# Study on Seepage Control in Canal System

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## ABSTRACT

Water is the most vital input in agriculture that has highly significant contributions in providing stability to food grain production and food self-sufficiency as well as food security in India. This resource can be optimally used and sustained for future generations only when quantity of water is assessed very well. In the present study, the seepage losses that are the major losses through the canal conveyance system were quantified. Seepage loss in irrigation water conveyance system is very significant, as it forms the major portion of the water loss in the irrigation system. One of the main problem that meet the Ministry of Irrigation and Water Resources is that about 80% is lost from its total length passing through soil. The quantity of seepage to surrounding area varies from section to other. The seepage losses affect the water surface profiles, slops, discharge, and water level. Various methods are used to estimate the canal seepage rate.

***Keywords***: *Seepage Control, Tunnel face, stability, Underwater tunnel, Failure mechanism, Sand, Canal System*

## Introduction

Irrigation is the key factor that boosts agricultural production. Our aim is to increase agricultural production per unit volume of water, per unit area of cropped land & per unit time it is essential to see that the water available for irrigation is judiciously used and as far as possible water loss through conveyance is prevented. The main loss of water during transit is seepage loss. The best method for this is to measure accurately the inflow and outflow for the system. [1]The difference between inflow and outflow will give the losses. Seepage losses depend upon the time for which the canal runs, type of soil i.e. capacity of soil to conduct water, wetted perimeter, length of channels, operation policies, method of construction and embankment material atmospheric temperature, microbial activity, type of lining, growth of aquatic weeds etc. The loss of water due to percolation seriously affects surface irrigation.

It has been reported in Maharashtra Irrigation Commission"s Report [2] that 52.6 and 18 lakh hectares can be brought under irrigation by rain water stored in reservoirs and wells respectively. This is about 30 per cent of the cultivable area of 20.26 Mha in the Maharashtra State. Seepage losses depend up on the time for which the channel runs type of soil i.e. capacity of soil to conduct water, wetted perimeter, length of channel, operation policies, and methods of construction and embankment material, atmospheric temperature, microbial activity, type of lining growth of aquatic weeds etc. The loss of water due to percolation seriously affects surface irrigation. The seriousness of such loss is keenly felt in arid and semi-arid region where the demand for water far exceeds the availability.

Seepage is not only an issue for agricultural applications that require canals for water transportation, but also for parts of the world where fresh water is a rare, precious commodity. In many areas, fresh water lost through seepage can never be recovered, making properly lined canals an absolute necessity. [3]As fresh water sources become harder to come by, it becomes necessary to conserve as much water as possible; a 1993 study by Washington State estimates that, were seepage to be mitigated from canals, the water within could prove to be a more effective water source.

## Measurement of seepage loss

The seepage loss through the sections was computed by inflow outflow method:

$$\text{Seepage loss } (I) = \frac{Q_1 - Q_2}{A}$$

I = Seepage loss, cumec/Mm$^2$ of weted area.

Q1=Discharge at upstream end (inflow) cumec

Q2=Discharge of downstream end (outflow) cumec.

A=Wetted area, Mm

**Causes of leakage in water conservancy project construction**

1. There is a problem with the lead wire of the through wall pipe

The number of water pipes used in many water conservancy projects is relatively large, and the types of water pipes are relatively rich. The appropriate construction method should be selected according to the construction technology, construction method category and installation requirements[4]. If there is a problem with the water pipe installation, there will be leakage. For example, when the water pipe is connected with other parts, the quality of the welding structure is not in place, which leads to a gap in the middle. Or, if the concrete is not used in accordance with the requirements in the concrete construction process, the quality of concrete will not meet the standards and lead to leakage at the concrete pouring place. If the concrete is not fully vibrated, the surface after pouring will be uneven and easy to seep.

2. Leakage due to construction joints

In many water conservancy projects, the concrete pouring area is large. In most cases, stacking pouring and segmental pouring are used to divide the concrete into small pieces to improve the efficiency of concrete pouring. During the construction of water conservancy projects, there will inevitably be gaps between the interconnected concrete blocks, and these gaps will lead to leakage.

3. Other reasons

The construction period of water conservancy project is long, the equipment used is more and more complex, and there are many uncertain factors, which are easy to cause the deformation of construction joints. For example, it is not suitable to carry out water conservancy project construction in bad weather. [5] Some construction units still insist on the construction so as not to delay the construction period, so that the construction quality cannot meet the standard requirements, and the construction gap is getting larger and larger, so it will leak when it rains

**Review of Literature**

In a nutshell, the total water resources available for irrigation in the Nuh block include the canal water remaining after seepage and other losses, groundwater available for irrigation up to safe draft (limit) and the runoff water from study area when it is conserved and stored properly. As the Nuh block is representative block of Mewat district of Haryana state of India; the same was taken as the study area. Most parts of the Block were suffering with water deficit and problems of poor quality groundwater (Kaur, et al., 2009).[6]

Inadequacy of both types of water forced the district to import the same through a canal network namely Nuh branch canal from out side the district. Later the canal water became the prime source of surface water resources available for irrigation in the block for quite some time till the canal water supplied dwindled. While, runoff water contributes only small amount of surface water resources potential of the block (Khan, 2007)[7]

Anonymous observed that seepage values were ranging between almost nil to 4.26 cumec /Mm2 from distributaries. Sharma et.al [8] observed that aquatic weed problem in irrigation system situated in southeastern part of Rajasthan and West Madhya Pradesh was increased to such an extent that it caused 20 to 60 percent reduction in carrying capacity.

Bihari and Patel[9] studied the conveyance losses in earthen channel and concluded that apart from steady state seepage, there could be a significant transit loss component that is not measured in steady state measurements. These include rapidly infiltrated water to wet up dry channel banks, water seepage and leakage during the time water was being transferted from one field to another, dead storage losses resulting from water course breaches and due to growth of grasses in the channel.

Sur. et.al. [10] reported that conveyance losses and efficiency in unlined field channels in the command area of Bhaini Distributory in South Western Punjab. Overall losses from the studied channels were 24.2% Conveyance efficiency decreased exponentially with increase in the length of channel. The results suggested that additional 18 minutes per hour per kilometer of channel length will be required to receive same amount of water at different field outlets along the channel

Both chemical and engineering measures have been inno-vated for reclamation of such lands but these measures continue to be unviable due to socio-economic and technical constraints. Strategic tree planting is now being viewed as an alternative to these cost-prohibitive chemical and engineering measures. On eof the greater benefits of tree plantation in relation to salinity management is their ability to draw down the water tables through seepage reduction and increased water use (Hotton et al.

2002[11]; McFarlane and Williamson 2002; Dunin 2002).[12]

**Objectives**

- To study overall process of fitting, forecasting and developing the seepage.
- To study irrigation system control
- To study efficiency of tree species in control of canal seepage
- To study causes of leakage in water conservancy project

**Research Methodology**

Research design The design selected for this research study was qualitative in nature using interviews, observations, and documents. Qualitative research provides an understanding of a situation or phenomenon that tells the story rather than determining cause and effect. In order to apply the analytical and descriptive methods to the research a close reading and detailed analysis of secondary sources available. It is significant to get other perceptions to elaborate the textual analysis and this would need close reading analysis of few secondary materials.

**Result and Discussion**

**Table 1 Relative efficiency of tree species in control of canal seepage**

| Tree species | Seepage rate* ($m^3$ $day^{-1}$ 12 $m^{-1}$ strip) | | Av. canopy spread (m) | |
|---|---|---|---|---|
| | Tree | Tree + napier | Tree | Tree + napier |
| *H. binata* | 0.287 | 0.251 | 0.92 | 1.06 |
| *S. grandiflora* | 0.251 | 0.215 | 1.60 | 1.50 |
| *A. nilotica* | 0.122 | 0.121 | 4.22 | 3.79 |
| *D. sissoo* | 0.143 | 0.179 | 3.90 | 3.14 |
| *C. equisetifolia* | 0.251 | 0.251 | 3.16 | 3.08 |
| *A. indica* | 0.359 | 0.287 | 1.03 | 0.90 |
| Control | 0.899 | 0.899 | - | - |

* Mean of 12 observations recorded after two years of plantations

Due to utilization of ground water for evapotranspiration, the incoming seepage declined markedly (0.12 – 0.36 m3 day-1 12 m-1 strip) under tree planted land. A. nilotica with a higher canopy spread (4.22 m) was the most effective (86%) in reducing the seepage compared with other species and this was followed by D. sissoo with 84% of the flow (Table 1). Amongst various tree grass combinations, A nilotica-napier (87%) proved to be the most efficient followed by D. sissoo-napier (80%) while A. indica-napier combination (68%) was least efficient after two years of planting.[13]

The basic design of an irrigation system operated continually with variable flows is to divide the canals into successive pools and to locate the regulators and the off-takes in such a way that the differential water level variations remain within certain limits.[14]

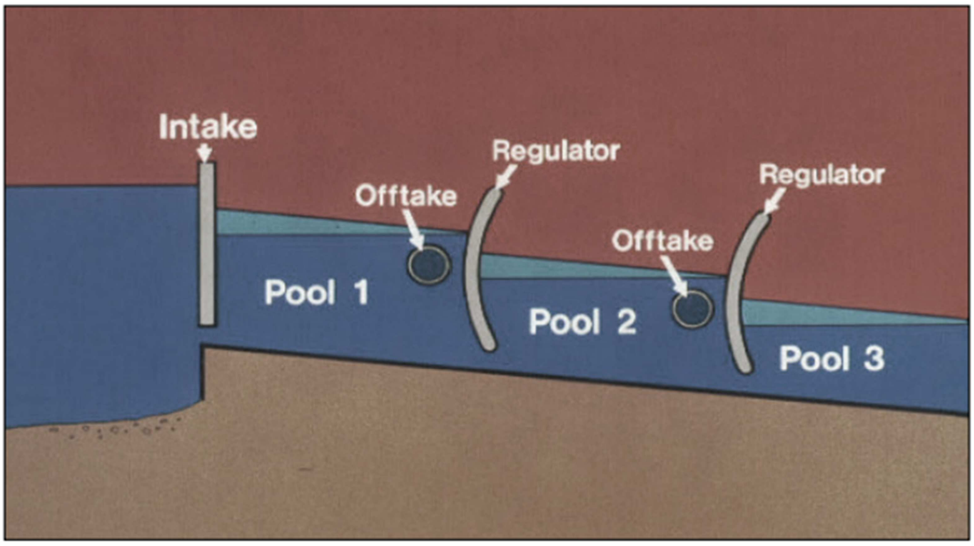


**Fig.1 Irrigation system control**

Seepage failure is one of the main crash modes of high core rockfill dam, and the monitored seepage quantity is a comprehensive effect of the seepage state. Therefore, develop a seepage quantity monitoring index will provide a technical guidance for the safety of high core rockfill dam. [15]Fig.2 describes the overall process of fitting, forecasting and developing the seepage.

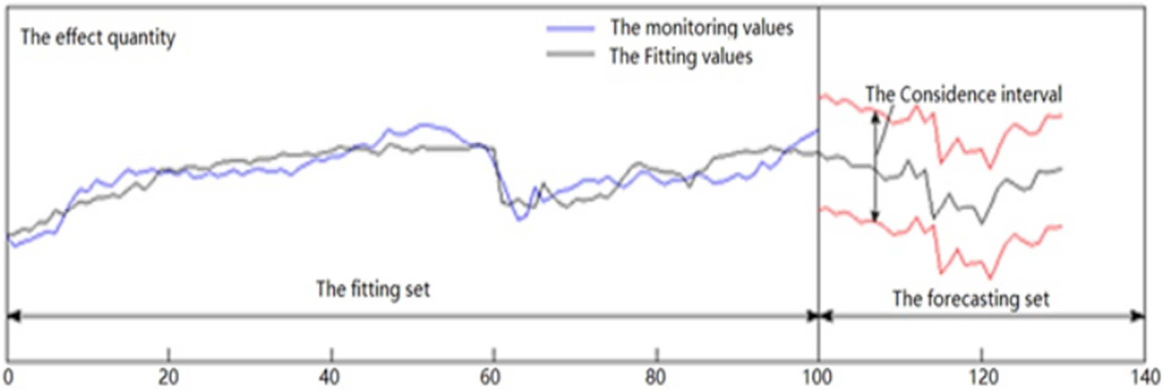


**Fig. 2 Fitting curve and the confidence interval.**

## Conclusion

Water conservancy is not only the lifeblood of agriculture, but also closely related to the national economy. Once there is a quality problem in a water conservancy project, it will affect people's lives and property safety, with unpredictable consequences. Leakage prevention and plugging construction technology is one of the commonly used technologies in water conservancy project construction. The combination of trees and perennial pasture can mitigate and even reverse waterlogging and secondary salinization. This supports the role of tree plantations for salinity/water table control in areas where shallow water table has limited water disposal options or economic considerations make ground water pumping unsuitable.

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