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Cropping systems dynamics in greater Kushtia

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Abstract

Understanding in changes of cropping systems over time and seasons related to the shifting of cropping patterns of a particular area is of importance for guiding policy makers, researchers and extension personnel for future research and development planning. The diagnostic sample survey was conducted in five Blocks under five upazilas of greater Kushtia district during 2004 using pre-designed and pre-tested questionnaire with a view to documenting the changes in cropping patterns and the reasons for the shift therein. About 80 % of the net cropped area were found under rice-based cropping patterns which was increased at about 89 % during 1998-99 to 2002-03. A total of 14 rice-based cropping patterns were identified in greater Kushtia district which was decreased and resulted in decreasing tendency in crop diversity. Lion's share of the cropped area was covered by *Boro*-Fallow-Transplanted *Aman*, which was remarkably increased in all Blocks over time. The pulses and spices are replaced by *Boro* rice, tobacco, maize, aroid and potato. Increased irrigation facilities, lack of appropriate marketing channel and increased insect and disease pressure in pulses and other minor crops are the main reasons for the shifting of cropping patterns. The farmers demanded improved varieties of *Aus* and Transplanted *Aman* rices like BR11 and Swarna, suitable for this drought prone area. Research and development activities for non-rice crops in this area might get priority for sustainable crop diversity.

Keywords: Cropping systems, Dynamics, Greater Kushtia

Introduction

Various crops under different cropping systems are grown yearly in different parts of the country with rice as the major crop. A cropping pattern is the yearly sequence, temporal and partial arrangement of crops in a given land area. The cropping pattern and the changes therein depend on a large number of factors like climate, type of soil, rainfall, agricultural technology, availability of irrigation water and the growth of agro-industries (Neena, 1998 and Gadge, 2003). Again, Sekhar (1998) reported that agricultural productivity growth is affected by increase in yield followed by shift in cropping patterns and their interaction.

The cereals are the synonym of food security in Bangladesh and obviously, the lion's share of net cropped area is under rice-based cropping systems. Varying potentials of irrigation, processes involved in marketing rice and other crops and the outbreak of pests or diseases are significant factors that contribute to changes in rice based cropping systems (Joshi, 2002). Many researchers reported on the comparative performance and other management aspects of cropping systems (Quddus *et al.*, 2004; Rashid *et al.* 2003; Badiuzzaman *et al.*, 1995 and Rahman *et al.*, 1998.) for different regions. However, literature on the dynamics of cropping patters in the country is scanty. Understanding in changes of cropping systems overtime and reasons related to the shifting of cropping patterns of a particular area may guide the policy makers, researchers and extension workers to take imitative for the betterment of livelihood and environment in time. The present study was designed to document the dynamics of changing in cropping patterns in greater Kushtia from 1998-99 to 2002-2003 and to identify the reasons for the shifting therein.

Materials and Methods

The study was conducted in the greater Kushtia district, which belongs to Agro-ecological zone (AEZ)-11. Five Upazilas, two from Chuadanga, two from Meherpur and one from Kushtia districts were included as the study area. In each Upazila, a Block was purposively

selected for the diagnostic sample survey during 2003-04. The selected Blocks were Amjhupi and Chandbil in Meherpur Sadar, Alokdia and Banka in Sadar and Jiban Nagar Upazilas, respectively, under Chuadanga district and East Abdalpur in Kushtia Sadar. Twenty farmers from marginal to medium category were selected at random in each Block and data were collected from them through personal interview using pre-deigned and pre-tested questionnaire. The data were validated by the family members at the time of interview with the household head. As most of the active farmers are under marginal to medium category, this study was limited to these three categories of farmers. Crop diversity index (CDI) was measured by using the following equation described by Kshirsagar *et al.* (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 unit as the level of diversity increase. 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

General Information

Age and academic qualification of the sampled farmers is presented in Table 1. On an average, farmer's age was found about 31 to 47 years in different Blocks. Most of the farmers were educated upto secondary school level with a majority up to class eight except in Chandbil. Number of family members per farm was four to five except Banka where it was more than five. Number of adult members ranged from 2.4 to 3.8. On the other hand, adult female members per family varied from 1.40 to 2.80 (Table 2). Irrespective of Blocks, majority of the farmers are under small (50 %) category in 1998-99, which is slightly decreased in 2002-03 with an increase in marginal farmers (Table 3).

Changes in area under irrigation

On an average, 66.46 % of the net cropped area was under irrigation in 1998-99 in the studied area which was increased up to 81.22 % in 2002-03. Figure 1 shows that irrigated area was markedly increased during five years in all Blocks.

Table 1. Age and academic qualification of the sampled farmers of different blocks

Block	Farmers age (years)	Qualification category			
		Primary level	Class VI-VIII	Class IX-S.S.C	H.S.C and above
Amjhupi	36.5 (24-55)	60	30	10	-
East Abdalpur	47.0 (35-55)	30	60	10	-
Chandbill	43.3 (22-60)	30	-	40	30
Alokdia	35.8 (27-40)	20	40	40	-
Banka	31.1 (19-45)	20	50	20	10

Figure in parentheses indicate the range

Table 2. Work force scenario of the sampled farms

Block	Family size (No. of family members)	Distribution of workforce		
		Adult (No.)	Male (No.)	Female (No.)
Amjhupi	4.78 (3-7)	3.44 (2-5)	2.67 (1-4)	2.11 (1-4)
East Abdalpur	4.86 (4-6)	2.61 (2-3)	2.14 (1-3)	2.71 (2-3)
Chandbill	3.80 (2-6)	3.40 (2-6)	2.50 (1-4)	1.40 (1-3)
Alokdia	4.40 (3-7)	2.40 (2-3)	2.20 (1-6)	2.20 (1-3)
Banka	5.60 (5-7)	3.80 (3-5)	2.80 (2-4)	2.80 (2-4)

Figure in parentheses indicate the range

Table 3. Changes in distribution of farm category (%) during 1998-2003

Block	1998-99			2002-03		
	Marginal (0.21-0.5 ha)	Small (0.51-1.0 ha)	Medium (1.1-2.0 ha)	Marginal (0.21-0.5 ha)	Small (0.51-1.0 ha)	Medium (1.1-2.0 ha)
Amjhupi	20	40	40	40	30	30
East Abdalpur	10	50	40	20	50	30
Chandbill	40	30	30	30	30	40
Alokdia	20	60	20	40	50	10
Banka	10	70	20	10	60	30
Mean	20	50	30	28	44	28

Overall changes in cropping systems

Cropping pattern with at least single rice was considered as rice-based cropping pattern. About 80 % and 20 % of the area was under rice-based and non-rice based cropping patterns, respectively, in 1998-99, which was changed as about 89 % and 11 %, respectively, in 2002-03 (Table 4). This increment of area under rice-based cropping patterns was due to increased irrigated area, disease and insect pressure and unstable market price for existing non-rice crops. Joshi (2002) also reported that availability of irrigation facilities favored the increase of rice area.

Table 4. Changes in distribution of net cropped area under rice and non rice-based cropping patterns

Block	1998-99		2002-03	
	% area under rice-based cropping patterns	% area under non rice-based cropping patterns	% area under rice-based cropping patterns	% area under non rice-based cropping patterns
Amjupi	87.62	12.38	88.85	11.15
East Abdalpur	75.40	24.60	84.60	15.40
Chandbill	85.48	14.52	88.24	11.76
Alokdia	75.64	24.36	93.81	6.19
Banka	77.91	22.09	88.82	12.18
Mean	80.41	19.59	88.86	11.34

Changes in rice-based cropping patterns

A total of 14 rice-based cropping patterns were identified in greater Kushtia varying in different Blocks which was slightly decreased during five years. Among the identified cropping patterns, *Boro*-Fallow-Transplanted *Aman*, Transplanted *Aman*-Wheat-Fallow and Jute-T. Aman-Fallow were the most dominant cropping patterns which covered about 38, 22 and 14 % of the net cropped area in 1998-99 (Table 5). Elahi *et al.* (2001) identified 34 cropping patterns all over the country. Among those, *Boro*–Fallow–Transplanted *Aman* was the most dominant, which covered 22% area of net cropped area. During five years, remarkable change was found in cropping pattern. Noticeable area was increased (26%) under *Boro*-Fallow-Transplanted *Aman*. Area under Transplanted *Aman*-Wheat-Fallow and Transplanted *Aman*-Fallow-Jute were decreased (Table 5 and 6). Rice-Pulses and Rice-Spices area also decreased during 1998-99 to 2002-03. In the rice-based cropping patterns under different Blocks, Aus rice, pulses and spices area decreased. These crops were replaced by *Boro* rice, maize, tobacco and aroid. Increasing market demand of maize, marketing channel and input supply by the tobacco companies for tobacco production and higher productivity with less resource needed in aroid cultivation are the main reasons for these shifting of crops under different cropping patterns. Saleth (1999) also reported that the impact of prices on the acres of some crops had gained in their area over the years.

Changes in cropping intensity and crop diversity

Number of cropping patterns is a gross indicator of crop diversity. This numbers varied from Block to Block and decreased from 1998-99 to 2002-03 in all Blocks except Chandbil (Table 5 and 6). Calculated crop diversity indices (CDI) are presented in Figure 2. The CDI also varied from Block to Block and decreased over the years. The average cropping intensity (CI) in greater Kushtia was 203 in 1998-99 and increased at 218 in 2002-03. Cropping intensity increased in all the studied Blocks except in Amjhupi (Figure 3).

Table 5. Cropping patterns and their share (%) in net cropped area in different Blocks during 1998-99

Cropping pattern	Block					
	Amjhupi	East Abdalpur	Chandbil	Alokdia	Banka	All sites
T. Aman-Wheat-F	15.79	33.33	25.00	-	36.84	22.19
T. Aman-F-Jute	40.79	16.31	14.29	-	-	14.28
Boro-F-T. Aman	34.21	31.11	46.43	54.55	26.32	38.52
T. Aman-Wheat -Jute	7.21	-	7.00	-	-	2.84
T. Aman-Wheat -Vegetables	2.00	-	2.52	-	-	0.90
Aus-T. Aman-F	-	14.80	2.38	-	-	3.44
T. Aman-Chickpea	-	4.45	-	1.82	-	1.25
Wheat-Aus-F	-	-	2.38	14.55	-	3.39
Mustard-Aus-F	-	-	-	7.26	-	1.45
Spices-Aus-F	-	-	-	7.27	-	1.46
Mustard-F-T. Aman	-	-	-	14.55	5.26	3.96
T. Aman-Black gram-F	-	-	-	-	21.05	4.21
F-T. Aman-F	-	-	-	-	5.26	1.05
Lentil-Aus-F	-	-	-	-	5.27	1.06
Total	100	100	100	100	100	100

F= Fallow

Table 6. Cropping patterns and their share (%) in net cropped area in different Blocks during 2002-03

Cropping pattern	Block					
	Amjhupi	East Abdalpur	Chandbil	Alokdia	Banka	All sites
T. Aman-Wheat-F	15.49	15.84	2.02	-	18.75	10.42
T. Aman-F -Jute	5.63	2.48	-	-	-	1.61
Boro-F-T. Aman	69.01	66.83	63.64	49.05	71.88	64.08
T. Aman-Wheat- Jute	6.00	10.60	9.16	14.22	-	8.00
T. Aman-Wheat- Vegetables	2.45	4.25	7.00	12.20		5.18
Wheat-Aus-F	-	-	8.08	-	-	1.62
T.Aman-Maize	1.42	-	2.02	15.09	-	3.71
Jute-T. Aman-Tobacco	-	-	6.06	-	-	1.21
Aroid-T. Aman	-	-	2.02	-	-	0.40
T. Aman-Mustard-Boro	-	-	-	1.89	-	0.38
T. Aman-Khesari	-	-	-	7.55	-	1.51
T. Aman-Potato-Jute	-	-	-	-	6.25	1.25
T. Aman-Potato-Boro	-	-	-	-	3.12	0.62
Total	100	100	100	100	100	100

F=Fallow

Changes in area coverage by variety of major crops under dominant cropping patterns

Adoption of modern crop varieties is highly dependent on land situation, irrigation facilities and other inputs. In the study area, *Aus* rice varieties were local (Table 7) due to lack of irrigation facilities in 1998-99. The dominant varieties were Baku followed by Kalsi and Manik. The adoption of modern varieties was increased at 50 % in 2002-03 (Table 8). In all the Blocks, BR11 was the most dominant variety in 1998-99, which was continued in 2000-03 with an increasing trend of the variety Swarna. The farmers demand for improved variety in Transplanted *Aman* season was like BR11 and Swarna. BRRIdhan28 was the most popular variety in all the Blocks for *Boro* season. In 1998-99 IR8 had the higher share in Amjhupi and East Abdalpur which was replaced by BRRIdhan28 with the supply of seed of this variety. This is an indication of choice of the farmers of this area for *Boro* variety that might be a considerable issue for the rice breeders for the variety development for this area. Kanchan is the only variety cultivated by the farmers for wheat. Some Indian jute varieties along with *deshi* are the main varieties for jute. However, *deshi* jute was replaced by the Indian varieties. Jute varieties developed by the Bangladesh Jute research Institute was lacking in this area that might be validated along with the existing varieties through farmers' participatory approach.

Table 7. Area coverage (%) by variety of major crops under dominant cropping patterns in central western of Bangladesh during 1998-99

Crops and variety	% Area under particular variety under specific crop				
	Amjhupi	East Abdalpur	Chandbil	Alokdia	Banka
Rice: Aus					
Manik (local)	-	20	5	10	15
Kalsi (local)		20	25	40	25
Baku (local)		60	70	50	60
T. Aman					
BR10	-	-	-	-	6
BR11	73	100	78	72	94
BR32	-	-	-	21	-
Swarna	27	-	7	-	-
Salika (local)	-	-	15	7	-
Boro					
IR8	62	29	6	4	5
BRRIdhan28	38	71	88	89	93
Nayanmoni	--	--	6	7	2
Wheat :					
Kanchan	100	100	100	100	83
Sonalika	-	-	-	-	17
Jute:					
Deshi	100	100	7	-	-
Maharashtraya	-	-	47	100	-
Nobin	-	-	46	-	-

Table 8. Area coverage (%) by variety of major crops under dominant cropping patterns in central western of Bangladesh during 2002-03

Crops and variety	% Area under particular variety under specific crop				
	Amjhupi	East Abdalpur	Chandbil	Alokdia	Banka
Rice: Aus					
BR26	-	-	20	-	-
BRRIdhan28	-	-	30	-	-
Baku (local)	-	-	50	-	-
T. Aman					
BR11	63	68	78	70	63
BRRIdhan32	-	5	-	-	-
BRRIdhan39	14	5	6	7	-
Swarna	23	22	8	23	37
Salika (Local)	-	-	8	-	-
Rice: Boro					
IR8	4	8	3	-	--
BRRIdhan28	84	92	88	92	92
Nayanmoni	-	-	3	8	-
Sajoni	12	-	6	-	-
Minikit	-	-	-	-	8
Wheat :					
Kanchan	100	100	100	100	100
Jute:					
Deshi	50	-	-	43	50
Nobin	50	-	17	-	40
Maharashtraya	-	100	83	57	-

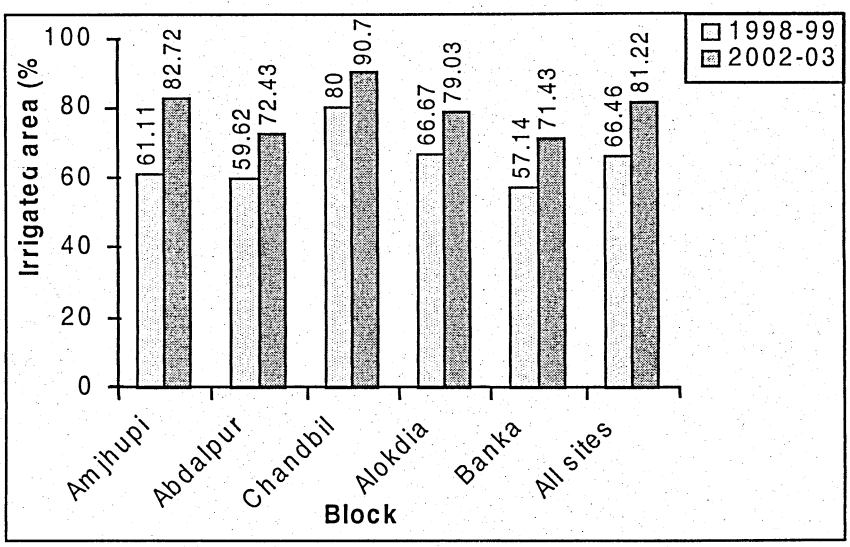

Fig.1. Irrigated area under different Blocks during 1998-99 to 2002-03.

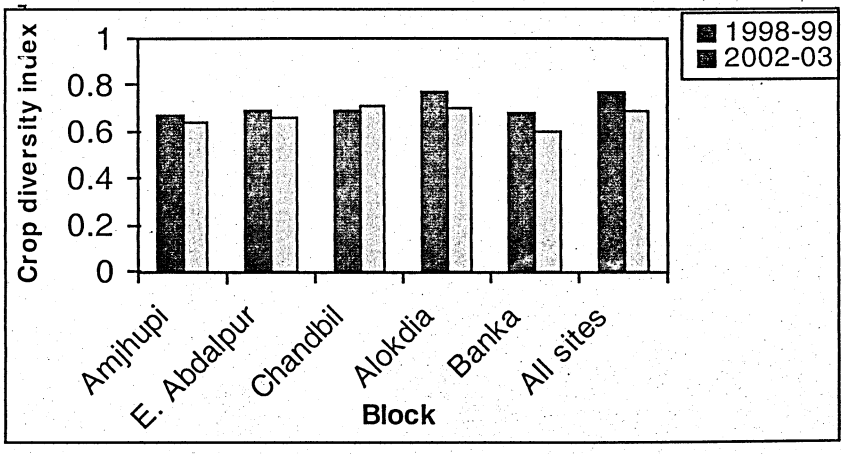

Fig. 2. Crop diversity index in different Blocks in 1998-99 and 2002-03.

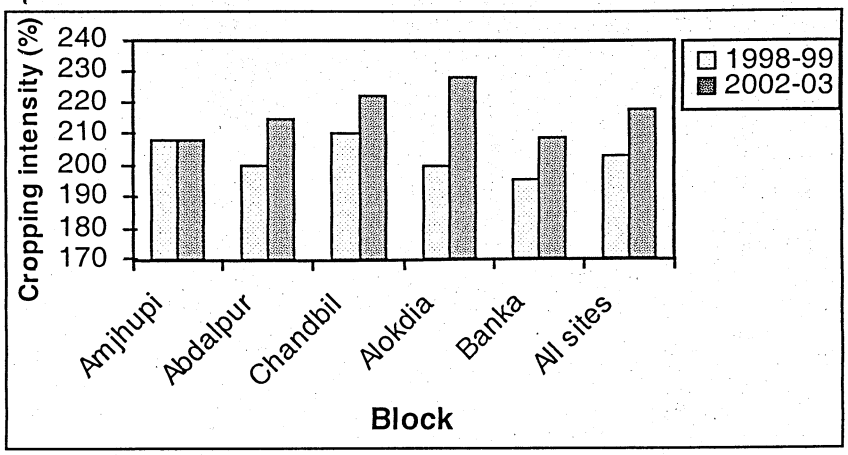

Fig.3. Cropping intensity in different Blocks in 1998-99 and 2002-03.

Conclusion

Increasing area under *Boro* badly needed for food security but it decreased the crop diversity. Meeting the food demand with a sustainable diversified farming is urgent for sustainable development. The varieties with higher productivity and less risk for non-rice crops and suited to the study area have great demand from the farmers. Farmers' participatory variety selection for major crops under dominant cropping patterns might be strengthened in system perspective for sustainable crop diversity and food security.

References

Badiuzzaman, M., Mandal, A.S. and Dutta, S. C. 1995. Profitability of some improved cropping patterns in a high and medium highland of Tangail district. *J. Rural Development.*25 (2):37-50.

Elahi, N.E.; Khan, A.H.; Siddique, M.R.; Saha, A.; Nasim, M.; Mollah, M.I.U. and Shahidullah, S.M. 2001. Existing cropping patterns of Bangladesh, potential technologies and strategies for improving systems productivity. *Proceedings of the workshop on modern rice cultivation in Bangladesh*, held at Bangladesh Rice Research Institute, Gazipur 1701.

Gadge, S.S. 2003. Influence of changes in cropping pattern on farmers' economic status. *Indian J. Extension Education.* XXXIX(1and 2): 99-101.

Joshi, M. 2002. Dynamics of rice-based cropping systems in the southern transitional zone of Karnataka, India. *International Rice Research Notes.* 27 (2):41-42.

Kshirsagar, K.G., Pandey, S. and Bellon, M.R. 1997. Farmers' perception, varietal characteristics, and technology adoption: The case of rainfed village in eastern India. *Discussion paper 5/97.* Social Science Division, IRRI.

Neena, D. 1998. Interstate variation in cropping pattern in India. *Indian J. Regional Science.* 30(2): 57-69.

Quddus, M.A., Rashid, M.H., Khan, A.H., Ibrahim M. and Khatun, A. 2004. Evaluation of improved cropping patterns in the medium highland rice ecosystem. *Pakistan J. Agronomy.*3 (3):175-178.

Rahman, M.S., Mandal, M.A.S., and Jabbar, M.A.. 1998. Profitability of different crops and cropping pattern in a selected area of Tangail district. *Progressive Agriculture.*9 (1 and 2):201-207.

Rashid, M. H., Khan A.H., Quddus, M.A., Elahi, N.E. and Saha, A. 2003. Performance of Photosensitive Modern Rice Varieties in the Medium Highland Phase-2 after Boro Rice. *Pakistan J. Agronomy.* 1(2-3):71-73.

Saleth, R.M. 1999. *Shift in cropping pattern from cereals to non-cereals.* Institute of Economic Growth, University of Enclave, New Delhi, India.78 pp.

Sekhar, C.S.C. 1998. *Sources of agricultural growth in semi-arid tropics-a case study of Haryana.* Agricultural Economics Research Centre, University of Delhi, New Delhi. 41p.