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Evaluation of Improved Cropping Patterns in the Medium Highland Rice Ecosystem

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Abstract: Four improved cropping patterns, BRRIdhan28-Fallow-BRRIdhan30, BRRIdhan28-Fallow-BRRIdhan31, BRRIdhan29-Fallow-BRRIdhan30 and BRRIdhan29-Fallow-BRRIdhan31 were evaluated in the farmers field along with the farmers' existing major cropping patterns BR14-Fallow-BR11 and BR14-Fallow-Pajam in six blocks under Sadar, Kapasia and Sreepur Upazilas of Gazipur district. Grain yields of all the alternative improved cropping patterns were significantly higher than the farmers' existing cropping patterns in each site. In all locations, pattern BRRIdhan29-Fallow-BRRIdhan31 gave higher grain yield and higher gross margin compared to other tested patterns.

Key words: Evaluation, cropping pattern, medium highland

INTRODUCTION

In Bangladesh, rice accounts for 95% of the food grain production. More than 90% of the people depend on rice for their daily diets. The population is increasing day by day and to feed the ever increasing population there is a need to increase the production of food. This can be done either by bringing more land under cultivation or by increasing the existing system productivity of different land types. The former one is not possible because of the limitation of land. The only option open to us is the increase of the system productivity of the prevailing lands.

The area under highland and medium highland is 9.27 m ha which is 75.24% of the evaluation of improved cropping pattern total land^[1]. The dominant cropping pattern in these land is Boro-Fallow-T. aman which is about 22% of the total land occupied by 34 major cropping patterns^[2]. The productivity of the existing cropping pattern, Boro-Fallow-T. aman is low. Vivekananda^[3] reported that the growth rate in productivity varies by zones and periods and the production of cereals depends on irrigation and the seeds of high yielding variety. In the study area, by variety, BR14-Fallow-BR11 and BR14-Fallow-Pajam are the most dominant cropping patterns for double cropped rice lands. The production of these patterns could be increased by replacing newly released rice varieties along with improved management practices. Kandalkar *et al.*^[4] also reported that the production of the cropping patterns could be increased by changing cultivars and improving cultural management practices. Practicing improved cropping patterns using latest Bangladesh Rice Research Institute released rice varieties with improved

management practices might be an option to increase the productivity of the land types. Therefore, the present study was undertaken to evaluate the alternative cropping patterns with the inclusion of newly released rice varieties both in T. aman and Boro seasons with recommended management practices for good fit into the existing cropping systems for maximizing the productivity of double rice ecosystem.

MATERIALS AND METHODS

The study was conducted in farmers' fields of three upazilas, namely, Gazipur Sadar, Kapasia and Sreepur of Gazipur district during December 2000 to November 2001. Four alternative improved cropping patterns, BRRIdhan28-Fallow-BRRIdhan30, BRRIdhan28-Fallow-BRRIdhan31, BRRIdhan29-Fallow-BRRIdhan30 and BRRIdhan29-Fallow-BRRIdhan31 were evaluated along with the farmers' existing patterns BR14-Fallow-BR11 and BR14-Fallow-Pajam. The cropping patterns were replicated three times in each site. Managemental practices followed by the farmers were monitored and recorded.

Grain and straw yields were recorded from the three samples per plot having 10 m² area per sample. The grain yield was expressed in t ha⁻¹ at 14% moisture content and then averaged. Straw yield was recorded after proper sun drying. Data were analyzed in a one-way analysis of variance with cropping patterns as factor for each site and mean comparison was done by Duncan's Multiple Range Test.

Economic analysis was done based on prevailing market price of all input and output costs.

RESULTS AND DISCUSSION

Managemental practices: During Boro season, irrespective of different test locations, seedlings of same ages were transplanted by last week of January for both improved and farmers' cropping patterns. Farmers transplanted higher number of seedlings hill⁻¹ without maintaining definite plant spacing. Farmers also used less amount of chemical fertilizers compared to improved

cropping patterns (Table 1 and 2). Weeding was done thrice in the plots of improved cropping pattern while this was twice in the check pattern. Similar trend of management variations were also found in T. aman season (Table 2).

Agronomic productivity

Grain yield: Grain yield varied significantly among the tested cropping patterns at each site (Table 3). Pattern

Table 1: Managemental practices followed in Boro season at different sites in Gazipur district

| Managemental factors | Improved management | | Management used by farmers |
|---|------------------------|---------------------|----------------------------|
| | BRRIdhan28 | BRRIdhan29 | BR14 |
| Date of sowing | Nov.30-Dec.14 | Nov.30-Dec.13 | Dec.3-8 |
| Date of transplanting | Jan.5-28 | Jan.5-30 | Jan.15-28 |
| Seedling age (days) | 32-52 | 32-50 | 42-51 |
| Seedling/hill (no.) | 2-3 | 2-3 | 3-5 |
| Spacing (cmxcm) | 20x15 | 20x15 | Uneven |
| Fertilizer rate: (N-P-K-S-Zn kg ha ⁻¹) | 100-26-50-10-4 | 120-26-50-10-4 | 75-16-21-0-0 |
| Basal: (P-K-S-Zn kg ha ⁻¹) | 26-50-10-4 | 26-50-10-4 | 16-21-0-0 |
| N top dress (DAT) | 15, 30, 50 | 15, 40, 55 | 20, 40 |
| N top dress (kg ha ⁻¹) | 34-33-33 | 40-40-40 | 37-38 |
| Weeding (no. and DAT) | 2-3 (12-15, 20-30, 40) | 2-3 (15, 26-30, 40) | 2 (20, 40) |
| Pest control | Curative | Curative | Curative |
| Irrigation | 6-10 | 6-12 | 10-12 |
| Date of maturity | April 28-May 9 | May13-23 | May 6-13 |

DAT= Days after transplanting

Table 2: Managemental practices followed during T. aman at different sites in Gazipur district

| Managemental factors | Improved management | | Management used by the farmers | |
|---|---------------------|---------------------|--------------------------------|--------------|
| | BRRIdhan30 | BRRIdhan31 | BR11 | Pajam |
| Date of sowing | June 21-July 07 | June 22-July 07 | June 26-30 | Jul.3-5 |
| Date of transplanting | Jul. 27-Aug.12 | Jul. 29-Aug. 13 | August 02-04 | Aug.13-15 |
| Seedling age (days) | 33-36 | 34-40 | 37-40 | 40 |
| Seedling/hill (no.) | 2-3 | 2-3 | 4-5 | 4-5 |
| Spacing (cmxcm) | 20x15 | 20x15 | Uneven | Uneven |
| Fertilizer rate: (N-P-K-S-Zn kg ha ⁻¹) | 80-22-33-10-4 | 80-22-33-10-4 | 67-10-12-0-0 | 69-18-15-0-0 |
| Basal: (P-K-S-Zn kg ha ⁻¹) | 22-33-10-04 | 22-33-10-04 | 10-12-0-0 | 0-18-15-0-0 |
| N top dress (DAT) | 15, 30, 50 | 15, 30, 50 | 18, 30, 45 | 18, 35, 45 |
| N top dress (kg ha ⁻¹) | 27-27-26 | 27-27-26 | 23-22-22 | 23-23-23 |
| Weeding (no. and DAT) | 2-3 (15, 26-30, 40) | 2-3 (15, 26-30, 40) | 2 (15, 30) | 2 (18, 45) |
| Pest control | Curative | Curative | Curative | Curative |
| Irrigation | Supplemental | Supplemental | Supplemental | Supplemental |
| Date of maturity | Nov. 18-23 | Nov.18-23 | Nov.19-25 | Nov. 27-29 |

DAT= Days after transplanting

Table 3: Grain yield of different cropping patterns at different sites

| Cropping patterns | Grain yield (t ha ⁻¹) | | | | | |
|------------------------------|-----------------------------------|----------|--------|----------|-------------|---------|
| | Moison | Rainanda | Toak | Porabari | Bhangnahati | Sreepur |
| Improved pattern | | | | | | |
| BRRIdhan28-Fallow-BRRIdhan30 | 11.28b | 9.93b | 9.90b | 9.87b | 11.16b | 11.77a |
| BRRIdhan29-Fallow-BRRIdhan30 | 11.90b | 10.61ab | 11.98a | 11.03a | 12.92a | 11.90a |
| BRRIdhan28-Fallow-BRRIdhan31 | 11.55b | 10.00b | 11.60a | 11.40a | 12.51a | 12.10a |
| BRRIdhan29-Fallow-BRRIdhan31 | 12.99a | 11.50a | 12.53a | 11.89a | 13.02a | 12.53a |
| Farmers' pattern | | | | | | |
| BR14-Fallow-BR11 | 9.59c | 9.73b | 9.83b | 9.63b | 10.57b | 10.10b |
| BR14-Fallow-Pajam | 8.43d | 8.53c | 8.63c | 9.30b | 8.73c | 9.10b |
| CV (%) | 4.20 | 4.70 | 5.80 | 5.10 | 4.40 | 5.30 |

In a column, means followed by a common letter are not significantly different at 5% level by DMRT

Table 4: Total straw yield of different cropping patterns at different sites

| Cropping patterns | Straw yield (t ha ⁻¹) | | | | | |
|------------------------------|-----------------------------------|----------|--------|----------|-------------|---------|
| | Moison | Rainanda | Toak | Porabari | Bhangnahati | Sreepur |
| Improved pattern | | | | | | |
| BRRIdhan28-Fallow-BRRIdhan30 | 13.34b | 11.23b | 11.26c | 12.65b | 13.59b | 13.91b |
| BRRIdhan29-Fallow-BRRIdhan30 | 13.16b | 13.14a | 14.58a | 13.83a | 15.34a | 13.26a |
| BRRIdhan28-Fallow-BRRIdhan31 | 13.20b | 11.64b | 13.87a | 12.77ab | 15.00a | 14.23a |
| BRRIdhan29-Fallow-BRRIdhan31 | 14.32a | 13.81a | 14.42a | 13.80a | 15.08a | 14.62a |
| Farmers' pattern | | | | | | |
| BR14-Fallow-BR11 | 11.12c | 11.76b | 12.66b | 11.96bc | 13.48b | 13.02b |
| BR14-Fallow-Pajam | 11.01c | 11.21b | 11.44c | 11.06c | 11.74c | 11.08c |
| CV (%) | 3.40 | 4.70 | 4.30 | 4.50 | 4.40 | 4.70 |

In a column, means followed by a common letter are not significantly different at 5% level by DMRT

Table 5: Variable costs of different cropping patterns at different sites

| Cropping patterns | Total variable costs (' 000' ha ⁻¹) | | | | | |
|------------------------------|---|----------|-------|----------|-------------|---------|
| | Moison | Rainanda | Toak | Porabari | Bhangnahati | Sreepur |
| Improved pattern | | | | | | |
| BRRIdhan28-Fallow-BRRIdhan30 | 45.05 | 36.90 | 31.15 | 36.12 | 42.50 | 41.35 |
| BRRIdhan29-Fallow-BRRIdhan30 | 45.66 | 41.46 | 32.45 | 38.47 | 43.62 | 43.82 |
| BRRIdhan28-Fallow-BRRIdhan31 | 45.69 | 38.09 | 31.50 | 37.98 | 42.79 | 42.58 |
| BRRIdhan29-Fallow-BRRIdhan31 | 46.29 | 41.46 | 35.14 | 40.34 | 43.91 | 42.59 |
| Farmers' pattern | | | | | | |
| BR14-Fallow-BR11 | 33.93 | 33.49 | 31.13 | 31.11 | 37.28 | 38.51 |
| BR14-Fallow-Pajam | 32.92 | 32.59 | 30.23 | 30.59 | 33.78 | 35.11 |

Table 6: Gross return of different cropping patterns at different sites

| Cropping patterns | Gross return (' 000' ha ⁻¹) | | | | | |
|------------------------------|---|----------|-------|----------|-------------|---------|
| | Moison | Rainanda | Toak | Porabari | Bhangnahati | Sreepur |
| Improved pattern | | | | | | |
| BRRIdhan28-Fallow-BRRIdhan30 | 84.22 | 75.64 | 72.17 | 71.87 | 80.55 | 84.53 |
| BRRIdhan29-Fallow-BRRIdhan30 | 84.56 | 80.31 | 86.46 | 79.01 | 92.86 | 85.53 |
| BRRIdhan28-Fallow-BRRIdhan31 | 82.50 | 73.95 | 83.87 | 81.17 | 90.06 | 86.83 |
| BRRIdhan29-Fallow-BRRIdhan31 | 92.26 | 83.96 | 30.37 | 85.14 | 93.20 | 89.80 |
| Farmers' pattern | | | | | | |
| BR14-Fallow-BR11 | 68.66 | 69.66 | 72.64 | 70.97 | 77.90 | 74.62 |
| BR14-Fallow-Pajam | 64.02 | 64.78 | 65.54 | 62.00 | 66.20 | 69.07 |

Table 7: Gross margin of different cropping patterns at different sites

| Cropping patterns | Gross margin (' 000' ha ⁻¹) | | | | | |
|------------------------------|---|----------|-------|----------|-------------|---------|
| | Moison | Rainanda | Toak | Porabari | Bhangnahati | Sreepur |
| Improved pattern | | | | | | |
| BRRIdhan28-Fallow-BRRIdhan30 | 39.17 | 38.74 | 41.02 | 35.75 | 38.05 | 43.18 |
| BRRIdhan29-Fallow-BRRIdhan30 | 38.90 | 38.85 | 54.01 | 40.54 | 49.24 | 41.71 |
| BRRIdhan28-Fallow-BRRIdhan31 | 36.81 | 35.86 | 52.37 | 43.19 | 47.27 | 44.25 |
| BRRIdhan29-Fallow-BRRIdhan31 | 45.97 | 42.50 | 55.23 | 44.80 | 49.29 | 47.21 |
| Farmers' pattern | | | | | | |
| BR14-Fallow-BR11 | 34.73 | 36.17 | 41.51 | 39.86 | 40.62 | 36.11 |
| BR14-Fallow-Pajam | 31.10 | 32.19 | 35.31 | 31.41 | 32.12 | 33.96 |

BRRIdhan29-Fallow-BRRIdhan31 gave the highest grain yield (12.99 t ha⁻¹) at Moison under Kapasia Upazila. The same pattern also produced the highest grain yield of 11.50 t ha⁻¹ at Rainanda followed by pattern BRRIdhan29-Fallow-BRRIdhan30 which gave an average yield of 10.61 t ha⁻¹. All the improved cropping patterns except BRRIdhan28-Fallow-BRRIdhan30 yielded higher at Porabari, Toak and Bhangnahati. On the contrary, all the improved cropping patterns performed better at Sreepur. The farmers' cropping patterns BR14-Fallow-BR11 and BR14-Fallow-Pajam yielded lower at all sites (Table 3). The

higher grain yields of improved cropping patterns might be due to higher yield potential of newly released varieties and improved cultural management practices that had bearing effect on total productivity. These results are in agreement with the results of Mandac *et al.*^[5] where they also obtained higher yield in a cropping pattern by changing cultivar, applying more fertilizer and better pest management practices.

Straw yield: The higher straw yields were found in pattern BRRIdhan29-Fallow-BRRIdhan31, BRRIdhan28-

Fallow-BRRIdhan31 and BRRIdhan29-Fallow-BRRIdhan30 at Toak, Porabari, Bhangnahati and Sreepur. Patterns BRRIdhan29-Fallow-BRRIdhan31 and BRRIdhan29-Fallow-BRRIdhan30 gave higher total straw yield at Rainanda and Moison, respectively (Table 4).

Economic productivity

Variable cost: In all sites, improved cropping patterns incurred higher total variable costs than the check patterns, BR14-Fallow-BR11 and BR14-Fallow-Pajam (Table 5). This was due to application of higher rate of chemical fertilizer and more number of weeding. Variation of variable costs among the patterns varied for harvesting and processing cost. Total variable cost of a particular pattern varied in different sites due to differences in labour wages.

Gross return: Across the sites, all the improved cropping patterns gave higher gross return than the farmers' pattern (Table 6). These were associated with higher grain yield of improved cropping patterns. In all sites, pattern BRRIdhan29-Fallow-BRRIdhan31 gave higher gross return than all other tested patterns.

Gross margin: In all sites, improved cropping patterns gave higher gross margins than the farmers' existing cropping patterns due to production of higher grain yield which resulted higher gross return. Hasbi and Hiremath^[6] also reported that the improved cropping pattern resulted higher profits than the existing pattern. Among the improved cropping patterns, BRRIdhan29-Fallow-BRRIdhan31 fetched the highest gross margin in all sites (Table 7).

From the results, it could be concluded that the replacement of BR14 in Boro season and BR11 and Pajam in T. aman season by the varieties, BRRIdhan29 and

BRRIdhan28 in Boro season and BRRIdhan31 and BRRIdhan30 in T. aman season in a Boro-Fallow-T. aman cropping pattern in the medium highland would be a better option to increase the agro-economic productivity of the existing system.

REFERENCES

1. Anonymous, 1988. Land resources appraisal of Bangladesh for agricultural development (Report 2). United Nations Development Programme, Food and Agriculture Organizations of the United Nations, pp: 63-70.
2. Elahi, N.E., A.H. Khan, M.R. Siddique, A. Saha, M. Nasim, M.U. Mollah and M. Shahidullah, 2001. Existing cropping patterns of Bangladesh, potential technologies and strategies for improving systems productivity. Proceedings of the Workshop on Modern Rice Cultivation in Bangladesh. Bangladesh Rice Res. Inst. Gazipur-1701, Bangladesh, pp: 107-170.
3. Vivekananda, M., 1999. Problems and prospects of agricultural development in Karnataka. Occasional Paper, National Bank Ag. Rural Dev. Mumbai, India, pp: 9-85.
4. Kandalkar, A.B., V.N. Autkar, D.P. Wahile and M.D. Kad, 1991. Intercropping as a factor share in agriculture in preference to risk. Economic Affairs Calcutta, 36: 233-239.
5. Mandac, A.M., R.D. Magbanua and M.P. Genesisila, 1987. Multiple cropping system in northern Mindanao, Philippines. Philippines J. Crop Sci., 12: 71-85.
6. Hasbi, D.G. and K.C. Hiremath, 1985. Economics of cropping pattern in Malaprabha command area (Karnataka State). Res. Bull., Dept. Agril. Econ., Univ. Agril. Sci., Dharwad, pp: 18-33.