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MANAGEMENT OF POOR QUALITY WATER FOR IRRIGATION

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ABSTRACT:

Supplies of good quality irrigation water are expected to decrease in the future because the development of new water supplies will not keep pace with the increasing water needs of industries and municipalities. Thus, irrigated agriculture faces the challenge of using less water, in many cases of poorer quality, to provide food and fiber for an expanding population. Some of these future water needs can be met by using available water supplies more efficiently, but in many cases it will prove necessary to make increased use of municipal wastewaters and irrigation drainage waters. Aside from increased levels of nitrogen, phosphorus, and potassium, the salinity (total salt content) and sodicity (sodium content) of these waters will be higher than that of the original source water because of the direct addition of salts to the water and the evapoconcentration that occurs as water is used. While the use of these waters may require only minor modifications of existing irrigation and agronomic strategies in most cases, there will be some situations that will require major changes in the crops grown, the method of water application, and the use of soil amendments.

Use of poor quality waters requires three changes from standard irrigation practices: (1) selection of appropriately salt-tolerant crops; (2) improvements in water management, and in some cases, the adoption of advanced irrigation technology; and (3) maintenance of soil-physical properties to assure soil tilth and adequate soil permeability to meet crop water and leaching requirements (LR). This paper looks at farmers' experiences, research, and computer modelling in these areas, and concludes with a discussion of examples of farm experiences with waters that caused problems with infiltration rates and soil tilth and the practices used to mitigate these problems.

KEY WORDS: Irrigation, Irrigation Water Quality, Salinity, Crop Effect, Soil Effect, Salty Water, Poor Quality Water

INTRODUCTION :

Whatever may be the source of irrigation water viz., river, canal, tank, open well or tube well, some soluble salts are always dissolved in it. The main soluble constituents in water are Ca, Mg, Na and K as cations and chloride, sulphate, bicarbonate and carbonate as anions. However, ions of other elements such as lithium, silicon, bromine, iodine, copper, cobalt, fluorine, boron, titanium, vanadium, barium, arsenic, antimony, beryllium, chromium, manganese, lead, selenium, phosphate and organic matter are also present. Among the soluble constituents, calcium, sodium, sulphate, bicarbonate and boron are important in determining the quality of irrigation water and its suitability for irrigation purpose. However, other factors such as soil texture, permeability, drainage, types of crop etc., are equally important in determining the suitability of irrigation water.

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OBJECTIVES

Following are the objectives of this study

1. To discuss about various poor qualities of water to be used for irrigation purpose
2. To discuss about different management practices of poor quality water for irrigation

RESEARCH METHODOLOGY

This is descriptive study based on secondary data. Various Research Journals, Books, Websites & various reports which is related to all the aspects of Irrigation Management were studied to draw the conclusions.

RESULTS AND DISCUSSIONS

In this paper different management practices of poor quality water for irrigation, Quality of Irrigation Water, Classification of Irrigation Water Quality, Factors affecting suitability of water for irrigation, Use of poor quality water, Projected waste-water utilization etc. are discussed as follows.

MANAGEMENT OF POOR QUALITY WATER FOR IRRIGATION

A. Quality of Irrigation Water

Whatever may be the source of irrigation water viz., river, canal, tank, open well or tube well, some soluble salts are always dissolved in it. The main soluble constituents in water are Ca, Mg, Na and K as cations and chloride, sulphate, bicarbonate and carbonate as anions. However, ions of other elements such as lithium, silicon, bromine, iodine, copper, cobalt, fluorine, boron, titanium, vanadium, barium, arsenic, antimony, beryllium, chromium, manganese, lead, selenium, phosphate and organic matter are also present.

Among the soluble constituents, calcium, sodium, sulphate, bicarbonate and boron are important in determining the quality of irrigation water and its suitability for irrigation purpose. However, other factors such as soil texture, permeability, drainage, types of crop etc., are equally important in determining the suitability of irrigation water. Following are the most common problems that result form using poor quality water.

Salinity

If the total quantity of salts in the irrigation water is high, the salts will accumulate in the crop root zone and affect the crop growth and yield. Excess salt condition reduces uptake of water due to high concentration of soil solution.

Permeability

Some specific salts reduce the rate of infiltration into the soil profile.

Toxicity

When certain constituents of water are taken up by plants, which accumulate in large quantities and result in toxicity and reduces yield.

Miscellaneous

Excessive Nitrogen in irrigation water causes excessive vegetative growth and leads to lodging and delayed crop maturity. White deposits on fruits or leaves may occur due to sprinkler irrigation with high bicarbonate water.

Based on the characteristic features of majority of ground waters in use by the farmers in different agro-ecological regions of the country, the various indices which describe the nature of hazards on soils and crops, irrigation waters have been broadly grouped into good, saline and alkali waters. Depending on the degree of restrictions, the too poor quality waters have been further grouped into three homogenous sub groups as given in the Table 01.

Table 01: Groups of Poor Quality Ground Waters for irrigation

Water quality	Ec (ds/m)	SAR (m.mol/L)	RSC (me/L)
A. Good water	< 2	< 10	< 2.5
B. Saline water			
Marginally saline	2-4	< 10	< 2.5
Saline	> 4	< 10	< 2.5
High SAR Saline	> 4	> 10	< 2.5
C. Alkali water			
Marginally alkali	<4	< 10	2.5-4
Alkali	< 4	< 10	> 4
Highly alkali	Variable	> 10	> 4

Majority of natural ground waters have pH between 7.2 and 8.5 and are either in equilibrium or even super saturated in respect of calcite and dolomite. Water with pH less than 7.2 seems to be unsaturated in respect of calcite. Water samples with pH > 8.4 invariably have SAR more than 10. High pH is associated with waters containing residual alkalinity and a high carbonate: bicarbonate ratio. Water having residual alkalinity contains carbonate and bicarbonate ions in varying proportions depending on pH. The ratio of CO3 ions in ground waters generally vary between 1:10 and 1:2, marginally saline waters have low SAR, the usual range being up to 20. Hardly 10-15 per cent of the total ground waters have both high SAR (>20) and high salinity. Based on some of the quality criteria like EC, pH, concentration of Na, Cl and SAR, suitability of irrigation water is classified into six grades.

Table 02. Classification of Irrigation Water Quality

Quality of water	EC (m.mhos/cm)	pH	Na (ppm)	Cl (me./l)	SAR
Excellent	0.5	6.5–7.5	30	2.5	1.0
Good	0.5–1.5	7.5–8.0	30–60	2.5–5.0	1.0–2.0
Fair	1.5–3.0	8.0–8.5	60–75	5.0–7.5	2.0–4.0
Poor	3.0–5.0	8.5–9.0	75–80	7.5–10	4.0–8.0
Very poor	5.0–6.0	9.0–10.0	80–90	10.0–12.5	8.0–15.0
Unsuitable	6.0	> 10	> 90	> 12.5	> 15

(SAR–Sodium Adsorption ratio)

B. Factors affecting suitability of water for irrigation

The suitability of particular water for irrigation is governed by the following factors.

• Chemical composition of water (TSS, pH, CO3, HCO3, Cl, SO4, Ca, Mg, Na and B).
• Total concentration of soluble salts or salinity (EC).
• Concentration of sodium ions, in proportion to calcium and magnesium or sodicity (SAR).
• Trace element boron may be toxic to plant growth, if present in limits beyond permissible.
• The effect of salt on crop growth is of osmotic nature. If excessive quantities of soluble salts accumulate in the root zone the crop has extra difficulty in extracting enough water from salty solution, thereby affecting the yields adversely.
• Besides this, total salinity depends on the extent to which exchangeable sodium percentage (ESP) of soil increase as a result of adsorption of sodium from water. This increase depends on sodium percentage.
• Soil characteristics like structure, texture, organic matter, nature of clay minerals, topography etc.
• Plant characteristics like tolerance of plant varies with different stages of growth. The germination and seedling stages are usually more sensitive to salinity.
• Climatic factors can modify plant response to salinity. Tolerance to saline water irrigation is often greater in winter than in the summer. Rainfall is the most significant factor for the leaching of salts from the plant root zone. Temperature also plays a vital role.
• Management practices also play great role. Wherever saline water is used for irrigation, adoption of management practices which allow minimum salt accumulation in the root zone of the soil is necessary. The primary parameters that have to be considered to ensure effective irrigation management for salt control are the water requirement of crop and quality of irrigation water. Correct irrigation should restore any soil water deficit to control salt levels.

C. Use of poor quality water

Besides the salinity and alkalinity hazard of water, some industrial effluents and sewage water are also problem waters that can be reused by proper treatment. The complex growth of industries and urbanization (Urban development) leads to massive increase in wastewater in the form of sewage and effluent. Waste water supplies not only nutrients but also some toxic elements such as total solids of chloride, carbonate, bicarbonate, sulphate, sodium, chromium, calcium, magnesium, etc., in high concentration. Besides this, the effluent or wastewater creates BOD (Biological Oxygen Demand). These wastewaters when used for irrigation lead to surface and sub surface source of pollution due to horizontal and vertical seepage.

Points to be considered

• Application of greater amounts of organic matter such as FYM, compost etc., to the soil to improve permeability and structure.
• Increasing the proportion of calcium, through addition of gypsum (CaSO4) to the irrigation water in the channel, by keeping pebbles mixed gypsum bundles in the irrigation tank.
• Mixing of good quality water with poor water in proper proportions so that both the sources of water are effectively used to maximum advantage.
• Periodical application of organic matter and raising as well as incorporation of green manure crops in the soil.
• Irrigation the land with small quantities of water at frequent intervals instead of large quantity at a time.

• Application of fertilizer may be increased slightly more than the normally required and preferably ammonium sulphate for nitrogen, super phosphate and Di Ammonium Phosphate (DAP) for phosphorus application.
• Drainage facilities must be improved.
• Raising of salt tolerant crops such as cotton, ragi, sugar beet, rice, groundnut, sorghum, corn, sunflower, chillies, tobacco, onion, tomato, garden beans, amaranthus and lucerne.
Projected waste-water utilization
It is estimated that 2,87,000 million m3 of waste water can be reusable. Hence, these waste waters can be properly treated as follows:
• Dilute with good quality water in the ratio of 50:50 or 75:25.
• Alternate irrigation with waste water and good quality water.
• Treat the effluent water through fill and draw tanks, lime tank, equalization tank, settling tank, sludge removal tank, aerobic and anaerobic treatment tanks etc.

CONCLUSION

Whatever may be the source of irrigation water viz., river, canal, tank, open well or tube well, some soluble salts are always dissolved in it. The main soluble constituents in water are Ca, Mg, Na and K as cations and chloride, sulphate, bicarbonate and carbonate as anions. However, ions of other elements such as lithium, silicon, bromine, iodine, copper, cobalt, fluorine, boron, titanium, vanadium, barium, arsenic, antimony, beryllium, chromium, manganese, lead, selenium, phosphate and organic matter are also present. Among the soluble constituents, calcium, sodium, sulphate, bicarbonate and boron are important in determining the quality of irrigation water and its suitability for irrigation purpose. However, other factors such as soil texture, permeability, drainage, types of crop etc., are equally important in determining the suitability of irrigation water.
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