Estimation of the Exchangeable Sodium Percentage from the Sodium Adsorption Ratio for salt-affected soils in the High Valley (Bolivia)

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INTRODUCTION

Salt-affected soils have either an excess of soluble salts (salinity) and/or sodium in the soil solution phase as well as in the exchange complex (sodicity)

Calculation of Exchangeable Sodium Percentage (ESP) trough exchangeable cations in Lab is time consuming and expensive. Also, there is a lack of models to predict ESP in the study area

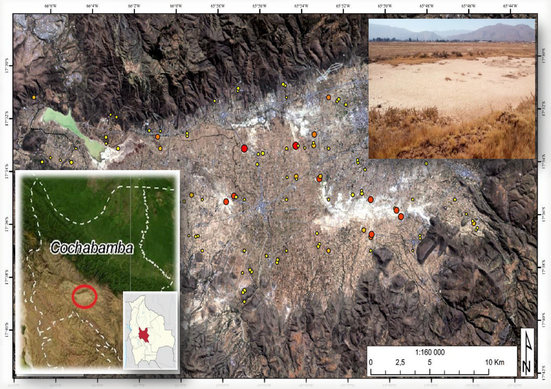

Figure 1. Location of study area (High Valley)

Objective: To generate a model for estimating the soil ESP from the SAR_e and contribute to the characterization and reclamation of salt-affected soils in the High Valley of Cochabamba

Methods: To generate the models, 84 soil samples were collected in the study area.

To validate the models, an independent set of 18 samples from soil profiles was used

To select a suitable prediction model, four regressions based on the mathematical formulas: $Y = b0 + b1\ x$, $Y = b0 + b1\ x^{0.5}$, $Y = b0 + b1\ x + b2x^2$, $Y = b0 + b1\ log\ (1+x)$, were initially evaluated

CONCLUSIONS

- ✓ The obtained models to predict ESP from SAR_e of salt-affected soils in the High Valley of Cochabamba were: $ESP = 0.972\ SAR_e + 1.576$ $ESP = 6.522\ SAR_e^{0.5} - 5.723$
- ✓ Both models were relatively similar in terms of performance, and according to the t-test, the estimated ESP and measured ESP values were not significantly different
- ✓ The models might be recommended to predict ESP from SAR_e in the High Valley, further for improving prediction, additional samples and stratification in terms of sodicity are needed

RESULTS

The linear and the square root transformation model were selected, due to their fairly high level of association between the variable to be predicted (ESP) and the predictor (SAR_e)

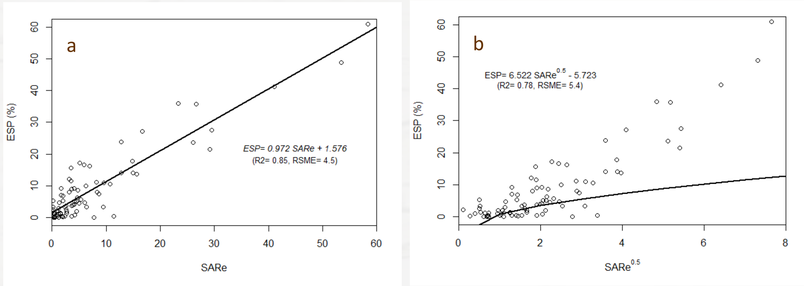

Figure 2. Best fitted models: a) Linear, b) Square root transformation

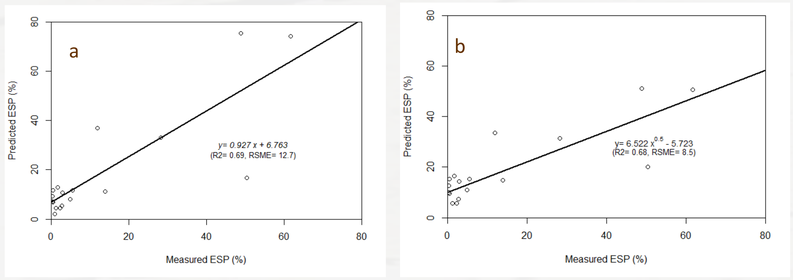

Figure 3. Prediction performance of models: a) Linear, b) Square root transformation

According to the validation, the prediction performance was relatively similar for both models.

The paired samples T-test showed that the measured ESP and predicted ESP values from linear and square root transformation model, were not significantly different.

Table 1. Paired samples analysis (T-test) parameters

	mean dif	SD diff	mean SE	P-value	CI min	CI max
Linear	5.80	12.38	3.00	0.06	-0.36	11.95
Square root	4.76	11.43	2.77	0.10	-0.93	10.44
Ref USLab	2.92	11.17	2.71	0.28	-2.63	8.47

SD: Standard deviation (%); SE: Standard error; CI: Confidence

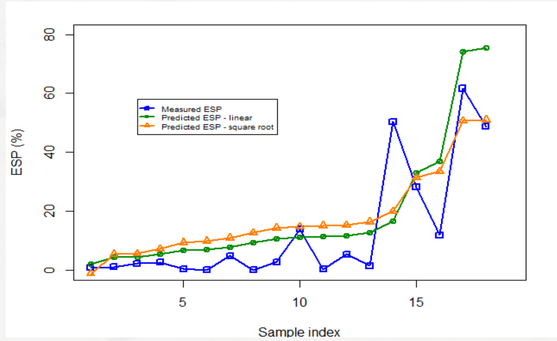

Figure 4. Measured ESP vs predicted ESP

Overall, the results are consistent with the findings/models of Seilsepour *et al*. (2009), Elbashier *et al*. (2016 a-b), Zare *et al*. (2014), Chi *et al*. (2011) and Richards *et al*. (1954)