

# Participatory Piloting of Agronomic Strategies to Mitigate the Impacts of Soil Salinity in Horticultural Systems of Southern Mozambique (SaliHort)

Activity Report: January – December 2022



**ABIODES**  
ASSOCIAÇÃO PARA  
DESENVOLVIMENTO SUSTENTÁVEL



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## (1) Agronomic Field Trials

### Scientific Field Trial – Organic Soil Amendments

As in the previous year, a scientific field trial on the comparison of different soil fertility management strategies under saline conditions was implemented. It included three plots, representing a salinity gradient. Once again, Tronchuda kale and lettuce constituted the research crops. The most successful treatment of 2021 – chicken manure application – was compared with 3 innovative soil amendments: biochar, plant-based compost, and a liquid biofertilizer, complemented with a control treatment which excluded any organic soil amendment. All treatments included a top dressing with urea. Two experimental cycles were completed between April and October. 4 students of the University Eduardo Mondlane took the lead in trial maintenance and data collection. Preliminary results were discussed in the context of the project's annual workshop (cf. ), indicating that chicken manure and plant-based compost outcompeted the other treatments, evaluated against final crop yields. Finalization of the respective student theses are expected for early 2023. An integrative and conclusive processing of the data gathered in the course of the last 2 years is planned for 2023.



## Extension Worker Led Complementary Experiments

In order to increase the outreach of the project and make use of available agronomic inputs, it was decided to engage extension workers as multipliers and complementary investigators. Interested colleagues were endowed with individual input/technology packages, which they applied independently in collaboration with the different farmer associations of their respective jurisdiction. The products handed out included:

- seeds of various alternative crops and varieties
- slow-release and conventional urea
- NPK fertilizer

The basic idea of all experiments was to compare conventional methods with recommended 'improved' approaches. In the case of the fertilizer approaches tested, basal (NPK) dressings and slow-release urea applications were considered as novel / 'improved' methods. A close (scientific) monitoring of these activities through the core project team wasn't possible. However, participating extension workers were required to report on activities and results. The following key learnings / observations were communicated:

- The distributed vegetable rape and beetroot varieties proved to be comparatively tolerant and productive.
- Slow-release urea applied during crop establishment and first growth stages was evaluated as superior to normal urea.
- Basal dressings with NPK proved to be advantageous in beetroot and cabbage crops.



## Pilot Trial 'Saline Agriculture Package'

Under the guidance of *The Salt Doctors*, which visited us for a training and evaluation assignment in November 2022 (cf. chapter 4), the project team, together with the collaborating farmer groups, elaborated a 'Saline Agriculture Package' which integrates several salinity management practices applicable in the local context. A respective demo trial was implemented on one of our experimental sites. It followed the following set-up:

- Increased height of individual planting beds and deeper trenches between beds for improved drainage.
- Higher irrigation intensity prior and after sowing/planting for improved salt leaching.
- Organic mulch cover for reduced evaporation and potential capillary rise of salts.
- Use of unconventional crop varieties which are proven to demonstrate higher tolerance level (in the case of this first pilot, a new beetroot variety was applied).

On an adjacent plot, a newly acquired *Sesbania* species (*Sesbania bispinosa*) is being piloted.



## (2) Farmer Field Schools

Also this year, our scientific field trial was complemented by a Farmer Field School, open to members of the respective producer associations. Six intensive sessions of training and joint trial assessment were implemented, one per trial plot (3) and experimental cycle (2). Apart from that, farmers and extension personnel were encouraged to actively participate in all maintenance activities of the trials. A final intensive 3-day FFS was implemented together with the *Salt Doctors* between 15. and 17.11.2022, which registered strong participation of all collaborating farmer associations and extension personnel, and led to the installation of a small complementary pilot trial (see above section). These classical FFS sessions were complemented by exchange visits in the context of our networking activities (see chapter 4). In both cases, participation of farmer representatives and extension personnel was encouraged and registered.



### (3) Promotion of Sensor-based Salinity and Soil Health Monitoring

The project's portable soil sensor equipment continued to be indispensable for all project activities, especially in the context of the scientific field trial. Apart from that, they were also increasingly employed in the numerous excursions and exchange visits realized by the project team (see chapter 4). With their help, we were able to realize rapid salinity assessments at the different field sites visited in southern Mozambique, thus improving our analytical skills and increasing the learning effects during each exchange. The trainings provided by the *Salt Doctors* in November (cf. chapter 4), introduced to us several additional technological solutions, which might be interesting to include as complementary tools in future project phases.



Furthermore, advances were made with regard to the mapping of several farmer associations in Maputo's agricultural green belt in terms of soil salinity parameters. One student of the geography department of the University Eduardo Mondlane, bringing with him valuable expertise in GIS, took the lead in this task. Key soil and water parameters were mapped, and local farmers' salinity knowledge documented. The results of this study will provide baseline information for targeted regular salinity monitoring in the project region, envisioned for the future.



## (4) Fostering Networks on Saline Agriculture

### Excursions to Salt-affected Production Systems in Southern Mozambique

This year we had the great opportunity to intensify our networking activities on the national level. The following excursions and exchange visits were realized (cf. table 1). The objective was to get a better understanding of soil salinity dynamics in the context of other production systems, exchange experience with respective local stakeholders, increase the technical capacities of our project personnel, and thus ultimately improve the training quality in our key project area. Furthermore, the realized exchanges will inform the conceptualization of future Saline Agriculture projects, intended to be implemented by the project consortium on a larger scale in Mozambique.

Table 1: Excursions and Exchange Visits realized in 2022.

Destination	Dates	Explanations
Chókwe	10.11.2022	Visit to highly degraded, salt-affected fields in one of the country's major irrigation schemes, dominated by rice production.
Xai-Xai	11.11.2022	Visit to moderately salt-affected rice production sites in one in one of the country's major irrigation schemes.
KaMabukwana	17.11.2022	Preliminary soil salinity evaluation in Maputo's second large agricultural green belt, sounding out prospects for the expansion of project activities in 2023.
Boane	23.11.2022	Visit to a salinity tolerance screening trial on sweet potato, implemented by the International Potato Center (CIP).
Marracuenne	08.12.2022	Visit to a salt-affected smallholder rice producing area along the Incomati river.
Inhambane	16.-17.12.2022	Visit to mixed-farming systems along the river Mutamba, partly affected by soil salinity. Visit to the urban coastal vegetable production sites of the town of Inhambane, being affected by seawater intrusion.





## Networking and Presentation of Preliminary Project Results on International Platforms

The project team participated in two international scientific conferences, presenting preliminary results in a poster format (cf. table 2). Given the hybrid set-up, participation was predominantly virtual. Only Jakob Herrmann had the chance to be present at the Tropentag conference in person. In any case, the project team was able to call attention to its work, receive valuable feedback through exchange with conference participants and gain insights into other interesting scientific work being done in the field of sustainable soil management and tropical agriculture.

Table 2: Conference Participation in 2022.

Conference	Dates	Poster title
Global Symposium on Soils for Nutrition (GSOIL4N)	26.-29.07.2022	<a href="#">Soil Salinity Management in Coastal Smallholder Vegetable Production in Mozambique - The Role of Synthetic and Organic Fertilizers and Manures.</a>
Tropentag Conference	14.-16.09.2022	<a href="#">Participatory Research for Agronomic Salinity Management - Experiences from Coastal Peri Urban Vegetable Production in Maputo, Mozambique.</a>  <a href="#">Complemented by a mini-paper.</a>

Furthermore, we followed up on the activities of the [International Network of Salt-affected Soils \(INSAS\)](#), e.g. participating in its work on the first global assessment of salt-affected soils.



## Annual Stakeholder Workshop

Following the same format as last year, a general stakeholder workshop was realised on November 23<sup>rd</sup> and November 24<sup>th</sup>. We were very grateful for the collaboration with the International Potato Center Mozambique (CIP), which allowed us to visit its salinity tolerance screening trial on sweet potato varieties, currently being conducted on a research plot in Boane. The field day was followed by a technical seminar on the second day of the event. We were honoured by a strong and active participation of our diverse guests, representing the farming community, extension services, NGOs, and scientific/technical institutions. A total of 31 participants, representing more than 10 institutions, were present. Next to the presentation of our own implementation milestones and preliminary scientific results, we counted with an interesting contribution of the CIP, along with sessions for open discussions and feedback to the projects' approaches.



## External Training and Evaluation Mission – The Salt Doctors

A highlight of this year's project activities was our collaboration with [The Salt Doctors](#), a social enterprise from the Netherlands with expertise in Saline Agriculture and soil salinity management. Thanks to additional financial support provided by *Stiftung Ursula Merz*, we were able to invite Dr. Arjen de Vos of *The Salt Doctors* for a training and technical project evaluation mission to Maputo. In the course of seven very intensive working days (10.-17.11.2022), theoretical trainings, in-field practical trainings and joint excursions were realized. The achieved knowledge transfer was considerable. We got a lot of vital impulses in the fields of salinity assessment, Saline Agriculture approaches and field experiment setups, amongst others. A technical project evaluation report was provided after the mission. All this input will allow us to improve our work on the promotion of Saline Agriculture in Maputo and Mozambique.



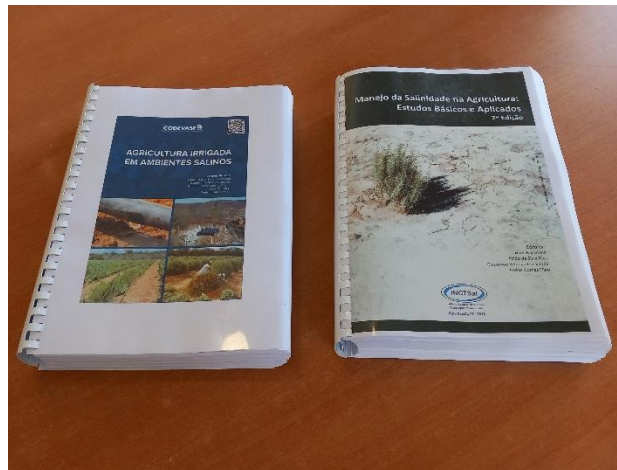
## Material Endowment

In 2022, we were again able to augment our technical equipment. A Leaf Area Index Meter is improving the analysis capacities regarding crop parameters in our field trials. Furthermore, replacement sensors for our Step Systems COMBI 5000 equipment were purchased.

Type	Item	Quantity
Plant Sensor	AccuPAR: LP-80 Leaf Area Index (LAI) Meter	1
Soil Sensor	STEP Systems: COMBI 5000 Add-on: activity sensor probe, 75 cm	2
Soil Sensor	STEP Systems: COMBI 5000 Add-on: multi sensor probe, 50 cm	2

Additionally, we purchased scientific literature in printed format, partly in Portuguese language, which is intended to improve the access to relevant information on soil salinity management, especially for university students. It is made available to interested persons through the agricultural faculty of the University Eduardo Mondlane.

Item	Quantity
Gupta and Goyal (2021): Soil Salinity Management in Agriculture - Technological Advances and Applications, APPLE ACADEMIC.	1
Chhabra (2021): Salt-affected Soils and Marginal Waters - Global Perspectives and Sustainable Management, Springer.	1
Arora et al. (2017): Bioremediation of Salt Affected Soils - An Indian Perspective, Springer.	1
Wallender and Tanji (2011): Agricultural Salinity Assessment and Management, ASCE.	1
Gheyi et al. (2016): Manejo da Salinidade na Agricultura - Estudos Básicos e Aplicados, INCTSal.	1
Santos Cerqueira et al. (2021): Agricultura irrigada em ambientes salinos, CODEVASF.	1



## Outlook

The initial project period has come to an end with December 2022, after two and a half years of implementation. A lot of lessons have been learned, and despite certain constraints encountered along the way, we are confident to draw a positive balance. The project was able to raise awareness, to put Saline Agriculture on the agenda, to stimulate exchange between various local stakeholders, and, most importantly, to provide impulses for the farmers of the project's target region in Maputo. A considerable part of the intended academic processing is going to be realized only in the course of 2023. Independent of this self-assessment, we are highly motivated to continue our efforts to promote Saline Agriculture in Mozambique and thus contribute to a sustainable and climate-smart development of the country's agricultural sector. We have prospects to continue our project activities in Maputo through a new (financial) partnership with stakeholders of the neighbourhood twinning initiative between KaMabukwana (Maputo) and Lichtenberg (Berlin). Furthermore, we intend to attract funding which will allow us to up-scale and eventually reach out to other affected production systems within the country.

## Relevant Links and Posts

### Project Website

[English Version](#)

[German Version](#)

### Selected Social Media Posts 2022

21.11.2022 - [The Salt Doctors – Training and Evaluation Mission](#)

31.07.2022 - [Poster Presentation at the Global Symposium on Soils for Nutrition](#)

01.06.2022 - [Difficult Start for This Year's Field Activities](#)

## Funding

### Total Funding in 2022

Approximately 42.000 EUR for general project activities, provided by:

- The Conservation, Food & Health Foundation,
- Development Cooperation of the German Federal State of Hesse

An additional funding package of 18.700 EUR for internal capacity building and project evaluation, provided by:

- Stiftung Ursula Merz

### THE PROJECT TEAM

Maputo, January 2023

# Participatory Piloting of Agronomic Strategies to Mitigate the Impacts of Soil Salinity in Horticultural Systems of Southern Mozambique (SaliHort)

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## (1) Agronomic Field Trials

### Successful Conclusion of 2021's Scientific Field Trials (June – October 2021)

The field trials were continuously implemented throughout the second half of 2021, without any significant complications or delays. Following the initial trial setup and schedule, 2 experimental cycles were completed on all 3 field sites. This year's trial focused on the comparison of 4 locally established strategies of soil fertility management, based on their effectiveness to sustaining vegetable crop yields under saline conditions (different combinations of urea, NPK and chicken manure applications; cf. Activity Report January-May 2021). However, it needs to be remarked that certain deviations in terms of cycle scheduling and duration between the different field sites became necessary; a foreseeable effect of their specific agro-ecological conditions (level of salinity, etc.) which influenced crop development. These aspects will have to be considered in subsequent data analysis and interpretation of results (see following section).

Key activities of trial implementation are documented in the following table, accompanied by visual impressions of the data collection consistently realised by the 3 collaborating students of the University Eduardo Mondlane and the Pedagogic University of Maputo (Ercília, Denilson and Aurelio) at the end of each experimental cycle.

Field Site / Association	Activity	Date
<b>Massacre de Mbuzine</b>	1 <sup>st</sup> Trial Setup	01.05.2021
	1 <sup>st</sup> Harvest / Yield Parameter Data collection	25.06.2021
	2 <sup>nd</sup> Trial Setup	21.07.2021
	2 <sup>nd</sup> Harvest / Yield Parameter Data collection	11.09.2021
<b>Costa do Sol</b>	1 <sup>st</sup> Trial Setup	11.05.2021
	1 <sup>st</sup> Harvest / Yield Parameter Data collection	08.07.2021
	2 <sup>nd</sup> Trial Setup	29.07.2021
	2 <sup>nd</sup> Harvest / Yield Parameter Data collection	18.09.2021
<b>Thomas Sankara</b>	1 <sup>st</sup> Trial Setup	18.05.2021
	1 <sup>st</sup> Harvest / Yield Parameter Data collection	16.08.2021
	2 <sup>nd</sup> Trial Setup	17.08.2021
	2 <sup>nd</sup> Harvest / Yield Parameter Data collection	12.10.2021







## Data Analysis and Presentation of Preliminary Results (November 2021)

In the frame of the project's first Stakeholder Workshop, held in November 2021 (cf. respective contribution under chapter 4 below), Ercília, Denilson and Aurelio presented preliminary results of their research efforts (see photos below). Certain trends in terms of effects of sites x treatment factors of the experiment were already highlighted in this context (e.g. clear positive effect of chicken manure application on crop productivity under saline conditions, etc.), which raised hopes for meaningful final results. Those are expected to be available in early 2022, when the 3 students are envisaged to submit and defend their theses. The Stakeholder Workshop, which partly functioned as a scientific colloquium, provided an ideal feedback platform. The students profited from valuable suggestions from the workshop's participants, which will guide and improve their scientific analysis and presentation of the trial's data.



## Setup of Pilot Trial for selected Salinity Management Practices (October – December 2021)

Taking into account indications of an extended dry season in 2021, which would result in preferable production conditions until the end of the calendar year, the project team decided to take the opportunity to pilot certain salinity management practices, which eventually will be picked up upon in upcoming scientific trials. Essentially, 2 approaches were applied, in 2 of the project's field sites (Massacre de Mbuzinbe, Thomas Sankara):

### a) Screening of selected locally available vegetable crop species and varieties with presumably higher salt tolerance.

In the course of the year, the project team already had realised an internal survey on the (leafy) vegetable crop species and varieties available through the conventional national seed distributors. The resulting varietal list, evaluated against information deduced from scientific literature on salt tolerance of vegetable crops, led to the selection of the following crop species / varieties for our pilot trial, eventually set up in mid-October 2021 (see also photos below):

Crop Species	Varieties
Leaf Mustard ( <i>Brassica juncea</i> )	Florida Broad Leaf
Rape Kale ( <i>Brassica napus</i> )	English Giant
Swiss Chard ( <i>Beta vulgaris subsp. vulgaris</i> )	Fordhook Giant
	Green Flag
	Rhubard
Beetroot ( <i>Beta vulgaris subsp. vulgaris</i> )	Crimson Globe
	Detroit Dark Red
	Detroit Short Top
Wild rocket ( <i>Diplotaxis tenuifolia</i> )	-

At this pilot stage, the trial was exclusively evaluated in qualitative terms. Under the elevated salt levels of the field site of Thomas Sankara, only the selected beetroot and swiss chard varieties proved to be productive. These insights will inform the decision making for upcoming scientific field trials of the project, along with the continuously improved Farmer Field School (FFS) curriculum. Latest FFS activities, as well as field visits in the context of our networking activities already benefited from joined in-field evaluation of this pilot trial (cf. chapter 2 and 4 below). The trial was concluded, and field sites cleared, on the 20.12.2021.



**b) Monitoring of growth and development of the green manure crop *Sesbania sesban* under local ecological conditions.**

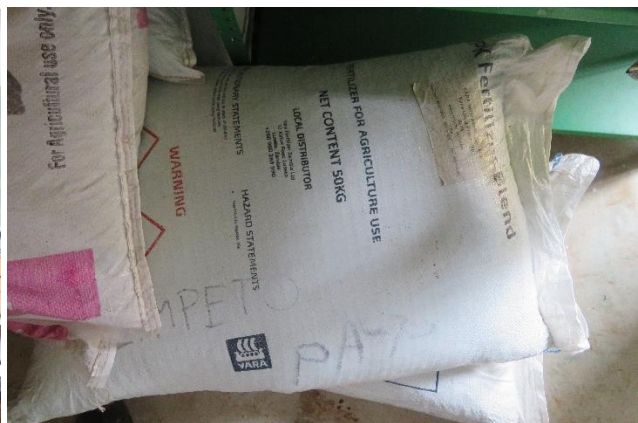
Following the same logic, a second pilot trial was set up for the evaluation of the promising green manure crop *Sesbania sesban*. *Sesbania* is a leguminous, naturally perennial plant with great potential of fixing nitrogen and generally improving soil conditions under saline conditions. Currently not widely used in Mozambican cropping systems, the project team had to make some efforts to identify a source of planting material. Eventually, we were able to secure a restricted quantity of seeds and seedlings through the Mozambican Institute of Agricultural Research (IIAM). The trial was set up in mid-October 2021 (see photos below). Growth and development of the seedlings will be continuously monitored until early 2022 (and possibly beyond). If crop development proves to be satisfactory under local conditions (as our preliminary observations indicate), and if sufficient additional planting material can be secured, participatory field trials on farmer plots, to identify viable modalities for *Sesbania*'s integration into the local cropping system, are envisioned for upcoming project periods.



## Conceptualisation and Preparation of 2022's Field Trials

Next to above-described pilot trials, the project team undertook further efforts to explore the possibilities for upcoming field experiments. With the aim of picking up on this year's trial, which compared locally common soil fertility management strategies with regard to their potential for mitigation of soil salinity effects, the project team envisions to introduce new and innovative soil fertility management approaches into the project's upcoming experimental activities. This may include the application of different kinds of fertilizers and soil amendments, such as biochar, biofertilizers, foliar fertilizers, slow-release fertilizers, soil corrective formulations, etc.

In the course of the second half of 2021, an internal survey of locally available products and suppliers was realised. Furthermore, selected products were purchased for familiarization with its application modalities and preliminary evaluation (see photos below). A conclusive experimental concept for the upcoming phase will be elaborated by the project team in early 2022. Re-initiation of experimental activities after the break of the rainy season is expected for March 2022.



## (2) Farmer Field Schools

### Farmer Field School Sessions in 2021 and Training Curriculum Development

The general conceptual approach to the Farmer Field School (FFS) work package has been outlined in our previous activity report: active farmer and extension personnel participation in all key maintenance activities of the scientific field trials is encouraged and complemented by specific field training events. A first pilot of such a FFS session has been realised on the 09.06.2021 at our field site of the association Massacre de Mbuzine (24 participants, see photos below). It proved to be a successful event, with positive feedback from all the participants. The farmers and extension workers present especially appreciated the consistent scientific and participatory approach of the FFS format, a concept still new to the project area. Since the training session happened at a stage of advanced crop development, certain trends of the effects of the trial's treatments were well visible (difference in crop development between the treatments), and a respective lively discussion evolved. At the same time, the event allowed the project team to pilot and probe different methodological approaches to the FFS format, as well as topical aspects of the pre-designed curriculum.

#### ***First Pilot Farmer Field School Session at the Association Massacre de Mbuzine (09.06.2021)***



Based on this initial experience, an internal FFS guiding document was elaborated, with a preliminary version having been finalized in July 2021. However, this document is considered as a work in progress, which will be continuously adapted throughout the project's implementation. Organisational and COVID-19 related constraints, along with an unexpected high workload of the project team eventually restricted us to only realize 1 one-day training session per association in this year's season. All of these 3 events were realised in September 2021 (see photos below). Next to a participatory evaluation of the current field trial, general concepts to soil salinity management were conveyed. An additional highlight of all 3 sessions, was the participation of representatives from Kvuno Soil Labs / Solidaridad Southern Africa, which presented their innovative technological solutions and services for in-field soil analysis (see chapter 3).

#### ***Farmer Field School Session at the Association Massacre de Mbuzine (08.09.2021, 24 participants)***



***Farmer Field School Session at the Association Costa de Sol (14.09.2021, 20 participants)***



***Farmer Field School Session at the Association Thomas Sankara (20.09.2021, 18 participants)***



These classical FFS sessions were complemented by additional field day activities (see following sections) and exchange visits in the context of our networking activities (see chapter 4). In both cases, participation of farmer representatives and extension personnel was encouraged and registered.

## Realisation of a Field Day for Knowledge Exchange in Maputo's Green Zone of KaMabukwana (29.11.2021)

The project's (experimental) activities are concentrated in Maputo's Green Zone of KaMavota, where the problem of soil salinity is most pertinent. But also, in other production zones of the city, salinity dynamics are noted. Therefore, towards the end of the season, when first tangible insights had been gathered in the frame of the project, a field day in the Green Zone of KaMabukwana was organised, with the aim of sharing key experiences with local farmer representatives, using the common communication and mobilisation structures of the extension services (see photos below, 33 participants).



## Realisation of a Field Day for Extension Personnel (08.12.2021)

In a similar effort, all of Maputo's extension personnel was invited to a field day at our project's field experimental sights a few days later (see photos below, 21 participants). Lively discussions, exchange of experience and positive feedback to the project initiative was registered at the event. While several extension workers were already closely accompanying the project's activities throughout the year, this event allowed for broad anchoring of our visions, approaches and preliminary insights on soil salinity management among the team of local extension experts, who will play an essential role in eventually transferring the knowledge to the wider farming community.







### (3) Promotion of Sensor-based Salinity and Soil Health Monitoring Continued Assessment of the Project’s Portable Soil Sensor Equipment

The project’s portable soil sensors proved indispensable for a consistent and efficient implementation of the scientific field trials. They allowed for a continuous monitoring of key soil parameters, which would not have been possible with conventional laboratory soil analysis. Especially, the 3 collaborating students mastered the handling of the equipment (see photos below). They were also in the lead of the numerous equipment demonstrations realized in the context of FFS, field days and exchange visits. These presentations along the year achieved considerable sensitization, especially among the extension structures. That is why we are optimistic that, in 2022, they will follow more actively the offer of applying the project’s equipment in the context of their routine extension work.

Also, the database used for our local correlation of sensor equipment based and conventional soil salinity parameters is expected to be enriched with data gathered in the context of 2021’s field trials. The integration of this data will be one of the key tasks in early 2022, when closely revising the data presented by the 3 students.



Despite the general positive experience with the currently used equipment (STEP Systems COMBI-5000), certain potential shortcomings have been noted which relate to suspected imprecise readings of selected parameters. This led to the decision of purchasing additional alternative equipment which in the future will allow for cross-checking, and a general diversification of in-field analysis approaches, including a more regular availability for the use by the extension personnel. The following devices have been purchased in the second half of 2021:

Type	Item	Quantity
Soil Sensor	HANNA HI993310 Direct Soil Activity and Solution Conductivity Measurement Kit	1
Water Sensor	HANNA HI98192 Waterproof Portable EC / TDS / Resistivity / Salinity Meter	1
Chlorophyll Meter (replacement)	KONICA MINOLTA Chlorophyll Meter SPAD-502Plus	1



The project's self-assigned task of elaborating a conclusive concept for soil salinity monitoring in Maputo's agricultural green belt has been postponed to 2022, where we plan to resume our respective efforts with essential support from collaborating students of the geography department of the University Eduardo Mondlane (providing, amongst others, valuable expertise in GIS and survey tool solutions).

## Collaboration with Kvuno Soil Labs / Solidaridad Southern Africa (ongoing)

Kvuno Soil Labs is an entrepreneurial initiative, supported by the development organisation Solidaridad Southern Africa, which aims at providing accessible soil analysis services to smallholder farmers in Mozambique. One of their key tools is a soil scanner, based on soil spectroscopy technology. More info can be found on the following websites:

<http://kvuno.io/index.html>

<https://www.solidaridadnetwork.org/regions/southern-africa/>

We learned about Kvuno Soil Labs' and Solidaridad's work in around June 2021, and immediately established contact, exploring opportunities for collaboration. Our enthusiasm was based on the fact that their technology and services are highly complementary to our own technological approaches, which we therefore wanted to make available to the farming community of our project implementation area. The mentioned soil scanner allows for the analysis of a much broader spectrum of important soil parameters (predominantly plant nutrient contents), while our sensors provide indications of specific key parameters related to soil salinity. Since September 2021, we successfully collaborated with Kvuno Soil Labs / Solidaridad Southern Africa in the context of several events, including our series of FFS sessions and our annual stakeholder workshop, where representatives of the initiative presented their technology and services (see photos below).



## (4) Fostering Networks on Saline Agriculture

### Production of Public-Relations and Information Material

In order to increase the project's visibility locally, and to facilitate our networking activities the following public-relations and information material was produced:

- Information boards were set-up at each of our 3 field sites in June 2021, with the main objective of raising awareness of the project's activities within the local farming community.
- A project information flyer was designed and printed in two versions (English and Portuguese) by September 2021, and since then has already been widely distributed.
- Furthermore, an information roll-up banner was designed and printed in December 2021, which will support any of the project's upcoming networking events.



### Intensification of Technical Exchange with the Project RESADE

The international project RESADE, in Mozambique implemented through the national Institute of Agricultural Research (IIAM), has already been presented in our previous activity report as a strategic collaboration partner for knowledge exchange and joint promotion of Saline Agriculture. Following our initial contacts and a visit to RESADE's project sites in Moamba in May 2021, joint activities intensified in the second half of 2021. We were happy to realise 2 further intensive exchange meetings with the RESADE team, both times welcoming them at our field experimental sites. On one occasion, the Mozambican team was accompanied by specialists from the International Center for Biosaline Agriculture's (ICBA), which is leading RESADE's multinational implementation (see photos below). More info on RESADE can be found on their official website: <https://resade.biosaline.org/>.

#### **RESADE exchange visit (07.06.2021, 11 participants)**

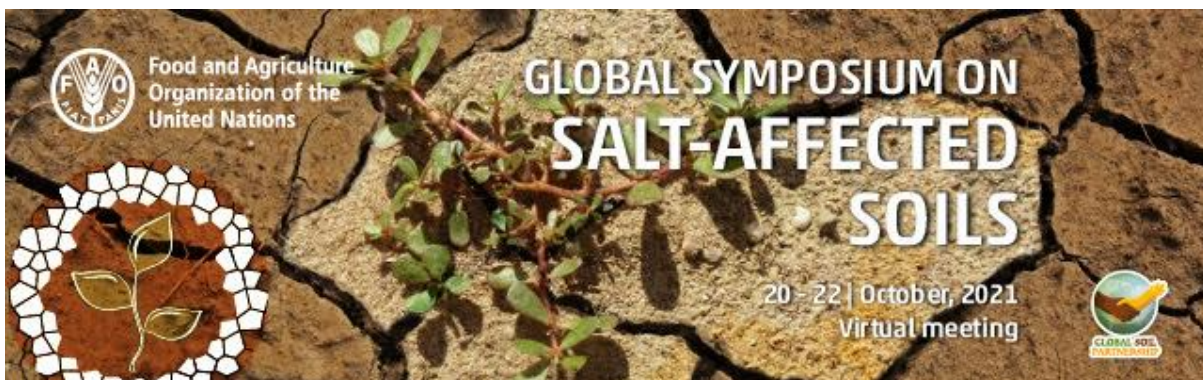


**RESADE exchange visit, including ICBA experts (16.07.2021, 16 participants)**



**Continued Follow-up on the Activities and Opportunities of the International Network of Salt-affected Soils (INSAS)**

Our signup into the International Network of Salt-affected Soils (INSAS, cf. previous activity report) proved very valuable. In the second half of 2021, project team members were able to participate in (or later follow up on) several informative networking and training events organised or promoted by INSAS. Most importantly this included the Global Symposium on Salt-Affected Soils, realised virtually between 20.10. and 22.10.2021. A comprehensive documentation of the event is available under the following link: <https://www.fao.org/events/global-symposium-on-salt-affected-soils/en>



Another opportunity was the ongoing webinar series of INSAS' sister Network "Global Soil Laboratory Network" (GOLOSAN), with several trainings on topics of interest to our project initiative:

<https://www.fao.org/global-soil-partnership/glosolan/capacity-development/en/>



Worth mentioning are furthermore the events around World Soil Day 2021, which with its motto "Halt soil salinization, boost soil productivity" brought into the spotlight our project's concern and that of many other agricultural scientists, activists and practitioners: <https://www.fao.org/world-soil-day/en/>



#### Annual Stakeholder Workshop (18.-19.11.2021)

The highlight of this year's networking activities was our first general stakeholder workshop, realised, under the motto of World Soil Day 2021 (see above), on November 18th and November 19<sup>th</sup>. A joint field day was followed by a technical seminar on the second day of the event (see photos below). We were honoured by a strong and active participation of our diverse guests, representing the farming community, extension services, NGOs, and scientific/technical institutions. A total of 34 participants, representing more than 10 institutions, were present. Next to the presentation of our own implementation milestones and preliminary scientific results, we encouraged contributions of our collaboration partners like the RESADE project (IIAM) and Kvuno Soil Labs / Solidaridad Southern Africa, along with sessions for open discussions and feedback to the projects' approaches. We were able to draw a very positive balance, being encouraged to continue and reinforce our efforts of participatory field experimentation and inter-institutional collaboration in the upcoming project phases.







## General Outlook

The following activities will dominate our project work in early 2022:

- (Financial) Reporting for 2021
- Supervision of student led data analysis and presentation
- Conclusive conceptualisation of experimental activities in 2022
- Incorporation of new batch of students
- Set-up of new field trials, planned for March 2022

## Relevant Links and Posts

### Newly Designed and Updated Project Website (December 2021)

- a) [English Version](#)
- b) [German Version](#)

### Selected Social Media Posts 2021

- 30.11.2021 - [Positive Résumé of Project's Preliminary Achievements in Annual Stakeholder Workshop](#)
- 23.06.2021 - [Start of Farmer Field School Activities](#)
- 12.06.2021 - [Outreach to other Projects and Platforms working on the Topic of Saline Agriculture](#)
- 17.05.2021 - [Field Trials Set Up](#)
- 20.04.2021 - [Exploring Smart Agricultural Practices for Saline Soils](#)

## Funding

### Total Funding in 2021

approximately 32.300 EUR, provided by:

- The Conservation, Food & Health Foundation,
- Development Cooperation of the German Federal State of Hesse,
- Stiftung Ursula Merz

### Confirmed Funding for 2022

approximately 26.000 EUR, provided by:

- The Conservation, Food & Health Foundation

## THE PROJECT TEAM

Maputo, January 2022



# Participatory Piloting of Agronomic Strategies to Mitigate the Impacts of Soil Salinity in Horticultural Systems of Southern Mozambique

Activity Report: January – May 2021

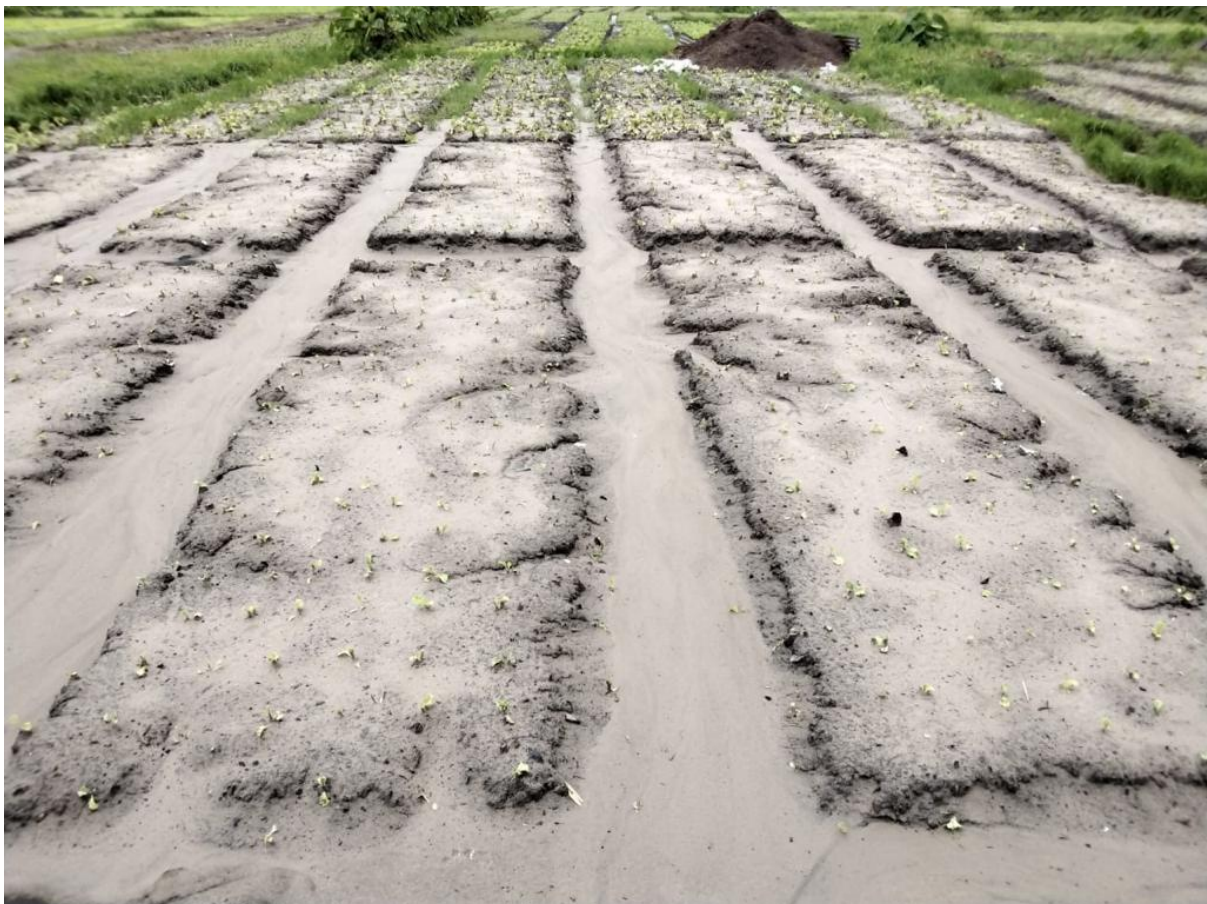


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### **Disruption of Field Activities due to Persistent Rains and Inundations (January – March 2021)**

Field activities of 2021 were slightly delayed, mainly due to persistent effects of the rainy season which had left vast areas of Maputo's agricultural Green Belt inundated and impassable. Collection of soil samples, preparation of field sites or even effective cultivation of crops was practically impossible in the zones of interest to the project until mid-March (see photos below).



## Virtual Stakeholder Exchange on Concept for Soil Salinity Monitoring in Maputo's Agricultural Green Belt (March 9<sup>th</sup>, 2021)

In order to initiate the process of participatory development of a soil salinity monitoring and control system for Maputo's Agricultural Green Belt, a virtual workshop was organised which involved key stakeholders, representing the Municipality of Maputo, the agricultural Faculty of the Eduardo Mondlane University, ABIODES, and the diverse local agricultural extension services.

The objective of this first broad inter-institutional exchange, was to present the project initiative, propose a first conceptual outline of the referred to monitoring system, and exchange ideas and perceptions on the pertinence, practicability as well as technical and human capacity needs of the latter.

The 15 participants gave a fundamentally positive feedback and provided valuable considerations, which will inform the project's procedure related to this work package. The following next steps have been agreed upon:

- Pilot and verify the functionality of the new soil sensor equipment introduced by the project in the context of the field trials run in the course of 2021.
- The project team elaborates a conclusive concept document for the monitoring and control system which will be circulated and revied by the relevant stakeholders.
- Convene follow-up stakeholder meetings.



### Salinidade dos Solos nas Zonas Verdes de Maputo — Potencialidades dum Sistema de Monitoramento



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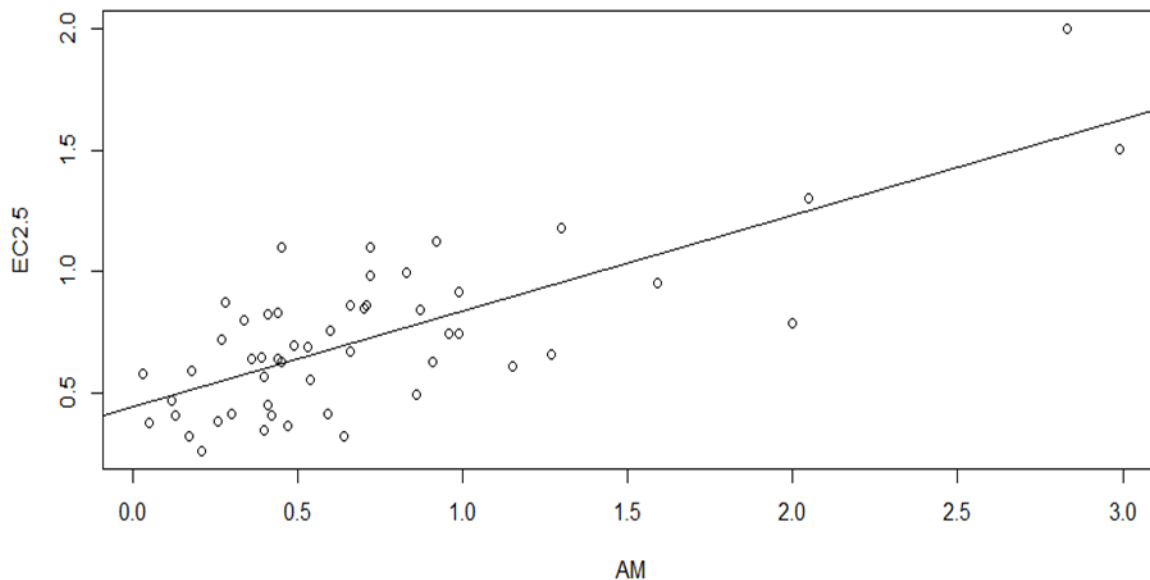
### Preliminary Establishment of Correlation and Regression Equation for Sensor Equipment Based and Conventional Soil Salinity Parameters (March 2021)

Based on the data generated in the context of last year's soil sampling activities, a first attempt has been made to compare the new sensor-equipment-based soil salinity parameter (Activity, AM; as determined by STEP Systems COMBI-5000) with the soil salinity parameter conventionally used by the local laboratories and agricultural extension institutions (Electrical Conductivity based on a 1:2.5 soil-water extract, EC<sub>2.5</sub>). The data base consisted of 52 samples.

The following preliminary linear regression equation has been established for the two parameters:

$$EC_{2.5} = 0.4440936 + 0.3942893 \times AM$$

The respective regression curve is depicted in the figure below. While the equation already is tentatively used in our project's operations, we plan on continuously increasing the data base to allow for its refinement.



## Selection, Measuring and Clearing of Experimental Fields and Coordination with Farmers' Associations (April 2021)

Based on the results of the preliminary soil analyses and in close coordination with the local farmers' associations, three suitable field sites have been identified. Each of the three host associations (Massacre de Mbuzine, Costa do Sol, Thomas Sankara) appointed one of its members as caretaker of the experimental plot and as focal point for all project related activities. All plots were sized and mapped on the 8<sup>th</sup> of April, and in the following days were cleared for cultivation.







## Conceptualisation and Setup of Field Trials, Involvement of University Students (April – May 2021)

All of the three envisioned field experiment sites have been successfully set up between end of April and mid-May. In a first phase, four alternative strategies of soil fertility management are compared based on their effectiveness to sustaining vegetable crop yields under saline conditions. Lettuce and kale have been chosen as the most representative crops of the local cropping system:

- 1) twofold superficial application of urea in the course of the cropping cycle, without application of additional manures or fertilizers (common practice in the local production system, hence our reference/control treatment)
- 2) control treatment + chicken manure application (basal dressing at the time of planting)
- 3) control treatment + NPK fertilizer application (basal dressing at the time of planting)
- 4) control treatment + chicken manure application + NPK fertilizer application (both as basal dressing at the time of planting)

The trial, which is based on a randomized complete block design (RCBD), is closely monitored by Ercília, Denilson and Aurelio, students of the University Eduardo Mondlane and the Pedagogic University of Maputo. Routine tasks include, amongst others, bi-weekly measurements of key soil parameters with the mobile sensors. Crop cycles are expected to last no longer than 40 days, so that first yield parameters can be evaluated by mid-June.

### a) Association Massacre de Mbuzine (30.04./01.05.2021)





**b) Association Costa do Sol (10.05./11.05.2021)**



**c) Association Thomas Sankara (17.05./18.05.2021)**





The setup of all three field experiments has been preceded by yet another collection of soil samples, which was meant to establish baseline characterisations of the experimental plots at the beginning of the experimental cycle.





## Conceptualisation of Farmer Field School Activities (May 2021)

The term Farmer Field School formally refers to a specifically defined participatory training approach developed and promoted by The Food and Agriculture Organization (FAO, see for example: <http://www.fao.org/farmer-field-schools/home/en/>). However, several similar concepts have been devised and applied by other institutions working in the field of agriculture and rural development. In the context of our project, we flexibly draw on these different resources, considering the particularities of our local implementation conditions and budgetary means. A prominent reference for us is the training concept ‘Participatory Agricultural Training’ (Formação Agrícola Participativa, FAP) of the NGO ESSOR. This is due to the fact that our project implementation partner ABIODES has applied this approach in several of its past and ongoing projects in collaboration with ESSOR, and thus gained considerable respective experience. The FAP manual (available only in Portuguese) can be accessed through ESSOR’s website:

<http://www.essor-ong.org/wp-content/uploads/2021/02/Manual-Formacao-Agricola-Participativa-FAP.pdf>

Several members of all the three collaborating farmers’ associations, along with the responsible agricultural extension personnel, are continuously involved in the maintenance activities of the field sites and are thus directly informed about the experiments’ motives and progress. This rather implicit exchange and learning experience is meant to be complemented by explicit in field training events. In the context of the current experimental cycle of 2021, we are envisioning 3 one-day training sessions per farmers’ association. The respective time of the first weeding event has been agreed upon as a suitable occasion to convene the initial training sessions.

The first event is planned for the second week of June, at the association Massacre de Mbuzine. It will focus on a general introduction to the problem of soil salinity in the local horticultural production system, and a thorough explanation of the ongoing field trials. Further training sessions are envisioned to touch topics like: alternative agronomic approaches for soil salinity mitigation, possibility of soil salinity assessment at plot level on the basis of mobile sensing technology, amongst others.



## Extension of Technical Networks and Establishment of Strategic Collaborations (continuous)

### a) Project RESADE – Country Component Mozambique

RESADE (Improving agricultural RESilience to SALinity through DDevelopment and promotion of poor technologies and management strategies in selected countries of sub-Saharan Africa) is a multi-national project led by the International Center for Biosaline Agriculture (ICBA), and funded by the International Fund for Agricultural Development (IFAD) and the Arab Bank for Economic Development in Africa (BADEA). The individual country-packages are implemented by national agricultural research institutions. As the project's title implies, there exist several parallels to our project objective and strategy, the major difference being the focus on different cropping systems. More info can be found on the official project website: <https://resade.biosaline.org/>.

In April we established contact to the project's component in Mozambique, which is implemented by the national Institute of Agricultural Research (IIAM). With the respective colleagues we agreed to maintain an intensive technical exchange. A first highlight was a field visit to RESADE's currently established field experimental side in Moamba, organized on the 31<sup>st</sup> of May. We witnessed the apparent salinization which is affecting extensive areas of the local irrigation system. RESADE plans to experiment with a plurality of agronomic mitigation strategies adapted to the local cropping system of arable crops. In early June we are planning to receive a visit of RESADE's team at our field sites in Maputo.







#### **b) International Network of Salt-affected Soils (INSAS)**

“The International Network of Salt-Affected Soils (INSAS), launched in 2019 during the International Center for Biosaline Agriculture’s (ICBA) first Global Forum on Innovations for Marginal Environments, is a Technical Network of the Global Soil Partnership (GSP) and follow its rules of procedure. The Network aims to facilitate the sustainable and productive use of salt-affected soils for the current and future generations. The mission of INSAS is to support and facilitate joint efforts towards the sustainable management of salt-affected soils for food security, agricultural sustainability and climate change adaptation and mitigation.” (<http://www.fao.org/global-soil-partnership/insas/en/>)

In May we actively joined the INSAS network, by inscribing and participating in its online working groups on ‘Sustainable management of salt-affected soils’ and ‘Halophyte agriculture and salt-tolerant crops and plants’. We are convinced that INSAS is providing an ideal platform for technical exchange. It will allow us to access valuable experience from all over the world and at the same time help us increase our outreach and impact.

#### **c) The Salt Doctors**

In May we also discovered and entered into contact with ‘The Salt Doctors’, a social enterprise from the Netherlands with expertise in saline agriculture and soil salinity management. They have supported and implemented several projects that approached the issue of soil salinity management in agricultural and horticultural cropping systems of the Global South (<https://www.thesaltdoctors.com/>).

Next to agreeing on informal technical exchange, we are considering to conceptualize collaborative work for future project phases.

## Outlook

The following activities will dominate our project work in the coming weeks and months:

- Finalisation of the first experimental cycles. Evaluate and refine the experimental strategy.
- Initiate the Farmer Field School activities.
- Implement the second (and further) experimental cycles.
- Further, accompanying soil analysis and thus complementing our internal data base of sensor-based soil parameters.
- Revert to and intensify the participatory processes for conceptualising a soil salinity monitoring system (first short strategy paper on potential monitoring system).
- Production and divulgation of project info-material in Portuguese (Information boards for field sites, flyers).
- Intensification of fundraising activities to guaranty the project's continuation (and growth) in 2022.
- Continuation and intensification of technical exchange and networking.



## THE PROJECT TEAM

Maputo, May 2021

# Participatory Piloting of Agronomic Strategies to Mitigate the Impacts of Soil Salinity in Horticultural Systems of Southern Mozambique

## Activity Report: August – December 2020

### Procurement of Equipment (July and August)

- Final research and comparison of different options
- Procurement process in Germany

Type	Item	Quantity
Soil Sensors	STEP Systems: COMBI 5000 (pH + Activity + EC + Moisture + Temperature)	2
Soil Sensors	STEP Systems: COMBI 5000 Add-on: multi sensor probe, 50 cm	1
Soil Sensors	STEP Systems: COMBI 5000 Add-on: activity sensor probe, 75 cm	1
Chlorophyll Meter	KONICA MINOLTA: Chlorophyll Meter SPAD-502Plus	1
Tablet	Samsung: Tablet Galaxy Tab Active Pro (10.1", LTE)	2
GPS Adapter	Garmin: GLONASS und GPS Sensor GLO™ 2	2
Camera	Canon: Camera PowerShot SX730 HS	1

### Transport and Hand-Over of Equipment (September)

- Travel of Jakob to Maputo
- Personal Hand-over to project partners on the 18<sup>th</sup> of September (see photo below)



### **Complementary Funding through the 'Development Cooperation of the State of Hesse' (September)**

- Official confirmation of the grant applied from the 'Development Cooperation of the State of Hesse' on 22<sup>nd</sup> of September
- Disbursement received on the 30<sup>th</sup> of September

### **Formalization of Project Partnership (October)**

- Elaboration of MoU
- Appointment of ABIODES as official manager of project funds in Mozambique
- Provisory simplified contract between ABIODES and Weltweit signed on the 12<sup>th</sup> of October
- Transfer of Project Funds to ABIODES on the 23<sup>rd</sup> of October

### **Workshops for Familiarization with the Equipment (November - December)**

#### **a) Sensor Equipment (09.11.2020)**

- Familiarization with the sensor equipment
- Lead by Matias and Professor Famba
- A total of 15 participants, representing the project institutions, agricultural extension bodies and farmer associations







**b) Mapping Tools and Applications (16.11.2020)**

- Introduction of mobile mapping applications
- First discussion of possible approaches for salinity monitoring system
- Lead by Jakob
- A total of 9 participants, representing the project institutions, agricultural extension bodies and farmer associations



**c) Sensor Equipment + Mapping Tools and Applications (16.12. + 17.12.2020)**

- Combinatory and more application-oriented training on the topics of the previous workshops
- Lead by Matias
- Also including participants which couldn't been reached through the previous workshops
- A total of 20 participants, representing the project institutions, agricultural extension bodies and farmer associations







## Collection of Soil Samples for Analysis and Pre-Selection of Project's Field Sites

(14. and 15.11.2020)

- Lead by Matias and Jakob
- Strategic collection of soils samples, always in combination with measurements of new equipment (to allow for generating a dataset to compare mobile sensing measurements with conventional laboratory analysis)
- Main Objective: determine locations in the project area that, based on soil conditions (salinity level, etc.) are suitable for the envisioned field trials and farmer field schools
- Laboratory results available on the 8<sup>th</sup> of December
- Based on the results, follow-up soil data collection planned in December and to be realized in early 2021









### **Outlook (early 2021)**

- Final determination of project field sites (based on second soil data analysis)
- Mini online conference between project partners and other relevant stakeholders on discussing potential strategies for soil salinity monitoring
- As a result, first short strategy paper on potential monitoring system
- Conceptualisation and preparation of field trials and Farmer Field Schools
- Production of project info-material in Portuguese (e.g. information boards for field sites, etc.)