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Research Note

INTERCROPPING: A SUSTAINABLE LAND USE SYSTEM IN THE RAINFED AGRICULTURE OF SOUTH WEST BANGLADESH

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INTRODUCTION

Mixed, inter and relay cropping are considered to be efficient age-old practices for productivity, profitability, sustainability, risk coverage and at the same time crop diversification. The performance of the cropping system depends upon how best of the resources are utilized by the component crops grown either alone or in combination.

Growing of two or more crops simultaneously intermingled in the same plot with no distinct row arrangement is defined as mixed cropping while growing of two or more crops simultaneously in the same plot with specific row arrangement is termed as inter cropping. Similarly relay cropping may be defined as growing of two or more crops simultaneously in the same plot such that one crop is seeded after the other has flowered (Rahman et al ..: 1989). The primary concern of intercropping is to increase the total yield compared to monoculture. Intercropping in farming practices has long been recognized, but in the recent years it has awakened real interest among the researchers. The main reason for this is undoubtedly the increasing evidence that intercropping can provide substantial yield advantage over mono cropping (Willey, 1979 ; Aktar, 1988).

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Mustard, lentil and chickpea are extensively grown under rainfed condition in the winter season with minimum inputs in the south-west region of Bangladesh. Intercropping of these crops are common in greater Jessore district (Gowda et al 1982). The High Ganges River floodplain agro-ecological region enjoys a tropical monsoon climate with the lowest and least reliable rainfall in Bangladesh (Manalo, 1976). The rainfall is very low and unstable not only over different years but also during different seasons of a

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year. The farmers , therefore, have been greatly using mixed cropping as an insurance against the risk of total crop failure. It is argued in a report (Haque et al . . . 1986) that farmers of Jessore region practise mixed cropping of lentil and chickpea for which returns are higher than their mono cropping. Crop yield was increased by 50 to 70 percent by utilizing natural resources such as water, soil nutrients and solar radiation more efficiently in mixed cropping (Ahmed, 1987). Similar result was reported in India (Pandey et al . . . 1981) where maize and groundnut combination gave significantly higher return than maize alone.

Practices by farmers of various intercropping need to be documented to know which practice is more profitable to them. These are required to be realized in order to make any improvement in such practices of the farmers. The monitoring was, therefore, undertaken to identify and evaluate the mixed, inter and relay cropping practices socio-agro-economically.

The main objective of the study was to identify and evaluate the agronomic and economic performance of mixed, inter and relay cropping.

This paper comprises four sections. Section II deals with the methodology of the study . Section III summarizes findings of the study. The conclusion have been presented in section IV.

II. METHODOLOGY

The monitoring was conducted at Farming Systems Research (FSR) site, Bagherpara, Jessore during Rabi 1990-91. All the existing mixed, inter and relay cropping practices were identified through meeting with the farmers of the field staff of Bangladesh Agricultural Research Institute (BARI) and Department of Agricultural Extension (DAE) and joint field visits. Six dominant crop mixes were selected for detailed monitoring. The crop mixes were lentil + mustard, chickpea+mustard, chickpea + linseed, chickpea + coriander, potato//sweetgourd and B. aman/grasspea. Here mixed, inter and relay cropping are denoted by the signs (+), (//) and (/) respectively . A total of 60 plots of 60 farmers, ten for each crop combination, were selected for the purpose. Data of all these crop combination were collected with a pre-designed schedule. The monitoring continued from October' 90 till May '91.

The data thus collected were edited, summarized and analysed to fulfil the objectives. Due to limitations in facilities and resources the analyses employed were relatively basic and relied mainly on tabular presentation using average, ratios and percentage. The land equivalent ratio (LER) and monetary advantage (MA) of the crop mixes were also calculated except those for linseed and coriander, because sole crop of these two crops were not found.

LER and MA were calculated according to Willey (1979) :

$$LER = \frac{\text{Inter crop yield of crop 'A'}}{\text{Sole crop yield of crop 'A"}} + \frac{\text{Inter crop yield of crop 'B'}}{\text{Sole crop yield of crop "B"}}$$

$$MA = \text{Value of combined intercrop yield} \times \frac{LER - 1}{LER}$$

Total variable cost (TVC) is calculated considering the costs of all the inputs that are affected by a choice (Amir and Knipscheer, 1989). In this case all kinds of inputs, human and animal labour, either home supplied or hired, were taken into account. Total cash cost (TCC) is calculated on the basis of out of pocket expenses of farmers during the period of different crop mixes cultivation. In other words, in cash cost approach unpaid family labour and other home supplied inputs were ignored from the costs items, since farmers did not pay any cash for these inputs (Hasan, 1990).

III. RESULTS AND DISCUSSION

Six dominant crop mixes were studied in details and the results are presented below :

A. Lentil + Mustard

Lentil and mustard mixed cropping is mainly practised under B. aus/jute - fallow-lentil + mustard cropping patterns in the sandy loam to loamy soils of the highlands under rainfed condition (Table 1).

Farmers prepared their lands for sowing with 3 to 7 ploughing and 3 to 10 laddering during October 20 to November 20. Only 33% of the farmers used fertilizers and the average rate was 9, 18 and 4 Kg/ha. of urea, TSP and MP respectively. They used 36 and 8 kg/ha of local seeds of lentil and mustard respectively. The average yield of lentil and mustard was 457 and 149 kg/ha

respectively where the sole crop yield of lentil and mustard was 618 and 329 kg/ha respectively indicating an LER of 1.19 (Table 2).

The gross benefit, total variable cost (TVC) and total cash cost (TTC) of this crop mix were Tk. 9170, 4693 and 1480 per hectare respectively resulting in a gross margin of Tk. 4777/ha. The ratio of gross benefit and TVC was 1.95 and the ratio of gross benefit and TCC was 6.20. The monetary advantage (MA) was Tk. 1464/ha (Table 3).

B. Chickpea + Mustard

Chickpea and mustard mixed cropping is mainly practised under B.aus/jute-fallow-chickpea + mustard cropping patterns in the sandy loam to loamy soils of the high and medium high lands under rainfed condition (Table 1).

The land was prepared for sowing with 2 to 6 ploughing and 3 to 12 laddering during October 20 to November 7. Only 14 percent of the farmers used TSP and the average rate was 7 Kg/ha. They used 46 and 7 kg/ha local seeds of chickpea and mustard respectively. The average yield of chickpea and mustard was 466 and196 kg/ha respectively where the sole crop yield of chickpea and mustard was 535 and 329 kg/ha respectively indicating an LER of 1.47 (Table 2).

The gross benefit of this crop mix was Tk 8336. TVC was Tk. 4675 and TCC was Tk 1132 per hectare resulting in a gross margin of Tk. 3661/ha. The ratio of gross benefit and TVC was 1.78 and the ratio of gross benefit and TCC was 7.36. The MA was Tk 2665 per hectare (Table 3)

C. Chickpea+Linseed

Chickpea and linseed mixed cropping is mainly practised under jute / fallow- T. aman - chickpea+linseed cropping patterns in the clay loam soils of medium high lands under rainfed condition (Table 1).

Farmers prepared their lands for sowing with 1 to 3 ploughing and 2 to 4 laddering during November 21 to December 1 and no fertilizer was used. They used 43 and 5 kg/ha local seeds of chickpea and linseed respectively. The average yield of chickpea and linseed was 430 and 90 kg/ha respectively (Table 2).

The gross benefit, TVC and TCC was Tk. 6015, 3882 and 1170 per hectare respectively resulting in a gross margin of Tk. 2133/ha. The ratio of gross benefit and TVC was 1.55 and that of gross benefit and TCC was 5.14 (Table3).

D. Chickpea + Coriander

Chickpea and Coriander mixed cropping is mainly practised under jute/fallow-T. aman- chickpea+coriander cropping patterns in the clay loam soils of medium high lands under rainfed condition (Table 1).

The land was prepared by the farmers for sowing with 1 to 4 ploughing and 2 to 4 laddering during November 22 to 27 following the harvest of transplanted aman rice and no fertilizer was used. They used 48 and 3 kg/ha local seeds of chickpea and coriander respectively. The average yield of chickpea and coriander was 460 and 44 kg/ha respectively (Table 2).

The gross benefit, TVC and TCC was Tk. 5960, 4548 and 1086 per hectare respectively resulting in a gross margin of Tk. 1412/ha. The ratio of gross benefit and TVC was 1.31 and that of gross benefit and TCC was 5.49 (Table 3).

E. Potato / Sweetgourd

Potato and sweetgourd intercropping is mainly practised under B. Aus /jute-fallow-potato/ sweetgourd cropping patterns in the sandy loam soils of high and medium high lands under irrigated condition (Table 1) .

Farmers prepared their lands for sowing with 3 to 6 ploughing and 6 to 10 laddering during November 17 to December 5. Seventy five percent of the farmers used fertilizers and the average rate was 151, 103 and 37 kg/ha of urea, TSP and MP respectively. They used 1536 kg HYV seeds of potato and 1.7 kg local seeds of sweetgourd per hectare. The average yield of potato and sweetgourd was 11. 6 and 12.1 t/ha respectively where the sole crop yield of potato and sweetgourd was 16.3 and 14.8 t/ha respectively indicating an LER of 1.53 (Table 2).

The gross benefit, TVC and TCC was 53268, 24907 and 18328 Tk./ha respectively resulting in a gross margin of Tk. 28361/ha. The ratio of the groos benefit and TVC was 2.14 and that of gross benefit and TCC was 2.91. The MA

was Tk. 18452/ha (Table 3).

Table 1. Crop Mixes and Cropping Pattern of Farming System Research Site, Bagherpara, Jessore.

Crop mixes		Cropping pattern (s)	
1. Lentil + Mustard	a)	Jute-Fallow-Lentil + Mustard	(30)
		Aus-Fallow-Lentil + Mustard	(40)
		Aroid-Fallow-Lentil + Mustard	(30)
	b)	Aus-Fallow-Lentil+ Mustard	(40)
		Aus-Fallow-Chickpea+ Mustard	(30)
		Jute-Fallow- Chickpea+Mustard	(30)
2. Chickpea + Mustard	a)	Aus-Fallow-Chickpea+Mustard	(70)
		Aroid-Fallow-Chickpea+Mustard	(10)
		Jute-T. Aman-Chickpea + Mustard	(20)
	b)	Jute-Fallow-Lentil	(10)
		Aus-Fallow-Chickpea+ Mustard	(60)
		Jute-Fallow- Chickpea+Mustard	(30)
3. Chickpea + Coriander	a)	Fallow-T. Aman-Chickpea + Coriander	(40)
		Jute-T. Aman-Chickpea+Coriander	(60)
	b)	Jute-T. Aman-Chickpea + Coriander	(70)
		Fallow -T. Aman- Chickpea+ Coriander	(30)
4. Chickpea + Linseed	a)	Jute-T. Aman -Chickpea+Linseed	(60)
		Fallow- T. Aman-Chickpea+Linseed	(40)
	b)	Fallow-T. Aman- Chickpea + Linseed	(70)
		Fallow- T. Aman- Wheat	(10)
		Aus-Fallow-Chickpea + Linseed	(20)
5. Potato// Sweetgourd	a)	Aus-Fallow-Potato//Sweetgourd	(70)
		Jute-Fallow-Potato//Sweetgourd	(30)
	b)	Jute-T. Aman- Wheat	(10)
		Jute-Fallow-Lentil + Mustard	(30)
		Aus-Fallow- Lentil + Mustard	(60)
6. B. Aman / Grasspea	a)	Fallow-B. Aman /Grasspea	(100)
	b)	Fallow-B. Aman / Grasspea	(80)
		Fallow-B. Aman - Linseed	(20)

Figures in the parentheses represent percent farmers followed the cropping patterns with crop mixes

a) Current year (1990-91). b) Previous year (1989-90)

F. B. Aman / Grasspea

Relay cropping of grasspea with B. aman is mainly practised under fallow – B. aman/grasspea cropping pattern in the heavy soils of medium low lands under rainfed condition (Table 1).

Table 2. Agronomic Performance of Mixed , Inter and Relay Cropping Practices at FSR site, Bagherpara, Jessore.

Items	Le+Mu	Ch+Mu	Ch+Li	Ch+Co	B.am /Gr	Po//Sg
Land type	High	H & MH	MH	MH	ML	H & MH
Soil texture	Sandy loam & loamy	Sandy loam & loamy	Clay loam	Clay loam	Clay loam	Sandy loam
No. of P & L	P : 3–7 L: 3–10	P:2–6 L:3–12	P:1–3 L:2–4	P:1--4 L:2–4	–	P: 3–6 L:6–10
Fertilization (Kg/ha)	U : 9 (33) T: 18 (33) M : 4 (33)	7 (14)	-	-	-	151 (75) 103 (75) 37 (75)
Period of sowing	Oct. 20 to Nov. 20	Oct. 20 to Nov. 7	Nov.21 to Dec. 1	Nov. 20 to Nov. 27	Sep. 20 to Oct 1	Nov 17 to Dec 5
Seed rate (kg/ha)	36 & 8	46 & 7	43 & 5	48 & 3	48	1536 & 1.7
Crop yield (kg/ha)	457 & 149	466 & 196	430 & 90	460 & 44	431	11632 & 12094
Sole crop yield (kg/ha)	618 & 329	535 & 329	-	-	-	16300 & 14821
LER	1.19	1.47	-	-	-	1.53

Note : Le = Lentil , Mu = Mustard, Ch = Chickpea, Li = Linseed, Co= Coriander, B. am = B. Aman, Gr = Grasspea, Po=Potato, Sg = Sweetgourd, H=Highland, MH = Medium high land, ML= Medium low land, P= Ploughing, L= Laddering , U=Urea, T= TSP and M= MP.

Grasspea was relayed with B.aman at its grain feeling stage in November and no fertilizer was used for grasspea. Farmers used 48 kg/ha local seeds of grasspea. The average yield was 431 kg/ha (Table (2).

The gross benefit, TVC and TCC was 2155, 1555 and 350 Tk. /ha respectively resulting a gross margin of Tk. 600/ha. The ratio of gross benefit and TVC was 1.39 and that of gross benefit and TCC was 6.16 (Table 3).

The crop mixes were found to be practised by the farmers after the recession of rainfall beyond September. Utilising the available soil moisture, farmers usually started to sow crop mixes in the highlands and gradually proceeded towards the lower elevation. After the harvest of aman rice the farmers were found to diversify their crops as per need. They practised the crop mixes based on the family needs, land type, soil texture, suitable crop species and on their planning geometry. They did not fertilize the crop mixes of chickpea + linseed, chickpea + coriander and broadcast aman/ grasspea. Only lower rates of chemical fertilizers were used for the lentil + mustard crop mix.

However, potato // sweetgourd crop mix received more or less balanced fertilizer.

Table 3. Economic Performance of Mixed , Inter and Relay Crops at FSR site, Bagherpara, Jessore.

Items	Le+Mu	Ch+Mu	Ch+Li	Ch+Co	B.am /Gr	Po//Sg
1. Gross Benefit (Taka/ ha)	9170	8336	6105	5960	2115	53268
2. Total variable cost (Taka/ ha)	4693	4675	3882	4548	1555	24908
3. Total cash cost (Taka/ ha)	1480	1132	1170	1086	350	18328
4. Gross margin (Taka/ ha)	4477	3661	2133	1412	600	28361
5. Gross benefit /T.V.C.	1.95	1.78	1.55	1.31	1.39	2.14
6. Gross Benefit /TCC	6.20	7.36	5.14	2.49	6.16	2.91
7. Monetary advantage (Tk/ha)	1464	2665	-	-	-	18452

Notes : (i) Le = Lentil , Mu = Mustard, Ch= Chickpea, Li = Linseed, Co= Coriander, B. am = B. Aman, Gr = Grasspea, Po=Potato, Sg = Sweetgourd,

(II) Price per Kilogram in Taka : Lentil = 15.75, Mustard = 14.00, Chickpea = 12.00,Linseed = 9.50, Coriander=10.00, Grasspea = 5.00 , Potato = 3.00, and Sweetgourd = 2.00

The farmers were found to practise the crop mixes taking into consideration of occassional rainfall during winter. The farmers reported that the heavy rainfall during the early part of winter increases the yield of mustard but lentil and chickpea were affected by ***Fusarium*** wilt and ***Sclerotium*** wilt. The yield of linseed and coriander were affected. The crop mixes were found to be some kinds of insurance against the impending the risk of occational heavy rainfall. The studied crop mixes were found to be well fitted under the existing socio-agro-ecological conditions of the farmers.

IV. CONCLUSION

Although potato and sweetgourd inter crop earned better monetary advantage but for the resources poor farmers the crop mixes of chickpea + mustard and lentil + mustard were found suitable. It was observed that local varieties were used for mixed and relay cropping. The seed rate and fertilizer dose were not balanced. Research should be done on seed rate, seeding ratio, fertilizer dose, etc., along with modern varieties for those crops in the crop mixes.

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