Bangladesh. In this context, the present study has taken an attempt to know the changes in wetland agriculture in Bangladesh taking Mithamain union of Kishoregonj District as a case study.

Mithmain union is located in the Kishoregonj District, the northeast wetland region of Bangladesh. It is a part of the large natural depression, commonly known as haor basin. Mithamain union occupies the Surma-Kushiara flood plain and older Meghna estuarine flood plain. The total area of this union is 3644 hectares. During the rainy season a complex of over 8 beels merge into a single, large water body and 85% land of this union turns into wetlands whereas during the dry season about 35% land of Mithamain union is recognized as wetlands. The maximum depth of water in the beels varies from approximately 8 to 10 m during the rainy season and 2 to 3 m during the dry seasons. The land type of the area is dominated by very low and low lands, which are seasonally flooded 7 to 8 months during May to November (Huq, 2005).

Location of the Study Area

The study area Mithamain union is located under Mithamain upazila. It is situated between 24° 22′ N to 24° 26′ N latitude and 91°01′ E to 91°04′ E longitude (Figure 01). The Kishoregonj District borders the districts of Netrokona and Mymensingh in the north, Norshingdi in the southwest, Brahmanbaria in the southeast, Sunamgonj and Hobigonj in the east and Mymensingh and Gazipur districts in the west. The main rivers of the districts are Old Brahmaputra, Meghna, Kalni, Dhanu, Ghorautra, Baurii, Narasunda and Piyain. Again Mithamain union is bounded by Itna and Ajmirigonj upazilas on the south; Ghagra union (Mithamain upazila) & Austogram upazilas on the east; Karimgonj & Nikli upazilas on the west; Dhaki and Gopedighi union of Mithamain upazila on the north.

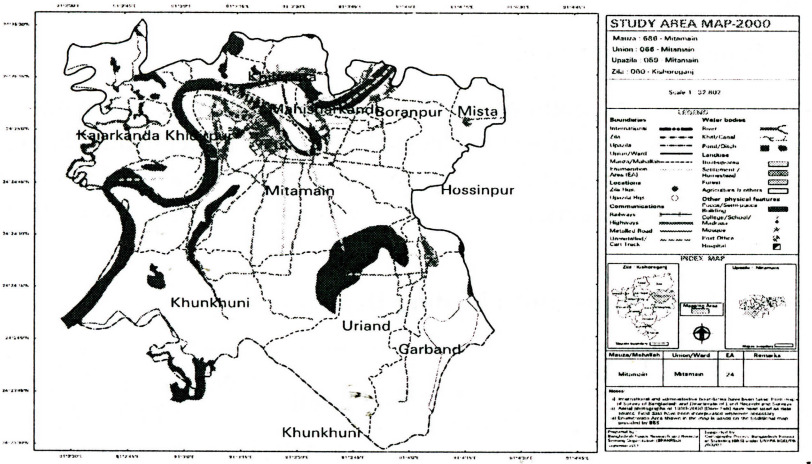


Figure 1: Map of Study Area

The large number of rivers and land depressions make this part of area a specific kind of landscape with its evergreen shrubs, berries and bamboos. Kishoregonj District is especially famous for its large area of inland open water that include a number of rivers and estuaries, land depressions and lakes varying in size from a few hectares to more than two thousand hectares and a large area of floodplains. The monsoon rains flood the area yearly and many parts retain some water throughout the dry season. This floodplain region is also a wetland eco-system and the region plays an important hydrological, biological and ecological role in the natural functioning of the region. Thus the physical environment is suitable for agricultural activities and a local person depends on it.

Methodology

The present study is mainly based on primary data. Secondary data both published and unpublished has also been used. Primary data were collected by field investigation with the help of direct observation and questionnaire survey in December 2004. The questionnaire accounts list of different kinds of crops including their past and present status, uses of fertilizer, agricultural pattern and mode of irrigation. As a part of primary data collection, the study has also conducted FGDs (Focus Group Discussion) with people from different professions like farmers, governmental officials, and agricultural labors. Relevant documents from various government and non-government organizations like Bangladesh Bureau of Statistics (BBS), Bangladesh Soil Research Development Institute (SRDI), Bangladesh Agricultural Research Council (BARC), Bangladesh Center for Advanced Studies (BCAS) and Center for Natural Resources Studies (CNRS) were consulted. Thereafter, all the collected data have been analyzed and presented by simple analytical methods.

Analysis

Land Types of Study Area

From an agricultural point of view, soil scientists in Bangladesh adopt a different approach to define wetlands. On the basis of depth and duration of inundation/flooding, the country has been divided into six broad land types. The scientific classification of land type has been given in Table-01 and Fig.-02.

Table 01: Land Types and Flooding Depths

Land Types			Flood Depth	Nature and Extent of Flood
MPO	SRDI	Local		
F0	High land	--	--	-
F1	Medium high land	---	30-90cm	Seasonal
F2	Medium low land	Viti	90-180cm	Seasonal (3/4 months)
F3	Low land	Haor	180-275cm	Approx.7 months
F4	Very low land	Haor	Above 275cm	Approx. 8-9 months

Source: SRDI, 2000.

Mithamain union only includes 3 categories of land types. Among them medium low land (F2) is mainly used for settlement and the amount is 430 hectares. Lowland (F3) is the dominant land type, which occupies 2451 hectares. This type of land is about 67.26% of the total land. Among these land catagories, medium lowland (which remains flooded up to a depth of 180 cm during monsoon) through bottomland (which remains wet throughout the year) is considered as areas of wetlands. Very low land is about 11.27% of the total land area.

Figure-2: Typical Soil Association in Mithamain Union

General Soil Type		Noncolcoreous Grey Floodplain Soils			Noncolcoreous Dark Grey Floodplain Soil	Acid Basin Clay	
FAO soil unit		Eutric Gleysols				Eutric Fluvisol	
Flood-level type							
Highland	Homesteads						
Medium Highland							
Medium Lowland (ML)		Balagonj (ML+L)					
Lowland (L)			Goyainghat (L)	Kanairghat (L)			
Very Lowland (VL)					Ajmirigonj (VL)	Sulla (VL)	Water
% of association	5	10	5	15	20	40	5
Soil descriptions							
Drainage		p	p	poor (p)	p	Very poor	
Topsoil colour		g	g	g	g-dg	g-dgrg	
Topsoil texture		sil-siol	sil-sic	sicl-sic	sic-c	sicl-c	
Subsoil colour		g+b	g+yb	g+yb	g+b	g	
Subsoil texture		sicl	sicl	sic	sic-c	sic (row alluvium)	
Selected laboratory data							
Topsoil OM %		10	30	34	26	33	
Topsoil pH		54	49	47	60	49	
Subsoil pH		60	53	52	55	48	
Subsoil clay %		18	30	44	63	49	

1 Adopted from Kishoregonj-Mymensingh South report soil association 40. That association also includes minor areas of 3 other soil series

2 N B : a) all soils are moderately deeply to deeply flooded in the rainy season, b) Sullo soils stay wet through the dry season; c) general increase in OM and clay contents between high and low sites; d) very strong acidity of most topsoils and subsoils, e) despite strong acidity, subsoil base saturation is above 50%, requiring the soils to be classified as Eutric Gleysols Fluvisols in the FAO Legend

3 Laboratory data show results for single profiles They do not indicate range in contents within the series.

4 Abbreviations Colour g=grey dg= dork grey dgrg=dark greenish grey b= brown yb = yellow-brown
Texture sil= silt loom sicl= silty clay loom sic = silty clay c = clay
Laboratory data OM=orgonic matter

Source : FAO, 1988

Water Resources

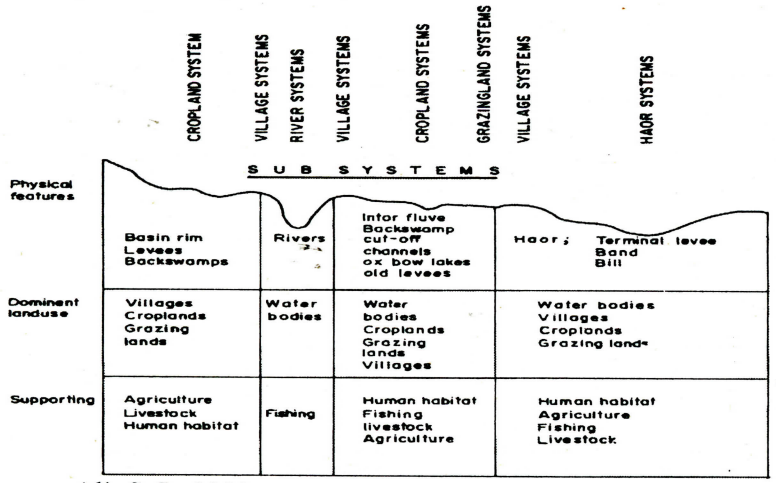
Different rivers and small or large water bodies bound the study area. The river Ghorautra divided the study area into two parts. Beels and khals are the major geomorphic features in Mithamain union. There are thirteen beels in the study area. They are as follows-

Table-2: Name of the Beels of the Study Area

Name of the beels	Name of the beels
Khunkhuni	Ujandar
Deoduri	Vatirdar
Lakhai	Rana beel
Valler Char	Joaira beel
Rani beel	Laodora
Goph beel	Dhupi
	Pada beel

These beels are playing a major role in the drainage system of the study area. Most of the beels are seasonal, ill drained and fed by monsoon water.

Figure 3 : Transect of Haor Basin Ecosystem



Source : Ali, S. I., 2000

Present Landuse

HYV boro paddy is the main crop, irrigated by pump. Local boro is grown with irrigation on some selected floodplain ridges and upper part of the basin margins. On the highest land near rivers, mustard is grown in a very small area and in other dry lands Rabi crops are grown. Non-irrigated haor areas are used as fishery. Figure 03 shows a transect of Haor Basin Ecosystem.

Most of the populations of the study area depend on agriculture and fishing. These are the main source of their income. Most of the people belong to low-income group. Mithamain union is less developed region of the haor area of Bangladesh.

Findings

Wetland Agriculture in Mithamain

Like other parts of Bangladesh, agriculture is the dominant activities in Mithamain Union. The system of wetland farming is based on the farmers' knowledge and experience on wetland hydrology, ecology, soil characteristics and the requirements of wetland crops. The agriculture of the study area is principally driven by seasonal hydraulics and the seasonality factors have a strong impact on cultivation. During the monsoon, the study area becomes single body of open water links to the river system. When floodwater recedes, the beels of the study area

become isolated and are prepared for agriculture. Before 1970, about 60-70% land of study area was cultivable in dry season and different varieties of local boro paddy were produced. Within the intervening period the land types of study area, particularly the beels have been raised due to over siltation by regular flood. As a result, at present about 95% land of Mithamain union become cultivable in dry season. It can be mentioned that 20-25 years ago agricultural activities began in November/ December when the water of the beels were drained out and paddy was sown on the residual soil moisture. Those were usually harvested between March / April. Off late, agriculture practices are begun in January/ February and paddy is harvested in between June/July. The main cause behind the shifting of cropping season is dependency on the changing behaviour of local hydrology. Due to establishment of embankment as well as FCD/I (Flood Control and Drainage/Irrigation) projects in the upstream, at present, flood water enters and drains in the low lying beels in the study area very lately and vise versa (Alam et. al. 2003). Flood water hampers agricultural activities very much. Due to late start of cultivation in recent years, the farmers cannot collect their ripen paddy properly as flood season begins at that time. But most striking feature is that villagers of this wetlands are now cooping this unstable condition by introducing homestead gardening and using relatively high land particularly the newly buildup area.

Changes in Agricultural Area

In the past century or so, when the population pressure was less, most of the rim-lands of the haors remained as cultivable wasteland and was used for extensive grazing in the dry season. As population increased, boro cultivation expanded onto these marginal lands leading to a large area being drained. Thus, the existences of these wetlands are now threatened. Consequently, more and more people are being forced into marginal areas in the search of agricultural land (Banglapedia 2003). In the search for productive agricultural areas, however, this traditional wetlands use strategies are being superseded by more intensive form of their uses. The impacts of such intensification in wetland uses, particularly cultivation are already evident in many areas.

Table 3 : Area Under Agriculture in Mithamain Union.

Area under agriculture (Hectare)	Year		Change		Remarks
	1984	1996	Changes from 1984	Percentage of change (%)	
Net temporary area	5850	4400	1450	24.79	Decreased
Gross cropped area	5642	4399	1243	22.03	Decreased

Source : Agriculture Census (BBS)-1996 & 1984.

In 1984, the net temporary area and gross cropped area were 5850 hectares and 5642 hectares respectively, whereas those were 4400 hectares and 4399 hectares in 1996 (Table 3). It is observed that both net temporary area and gross cropped area have been decreased about 24.79% and 22.03% respectively during that decade. Agricultural land has decreased due to human interferences with the increase of settlement. Apart from this, during the rainy season the agricultural fields is frequently inundated and it receives huge amount of alluvium. According to FGD survey, 20-25 years ago, silt was full of different kinds of biomass. But now when floodwater recedes or after inundation an amount of 1 to 1.5 inches sand is deposited on topsoil. In addition, decomposing plants fill up wetlands and the plant residuals help to settle down more sediment in that place. In such way of cumulative deposition of 'very lowland' is converted into 'lowland' and gradually into 'medium highland'.

Changes in Paddy

Rice cultivation in the study area like other area of Bangladesh has undergone some changes in terms of yields. Earlier, the farmers of Mithamain union cultivated 11 types of indigenous paddy (Table 4). But now, they are producing only HYV paddy. Observation reveals that BR-28 and BR-29 are very much popular in Mithamain union. Some farmers also introduced an imported HYV named HIRA, which comes from China. The farmers of the study area opined that HYV paddy has some problems. It is very tuff to carry the ripen HYV paddy from paddy fields to house as they rapidly detached from the ear of corn. The present study found that nine types of local varieties are locally extinct and two are rare. Before 1970, about 60-70 percent land of the study area were cultivated in the dry season and were producing many varieties of local Boro paddy like Laldingi, Jagli boro, Tapi & Topa Boro, Buchibaroi, poshushail, Kala Boro, Rajashail, Lakhai Boro, etc. Bogra, Buchibaroi, Rajashail, Lakhai Boro, which were used to be cultivated at beels.

Table 4 : List of Paddy Cultivated in Wetland of Mithamain Union.

Sl. no.	Boro Varieties	Name of Boro paddies	Status	
			Past	Present
1	Local	Laldingi	VC	ED
2		Bogra	VC	E
3		Buchibarai	VC	E
4		Poshushail	VC	E
5		Tapi boro	VC	R
6		Topa boro	VC	E
7		Kala boro	VC	E
8		Lakhai boro	VC	E
9		Rajashail	VC	ED
10		Jagli boro	VC	R
11		Kalijira	C	R
12	Bangladeshi HYV	BRI-28	-	C
13		BRI-29	-	VC
14		BRI-8	VC	R
15		BRI-36	VC	R
16		Mongol (BR-19)	VC	R
17		Biplob (BR-3)	VC	C
18		Gazi (BR-14)	VC	C
19		Shahjalal (BR-18)	VC	R
20		Balam (BR-16)	VC	R
21		Mala-IRRI	VC	C
22	Imported HYV	HIRA	-	VC
23		ALOK	-	R
24		SONAR BANGLA	-	VC
25		JAGORON	-	C

[Code: Status: Very common=VC; Common=C; Rare=R; Endangered=ED; Locally Extinct=E]
(BRRI=Bangladesh Rice Research Institute; BARI= Bangladesh Agricultural Research Institute)

But now local Boro rice is not cultivated except at few places and many of them are now locally extinct. In 1984 the total local Boro paddy cultivated area was 1363 hectares whereas it was only 985 hectares in 1996 (BBS, 2000). Although the land of the study area has already been raised due to siltation and at present about 95 percent land of the study area became cultivable in the dry season. The farmers did not get expected return by cultivating local Boro because of poor production.

Moreover, flash floods damage Boro crops during harvesting period in June and July.

Cultivation of New Crops

The inhabitants of Mithamain union have been cultivating a small amount of new crops for a few years like potato, chili, onion, garlic and groundnut (Table 5). They also cultivate few vegetables such as cabbage, cauliflower and tomato in winter season in their yard. Most of the Chili and groundnut are cultivated at bar land.

Table 5: New crops of Mithamain union.

Sl. No.	English name	Local name	Scientific name
1	Cabbage	Bandhakopi	Brassica oleracea var capitata
2	Cauliflower	Phulkopi	Brassica oleracea var botrytis
3	Mustard green	Sarisa shak	Brassica campestris
4	Radish	Mula	Raphanus sativus
5	Bottle gourd	Lau	Lagenaria siceraria
6	Potato	Alu	Solanum tuberosum
7	Brinjal	Begoon	Solanum melongena
8	Tomato	Tomato	Lycopersicon esculentum
9	Chilli	Jhal marich	Capsicum species
10	Stem amaranth	Danta	Amaranthus lividus
11	Garlic	Roshun	Allium sativum
12	Onion	payaj	Allium cepa

People with wetland gardens plant different types of vegetables in the winter season. Most of the farmers do not cultivate these new crops for commercial purpose. These crops are only used for home consumption and sometimes as households supplement for their cash by selling crops such as potatoes, tomatoes, chili, and vegetables. Block supervisor (Agriculture activitist) of the Mithamain union claimed that they are trying to create awareness for growing vegetables and other crops because they have to import vegetables from other parts of Bangladesh.

Changes in Mode of Irrigation

Irrigation is an agricultural strategy designed to reduce moisture deficiency, i.e. the imbalance between the moisture supplied by rainfall and the evapotranspiration demand. In Bangladesh irrigation plays a pre-eminent role in minimizing the adverse influence of scanty and unreliable rainfall. Many agricultural regions of the world get enough rainfall and it becomes essential to redistribute rainwater for the inadequate rain during the growing season.

Table 6: Mode of irrigation

Mode of irrigation	Percentage (%) of the respondent (2004)	Percentage (%) of the respondent (25 years ago)
Diesel engine (Boro scheme)	82.00	17.83
Canal	13.43	72.15
Hand/lift	4.47	10.02

Wetland agriculture in Mithamain takes place as formal and informal irrigation. Formal irrigation encompasses government schemes that were established from the 1980s and self-help schemes that were constructed in the 1960s to 1970s. The table 6 shows the mode of irrigation of Mithamain. The table 6 depicts that in 2004, 82% respondents use diesel engine, which is locally called Boro scheme. The Boro schemes collect irrigation water from river and they have to pay money to local government. Besides, a few people use canal for irrigation (13.43%). 25 years ago, they used to collect water from nearest beels but at present at the time of irrigation, the cultivators do not get sufficient water in beels as they have been filled up by siltation. But 25 years ago beels contain enough water, people used canal for irrigation (72.15%)

Uses of fertilizer and pesticides

Chemical fertilizers today hold the key to the success of the crop production system of Bangladesh agriculture, and contribute about 50% of the total production. The peasants of Mithamain union did not use any fertilizer in 20 to 25 years ago. Now they use 100-150-kg/acre urea, 50-60 kg/acre TSP and 35-40 kg/acre MoP to their paddy field and very low amount of urea is used in vegetable cultivation.

Table 7 : Uses of fertilizer in Mithamain Union

Name of Crop	Uses of Fertilizer (kg/ acre)					
	Urea		TSP		MoP	
	Past	Present	Past	Present	Past	Present
Boro	-	100-150	-	50-60	-	35-40
Vegetable	-	10-15	-	-	-	-

According to their statement, fertilizer was not essential for growing paddy. During the rainy season the agriculture fields are frequently inundated and receive huge amount of alluvium. At that time silt was full of different kind of biomass. But now, land fertility has decreased due to use of a high amount of chemical fertilizer. Again, floodwater deposits an amount of 1 to 1.5 inch sand on the topsoil in every year. As a result they have to use more fertilizer for growing more food on the limited

cultivable land. Apart from these, with the pressure of more population, the farmers have to grow more food by using more fertilizer. Another reason is the use of HYV seeds, which require more fertilizer.

Effect of Pesticides in the Land

In the past, the farmers of the study area did not use any pesticides for pest or any kind of diseases. Most of the local paddy varieties are naturally, to a great extent, resistant to the pest. That was the reason why the local paddy producers depend only natural control. The study area with its heavy population pressure has a very limited scope of expanding its potential arable land. So the farmers improved their productivity by increasing the cropping intensity. Farmers took all possible measures to use of HYV seed, which includes adequate quantity of fertilizer and management of all kinds of pests and diseases.

Table 8 : Pesticides Used in Mithamain Union

Sl. no.	Pesticides varieties	Name of Pesticides	Group	Amount / Acre
1	Granular	Basudin	Diaginon	2-3 kg
2		Furadan	Carbofuran	2-3 kg
3		Bistaren		
4		Sunfuran		
5		Miral (banned-2000)		2 kg
6	Liquid	Nogos (banned-2000)	Dichlorobos	400 ml
7		Dimacron (banned-2000)	Organophosporus	400-500 ml
8		Novacron(banned-2000)	Monocrotophos	350-450 ml
9		Monotuff(banned-2000)		
10		Darsban	Chlorophyriphos	800-900ml
11		Classic		
12		Irridan	Carbofuran	700-800 ml
13		Foratuff		
14		Raison	Diaginon	

Now a days, the cultivators of Mithamain union are using pesticides both liquid and solid. Commonly used pesticides in the study area under different trade names include Carbofuran, Diazinon, and Chlorophilfos. Among the group of pesticides they usually use the Diazinon group. Despite the Government's ban on Nogos, Dimecron, Novacron and Monotuff, the farmers also use them (Table-8).

Conclusion

In Bangladesh, as in most developing countries, agriculture plays a key role in the overall economic performance of the country. It still dominates

in terms of its contribution to GDP, poverty alleviation and foreign exchange earnings and in providing employment to a large segment of the population, especially the rural poor. Consequently the Nation's progress will depend on government intervention in developing the agricultural sector. Wetland areas in Bangladesh have been extensively and intensively developed for food production system, especially those that are rice-based. The major impact has been on cropping patterns and intensity. Though there has a positive effects of changes in wetland agriculture, it has caused several environmental problems including extinction of many indigenous rice varieties, loss of natural soil nutrients, loss of many indigenous aquatic plants, herbs, shrubs and weeds, loss of natural water reservoirs and of their resultant benefits, increase in the occurrence of flooding and degeneration of wetland based ecosystems, occupations, socio-economic institutions and cultures. Therefore, multiple uses may thus be considered as a form of "wise use" which the Ramsar Convention champions in its search for protecting and maintaining wetland across the world (Ramsar Convention Bureau, 2000). To ensure food and nutrition for the ever-increasing population, suitable cropping patterns for wetland agriculture should be introduced based on the concept of crop diversification depending on soils and other agro-climatic conditions and to enhance the positive role that sustainable agricultural practices may have vis-à-vis the conservation and wise use of wetlands. However, over the last couple of decades, the biodiversity and resources of land depressions and oxbow lakes have come under great threat in the absence of effective government control. So, much remains to be done to improve the overall agricultural performance of the country as well as the proper use of wetlands.

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