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Drainage Engineering

(BTAI3103)

Module 2

Drainage for Salt Control

(Lecture-05: Salt problem in Soil and Water_3)

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Classification of salt affected soils

Saline Soil	$EC_e > 4 \text{ dS/m}$, $ESP < 15\%$ and $pH < 8.5$.
Alkali Soil	$EC_e < 4 \text{ dS/m}$, $ESP > 15\%$ and $pH > 8.5$.
Saline-Alkali Soil	$EC_e > 4 \text{ dS/m}$, $ESP > 15\%$ and $pH = 8.5$ or slightly higher.



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Quality of Irrigation Water

- The Quality of irrigation water is assessed in terms of soluble salt content, percentage of sodium, boron and bicarbonates contents.
- Major dissolved constituent in natural water are the salts of sodium, calcium and magnesium in the form of chloride, sulphate, carbonate and bicarbonates.
- EC of water sample is measured by using standard Wheatstone Bridges or Direct indicating Bridges.



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Classification of Irrigation Water

Based on Electrical conductivity

Low salinity water (C1)	Used for most crops and soils. Some leaching is required
Medium salinity water (C2)	Used for crops which can tolerate moderate salinity and leaching
High salinity water (C3)	Used with adequate drainage salt tolerant crops
Very high salinity water (C4)	Not ordinarily suitable for irrigation but to be used under special conditions with good drainage and salt tolerant crops.



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Classification of Irrigation Water

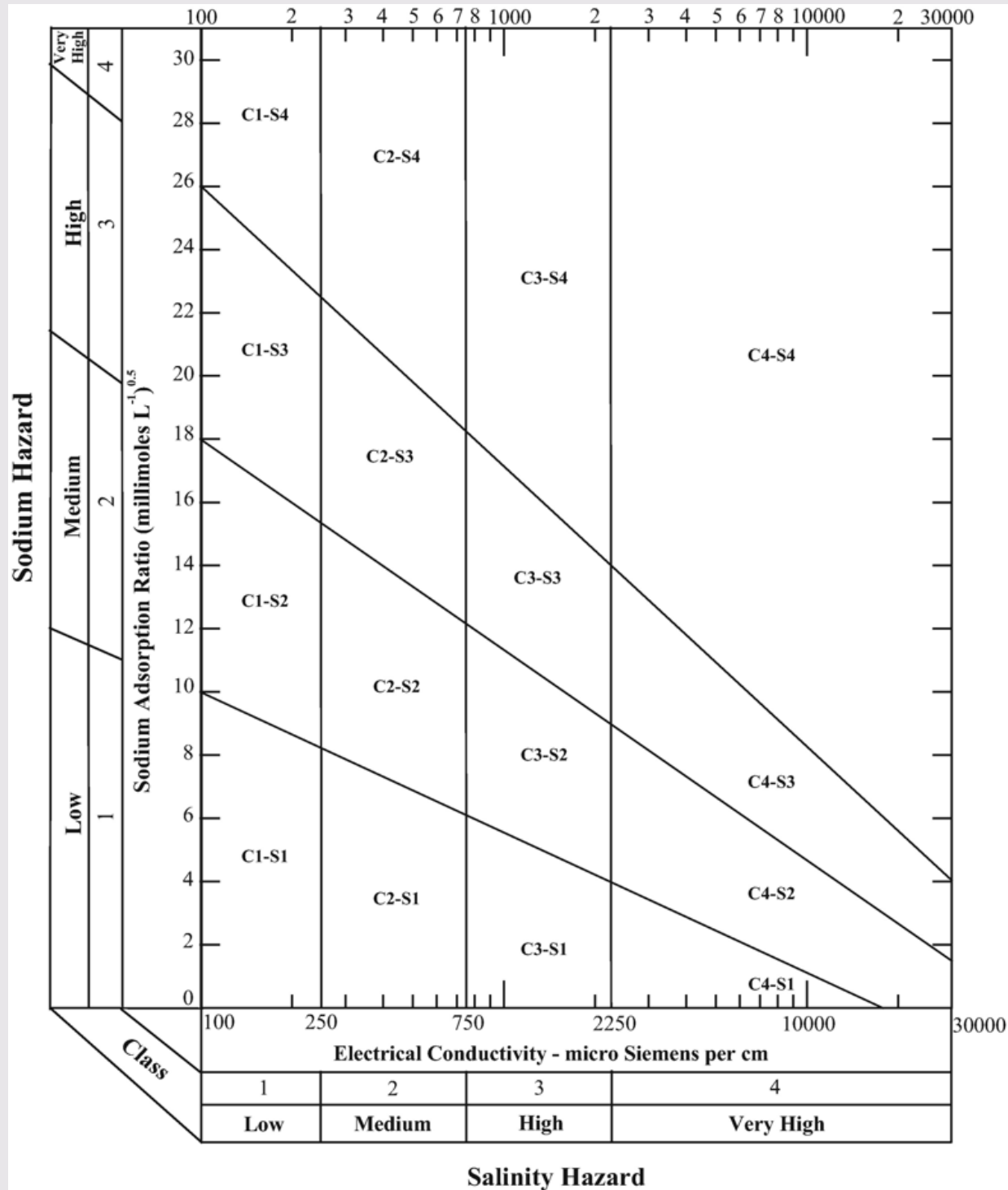
Based on Sodium adsorption ratio

Low sodium water (S1)	
Medium sodium water (S2)	
High sodium water (S3)	
Very high sodium water (S4)	



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Classification of irrigation water given by USSL



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Salt tolerance of different crops

Sensitive	Semi-tolerant	Tolerant
Apple	Maize	Wheat
Cluster beans	Sorghum	Barley
Cowpeas	Pearl Millet	Oat
Citrus	Rice	Sugarbeet
Gram	Safflower	Date Plam
Lentil	Sugarcane	Coconut
Lemon	Cotton	
Mash	Onion	
Peach	Potato	
Pear	Mango	
Peas	Pomegranate	



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Reclamation of saline soils

The leaching fraction, LF, is the leached depth or seepage depth divided by the applied depth where i in the following includes precipitation as well as irrigation if C_{in} is the average salinity of both.

$$LF = \frac{d_{out}}{d_{in}} = \frac{d_{seepage}}{i}$$

Since, $d_{in}C_{in} = d_{out}C_{out}$;

$$d_{in}C_{in} = LF \times i \times C_{out};$$

$$C_{out} = \frac{C_{in}}{LF};$$



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Reclamation of saline soils

Because EC is proportional to the concentration C, the leachate salinity for uniform water application can be written as

$$EC_{dw} = \frac{EC_{iw}}{LP}$$

Where EC_{dw} is electrical conductivity of drainage water (leachate or seepage), dS/m, EC_{iw} is the electrical conductivity of irrigation water, dS/m.

Depth of drainage water is equal to the irrigation water minus d_{ET} .

Substitute into $LF = \frac{d_{out}}{d_{in}} = \frac{d_{seepage}}{i}$

$$d_{out} = 1 - d_{ET}$$

$$LF = \frac{i - d_{ET}}{i}$$



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Reclamation of saline soils

The maximum allowable EC_e can be calculated based on crop sensitivity to salinity stress. An equation based on field experiments conducted with low frequency irrigation systems it has been a standard method for calculation of leaching fraction:

$$LF = \frac{EC_{iw}}{5 \times EC_e - EC_{iw}}$$



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Reclamation of Alkali soils

The objective in alkali soils is to reduce the exchangeable sodium percentage and remove the released sodium salts.

Reclamation of alkali soils is achieved by:

- i. Treating with chemical amendments like gypsum, Sulphur, etc.
- ii. Adding organic material such as farm yard manure, crop residues and green manuring
- iii. Leaching the products of reaction after amendments are added
- iv. Deep ploughing to break any hard pan for improving drainage



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Reclamation of Saline Alkali soils

- In certain cases these soils can be reclaimed by leaching alone.
- If amendments are needed, it is necessary to leaching soluble salts before adding any amendments.



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