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Cost Analysis of Closed Conduit Pipeline Irrigation over Open Branch Canal Irrigation

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Abstract —*The present paper is based on the case study of Nilwande Left Bank Kopergaon Branch Canal (NLBKBC) of Ahmednagar District, Maharashtra. The reach of this canal is 14 km which is running open to atmosphere. The main objective of this paper is to use the closed circular conduits for entire 14 km reach of canal in place of traditional open canal irrigation network to minimize conveyance and evaporation. Overall cost analysis shows greater saving of water, modern distribution system and initial high investment can be overcome within few years therefore closed conduit irrigation system can be thought for the implementation for optimally utilization of irrigation water.*

Keywords- *Nilwande Left Bank Kopergaon Branch Canal (NLBKBC), Closed conduit irrigation (CCI).*

I. INTRODUCTION

Water is a precious commodity. However its value is appreciated only in times of scarcity and non-availability. Open canal system conveys water from dam to the agriculture land for irrigation. The actual utilization of the available potential is less than 50%, leaving a huge gap between creation and utilization of the irrigation potential. The main cause under utilization of irrigation potential include incomplete land development works, non- maintenance of distribution system, heavy transit, seepage losses and theft losses, land acquisition cost . The main objective of this paper is to convert existing open canal system of NLBKBC into Closed Conduit pipeline Irrigation (CCI) network to minimize the conveyances losses which are 50% for open canal network.

II. OBJECTIVES

1. To study land acquisition cost analysis.
2. To study cropping pattern and crop revenue system.
3. To compare between open canal irrigation with closed conduit irrigation.
4. To prepare detail estimate for close circular pipeline.

III. CASE STUDY

Ahmednagar district is geographically largest district in Maharashtra state with moderate rainfall. Udarva Pravara Project (Nilwande) dam is masonary and concrete structured constructed across river Pravara, a right tributary of Godavari river near village Nilwande. Project gross storage capacity is 9.16 TMC with live storage 8.80 and dead capacity of 0.28 TMC.Two unlined canals namely NRBC (Nilwande Right Bank Canal) having length 97 km and NLBC (Nilwande Left Bank Canal) having length 85 km. This present paper is based on case study of Kopergaon Branch Canal running 14km in length benefiting17 villages. The designed discharge of NKBC is 2.7048 cumec up to 3 km, 1. 886 cumec from 3 km to 9.3 km, 1.2011 from 9.3 km to 11.70 km and 0.958 cumec from 11.70km to 14 km which proposed irrigates 5666 Ha of land in Rabi and Kharif weather seasons.

Figure 1: Under construction of NLBKBC

1) Fund and completion status of project:

- Date of commencement –Dec 2018 (for Dam)expected
- Fund required for dam construction – Rs 2. 40cr
- RBC completion –11%
- LBC completion –23%
- Proposed fund required for RBC, LBC& Distribution – Rs 1471. 37 cr
- KBC completed upto 2 km - Rs 1. 07 Cr
- Proposed fund required for remaining KBC - Rs 26 cr

Table 1: Kopergaon Branch Canal (KBC) details

Sr no	Description	Data
1	Canal Bed Level (CBL)	559. 71M
2	Bottom width (BW)	3. 90M
3	Slope	1:2500
4	Length	14 km
5	Full supply depth (FSD)	1. 20M
6	Freeborad	0. 60m
7	Type	Unlined

Source- Annual Water Accounts of Major and Medium projects AID

IV. ON FIELD OBSERVATION

On field location was shoot with high quality Arial drone. This arial view footage gave real images of under construction canal which helped to study land acquisition nature, ground profile, permanent & temporary structures & other project related information. This help for real & honest on site survey which will suspend any misleading information.

Figure 2: Arial view of NLBKBC

1) Diameter Calculations:

The conduit diameter is evaluated from the relation of actual discharge with area and velocity. Chezy's equation is used for the velocity of flow with value of C taken as 120 for Mild Steel. The diameter of equivalent conduit section required to be provided to the KBC as below,

Table No. 2 Design Diameter & Velocity

Sr No	Length (Km)	Diameter (M)	Velocity (M/S)
1	00 TO03	2. 00	0. 852
2	03 TO 9. 3	1. 73	0. 798
3	9. 3 TO 11. 70	1. 312	1. 166
4	11. 70 TO 14	1. 19	1. 12

Hence, Mild Steel (MS) pipe is suggested for this case study.

2) Characteristics of Mild Steel (MI)

- Type: Medium and flexible

- Strength : High strength and high impact resistance
- Laying, joints and installation: Long laying, rigid welded joints fast installation.
- Durability : more than 75yrs under proper anticorrosive treatment
- Roughness coefficient: 0. 011 with CML
- C value : 120
- Deflection :Nil
- Handling : easy to handle with equipment
- Surge pressure : Medium hydraulic surge
- Available sizes :300-2500
- Standards: IS-3589
- Operation & Maintenance : Medium

3) Economy of MS pipeline over open canal

The capital cost that will be required for MI closed conduit irrigation of KBC has been found out by an approximate estimate Capital required for MILD steel pipeline = Rs. 32 crores.

4) Cost recovery analysis of MS pipeline over Open Canal Irrigation

- Every year proposed KBC requires proposed maintenance of about10, 00, 000. 00.
- The MI pipeline minimizes the conveyance loss of 40 % which can used to irrigate extra irrigable land which comes under command area. Extra revenue per year = Extra revenues /year of Rabi + Extra revenues /year ofhot weather = Rs. 6, 00, 000. 00.
- Profit in 1 year by adopting MI pipeline for KBC=Maintenance amount of Open canal irrigation of KBC+ extra revenue generated per year= 16, 00, 000. 00.
- The working life of Mild steel pipe is 70 years .
- The number of years required for accumulation of the capital cost for MS pipe is 28 years and 4months.
- An amount of benefit generated in 41 yrs and 6 months =Rs. 5, 82, 40, 000. 00.
- Benefit cost ratio of MS is greater than 1.

5) Advantages of Mild Steel pipeline over OCI MS pipeline

- Mild Steel pipeline will be laid on existing canal alignment which will directly reduce land acquisition cost, which is very sensitive issue in India, as per capital land holding is very less.
- KBC need maintenance cost nearly to Rs 10 lacks yearly wherein complete MS pipeline needs negligible maintenance cost.
- Conveyance losses have resulted into decreased efficiency of canal ranging from 40%to 50%in Rabi and Hot season weather, hence MS pipeline will save conveyance losses which will directly increase surplus revenue with increase in catchment area
- Part of un-command area under open canal irrigation can be brought under irrigation.
- MS pipeline is suitable in all types of soil strata.
- Water logging and growth of weeds can be minimized.
- 'Equitable water supply' and 'from tail to end head', irrigation principle can be achieved.
- Accurate volumetric supply of water can be ensured.
- As calculated in cost recovery analysis of close conduit irrigation over MS pipeline, the cost benefit ratio is greater than 1 .
- Therefore, this system can be brought under implementation.

6) Limitations of Close conduit Irrigation

- High care in technical design and construction of Close conduit
- MS pipeline requires provision for silt extraction is necessary to avoid silt its entry into the system.
- Close conduit irrigation is advanced irrigation system ,its smooth functioning is matter of high concern.

V. CONCLUSION

Considering uneven rainfall, increase in drought prone regions, scarcity of water and high water demand for domestic, agriculture and industrial use, it is recommended that irrigation in command shall be popularized through pipeline distribution network system. The planning for deriving maximum benefits from pipeline distribution system can be effectively implemented. Pipeline distribution system can be preferred where land cost is comparatively high and farmers are lucent for sparing the valuable land. Technical, financial and overall analysis indicates pipeline distribution system is need of future irrigation and feasible. hence, it is recommended to use pipeline distribution system to save precious water.

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