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Cropping Patterns in the South East Coastal Region of Bangladesh

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ABSTRACT

The study was conducted in greater Noakhali district to investigate the major cropping patterns during 2000–2001. Information was collected through a structured interview schedule. A total of 18 major cropping patterns were identified. Most dominant cropping pattern, single T. Aman alone occupied 35% land of net cropped area. The next three, Boro–Fallow–T. Aman, Fallow–B.Aus–T. Aman and single Boro represents 14, 11 and 11%, respectively of the net cropped area. A sharp variation was observed in cropping patterns among the different upazillas. Crop land of Noakhali, Companiganj, and Ramgati is mainly occupied by single T. Aman cropping pattern. Lion share of net cropped area in Feni, Chhagalnaiya, Parshuram and Raipur is covered by Boro–Fallow–T. Aman pattern. Begumganj and Chatkhil are an exception. More than 80% of the cropped area is in these two upazillas is cahracterized by single Boro cropping pattern. The average cropping intensity of the greater Noakhali district was 163%. The highest cropping intensity was 194% in Ramganj and the lowest 115 % was in Begumganj. The highest adoption rate of modern rice varieties was found in Boro–Fallow–T. Aman cropping pattern in all upazillas. The farmers need improved varieties of Aus, T. Aman and minor Rabi crops purposively suitable for coastal area. Researches in these fields should get priority. Single Boro area, especially of Begumganj and Chatkhil is the most potential area for fish culture after the harvest of Boro rice.

Key words: Cropping patterns, cropping intensity, coastal area.

INTRODUCTION

A cropping pattern is the yearly sequence, temporal and partial arrangement of crops in a given land area. It is dependent on physical, historical, social, institutional and economic factors as well as government policies (Agrawal and Kassam, 1976). The cropping pattern and the changes therein depend on a large number of factors like climate, soil type, rainfall, agricultural technology, availability of irrigation facilities and other inputs, marketing and transport facilities and growth of agro-industries (Neena, 1998; Gadge, 2003). The south east coastal region holds an environment different from other parts of Bangladesh. About 78 thousand hectares of land is affected by salinity at different levels. The crop production is restricted due to salinity during dry season, a peculiar environmental and hydrological situation prevails in the region. It is the most serious threat to the coastal agriculture. Determinants that influence the dynamics of salinity which, in tern determine the type of cropping patterns to be followed in the saline area are: rainfall, temperature,

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topography, crops and their varieties, and various socio-economic factors. The cropping intensity is much lower than those of non-saline areas of the country. Sweet water availability during dry season is very limited in the coastal area.

The yields of cereal crops are tending to stagnation, especially in favourable environments. Moreover, cultivable land area is decreasing day by day in the country. In this context, there is no other alternative but to address less favourable and unfavourable environments. To increase the system productivity of the total environment it needs to bring diversity in enterprises for better utilization of limited resources. A detail information on land situation and cropping systems is a pre-requisite for a fruitful development programme. Upazilla level office of the Department of Agricultural Extension (DAE) maintains a statistics on individual crop, which has some limitation for getting a real picture of existing cropping patterns and land utilization. The present study was designed with the following objectives:

1. Build up a database on major existing cropping patterns in the south east coastal region of Bangladesh,
2. Know the status of modern rice varieties in different patterns and seasons and
3. Identify the constraints and explore the scope of better utilization of resources in the area.

MATERIALS AND METHODS

The study was conducted in greater Noakhali district during 2000–2001. The study area included all the fifteen upazillas, six in Noakhali, five in Feni and four in Laxmipur district. It holds an area of 6.17 lac hectares that shares 4.17% of the whole Bangladesh (BBS, 2001). It consists of 174 unions, the smallest administrative units. An interview schedule was developed by the multidisciplinary experts of the Rice Farming Systems Division of Bangladesh Rice Research Institute. Necessary modification was done after the field test of the interview schedule. Data were collected in different stages, viz. (i) Focus group discussion at union level, (ii) Verification and cross checking by another focus group, (iii) Finally the data were validated in the weekly discussion meeting of the DAE officers and Block Supervisors (BS) in the upazilla. Each focus discussion group (FDG) consists of 6–8 key informants. All the key informants were selected with the help of BS. In the interview schedule wheat, mustard and potato were considered as major non-rice crops in winter. All other crops including winter vegetables were grouped as Rabi crops. Crop diversity index (CDI) was calculated by using the following equation described by Kshirsagar (1997).

$$CDI_i = 1 - \sum_{j=1}^{n} \left(\frac{a_{ij}}{A_i} \right)^2$$

Where, CDI_i = crop diversity index
a_{ij} = area planted to the jth crop in the ith location
A_i = total area planted under all crops.

The index is zero for a land area growing only one crop and approaches unity as the level of diversity increase. Yield was calculated as an average over ten crop cut results in each upazilla. Compilation and processing of collected data were done in Micro Soft Excel programme. Descriptive statistics were used to facilitate the presentation of the findings.

RESULTS AND DISCUSSION

Area coverage of major cropping patterns

Greater Noakhali district possesses 3.66 lac hectares of net cropped area. A total of 18 major cropping patterns were identified which covered about 93% of the net cropped area. Out of eighteen, only a single cropping pattern of single T. Aman occupied 1.28 lac hectare which holds 35% area. The three followers are Boro – Fallow – T. Aman, Fallow – B. Aus – T. Aman and Boro – Fallow – Fallow. These top four represents more than 70% of the cultivated land (Table 1). Nur-E-Elahi *et al*. (1999) identified 34 cropping patterns all over the country. Among those, Boro–Fallow–T. Aman, single T. Aman and single Boro were most dominant which covered 22, 13 and 10% area, respectively of net cropped area. That study was confined up to district level.

Table 1. Area under major cropping patterns in greater Noakhali district, 2000- 2001

Cropping pattern	Area coverage (ha)	% to net cropped area
01. Fallow – Fallow – T. Aman	128,200	34.99
02. Boro – Fallow – T. Aman	50,650	13.82
03. Fallow – B.Aus – T. Aman	42,000	11.46
04. Boro –Fallow – Fallow	40,000	10.92
05. Rabi – Aus – T. Aman	25,100	6.85
06. Rabi – Fallow – T. Aman	20,200	5.51
07. Groundnut – Aus – T. Aman	13,000	3.55
08. Fallow – T.Aus – T. Aman	9,900	2.70
09. Rabi – Vegetables	4,000	1.09
10. Boro –DW Aman	1,500	0.41
11. Rabi – B.Aus + B.Aman	1,160	0.32
12. Wheat – Fallow – T. Aman	915	0.25
13. Fallow – B.Aus + B.Aman	900	0.25
14. Potato – Fallow – T. Aman	780	0.21
15. Mustard – Boro – T. Aman	750	0.21
16. Mustard – Fallow – T. Aman	310	0.09
17. Wheat – T.Aus – T. Aman	300	0.08
18. Boro – Aus – Fallow	200	0.05
Others	26,535	7.24
Total (Greater Noakhali)	3,66,400	100.00

Another important feature of the region is that eight patterns out of 18 are composed of absolute rice crops. These are the above mentioned top four along with Fallow–T.Aus–T. Aman, Boro–DW Aman, Fallow–B.Aus+B.Aman and Boro–Aus–Fallow. About 75% of the crop land belongs to these eight patterns of single or double rices. A very negligible portion, less than 1% of net cropped area is occupied by five minor cropping patterns consisting wheat, mustard and potato. These crops do not perform well in the coastal region due to shorter (30 – 40 days) winter period compared to that of north-west region (3 – 4 months). The turn around time after T. Aman harvest in the coastal saline environment is very short to catch Rabi crop (Karim, 1990). Moreover, rapid tillage operation in many cases is not possible because of late November shower.

In the Rabi season, about 50% of the cropped area remains fallow under single T. Aman and Fallow – B. Aus/T. Aus – T. Aman cropping patterns. In this period a vast portion of this fallow area is used as an unplanned grazing land of buffaloes and sheep. Drought resistant and saline tolerant crops like barley and triticale could be tried to grow for grain as well as fodder. Grass pea is grown as a relay crop with T. Aman to a limited scale. It also could be expanded in unexploited areas.

Land utilization in different upazillas

A wide variation was observed in cropping patterns among the different upazillas. Seven upazillas *viz*. Noakhali, Companiganj, Senbagh, Hatiya, Dagonbhuiyan, Ramgati and Laxmipur are dominated by single T. Aman cropping pattern. Only this one covers about 60% land of net cropped area in Noakhali, Companiganj, and Ramgati (Table 2).

The existence of Boro–Fallow–T. Aman cropping pattern is almost common in every upazillas but dominant only in Feni, Chhagalnaiya, Parshuram and Raipur. About two-thirds cultivated land of these four upazillas are allocated for the pattern.

Fallow–B.Aus–T. Aman is the most important cropping pattern in Sonagazi and it represents about half of the cultivated area. It is important also in Senbagh, Hatiya and Ramganj and negligible in other parts of the region. In the Aus crop establishment, broadcasting and dibbling methods are practised simultaneously. In the dibbling method, seeds are put in a deeper hole to ensure the moisture and for the escape of germinating seeds from saline soil crust.

Single Boro cropping pattern is available in several upazillas. Begumganj and Chatkhil are an extreme exception for single Boro for which more than 80% of the area is allocated. Cultivation

system of these two upazillas is characterized by a unique hydro-ecological situation completely different from any other part of the country. It is a vast field of medium high land and medium lowland with a very shallow water table. For a long period of the year its stagnant water holds a thick cover of aquatic weeds that helps organic matter deposition in the soil. Crop is almost dependent on surface water from ponds and ditches and sometimes canals.

Table 2. Area covered by dominant cropping patterns in different upazillas of greater Noakhali district, 2000- 2001

Upazilla	Net cropped area (NCA) in ha	Status of dominant cropping patterns		
		Cropping patterns	Area (ha)	% of NCA
01. Noakhali	67,000	F- F- T. Aman	40,000	60
02. Companiganj	22,000	F- F- T. Aman	12,500	57
03. Begumganj	26,500	Boro- F- F	22,000	83
04. Chatkhil	8,700	Boro- F- F	7,000	80
05. Senbagh	12,500	F- F- T. Aman	4,000	32
		Boro- F- F	2,000	16
		F- B.Aus- T. Aman	2,000	16
		Boro- F- T. Aman	2,000	16
06. Hatiya	55,000	F- F- T. Aman	15,000	27
		F- B.Aus- T. Aman	10,000	18
		G.nut-Aus-T. Aman	8,000	15
07. Feni	16,500	Boro- F- T. Aman	10,000	61
08. Parshuram	12,700	Boro- F- T. Aman	8,300	65
09. Chhagalnaiya	10,000	Boro- F- T. Aman	7,000	70
10. Dagonbhuiyan	10,500	F- F- T. Aman	3,500	33
		Boro- F- T. Aman	2,400	23
		F- T.Aus- T. Aman	2,000	19
11.Sonagazi	21,000	F- B.Aus- T. Aman	10,000	48
		F- F- T. Aman	5,800	28
12. Ramgati	48,000	F- F- T. Aman	27,000	56
13. Raipur	11,500	Boro- F- T. Aman	6,500	57
14. Laxmipur	36,000	F- F- T. Aman	12,000	33
		Boro- F- T. Aman	10,000	28
15. Ramganj	8,500	Boro- F- T. Aman	2,000	24
		Boro- F- F	1,000	12
		F- B.Aus- T. Aman	1,000	12
		Boro- DW Aman	1,000	12

Groundnut–Aus–T. Aman is a different cropping pattern exists only in Hatiya, which covers 15% area. The newly formed light soil of the upazilla is very suitable for the groundnut cultivation. Replacement of local varieties by high yielding varieties of groundnut might be a tool for the increase of productivity. Boro–DW Aman is a cropping pattern in the bank of extinction. A considerable land area is steel now under this cultivation in Ramganj.

Number of cropping patterns is a gross indicator of crop diversity. The highest number of cropping patterns identified was 12 in Laxmipur and the lowest was six in Chatkhil. Calculated crop diversity indeces (CDI) for the upazillas are also presented in the Table 3. Over all crop diversity index in the

greater Noakhali was 0.70. The highest CDI was found 0.76 in Hatiya and Ramganj and the lowest 0.41 in Begumganj. The average cropping intensity of the greater Noakhali district was 163%. The highest cropping intensity was 194% in Ramganj and the lowest 115 % was in Begumganj.

Table 3. Crop diversity and cropping intensity (CI) in different upazillas of greater Noakhali district, 2000- 2001

Upazilla	Number of identified patterns	CDI	Cropped area (ha)			CI (%)
			Single	Double	Triple	
01. Noakhali	10	0.59	50,000	11,000	6,000	134
02. Companiganj	10	0.66	12,500	6,500	3,000	157
03. Begumganj	7	0.41	23,000	3,000	500	115
04. Chatkhil	6	0.48	7,000	1,200	500	125
05. Senbagh	10	0.72	6,000	6,000	500	156
06. Hatiya	7	0.76	20,000	20,000	15,000	191
07. Feni	8	0.69	3,000	12,500	1,000	188
08. Parshuram	8	0.67	3,000	9,200	500	180
09. Chhagalnaiya	8	0.68	1,000	8,500	500	195
10. Dagonbhuiyan	9	0.69	3,500	6,000	1,000	176
11.Sonagazi	9	0.66	6,000	14,000	1,000	176
12. Ramgati	10	0.74	28,000	12,000	8,000	158
13. Raipur	7	0.73	2,000	8,500	1,000	191
14. Laxmipur	12	0.71	14,000	18,000	4,000	172
15. Ramganj	11	0.76	2,000	5,000	1,500	194
Greater Noakhali	18	0.70	181,000	141,400	44,000	163

The interrelationship between cropping intensity, crop diversity index and the number of cropping patterns was calculated in terms of correlation coefficient. From this analysis, it is observed that CI and CDI were positively correlated with a coefficient value 0.84. A linear relationship between CI and CDI was with r^2 = 0.70 (Fig. 1). The number of cropping patterns showed a negligible relationship (r^2 = 0.012) with CI and a poor relationship (r^2 = 0.20) with CDI.

Adoption level and yield of MV rices under different cropping patterns

Adoption of modern rice varieties is highly dependent on land situation, irrigation facilities and other inputs. It may show a great fluctuation in different locations under the same cropping pattern and in different cropping patterns of similar location. In the study area, adoption rate of modern Boro is almost 100% in Boro–Fallow–T. Aman cropping pattern. But in single Boro it ranges from 90 to 99% in different locations (Table 4). Some pocket area under the threat of flush flood in bottom land is out of modern Boro cultivation.

In T. Aman season modern varieties cover 18 – 100% area of Fallow–Fallow–T. Aman, Boro–Fallow–T. Aman and Fallow–Aus–T. Aman cropping patterns. This wide variation is mainly due to land type, soil salinity and lack of irrigation facilities. Medium high land–II is not usually suitable for modern Aman transplanting. In addition, some local varieties are specially preferred for different/specific purposes. Modern rice adoption rate in Aus season is 18 – 100% over the greater Noakhali district. Irrespective of season and cropping pattern, adoption rate is the highest in Dagonbhuiyan and the lowest in Hatiya.

Binnatoa is a popular local Aus and Rajasail and Kajalsail are two dominant local varieties of T. Aman. Basically they are not characterized by high salt tolerance. But these land races have got stability/adaptation by cultivation over yeras. Among the modern Aus varieties, BRRIdhan27 is getting popularity because of its taller plant type and increasing adaptation. Modern T. Aman varieties like BR22, BR23, BRRIdhan40 and BRRIdhan41 have slight tolerance to salinity. These varieties could be expanded tremendously. Efforts should be given on continuous research trials

with a large number of genotypes. Selected genotypes from the regional trials could be expected to perform well over time.

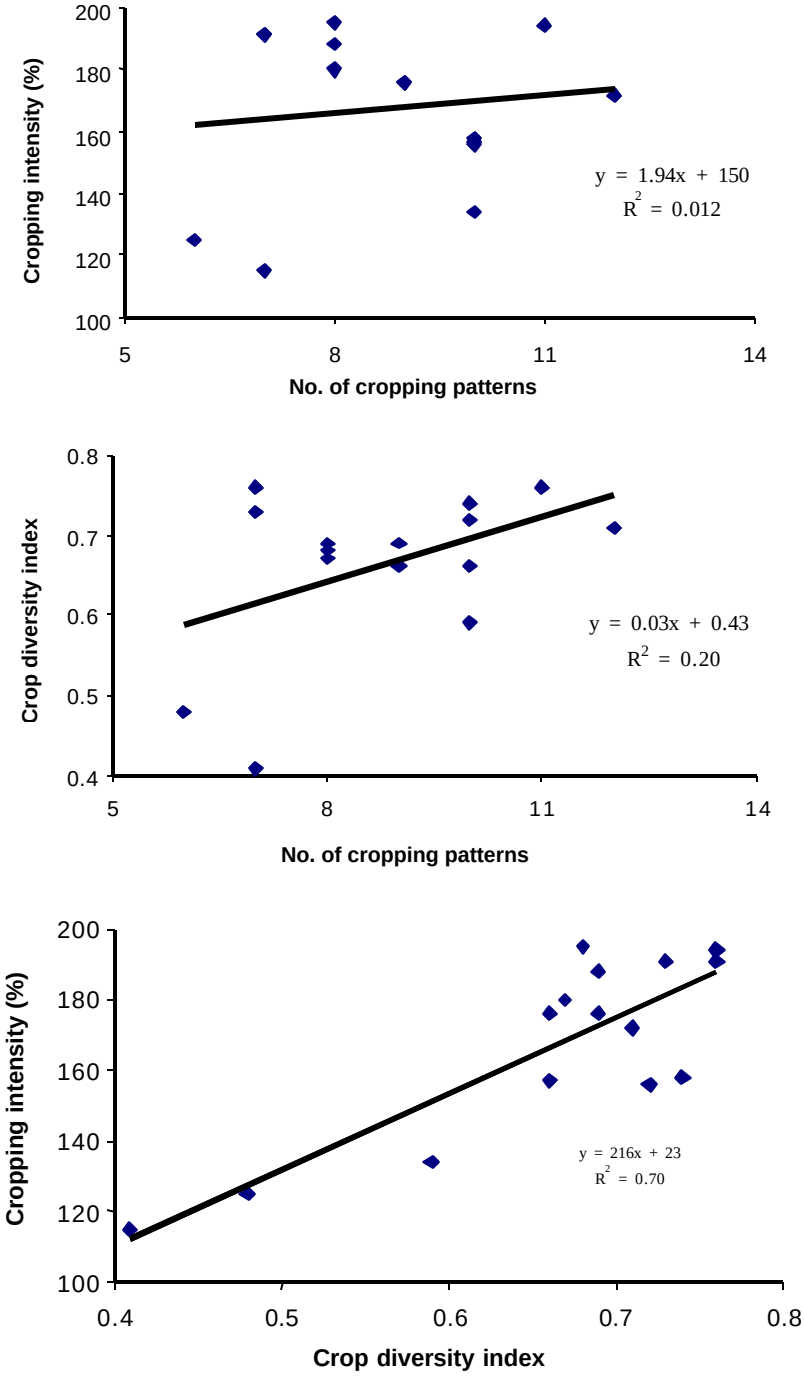

Fig. 1. Relationship between different pairs of parameters

Table 4. Adoption of modern varieties of rices (MV rices) in different upazillas under dominant cropping patterns, 2000- 2001

Upazilla	Boro- F- F	F- F- T. Aman	Boro- F- T. Aman		F-Aus-T. Aman	
			Boro	T. Aman	Aus	T. Aman
01. Noakhali	98	20	-	-	30	20
02. Companiganj	-	20	100	25	50	25
03. Begumganj	95	-	100	25	50	25
04. Chatkhil	99	-	-	-	70	30
05. Senbagh	90	60	100	80	80	60
06. Hatiya	-	18	-	-	18	18
07. Feni	-	90	100	90	60	90
08. Parshuram	-	80	100	80	80	80
09. Chhagalnaiya	-	65	100	70	70	60
10. Dagonbhuiyan	-	100	100	75	50	75
11.Sonagazi	-	50	100	100	70	50
12. Ramgati	-	25	100	100	25	25
13. Raipur	-	70	98	80	-	-
14. Laxmipur	90	20	100	50	20	20
15. Ramganj	98	-	100	80	30	70

Modern rice yield of single Boro is 4.5 – 5.2 t/ha (Table 5). The highest yield was recorded in Ramganj and Noakhali upazilla was the lowest in position. The yield of single T. Aman ranges from 3.2 to 4.2 t/ha in different upazillas. Total rice yield of Boro–Fallow–T. Aman ranges from 7.0 to 8.5 t/ha and that of Fallow–Aus–T. Aman is 5.5 – 7.2 t/ha. After overall consideration it could be said that the highest yields of modern varieties of rice were recorded in Ramganj/Parshuram and the lowest in Noakhali/Senbagh upazillas.

Table 5. Total grain yield (t) of modern varieties of rice of different cropping patterns in the upazillas of greater Noakhali district, 2000- 2001

Upazilla	Boro- F- F	F- F- T. Aman	Boro- F- T. Aman	F-Aus-T. Aman
01. Noakhali	4.5	3.3	-	5.8
02. Companiganj	-	3.5	7.2	6.0
03. Begumganj	5.0	-	7.7	6.5
04. Chatkhil	5.0	-	-	6.0
05. Senbagh	4.8	3.5	7.0	5.5
06. Hatiya	-	4.2	-	7.0
07. Feni	-	4.0	8.0	6.5
08. Parshuram	-	4.2	8.5	7.2
09. Chhagalnaiya	-	4.0	8.4	6.5
10. Dagonbhuiyan	-	4.0	8.2	6.8
11.Sonagazi	-	4.0	8.0	7.0
12. Ramgati	-	3.5	8.3	5.8
13. Raipur	-	4.0	7.9	-
14. Laxmipur	5.0	3.2	7.4	6.0
15. Ramganj	5.2	-	8.5	7.0

Constraints to adoption of improved technologies

A series of constraints were identified in the survey activities. Ten major of those were prioritized and presented in the Table 6. According to the severity ranking 'unplanned polder/embankment construction' is the most serious one. It results the siltation in rivers and canals. In most of the cases, repair and maintenance of the constructions is not done properly. It aggravates the water stagnation situation in an additional scale. 'Poor soil in *charland*' and 'soil salinity' are the two least frequent constraints possess higher ranks. The most common and frequent constraint is the high price of agricultural inputs, but in the order of ranking it got least priority.

Table 6. Constraints to adoption of improved technologies in crops and cropping patterns in greater Noakhali district

Constraints	Ranking of severity	Frequency	
		Number	%
1. Unplanned polder/embankment	1	83	48
2. Poor soil of *charland*	2	64	37
3. Water stagnation	3	76	44
4. Soil salinity	4	65	37
5. Groundwater salinity	5	71	41
6. Absentee farmer	6	111	64
7. People's tendency of going abroad	7	119	68
8. Lack of knowledge	8	98	56
9. Lack of suitable crops and varieties	9	150	86
10. High price of agricultural inputs	10	160	92

N = 174

CONCLUSION

Non-rice Rabi crops hold a poor position in the agriculture of the south east coastal region. As a result crop diversification is restricted. Adoption of modern rice varieties in Kahrif season is very low in several upazillas. The farmers need improved varieties of Aus, T. Aman and minor Rabi crops purposively suitable for coastal area. Researches in these fields should get priority.

Drought resistant and saline tolerant crops like barley, triticale and other suitable pulse crops could be tried to grow for feed as well as food.

Rapid expansion programme of BRRIdhan27 in Aus Season and BR22, BR23, BRRIdhan40 and BRRIdhan41 in Aman season should continue. Regional trial for searching new genotypes should strengthen.

Single Boro area, a broad avenue, could be emphasized and addressed in different way. Begumganj and Chatkhil are the most potential area for rice-fish culture. After Boro harvest, successful rearing and catching of fishes is very possible in the boundary of frequently available natural barriers. Effort could be initiated in research for the development of packages of appropriate technologies.

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