Economic Analysis of Canal Lining

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Abstract

Canals are the major conveyance system of any irrigation project, which delivers the irrigation water to fields. Most of these canals are earthen so considerable water losses take place due to seepage. These losses can be overcome by lining the bed and sides of the canal cross-section with an impervious material. Lining of canal reduce the operation and maintenance cost, erosion and also improves the flow velocity. Different materials are available for lining the canal like concrete lining, mineral lining, brick lining, asphaltic lining, and geo membranes lining. However, in our country as per environmental condition mostly tile and cement concrete lining is popular. These type of lining have long life or effective in price and most satisfactory for all kind of locations. The main objective is to find out the most economical method of canal lining based on the cost criteria in relation to the wastages etc.

Keyword- Canal, Cost, Irrigation, Lining

I. INTRODUCTION

As time goes, water becomes difficult to acquire and the need of secure water is contaminated. This problem is more increased due to urban water demands and increased agriculture production in remote areas around the world. To overcome this problems canals have been constructed to transport the water from its source to where it is needed.

A system of irrigation canals which is also known as canal network transports water from its source to fields. The canal network comprising of main canal, branch canal, major & minor distributaries, field channels & water courses. In canals mainly two kind of losses are taken place, one is evaporation loss and another is seepage loss. As the canal water is exposed to atmosphere, evaporation losses are taken place. It may range from 0.25% to 1% of canal discharge. In most of cases evaporation losses are not significant. The rate of loss of water mainly depends upon the temperature of a region, prevailing wind velocity of the region, humidity and area exposed to the atmosphere. Seepage loss is the most significant irrigation water loss from a canal. In canals 50% or more amount of water is lost due to seepage. Seepage loss mainly depends upon ground water conditions, porosity of soil, and physical properties of canal water.

Many of these canals are earthen canal which is inexpensive to construct but loses 50 percent or more water due to seepage. They are more liable to get eroded, weed growth and other problems that gently reduces its effectiveness over the time Old earthen irrigation channels in permeable soil, considerable water loss takes place due to seepage from its sides & bed. This loss leads to low conveyance efficiency. Also, earthen canals get clogged due to weed growth which reduces its water carrying capacity. This loss overcomes by providing lining to earthen canals which a resistant layer is made of concrete. Lining of irrigation canals gives the best opportunities to extend limited water supplies. It is not only reducing the seepage but also gives a measure against breaks & reducing maintenance cost.

Lining of irrigation canals is a very important part of any irrigation project. As it improves the flow characteristics, reducing seepage rates, weed growth much water is saved which can be utilized for the extension & improvement of irrigation. In lined canals high velocities are achieved which leads to saving in cross-sectional area of canal & land width required, with corresponding saving in the excavation cost & masonry work. Many materials have been used for canal lining such as earth, concrete, asphalt are most commonly used. Many new materials have been investigated now a day like butyl rubber, plastic film, soil stabilizers. The choice of lining material will be depending on available site conditions, availability of materials, materials and equipment, cost structure and labour.

Canal liners are one of the new and cost effective way to line canals compared to the traditional concrete. In traditional concrete lining cost as much as 30 times or more compared to the cost of liners.

The impact of project on economic welfare in terms of associated benefits and costs. If benefits are more than the costs, it indicates that nation would be beneficial by adopting the project. On the other hand, an excess of costs over benefits implies that there is a wastage of money. So, in general project should be only taken up if benefits exceed costs.

A. Objectives

The main objective is to find out the most economical method of canal lining based on the cost criteria in relation to the wastages etc.

B. Need of Study

1) Lining to whole canal section of Hajira branch canal, which would carry enhanced discharge. This would not need any additional land acquisition.
2) To increase additional irrigable area by saving of water from seepage through provision of lining.
3) Economic analysis of study work by the study of Benefit derived and Cost incurred in the project. Thus benefit-cost ratio is to be studied in addition to technical feasibility and economic viability.

II. STUDY AREA

Hajira Branch Canal was constructed as unlined canals in 1954 and 1975 respectively. Hazira branch canal is taking off from kakarapar right bank main canal having total discharge of 1207 cusecs and having total length of 34 km.

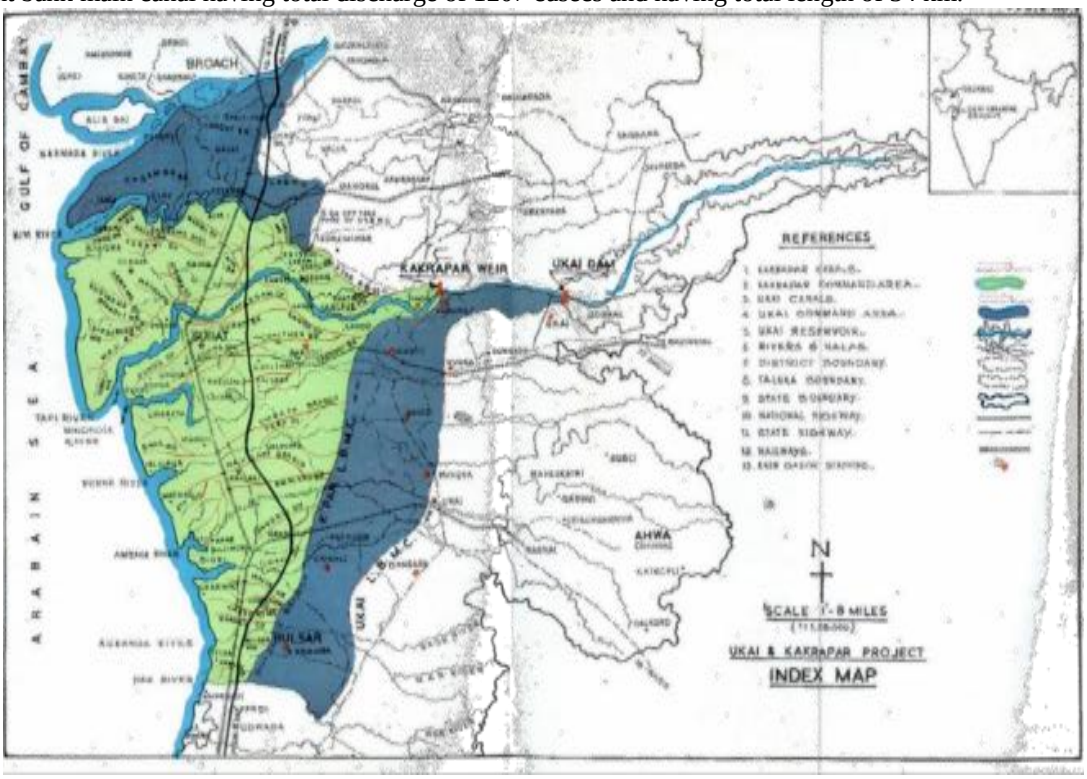

Fig. 1: Index map (Source: From irrigation department)

Chainage								
CH- From		*To*		*Length m*	*BW m*	*FSD m*	*FB*	*SS*
0	*0*	*15.6*	*4755*	*4755*	*12.80*	*2.10*	*0.90*	*5.41*
15.6	*4755*	*21.43*	*6530*	*1775*	*12.50*	*2.05*	*0.90*	*5.32*
21.43	*6530*	*34.47*	*10506*	*3976*	*12.30*	*1.85*	*0.90*	*4.96*
34.47	*10506*	*37.46*	*11418*	*911*	*12.30*	*1.80*	*0.90*	*4.87*
37.46	*11418*	*41.84*	*12753*	*1335*	*12.30*	*1.80*	*0.60*	*4.33*
41.84	*12753*	*46.5*	*14173*	*1420*	*9.75*	*1.80*	*0.60*	*4.33*
46.5	*14173*	*57.375*	*17488*	*3315*	*9.4*	*1.8*	*0.6*	*4.33*
57.375	*17488*	*71.825*	*21892*	*4404*	*8.6*	*1.8*	*0.6*	*4.33*
71.825	*21892*	*80.86*	*24646*	*2754*	*6.3*	*1.62*	*0.6*	*4.00*
80.86	*24646.13*	*82.2*	*25055*	*408*	*6.3*	*1.3*	*0.6*	*3.43*
82.2	*25054.56*	*90.04*	*27444*	*2390*	*6*	*1.25*	*0.6*	*3.34*
90.04	*27444.19*	*91*	*27737*	*293*	*6*	*1.25*	*0.6*	*3.34*
91	*27736.8*	*96.236*	*29333*	*1596*	*4.88*	*1.16*	*0.6*	*3.17*
96.236	*29332.73*	*100.47*	*30623*	*1291*	*6.9*	*2.05*	*0.6*	*4.78*
100.47	*30623.26*	*104.75*	*31928*	*1305*	*7.6*	*1.35*	*0.6*	*3.52*
104.75	*31927.8*	*111*	*33833*	*1905*	*7.6*	*1.2*	*0.6*	*3.25*
111	*33832.8*	*113.034*	*34453*	*620*	*7.2*	*1.2*	*0.6*	*3.25*

Table 1: General details (the dimensions and characteristics of different sections)

III. METHODOLOGY

A. Steps To Find Out The Discharge Of Canal

For rounded bottom corner trapezoidal section steps are given below to find out the discharge after modified the section of Hajira branch canal.

1) Step 1: Find out the area of canal cross-section
   Area A = Bd+d2(θ+cotθ) in m2
2) Step 2: Find out wetted perimeter of section
   Perimeter P = B+2d(θ+cotθ) in m
3) Step 3: Find out hydraulic mean depth
   Hydraulic mean depth R = A/P
4) Step 4: Find out the limiting velocity of flow
   Velocity V = 1/N XR 2/3xS1/2 in m/sec
5) Step 5: Calculate the discharge
   Discharge Q = A*V in m3/sec

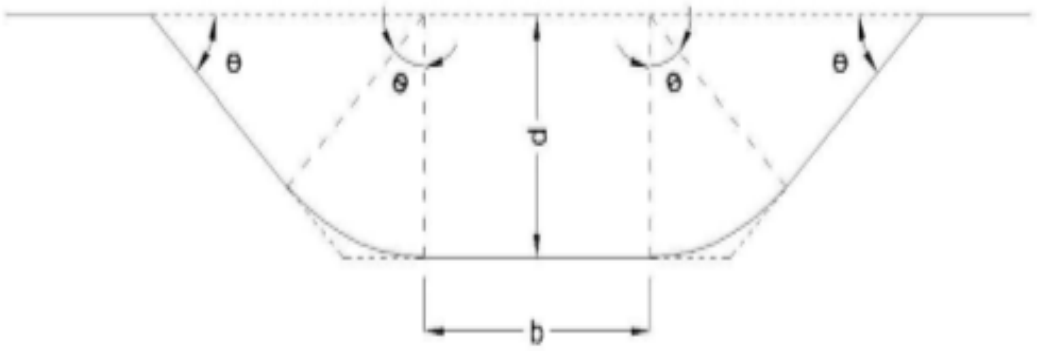

Fig. 2: Trapezoidal Canal With Rounded Bottom Corner Section

Chainage	*Length*	*Area*	*Perimeter*	*Discharge*	*Area of lining*
0 to 4754.88	*4754.88*	*36.09*	*21.57*	*35.90*	*10256.28*
4754.88 to 6530.34	*1775.46*	*34.40*	*21.06*	*33.712*	*3739.12*
6530.34 to 10506.46	*3976.12*	*29.90*	*20.03*	*27.51*	*7964.17*
10506.46 to 11417.81	*911.35*	*28.90*	*19.82*	*30.634*	*1806.29*
11417.81 to 12752.83	*1335.02*	*28.90*	*19.82*	*28.322*	*2646.00*
12752.83 to 14173.20	*1420.37*	*24.32*	*17.27*	*23.35*	*2452.98*
14173.20 to 17487.90	*3314.70*	*23.69*	*16.92*	*22.74*	*5608.47*
17487.90 to 21892.26	*4404.36*	*22.25*	*16.12*	*21.14*	*7099.82*
21892.96 to24646.13	*2753.87*	*16.08*	*13.19*	*17.21*	*3636.35*
24646.13 to 25054.56	*408.44*	*11.72*	*11.73*	*12.96*	*479.10*
25054.56 to 27444.19	*2389.63*	*10.76*	*11.22*	*11.62*	*2681.16*
27444.19 to 27736.8	*292.61*	*10.76*	*11.22*	*12.27*	*328.34*
27736.8 to29332.73	*1595.93*	*8.47*	*9.73*	*7.25*	*1552.84*
29332.73 to 30623.26	*1290.53*	*12.5*	*12.33*	*10.375*	*1591.22*
30623.26 to 31927.8	*1304.54*	*14.07*	*13.24*	*12.04*	*1727.21*
31927.8 to 33832.8	*1905*	*12.13*	*12.61*	*9.69*	*2402.20*
33832.8 to 34452.76	*619.96*	*11.65*	*12.21*	*7.96*	*756.97*
					56728.52

Table 2: Details of Calculation Showing the Total Area of Lining

B. Benefit cost Ratio of PCC Lining

- Preliminary survey and investigation of canals has been carried out. It is proposed to line the Branch canals with concrete lining in M: 15 grade between Ch 0 to 24650 M on Hajira Branch Canal.
- As per the calculation, for PCC the possible Cost is Rs. 8134.452 Lac for the project.
- As per the calculation, for PCC the possible benefit is Rs. 2296.50 Lacs for the project.
- Thus Benefit cost ratio carried out 2.82

IV. CONCLUSION

- Seepage losses are very high in earthen canal so by providing lining of the whole section of Hajira branch canal Seepage losses are decreased so considerable amount of water is saved, so more area can be irrigated.
- By providing lining, not only seepage can be reduced, but it will also minimize the problem of water logging. Whatever quantity of water saved can be used for improvement of crop pattern.
- Due to this lining works economic status of the tribal, non-tribal farmers improves. Further this canal will provide support of assured water supply for irrigation to tail end command area near Arabian Sea.

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