Participatory Research for Agronomic Salinity Management – Experiences from Coastal Peri-Urban Vegetable Production in Maputo, Mozambique.

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Introduction

- Saline Agriculture (SA) provides a versatile toolbox of agronomic practices which have the potential to sustain agricultural production under saline conditions.
- Practicable soil and water assessment tools must be accessible to farmers in order to correctly categorize and monitor the specific salinity level.
- The successful management of salinity is highly context specific, which makes multidisciplinary and participatory SA technology development relevant.
- Maputo's peri-urban coastal vegetable production zones in southern Mozambique provide an interesting case study (Figure 1), given that SA approaches for smallholder vegetable production systems in (sub-) tropical environments are poorly developed.
- An exploratory study was conducted to understand the local extent, farmers' perception, and agronomic implications of salinization in the target region, followed by participatory field trials for SA piloting.

Figure 1: Typical aspects of salinity in Maputo's coastal vegetable production zones: Unproductive plots due to high soil salinity (a) High (saline) groundwater tables (b); Soil crusting (c); Leaf yellowing on collard green crop (d).

Methodology

1) Stakeholder interviews and field observations were conducted between April and July 2018, followed by qualitative analysis, in order to map out local perception and management of soil salinity.
2) A participatory mapping workshop with farmer representatives was conducted in July 2018 to define the perceived spatial dimensions of salinity. Systematic soil and water sampling/analysis followed, with the objective to compare farmers' categorization with standard salinity parameters (EC_e, EC_w). Since November 2020, portable soil and water sensor equipment is being piloted and calibrated against standard salinity parameters.
3) A participatory field trial is being conducted throughout the cropping seasons of 2021 and 2022, comparing different SA strategies. A randomized complete block design is applied on farmer plots with different salinity levels. Farmer Field Schools are aligned with the trial.

Results and Insights

1) Local Salinity Knowledge

- A variety of sensory salinity indicators are used by farmers (plant symptoms, salt crusts, tasting, indicator plants; Figure 1 c, d).
- Spatial and temporal dynamics of the salinity problem are acknowledged/explained by farmers.
- Farmers apply a variety of agronomic strategies to mitigate the negative effects of salinity. Most commonly practiced are increased chicken manure applications and use of tolerant crop species.
- Nonetheless, knowledge gaps and potential entry points for innovative SA approaches were identified.

2) Salinity Evaluation and Monitoring

- Local farmers' spatial salinity categorizations compared well with standard soil and water measurements, especially at higher salinity levels (Figure 2). Local salinity assessment thus can serve as a tentative proxy-indicator for salinity levels.
- However, standard salinity assessment should complementarily inform salinity management decision making.
- Portable soil and water sensor equipment provides a cost-effective tool for improving salinity related agricultural extension services (Figure 3 f).

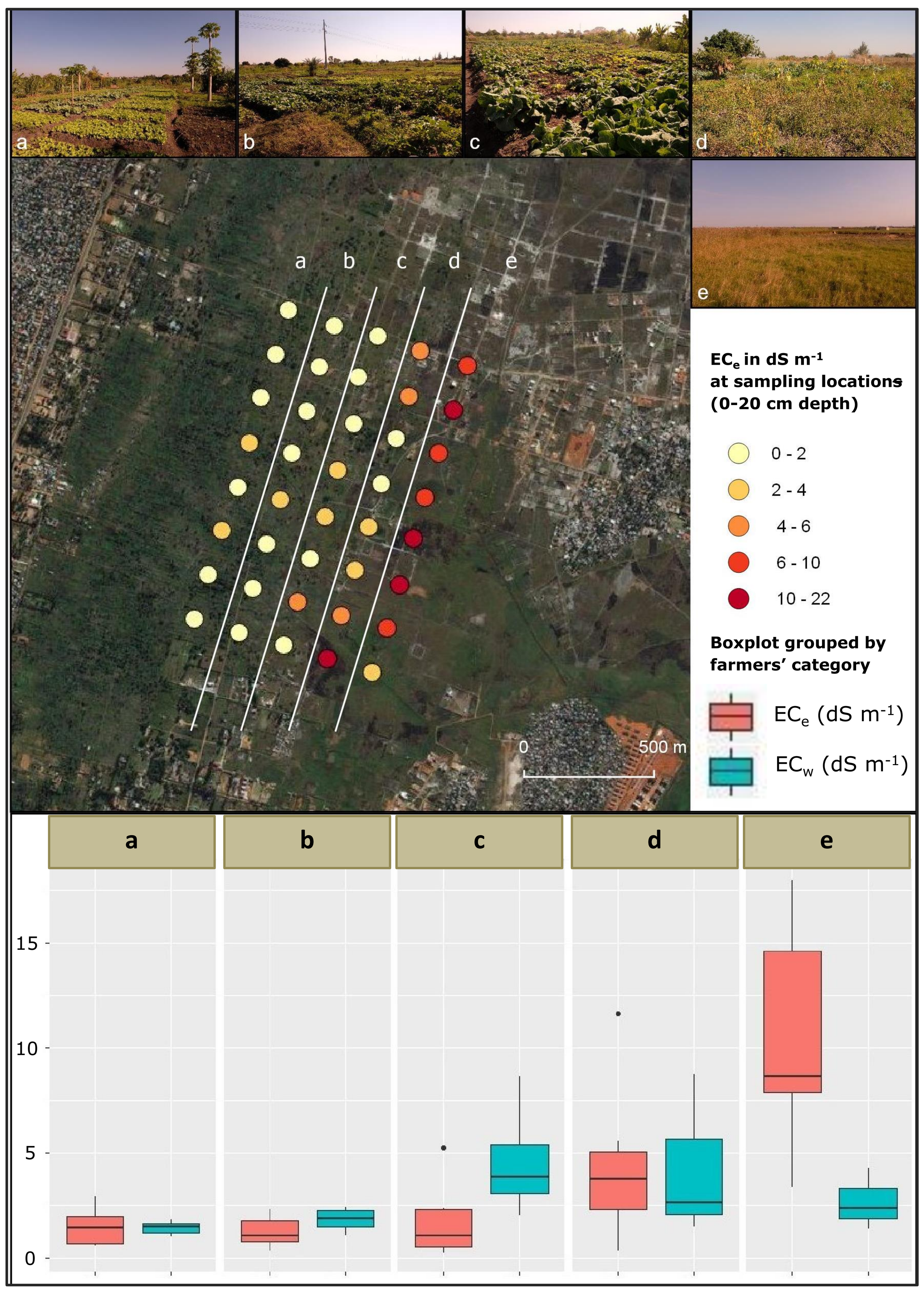

Figure 2: Measured salinity levels of upper 20 cm soil layer (EC_e) and irrigation water source (EC_w) plotted against local farmers' salinity categorization (a-e), which were described as: (a) 'non-saline', (b) 'slightly saline' (25-50% yield loss), (c) 'saline' (50-75% yield loss), (d) 'too saline for crop production' (75-100% yield loss), (e) 'highly saline'. Upper section: Photographs of each category, demonstrating apparent changes in crop health and land use. Middle section: Spatial representation of EC_e for individual sample points. Lower section: Boxplot representation of EC_e and EC_w grouped by farmers' salinity categorization. ANOVA and Fisher's LSD test confirmed farmer categories c, d and e as statistically distinctive entities based on either EC_e or EC_w measurements; while a differentiation between categories a and b couldn't be substantiated.

3) Saline Agriculture Field Trials

- Innovative SA practices with potential to be sustainably introduced into the local production system were identified and are successively tested, a.o.: * animal manures * biofertilizer * biochar * composts * slow-release urea * tolerant cultivars * *Sesbania* spp. green manures * (Figure 3 a, e).
- Farmer Field School format proved to be a viable participatory approach. Farmers strongly informed trial design and support monitoring (Figure 3 c, d).
- The participatory trial setup proved to partly compromise scientific accuracy but to increase ownership of local stakeholders.

Figure 3: Impressions of participatory trial setup and monitoring: Application of biochar amendment (a), Data collection at lettuce harvest (b), Farmer Field School session (c), Preparation of experimental plots (d), *Sesbania sesban* pilot demonstration (e), Monitoring of soil parameters with portable sensor equipment STEP Systems COMBI 5000 (f).

Conclusions and Outlook

- Globally, more application-oriented research is needed to further the understanding of sustainable salinity management adapted to the particularities of smallholder vegetable production systems in the Global South.
- Smallholder farmers exposed to salt-affected soil and water resources often demonstrated a considerable but expandable (tacit) knowledge level on agronomic salinity management.
- Local sensory approaches for salinity assessment should be complemented by cost-effective portable soil and water sensor equipment for improved salinity management decision making.

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