



Status of bio-diversity, species lost, cropping pattern, homestead diversity in southern coastal zones of Bangladesh*

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Abstract: An intensive survey on agrobiodiversity, information collected from key informants, and Focus Group Discussion (FGD), were made in three Aquatic Agriculture System (AAS) hub areas of Borguna, Satkhira and Khulna. In Satkhira the upazilla was Kaligonj and community was Tarally, in Khulna the upazilla was Batiaghata and communities were Gangarampur and Andharia and in Borguna the upazilla was Amtali and communities were Bazarkhali, Gojkhali and Khekuani. This work was conducted by Bioversity International in partnership with Fruit Tree Improvement Program (FTIP)-BAU-GPC of Bangladesh Agricultural University (BAU), WorldFish as part of its work under the CGIAR Research Program on AAS. In three polder zones interviewed the key personnel's including farmers, businessmen, political personnel's, local leaders, local public representatives both male and female, Government and Non-government officials, religious leader on species loss (crops, fish, livestock), cropping pattern, homestead diversity, food habit, marketing system, and relevant matters. Information also taken on causes of loss, major constraints, probable suggestions, responsibility and solutions have been addressed. Wide variations were observed in respect of species loss, cropping pattern, food habit, marketing system in three polder zones. Homestead diversity of crops was found wide variation too (tails of species). Major reasons for species loss were the natural disaster, rise of sea level, increase in salinity and political interventions.

Key message: Major reasons for species loss in the coastal zones of Bangladesh are natural disaster, rise of sea level, increase in salinity and political interventions.

Key words: Agrobiodiversity, dhap cultivation, sorjan system, key organization, endangered plant and fish species, conservation.

Introduction

The coastal zone of Southern Bangladesh contains 185 islands and chars, and is divided into the eastern, central, and western regions by the 2009 Government's Concept Note on Integrated Coastal Zone Management. A particular area is defined as "coastal" if it is comprised of tidal movements, salinity intrusion, and risk of cyclones and storm surges, as stated by the 2006 Coastal Development Strategy. The coastal zone contains 133 coastal Upazilas and is located in 19 districts, covering an area of about 47,203 km² (32% of the country's surface). Around 40 million people inhabit the coastal areas (28% of the total population), with 30.2 million of them living in rural areas and 10 million in urban areas (de Wilde, 2011). The Feed The Future Zone (FTF Zone) of Bangladesh comprises of the southwestern and central coastal areas, and has been deemed a target area for a global hunger and food security initiative by the U.S. (<http://www.feedthefuture.gov> Accessed, 2013). In this area, only 36% of women show parity with men in household empowerment, with 'empowerment' being evaluated based on production, resources, income, leadership, and time and the term as a whole pointing to agricultural empowerment. More specifically, the Khulna region in the southwest holds 31% of women with parity to men household empowerment. In the southeastern coastal area, the Chittagong region also accounts for a low of 30% of women with parity. The statistics for areas of southern Bangladesh hold in contrast to other areas of the country such as Barisal (46%), Dhaka (41%), Rajshahi (45%), and Rangpur (42%), with the value for all of Bangladesh being around 39% of women with parity with men in household empowerment. Empowerment relationships with education, income, and household hunger levels exist. Households with higher hunger levels

in the FTF Zone were found to correlate with lower levels of empowerment for both men and women (Sraboni *et al.*, 2013).

This paper reviews the current status of agrobiodiversity in Southern Bangladesh-on-farm, in homesteads and in the wild, and agrobiodiversity related development programs. Key organizations and institutes conducting agro-biodiversity research and development programs are presented. Due to the interdisciplinary nature of conservation and environmental studies, gender related studies and policy studies are also explored.

Materials and Methods

Working Areas and Methodologies

Three AAS hub areas of Barguna, Satkhira and Khulna taken for the study (Fig.1). In Satkhira the upazilla was Kaligonj and community was Tarally. In Khulna the Batiaghata Upazilla and community was in Gangarampur and Andharia. In Barguna, under Amtali Upazilla Bazarkhali, Gojkhali and Khekuani community were done. In addition, for special cultivation procedure (floating cultivation popularly known as Dhap cultivation), Banaripara upazilla of Barishal has been visited. In three polder zones interviewed the key personnel's including farmers, businessmen, political personnel's, local leaders, local public representatives both male and female, Government and Non-government officials, religious leader on species loss (crops, fish, livestock), cropping pattern, homestead diversity, food habit, marketing system, and relevant matters. Information also taken on causes of loss, major constraints, probable suggestions, responsibility and solutions have been addressed.

This work was conducted by Bio-diversity International in partnership with FTIP-Bangladesh Agricultural University as part of its work under the CGIAR Research Program on Aquatic Agricultural Systems.

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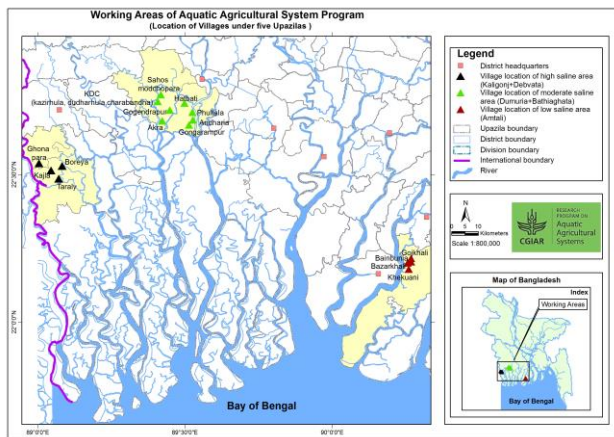


Fig. 1. Study areas in the coastal zone of Bangladesh

Results and Discussion

Status of On-farm and In-Situ Diversity

Crops/Plants: Around 300 of 5,000 species of angiosperms are cultivated, along with 224 species of timber yielding plants and 130 species of indigenous fiber plants (Khan and Mia, 1984; Mia and Haque, 1986). According to the Red Data Book on plants 96 seed-bearing

plant species are listed as threatened (IUCN, 2000). Uses of plant species include food, timber, fuel, medicinal, and ornamental purposes, with native species more commonly used for all purposes except for food, commerce, and fiber (Kabir and Webb, 2008). In the time frame 1961-2010, coastal forestry development efforts have accounted for net plantation establishments of 61-90% in various coastal areas (de Wilde, 2011).

The main crops farmed in the coastal regions are *aman* rice varieties, which provide the bulk of the agricultural yields throughout southern Bangladesh. Double cropping is also practiced, providing harvests of *aman* varieties and various *rabi* varieties such as green chilies, sweet potatoes, tomatoes, cucumbers, watermelon, maize, soybean, sesame and sweet gourd (de Wilde, 2011). Cropping pattern of three southern districts namely Khulna, Satkhira and Barisal is given in Tables 1a-1c. A number of crop species being lost in these areas (Tables 2a-2b and Figs. 2-3). The major causes of species losses are increasing soil salinity, natural disaster shrimp monoculture, indiscriminate use of agrochemicals, industrial waste disposal, oil spills etc.

Table 1. Cropping pattern of three southern districts of Bangladesh

Table 1a. Cropping pattern of Khulna practiced in 2011-2012

Sl. No.	Cropping pattern			Area (ha)	Percentage (%)
	Rabi (Nov-Feb)	Kharif-I (Mar-Jun)	Kharif-II (Jul-Oct)		
01.	Fallow	Fallow	T. Aman	25640	22.58
02.	Fallow	Shrimp	Shrimp	12850	11.31
03.	Fallow	Shrimp	T. Aman	7000	6.16
04.	Boro	Fallow/ <i>Sesbania</i>	T. Aman	24270	21.37
05.	Fallow	Sesame	T. Aman	10910	9.60
06.	Fallow	Sesame + Mung bean	T. Aman	1050	1.00
07.	Fallow	Mixed Aus	T. Aman	4000	3.52
08.	Boro	Fallow	T. Aman + Fish	4130	3.63
09.	Boro	Fallow	T. Aman	4835	4.22
10.	Fallow	Aus/Jute	T. Aman	4355	3.83
11.	Boro	Aus/Jute	Fallow	3940	3.46
12.	Wheat/Potato/Oilseed, Pulses and spices	Fallow	T. Aman	1535	1.35
13.	Vegetables	Vegetables	T. Aman	2200	2.00
14.	Vegetables	Vegetables	Vegetables	3000	2.63
15.	Fallow	Mung bean + Chilli	T. Aman	380	0.33
16.	Water melon	Aus	T. Aman	700	0.61
17.	Water melon	Fallow	T. Aman	1936	1.70
18.	Betel vine	Betel vine	Betel vine	555	0.48
19.	Sugarcane/ginger/turmeric	-	-	261	0.22
Cropping intensity: 198%			Total net cropped area	113547	100

Table 1b. Cropping pattern of Satkhira practiced in 2011-2012

Sl. No.	Cropping Pattern			Area (ha)	Percentage (%)
	Rabi	Kharif-I	Kharif-II		
01.	Boro	Fallow	T. Aman	101858	54
02.	Fallow	Fallow	T. Aman	39611	21
03.	Boro	T. Aus	T. Aman	11318	06
04.	Mustard, Boro	Fallow	T. Aman	9431	05
05.	Vegetables	Vegetables	Vegetables	9431	05
06.	Pulse	Jute	T. Aman	3773	02
07.	Potato	Jute	T. Aman	1886	01
08.	Others	Others	Others	11318	06
Cropping intensity: 191%			Total net cropped area	188626	100

Table 1c. Cropping pattern of Barisal practiced in 2011-2012

Sl. No.	Cropping Pattern			Area (ha)	Percentage (%)
	Rabi	Khari-I	Khari-II		
01.	Boro	Fallow	T. Aman	44240	25
02.	Fallow	Fallow	T. Aman	20963	12
03.	Boro	Fallow	Fallow	19360	11
04.	Fallow	Aus	T. Aman	14500	8.30
05.	Khesari	Aus	T. Aman	11500	6.50
06.	Khesari	Fallow	T. Aman	2762	1.60
07.	Pulse	Aus	T. Aman	7000	04
08.	Fallow	Fallow	B. Aman	4530	2.50
09.	Vegetable	Vegetable	Vegetable	5000	03
10.	Oilseed	Aus	T. Aman	3000	1.85
11.	Spices	Aus	T. Aman	2000	01
12.	Fallow	Jute	Fallow	4000	02
13.	Banana	Banana	Banana	4000	02
14.	Chilli	Fallow	T. Aman	4700	03
15.	Betel vine	Betel vine	Betel vine	2200	01
16.	Wheat	Fellow	T. Aman	1200	0.70
17.	Fallow	Jute	T. Aman	8000	05
18.	Vegetable	Vegetable	T. Aman	3000	1.85
19.	Oilseed	Fallow	T. Aman	3500	02
20.	Pulse	Fallow	T. Aman	4000	02
21.	Papaya	Papaya	Papaya	2500	1.55
22.	Sugarcane	Sugarcane	Sugarcane	1000	0.55
23.	Others	-	-	2734	1.60
Cropping intensity: 198%			Total net cropped area	175689	100

Table 2. Plant species lost from Southern Parts of Bangladesh; **Table 2a.** Critically Endangered Plant Species

Sl.	Common name	Bengali name	Scientific name	Family	Source	Tree category	Utilization
1.	Uri Am	জ্বলি আম	<i>Mangifera sylvatica</i> Roxb.	Anacardiaceae	Seed/cutting	Evergreen tree	Fuel & Timber
2.	Kusum	কুমুম, জয়লা	<i>Schleichera oleosa</i> (Lour.) Oken	Sapindaceae	Seed/cutting	Evergreen tree	Timber
3.	Sharogondha	সর্পগন্ধা	<i>Rauwolfia serpentina</i> (L.) Bth. ex Kurz	Apocynaceae	Seed/cutting	Evergreen tree	Medicinal
4.	Morang Elachi	মুংং এলাচি	<i>Amomum aromaticum</i> Roxb.	Zingiberaceae	Seed/cutting	Evergreen tree	Food
5.	Kalomegh	কালোমেঘ	<i>Andrographis paniculata</i> Nees	Acanthaceae	Seed/cutting	Evergreen tree	Medicinal

Table 2b. Endangered plant species

Sl.	Common name	Bengali name	Scientific name	Family	Source	Tree category	Utilization
1.	Chhatian	ছাতিয়ান	<i>Alstonia scholaris</i> (L.) R. Br.	Apocynaceae	Seed/cutting	Evergreen	4
2.	Amoor	অমর	<i>Amoora cucullata</i> Roxb.	Meliaceae	Seed/cutting	Evergreen	6
3.	Pitraj	পিতরাজ	<i>Aphanamixis polystachya</i> (Wall.) R.N.Parker	Meliaceae	Seed/cutting	Evergreen	4, 6
4.	Dewa	ডেউয়া	<i>Artocarpus lakoocha</i> Roxb.	Moraceae	Seed/cutting	Evergreen	1, 2, 4, 6
5.	Hijal	হিজল	<i>Barringtonia acutangula</i> (L.) Gaertn.	Lecythidaceae	Seed/cutting	Evergreen	4, 5
6.	Simul	শিমুল	<i>Bombax ceiba</i> L.	Bombacaceae	Seed/cutting	Evergreen	2, 8
7.	Sagu	সাগু	<i>Caryota urens</i> L.	Palmae (Arecaceae)	Seed/cutting	Evergreen	5
8.	Shonalu	শনালু	<i>Cassia fistula</i> L.	Caesalpinioideae	Seed/cutting	Evergreen	4
9.	Jafran	জাফরান	<i>Crocus sativus</i> L.	Iridaceae	Seed/cutting	Evergreen	2
10.	Chalta	চালতা	<i>Dillenia indica</i> L.	Dilleniaceae	Seed/cutting	Evergreen	1, 2, 4
11.	Kao	কাউ	<i>Garcinia cowa</i> Roxb.	Guttiferae (Clusiaceae)	Seed/cutting	Evergreen	1, 2
12.	Jarul	জারুল	<i>Lagerstroemia speciosa</i> (L.) Pers.	Lythraceae	Seed/cutting	Evergreen	8
13.	Nageshwar	নাগেশ্বর	<i>Mesua nagassarium</i> (Burm.f.) Kost.	Guttiferae (Clusiaceae)	Seed/cutting	Evergreen	1, 4
14.	Potka	পটকা	<i>Microcos paniculata</i> L.	Tiliaceae	Seed/cutting	Evergreen	4
15.	Ashok	অশোক	<i>Saraca asoca</i> (Roxb.) De Wilde	Caesalpinioideae	Seed/cutting	Evergreen	6
16.	Kalo Jam	কালো জাম	<i>Syzygium cumini</i> (L.) Skeels	Myrtaceae	Seed/cutting	Evergreen	2, 4, 6, 7
17.	Puti Jam	পুটি জাম	<i>Syzygium fruticosum</i> DC.	Myrtaceae	Seed/cutting	Evergreen	1, 4
18.	Golap Jam	গোলাম জাম	<i>Syzygium jambos</i> (L.) Alston	Myrtaceae	Seed/cutting	Evergreen	1, 4
19.	Khudi Jam	খুদি জাম	<i>Syzygium syzygioides</i> (Miq.) Merr. & L.M. Perry.	Myrtaceae	Seed/cutting	Evergreen	1, 6
20.	Bohera	বহেরা	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Combretaceae	Seed/cutting	Evergreen	3, 4
21.	Horitoki	হরিতকি	<i>Terminalia chebula</i> Retz.	Combretaceae	Seed/cutting	Evergreen	1, 3, 6
22.	Hargaja	হরগাজা, আজুলি	<i>Acanthus ilicifolius</i> L. **	Acanthaceae	Seed/cutting	Evergreen	3, 5
23.	Pati Lebu	পাতি লেবু	<i>Citrus aurantifolia</i> (Christen.) Swingle	Rutaceae	Seed/cutting	Evergreen	1
24.	Tok Lebu	টক লেবু	<i>Citrus aurantium</i> L.	Rutaceae	Seed/cutting	Evergreen	1, 2
25.	Daton Gach	দাতুন গাছ	<i>Glycosmis pentaphylla</i> (Retz.) DC.	Rutaceae	Seed/cutting	Evergreen	4
26.	Bashok	বসাক	<i>Justicia adhatoda</i> L. Nees * *	Acanthaceae	Seed/cutting	Evergreen	3
27.	Kika	কাইকা	<i>Adina cordifolia</i>	Rubiaceae	Seed/cutting	Evergreen	5
28.	Bailam	বৈলাম	<i>Anisoptera scaphula</i>	Dipterocarpaceae	Seed/cutting	Evergreen	5
29.	Agor	আগর	<i>Aquilaria agallocha</i>	Thymelaeaceae	Seed/cutting	Evergreen	5
30.	Chapalish	চাপালিশ, চামল	<i>Artocarpus chama</i> (Syn. <i>A. chaplasha</i>)	Moraceae	Seed/cutting	Evergreen	5
31.	Mahua	মহুয়া	<i>Madhuca indica</i>	Sapotaceae	Seed/cutting	Evergreen	5
32.	Cevit	আম চুড়ল, সিভিট	<i>Swintonia floribunda</i>	Anacardiaceae	Seed/cutting	Evergreen	5
33.	Jamun	ঢাকি-জাম	<i>Syzygium grandis</i>	Myrtaceae	Seed/cutting	Evergreen	5
34.	Budha narikel	বুডু নারিকেল	<i>Pterygota alata</i> (Syn. <i>Sterculia alata</i>)	Sterculiaceae	Seed/cutting	Evergreen	5
35.	Punnal	পনিয়াল, পুনাল	<i>Calophyllum inophyllum</i>	Calophyllaceae	Seed/cutting	Evergr	5

For uses, 1 = food, 2 = commercial, 3 = medicinal, 4 = fuel wood, 5 = ornamental, 6 = timber, 7 = fodder, 8 = fiber, and 9 = religious/ceremonial. * indicates IUCN red listed species for Bangladesh. ** indicates the species planted as hedgerow. RIV for the species of trees and shrubs that have planted as hedgerow and for the species of herbs and woody and non-woody climbers was not computed as the abundance for those species was not measured.



Fig. 2. Critically endangered plant species from southern parts of Bangladesh



Fig. 3. Endangered plant species from southern parts of Bangladesh

Aquatic Species/Fish: Aquaculture accounts for about 43.5% of the total fish production and fisheries contribute about 22.18% to the agricultural GDP (FAO, 2005; Anonymous, 2011). The Sundurbans mangrove ecosystems are home to five species of marine turtles and two endangered reptiles: the estuarine crocodile and the Indian python (Anonymous, 1997). The marine water bodies stretch about 200 nautical miles along the coast and are home to 442 species of fish, 36 species of marine shrimp, and 336 species of mollusks. The inland water bodies contain 266 species of indigenous fish, 13 species of exotic fish, 56 species of prawns, 26 species of freshwater mollusks, and 150 species of birds (Sarker and

Sarker, 1988). A number of fish species being lost in these areas (Table 3 and Fig. 3).

Table 3. Fish species lost from Southern Parts of Bangladesh (Endangered /vulnerable species)

Sl. No.	Local name	Bangla name	Scientific name
1.	Chitra	চিত্রা	<i>Scatophagus argus</i>
2.	Krati hagor	করাতি হাঙ্গর	<i>Pristis microden</i>
3.	Gang Magur	গাং মাগুর	<i>Plotosus canius</i>
4.	Sea horse	সমুদ্র ঘোড়া	<i>Hippocampus kuda</i>
5.	Thunus	থুনাস	<i>Thunus obesus</i>
6.	Kala Hagor	কাল হাঙ্গর	<i>Carcharhinus limbatus</i>

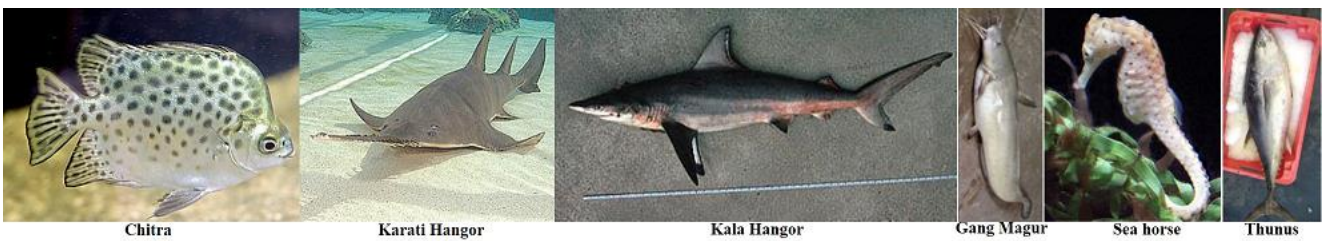


Fig. 3. Fish species lost from southern parts of Bangladesh

Three types of coastal fisheries exist: offshore fisheries, inshore harvesting of shrimp and prawn, and inshore crab harvesting. The marine catches saw an increase of around 65% from 1995/1996-2002/2003 (Islam and Ahmad, 2004). The fish and prawn species caught vary by season throughout the year. Because most fishermen don't own their own boats for nets, investments have to be made for fishing amenities. Harvesting and catching of post-larvae shrimp and prawn has grown due to economic need, with involvement of women and children. *Bagda* and *Golda* are the two most common types of post-larvae species (de Wilde, 2011). The peak catching season for *Bagda* is from

December-January and that of *Golda* is from mid-March-June. In the coastal areas, shrimp farming is predominant in the districts of Cox's Bazar, Khulna, Bagerhat, and Satkhira (Islam and Ahmad, 2004).

Socio Socio-Cultural Observations of the Investigated Area: Data collected from the targeted area and discussed with the key personnel's revealed that rice is the major crop in the area. The others are sesame, vegetables, cucurbits, pulses, and others. Local varieties of rice are mostly grown in the area. Main cultivation is practiced in rainy season. Many lands remain fallow in dry season. People of the area depend mainly on canal and river fish

and supply of fish from other parts of the country. The homestead areas are intensively utilized through various plantations. They are mostly fruit trees (especially banana both seeded and other local) and others are timbers plants (Figs. 5-7). Most of the houses have a small pond which

they use for shower and other cleanings, fish culture and as water source for other domestic and farming purposes. They also used to rear some domestic animals like cow, goat, chicks and other small livestock. Some house also rear water buffaloes.

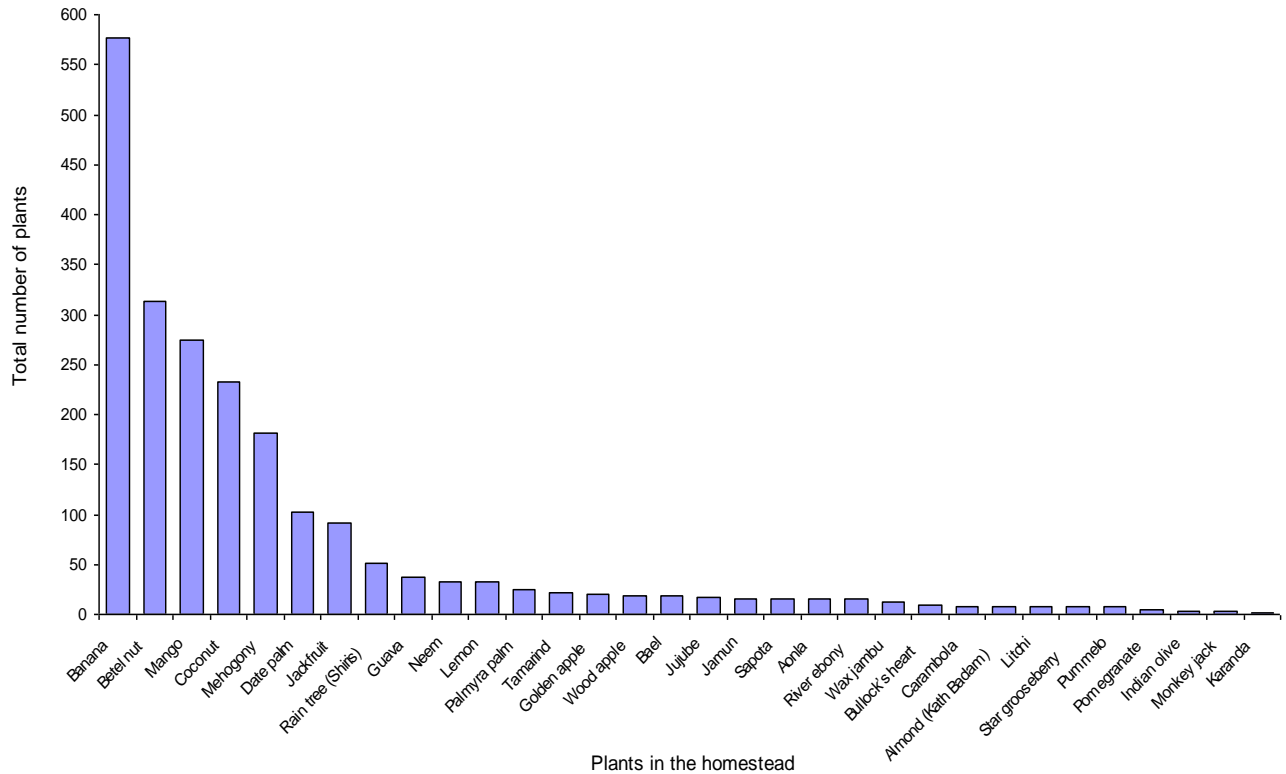


Fig. 5. Tails of Fruit Trees in 14 Homestead in Batiaghata, Khulna

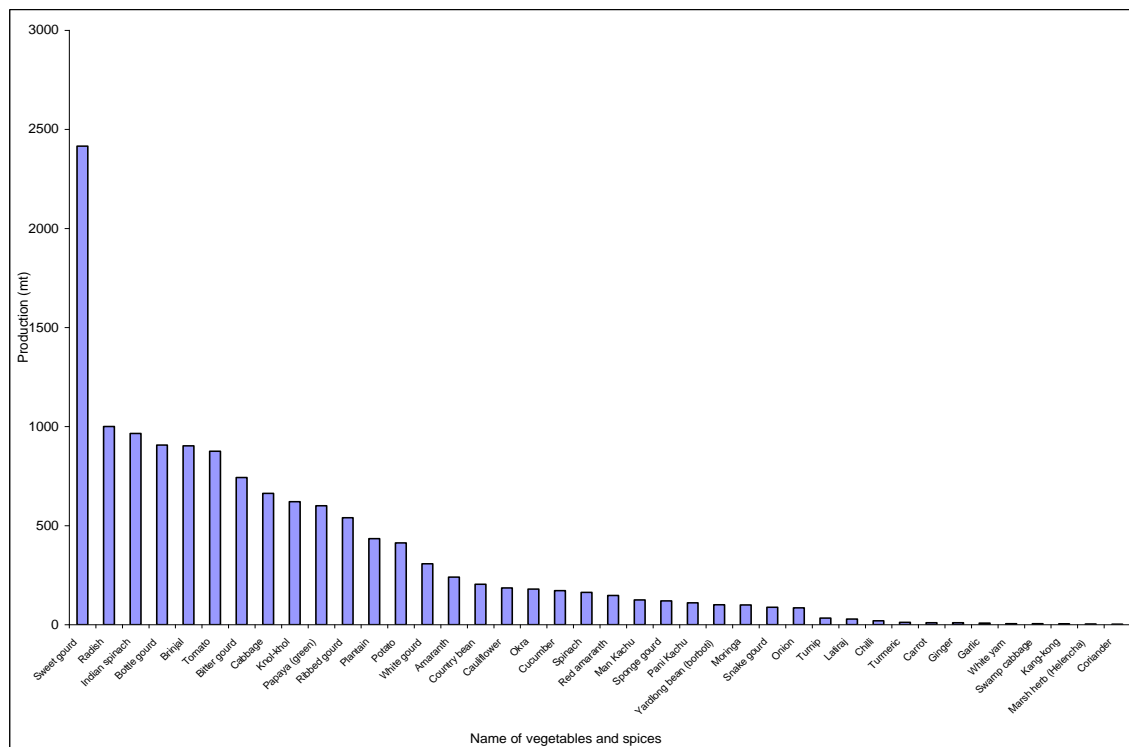


Fig. 6. Tails of vegetables and spices production (mt) in a cropping season (2012-13) of Batiaghata, Khulna

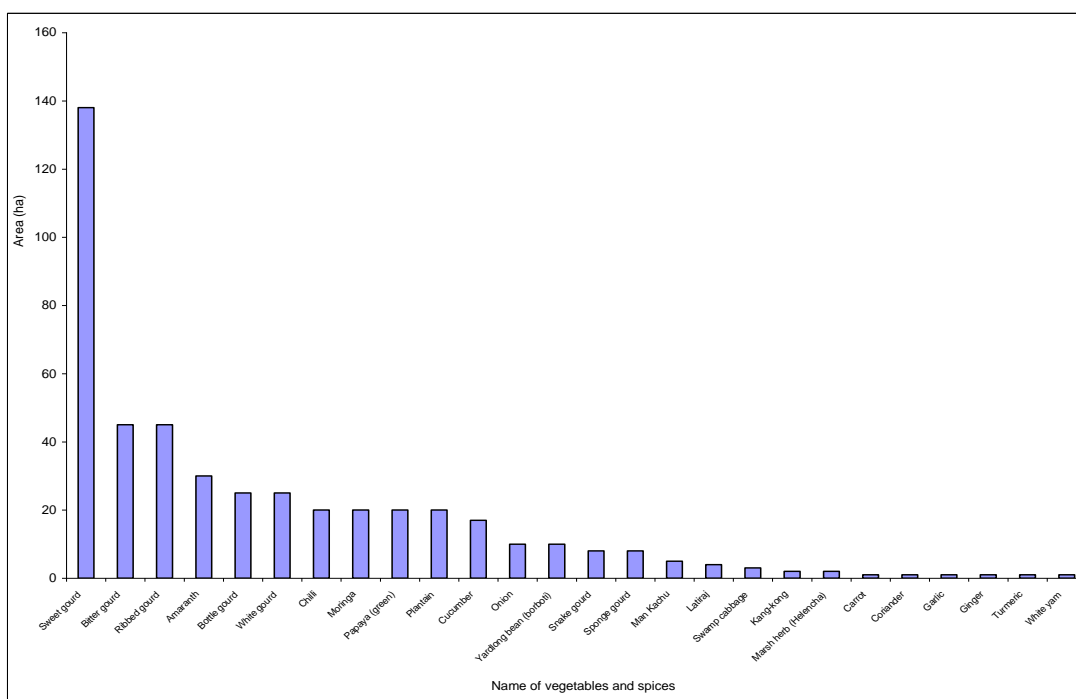


Fig. 7. Tails of vegetables and spices area (ha) in a cropping season (2012-13) of Batiaghata, Khulna

The on-farm diversity is not so high and consequently the market diversity is low. Thus, the conservation diversity is understood to be poor. Geo-climatic factors play a major role on the biodiversity distribution and utilization in the area. The sudden climatic hazards add to the vulnerable scenario. Increase in farming diversity through cultivation

of different species of crops may add good incentives to inter-linked biodiversity phenomenon in the area. Even ethnic culture of various fruits and vegetables and their consumption may enrich nutrition status of the area. Huge diversity, cropping pattern, species loss of crop, fish and livestock were found in the study areas (Tables 4-6).

Table 4. Crop species loss, endangered and present status in three polder zones

Species	Batiaghata, Khulna				Kaligonj, Satkhira				Amtali, Borguna			
	Loss	Endangred	Present Status	Remarks	Loss	Endangred	Present status	Remarks	Loss	Enangred	Present status	Remarks
Rice (<i>Oryza sativa</i>)	Local Rice varieties like Khoia, Balam, Boro	Rice varieties like Kachra Rice, Rani Salut, Benapole, and some fruits like	Sesame and rice (both local and HYV) are cultivating Now Date palm cultivating in large scale Cropping Pattern:	Problems in Mango insect and Coconut mite	Fruits like Coconut, Tamarind and Rice varieties like Balam rice, lalmoti, Kachrail, Jamainado, Khoia Rice, Balam, Boro balam, Rangon, Chinikara, Bazra, Khato Kumra,	Rice varieties like Kachra Rice, Rani Salut, Benapole, and fruits like Kolambat lebu, Bullock's heart, Custard Apple	Sesame and rice (both local and HYV) are cultivating Now Date Palm cultivating in large scale Cropping Pattern	Problem in Coconut mite	Rice varieties like Gotaila, Digamoni, Khalo aus, Ghirmi, Ghinishail, Shakorkara	Rice Varieties like Kalokhaiya, Moulota, Shada mota, Chingrishail, Razashaia, Mothamota, Boholimotha	Kala Boro, Shadachikon, Binnidhan, Dudhkalom, Kajolshail, BR 2, BR 3, BR 11, BR 14, BR 12, BR 23, BR 26, BRRI Dhan 28, BRRI Dhan 29, BRRI Dhan 30, BRRI Dhan 32, BRRI Dhan 33, BRRI Dhan 39, BRRI Dhan 45, BRRI Dhan 47, BRRI Dhan 48 & BINA Dhan 8, Potato, Mungbean, Mustard, Sunflower, Onion, Garlic, Chilli, Ginger, Coriander, Turmeric, Sweet Potato, Groundnut, Chickpea, Sesame, Sugarcane, Watermelon, Taro, Vegetables,	This year cyclone-Mohasen damages kharip-2 crops
Chickpea (<i>Cicer arietinum</i>)	Rangon, Chinikara, Bazra and Khato Kumra	Chinikara, lemon, Deshi Custard Apple, Monkey jack and Bullock's heart	1. Sesame-T. Aman -Fallow 2. Sesame-Fallow - Fallow 3. Fallow - T. Aman - Fallow 4. Summer Veg. - T. Aman - Fallow 5. Summer Veg. - T. Aman - Boro 6. Summer Veg. - T. Aman - Winter 7. Fallow - T. Aman -Potato 8. Fallow - T. Aman - Spices 9. T. Aus-T. Aman - Oil corps				1. Fallow-T. Aman-Fallow 2. Fallow-T. Aman-Boro 3. Summer Veg. - T. Aman-Winter Veg. 4. Summer Veg. - T. Aman-Pulses 5. Summer Veg. T. Aman-Potato 6. Summer Veg. T. Aman-Mustard 7. T. Aus-T. Aman-Boro 8. Fallow-T. Aman-Spices 9. Mukhi kachu-T. Aman-Winter Veg.				1. Fallow-T. Aman-Fallow 2. Fallow-T. Aus-T. Aman 3. Khesari- Fallow-T. Aman 4. Khesari -T. Aus-T. Aman 5. Mungbean - T. Aus-T. Aman 6. Mungbean - Fallow T. Aman 7. Watermelon- Fallow-T. Aman 8. Watermelon- T. Aus-T. Aman 9. Groundnut-Fallow-T. Aman 10. Groundnut- T. Aus- T. Aman 11. Chilli- Fallow- T. Aman	

lakoocha)	Mungbean (<i>Vigna radiata</i>)	Muskmelon (<i>Cucumis melo</i>)	Mustard (<i>Brassica nigra</i>)	Onion (<i>Allium cepa</i>)	Potato (<i>Solanum tuberosum</i>)	Sesame (<i>Sesamum indicum</i>)	Sugarcane (<i>Saccharum officinalis</i>)	Sunflower (<i>Helianthus annuus</i>)	Sweet Potato (<i>Ipomoea batatas</i>)	Tamarind (<i>Tamarindus indica</i> L.)	Taro (<i>Colocasia esculenta</i>)	Turmeric (<i>Curcuma domestica</i>)	Watermelon (<i>Citrullus vulgaris</i>)	10. Shrimp- T.Aman- Pulses Sugarcane- Sugarcane- Sugarcane-	10. Olkachu- Rainy Veg. -Winter Veg. 11. Fallow-T. Aman- Chilli 12. Fallow- Fallow - Sugarcane/ Onion + Winter Veg. 13. T. Aus- T. Aman- Fallow 14. Fallow- T. Aman + Shrimp + Fallow 15. Fallow- T. Aman- Khesari 16. Jute- T. Aman- Mustard 17. Jute- T. Aman- Potato T-Aus- T. Aman- Grass pea	12. Fallow-Sunflower-T. Aman 13. Others
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Table 5. Fish species loss, endangered and present status in three polder zones

Species	Batiaghata, Khulna				Kaligonj, Satkhira				Amtali, Borguna				
	Loss	Endangred	Present Status	Re- marks	Loss	Endangred	Present status	Re- marks	Loss	Endangred	Present status	Re- marks	
Assamese Batisio (Batas Tengra) - <i>Batisio tengana</i> , Banded Gourami (Khalisha) - <i>Colisa fasciata</i> , Black Rohu/Kalbasu/Orange-fin labeo (Kalibus/Kalobosh/Baus/Kalia) - <i>Labeo calbasu</i> , Bronze featherback (Folimas) - <i>Notopterus notopterus</i> , Canine Catfish-eel (Gang magur) - <i>Pristius canius</i> , Catla (Katoimas) - <i>Catla catla</i> , Chilinda (look like Pungas) - <i>Pangasius pangasius</i> , Choto gussi -, Climbing Perch (Deshi Koi/Koi) - <i>Anabas testudineus</i> , Clown Knife fish (Chitol) - <i>Chitala chitala</i> , Corsula (Khorsula) - <i>Rhinomugil corsula</i> , Crab (Local Kakra) - <i>Crab (Local Kakra)</i> , Freshwater Shark (Boalmas) - <i>Wallago attu</i> , Gangetic Bola (bola) - <i>Johnius gangeticus</i> , Gangetic Leaffish (Bheda/Naina/Roima) - <i>Nandus nandus</i> , Giant Perch (Vetki) - <i>Lates calcarifer</i> , Gold-spot Mullet (Parsha) - <i>Liza parsia</i> , Gray Eel Catfish (Kain magur) - <i>Plotosus canius</i> , Great Snakehead (Gajar) - <i>Channa marulius</i> , Hilsa Shad (Ilish) - <i>Tenualosa ilisha</i> , House mas -, Hsahia Kassop (Tortoise) -, Indian Trout (Bhol/Bol) - <i>Raïmas bola</i> , <i>Barilius bola</i> , Long Whiskered catfish (Air) - <i>Aoriehiys aor</i> , Long Whiskers Catfish (Nona Tengra) - <i>Mystus gulio</i> , Menoda catfish (Ghagra/Ghagla- like tengra wide and white in color) - <i>Hemibagrus menoda</i> , Mottled Nandus/ Mud Perch (Meni/Bheda/Bhedary) - <i>Nandus nandus</i> , Mrigel (Mrigel) - <i>Cirrhinus cirrhosus</i> , Mud Eel (Kuicha) - <i>Monopterusuchia</i> , Nilotika (large scale) -, Olive Barb (Deshi Shar Punt) - <i>Puntius sarana</i> , Pabdah Catfish (Pabdamas) - <i>Ompok pabda</i> , Paradise Threadfin (Taposi) - <i>Polytermus paradiseus</i> , Prawn (Galda Chingri) - Queen Loach (Boumas) - <i>Botia dario</i> , Reticulated Loach (Ranimas) - <i>Botia lohachata</i> , Rohu (Ruimas) - <i>Labeo rohita</i> , Sawfish (Hangar) - <i>Anoxypristis cuspidata</i> , Scatophagus (Chitra) - <i>Scatophagus argus</i> , Scribbled Goby (Belemas) - <i>Awaous grammepomus</i> , Sharpnose Hammer Croaker (Poa) - <i>Johnius vogleri</i> , Shingri Magur -, Shrimp (Bagda Chingri) -, Silver carp -, Snakehead Murrel (Shol) - <i>Channa striata</i> , Sonali -, Stinging Catfish (Shing) - <i>Heteropneustes fossilis</i> ,	Bronze featherback (Folimas)	Banded Gourami (Khalisha)	Bagdha Prawns (Khalisha)		Banded Gourami (Khalisha)	Chingri Choto gussi	Carp kike Ruhi, Katla, Mrigel, Silver, Olive	Loss due to intrusion of high saline water	Boal featherback (Folimas)	Bhola Chingri Choto gussi	Bhola Chingri Choto gussi	Cultivated fish- Yellowtail Catfish (Deshi Pangas) and Nitotika (large scale), Koi (small scale), Carp kike Ruhi, Katla, Mrigel, Silver, Olive Barb (Shar Punt)	
	Canine Catfish-eel (Gang magur)	Bhola	Bagdha shrimp		Bronze featherback (Folimas)	Local Kakra	Mrigel, Silver, Olive		Canine Catfish-eel (Gang magur)	Crab (Local Kakra)	Crab (Local Kakra)	Crab (Local Kakra)	
	Chilinda (look like Pungas)	Bronze featherback (Folimas)	Carp kike		Canine Catfish-eel (Gang magur)	Folimas	Barb (Shar Punt), Nilotika (large scale), Koi (small scale), Long		Chilinda (look like Pungas)	Golda (Kakra)	Golda (Kakra)	Golda (Kakra)	
	Clown Knife fish (Chitol)	Chingri	House mas		Clown Knife fish (Chitol)	Katla	Whiskers Catfish (Ruh), Mrigel, Paradi		Clown Knife fish (Chitol)	Katla	Katla	Katla	
	Crab (Local Kakra)	Knife fish (Chitol)	Koi (small scale)		Crab (Local Kakra)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Crab (Local Kakra)	Mrigel	Mrigel	Mrigel	
	Gangetic Bola (bola)	Koi (small scale)	Mrigel		Gangetic Bola (bola)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Gangetic Bola (bola)	Mrigel	Mrigel	Mrigel	
	Gangetic Leaffish (Bheda/Naina)	Local Kakra	Nilotika		Gangetic Leaffish (Bheda/Naina)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Gangetic Leaffish (Bheda/Naina)	Mrigel	Mrigel	Mrigel	
	Gray Eel Catfish (Kain magur)	Local Kakra	Nilotika		Gray Eel Catfish (Kain magur)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Gray Eel Catfish (Kain magur)	Mrigel	Mrigel	Mrigel	
	Great Snakehead (Gajar)	Deshi Koi (large scale)	Whiskers Catfish (Ruh), Mrigel, Paradi		Great Snakehead (Gajar)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Great Snakehead (Gajar)	Mrigel	Mrigel	Mrigel	
	Giant Perch (Gajar)	Deshi Koi (large scale)	Whiskers Catfish (Ruh), Mrigel, Paradi		Giant Perch (Gajar)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Giant Perch (Gajar)	Mrigel	Mrigel	Mrigel	
	Hsahia Kassop (tortise)	Whiskers Catfish (Ruh), Mrigel, Paradi	Whiskers Catfish (Ruh), Mrigel, Paradi		Hsahia Kassop (tortise)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Hsahia Kassop (tortise)	Mrigel	Mrigel	Mrigel	
	Kalobosh	Whiskers Catfish (Ruh), Mrigel, Paradi	Whiskers Catfish (Ruh), Mrigel, Paradi		Kalobosh	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Kalobosh	Mrigel	Mrigel	Mrigel	
	Long Whiskered catfish (Air)	Whiskers Catfish (Ruh), Mrigel, Paradi	Whiskers Catfish (Ruh), Mrigel, Paradi		Long Whiskered catfish (Air)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Long Whiskered catfish (Air)	Mrigel	Mrigel	Mrigel	
	Menoda catfish (Ghagra/Ghagla- like tengra wide and white in color)	Whiskers Catfish (Ruh), Mrigel, Paradi	Whiskers Catfish (Ruh), Mrigel, Paradi		Menoda catfish (Ghagra/Ghagla- like tengra wide and white in color)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Menoda catfish (Ghagra/Ghagla- like tengra wide and white in color)	Mrigel	Mrigel	Mrigel	
	Mud Eel (Kuicha)	Whiskers Catfish (Ruh), Mrigel, Paradi	Whiskers Catfish (Ruh), Mrigel, Paradi		Mud Eel (Kuicha)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Mud Eel (Kuicha)	Mrigel	Mrigel	Mrigel	
	Olive Barb (Deshi SharPunt)	Whiskers Catfish (Ruh), Mrigel, Paradi	Whiskers Catfish (Ruh), Mrigel, Paradi		Olive Barb (Deshi SharPunt)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Olive Barb (Deshi SharPunt)	Mrigel	Mrigel	Mrigel	
	Queen Loach (Boumas)	Whiskers Catfish (Ruh), Mrigel, Paradi	Whiskers Catfish (Ruh), Mrigel, Paradi		Queen Loach (Boumas)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Queen Loach (Boumas)	Mrigel	Mrigel	Mrigel	
	Reticulated Loach (Ranimas)	Whiskers Catfish (Ruh), Mrigel, Paradi	Whiskers Catfish (Ruh), Mrigel, Paradi		Reticulated Loach (Ranimas)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Reticulated Loach (Ranimas)	Mrigel	Mrigel	Mrigel	
	Sawfish (Hangar)	Whiskers Catfish (Ruh), Mrigel, Paradi	Whiskers Catfish (Ruh), Mrigel, Paradi		Sawfish (Hangar)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Sawfish (Hangar)	Mrigel	Mrigel	Mrigel	
	Scatophagus (Chitra)	Whiskers Catfish (Ruh), Mrigel, Paradi	Whiskers Catfish (Ruh), Mrigel, Paradi		Scatophagus (Chitra)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Scatophagus (Chitra)	Mrigel	Mrigel	Mrigel	
	Snakehead Murrel (Shol)	Whiskers Catfish (Ruh), Mrigel, Paradi	Whiskers Catfish (Ruh), Mrigel, Paradi		Snakehead Murrel (Shol)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Snakehead Murrel (Shol)	Mrigel	Mrigel	Mrigel	
	Walking Catfish (Magur)	Whiskers Catfish (Ruh), Mrigel, Paradi	Whiskers Catfish (Ruh), Mrigel, Paradi		Walking Catfish (Magur)	Mrigel	Whiskers Catfish (Ruh), Mrigel, Paradi		Walking Catfish (Magur)	Mrigel	Mrigel	Mrigel	

Species	Batiaghata, Khulna				Kaligonj, Satkhira				Amtali, Borguna			
	Loss	Endangred	Present Status	Re-remarks	Loss	Endangred	Present status	Re-remarks	Loss	Endangred	Present status	Re-remarks
Striped dwarf catfish (Tengra) - <i>Mystus vittatus</i> , Tiger shrimp - Walking Catfish (Magur) - <i>Clarias batrachus</i> , Whale Catfish (Rita) - <i>Rita rita</i> , Yellowtail Catfish (Deshi Pangas) - <i>Pangasius pangasius</i>		(Deshi Pangas)			(Magur)						Ruhi, Katla, Mrigel, Silver, Olive Barb (Shar Punt)	

Table 6. Livestock species loss, endangered and present status in three polder zones

Species	Batiaghata, Khulna				Kaligonj, Satkhira				Amtali, Borguna			
	Loss	Endangred	Present Status	Remarks	Loss	Endangred	Present status	Remarks	Loss	Endangred	Present status	Remarks
Buffalo (<i>Bubalus bubalis</i>) Cow (<i>Bos primigeninus</i>) Crow Duck Goat (<i>Capra aegagrus</i>) King Stork Nightingale (Bulbuli) Phinge Pig Pigeon Poultry Quail Shalik Sheep (<i>Ovis aries</i>) Stork Wild Parrot		Buffalo, Local Pigeon, Quail, Wild Parrot, Nightingl (Bulbuli), Stork, King Stork	Local Cow, Milking Cow, Local Ox, Bull, Pig, Duck like Indian Runner, Zingding (Mixed), Zingding (Color), Patihias, Khaki Cambel, Pigeon (Ornamental), Local Poultry, Goat (Jamunapari), Goat (Black Bangle) and Sheep.	Pigs are available in large scale in this area; it has an organized local market (hatt) where meat of pig sold abundantly, Currently Hindu communities extensively consume pig in their weeding ceremony.		Buffalo, Local Pigeon, Quail, Wild Parrot, Nightingl (Bulbuli), Stork	Local Cow, Pig, Pigeon (Ornamental), Local Poultry, Goat (Jamunapari), Goat (Black Bangle), Sheep, Local Duck like Patihias, Khaki Cambel, Indian Runner, Zingding (Mixed), Zingding (Color), Goat (Jamunapari), Goat (Black Bengal), Sheep, Local Ox, Bullock, Milking Cow, Pig, Pigeon (Ornamental), Crow, Shalik, Phinge			Buffalo, Local Pigeon, Quail, Wild Parrot, Nightingl (Bulbuli), Stork, Buffalo	Local Cow, Local Ox, Bullock, Milking Cow, Pig, Local Duck like Patihias, Indian Runner, Zingding (Mixed), Zingding (Color), Pigeon (Ornamental), Local Poultry, Goat (Jamunapari), Goat (Black Bangle), Sheep	

Marketing system in three polder zones are given in Table 7.

Table 7. Marketing system in three polder zones

Items	Market Category (Market that people in the area attend)	Purpose of market visit (sell, purchase, gain information, socializing)	Benefit associated with selling and purchasing in those market	Constraint associated with selling and purchasing in those market
Crops	Local and Whole sell	Selling, purchasing and socializing	Purchasing the essentials, selling for income to improve their livelihood	Middle men, Arotdar and whole sellers are not given appropriate price of the crops; marketing channel are not well organized, government has no effective control over the market price and system
Fish	Local and whole sell market	Selling, purchasing and socializing	Purchasing the essentials, selling for income to improve their livelihood	Cheated by the middlemen, no well-organized market, sometime the local investor getting whole product with very low price, sometime looted by the miscreant
Livestock	Local market mainly	Selling, purchasing and socializing	Purchasing the essentials, selling for income to improve their livelihood	no well-organized market,

Agro-biodiversity Related Development Programs:

Home gardens allow for the cultivation of plants in a stratified vertical position, optimizing space use and production, and exhibiting around 419 plant species in southwestern Bangladesh (Kabir and Webb, 2008b; Talukder, 2012).

Other innovative methods of cultivation include Vasoman Chash (dhap cultivation), the zero-tillage system, the Sorjan system (Kandi system), and rainwater harvest. "Vasoman Chash" or "Dhap Cultivation" (Fig. 8) translates to floating agriculture, and is used in flooded and submerged areas. The technique is similar to that of hydroponics, the growth of plants in water without soil.

These floating beds are made using water hyacinth, aquatic algae, straws, and other plants and plant residues. The waterbeds of each region vary in their size, shape, and structure (Sen., 2004; Anonymous, 2010b; Hossain, 2010). The zero-tillage system (no till system) reduces the amount of erosion on soil, the amount of pesticide needed, as well as fuel and labor requirements (<http://www.cropwatch.unl.edu> Accessed 2013). The sorjan system (Fig. 09) is an integrated farming system that uses water-filled lowlands to plant rice and the higher areas to plant dry crops (<http://www.ati.da.gov.ph> Accessed 2013).

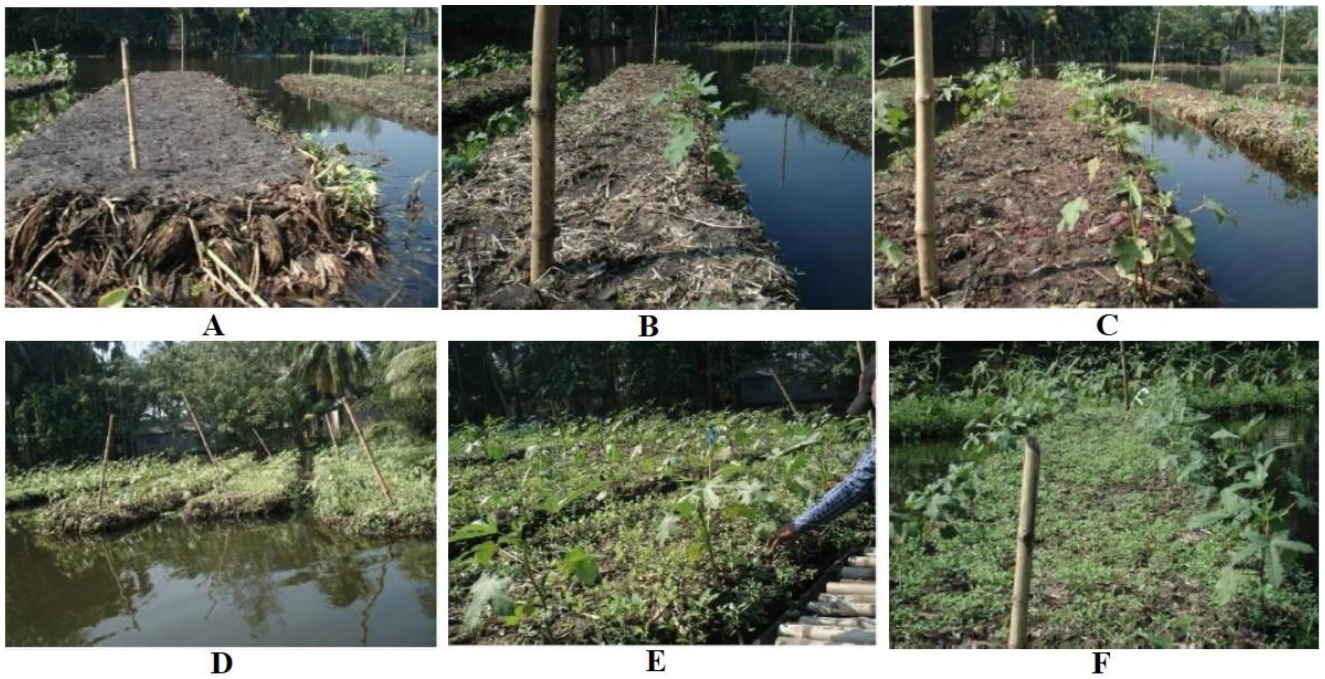


Fig. 8. Different stages of Dhap Cultivation in Southern Bangladesh, (A) A newly build floating bed (B) A ready bed for planting (C) Red Amaranth (D) A group of beds (E) Intercultural operations (F) Coriander and Okra



Fig. 9. Crop cultivation through sorjan method in Southern Bangladesh (Photo courtesy: Rahim and Alam, 2013b)

Many challenges like natural disaster (Aila, Sidr, Mohasen), salinity, poverty, climate change, political interventions are faced by organizations that have aimed to establish and implement projects that ensure environmental sustainability. Organizations such as WorldFish (Anonymous, 2009) and the Bangladesh Forest Department are working to manage natural resource use and put a dent on current stressors. An approach that aims to conduct research through participatory action has proven to be worthwhile, generating higher crop yields, better income, and resilience to climate change (Anonymous, 2009). The introduction of microfinancing techniques is a development effort that also helps farmers better manage their crops, produce greater yields and gain a higher income (Siddiqui, 2004). Shrimp cultivation has been taken up in vast amounts in recent years (Talukder, 2012). More sustainable approaches include shrimp-rice cultivation and a shrimp-rice-vegetable integrated system. Polders provided by the World Bank in the 1960s-1980s were later utilized for shrimp farming (Islam, 2006).

Key constraints and recommendations on status and trends in diversity in agro biodiversity components (crops, wild plants, fish, livestock, fungi, edible insects, pollinating insects)

Crops: Major constraints for loss and not increasing diversity are mainly due to increasing salinity, natural

disaster (Aila, Sidr, early and heavy rain), urbanization etc.

Fish: Major constraints for loss and not increasing diversity are mainly due to increasing salinity, natural disaster (Aila, Sidr, early and heavy rain). The dam and flood control embankment by WAPDA is one of the reasons for fish losses. Netting to catch the fingerlings of Shrimp, destroying the local/indigenous fishes.

Livestock: Mainly Buffalo is decreasing due to decreasing their grazing land. Natural disaster also a cause of species loss and decrease.

Key factors affecting diversity in each agrobiodiversity component and their effects

Climate: Global warming, increasing sea level consequently increasing the salinity

Environment: Natural disaster like Aila, Sidr, Heavy rain, early rain

Sociotechnical changes: Most of the areas, the original fishermen are not getting legal prices of fishes due to intervention of middle men, political intervention, illegally harvesting of eggs laying fishes by the miscreant. Moreover, some time miscreant looted the fish from fishermen. Therefore, the experience fishermen diverting to alternate jobs. Faulty marketing system, political intervention also major cause of diversity loss.

Institutional: Lack of adequate and appropriate research and development. Government supports are poor and erratic.

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