Soil Salinity in the Central Valley and its Effect on Food Production

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Introduction

The global population is projected to increase to over 9.7 billion by 2050 and over 11 billion by the end of the century[1]. To meet demand, food production must increase 70%. For many developing countries this increased production must come from increased yields, rather than expansion of arable land[2].

California is the nation's leading agricultural producer; growing over a third of the country's vegetables and two-thirds of its fruits and nuts[3]. A majority of this production is in the Central Valley having six of the nation's top 10 agricultural counties in terms of revenue.[4]

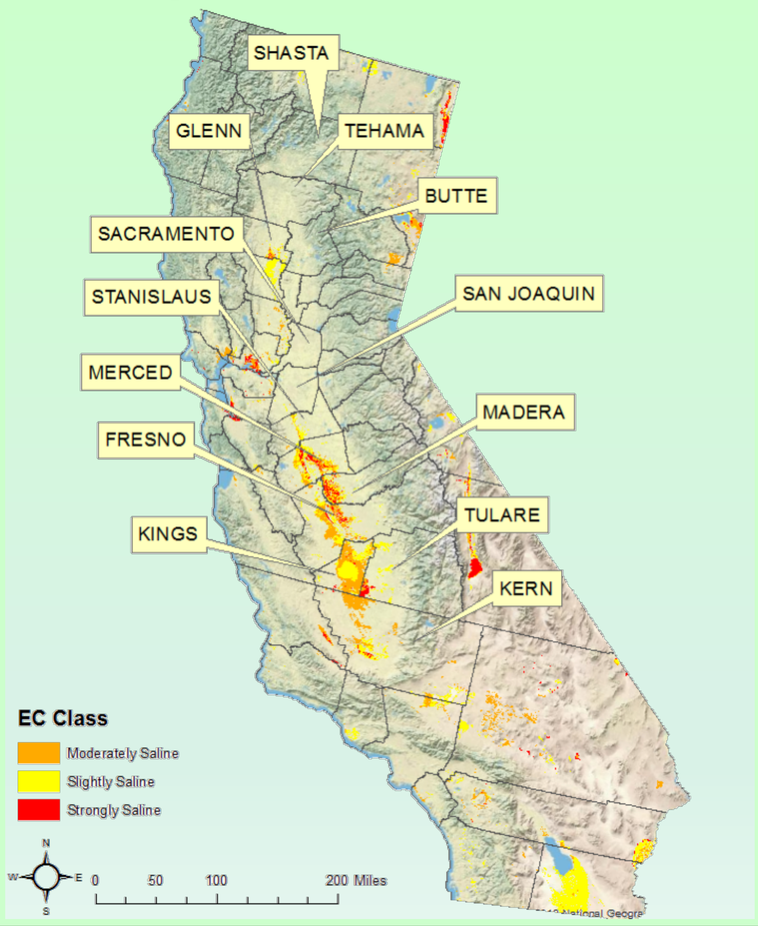
While it remains productive, the quality of the Central Valley soils will be subjected to a changing climate and farming practices. An issue that must be addressed is salinization, or increasing salt concentrations in the soil. Soil salinity negatively affects crop yields by limiting plants' ability to take up water. This project aims to asses the current soil conditions in the Central Valley and the possible impacts it has on the crops grown in the region.

Methods

Preliminary assessment of the State's saline soils was conducted by the NRCS and uploaded to a database on 2011[5]. Electrical conductivity (EC) is often used to measure salinity in soils, with units in mmhos cm^{-1} or dS m^{-1} equivalent. An EC of 4 dS m^{-1} or greater impairs the growth of most crops and is the baseline for the characterization of saline soils.

Using a mapping software (ArcGIS) this dataset was used to calculate the total acreage of saline soils in the central Valley.

DWR's 2014 cropping dataset was used to estimate the amount of farmland in the Central Valley and the top commodities based on acreage[6]. A study by Hoffman et al.[7] was used to define the tolerance of these crops.



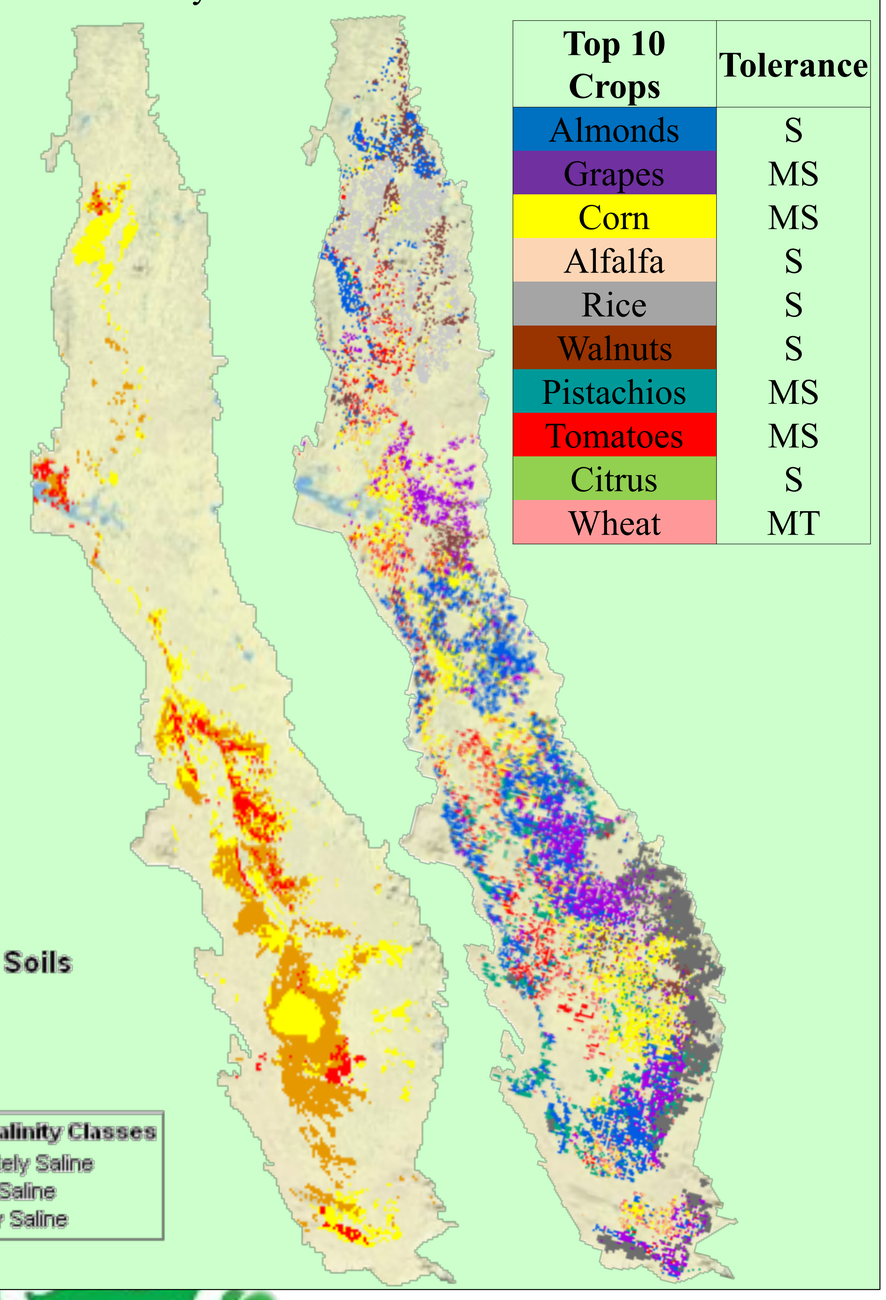
Results

Of the saline soils surveyed in the Central Valley roughly 43% is classified as slightly saline (4-8 dS m^{-1}), 46% is moderately saline (8-16 dS m^{-1}), and 11% is strongly saline (≥16 dS m^{-1}). The total acreage of each is summarized below.

According to land use data, the top 10 crops grown in the Central Valley are almonds, grapes, corn, alfalfa, rice, walnuts, pistachios, tomatoes, citrus, and wheat, which are relatively sensitive to salinity with thresholds as low as 1 dS m^{-1}.

Where saline soils are present, crops will experience some reduction in yields depending on the tolerance of the crop. Most woody fruit and nut crops such as almonds and citrus tend to be salt sensitive. Some tolerant crops include wheat, grains, olives, and cotton.

Top 10 Crops	Tolerance
Almonds	S
Grapes	MS
Corn	MS
Alfalfa	S
Rice	S
Walnuts	S
Pistachios	MS
Tomatoes	MS
Citrus	S
Wheat	MT



Conclusion

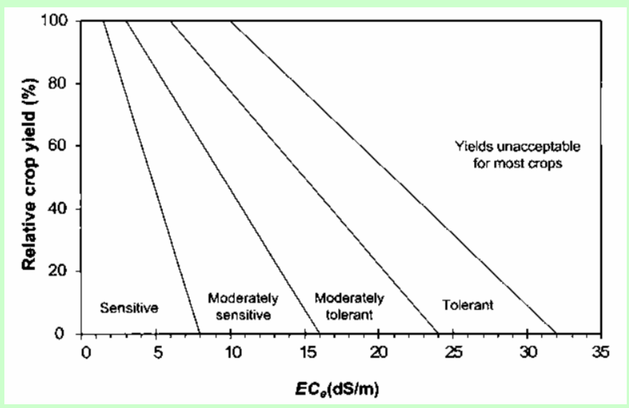


Figure 1.1 Crop Yield as a function of EC Bernstein et al., 1962

Based on changing salinity conditions, relative yields of common crops may be threatened. Furthermore, a shift to more salt tolerant crops may be needed in very saline soils to keep farmland in production. This has looming implications not just for food production in the Central Valley, but around the world.

https://www.istockphoto.com/vector/california-farming-and-agriculture-green-icon-pattern-gm584493062-100071675

References:
[1]United Nations Department of Economic and Social Affairs (2015)
[2]Food and Agriculture Organization (2009) *Synthesis Report*
[3]California Department of Food & Agriculture (2016) *Agricultural Statistics Review 2015-2016*
[4]USDA Census of Agriculture (2014) *2012 Census Highlights*
[5]Data Basin Conservation Biology Institute (2014) *NCRS Soil Salinity Classes*
[6]Department of Water Resources (2014) *Statewide Crop Mapping 2014*
[7]Food and Agriculture Organization (2002) *Agricultural Drainage Water Management in Arid and Semi-Arid Areas*
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