# Enclosed Pipeline Alternative to Canal System: A Review

**Prof Assit. Prof. Pranav Lende[1], Mr.Kartik Rathod[2]**
[1]Associate Professor
[1, 2] G. H. Raisoni University Amravati

***Abstract-*** *Water is the prime need of every living organism on the earth's surface. Food is the second most important need of each animal, including humans. Without water, it is impossible to produce the food. Recently the government of India passed the food security bill, but due to climatic changes, the rear huge variations in rainfall, runoff, ground water storage and surface water storage. Many predictions are pointing towards water as the reason for the third world war. So it is necessary to find out the way of optimum water use. The development factor of any country is now directly related to several natural or artificial water bodies in that country. There are ecological, financial, social, political, and religious ties to current fresh water; the Canal system is currently the main source of water distribution method in India. India has many dams, ponds, and rivers from which ample area is irrigated, but rainwater is the main source of all these water bodies. Since the last couple of decades, environmental issues have impacted the frequency and quality of rainwater, leading to problems in litigation.*

*The Canal Distribution Networkis one of the prime structures supplying water to agricultural land. It has many advantages lie all the work is done under gravity force, and the water supplied is greater than the needed. Canals are also the means of transportation and navigation in some countries. However, it has serious disadvantages like loss due to leakage, evaporation losses and excess water use. The ill effects of the efficiency of the canal distribution network decrease sufficient level.*

***Keywords***- Enclosed Pipeline Solution, Subterranean Pipeline Alternative, Closed Conduit System, Underground Pipeline Alternative,

## I. INTRODUCTION

### 1.1 GENERAL

Therefore, there is a need to save and reserve water for all these purposes. Maharashtra is India's one of the most developed states, and a large part of the population suffers from severe water scarcity. In nearly 70% of the village (around 27,600 villages), water is neither available within 500m nor 15m below the ground. This causes less crop production, reducing the country's GDP. To serve this purpose,irrigation is used.Watering is required for Indian agriculture due to the country's diverse climate and weather circumstances. In addition, the unpredictability of the monsoon season in both locations and times, the erratic pattern of rainfall throughout the year, excessive precipitation that causes flooding, the yearly occurrence of drought in some regions, and the need for additional moisture in some soils all contribute to this issue.

Drainage is "the intentional transfer of water to land or dirt in a sufficient quantity for optimal plant growth and optimum crop yields." It is employed to help in crop growth, landscaping upkeep, and reforestation of disturbed soils in arid regions. During insufficient precipitation, the water cycle is carried out by manufactured or artificial pathways, called channels, "Irrigation by Canals". Canal irrigation is observed in Uttar Pradesh, Punjab, Haryana, Maharashtra and the coastal plains of Kerala. There are some functions and necessities of irrigation in our country.The structure is broken down into two primary components: traditional canal irrigation and pipe water supply, referred to as (CCDN) close conduit distribution network.

### 1.2 Need to study

Many losses are observed in the canal system, which does not provide the required water quantities to the irrigation field. This leads to the preservation and conservation of water resources. As the population is ever-increasing, it has led to the exploration of resources. With diminishing water supplies, India is being promoted to investigate alternative water resources, of which water supply through the pipeline has great potential to fulfil the ever-increasing demand. The water for Irrigation through CCDN will increase water use efficiency.It will ensure that nearly all dam-released water is accessible to end users. It will also increase the amount of land irrigated with accessible water storage, particularly during recurrent water shortages.

### 1.3 Scope of Project

The two primary limitations for the replacement of canals with pipelines are:

1. Cost
2. Capacity

In the future, there will be a great need to replacethe existing canal system with pipelines for water conservation. The cost ofthe pipe depends on the pipe diameter and the distance between the installation site and the factory. The cost per acre can be estimated by dividing the estimated quantity of water in cumec by the cost per acre of the system. Considering all these factors for the installation of pipelines over the canal, the entire work is divided into tiny stages,making the work much easierand faster and output for understanding.

**1.4 Objectives**

- The objective of Irrigation by Closed Conduit Distribution Network (CCDN) is as follows:
- To provide more water available for agriculturists with an adequate amount of water for their cultivation purpose and other domestic basic needs on a sustainable basis.
- For better demand management and distribution performance.
- To increase the efficiency of water distribution for better yields.
- To reduce the various types of losses such as percolation loss, evaporation loss, seepage loss, etc.
- For transferring water quickly and effectively.
- To reduce erosion and protect the water quality.
- Irrigation by this system ensures the saving of land, i.e. the main obstacle to land acquisition problems created by farmers.
- Although the initial cost is more, this system is cost-effective due to the increased efficiency and water productivity impact.

## II. LITERATURE REVIEW

**1.Skogerboe V. Gaylord, WalkerR. Wynn, Austin H. Lloyd (1969)** "Analysis of Small Water Management Structures in Irrigation Distribution System" This paper describes how to handle controls and measures for water structures that have degraded over time due to stress and strain. In addition, it describes the factors that influence the water-holding structures. The measures are highly effective at preventing deterioration. Limiting wear and strain. This article examined the management and oversight methods for wastewater buildings.

***2.*Swamee Prabhata K., Mishra Govinda C., Chahar Bhagu R. 2003**"Design of Minimum Water-loss Canal Sections."The study depicts canal water losses as seepage and evaporative expenses, which are largely influenced by the channel shape and concave surface area—the shape and size of the canal aid in creating canal sections with minimal water loss. Water loss accounts for a significant portion of usable water. In addition, it provides methods for avoiding losses from occurring within a period, which is the primary cause of the failure. The paper provides a concise explanation of the canal system's effects. We investigated the impact and the method used to quantify irrigation canal costs.

**3.Choo Sivapan and Kaseamsawat Srisuwan(2007)**" Factors Influencing Water Quality of Kwae-om Canal, Samut Songkram Province."It investigated the variables that affect the water condition in the Kwae-om Canal in Samut Songkhram. It emphasizes the purity of water released into the environment and the pollutants that influence it. This investigation examined the variables and procedures that regulate water quality.

**4. Gupta Gangopadhyay Sumita and Gupta Janmejoy (2008)**" Restoring the Kestopur Canal System in the Greater Kolkata Area "This paper gives a broad idea about the plan to meet the water supply requirement for the upcoming new town at Rajarhat located in Eastern fringes of Kolkata on which the transfer of water in the right quantity and quality from the river Hooghly to the new town through existing Kestopur can al has been preferred to transfer through pipelines. In this research, we studied the supplying required water demands for the new towns of Kolkata by properly conserving water.

**5. Rogers David J.(2010)**" Innovative Solution for Water Warsin Israel, Jordan and Palestinian." The case study gives an innovative solution for the water war in Israel, Jordan and Palestinian, which has exploited limited water resources using pipelines and canals. These solutions increase efficiency, reduce disputes, and create peaceful conditions. In this study, we studied that Israel's multi-faceted approach to water resource development through pipelines is seen as significant.

**6. Fort Denise and Nelson Barry (2011)**"Pipe Dreams: Water Supply Pipeline Projects in the West."The research paper provides an overview of current pipe proposals in the western region of Mexico. In addition, it offers a synopsis of issues frequently disregarded in planned pipeline initiatives, as well as suggestions addressing a wide range of problems such as "New Drinking Water Tasks, Federal Funds, A Beneficiary-Pays Strategy to Funding Water Programs."This article examined the smallest details regarding current and new pipe developments.

**7.Zaccaria S.A. Daniele (2011)**"A Methodology to Conduct Diagnostic Performance Assessment and Simulation of

Deliveries in Large–Scale Pressurized Irrigation Systems "The computerized study enables the watered region of Southern Italy to assess its irrigate system of delivery and its impacts on agricultural management through irrigation and aquifer salinization increase. The other delivery scenario for diagnostic accuracy in the pressurized irrigation distribution system. In this study, we determined that the article provides novel solutions for pressurized water distribution systems to maximize the yield of crops.

**8. Aldakheel Yousef and Zeineldin Faisal.(2013)** "Improving Conveyance andDistribution Efficiency" By Converting an Open Channel Lateral Canal to a Low-Pressure Pipe for the Al – Hassa Irrigation Project in Saudi Arabia. The research paper details a field case study involving a semi-buried PVC conduit system in Al – Hassas Oasis, Saudi Arabia, and how it contributes to water saving. Transport and delivery rates grew by 25.3% and 25%, accordingly, due to the setting up of pipelines and the decrease of unlawful water consumption by additional siphons by 29.2%. In this study, we studied the conservation of water in the desert areas of Saudi Arabia by increasing efficiency.

**9. Kolhe P. S, Shinde J. K. and Thorat V. B.(2015)**"Closed Conduit Irrigation Water Distribution System for Improving in 2050, water usage efficiency will mitigate the global water depletion problem."This work includes the sustainable development and efficient management of water using a closed conduit distribution network to fulfil the population's needs and water demand by increasing the efficiency by 70% - 80% of the available water capacity. Also, it emphasizes the water crisis in India, and to meet this problem Case Study of CCDN is done in this paper. In this research, we studied how to increase the efficiency of the pipeline canal and how it can be obtained.

**10. Kulkarni Maya S. and Patil K. A.(2015)** "Optimisation of Pipe Distribution Network for Irrigation by Genetic Algorithm." This paper works on the cost Optimization of Investment in Irrigation in water scarce region of Aurangabad District. Also, cost optimization is carried out by computer-aided programs like Genetic Algorithm and Spread Sheet, which satisfies the discharge requirement by the set of diameters of pipes for the network. In this paper, we studied that cost minimization is done by computer-aided software.

## III. MATERIALS AND METHODOLOGY

### 3.1 Irrigation by Canal Method

If it rains according to the requirement of the agricultural crop throughout its growth period, it is not at all necessary to store water and then apply it artificially to the agricultural crop. However, due to diversified climatic and topographic conditions, the Indian monsoon is erratic and not evenly distributed. The growth of the crop depends upon the soil fertility, sunshine and the assured water supply (Bara, J.P.1969). In a tropical country like India, whose more than 70% of the population depends on agriculture, there is plenty of fertile soil and sufficient sunshine for the growth of crops; however, the rainfall is uncertain, untimely and unevenly distributed, resulting in the necessity of artificial application of water by the efficient irrigation system crop needs a specific quantity of fluids at various times during its development phase. Suppose it rains as and when required by the crop. It is not necessary to supply water to it artificially. However, in our country, it may not rain when required by the crops, and sometimes it may rain more than its requirements, thus damaging the crops. Thus instead of depending entirely on the mercy of nature, man thoughtof storing the water during excessive rainfall and utilizing it during the scanty or less rainfall period. Thus, irrigation may be defined as 'the artificial scientific application of water to the agricultural land to supply necessary moisture to the crop as and when required for its healthy growth. Now a day's, water is one of the most valuable things in the world, so efficient use of water has becomean important parameter. As we have seen in the canal irrigation system, more water is used than required to overcome this research work. A large amount of water is wasted by providing water through the canals because of many losses.

The water flowing through the irrigation canals may be applied to the crops by 'surface irrigation or 'sub-surface irrigation'. The surface irrigation method may further be classified as 'gravity flow irrigation' depending on whether the available water is higher or lower than the agricultural land to be irrigated. In the former case, it must be lifted from the source by mechanical means such as pumps etc., before applying it to the agricultural crop. The latter method is found to be expensive compared to the former. The Pictorial view of the Gangapur Canal is shown in Fig. 3.1

**Fig.3.1 Pictorial view of Gangapur Canal**

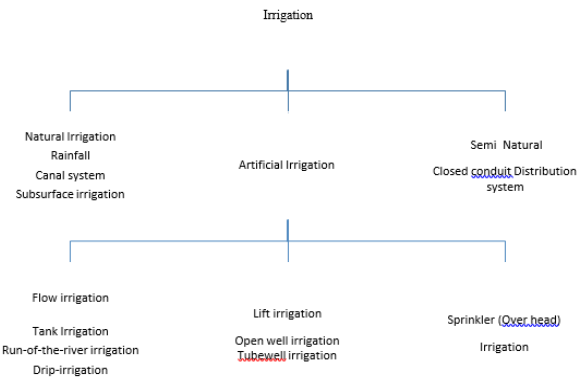


**Fig. No. 3.2 Types of Irrigation System**

The schematic diagram gives us a brief knowledge ofthe different types of irrigation used in India. Irrigation is broadly classified into three types, viz. Natural Irrigation (like rainfall, canal system, and subsurface irrigation), Artificial Irrigation (like flow irrigation, lift irrigation and sprinkler irrigation) and Semi-natural irrigation (like closed conduit distribution system). These different types of irrigation can be understood from the above schematic diagram. (Fig. No. 3.2).

### 3.2 Components of Irrigation by Canals Method

In this method, the main components are:

- Reservoir: In this process, first, the water is discharged from the main reservoir, then the water passes through the pipeline as the main reservoir is the water source. It may be a Dam, Pond, river etc. For this, the reservoir contains automatically operated gates that control water discharge.
- Main Canal: The primary canal is separated into two sections.
- The canal end operations are located in a river flowing through the valley, and the canal should traverse the top of the ridge in the shortest distance feasible. Therefore, the canal must be aligned and dug in deep excavations beneath NSL (Natural Surface Level).
- The canals in question are aligned along the ridge and are central to the command area.
- Branch canal: These diverge from the primary canal on both sides to transport water for irrigation to the entire irrigable track.
- Distributaries: Small channels originating from branch canals disperse their water through outlets to minors or waterways. These are arranged as either reach or contour canals.
- Minor: While the gap between the distributary's outflow and the farmer's field is great (greater than 3 kilometres), a minor channel is diverted from the branches to furnish water for the farmers at a point closer to their field.
- Watercourses: These are not governmental waterways and belong to the cultivators; they are excavated and kept running by the farmers at their expense to draw water from governmental-owned outlets offered through distributary or secondary waterways. Demonstrates an animated illustration of the whole thing and its parts Fig. 3.3

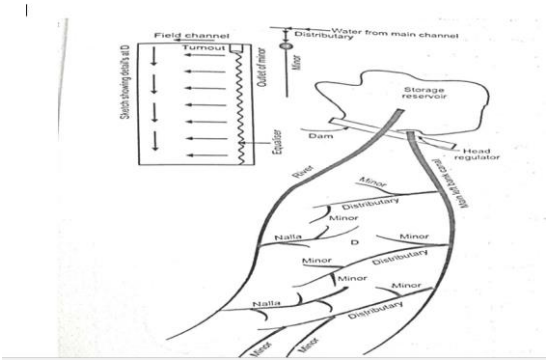


**Fig.3.3 Parts of the Surface flow irrigation system for mastorage reservoir in irrigation by canals**.

### 3.2.1 Basic Functions of Irrigation System

When agriculture makes water available, the crop yield increases considerably. The functions of water are as follows:

- The crop can't extract the nutrients present in the soil directly. The water acts as a solvent for the nutrients which the roots of the plants of crops can readily absorb.
- Water controls the temperature of the soil in which plants are grown
- The application of irrigation water helps maintains optimum moisture in the root zones of the soil.

### 3.2.2 Working of Irrigation by Canals Method

Water in our country is public property owned by the respective State Governments. It is the responsibility of the State Government to harness the water resources for the benefit of the society.In Maharashtra, before1976, three different Irrigation Acts were followed three different regions, i.e., old Bombay State, Vidarbha and Marathwada. To bring uniformity in the Acts, the Maharashtra Irrigation Act, 1976, has been enforced from Jan 1, 1977.

According to the above act 1976, all works about irrigation systems such as channels, canals, reservoirs, and dams are constructed, maintained, and entirely controlled by the state Government. All field channels are to be constructed

and maintained by the cultivator at their cost per the instruction of the Government canal officer. The watercourse, i.e., the length of the channel between the outlet of minor and field channels, shall be constructed by the state government and maintained by its users. After careful estimation, water is supplied to the area, considering the available storage and losses.

In Maharashtra, the crop season is divided into the following categories:

- Rabbi crops
- Kharif crops
- Hot weather
- Perennial crops

### 3.2.3 Advantages of Irrigation by Canals Method

- Increased food production: As there is an assured water supply to the agricultural crop, there is bound to be an increase in food production. This is the most important benefit for our country because of the tremendous growth in population and sizeable quantities of food grains that are to be imported every year.
- Plantation and Navigation: The plantation of trees along the canal banks leads to the increase in the timber wealth of the country and also prevents erosion. The large irrigation canals may serve as the cheapest means of transport and thus serve a useful purpose.
- Overall development of Irrigable area: Due to the availability of irrigation facilities, there will be overall development and prosperity, and the general standard of living in the areas will increase.
- Increase in groundwater table: Irrigation facilities in an area increase the groundwater table level by seepage of water through the reservoir and thus the cost of lifting water through the reservoir and canal.
- Other: The cost of the project is very less. The obvious reason is that cost no expensive regulatory and distributary works are constructed. Silt and fine sand particles have free entry into the canal system. As a result, the canal water possesses good material properties. In turn, crop growth improved.

### 3.2.4 Disadvantages of Irrigation by Canals Method

- Water Logging: Due to over-irrigation and seepage from canals, the groundwater table rises and,without proper soil drainage, leads to water logging. Water logging renders the soil infertile and useless for cultivation.
- Bad climate: Due to intense irrigation of an area, the climate becomes cold and damp, resulting in an unhealthy climate, causing an outbreak of malaria. Excess and intense irrigation may result in increasing the humidity of the area.
- Evaporation losses: 'Evaporation' that forms a part of the hydrologiccurve is the process by which In, along with the loss of evaporation to bodies of water, rainwater falling on the planet's surface returns to the environment as vapour. It is one of the most important parameters in the losses of this system. The Gangapur dam's evaporation losses are considered 15% of the total losses. The evaporation losses are shown in Fig. 4.

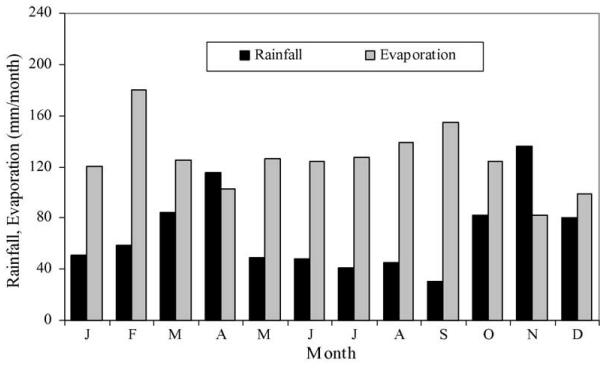


**Fig.4 Observed long-term mean monthly rainfall an devaporation of the Gangapurcanal.**

### 3.2.5Other disadvantages:

- It provides more amount of water than required.
- The water of a reservoir has a specific area for irrigation, and if you want to provide the water to an area far from a reservoir, it is very compliable.
- The people place their homes on the banks of canals and make slums
- The cross-section, when it remains empty, it produces pollution
- In the period between two rotations' the canal becomes polluted, as shown in Fig. 5

**Fig.5Disadvantage ofCanal**

## IV. METHODOLOGY

### General

- Introduce the topic of using confined pipelines as a substitute for conventional canal networks for various reasons.
- Emphasize the importance and usefulness of this other method.
- Identify the objectives of the review paper.

### Literature Search Strategy

- Explain the methodology employed to identify relevant literature.
- Specify the databases, search terms, and inclusion/exclusion criteria used.
- Outline any limitations or biases associated with the literature search.

### Selection of Research Articles

- Describe the process of screening and selecting relevant research articles.
- Specify the criteria used to determine the inclusion of articles in the review.
- Provide a flowchart or table to illustrate the article selection process.

### Data Extraction

- Explain the data extraction process from the selected articles.
- Outline the key information extracted, including study design, methodology, findings, and conclusions.
- Discuss any challenges encountered during the data extraction phase.

### Data Synthesis and Analysis

- Describe the approach used to synthesize and analyze the extracted data.
- Identify common themes, trends, or patterns that emerged from the analysis.
- Present any statistical methods or qualitative techniques employed, if applicable.

## V. CONCLUSION

From the project's findings, it can be inferred that underground irrigation proves more helpful than canal watering. Observations indicate that losses such as evaporated water, transportation, and loss are greater in the canal system, whereas they can be eliminated in a closed tube distribution network. Evaporation losses account for 1.5% of total losses. Seepage losses account for 39% of total losses, while transport losses account for 12%.

Enclosed Conduit Distributing The network has a benefits-to-cost ratio of 1.48, while the canal system has a ratio of 0.953. The produced area's efficacy is enhanced in the Closed Tube Distribution Network.

Using the same volume of water, the enclosed Conduit theNetwork Distribution system waters 45% more agricultural land than the network of canals.

## REFERENCES

[1] Akbar S, Abbas A, Hanjra M A, Khan S. (2003) "Structured analysis of seepage losses in irrigation supply channels for the cost-effective working of canals" Volume 1: Water supply and distribution system concepts. Page no 47

[2] Alam M. M., Bhutta M N (2004) "Comparative evaluation of canal seepage investigation techniques Agricultural Water Management" vol. (66:65–76. 2004)

[3] Bahramloo Abbasi N. (2008) "Strategic planning for optimization of irrigation and drainage"direct science journals, page no. 27-35

[4] Bahramloo, R. (2004) "Evaluation of different canal linings in Hamadan network" Iranian Agricultural engineering vol -3

[5] Bara J.P. (1969) "Controlling the expansion of desiccated clays during construction' Irrigation and Drainage" ICID, Vol. construction, report No.39 Drainage, Report No.16
[6] Corwin D. L., Hopmans J (2006) "Field to landscape-scale Vadose Zone Processes" Scale Issues, Modelling and Monitoring. Vadose Zone Journal, 1:129-139
[7] EEA 2009 "Water resources across Europe-Confronting water scarcity and drought" Published: Mar 17, 2009
[8] Fipps G. (1999) "Potential Water Savings in Irrigated Agriculture for the Rio Grande Planning Region, published Oct 28, 1999
[9] Herschy R. W. (1998) "Investments case studies from the southern Murray-Darling Basin of Australia" Irrigation and Drainage, Workshop on Limitations and Approaches of Irrigation Canals Construction, Report, Netherlands, vol. 442, p. 777–778
[10] Kacimov A.R. (1992) "Seepage optimization for trapezoidal channel" ASCE Irrigation Drainage118:520–526.
[11] Kraatz D. B. (1977) "Irrigation Canal Lining" Rome published in ASCE on Nov 5, 1977
[12] Molden D. Oweis T., Steduto P., Bindraban P., Hanjra M.A., Kijne J. (2010 "Improving agricultural water productivity" optimism and caution. Agricultural Water Management; 97: 528-535. No.39
[13] Rahimi (2000) "Limitations of irrigation canal construction on difficult soils" Iranian National Committee on Irrigation and Water Supply system
[14] Refahi El N. (1976) "Problems of the irrigation networks in gypsum lands" Iranian Committee on Irrigation and Engineering ResearchInstitute, (IAERI), Technical report, No.169
[15] Ritzema H. P. "Drainage Principles and Applications" ILRI Publication 16. International Land Reclamation Institute (ILRI), Report no. 7