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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

|                           |   |
|---------------------------|---|
| <b>Saline Soil</b>        | $EC_e > 4 \text{ dS/m}$ , $ESP < 15\%$ and $pH < 8.5$ .                   |
| <b>Alkali Soil</b>        | $EC_e < 4 \text{ dS/m}$ , $ESP > 15\%$ and $pH > 8.5$ .                   |
| <b>Saline-Alkali Soil</b> | $EC_e > 4 \text{ dS/m}$ , $ESP > 15\%$ 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<br>(C1)       | Used for most crops and soils.<br>Some leaching is required   |
| Medium salinity water<br>(C2)    | Used for crops which can tolerate<br>moderate salinity and leaching   |
| High salinity water<br>(C3)      | Used with adequate drainage salt<br>tolerant crops  |
| Very high salinity<br>water (C4) | Not ordinarily suitable for<br>irrigation but to be used under<br>special conditions with good<br>drainage and salt tolerant crops. |



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# Classification of Irrigation Water

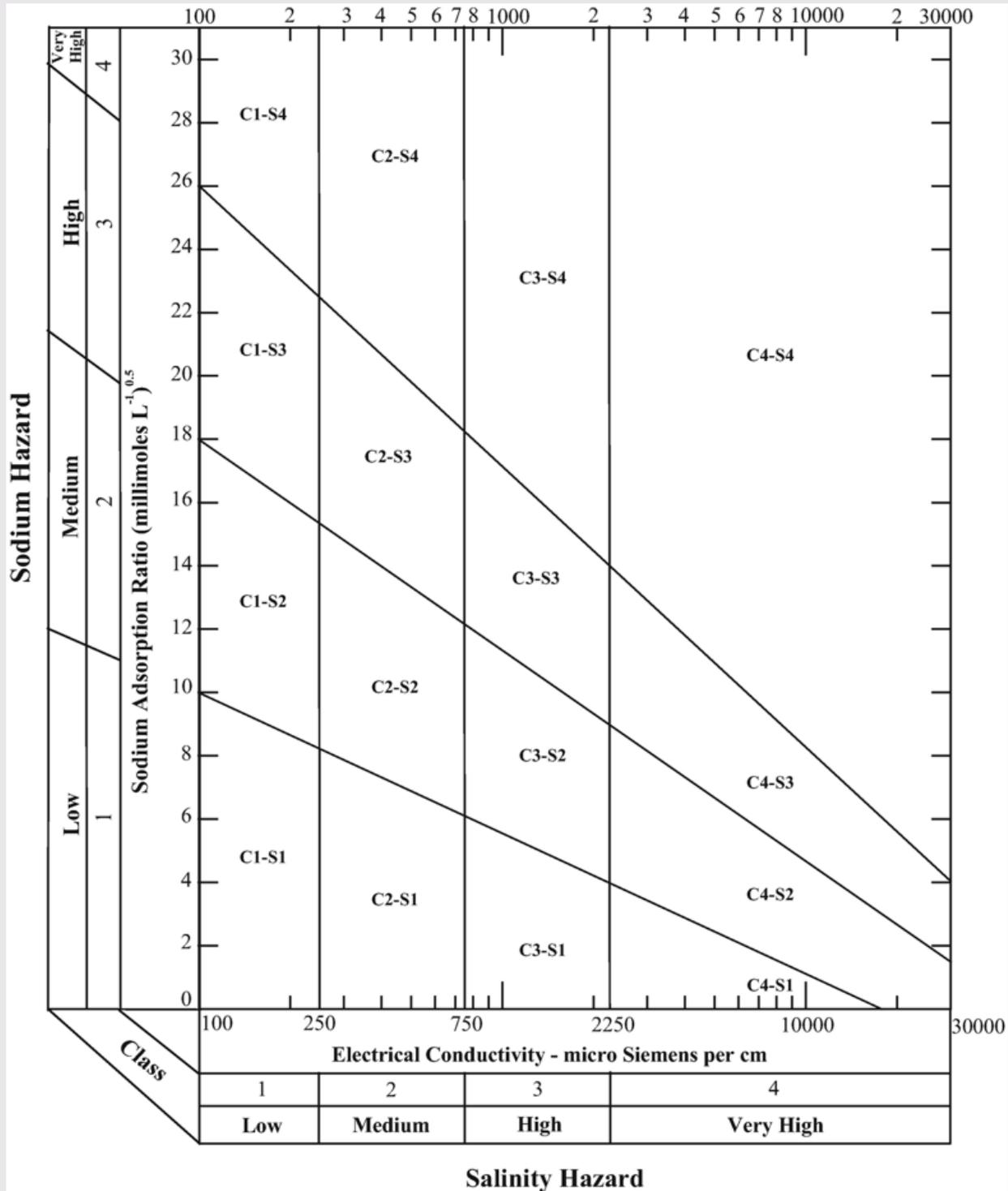
## Based on Sodium adsorption ratio

|                                |  |
|--------------------------------|--|
| Low sodium water<br>(S1)       |  |
| Medium sodium water<br>(S2)    |  |
| High sodium water<br>(S3)      |  |
| Very high sodium<br>water (S4) |  |



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Classification of irrigation water given by USSL



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# Salt tolerance of different crops

| <b>Sensitive</b> | <b>Semi-tolerant</b> | <b>Tolerant</b> |
|------------------|----------------------|-----------------|
| 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 leach soluble salts before adding any amendments.



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