Seedling Transplanting: An Alternative Approach for Maize Cultivation in *Haor* Areas of Bangladesh

KRISHI GOBESHONA FOUNDATION

A non-profit foundation for sustainable support in agricultural research and development

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M. Hazrat Ali, PhD
Program Specialist (Field Crops), KGF

M. Mohiuddin, PhD
Senior Scientific Officer
OFRD, BARI, Kishoreganj

Tapan Kumar Dey, PhD
Senior Program Specialist (Crops), KGF

Wais Kabir, PhD
Executive Director, KGF

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Introduction

In Bangladesh, *haor* is a very low-lying river basin area that generally remains under water for about six months of the year during the monsoon season in April-May to September-October (Sharma, 2010). The *haor* basin comprises about 6300 beels (water bodies) of which 3500 are permanent and 2800 are seasonal. *Haors* cover about 859,000 ha in the northeastern districts of Sunamganj, Sylhet, Habiganj, Moulvibazar, Netrakona, Kishoreganj and Brahmanbaria and are home to 20.0 million people, i.e., about 13% of the total population of Bangladesh (Fig. 1). The *haors* are generally flooded to a depth of about 5-6 m during late May to October. The *haor* people live their lives constantly facing challenges arising from unique topographic and hydrologic features of the *haor* ecosystem. Flashflood is a major disaster in the *haor* areas that gets in the way of agriculture threatening the lives and livelihoods of the inhabitants. Besides, siltation and sedimentation of major rivers, river bank erosion, impeded navigability, lack of proper sanitation, scarcity of drinking water, fragile and inadequate road network, degradation of ecosystem, indiscriminate harvest of natural resources, over exploitation of fisheries resources and swamp forests, weakness in the leasing system for fisheries, illiteracy, poverty, inadequate health facilities and inadequate operation and maintenance of existing infrastructure are critical issues in *haor* areas (CEGIS, 2012).

Among the many areas important for sustainable development in *haor* areas, the crops, fisheries and livestock sub-sectors of agriculture deserve special attention in terms of achieving and sustaining food security, promoting economic development and poverty reduction in the region. Almost 90% of the arable land in *haor* areas is cropped to Boro rice and 10% to T. Aman rice and a few other crops. Boro-fallow-fallow, wheat-fallow-fallow and ground nut-fallow-fallow are the three dominant cropping patterns covering about 82, 3 and 2% of cropped land, respectively in *haor* areas of Kishoreganj (Alam et al., 2011; Huda, 2004).

About 39.2% of the *haor* farmers practice a crop-livestock-fish farming system. The differences in the productivity of crop farming and poultry rearing between *haor* areas and other areas in favorable ecology were found to be statistically significant. Remarkable differences between *haor* areas and the main land in terms of quantities and prices of inputs and outputs are noticed. A favorable farming environment and proper utilization of agricultural resources are the major strengths, but a weak marketing system and lack of access to agricultural credit are the major bottlenecks for agricultural development in the *haor* areas of Bangladesh (Uddin et al., 2019).

As climate change (CC) impacts become increasingly tangible there is a need to look for alternative crops and cropping patterns to cope with the emerging challenges. Boro rice is the main crop in the *haor* areas and is harvested in late April to mid-May. However, more often than not, Boro rice is damaged by flashfloods resulting in huge food shortages and economic losses. The fateful late March flashfloods in 2017 causing widespread damage to Boro rice in the *haor* areas may be cited as an example. Moreover, Boro rice has a degree of vulnerability to rising ambient temperatures during anthesis and grain filling. In comparison, maize is relatively tolerant of heat stress. Besides, maize is a versatile crop which can be used as feed, food and industrial raw material. In this backdrop, maize can be considered as an alternative Rabi crop and can be introduced in the *haor* areas for improving farm productivity. This study was undertaken in the *haor* areas of the Kishoreganj district during 2018-19 to explore the possibilities of shortening the field duration of maize by using an appropriate crop establishment method(s) to escape damage from early flash floods.

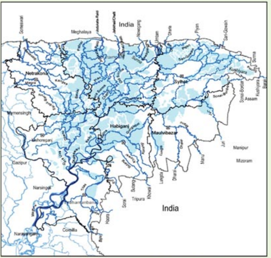

Fig. 1. *Haor* in north-east region of Bangladesh (CEGIS, 2012)

Materials and Methods

The experiment was conducted in farmers' fields in the Nunir Haor area of Kishoreganj during the Rabi season of 2018-2019 to compare transplanting and direct seeding as methods of establishing and growing maize. The treatments were: 10-day-old seedlings raised in polythene bag (poly-bag) (T1), 20-day-old seedlings raised in poly-bag (T2), 10-day-old seedlings raised in seedbed (T3), 20-day-old seedlings raised in seedbed (T4) compared with the farmers' practice (FP) of direct seeding (T5). The treatments were assigned in a randomized complete design with three dispersed replications. The unit plot size was 10m x 8m. The experimental plots were treated with chemical fertilizers with or without cow dung (CD) as shown in Table 1.

Table 1: Fertilizer/cow dung used for growing maize in Kishoreganj, 2018-19

Treatment	Fertilizer/cow dung used (kg/ha)						
	Urea	TSP	MoP	Gypsum	Zinc sulfate	Borax	Cow dung
10-day-old seedling raised in poly-bag (T1)	543	257	198	207	12	8	1235
20-day-old seedling raised in poly-bag (T2)	543	257	198	207	12	8	1235
10-day-old seedling raised in seedbed (T3)	543	257	198	207	12	8	1235
20-day-old seedling raised in seedbed (T4)	543	257	198	207	12	8	1235
Direct seedbed (T5)-FP	543	257	198	207	12	8	-

BARI Hybrid Maize-9 was used as the test variety. Seed rates of 25 and 28 kg/ha were used in FP and T1-T4 plots, respectively. Seeds were sown in seedbed on 16 October (T2 and T4) and in poly-bag on 26 October (T2 and T3), 2018. Direct sowing or transplanting in the plots for all the treatments was done on 5 November, 2018. Seedling mortality was recorded and re-transplanting was done as and when required. One-third of the required urea and the full doses of all other fertilizers were basally applied at final land preparation and the remaining urea was topdressed in two equal splits, 35 and 60 days after sowing/transplanting. Intercultural operations, such as, one time weeding, two times irrigation and earth raising were done and the insecticide Karate was sprayed once to control insects. The crop was harvested on different days based on physical maturity.

Results and Discussion

Transplanting method affected seedling survival as indicated by the significant differences in seedling mortality which varied from 5 to 30% (Fig. 2). The highest mortality (30%) occurred when seedlings were raised in seedbed and 20-day old seedlings were transplanted. The lowest seedling mortality was observed for T3 (raising seedlings in poly-bags and transplanting10-day old seedlings). No seedling mortality was observed in direct seeded plots (FP). However, the major issues under observation in this experiment were field duration and yield of maize.

Field duration of maize differed markedly between the transplanting and direct seeding methods of maize establishment, the former bringing about maturity almost 2 weeks earlier than the latter (Table 2). Field duration of transplanted maize varied between 129 and 136 days differing marginally between the seedling raising method (raised in poly-bag and seedbed) or the age of seedling (10-day-old or 20-day-old) while maize had a field duration of 143 days when direct seeded (T5). Thus, the longest (143 days) field duration was observed for the direct seeding treatment (FP) and the shortest field duration (129 days) was found for T2, i.e., for transplanting 20-day-old seedlings raised in poly-bag.

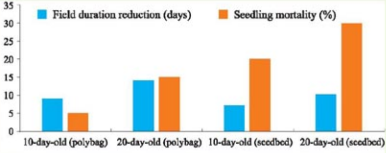

Fig. 2. Effect of seedling raising method on seedling mortality and field duration of maize, Kishoreganj, 2018-19

Table 2: Field duration and yield of maize in *haor* area, Kishoreganj, 2018-19

Treat	D/S[1]	D/P or D/S[2]	D/H	FD (days)	FD diff. with FP (days)	Seedling mortality (%)	Yield (t/ha)
T1	26 Oct	5 Nov	19 Mar	134	-9	5	10.87 ab
T2	16 Oct	5 Nov	14 Mar	129	-14	15	10.73 b
T3	26 Oct	5 Nov	21 Mar	136	-7	20	9.93 c
T4	16 Oct	5 Nov	18 Mar	133	-10	30	10.50 bc
T5	-	5 Nov	28 Mar	143	-	-	11.47 a

D/S[1]= Date of sowing for seedling raising in 2018; D/P= Date of transplanting in 2018; D/S[2]= Date of seeding for T5 in 2018; D/H=Date of harvest in 2019; FD= Field duration; FP= Farmers' practices (T5)

In terms of maize grain yield, the farmers' direct seeding method gave the best results (Table 2) yielding 11.47 t/ha while the lowest yielder (9.93 t/ha) was the 10-day-old seedling transplantation method (T3). Although the results from the transplanting treatments except T3 with (10-day-old seedlings raised in seedbed) were statistically similar in terms of yield, yet seedling mortality and field duration differed significantly among them (Fig. 2 and Table 2). Overall, the results of this experiment suggested that transplanting of seedlings raised either in poly-bags or in seedbeds can be an agronomically suitable method of establishing and growing maize in *haor* areas. This can shorten the field duration by at least 10-14 days to avert damage by flashfloods with a small and acceptable grain yield penalty of about 0.6-0.9 t/ha compared with the farmers' practice of direct seeding.

An economic analysis of the results revealed that the highest total production cost of Tk 97,989/- was incurred for transplanting with poly-bag raised seedlings and the lowest, Tk 72,795/-, for the direct seeding method (Table 3). On the other hand, the highest gross return of Tk 1,66,170/- was obtained from the direct seeding method (Fig. 3). Considering economic performance, direct seeding method was more profitable than the seedling transplanting methods but the prospective avoidance of flashflood damage due to shortening of the field duration by 10-14 days facilitated by transplanting appeared to be an advantage over direct seeding for maize cultivation in *haor* areas.

Table 3. Production cost and gross margin as influenced by maize establishment technique

Treatment	Total production cost (Tk/ha)	Gross margin (Tk/ha)
10-day-old seedling raised in poly-bag	97,989/-	1,57,615
20-day-old seedling raised in poly-bag	97,989/-	1,55,585
10-day-old seedling raised in seedbed	85,639/-	1,43,985
20-day-old seedling raised in seedbed	85,639/-	1,52,250
Direct seeding (FP)	72,795/-	1,66,170

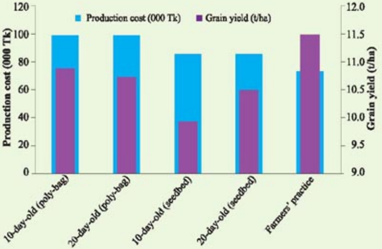

Fig. 3. Production cost and grain yield of maize as influenced by planting method, Kishoreganj, 2018-19

Farmers' opinion

Transplanting with poly-bag raised seedlings is time consuming, laborious and expensive but crop performance is satisfactory.

Conclusion

Transplanting of maize seedlings is found to be expensive due to associated labor costs but the crop can be harvested about 10-14 days earlier than that with the direct seeding method. Consequently, transplanting of maize seedlings may create an opportunity to harvest maize by 15 March with a reasonable yield averting probable damage by flash floods.

Growth of maize under different planting method, Kishoreganj, 2018-19

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