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WATER, ENVIRONMENT AND MANAGEMENT

Economics of buried pipe systems

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ABSTRACT

Analysis of buried pipe (BP) systems usually consider their effect on the gross margins of irrigators, overlooking the financial implications for the intermediary organisation supplying the water - the KSS or farmers' cooperative, in the case of the Deep Tubewell II Project.

Where the KSS is a genuine co-operative and the land in the incremental command area belongs to its members, gross margin analysis may capture the key variables in the decision to invest in a buried pipe system. Where narrower factional interests dominate, the financial effects on operating costs and the income from water charges are a better guide to the balance of incentive.

A model of the financial effects of BP schemes on KSS finances has been developed, using typical operating costs and water charges and conveyance efficiencies. (The capital cost of the well is treated as a sunk cost and does not enter the calculations). Improvements in irrigation efficiency on the existing command area (CA) save pumping costs, but cannot alone justify a BP investment. The critical variables were the capital cost (chiefly determined by the length of buried pipe) and the incremental command area. Examples of this analysis will be given for a range of BP schemes, as will graphs of the relationship between incremental CA, rates of water charge and the financial viability of the scheme. Financial viability is defined here as the ability to meet full loan repayments in the first year. (This is rather a restrictive assumption due to the "front-loading" of instalments).

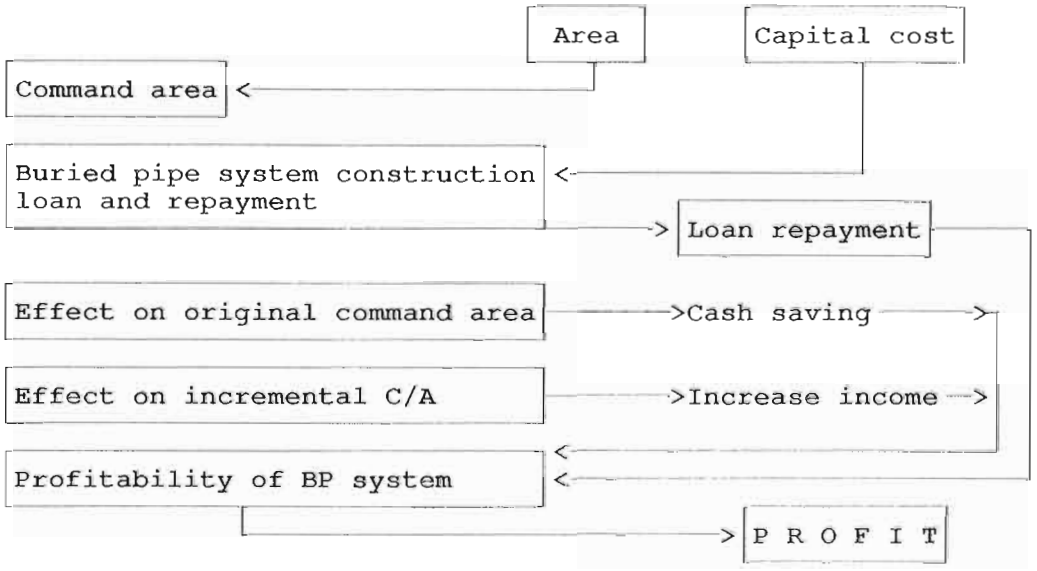
Where the length of pipe is short relative to potential incremental CA, the returns from irrigation would be more than adequate to meet repayments if the full potential CA is irrigated. Experience suggests that this potential is not always attained; more investigation is required to find out why this is.

INTRODUCTION

Although buried pipe systems (BPSs) offer many operational advantages over open channels (OCs), their high capital cost limits the circumstances in which they are economically viable. Improvements in irrigation efficiency for an existing command area (CA) save pumping costs, but can not alone justify an investment in a BPS because of the relatively low marginal costs of groundwater extraction. Critical variables are the cost and the incremental CA resulting from the BPS. Where the length of the pipe is short relative to the potential incremental CA, the returns will exceed capital repayments. The overall costs of construction from DTW II demonstration schemes plotted against length of pipeline given in Figure 1, show a reasonable linear relationship.Before embarking on the construction of a buried pipe distribution system, an financial analysis is needed to test its viability; otherwise the investment may be unsuccessful.

MODEL

A simple computer model has been developed to analyse the financial benefits of a buried pipe system based on data collected from DTWII demonstration schemes. It calculates the pumping cost required to irrigate the incremental command area and the savings in pumping costs land already irrigated, and then compares this with the additional water charges collected; the difference between the two amounts less the loan repayment is the net gain accruing to the farmer group or KSS. This value must be positive for the scheme to be financially viable.



The input required is:

- Initial command area
- Total potential command area
- Buried pipe potential area
- Open channel potential command area (which acts as a check to ensure that the system will not exceed pumping constraints)
- Original command area now covered by buried pipe (i.e. that land under the command of the buried pipe which used to be irrigated from the open channel)
- The capital cost (obtained from the cost estimate)
- Down payment to bank or other source of funding
- Interest rate and loan recovery period
- Hours pumped per acre under open channel system
- An estimate of open channel conveyance losses, generally in the range 20-30%
- An estimate of the buried pipe conveyance losses generally in the range 3-8 l/s 1000m
- Cost of pumping per hour 35-40 Tk/hr for diesel pumps or 20-25 Tk/hr for electric pumps
- An estimate of the water charge/acre for the incremental command area.

ANALYSIS

An example of the financial analysis for a buried pipe scheme shown in Figure 2, based on input data shown in Table 1.

Figure 2 illustrates the point graphically for the case of Jallabad. The intercept on the Y axis is a function of the loan repayment required less the value of cost savings on the area covered by the BPS that was originally irrigated from open channels. The figure indicates that, with a water charge of Tk2,000, an incremental CA of at least 37 acres is needed to allow the farmer group to meet the first loan repayment of Tk.43,459. A lower incremental CA would be necessary if water charges were above Tk.2,000, as shown by the intercept of the radial lines and the X axis. The position of the radial line representing a water charge of Tk.1,500 indicates that the profit would be insufficient to cover the loan repayment.

It must be noted that many of the demonstration BP schemes - like those operating open channel systems - have failed to achieve their potential CA. The reasons for this are poorly understood. A number of hypotheses have been put forward:

i) Farmer groups are poorly organised and motivated.

ii) As the schemes have been largely subsidised, the incentives to fully exploit the investment are reduced.

iii) Farmers are reluctant to change their cropping patterns or cultural practices quickly; so some years are needed to achieve the potential CA.

Figure 1: Cost/pipe length relationship

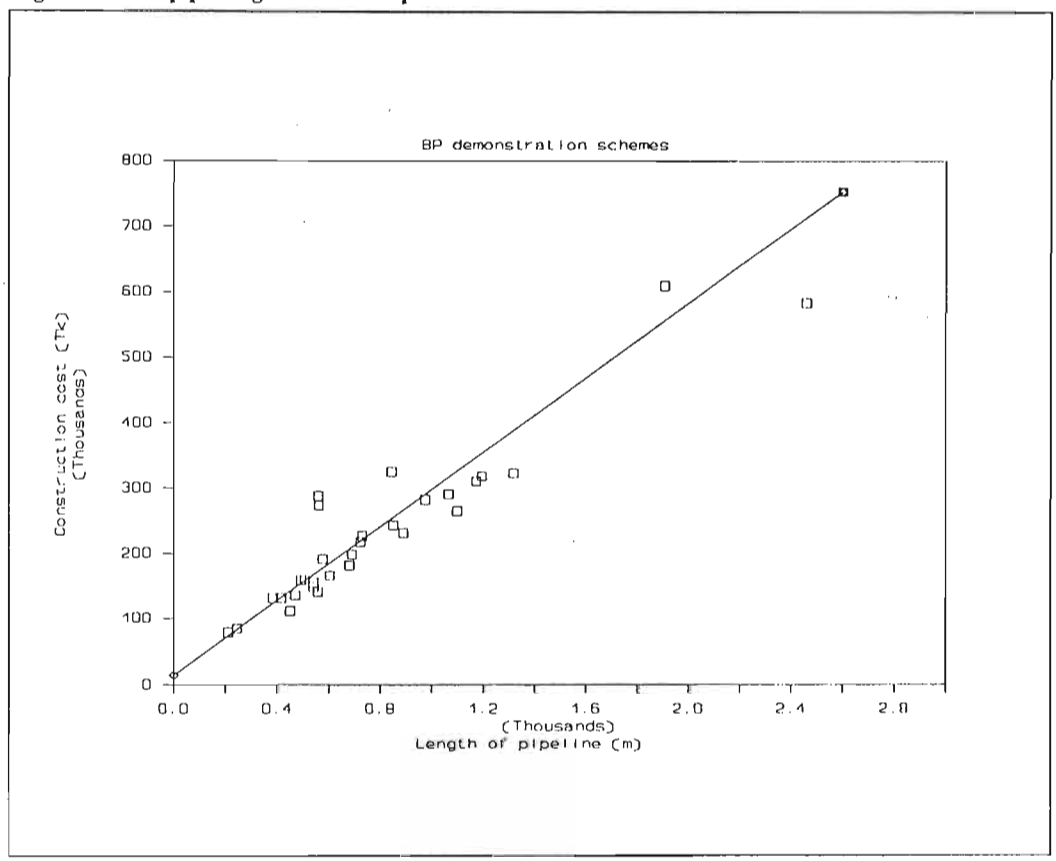


Figure 2: Jallabad BP Scheme: Incremental CA required with different water charges.

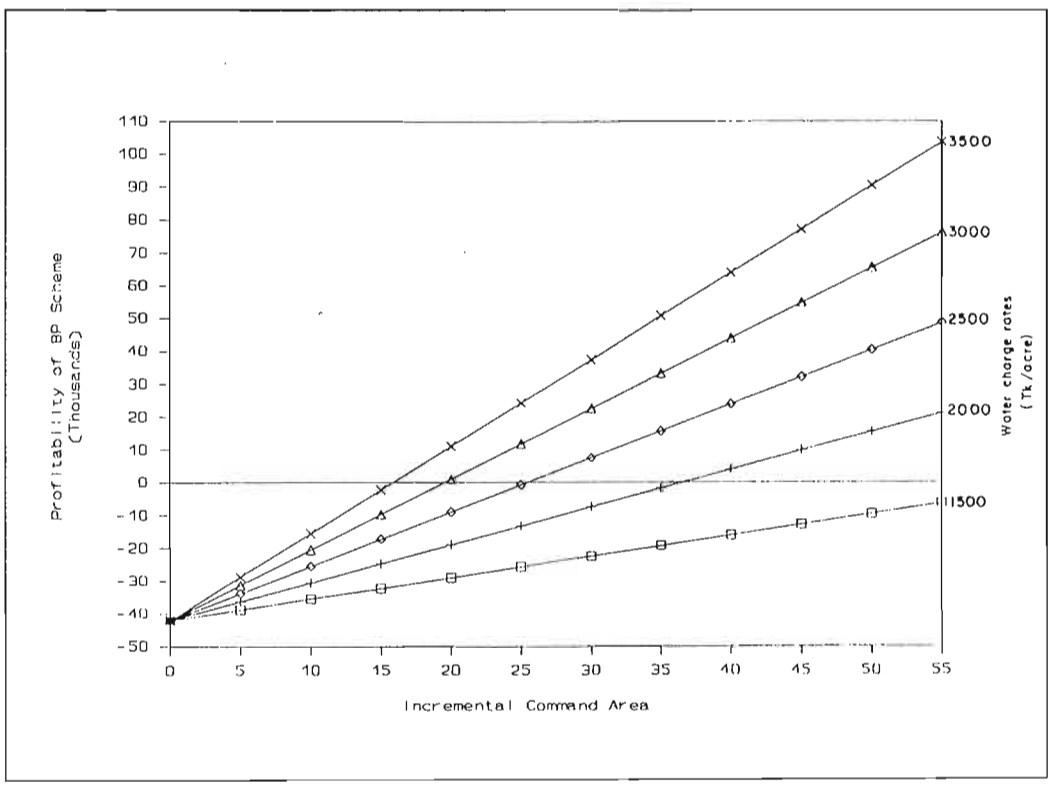


TABLE 1
Financial analysis of a buried pipe scheme

Jallabad	**IDCODE: 2/04/166/00229**	
Command Area (CA)		
Original CA before improvement	Acres	34
Potential CA	Acres	107
- BP potential CA	Acres	70
- OC potential CA	Acres	37
Original CA covered by BP	Acres	10
Incremental CA	Acres	60
Buried Pipe System - Capital Cost & Loan Repayment		
Total Capital Cost	Taka	198,444
Downpayment	%	10%
Loan value	Taka	178,600
Interest rate	%	16%
Period	Years	12
Equal instalment - annual payment	Taka	34,365
Front loaded - Year 1	Taka	43,459
Effects on Original CA		
Hours pumped/acre	Hours	25.0
Conveyance losses - open channel	%	20%
Conveyance losses - BP	%	6%
Hours pumping saved/acre	Hours	3.7
Total hours saved	Hours	37
Cost of pumping/hour	Taka	40
Total cost saving	Taka	1,489
Effects from Incremental CA		
Water charge/acre	Taka	2,000
Total water charge	Taka	120,000
Hours pumped/acre	Hours	21.3
Total hours for incremental CA	Hours	1,277
Total cost of pumping	Taka	51,064
Net increase in revenue	Taka	68,936
Profitability of BP System to KSS		
Financial gain to farmer group	Taka	70,426
Less: first instalment of loan	Taka	43,459
Net Gain to farmer group	Taka	26,967
	US $ = Tk. 38.87	