Bureau d'analyses macro-économiques

DyTAEL DE FATICK

Recovery of salty soil

Workshop report on the construction of a guidebook


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I. Context

In Senegal, land salinization affects 1,700,000 ha of the 3,800,000 ha of arable land (LADA, 2003), a fifth of which is located in the Sine-Saloum natural region, particularly in the Fatick area. This salinization, linked to saline ridges and exacerbated by climate change, leads to a reduction in soil biodiversity and fertility, resulting in lower productivity and the disappearance of natural plant cover (Sagne et al., 2022). This situation contributes to the abandonment of arable land, particularly rice paddies, which are gradually being replaced by tannes, with adverse consequences for the food security and resilience of local populations (Amar et al., 2024).

To address this issue, ISRA/CNRF, with funding from the FAO, has carried out a study as part of a research program into efficient methods for integrated control of land salinization, in the village of Fayil, located in the Commune of Diouroup, Fatick Region. The study puts local communities, in particular women rice growers, at the heart of the action in a participatory approach to the sustainable development of saline lands through the promotion of agroecological practices. Indeed, a combination of research-proven methods for restoring saline lands, notably agrochemical (spreading peanut hulls and phosphogypsum) and biological (planting halophytic species : *Eucalyptus camaldulensis* Dehnh, *Casuarina equisetifolia* L. and *Melaleuca leucodendron* Kohler) has been used for greater efficiency and sustainability in the recovery and reclamation of saline lands. And it is important that the results of this study can be capitalized on through a simple tool accessible to technicians and practitioners.

The Initiative Agro-écologie (I-AE) project is an international initiative, supported by the CGIAR, for the holistic implementation of the 13 principles of agroecology. It is being implemented in several countries, including Senegal, with the aim of producing scientific evidence of the positive impact of agroecology, in order to encourage its large-scale development in local areas. The initiative is centered on local partnerships, with a focus on producing scientific data and demonstrating the feasibility of large-scale agroecology in order to foster the agroecological transition by adapting approaches to each local context. To this end, I-AE is supporting the Dynamique pour la Transition écologique locale (DYTAEL) in Fatick, in line with the priorities identified by the collective. One of these priorities is the restoration of saline lands in the Fatick department. This is why the ISRA/CNRF team, as part of the I-AE WP 1.2 devoted to co-design processes, is working on strategies for scaling up innovations enabling the recovery and valorization of saline lands. To this end, a workshop has been held to draft tools for scaling up a range of practices, including a manual for restoring saline lands.

This report reviews the main stages of the workshop organized by teams from ISRA/CNRF, CIRAD and their partners.

II. Workshop objectives

The aim of the workshop, held from May 14 to 17, 2024, was to develop a tool for the optimal scaling-up of best practices in the recovery and reclamation of saline soils. The workshop took place in 4 stages: (i) a visit to the Fayil community plot, (ii) a focus group with representatives.(iii) a session during which the Wheel of the Future methodology was used to characterize the potential impacts of the restored plot, and (iv) a session to draw up a draft guide to restoring saline lands.

III. Workshop sequence

The development of a guide to restoring saline lands, undertaken to capitalize on the results obtained with the implementation of agroecological practices to enhance the Fayil community plot, followed a four (4) step process:

1. Visit to the Fayil community plot

A visit to the one-hectare community plot installed in the village terroir of Fayil, Commune of Diouroup, since 2017 and developed for the benefit of women rice growers, was made in the company of members of the Ndiokhtor economic interest group (GIE). This GIE is active in agriculture (growing rice, groundnuts and millet), livestock (cattle and sheep), and combating the salinization of their land through the management of a vast network of anti-salt dykes. The visit gave workshop participants (see list of participants in Appendix 1) an idea of the results achieved and the scale of the work involved in reclaiming this once bare tanne.

The visit was made by the ISRA/CNRF team, accompanied by representatives of the Fatick DYTAEL, the Association Ambassadeur de l'Environnement (ADE) and the Agence National de Conseil Agricole et Rural (ANCAR), to the community demonstration plot.

In this one-hectare (1ha) plot under enclosure, tillage was followed by the application of peanut hulls (6t/ha) and phosphogypsum (1t/ha) as soil improvers, used alone or in combination at half dose in a completely randomized block design. A plantation of halophytic woody species was planted all around to act as a windbreak and reinforce the wire fence with *Casuarina equisetifolia* and *Eucalyptus camaldulensis*, and inside with *Melaleuca leucadendron* to facilitate recovery from saline soils while creating a microclimate. At the end of the visit, the following results were noted:

- A generally satisfactory planting success rate
- Higher mortality of *E. camaldulensis* followed by *C. equisetifolia*
- Slower growth of *C. equisetifolia* plants in the plot compared with those planted under optimal growth conditions.
- *M. leucadendron* is the most resistant species in these saline soil conditions.
- The wire mesh used to secure the community plot is still holding, despite sagging in places due to the impact of salt on the ferrous materials (rust).
- Standing dead trees due to unauthorized cutting and pruning in the plot.
- Straw from dried-out rice left in place. This drying out of the rice grown on the plot the previous year is due to a break in rainfall that occurred before the rice reached maturity.
- The absence of features such as anti-salt bunds and drains that could have helped retain rainwater and leach out salt.

2. Collecting feedback on the implementation of the Fayil community plot

A focus group was held with some members of GIE *Ndiokhtor* to gather their feedback on how the restoration approach had been carried out, the difficulties encountered and suggestions and/or proposals for improvement. Discussions focused on both the benefits and the constraints they had encountered:

- **Peanut shells**

The plot provided them with good rice yields on the surface units treated with groundnut hulls, with a 39.1% increase between the 2017 and 2018 productions. However, the difficulty of accessing peanut hulls was raised due to their use in the manufacture of livestock feed, and its price which makes it not very accessible to which is added the cost of transport. In fact, supplies in quantity can only be obtained from Kaolack or Lindiane.
The possibility of using manure instead of groundnut hulls was raised, but the small number of livestock quickly became a barrier to this alternative. The possibility of a collective collection of manure was then proposed for compost production, mixing it with some millet stalk residues, tree or shrub twigs or other calcium-enriched materials was suggested as a solution to be tested.

- **Rice**

The rice straw collected during the rice growing season enabled us to get through the lean season without any problems. Discussions revealed that the option of planting nurseries and transplanting rice (preferably a short-cycle variety), although tedious, would result in better yields.

- **Productive water**

The absence of a network of earthen bunds would have reduced the drying out of the rice plants as a result of water evaporation. As the plot is located in a watershed, the erection of a protective dyke/dike completely surrounding the plot would have prevented it from being submerged. Plotting the surface of the land was identified as an important practice to take into account.

- **Halophytic species**

Re-planting the plot with *M. leucadendron*, which is better adapted than the other species (*C. equisetifolia* and *E. camaldulensis)* to these soil and climate conditions, is necessary to ensure the long-term survival of a tree layer in the Fayil community plot.

- **Work organization**

The women's failure to plan the work to be done on the plot, giving priority to their work on their own plot of land to the detriment of the community plot. In fact, the women had agreed to work 3 times a week on the Fayil plot. This was not the case.

3. Session on the Wheel of the Future

Conceived by J. C. Glenn in the early 1970s, "the Future Wheel" is a way of organizing creative thinking and questioning about a future development or trend. It enables us to visualize, analyze and collectively explore the direct and indirect consequences of a specific change (in our case, the reclamation of one (1) hectare of salt land). This tool takes the form

of a graph on which the change under study is placed at the center, and all around the consequences linked together by one or more levels.

The results are then used to identify all the expected or unexpected consequences, whose impacts can be positive or negative. This enables us to think in the present about decisions to be made and actions to be taken to anticipate the best.

In implementing the method, the various dimensions of the STEEP analysis framework (social, technical, economic, environmental and political) were used to fill in the first circle of consequences (effects/impacts), then the second circle and so on. Thus, the impacts identified (Table 1) are broken down and linked as follows:

- ⇨ **The 1st order impacts**, direct consequences of the recovery of the one-hectare plot, concern positive impacts, namely :
  a. Salinity reduction (Ev4)
  b. Improving the availability of agricultural land (S2)
  c. Improving water management (T3)
- ⇨ **The 2nd order impacts** resulting from the first:
  a. *The reduction in salinity* (Ev4), which will result in :
     - Creating a microclimate in the locality (Ev5)
     - Increased availability of forage (woody / herbaceous) (E4)
     - Improving the availability of wood energy (E5)
     - Enhancing biodiversity (Ev1)
     - Increased agricultural production (T1)
  b. *Improving the availability of agricultural land* (S2), which will have the following impact:
     - Increased agricultural production (T1)
     - Increasing land conflicts over access to the most fertile land (S4)
     - Increasing farmer-breeder conflicts linked to divagation (S5)
     - Reducing land conflicts for disadvantaged groups (S6)
  c. *Improved water management* (T3) with the following impact:
     - Increased agricultural production (T1)
     - Enhancing biodiversity (Ev1)
     - Increased availability of forage (woody / herbaceous), (E4)
     - Increased methane emissions (Ev3)
     - Increased farmer-herder conflicts linked to divagation, (S5)
     - Job creation (E2)
- ⇨ **3rd order impacts** :
  - Reducing land conflicts for disadvantaged groups (S6)
    - Increasing social cohesion (S1)
  - Increased farmer-herder conflicts linked to divagation (S5)

- Reduced social cohesion (S1)

- Increased agricultural production (T1)
  - Reducing the rural exodus (S3)
  - Increased revenues (E1)
  - Contributing to food sovereignty (P3)
- Improving the availability of wood fuel (E5)
  - Increased carbon sequestration (Ev2)
- Job creation (E2)
  - Reducing the rural exodus (S3)
  - Increased revenues (E1)

⇨ **4th order impacts :**

- Increased incomes (E1), leading to a reduction in poverty (E3)
- Increased carbon sequestration (Ev2), which has an impact on obtaining potential financing.

The graphic representation of the cascade of impacts caused by the reclamation of a one-hectare plot of land in the village of Fayil takes the form of a mental map representing the relationships between the various consequences identified in terms of the STEEP dimensions.

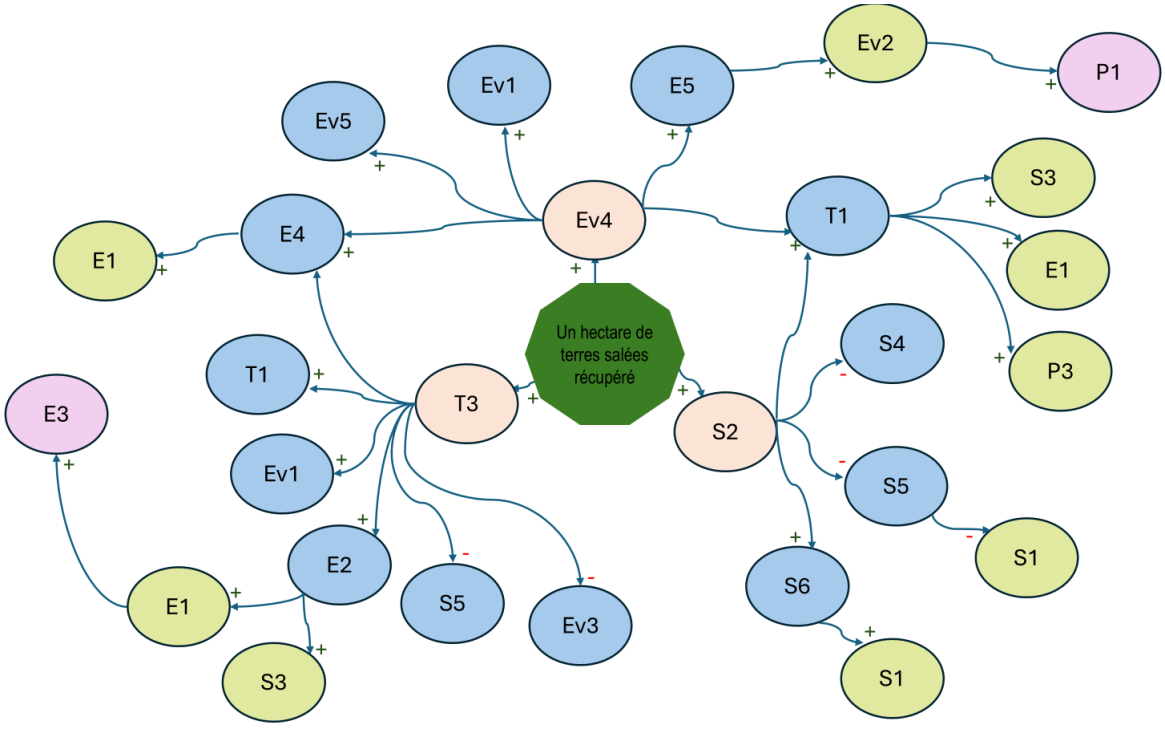

***Figure 1**: Future Wheel representation of the one-hectare plot recovered from Fayil*

Reflection on the consequences of reclaiming the one-hectare parcel of saline land led to the identification of four (04) underlying action levers inherent to the desired state of the parcel.

a) The **land tenure status of the plot**, its location, the type of security, etc., is a determining factor in the success of the saline land reclamation project and its future development. The status of the plot of land to be reclaimed

has a direct influence on its management, the sustainability and profitability of the actions undertaken, and the resolution of any conflicts relating to the use of the plot.

b) **Building the capacity of local communities** by acquiring knowledge of the causes, negative effects and solutions, in particular (c) **approved technical innovations** for reclaiming saline soils, is a key factor in the success and sustainability of actions to reclaim and reclaim saline soils. In fact, it is essential to rely on (d) **collective action** to mobilize and train local communities to take charge themselves, manage and sustain the actions undertaken over the long term to improve their resilience in the face of environmental and socio-economic challenges, a guarantee of food sovereignty.

Table 1. Summary of effects/impacts identified for the different dimensions of the analysis framework

DIMENSIONS	IMPACTS
SOCIAL	1. Social cohesion 2. Improving the availability of agricultural land 3. Reduced rural exodus 4. Potential increase in land conflicts over access to the most fertile land 5. (Potential) increase in farmer-breeder conflicts linked to divagation 6. Reduction of land conflicts for disadvantaged groups 7. Population increase
TECHNICAL	1. Increased agricultural production 2. Producer capacity building 3. Improved water management 4. Innovative techniques for reclaiming proven salt soil
ECONOMY	1. Increased revenues 2. Job creation 3. Poverty reduction 4. Increased availability of forage (woody / herbaceous) 5. Improving the availability of wood energy
ENVIRONMENTAL	1. Improving biodiversity 2. Increased carbon sequestration 3. Increase in methane emission rate 4. Salinity reduction 5. Creating a microclimate in the locality
POLICY	1. Obtaining potential financing 2. Policy to combat land degradation 3. Contributing to food sovereignty 4. Parcel status

5. Drawing up a guide to restoring saline lands

The final stage of the workshop focused on drafting a guide to restoring saline lands. The methodology adopted was to start from the practical case of the Fayil community plot, to be enriched with (i) workshop outputs (visit to the Fayil plot, exchanges with local communities, results of the Wheel of the Future), (ii) other experiences related to the theme, and (iii)

practical cases of saline land recovery in the Dioffior and Djilas terroirs reported by participants and supported by ANCAR and ISRA/Bambey.
ANCAR's agricultural and rural advisor explained a practical case study of the use of reclaimed saline land for rice-growing activities, with a revisited rice production itinerary and the development of the plot with the installation of dikes preserved until the rice harvest, using the Isriz 10 variety (the variety developed by research for rice-growing in upland areas), and taking advantage of existing dikes on the site.

The Saline Land Reclamation Guide will be aimed at populations in areas affected by land salinization. Its objective will be to enable the recovery and valorization of saline lands in order to strengthen the resilience of communities in the face of global change and contribute to food sovereignty.

Implementation of the community plot in the Fayil terroir has highlighted the importance of an integrated approach to reclaiming saline land, involving local populations from start to finish (collective action) and putting their local knowledge into practice. As a result, the guide promotes the combination of several proven methods for greater efficiency in the fight against land salinization. This innovative approach, an agroforestry model of saline soil recovery, combines (i) physical or mechanical methods through the construction of hydro-agricultural structures such as anti-salt dykes and dikes; and end-of-cycle ploughing, (ii) biological methods with the reforestation of halophytic forest species, (iii) chemical or organic methods with the spreading and burial of calcium-rich materials (peanut shells, phosphogypsum, compost....) at recommended doses, (Guide Map in Appendix 2).

IV. Conclusion

A visit to the Fayil community plot in the company of women rice growers, members of GIE *Ndiokhtor* and a representative of Fatick's DYTAEL enabled us to gather very pertinent suggestions/observations from resource persons.

Feedback from the women rice growers highlighted a number of points to be taken into account when continuing the plot's activities and scaling up this innovative approach.

The Wheel of the Future method applied to the recovered community plot, taken as an element of change in the ecosystem of the Diouroup commune, enabled us to identify (i) its social, economic, environmental, technical and political impacts and (ii) the levers of action to be set in motion for its sustainability.

The information gathered during the workshop was used to draw up a proposal for a guide to reclaiming salt soil.

Appendix 1: List of participants in the visit to the Fayil community plot

	First and last names	Membership/Structure
1	Tening NGOM	GIE *Ndiokhtor*
2	Marie Louis FAYE	GIE *Ndiokhtor*
3	Ngor SARR	GIE *Ndiokhtor*
4	Mame Birame SENE	DYTAEL Fatick
5	Daouda Kane	DYTAEL Fatick
6	Birame DIOP	ANCAR
7	Katim TOURE	UT/ENSA
8	Marième fall BA	ISRA/CNRF
9	Dioumacor FALL	ISRA/CNRF
10	Mame Arona THIAW	ISRA/CNRF

Appendix 2: Plan of the salty soil recovery guide

Introductory note

I. Context

II. Definition

- ***Land salinization***
- ***Recovery***

III. Scope of the phenomenon

IV. Consequences

V. Recovery methods

1. ***Physical or mechanical methods***
2. ***Biological methods or reforestation***
3. ***Chemical or organic methods***

VI. Integrated saline land reclamation strategy

VII. Agrosilvopastoral and fisheries development strategies

VIII. Constraints on reclamation of saline soils

Conclusion

Appendix 3 : photos of the meeting

Family photo of the field visit and workshop

Melaleuca leucadendron trees in the reclaimed plots of Fayil

Plot recovered from Fayil: discussions in the rows of Melaleuca leucadendron plants

Trees on a once bare tanne

(A) Pruning (excessive cuts) on a Filao (*Casuarina equisetifolia*). (B) A dead standing tree (*M. leucadendron*)

Traces of grazing (A) and cutting woody plants (B) in the reclaimed plots of Fayil

Observations and exchanges with community plot stakeholders

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