CHAPTER 6

CURRENT SCENARIOS AND DEVELOPMENT POTENTIALS

The region has many challenges confronting agricultural development. Yet, it also has a diversified positive potential in crop, horticulture, fishery, livestock and value chain management systems. The region is largely dominated by medium high land which is suitable for different agricultural practices round the year.

Highland may be suitable for *Kharif* or perennial dry land crops if the soils are permeable. Impermeable soils or soils which can be made impermeable by puddling may be suitable for transplanted Aus and/or *Aman* paddy if *bundhs* are made to retain rainwater on fields.

Medium Highland is suitable for crops which can tolerate shallow flooding, such as broadcast or transplanted Aus, jute and transplanted *Aman*. Early *Kharif* dry land crops, which mature before flooding starts, can be grown on permeable soils, and late *Kharif* and early Rabi dry land crops on soils which drain in September-October.

Medium Lowland is flooded too deeply for transplanted *Aus* or transplanted *Aman* to be grown reliably. Mixed broadcast Aus and deepwater *Aman* is a common practice; or long Aman seedlings may be transplanted as the floodwater recedes, if it does so early enough. Dry land Rabi crops are widely grown on soils which drain in October or November.

Lowland is flooded too deeply for broadcast Aus or transplanted *Aman*. Deepwater Aman is typically grown on such land (although the cultivation of irrigated *Boro* on such land in the dry season now precludes the cultivation of deepwater *Aman* over considerable areas of lowland). Dry land Rabi crops can only be grown if floodwater recedes before December.

6.1 Crop

Transplanted *Aman* rice is the dominant crop in the entire region. Major land types and cropping patterns by district are presented below (Table 6.1).

The productivity of rice in all seasons can be increased more than two tonnes per hectare (Figure 6.1). This is possible through expansion of suitable HYV cultivars, better agronomic management practices and on-farm water management.

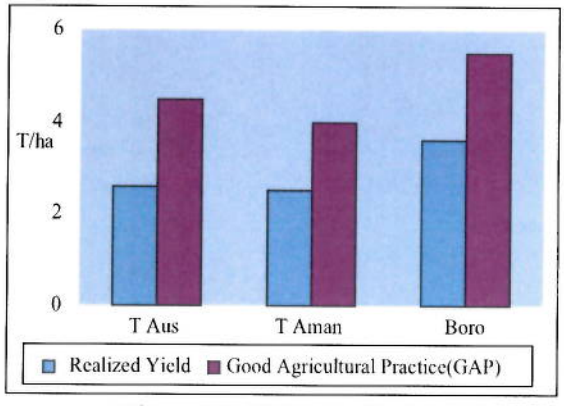

Figure 6.1: Yield of milled rice

An analysis of water salinity data for different months provides an opportunity of increasing surface water irrigation in the region (Figure 6.2). Water resources in the region are abundant, the salinity level in many areas is less than the threshold limit of many crops, indicating that about 0.7 million ha of land can be brought under surface water irrigation (Table 6.2).

Table 6.1: Current land use by land type

Name of district	Land type	Major cropping patterns
Barisal	MHL (56%) followed by MLL (9%) and LL (3%) and 29% Misc. land. Percentage of H L only 3% which mostly used as homestead.	1. Boro – Fallow - T.Aman 2. Boro - Fallow – Fallow 3. Fallow – Aus – T.Aman
Bhola	A total of 47% classified land of which 43% MHL and only 3% MLL. Two percent HL mostly used as domestic purposes	1. Boro – Fallow – T.Ama n 2. Chilli - Dibbling Aus – T.Aman 3. Mungbean – Fallow – T.Aman
Barguna	A total of 66% classified and 34% misc. Land type, 61% is MHL and 3% MLL. Only 2% HL is being used as domestic and other purposes	1. Khasari – T.Aus -T.Aman 2. Mungbean – T.Aus – T.Aman 3. Water melon – T.Aus – T.Aman
Jhalokati	A total of 76% classified and 24% misc. Land type, 54% is MHL and 17% MLL. Only 5% HL is being used as domestic and other purposes	1) Rabi crops – T.Aus – T.Aman 2) Fallow – T.Aus – T.Aman 3) Rabi crops/vegetable - Fallow – T.Aman
Patuakhali	A total of 63% classified and 37% misc. land of which 58% MHL and only 4% MLL. One percent HL mostly used as domestic purposes	1. Fallow – Fallow – T.Aman 2. Mungbean – T.Aus – T.Aman 3. Khesari - Fallow – T.Aman
Pirojpur	A total of 69% classified and 31% misc. Land type, 56% is MHL and 6% MLL and 3% LL. Only 4% HL is being used as domestic and other purposes	1. Fallow – T.Aus _ T.Aman 2. Boro - Fallow – T.Aman 3. Fallow – Fallow – T.Aman
Khulna	A total of 78% classified and 22% misc. Land out of which 6 2% is MHL and 10% MLL and 2% LL. Only 4% HL is being used as domestic and other purposes	1. Boro – Fallow – T.Aman 2. Fallow – Fallow – T.Aman 3. Fallow – T.Aus – T.Aman
Satkhira	A total of 82% classified and 18% misc. land of which 62% MHL and only 3% MLL and 17 % HL	1. Fallow – Fallow – T.Aman 2. Boro – Fallow T.Aman 3. Wheat - Jute – T.Aman
Bagerhat	A total of 75% classified and 25% misc. Land out of which 61 % is MHL and 7% MLL and 2% LL. Only 5% HL is being used as domestic and other purposes	1. Fallow – Fallow – T.Am an 2. Boro – Fallow – T.Aman 3. Boro – Fallow – Fallow
Noakhali	A total of 64% classified and 36% misc. of which 51% MHL, 11% MLL and only 1% each of HL and LL	1. Boro – Fallow – Fallow 2. Soybean - Fallow - T.Aman 3. Vegetable /Wheat – T.Aus – T.aman
Lakshmipur	The land type of the area as per SRDI report 72% classified and 28% misc. of which 62% MHL, 7% MLL and only 2% HL	1. Soybean – Aus – T.Aman 2. Boro – Fallow – T.aman 3. Soybean – Fallow – T.Aman
Feni	According to SRDI report the land type of the area are 73% classified land and 27% misc. of which 72% MHL and only 1% HL	1. Boro – Fallow – T.Aman 2. Mungbean - T.Aus – T.Aman 3. Vegetable – T.Aus – T.Aman

Source: DAE, SRDI and primary data collected from field.

Table 6.2: Maximum salinity level of surface water (unit: dS/m)

ST. ID	Station name	River name	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1	Bagerhat	Alaipur Khal Daratona	0.98	1.52	3.60	7.25	18.00	20.00	15.30	15.0
1.5	Morrelganj	Alaipur Khal Daratona Gasiakhali	0.93	1.65	4.08	12.00	11.00	16.50	12.00	6.50
106	Patgati	Gorai - Madhumoti	0.56	0.90	1.10	1.07	0.94	0.90	0.85	0.58
107	Pirojpur	Gorai - Madhumoti	0.44	0.40	0.78	0.78	0.80	0.61	0.78	0.58
107.2	Rayanda	Gorai - Madhumoti	0.63	0.91	0.98	1.70	3.60	4.70	4.50	1.00
108	Chardoani	Gorai - Madhumoti	0.66	0.90	1.18	1.55	6.25	6.00	2.00	0.95
136	Kawkhali	Kacha	0.42	0.42	0.58	0.50	0.83	0.62	0.62	0.41
18	Barisal	Barisal-Buriswar	0.38	0.27	0.41	0.70	0.48	0.48	0.38	0.32
184	Patuakhali	Lohalia	0.35	0.28	0.60	0.85	1.60	1.80	0.79	0.64
185	Galachipa	Lohalia	0.51	0.41	0.43	0.63	1.76	3.40	2.85	0.61
185.1	Gulbunia	Lohalia	0.37	0.45	0.57	1.50	3.40	3.10	1.55	0.80
19	Mirjaganj	Barisal-Buriswar	0.40	0.39	0.80	0.85	1.28	1.25	0.84	0.50
20	Amtali	Barisal-Buriswar	0.40	0.36	0.75	0.93	1.00	1.70	1.25	1.50
219	Gazirhat	Nabaganga	0.37	0.40	1.45	1.10	5.00	14.00	13.00	3.0
220	Khepupa ra	Nilakhi	10.00	12.05	17.50	22.00	19.50	22.00	15.40	12.0
23	Kalaroa	Betna-Kholpetua	1.51	3.55	9.00	10.50	20.00	21.00	22.50	9.0
253A	Uzirpur	Sarupkati	0.31	0.41	0.36	0.52	0.44	0.44	0.45	0.54
258	Paikgacha	Shibsa	6.50	8.00	11.95	24.00	28.00	35.00	36.00	40.00
259	Nalianala	Shibsa	4.50	11.00	11.21	24.00	40.00	40.00	40.00	40.00
278	Daulatkhan	Surma -Meghna	0.80	2.00	1.00	6.97	8.00	5.00	1.90	1.30
279	Tajumuddin	Lower -Meghna	0.75	4.00	3.50	9.20	15.00	11.00	4.00	0.85
279.1	Char fession	Lower -Meghna	3.25	8.00	12.30	13.50	19.00	19.00	10.50	3.50
28	Dumuria	Bhadra	1.45	3.10	6.80	16.00	21.60	28.00	26.00	30.0
288	Illishaghat	Tentulia	0.34	0.58	0.64	1.50	3.50	5.00	0.90	0.49
289	Dhulia	Tentulia	0.52	0.55	0.52	0.48	2.15	2.20	0.53	0.36
290	Dasmunia	Tentulia	0.52	0.38	0.49	0.80	2.00	2.20	0.85	0.42
300	Gournadi	Torki	0.44	0.36	0.34	0.55	0.51	0.48	0.51	0.52
318	Babuganj	Babuganj	0.37	0.35	0.38	0.37	0.40	0.40	0.47	0.36
330	Atharabanka	Atharabanka	0.46	0.84	0.70	1.60	4.00	6.36	4.24	0.90
332	Hironpoint	Kunga	23.87	32.00	40.00	49.00	49.00	50.95	49.60	48.0
37	Jhalakati	Bishkhali	0.38	0.25	0.36	0.44	0.45	0.34	0.34	0.31
37.5	Betagi	Bishkhali	0.40	0.95	0.75	0.70	0.42	0.65	0.39	0.42
38	Bamna	Bishkhali	0.50	0.28	0.50	0.49	0.65	0.53	0.48	0.40
38.1	Barguna	Bishkhali	0.47	0.95	0.49	3.50	3.20	2.80	2.00	0.50
39	Patharghata	Bishkhali	1.90	6.00	2.80	5.00	13.00	11.50	6.50	1.05
60	Hajimara	Dakatia	0.24	0.36	0.54	0.54	0.63	0.58	0.50	0.50

Source: BWDB and CEGIS

There is potential to increase productivity of T.Aus, T.Aman and Boro rice with good agricultural practices. T.Aus area can be increased substantially using improved management practices. Total potential T.Aus area in the region is 740,346 ha of which 38% is suitable, 40% is moderately suitable and 22% is marginally suitable (Figure 6.3).

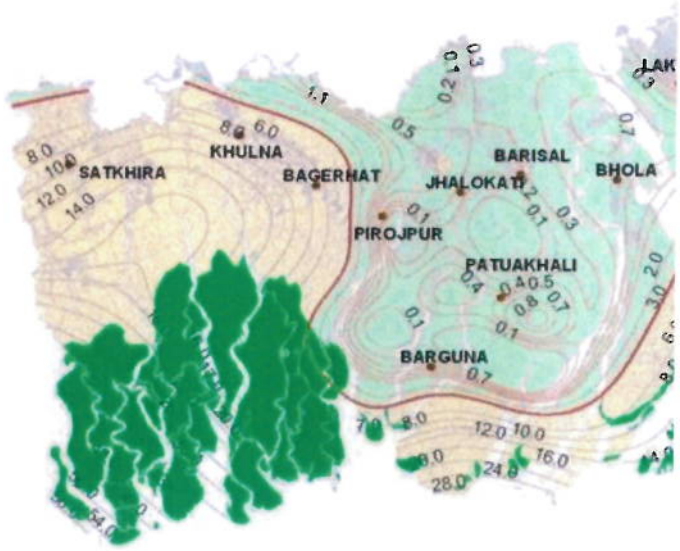

Figure 6.2: Irrigation potential area

Potential Boro area under surface water irrigation in the region is estimated at 467,000 ha. The area mostly lies in the districts of Barisal, Jhalokati, Pirojpur, Barguna, Patuakhali, Bhola, Bagerhat and Lakhshmipur.

The region also has the potential to grow high value crops using groundwater from the shallow aquifer. Potential areas are mainly located in Khulna, Satkhira, Bagerhat, Chittagong, Cox's Bazar, Lakhshmipur and Feni (Figure 6.4).

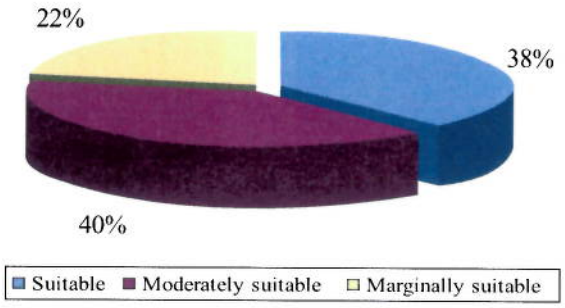

Figure 6.3: T.Aus suitability

The following strategic interventions are suggested for increasing productivity of different crops and sustaining cropping patterns:

- Productivity increase of T.*Aman* in tidal and non-tidal areas;
- Productivity enhancement of T.*Aus*, as well as introduction of short duration (85-90 days) varieties may be encouraged. Those varieties can be obtained through technical cooperation with Vietnam;
- Expansion of *Boro* cultivation and productivity enhancement;
- Promotion of pulses (khesari, mungbean, cowpea and chickpea), oilseeds (sesame,

sunflower, groundnut etc.) and new crops (maize, chili, sugar beat, soybean, mushroom, jute and sugarcane).

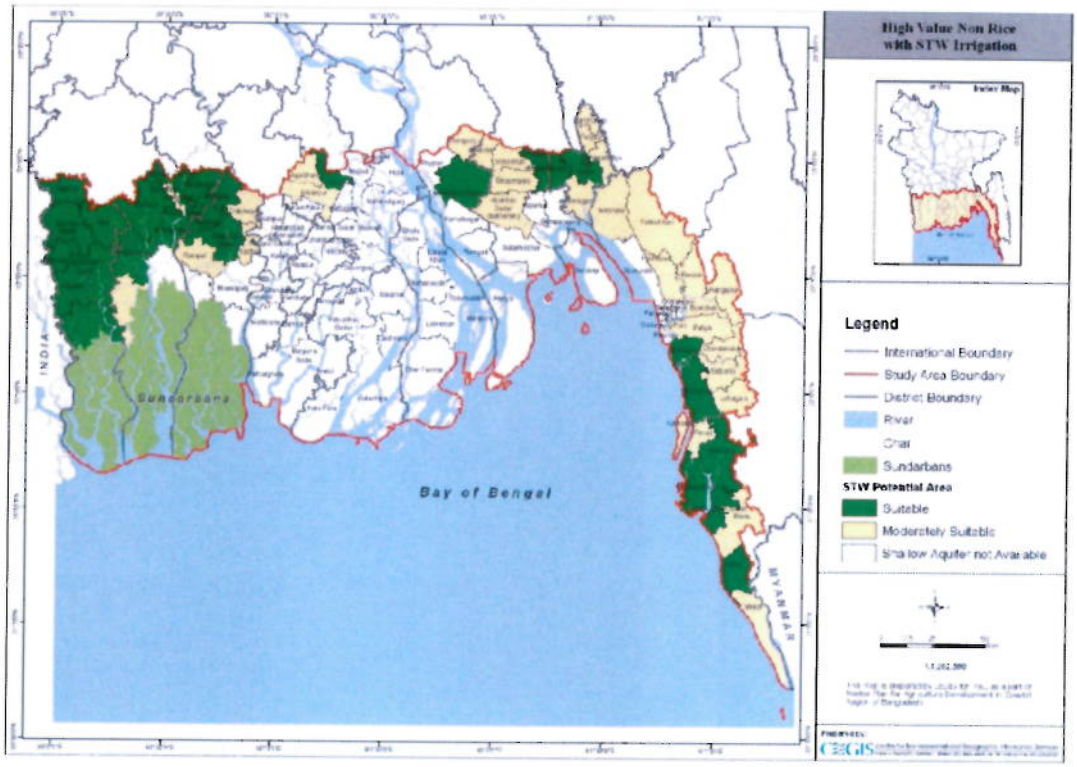

Figure 6.4: Potential area for high value crops using STW

Jute is conspicuously absent in most parts of the region. Bangladesh Jute Research Institute should develop a programme to breed variety and develop management practices suitable for the coastal region that fits in the existing cropping pattern.

Cotton is a salt-resistant crop, but is susceptible to water logging. The Cotton Development Board should consider pilot demonstrations in well-drained highland place in the coast.

Bangladesh Sugarcane Research Institute may establish demonstrations of growing sugarcane in the coastal region.

6.2 Horticulture and Agro-forestry

6.2.1 Horticulture

Because of agro-ecological sensitivity, horticultural crops like fruits, vegetables and spices are not highly suitable in the southern region. Most of the horticultural crops are sensitive to agro climatic conditions. Less availability of high and medium highland; high temperature and humidity; poor drainage and water logging; soil salinity; lack of irrigable water and irrigation facilities hinder horticultural crop production in the region except coconut and areca nut. Despite these constraints,

the area has potential for the expansion of coverage and increase in productivity of horticultural crops with special care and techniques.

A good number of fruits and vegetables grow well. About 80 percent of guava produced in the country comes from the southern region. The region is also famous for some minor fruits having high nutrition and processing potential, such as sapota, velvet apple (gab), hog plum, date palm and palmyra palm. Horticultural crops in the region suffer from large yield gaps (Table 6.3). Potential growth largely lies in management of yield gaps.

Table 6.3: Yield of selected horticultural crops

Crop	Yield (tonne/ha)		
	Present yield	Good farmers' yield (GFY)	Yield gap
Cucumber	10.44	20	9.56
Bitter gourd	9.87	20	10.13
Pumpkin	14.38	20	5.62
Indian spinach	15.94	40	24.06
String bean	8.08	12	3.92
Brinjal	15.9	50	34.10
Okra	8.5	14	5.50
Aroids	13.96	16	2.04
Tomato	18.94	60	41.06
Radish	20.47	50	29.53
Cauliflower	16.65	25	8.35
Cabbage	22.45	30	7.55
Red amaranth	4.48	10	5.52
Onion	6.82	15	8.18
Garlic	5.78	7	1.22
Chili	1.37	4	2.63
Mango	7.70	15	7.30
Litchi	2.86	12	9.14
Banana	17.75	20	2.25
Papaya	17.75	25	7.25
Guava	10.50	20	9.50
Lemon	7.75	12	4.25
Jujube	7.18	20	12.82
Hog plum	12.00	15	3.00
Pumelo	6.60	20	13.40
Sapota	12.00	20	8.00
Coconut	1.00	2	1.00
Areca nut	2.40	4.5	2.10

Source: DAE field demonstration; field level consultation

The salt-affected soil requires hardy species. On the basis of experiment with salt tolerance, fruit crops have been classified as follows:

- High tolerant: date palm, jujube, tamarind;
- Medium tolerant: anola, phalsa, pomegranate, karantia, monkey jack (dewa), ananas, jamun, sapodilla;
- Low tolerant: guava, mango, wood apple (kodbel);
- Susceptible: banana, papaya, pineapple, jackfruit;
- Modern varieties of watermelon would be a promising crop for the silty loam soil of the region;
- Sweet potato can be successfully grown; particularly orange-fleshed sweet potato may be piloted.

Farmers practice some innovative techniques for the production of vegetables and spices. NARS institutes also developed or modified an appreciable number of technologies suitable for the promotion of vegetables and spices in the region. NARS technologies and farmers' innovative practices for vegetable cultivation can be materialized through the use of mound or raised beds in water logged areas, floating bed and hanging basket.

NARS technologies suitable for the region are

- Year round vegetable production on *gher* boundary;
- Ditch and dyke system of vegetables in non-saline tidal areas;
- Vegetable and spice cultivation on the mound/bed.

6.2.2 Vegetables and spices

Summer vegetables

The southern region has huge potentials of summer vegetable area expansion and productivity enhancement in non-tidal and non-saline areas. At present cucurbitaceous vegetables, Indian spinach, String bean, brinjal, okra and aroids are grown in the region. Total area under summer vegetables is about 25,300 ha and yearly production is 321,850t. By removing existing constraints of surface water irrigation, expansion of minor irrigated area and through extension services, summer vegetable area can be expanded to more ridges and adjacent areas in non-tidal and non-saline zone and by adopting special techniques like floating ridge/mount and raised bed techniques. In the southern region, 86,500 ha can easily be brought under summer vegetables and annual production could be raised to 1.2 million tonnes.

Winter vegetables

The region is moderate to less suitable for cultivation of winter vegetables. Unplanned plantation in homesteads has narrowed the area for vegetable cultivation. Winter vegetables are produced in the strip land of non-tidal and non-saline areas. At present winter vegetables are grown in about 26,000 ha of land and annual production is 0.52 million tonnes. With all out support from relevant service providers and through integrated and intensive cultivation, winter vegetable area could be increased

threefold to 80,000 ha with annual production of 2.46 million tonnes. This needs timely supply of HYV and hybrid seeds, farmers' training, credit and improvement in marketing.

Spices

Among spices, the most important is chilli, which is mostly grown in *char* lands of Noakhali, Lakshmipur and Bhola. Other important spices grown are onion and garlic. In some pockets of Noakhali, Feni and Chittagong, coriander is grown. At present major spices are grown in about 17,700 ha of land with annual production of about 92,000t. By improving extension services, the spice area can be increased to about 28,000 ha and production up to 168,000t.

Productivity enhancement through exploring possibilities and potentials are summarized as follows:

Fruits

- Collection of fruit tree germplasm from public and private sources for promotion;
- Zoning for suitable underutilized fruit production and marketing;
- Improvement of coconut orchard and commercialization of cultivation.

Vegetables and spices

- Mapping of potential vegetables and spices suitable for cultivation in various agro-climatic situations:
- Identifying, improvement of innovative practices and up-scaling of indigenous and NARS technologies;
- Up-scaling of betel leaf cultivation in the south central and southeastern zone;
- Promotion of leafy vegetables.

6.2.3 Agro-forestry

In the southern region, agro-forestry is administered by the Forest Department (FD) and NGOs. In the development vocabulary, this is known as social forestry, as the community is engaged as the main stakeholder. Species planted in the social forestry program are selected on the basis of

- suitability of species to the specific plantation site;
- preference of social forestry group members; and
- sylvicultural characteristics of the species.

The region is highly suitable for forestry. Agro-forestry is at its initial stage, though homestead plantations, strip plantations and mangrove forestry in the accreted land have significantly progressed. Community forestry in Boyer Char (Noakhali) through the CDSP is an example of good practice. The FD implemented the program with assistance from local NGO and WMGs. A benefit sharing arrangement has been agreed between all the parties involved (Table 6.4). This can be replicated in other areas in the region.

Table 6.4: Benefit sharing (%)

Stakeholder	Woodlot and agro forestry on lands under control of FD	Strip plantation on lands owned by public or statutory body other than FD	Social forestry in the forest land by the local community	Social forestry on land of government, semi-government or autonomous organizations invested by the local community
Forest Department	45	10	25	10
Participants	45	55	75	75
Tree Farming Fund	10	10		
Land owning agency		20		10
Local UP		5		5

Source: CDSP

6.3 Fisheries

Fisheries resources in Bangladesh are of three types on the basis of water salinity, such as, freshwater (salinity 0<0.5 ppt), brackish water in the estuary and the coast (0.5-29 ppt), and saline water of the sea (salinity >29 ppt). Along with very productive sweet water, brackish water is suitable for diversified fisheries and aquaculture production of fin and shell fishes and *Ilish* resources.

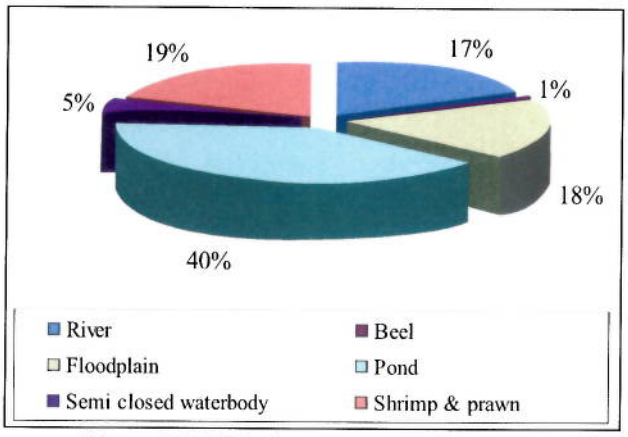

Figure 6.5: Fisheries resources by source

Brackish water shrimp farming grew very fast covering an area of 217,000 ha in 2008 from the 51,812 ha in 1984. The expansion took place in the southwest region due to favorable geo-physical conditions, availability of shrimp PLs and management technology. But the productivity is very low, but levels could be doubled or even tripled through improved technology, better scientific management and more investments.

Annual production/catch of fisheries resources from major inland waters in the region amounts to about 0.71 million tonnes (DoF). Ponds are the single largest source (40%) of fish (Figure 6.5). Average yield per ha in ponds is 2.77t, which is much lower than that of Mymensingh (6.63t), Comilla (4.22t) and Rajshahi (3.63t). Use of ponds exclusively for domestic purpose has changed over the period as potable water is more and more accessible with extension of tube wells, particularly in Barisal region and Lakshmipur. This means that more ponds can be brought under productive use.

Ilish contributes about 13 percent of the annual fish production/catch of the country. Total

catch of *Ilish* in 2009-10 was estimated at 0.31 million tonnes. This resource is dwindling fast because of overfishing, lack of enforcement of conservation regulations, morphological changes in the estuary and different forms of encroachments and pollution. There is high potential for productivity enhancement, which requires the following:

- Community based cage and pen culture;
- Community based open water stocking and biological management;
- Enhanced productivity of pond culture;
- Enforcing zoning and productivity enhancement of shrimp;
- Establishing and maintaining fish sanctuaries.

6.3.1 Cage/pen culture

Productivity enhancement through cage/pen culture exists in the region, particularly in the south-central area. At the moment, this practice is negligible. Expansion of cage/pen culture through community mobilization will be a viable source of employment in villages along the rivers (Figure 6.6).

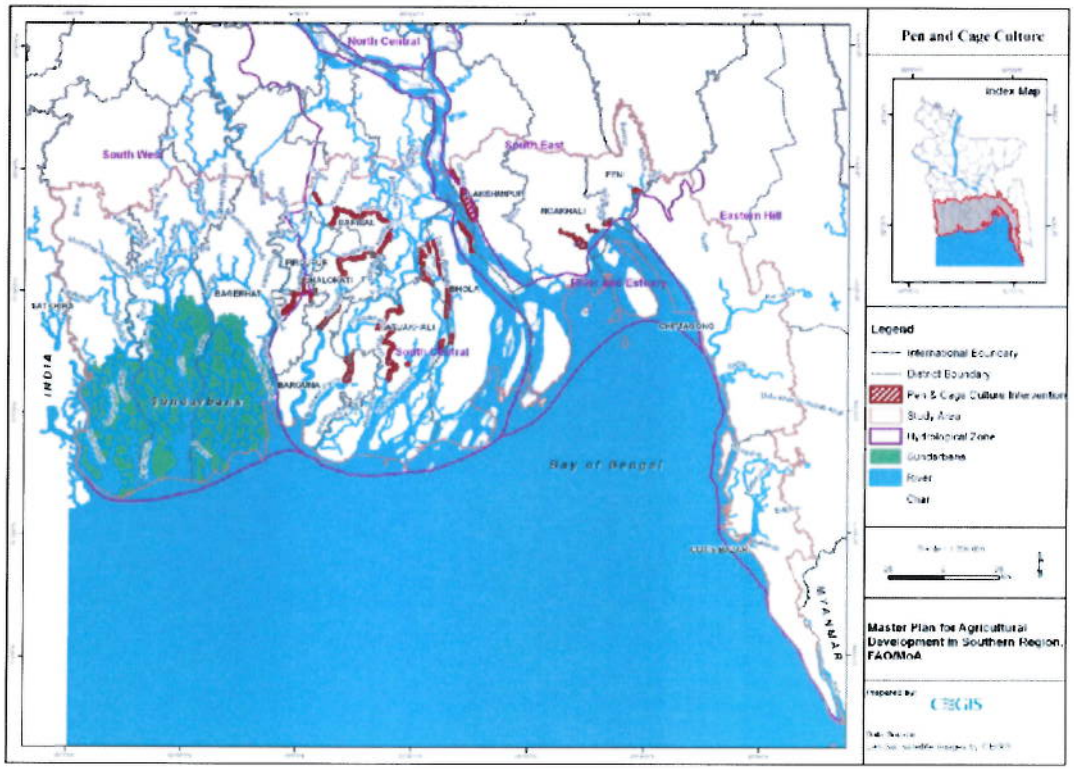

Figure 6.6: Potential areas for cage and pen culture

Cage/pen culture potential also exists in seasonally water-logged areas of Noakhali and Lakshmipur. Total area suitable for cage/pen culture in the southern region is estimated at 7,900 ha and the productive potential stands at 118,500 tonnes.

6.3.2 Shrimp culture

Currently the southern region has 0.21 million ha of shrimp/prawn *ghers*, mostly located in Satkhira, Khulna, Bagerhat and Cox's Bazar districts. Although shrimp area and production have increased significantly in recent decades, there has been negligible or no improvement in yield. For example, average yield per hectare of shrimp (*bagda*) is only 302 kg and that of prawn (*golda*) is 555 kg. This is much lower than the *bagda* yield level of over 1,800 kg/ha as demonstrated by farmers in the southwest region supported by the World Fish Center (WorldFish Center, 2011).

While it is necessary to restrict unplanned expansion of shrimp culture in areas where the potential is low, it is also important to promote it in areas where the suitability is high. Suitability criteria are summarized as follows:

- proximity of *ghers* from the intake canal or channel;
- land type preference, F2 first and F1 second;
- land (plot) to be selected from an area where water goes up to 1.2-1.5 meter in high tide;
- soil pH for *golda* and *bagda* shrimp should be 6.5 – 7.4;
- surface water salinity for *golda* and *bagda* shrimp should be 0 – 0.5 ppt and 15 – 25 ppt Respectively;
- *ghers* in which salinity goes down to 0 ppt in the rainy season or up to 50 ppt due to evaporation in the dry season are not suitable;
- *Doash* soil is favorable (fine particles of less than 0.002 mm mixed with sand particles of 2.0-0.05 mm);
- acid sulfate soil, red soil with stones, black soil and *bele-doash* are not suitable.

The southwest region (greater Khulna district) can be especially addressed for planned *bagda* culture where the land and water conditions are favorable and yield potentials are high.

6.3.3 Marine fishery

Marine fishery is a very important and potentially resourceful sector, contributing 517,282 tonnes (18%) out of total production/catch of 2,899,198 tonnes in the country. There are 41 shrimp trawlers and 124 fish trawlers involved in the marine area with 2,496 tonnes of shrimp and 31,686 tonnes of fin fish catch (total 34,182t). Using mechanized and non-mechanized fishing boats, artisanal fishers harvested 50,096 tonnes of shrimp and 464,690 tonnes of fin fishes (total 483,100t) in 2009-10 (DoF, 2011). About 270,000 fisher families are directly or indirectly depended on marine fishery for their livelihoods.

Marine fisheries resources are mainly capture-based fisheries extended along the coastline to 200 nautical miles. Through the fixation of the marine boundary with Myanmar, Bangladesh has access to vast areas in the Bay of Bengal, enabling its reach to exclusive economic zone (EEZ) with wider coverage.

In the Bay of Bengal, there are 36 species of shrimp and approximately 475 species of fin fish. These are mainly captured based fisheries. Protection and conservation strategies are needed as the prime means to develop and increase the volume of the harvest. This requires the following:

- Stock assessment of pelagic and demersal fisheries resources, as well as harvesting policy and guideline following the MCS;
- Modernization of boat, gear and communication system of the artisanal fishers to ensure their safety.

6.4 Livestock

Basically four factors contribute to low productivity and unutilized potential of livestock resources in the region. These are:

- loss due to the lack of disease control and prevention, malnutrition and under feeding;
- lack of appropriate breeds;
- lack of poor husbandry practices due to inadequate farmers' knowledge and information; and
- natural calamities, tidal surges, and intrusion of salinity.

Lack of feed and fodder in the region is acute. Animals are normally emaciated and productivity is low because of malnutrition. The level of animal malnutrition is high in Barisal region. No grazing land is available in this area. Animals seasonally get some grazing opportunities after harvesting of crops. Feed resources mainly come from crop residues and cereal byproducts.

The region has a wide coverage of land, river and canal and vast accreted area, which can be utilized for livestock rearing.

The density of sheep, goat and duck in Noakhali, Bhola and Patuakhali is high and can be further expanded. In some parts of Patuakhali; goose farming is found profitable.

Satkhira seems to have the highest number of cattle and small and medium dairy and poultry farms, which indicates that Satkhira district is suitable for livestock production.

Chittagong district is another potential area for investment in the dairy chapter. Already there are 1,783 small and medium dairy farms at the farmers' level. Everyday about 200,000 liters of milk is produced in coastal upazilas of Chittagong, such as, Mirsarai, Sitakundo, Anowara and Bashkhali. Farmers sell their products mostly to sweetmeat shops. Establishing a milk processing plant in Chittagong will greatly enhance the potential.

At the household level, backyard poultry is a common phenomenon and can be further promoted and expanded. This will help in enhancing income of poor women who usually look after poultry.

Productive potentials are summarized as follows:

- community livestock, dairy and poultry development, replication and up-scaling;
- up-scaling of dairy farming in Satkhira;
- promotion of HYV fodder cultivation;
- strengthening health care;

- establishing AI service center in each union; and
- establishing improved buffalo farm;

6.5 Water Resources

Water resources management is a big challenge. The most critical of this are alternating flood and water scarcity during the wet and the dry seasons, ever-expanding water need, river sedimentation and bank erosion.

Inadequate supply of surface water for irrigation is a serious problem throughout the southern region except Barisal. The shortage also occurs because many internal *khals* are silted up and water during high tide does not reach the land or the amount of water reaching is not enough for lifting.

Groundwater is not available and suitable everywhere for crop production. In some places like northern part of Barisal, Khulna, Bagerhat and Satkhira, groundwater is used for irrigation in small scale. But in other areas, there is no scope for groundwater irrigation because of the salinity problem. In the southern part of Patuakhali, a large area remains fallow in the dry season because of lack of irrigation infrastructure.

There is huge potential of augmenting water resources by reactivating silted-up rivers through re-excavation. In Barisal region, dry season irrigation can be greatly facilitated using surface water, which remains fresh almost round the year. In other areas, particularly in the northern part of Khulna region and in the Chittagong region, groundwater irrigation can be selectively exploited from the shallow aquifer. Potential areas for intervention are summarized as follows:

- Excavation/re-excavation of silted and dried up canals, construction of water control structures and construction of pump houses;
- Surface water conservation through construction of rubber dam / cross-dam / regulator, etc for development of irrigation;
- Excavation of reservoir/ pond for water conservation for surface water irrigation development;
- Restoration of severely waterlogged areas in Noakhali mainland
- Improving drainage, water logging and flood management through capital dredging of silted and dried up rivers
- Community driven and managed tidal river management (TRM) in severely waterlogged areas in the southwest region;
- Integrated on farm water management;
- Promotion of solar energy for operating irrigation equipment;
- Rehabilitation and improvement of Muhuri, Bhola and Barisal Irrigation Project;
- O&M by community based institutions;
- Emergency public fund for disaster management;
- Legal framework for implementation of institutional arrangements;
- Repair and rehabilitation of damaged polders;

- Redesigning and new construction of climate resilient polders;
- Accelerating land accretion through construction of cross-dam;
- Sustainable use of accreted land resources;
- Creation of rain water harvesting facility.

6.6 Nutrition and Food Security

6.6.1 Poverty and malnutrition

Access at all times to sufficient, safe and nutritious food to meet the dietary needs and food preferances for an active and healthy life is at the heart of food security and nutrition. Poverty and malnutrition are closely linked in that chronic energy deficiency is directly related to the ability to invlove in income generation activities and learning capacity. Declining poverty rates in Bangladesh have been accompanied by a significant increase in purchasing power, increasing access to basic foods. Despite decline in poverty, equally strong progress is not seen in nutritional outcomes. Malnutrition is an underlying cause of childhood illness and maternal mortality. Bangladesh has achieved a slow but sustained reduction in prevalence of underweight and stunting. However prevalence of malnutrition is still alarming. Bangladesh is placed in the bottom 25% of the Global Hunger Index and that signifies its vulnerability in the context of recent food price hikes. Chronic energy deficiency, protein-energy malnutrition, low birth-weight and micronutrient deficiency are critical issues faced by Bangladesh (Planning Commission, 2011). Poverty reduction should be coupled with integrated nutrition interventions, that can help increase nutrition awareness and behaviour change across all income groups and also instill a sense of community responsibility to undertake relevant actions for improving household/community food and nutrition security.

6.6.2 Development strategies

Efforts to reduce malnutrition must be based on a clear understanding of the role of poverty as a cause and a consequence of malnutrition. Poverty affects men and women differently. To combat it, a different approach is needed. Moreover as poverty in the region is predominantly rural, agriculture-based strategies are important for improving household food security and nutritional status. These measures include shifting toward production of high-value crops for boosting income, enhancing agricultural biodiversity, increasing consumption of indigenous food plants and bio-fortified crops.

A widely used conceptual framework published by UNICEF in 1990 identifies three main underlying determinants of nutritional status: availability and access to food, the quality of feeding and care giving practices, and the health of the surrounding environment and access to health care services. Each of these determinants is a necessary condition to good nutrition, food security and health outcomes. Household production for own consumption is the most fundamental and direct pathway by which increased production translates into greater food availability and food security. Increased production of fruits, vegetables, and animal source foods (dairy, egg, fish and meat) can raise access to energy, protein, and fat, but can also greatly improve the quality and micronutrient content of diets.

Finally, agricultural growth itself represents an indirect pathway to better nutrition through its contribution to macroeconomic growth and higher levels of national income, which can support nutritional improvements by reducing poverty.

Homestead and nutrition education programmes that have been in operation for last two decades need to be scaled up. Future agricultural intervention programmes should include explicit objectives of improving nutritional status with a focus on addressing child malnutrition. Child stunting should be addressed through strengthening linkage between complementary feeding requirements/practices and agricultural production. The most sustainable and cost effective way to improve complementary feeding of children in poor rural households is by ensuring availability and access of nutritionally appropriate foods at household and community levels.

6.6.3 Development potential

Agriculture

Increasing production and availability of nutritious food is key to ensuring food security. This means that there should be all out efforts to

- increase cropping intensity and productivity to promote the production of basic staples for meeting the energy needs;
- promote mixed fruit orchards and intercropping for increasing production of horticulture foods that can provide dietary micronutrients, anti oxidants and to intensify the process of crop diversification to make available more energy and protein foods at low cost, e.g. maize, sorghum, millets, etc;
- encourage intercropping in order to produce more non staple food crops;
- increase production and consumption of fish by developing capture fisheries, fish seed multiplication farms to supply more fish fry and marine fish production from the Bay of Bengal;
- increase production of fish feed for fish fry and pisciculture;
- encourage development of biotechnology in animal and plant breeding and facilitate exchanges of new advances in biotechnology related to nutrition;
- capacity building for promoting post harvest handling, processing, preservation and storage with a focus on preserving micronutrient rich foods;
- prepare national food balance sheet.

Nutrition education, advocacy and community participation

This is to provide formal and non-formal nutrition education to people at all levels about effective nutrition, especially for vulnerable groups, that is, children, adolescent girls, women and the elderly. Diet-based strategies are the most promising approach for a sustainable control of macro/micronutrient deficiencies. There is need for increasing dietary diversification through consumption of a broad variety of foods, preferably from home gardens, fisheries and small livestock production. Mass media nutrition awareness campaigns and intensive nutrition education should be implemented to support and educate farmers to increase production of dark-green leafy

vegetables, yellow and orange fruits, poultry, egg, fish and milk in their homesteads. Emphasis should be given to

- Educate decision makers in the family to change the method of food distribution in the family to meet specific requirements of vulnerable members, especially during pregnancy and lactation. Adolescent girls, young children and the elderly should receive more nutritious food according to their need.
- Teach all people about the proper preparation and feeding of weaning foods made from locally available foodstuffs.
- Motivate the people to modify their food habits to increase their intake of non-rice foods.
- Introduce formal and non-formal nutrition education at all levels. A nutrition component should be included in the curricula of primary, secondary and tertiary levels.
- Primary training on family nutrition to women participating in mothers' club, non-monetized food distribution programs and others women's development activities.
- Develop effective audio-visual materials and manuals on nutrition for use in education and training. Use of community radio for nutrition education will be very effective.

Community development and social welfare

This is to support diversification of rural economy, promote investment in human resource development and make appropriate technology available to provide integrated production and employment.

- Increase rural people's participation in the development process and their enjoyment of a share of development for physical, social and economical benefit.
- Encourage simple and appropriate technologies for home food processing and preservation.
- Encourage integrated homestead farming for the production of vegetable, fruit, fish, milk, meat, egg, fish feed and fertilizer for income generation.

6.7 Market and Supply Chain

Most of the rural markets have developed in an *ad hoc* manner. As such, facilities, infrastructure, management and operations are haphazard and rarely meet the changing needs of market users.

Some growth centers have been improved by the LGED. A survey of rural markets done by the Department of Agricultural Marketing (DAM) found that growth centers/market places are mostly of primary/retail character (Table 6.5).

Despite the marketing system being fragmented, it is highly competitive. A study by DAM analyzed the cost of marketing and concluded that for the five main spice crops, producers get about 65 percent of the consumer price, with the remaining 35 percent being shared by others in the value chain (5% by traders, 20% by wholesalers/*aratders* and 10% by retailers). Naturally enough, marketing margins will be higher for perishable products like fruits and vegetables, especially at times of gluts when producer prices fall by much more than consumer prices, as producers compete

to sell in a saturated market, but consumers cannot respond by increasing consumption to equal the excess supply.

Table 6.5: Markets in selected coastal districts

District	Type of market			Total	
	Primary/ retail	Assembly/ wholesale	Wholesale cum retail	2000	1985
Barisal	196	13	23	232	181
Bhola	134	7	27	168	104
Patuakhali	247	13	34	294	71
Lakshmipur	118	9	61	158	88
Noakhali	145	12	62	219	218
Total	840	54	177	1,071	662
Percentage	78	5	17	100	

Source: DAM, 2000

In the fishery sub-sector, the degree of consumer price share can vary considerably according to the type of fishery and location. The Fishery Sector Review (2003) concluded that, in remote coastal villages, artisanal fishermen after deducting *dadan* loan repayments get only 25 percent of the final retail price. In contrast, a pond owner selling directly in a village market may get 80 to 90 percent of the retail price. Analysis of the margins and costs involved in marketing of *Ilish* from fisherman in Chittagong to *paiker* - to *aratder* - to retailer in Dhaka shows the fisherman getting 50 percent of the final retail price; but the margin net of costs for the wholesaler is 5 percent, *aratder* 6 percent and retailer 5 percent.

The region has localized seasonal surpluses in some commodities of perishable nature, such as fish and milk. Development of agro-processing facilities and market infrastructure can prevent post-harvest loss and enhance farmers' income. Agro-processing industries are presently at a nascent stage of development. Most of the technologies and facilities for handling, storage, processing and packaging are sub-standard and outdated and cater primarily to the local market. There also exists considerable under-utilization of capacity (Planning Commission, 2011).

There is no organized milk marketing network in the region. Normally farmers sell their products in the local market. In Sadar and Tala upazila of Satkhira district, Milk Vita and BRAC have established milk collection centers and chilling points.

There is not a single meat processing plant in the southern region. With increasing urbanization, demand for milk, meat and egg are also increasing, and so also the potential for processing plants and marketing systems.

Poor transport system and network is another constraint. This requires investment in developing and upgrading road and water transport systems. This includes enhancement of capacity to handle larger volume of freight traffic, as well as improvement in safety standards.

Development potential in regard to processing is summarized below.

Crops and agro-forestry

- Soybean oil extraction plant in Noakhali and coconut oil extraction plant in Khulna and Noakhali;
- Value addition to farm produce and processed products by environmental and user friendly post harvest technologies and byproduct utilization;
- Developing refrigerated and/or non-refrigerated storage technology for preservation of potato, sweet potato, aroids, onion, spices and fresh vegetables;
- Developing refrigerated storage technology for fresh cut vegetables and fruit cobblers;
- Developing processing and preservation technologies for fruits, vegetables and spices;
- Establishment of fruit processing plants for guava, hog plum and chalta;

Fisheries

- Support to establishment of shrimp and fish processing and preservation plants in the private sector in Khulna, Satkhira, Barisal, Bhola, Noakhali and Cox's Bazar;
- Support to environment friendly quality fish drying plants in Noakhali, Khulna and Cox's Bazar;
- Support to establishment of modern hatcheries in the private sector;

Livestock

- Expansion of Milk Vita activities in Bhola, Chittagong and Khulna region. Other milk processors need to be encouraged with special incentives;
- Meat processing plant can be established in Chittagong, Noakhali, Khulna, Barisal and Bhola;
- There is scope for establishment and expansion of feed mills in Chittagong, Noakhali and Khulna;
- Promotion of private veterinary health care practices through training professionals and para-professionals;

Transport

- Building and improving road and river transport network with good cargo facility;
- Developing and upgrading carrying and handling capacity of freight traffic between growth centers and inland ports;
- Improving safety standards for transporting agricultural commodities.

6.8 Land Zoning

Land is used for multiple purposes: housing, infrastructures, crops, fisheries, forestry, salt-production, industries, tourism, conservation of critical ecosystems, etc. Land use in the southern region has undergone major changes in past decades. Major features in this respect are:

- Rapid urbanization: conversion of agricultural land into areas for housing and other infrastructures;
- Shrimp culture: change of land use from crops to *bagda* farming;
- Afforestation in *chars* and newly accreted land.

Government policy documents highlight the importance of optimizing land use and land zoning for integrated planning of resource management. The Coastal Zone Policy 2005 describes that "actions shall be initiated to develop land use planning as an instrument of control of unplanned and indiscriminate use of land resources" and "zoning regulations would be formulated and enforced in due course" (WARPO, 2006). An indicative land zoning has emerged out of the ICZM process that identified the following zones (Table 6.6).

Table 6.6: Indicative land zoning

Zone	District	Upazila / Thana (in city corporation areas)
Shrimp (brackish water)	Khulna	Batiaghata, Paikgachha
	Satkhira	Sadar, Assasuni, Kaliganj, Debhata
	Bagerhat	Sadar, Rampal, Morrelganj
Prawn (sweat water)	Khulna	Dumuria, Phultala
	Bagerhat	Fakirhat, Mollahat, Chitalmari
Salt-shrimp	Cox's Bazar	Chakaria, Moheshkhali, Kutubdia, Pekua
	Chittagong	Bashkhali
Forest	Chittagong	Fatikchhari
	Cox's Bazar	Ramu, Teknaf, Ukhiya
Urban	Chittagong	Port, Double Mooring, Hathazari, Pahartali, Bakalia, Panchlaish, Patenga, Halishahar, Kotowali, Baizid Bostami, Sitakunda, Karnaphuli
	Khulna	Kotowali, Rupsa, Dighalia, Khalishpur, Sonadanga, Daulatpur, Khanjahan Ali
	Barisal	Sadar
	Bagerhat	Mongla
Tourism	Cox's Bazar	Sadar
	Patuakhali	Kolapara (Kuakata)
Agriculture	Khulna	Terokhada
	Satkhira	Tala, Kolaroa
	Bagerhat	Kochua
	Pirojpur	Entire district
	Barisal	Entire district except Sadar
	Patuakhali	Entire district
	Jhalokati	Entire district
	Barguna	Entire district
	Bhola	Entire district
	Feni	Entire district
	Lakshmipur	Entire district
	Noakhali	Entire district
	Chittagong	Mirsarai, Chandgaon, Boalkhali, Lohagara, Rangunia, Patiya, Anowara, Chandanish, Satkania, Raozan, Sandwip

Source: PDO-ICZMP, WARPO

In the past decades, land use pattern has changed significantly in the Khulna region with the advent of *bagda* shrimp farming. This has led to social contention and conflict in many areas. The yield level has also remained very low. Poor technology, poor management practices and farming in areas not suitable for shrimp culture have all contributed to this. For Khulna region, zoning for shrimp culture is important. This should be based on suitability conditioned by bio-physical characteristics of the land, current practices, emerging trends, long term market behavior, etc (Figure 6.7). Farmers can not be forced to follow what to do or what not to do. But their activities in particular areas can be regulated and streamlined through measures of incentive and disincentive.

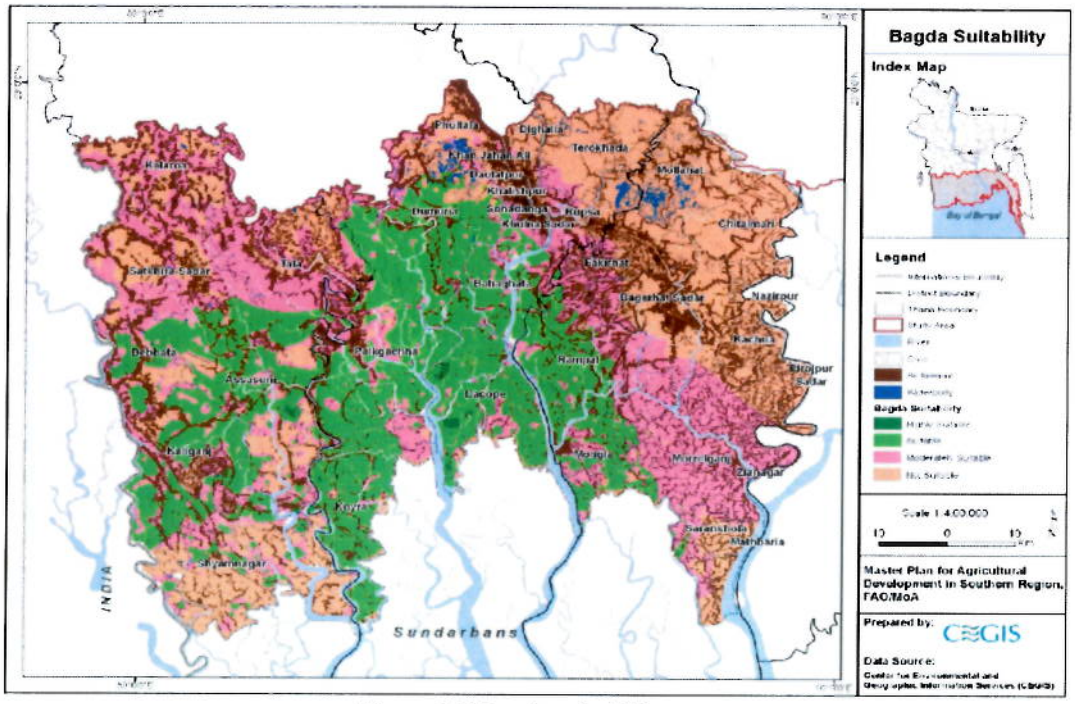

Figure 6.7: Bagda suitability map

6.9 Sub-regional Perspective

6.9.1 Khulna

Fifteen years after construction of coastal embankments, water logging began to emerge in the polders of upper part of the southwest region. As water logging gradually turned severe, its solution became a popular demand. As the authorities paid no heed to their grievances, people took the initiative to organize and mobilize the community and devised plans for solving the problem. From their own experience and observation, people identified polders as the main cause for water logging and began to present their arguments for breaching or cutting away polders to allow unrestricted tidal flow to solve the problem. Their logic was that if tidal flows can be made free, the navigability of the rivers will be restored, *beels* will be free from water logging, alluvial soil will accumulate inside *beels* and, as a result, the bed level of *beels* will rise. The first manifestation of this logic was seen in the *Beel Vaina* in September 1990 when the polder of the *Beel Dakatia* was breached at four

places. This concept is called Tidal River Management (TRM). Later, TRM has been practiced in the *Beel Kedaria* and the *Beel Khuksia*.

The main objective of the TRM is to keep the river functional and make the area free from drainage congestion and water logging. Another objective is to raise the associated *beels* through sediment management in the TRM *beel* areas. The process of natural sedimentation is uneven and scattered. In some places more sedimentation will take place while in some other places the sedimentation will be less, especially at the furthest end of the TRM basin.

On the basis of the TRM option, waterlogged area and areas susceptible to water logging can be converted into tidal basins on rotational basis with modification of existing structures and allow sedimentation in a planned way (Figure 6.8). This means deposition will be in a certain site or sites by a specific tidal channel or channels. Later deposition site will be shifted to other sites according to the topography of the area. This is a non-regulator/ non-structural type of solution.

Planning and design requirements of the TRM are:

- Suitable *beels* and depressions should have sediment caring capacity;
- There should be defined drainage network;
- Proper connectivity of *beel* area with drainage channels;
- Stopping tidal flow penetration towards upland;
- Establishment of designed drainage condition of river;
- Scope of compartmentalization in the TRM *beel*.

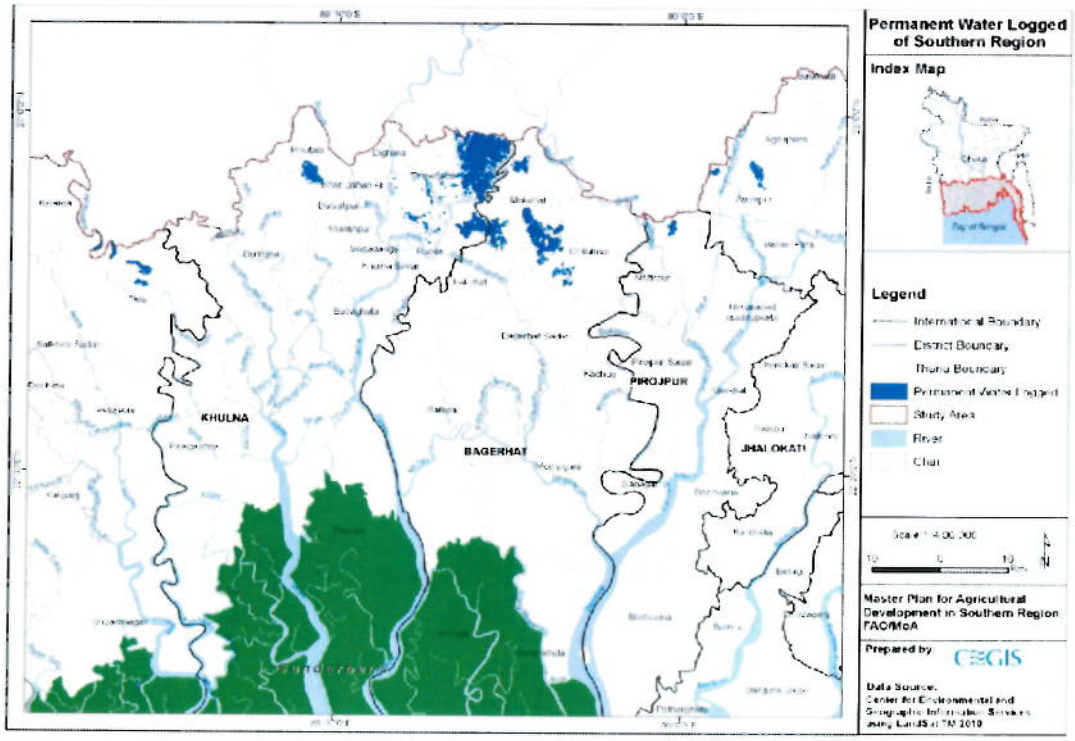

Figure 6.8: Waterlogged area suitable for TRM

TRM is a continuous process. Necessary conditions for successful TRM process are:

- Construction of a 2nd TRM should start immediately after operation of the 1st TRM, otherwise connected rivers will be silted up;
- No time gap in between successive TRM *beels*;
- Landowners should have enough motivation to accept and cooperate.

6.9.2 Barisal

Barisal region is rich in open water resources. It has a huge network of rivers that flow round the year. Surface water salinity is negligible, which provides an excellent opportunity for irrigation. This opportunity may be harvested for growing crops, particularly in the Kharif-I and Rabi seasons. Cropping intensity is low in Barisal compared to other regions of the country. Also vast areas remain fallow. A dominant cropping pattern is Fallow-T.Aman-Fallow. Agricultural productivity in this area may be expanded and accelerated by concentrating on surface water irrigation.

In Barisal region, 78 percent of the area is suitable or moderately suitable for T.Aus, though the present coverage is low. On the other hand, huge amount of land can be brought under Boro rice cultivation using surface water for irrigation (Figure 6.9).

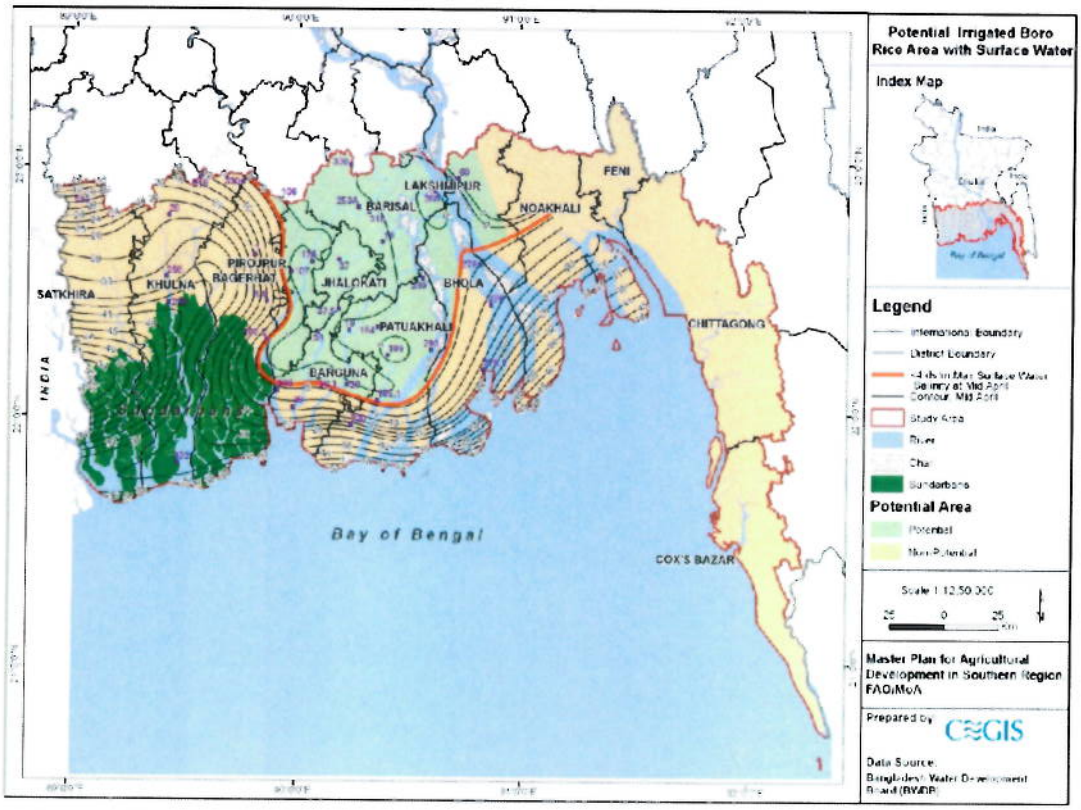

Figure 6.9: Boro suitable area with surface water irrigation

6.9.3 Noakhali

Land reclamation

The Meghna estuary has a very high potential for land accretion. Two cross-dams (no. 1 and 2) built in 1959 and 1964 respectively by the BWDB, had helped in reclaiming a huge land mass and the coastline of Noakhali has moved further southward. In the accreted land, BWDB developed several polders, other protective infrastructures and settled thousands of landless families though the Land Reclamation Project (LRP) and the Char Development and settlement Project (CDSP) since 1979 (Figure 6.10). Urir Char-Noakhali cross-dam with a length of 3.3 km is being envisaged to accelerate the process of land accretion in the *Meghna* estuary and to reclaim *char* land for human settlement and agricultural development.

When land will be accreted, the shoreline will be shifted toward the south keeping inlands safe from tidal surge. The need for bank protection will be reduced. Through plantation in the accreted area, a biological protection against cyclone and tidal overflow can be developed. An estimated 10,000 ha of reclaimed land will be available for productive use.

Drainage improvement

Greater Noakhali region has been suffering from acute drainage congestion for a long time. Water logging resulted from shifting of the Meghna river to the south accelerated by construction of two cross-dams. Due to land accretion, drainage channels have become lengthy. Eventually water surface slope decreased and the drainage flow was reduced. Unplanned infrastructures also impeded the natural drainage.

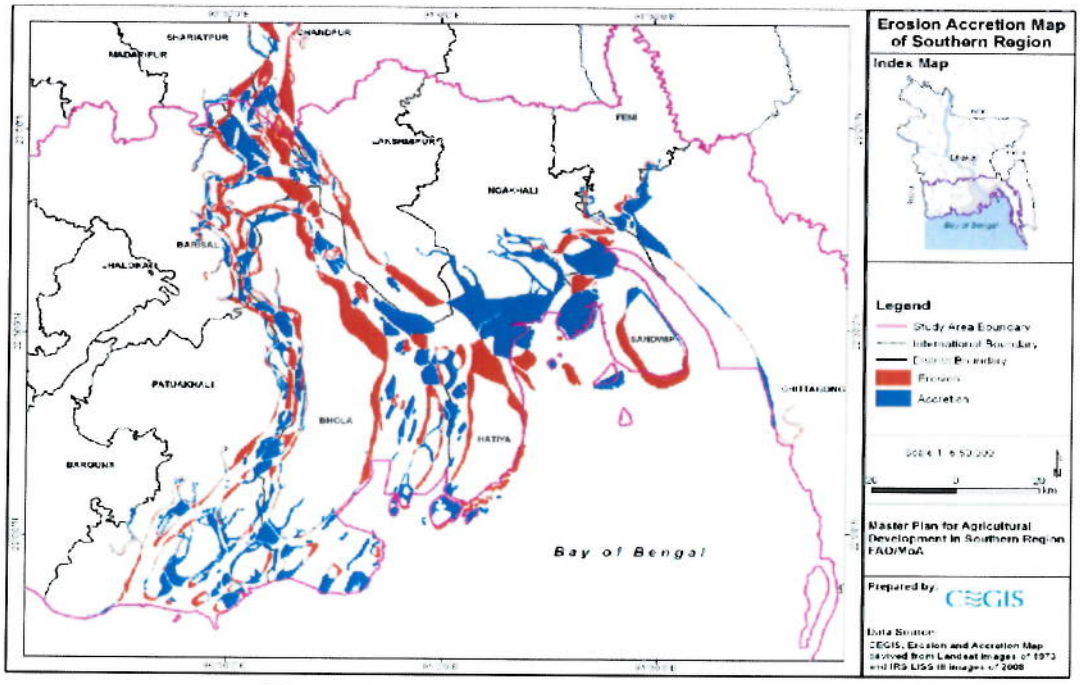

Figure 6.10: Land accretion in the Meghna estuary

The Noakhali Khal had been the main drainage route for monsoon runoff from 160 km^2 floodplain area. At the downstream, the flow is directed from north to south following the Algir Khal and Bamni outfall. Noakhali Khal does not drain to Bamni outfall until a certain level of high water is reached; rather the major portion of catchment runoff is draining towards Wapda Khal and Rahmatkhali regulator. Due to this reason, drainage of monsoon water is extremely slow causing drainage congestion. Besides, the flow direction is from south to north because of adverse bed slope, which is supposed to be in the reverse direction.

The Borrowpit Khal is connected with Noakhali Khal at its upstream end and drains monsoon water flow to the Bamni regulator. Currently the conveyance of the *khal* is not at its design condition.

Two 15 vent regulators were constructed to enhance the drainage of the Noakhali area and also to restrict large scale sedimentation from the Meghna estuary towards inward *khals*. But the second regulator collapsed in October 2010. A new regulator is needed for smooth drainage and also for arresting sedimentation of the Bamni drainage channel.

Along with the siltation of the Noakhali Khal, the absence of well-managed internal drainage network has been causing water logging in Noakhali urban area. Linkage of local *khals* and floodplains is needed to the Noakhali Khal to improve drainage condition of Noakhali town. Some *khals* need immediate re-excavation for drainage improvement (Table 6.7).

Table 6.7: Khals needing immediate re-excavation

Item	Khal	Average width (m)	Length (km)
Excavation of major khal	Noakhali Khal	45	40
	Borrowpit Khal	20	8
Excavation of secondary khal	Debipur Khal	20	12
	Datterhat Khal	15	9
	Ramjanbibi Khal	18	8.5
	Kalamunshi Khal	20	20
	Gabua Khal	20	18
	Choumuhani Khal	20	13
Protective work	Reconstruction of Bamni regulator		1