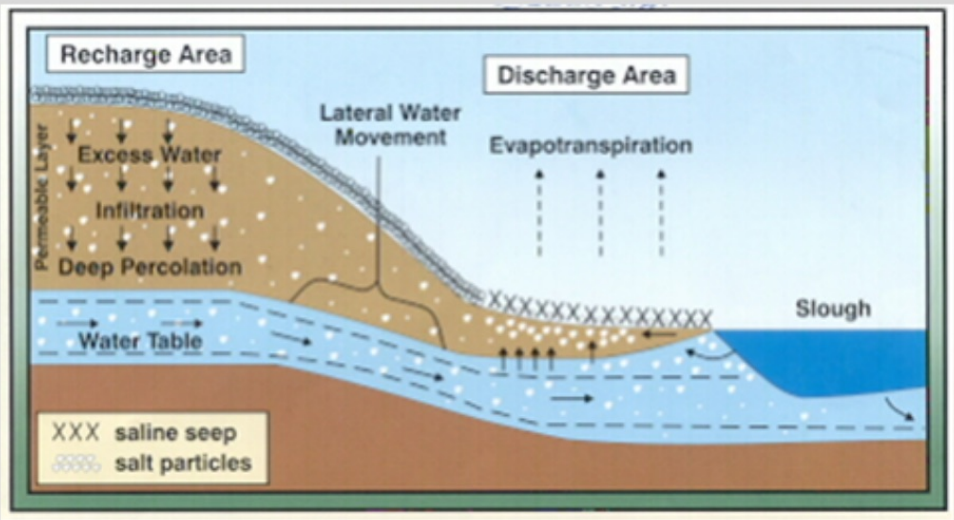
# Humic Acids and Salinity




**Sodic & Saline Soil**

**Salinity** indicates the presence of water-soluble ions (cations and anions) in soil. It is measured as the electrical conductivity (EC). Water-soluble ions increase soil's osmotic pressure. Plants will have difficulties absorbing water from soil, resulting in their reduced growth and yield. For example, dry beans, potato, and soybean experience a 70% yield reduction at EC values of 2.6, 3.6, and 9.0 dS/m, respectively. Typically, soil with an EC value of 2 or above is considered to be saline.

**Sodicity** indicates the presence of water soluble sodium cations in soil. It is measured as the sodium adsorption ratio (SAR): SAR = [soluble sodium] / ✓ {½ ([soluble calcium] + [soluble magnesium])} (Equation 1) Although sodium is not toxic, it is not a nutrient for most plants either (note: it might be uptaken by some salt resistant plants). However, water-soluble sodium cations cause clay-soil structures to compact and make it hard to till. Most water and nutrients will flow on the surface, never reach the root zone. Soil organisms also have difficulties to grow in this environment. Typically, soil with an SAR value of 6 or above is considered to be sodic.

**Traditional Soil Treatment**

The quality of sodic soil can be improved by reducing the amount of ions (i.e. nutrients) in soil. This can be done by applying organic matter bound nutrients. They are rather insoluble in water, therefore do not influence soil's osmotic pressure nor easily leach out to the groundwater table. They are the most efficient types of nutrients to be uptaken by plants. The quality of saline soil can be improved by adding gypsum (calcium sulfate), calcium nitrate, and epsom (magnesium sulfate). While the amount of water-soluble sodium in soil might not change, SAR will be reduced due to the presence of water soluble calcium and magnesium (see Equation 1). This method, however, will not work under the following conditions: 1) Very high water-soluble sodium cations in soil. A great amount of amendment will be required to reduce SAR at the expense of a very high EC due to the addition of water soluble anions (sulfates or nitrates) and cations (calcium or magnesium). 2) Very high water soluble ions in soil (sulfates, potassium, phosphorus, etc) due to an excessive application of fertilizers. A fair amount of amendment might be able to reduce the SAR, but its EC could rise to an undesired level.

**Humic acids applied to Sodic & Saline Soil**

Due to HA larger molecular weights and functional groups, Humic Acids bind ions (cations and anions) in soil. It also has a strong ability to chelate divalent cations in soil. Humic acid is very effective in improving soil quality especially the one with high sodicity and salinity levels. The chelation process makes some ions rather water-insoluble and stay in soil matrix without affecting soil's osmotic pressure or leaching to the groundwater table. At the best scenario, they will be uptaken by plants. Equation 1 above shows that SAR drops with the decrease of the water-soluble sodium cations. Water-soluble calcium and magnesium cations will also be reduced but its effect is less dominant (see Equation 1). Its EC will not increase significantly as there is relatively small amount of humic acids required and most of it will be in the rather water-insoluble form.