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Irrigation water testing: Step for securing Nation's Asset

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Irrigation water quality is crucial for a number of reasons. All naturally occurring sources will inevitably contain varying amounts of dissolved solids, gasses, and occasionally suspended organic and inorganic colloidal components because water is the universal solvent. The water's immense effect depends on its purity. Depending on how irrigation water is used in industry, public health, and agriculture, several laboratory tests are conducted. One of the most crucial factors in determining the quality of irrigation water, particularly in dry and semi-arid regions, is salinity. The kind and quantity of salt dissolved in irrigation water determines its quality.

Water that is regarded unsuitable for home or industrial use may be ideal for irrigation. Both the number of crops and their yields may be impacted. Maintaining soil productivity and using best practices to protect the environment are therefore crucial. Soil degradation can be accelerated by poor irrigation water quality, particularly in regions with salt-affected sources. Consequently, it may cause crop stress and lower agricultural production.

Does the source have an impact?

Groundwater and surface water are the two main sources of irrigation water. Surface water is found above earth, while groundwater is found in subterranean aquifers. Freshwater that enters lakes, rivers, streams, and marshes is also included. Rain and melted snow that percolates through the soil and reaches the bedrock are the sources of groundwater.

Negative implications of poor quality irrigation water

The soil becomes saline or alkaline if water with too many soluble salts is delivered to the field; the detrimental effects of low-quality water are caused by an increase in the osmotic pressure of the soil solution, which inhibits;

- Water and nutrients are taken up by plant roots from the earth.

- Clay particles may adsorb too much Na from irrigation water, causing deflocculation and destroying the soil's structure, which results in inadequate air and water circulation.

Irrigation Water Quality Criteria:

The impacts of irrigation water on soil quality and crop productivity are typically classified into the following categories:

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- **Salinity hazard:** the total soluble salt content
- **Sodium hazard (SAR)**
- **Bicarbonate hazard (RSC)**
- **Soil Reaction**
- **Boron and Chlorides**

1. Salinity Hazard :

The most influential water quality guideline on crop productivity is the water salinity hazard (Table 1) as measured by electrical conductivity (ECw). The primary effect of high ECw water on crop productivity is the inability of the plant to compete with ions in the soil solution for water (physiological drought) uptake. The higher the EC, the less water is available to plants, even though the soil may appear wet.

Table 1. General guidelines for salinity hazard of irrigation water based on electrical conductivity

Class	Electrical conductivity (dS m^{-1})	Remarks
C1	0 to 0.25 dS m^{-1}	Low salinity water, can be used for most crops
C2	0.25 – 0.75 dS m^{-1}	medium salinity water, can be used with moderate leaching.
C3	0.75 – 2.25 dS m^{-1}	High salinity water, and this water cannot be used on soils with restricted drainage.
C4	>2.25 dS m^{-1}	very high salinity water, not suitable for irrigation

2. Sodium Hazard

The salt (ECw) level of the irrigation water is the main factor limiting plant growth, however under some soil texture circumstances, applying water with an imbalance in sodium might further lower yield. When irrigation water has a higher sodium content than calcium and magnesium, water infiltration may be reduced. This state, known as "sodicity," is brought on by an excessive buildup of sodium in the soil. Saline water is not the same as sodic water. Sodicity results in pore clogging, surface crusting, and soil clay expansion and dispersion. In turn, this deteriorated state of the soil structure prevents infiltration and could lead to an increase in runoff. if water ponds on the soil's surface after irrigation, sodicity reduces the downward passage of water into and through the soil, which may prevent actively growing plant roots from absorbing adequate moisture.

The Sodium Adsorption Ratio (SAR) is the most often used metric to evaluate the sodicity of water (Table 2). The relative concentration of sodium (Na) in relation to the total of calcium (Ca) and magnesium (Mg) ions in a sample is how the SAR determines sodicity. The SAR evaluates the possibility of infiltration issues brought on by an imbalance in sodium in irrigation water. However, a "adjusted" SAR (where the HCO3 is larger than 200 mg/L or the pH is greater than 8.5) can be computed for irrigation water with a high bicarbonate (HCO3) content.

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Table 2. Guidelines for sodium hazard of irrigation water based on SAR

Class	Sodium Adsorption Ratio (SAR)	Remarks
S1	<10	Low Na water, can be used on all soils with little danger of development of normal level of exchangeable Na
S2	10-18	Medium Na water, can produce hazards with fine textured soils with high CEC especially with low leaching conditions
S3	18-26	High Na water, requires special management practices such as good drainage, high leaching and organic matter additions. Exchangeable Na should be replaced by the use of chemical amendments
S4	>26	Very high Na water, not suitable for irrigation, this water can be used with the addition of gypsum or other amendments.

3. Bicarbonate hazard (RSC)

The sodium permeability hazard for irrigation water is usually assessed when bicarbonate and carbonate levels are >120 and 15 mg/L, respectively. The bicarbonate/carbonate and calcium/magnesium ratios in irrigation water are taken into consideration when evaluating the sodium permeability hazards using residual sodium carbonate (RSC) (Table 3). RSC is significant because the relative concentrations of bicarbonate and carbonate in relation to calcium, magnesium, and sodium concentrations are more significant than the absolute amounts of these substances.

Table 3. Guidelines for Bicarbonate hazard of irrigation water based on RSC

RSC (me L^{-1})	Category	Remarks
1.25	Safe for irrigation	This water can be used safely
1.25 and 2.5	Marginal	This water can be used with certain management
2.5	Unsafe	This water is not suitable for irrigation purposes.

4. Soil Reaction

Irrigation water's pH indicates its acidity or basicity. Water used for irrigation typically has a pH between 6.5 and 8.4. Alkalinity, or high concentrations of carbonate (CO32-) and bicarbonate (HCO3-), is frequently the source of high pH values exceeding 8.5. Sodium is the predominant ion in solution as a result of calcium and magnesium ions forming insoluble minerals due to high carbonates. This alkaline water may exacerbate the effects of high SAR water on sodic soil conditions. When scale accumulation results in decreased flow rates through emitters, excessive bicarbonate concentrations can also pose issues for drip or micro-spray irrigation systems.

5. Chloride

Chloride is an essential ion that is frequently found in irrigation waters and is needed in small quantities. Sensitive crops may become harmful at high doses (Table 4). Applying a sprinkler at night or on cloudy, chilly days helps lessen leaf burn caused by salt and chloride. In order to prevent direct contact with leaf surfaces

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while applying any saline irrigation water through a sprinkler system, drop nozzles and drag hoses are also advised.

Table 4. Classification of irrigation water based on chloride content (me L^{-1})

(Chloride (me L-1	Remarks
4.0 >	Excellent water
4.0-7.0	Moderately good water
7.0-10.0	Slightly usable
10.0 <	Not suitable for irrigation

6. Boron

In smaller quantities, boron is also necessary, but in larger quantities, it is hazardous. In fact, concentrations as low as 1.0 ppm can be harmful to susceptible crops (Table 5). Therefore, before adding additional B to irrigated crops, a ground water irrigation water analysis is recommended.

Table 5. Classification of irrigation water based on Boron content (ppm)

class	(Boron concentration (ppm			Remarks
Very low	0.33 >	0.67 >	1.0 >	Can be used safely
Low	0.67 – 0.33	1.33 – 0.67	2.00 – 1.00	Can be used with management
Medium	1.0 – 0.67	2.0 – 1.33	3.0 – 2.0	Unsuitable for irrigation
High	1.25 – 1.0	2.5 – 2.0	3.75 – 3.0	
Very high	1.25 <	2.5 <	3.75 <	

Summary

Water has a remarkable impact on a number of soil characteristics. It can change the soil's physical, chemical, and biological characteristics, impact plant health, lower irrigation system efficiency, and lower crop quality. Thus, Water testing is an essential step in maintaining the general health of the soil.

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