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Study of Economic Feasibility of Agricultural Subsurface Drainage in Saline Soil of Bangladesh

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A field experiment was conducted with rice on saline soil of Satkhira using bamboo as tile laid at a depth of 0.75 m with 10 m spacing. Benefit/cost ratio suggests that use of bamboo was economic as low cost agricultural subsurface drainage material.

Soluble salts and water can only move when the water table is low. So, the depth of water table should be kept such that roots are beyond the zone of capillary action (Michael, 1986) and could be effectively maintained by proper drainage. Kovda *et al.* (1973) and Rao (1984) stated that drainage has been found to be a pre-requisite in overcoming and reclaiming saline and waterlogged areas. The common materials used for a tile drainage are cement concrete, asbestoes, plastic etc. (Gupta and Gupta, 1987). The authors further reported that optimum depths to water table for rice and wheat are 0.3 and 0.6m, respectively. However, the critical depth to water table was reported to be between 0.57 and 1.07m (Sen and Bandyopadhyay, 1979) and 0.7m (Tanton *et al.*, 1990).

Cost of subsurface drainage varies from place to place due to variation in cost of materials, labour and spacing. Higher the spacing, the lesser will be cost/ha (Joshi *et al.*, 1987). For successful cultivation, benefit/cost ratio should be taken into consideration. However, no such work has been reported in Bangladesh for the reclamation of saline soils under subsurface drainage condition. Thus, an attempt has been taken to assess the economic feasibility of introducing low cost agricultural subsurface drainage in saline soil for production of rice.

MATERIALS AND METHODS

A field experiment was conducted in saline soil with sweet and brackish water irrigations under subsurface drainage and non-drainage condition with a semi-salt tolerant variety of rice (CV. Purbachi) at Satkhira. The salinity (ECe) of soil was 11.4 dSm^{-1} and clayey in nature having pH 8.3. The experimental plot was divided into three blocks. Each bloak

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was further divided into four subplots (50 m^2) surrounded by a buffer zone of 2m wide and 25 cm high. The treatments applied were as follows, viz. (i) Non-drainage+sweet water irrigation (ECiw 0.7 dSm^{-1}), (ii) Subsurface drainage+sweet water irrigation (ECiw 0.7 dSm^{-1}, (iii) Non-drainage + +brackish water irrigation (ECiw 5.0 dSm^{-1}), (iv) Subsurface drainage+ brackish water irrigation (ECiw 5.0 dSm^{-1}).

In subsurface drainage system, trenches were made manually at a depth of 0.75m having a spacing of 10m. Uniform bamboos were selected as tiles. The average internal diameter of tile was 65 mm. The bamboos were divided into two equal parts longitudinally from the base to the apex. The internal nodes were cleaned and made hollow. Holes (0.5mm diameter) were made in one part of the bamboo in a single line at an interval of 15 cm. Then two parts of each bamboo were tied together resembling a PVC pipe. A nylon net was used to cover the bamboo for filtration. Rice straw was applied surrrounding the tiles before refilling with soil to enhance hydraulic conductivity of the soil. The hole side of the bamboo faced to the downward direction. The top soils were placed in the surface whereas subsoil was used to refil the trenches around the tile lines. The sloping of the bamboo tile was 0.1 percent. To consolidate the filled soils, surface irrigation was given with water (EC of 1.2 dSm^{-1}). The experiment was arranged following completely randomised block design with three replications. PK (80:60 kg/ha) and one-third of N (90 kg/ha) was applied as basal and rest of the N was applied in two equal splits during tillering and just before panicle initiation stages of growth. Thirty-five day old seedlings of uniform size were transplanted on the 15th February during 1991 and 1992. Irrigation was provided as per treatment after ten days of transplantation whenever required. The cost of installations of subsurface drainage was estimated as per work schedule rate of Water Development Board, and cost of cultivation was calculated on the basis of actual requirement. Total cost of cultivation and grain yield was recorded. The income was estimated by selling grain of rice as per the government purchasing rate. Benefit-cost ratio was evaluated.

RESULTS AND DISCUSSION

Total cost of suhsurface drainage system with bamboo tiles was Tk. 12588/- approximately per ha (1991 price level) (Table 1). The life of subsurface drainage was considered to be about 5 years. Therefore, average cost would be Tk. 2518/- yearly. The maintenance cost of the drain was considered to be about 10% annually. Cost of subsurface drainage system varies due to the variation of materials, labour cost of locality, spacing and depth.

Lovas (1972) reported that the cost of drainage with asbestos pipes as tile material was worked out to be Tk. 3000/ha at depth and spacing of 1 and 10m, respectively. Gupta and Gupta (1987) stated the cost of tile drains with cover collector as Tk. 12.600/- and 6,600/- at 20 m and 50 m, respectively. Use of bamboo tiles and nylon as the envelope reduced the cost considerably.

Table 1. *Detailed cost of installation of sub surface drainage (Tk./ha)*

Sl. No.	Description	Qty (Tk.)	Rate (Tk.)	Amount (Tk.)
1.	Bamboo	1000 m	7/- m	7,000/-
2.	Trenches cost of earthen work (as per schedule rate of BWDB) 1000 m × 0.75 m × 0.25m	187.5 cum	1532/- per 100 cum	2872/-
3.	Labour cost of preparation of bamboo tile by cutting, cleaning binding etc. (BWDB'S schedule rate)	10 labour	50/- /day	500/-
4.	Labour cost for installation of tiles (as required)	5 labour	50/- /day	250/-
5.	Digging of collector drains (100 m × 1m × 0.5 m)	50 cum	1532/- per 100 cum	766/-
6.	Nylon net for envelope (As per market price)	100 m	12/- /m	1200/-

Total cost Tk. 12,588/-

Average yield of grain recorded was 2.87 and 1.23 t/ha due to sweet and brackish water irrigation, respectively under non-drainage condition, whereas 4,39 and 2.82 t/ha were recorded due to the same irrigation under sub surface drainage condition. Average of two years cost of production/ha under non-drainage and subsurface drainage was Tk. 13074/-. Averages of two years net income were Tk. 6,921/-, 14,880/-, -4,525/-, and 3,892/-, and those of benefit-cost ratios were 1.52, 1.94, 0.65 and 1.25 for non-drainage + sweet water irrigation, subsurface drainage + sweet water irrigation, non-drainage

Table 2. *Effect of sweet and brackish water application on the grain yield of rice and benefit-cost ratio under non-drainage and sub surface drainage conditions*

Treatments	Grain yield (t/ha)		Total income (Tk./ha)		Cost of cultivations (Tk./ha)		Cost of sub-surface drainage (Tk./ha)		Total production cost (Tk./ha)		Net income (Tk./ha)		Benefit/cost Ratio	
	'91	'92	'91	'92	'91	'92	'91	'92	'91	'92	'91	'92	'91	'92
1. Non-drainage + Sweet water irrigation	2.75	2 98	18040/-	21958/-	12338/-	13818/-	—	—	12388/-	13818/-	5702/-	8140/-	1.46	1.58
2. Sub surface drainage + sweet water irrigation	4.32	4.46	28339/-	32864/-	12338/-	13818/-	2518/-	2769/-	14856/-	16587/-	13483/-	16277/-	1.90	1.98
3. Non-drainage + brackish water irrigation	1.26	1.28	8265/-	8842/-	12338/-	13818/-	—	—	12338/-	13818/-	4073/-	4976/-	0.66	0.63
4. Sub surface drainage + brackish water irrigation	2.88	2.76	18892/-	20335/-	12338/-	13818/-	2518/-	2769/-	14856/-	16587/-	4036/-	3748/-	1.27	1.23

+brackish water irrigation and subsurface drainage + brackish water irrigation treatment, respectively (Table 2). High cost of drainage appeared to be one of the major constraints in the adoption by the farmers. From the results, it is assumed that the mechanism and the use of bamboo might make it possible to reduce the cost of the sub surface drainage in salt affected areas of Bangladesh.

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