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# Assessment of Water Logging and Its Remedial Measures

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## ABSTRACT

**Water logging is the achromatization of soil with water. Soil may be regarded as doused when it's nearly impregnated with water, similar to when its air phase is confined and anaerobic conditions prevail. This design deals with the analysis of waterlogging in soil samples. Which include data collection of soil from nearby a campus, infiltration dimension of the soil, study of the drainage system at the soil sample, study of drainage outside the soil sample, study of the living rainwater harvesting system at nearby a campus, and eventually, grounded on the studies, remedial measures for reducing water logging of soil nearby a campus are set up. Waterlogging is one of the focal abiotic stresses that affect crop growth. It has become the key constraint to crop production in the temperate high rainfall zone (HRZ), particularly in regions with duplex soils.**

**Key word: Soil salinity, seepage, water logging, perforated pipe method, geomembrane.**

Rises to such an extent that the soil pores in the crop root zone are saturated, resulting in a restriction of the normal circulation of air. This causes a decline in the level of oxygen and an increase in the level of carbon dioxide. Generally, the water table is located at or near the surface, resulting in poorly drained soils that adversely affect crop production. Areas with a water table within 2 m below the ground surface are considered prone to water logging, and those with a water table within 2–3 m are considered to be at risk. Water logging can reduce the agricultural and economic value of land, causing yield reductions or, at times, total crop failures. Water logging is also a drainage problem.

**Need of Study**

Due to geological reasons, some areas are located in low-lying regions, and water from the highlands moves towards that area, where it's submerged for a period of time or fairly endlessly. On the other hand, some spatial development and masonry construction help water infiltration into the soil or block the water

## INTRODUCTION

Waterlogging refers to the achromatism of soil with water. Soil may be regarded as doused when it's nearly impregnated with water, especially when its air phase is confined and anaerobic conditions prevail. In extreme cases of prolonged waterlogging, an aerobiosis occurs, the roots of mesophiles suffer, and the subsurface reducing atmosphere leads to similar processes as denitrification, methanogenesis, and the reduction of iron and manganese oxides. Water logging may be divided into two categories:

1. Natural
2. Man made

A land is said to be "waterlogged" when the soil pores within the root zone of the plant get saturated and the normal growth of the plant is adversely affected due to insufficient air circulation.

Water logging is a condition of land in which the soil profile is saturated with water either temporarily or permanently. In waterlogged lands, the water table

from draining out of the affected area, and that area became waterlogged. The depth and duration of alluvion vary from place to place; similar areas are freed from alluvion by processes of evaporation and infiltration.

The reasons for water logging are specialised, social, and institutional. Thus, water logging is taking place as different corridors of the megacity remain submerged for several days. Shy drainage sections, conventional drainage systems with low gravity and capacity, natural siltation, the absence of coves and outlets, indefinite drainage outlets, a lack of proper conservation of the drainage system, and over-disposal of solid waste into the rainspouts and drainage paths are reckoned as the major causes of blockage in drainage systems and water logging.

Waterlogging is one of the focal abiotic stresses that affect crop growth. It has become the key constraint to crop production in the temperate high rainfall zone (HRZ) of Australia, particularly in regions with duplex soils. Global climate change causes waterlogging events to be more frequent, severe, and unpredictable. Some currently wet areas will become wetter, and prolonged waterlogging will also become more prevalent. Waterlogging caused a 40–50% wheat yield reduction in a wet year, resulting in 100 million in crop losses (Zhang et al., 2004). Waterlogging is also a matter of worldwide concern, affecting 16% of the soils in the United States, 10% of the agricultural lands in Russia, and irrigated crop production areas in India. Frontiers in Plant Science Management Practises to Minimise the Impact of Waterlogging in Pakistan, Bangladesh, and China

**Scope of the Project**

Improved soil management can increase infiltration, reduce surface runoff, and additionally improve the availability of water and nutrients to plants. This review focuses on the impact of waterlogging on soil properties, plant growth, and agricultural management practises to mitigate waterlogging. The gaps in current knowledge, technology, and farm practises are identified, and recommendations are made for future opportunities to ensure sustainable soil under waterlogged conditions. Thus, our study provides a method for screening water logging.

## LITERATURE REVIEW

**J.M. Lynch, "Production and phytotoxicity of acetic acid in anaerobic soils containing plant residues" Soil Biology and BiochemistryVol.No.10, (2), pp 131-135, (1978)**

Acetic acid accumulated in slurries of peat, loam and clay soils mixed with wheat (Triticum aestivum) straw and reduced the growth of roots of young barley (Hordeum vulgare) plants. Straw from wheat, barley, oat (Avena sativa) and rape (Brassica napus) and decaying rhizomes of couch grass (Agropyron repens) mixed with slurries of the loam soil, had the same effect. The breakdown of acetic acid was slow in flooded soil and the maximum accumulation took place under these conditions; by contrast aeration of the soil prevented its accumulation. Solutions in which straw had fermented produced inhibitory effects on seed germination and the growth of seedlings in atmospheres containing between 3 and 21% $O_2$. The phytotoxicity could be mitigated by dusting the seeds with powdered chalk.

**D.P. SHARMA and ANAND SWARUP, "Effects of short-term flooding on growth, yield and mineral composition of wheat on sodic soil under field conditions", Plant and Soil Vol. No.107, (Issue 1), pp. 137-143, (1988)**

In sodic soils of the Indo-Gangetic alluvial plains of Northern India, flooding for short periods often occurs during the growing season of wheat, leading to low yields. A field study was therefore conducted to evaluate the effects of short-term flooding on growth, yield and mineral composition of wheat (Triticum aestivum Linn. emend. Fiori and Paol) in a sodic soil (pH 8.9, exchangeable sodium percentage 25) Flooding wheat for 2, 4 and 6 days at the time of first irrigation (25-day old plants), significantly reduced tillering, plant height, delayed head emergence and resulted in 17.6, 29.0 and 46.7% reduction in grain yield, respectively. Flooding decreased oxygen diffusion rate (ODR) values, restricted root growth and reduced ion uptake, especially of N, P. K. Ca, Mg and Zn and led to higher absorption of Na, Fe and Mn.

**T. L. SetterandI. Waters, "Reviewof prospects forgermplasm improvement for waterlogging tolerance in wheat, barley and oats"Vol.No.253, pp 1–34, (2003)**

In the waterlogged environments for crop production' section, the extent of waterlogging is reviewed commencing with determination of environmental factors which may limit plant growth and development in waterlogging prone regions. This highlights that different types of waterlogging may exist, there may be large spatial and temporal variation in waterlogging, and that waterlogging may be confounded in field experiments with additional environmental factors. For wheat and barley, there is some genetic diversity for waterlogging tolerance at the germination stage, however the full potential seems yet to be exploited. Varietal differences in tolerance at the germination stage often differ from tolerance at later stages of development, and this supports the view that different mechanisms of tolerance exist at the whole plant and tissue level. Limited work from genetic studies indicates a high heritability for waterlogging tolerance. It is concluded that the best opportunities for germplasm improvement are for further exploration and utilization of genetic diversity by improving selection criteria including the use of marker assisted selection. Additional opportunities are described for increasing genetic diversity using wide hybridizations and development of transgenic plants

**H.T. Nguyen, K.S. Fischer and S. Fukai, "Physiological responses to various water saving systems in rice" Field Crops ResearchVol.No.112, (2–3), pp 189-198, (2009)**

The conventional system for irrigating rice uses a large amount of water. Recently a few water saving technologies (saturated soil culture, well-watered aerated conditions such as aerobic rice) have been trailed in the field to reduce water use and to improve water use efficiency. However, rice appears to be sensitive to small water deficits; yields are often lower in the water saving technologies.

Pot experiments were conducted to simulate rice grown in saturated soil conditions with varying depths to the free water and to measure the physiological responses of rice seedlings and mature plants to them compared to the conventional flooded system of growing rice and to rice grown in aerated conditions. A field study compared the performance of one saturated soil system with flooded rice.

**Ammara Maryam and Shimalla Nasreen, "Water Logging Effects on Morphological, Anatomical, Physiological and Biochemical Attributes of Food and Cash Crops", International Journal of Water Resources and Arid Environments Vol.No.2, (4), pp 119-126, (2012)**

Effects of waterlogging on different attributes of cash and food crops. For this purpose, many papers were studied to understand the changing brought about by waterlogging.

Saturation of any soil with water is known as waterlogging or flooded soil. Excess of water present in sol do not allows the crops to grow expediently. In such conditions some varieties cannot exist and some becomes tolerant or resistant.

## METHODOLOGY AND SITE WORK

**Study Area:**
Address: -Near Panchgangaghat At-P-Ichlarkarnji 416115 Ichalkaranji is princely city in Maharashtra in western Maharashtra located on the bank of river panchaganga, it has economic base of textile industry hence attracted people from not only Maharashtra but also in india.it is immerging as dense populous city with present population 450000 according to census 2011.the town is situated 16 40 N latitude and 74 32 E longitude.

The land is salinity soil land and the water logging is on rainy season at previous 5 years continuously.

Soil salinity is the salt content in the soil the process of increasing the salt content is known as salinization. Salt occurs naturally within soils and water.


**Fig 3.1: Satellite Image of Study Area**

## METHODOLOGY

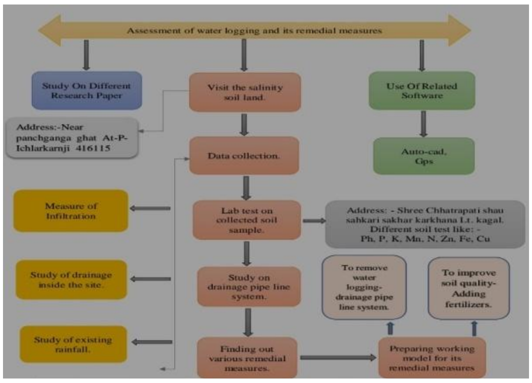


**Fig 3.2: Image of Methodology**

**Site Work / Proposed Work: Planning of work**

**Step 1:**
Discussion with Client/Owner and take permission about their site in which we collected the soil sample. One of the simplest and most important things is to discuss with client or owner about their land and gathering information from them.

We ask them:

- ➢ Due to which reasons, the water logging is happened on your land?
- ➢ In which period, the problem of water logging is happened on your land?
- ➢ Ask them whether any repair work was carried out on this problem of water logging if yes, then what was the result?

**Step 2:**
Visit the Site.

- ➢ Photograph on the site and number them.
- ➢ Checking the water logging is happened on site, is natural or man-made.
- ➢ Understanding the problem is happening on site, and its causes.

**Step 3:**
To checking water logging is happening on site, we take following procedure.

1. **Data Collection**

Data about annual rainfall in campus, in which soil sample is collected. Mainly focused on data include amount of rainfall during rainy season. Collected data also shows the whole area of the campus and rainfall storage capacity of each area.

2. **Measure of Infiltration**

Infiltration of the campus is measured. Infiltration is the process by which water on the ground surface enters the soil. The infiltration capacity is defined as the maximum rate of infiltration. Infiltration capacity of several part of the campus is very less. The infiltration capacity decreases as the soil moisture content of soils surface layers increases.

**3. Study of Drainage Inside the Site**

The size of the drainage area, topography and soil of drainage is analyzed. The larger the area, the greater the volume of runoff. By studying about the drainage system of campus, we came to the conclusion that the drainage system is not appropriate enough to transport the amount of rain water falls in.

**4. Study of Existing Rainfall**

Campus is consisting of rainfall, a study about its capacity, its materials, location, overall drainage scheme are conducted and new system can be constructed based on this information.

**5. Remedial Measures**

By using the data in above steps, various remedial measures can be found to reduce the water logging in the campus. Measures should be in such a way that it should reduce the water logging problem to a great extent.

**Step 4:**

- To prepare working model for its remedial measures.

**Step 5:**

- Formation of Report

**Use of Related Software**

**Auto-Cad 2019: -**

This software is used to planning 2D plan of perforated pipe method. to showIts different components and its layers for better understanding.

**GPS Software: -**

This software is used to show satellite image of study area and site work. To collect information about that place GPS software is used.

**Lab Test on Collected Soil Sample**

Address: - Shree Chhatrapati shausahkari Sakharkar khana Lt. kagal.

Different soil test like: - $P_H$, P, K, Mn, N, Zn, Fe, Cu

**Collection of Information about Require Data**

**Fig 4.1: Permanent water logging resulting from ground contribution (wetland)**

**Causes of Water Logging**

Water logging is a drainage problem that results in high water inflow caused by rain, runoff, interflow, rises in groundwater, over irrigation, or flooding. Drainage problems can be caused by low water outflow due to a low infiltration rate, low hydraulic conductivity, flat terrain, a lack of outlet, or a restricted outlet in the soil. In irrigated agriculture, drainage should be part of the overall design and implementation to avoid problems with water logging. Waterlogging can be caused by natural conditions or human-induced activities, as follows:

**Natural Causes:**

a) **Topography of a watershed**
The topography, its slope, shape, and drainage pattern have an important bearing on the drainage of a watershed. Areas that lie in valley bottoms, depressions and other flat lowlands tend to become waterlogged naturally as surface flows concentrate in these lowlands, causing natural swamps.

b) **Geology**
Some areas have an impervious stratum below the top soil which obstructs the infiltration of rainfall. This creates a false water table or perched water table. Also, Areas with shallow. high water tables or a hard pan close to the ground surface are likely get waterlogged, particularly if subjected to high rainfall events

c) **The weather**
Areas that receive heavy rainfall for prolonged duration can get waterlogged temporarily or permanently. Heavy clay soils such as black cotton soils are prone to water logging, as they hold moisture for long periods. Also, soils prone tour face sealing cause temporary water logging.

d) **Seepage In flows**
Seepage and interflow from other water bodies e.g., lakes, rivers and shallow aquifers can cause water logging of adjacent lands. Also, subsoil

flows from upper regions to lower areas matriculation water logging

**Fig 4.2: Water logging after heavy rains on shallow water table**

**Fig 4.3: Water Logging Due To Seepage Inflows from River Valley**

**Human-Induced Causes of Water Logging**

Human induced causes of water logging in agricultural lands are usually associated with bad water management whether under irrigated or rain fed agriculture. For instance:

**Irrigation:** Irrigation, if not well planned, can cause drainage problems for the irrigated lands and adjacent ones. This is because irrigation adds extra water to the soil profile, over and above the naturally occurring rainfall. There are several ways in which irrigation can increase water logging. They include:

**Over irrigation:** Over irrigation and intensive irrigation result in water logging. The excess water from irrigation and without proper drainage contributes to rise in the water table.

**Seepage from canals:** Excessive seepage from unlined canal system and water courses result in the rise of water table leading into water logging

**Inadequate drainage:** In irrigated areas, water losses from canal system and water courses continuously contribute to water table.

**Poor irrigation management:** Poor irrigation and cropping management by the cultivator

**Obstruction of natural drainage:** Interception of natural drainage by the construction of canals, roads, railways, water courses, etc.

**Land locked parches having no outlets:** Water logging develops due to absence of outlet to drain excess irrigation or rain water.

**Fig 4.4: Harvesting rice in waterlogged conditions due to poor drainage**

**Fig 4.5: Water logging due to poor land levelling**

**Effects of Water Logging**

The various effects of waterlogging on land and crops are as follows:

1. **Creation of Anaerobic Condition in the Crop Root-Zone:**
   When the aeration of the soil is satisfactory, bacteriological activities produce the required nitrates from the nitrogenous compounds present in the soil which helps the crop growth. Excessive moisture content creates anaerobic condition in the soil. The plant roots do not get the required nourishing food or nutrients. As a result, crop growth is badly affected.

2. **Growth of Water Loving Wild Plants:**
   When the soil is waterlogged water loving wild plant life grows abundantly. The growth of wild plants to tally prevents the growth of useful crops.

3. **Impossibility of Tillage Operations:**
   Water logged fields cannot be tilled properly. The reason is that the soil contains excessive

moisture content and it does not give proper tilth.

4. **Accumulation of Harmful Salts:**
The upward water movement brings the toxic salts in the crop root-zone. Excess accumulation of these a salts may turn the soil alkaline. It may hamper the crop growth.

5. **Lowering of Soil Temperature:**
The presence of excessive moisture content lowers the temperature of the soil. In low temperature the bacteriological activities are retarded which affects the crop growth badly.

6. **Reduction in Time of Maturity:**
Untimely maturity of the crops is the characteristic of waterlogged lands. Due to this shortening of crop period the crop yield is reduced considerably.

7. **Inhibiting activity of soil bacteria:**
The liberation of plants food is dependents upon the activity of soil bacteria, which requires adequate amount of oxygen in the air for proper functioning. When the soil pores within the rootzones of crops normally grown are so saturated as to effectively cut off the normal circulation of air, the land is said to be waterlogged.

8. **Decrease in available capillary water:**
Plant life draws its substance from the soil-solution round the soil particles which is drawn into the plants by capillary action and osmosis. If the water table is high, the roots of the plants are confirmed to the top layers of the soil above the water table while if the water table is lower, the root of plants have more room for growth.

9. **Defective air circulation:**
When the water-table is high, the drainage becomes impossible and the carbon dioxide liberated by plants root cannot be dissolved and taken away. Consequently, fresh air containing oxygen is not drawn and activity of soil bacteria and plant growth suffers.

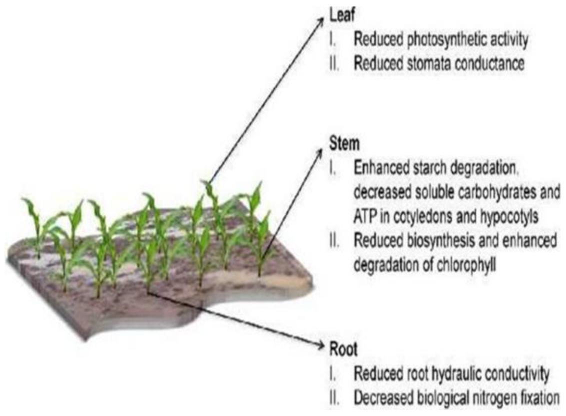


**Fig 4.6: Effect of Water Logging on Plant Growth**

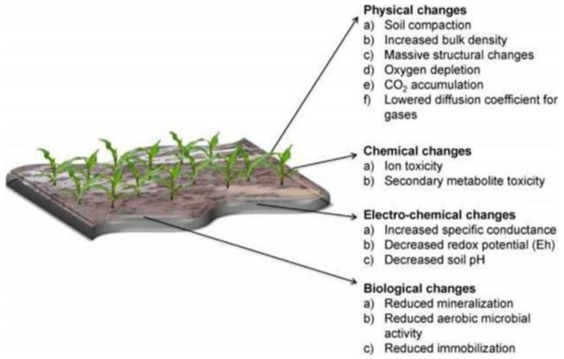


**Fig 4.7: Effect of Water Logging on Soil Properties**

**Solution to the Problem of Water Logging**

The problem of water logging may be attacked on two fronts.

- First are preventive measures, which keep the land free from water logging.
- Secondly curative measures may be adopted to reclaim the waterlogged area.

But in principle both measures aim at reducing the inflow and augmenting the outflow from the underground reservoir.

**Preventive Measures:**

Controlling the loss of water due to seepage from the canals:

The seepage loss may be reduced by adopting various measures for example

**I. By lowering the FSL of the canal:**
Loss may be due to percolation or absorption but when FSL is lowered the loss is reduced to sufficient extent. It is course essential to see that while lowering the FSL command is not sacrificed.

**II. By lining the canal section:**
When the canal section is made watertight by providing lining the seepage loss is reduced to quite a good extent.

**III. By introducing intercepting drains:**
They are generally constructed parallel to the canal. They give exceptionally good results for the reach where the canal runs in high embankments.

**(a) Preventing the loss of water due to percolation from field channels and fields:**

The percolation loss can be removed by using water more economically. It may also be affected by keeping intensity of irrigation low. Then only small portion of the irrigable tract is flooded and consequently the percolation loss takes place only on the limited area. It keeps the water- table sufficiently low.

**(b) Augmentation of outflow and prevention of inflow:**

It may be accomplished by introducing artificial open and underground drainage grid. It may also be achieved by improving the flow conditions of existing natural drainages.

**(c) Quick disposal of rainwater:**
Quick removal of rainwater by surface or open drains is a very effective method of preventing the rise in water table and consequent water logging of the tract.

It is needless to state that the rain water removed is net reduction in inflow.

**Curative Measures:**
Curative measures include the following:

**(a) Installation of lift irrigation systems:**
When a lift irrigation project in the form of a tube well irrigation system is introduced in the water logged area the water table gets lowered sufficiently.

It is found to be very successful method of reclaiming waterlogged land.

Thus, a combination of a canal system and a supplementary tube well irrigation system may be most successful and efficient irrigation scheme.

**(b) Implementation of Drainage Schemes:**
The waterlogged area may be reclaimed by introducing overland and underground drain age schemes

**ACTUAL WORK**

**Visit the site**
Address: - Near Panchganga ghat At-P- Ichlarkarnji 416115


**Fig 5.1: satellite image of study area**

**Fig 5.2: Image of visit land. (Salinity soil land)**

**Collection of required materials**

**Fig 5.3: Container**

**Fig 5.4: Suction pipe(Perforated pipe)**

**Fig 5.5: Geo composite Salt Barrier**

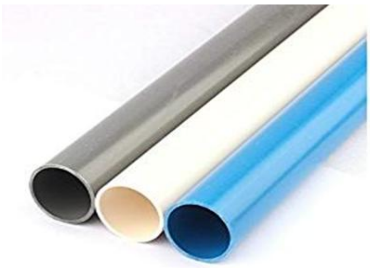

**Fig 5.6: ½ inch pvc pipe**

**2D Plan for perforated pipe method**

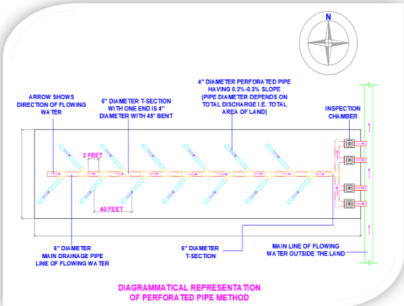


**Fig 5.7: 2D Plan for perforated pipe method**

**Preparing working model of drainage pipe line system**

**Fig 5.8: Preparation of working model for drainage pipe line system**

**Fig 5.9: Completion of working model for drainage pipe line system**

## RESULT AND DISCUSSION

**Lab test report on collected soil sample**
Address: - Shree Chhatrapati Shau Sahkari Sakhar Karkhana Lt. kagal.
Date: - 28/11/22
Soil test report: -

**Table No.6.1: Analysis of Lab Test Report**

| Sr. No. | Parameter | Test Value | Unit | Rating | Normal Level |
|---|---|---|---|---|---|
| 1. | Ph | 7.65 | - | Basic | 7 (Neutral) |
| 2. | Phosphorus (P) | 35.36 | Kg/Ha | High | 11-26 Kg/Ha |
| 3. | Potassium (K) | 274.19 | Kg/Ha | Sufficient | 120-280 Kg/Ha |
| 4. | Nitrogen (N) | 263.65 | Kg/Ha | Low | 280-560 Kg/Ha |
| 5. | Manganese (Mn) | 0.64 | ppm | Low | >2.0ppm |
| 6. | Zinc (Zn) | 0.16 | ppm | Low | >0.6 ppm |
| 7. | Iron (Fe) | 1.01 | ppm | Low | >4.5 ppm |
| 8. | Copper (Cu) | 0.74 | ppm | High | >0.2 ppm |

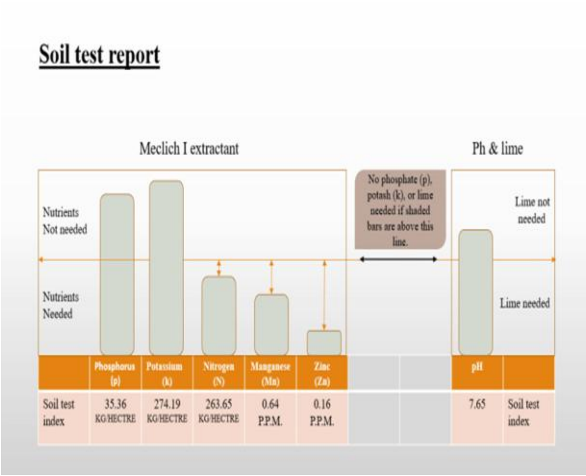


**Fig 6.1: Analyzing soil test report**

## CONCLUSIONS

**Waterlogging:** It has the potential to significantly reduce the problems associated with water logging in both irrigated and non-irrigated agriculture.

**Stalinization:** The problems associated with a rise in salinity in the root zone can be effectively delayed using bio-drainage systems in semi-arid and arid areas.

Positive aspects of saline water systems may be summarized as follows:

1. A more natural environmental setting is achieved in irrigated areas (projects).
2. A significant contribution is made to integrated rural development and the well-being of rural
3. Depending on the vegetation used, additional benefits of saline water and bio-disposal systems include: production of timber, fuel wood, oil, fruits, fibre, carbon contribution, reduction of wind erosion, provision of shade and shelter, function as windbreaks, yield organic matter for fertilizer, and enhancement of soil fertility.
4. As compared to conventional subsurface drainage systems, saline water systems perform the following four functions together:

- Dewatering, i.e., inducing water flow through the soil towards a tube well or pipe drain.
- transportation of the drain water to collector drains and thereafter to main
- Pump lifting effluent to higher levels in the evacuation system (as often required) and/or further conveyance by gravity outflow to disposal
- Final disposal at selected sites (e.g., by evaporation ponds).

Investment might be relatively low and could be borne by the farmer beneficiaries.

However, costs could be increased by fencing, wildlife protection, etc., depending on location.

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