Saline farming: a tangible reality for sustainable food production in salinized areas

➢ 11% of the world’s irrigated areas are already affected by some degree of salinization (FAO, 2012)
➢ Globally 1 billion hectares of lands are salt-affected
➢ Estimated rate of soil salinization per year = 0.25-0.50 million hectares

https://salcc.databasin.org/maps/new#datasets=2456df2b123f4f979444139f11f88233
On a global scale, it has been estimated that every minute 3 ha of currently arable land becomes unproductive due to secondary-induced salinization, and it is estimated that between 10 and 20 Mha of irrigated land deteriorates to zero productivity each year. (Zhu et al., 2005)
Desalination – Brine discharge

GLOBAL

141.5 million m³/day reject brine from all types of desalination

MENA region

100 million m³/day reject brine from all types of desalination = 70.3 % of global brine production


Why Saline Agriculture?

✓ Releases pressure on good quality water and land resources
✓ Utilizes wastelands and poor quality water resources
✓ Provides new sources of food, feed, biofuels, fiber
✓ Generates employability particularly youth and women
✓ Climate change mitigation: rehabilitation of degraded lands, CO₂ sequestration
✓ Climate change adaptation: improves resilience of local communities

Improved food and nutrition security. Improved livelihoods.
Resources for saline agriculture implementation

• Saline water resources (brackish ground water, seawater, reject brine from desalination, drainage water, aquaculture effluents, etc.)
• Degraded soils (saline, saline-sodic, barren lands)
• Plants (salt-tolerant varieties of conventional crops, halophytes)

Crops Salinity Tolerance

(Munns and Tester, Ann. Rev.PB, 2008)
ICBA’s projects

1. Rehabilitation of Degraded Lands in UAE

- Farms abandoned due to high irrigation water salinity (15-18 dS/m)
- ICBA introduced four salt-tolerant perennial grasses:
  - Distichlis spicata
  - Sporobolus virginicus
  - Sporobolus arabicus
  - Paspalum vaginatum

- Fresh biomass yields ranged 75-150 t/ha/yr → 66% higher than Rhodes grass (low salinity 2 dS/m)
- 44% less water use than traditional forages
2. RESADE project

The project is focusing on:
1) Introducing salt-tolerant crops and best agronomic management practices
2) Developing value chains for introduced cropping systems
3) Building the capacity of farmers and extension workers in salinity-resilient and climate smart agriculture in collaboration with national agricultural research and extension services (NARES)


3. RAMSAP project – Rehabilitation of Degraded Lands in Ethiopia

- Field trials were conducted to test suitability of salt-tolerant crops and forage genotypes under different agro-climatic zones of Ethiopia and South Sudan.

- More than 20 salt-affected genotypes were introduced. These include (Barley = 3; Sorghum = 5; Quinoa = 5; Cowpea = 3; Sesbania = 3; Pearl Millet = 2; Rhodes grass, Panicum and Cinchurus).

- Trials were conducted in the research centers and farmer fields in collaboration with the MoA.

- These crop varieties produced 20-30% higher yields than the local traits.

4. Morocco: Quinoa Value Chain

<table>
<thead>
<tr>
<th>Protein content (%)</th>
<th>Seed yield (T/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9</td>
<td>1.6</td>
</tr>
<tr>
<td>3.4</td>
<td>1.5</td>
</tr>
<tr>
<td>1.9</td>
<td>1.6</td>
</tr>
</tbody>
</table>

---

5. Building Sustainable Networks and Unleashing Entrepreneurial Potential in Farming Communities living in Marginal Areas

- Development of quinoa value chain in Egypt
  - Development & implementation of business model
  - Development of a seed production unit for quinoa
  - Capacity building

- Salicornia production trials in Egypt
  - Establishment of Salicornia
  - Assessment of demand
  - Farmers’ training

- Training on integrated farming in UAE
  - Training videos translated in Urdu, Arabic for farm workers
  - Smart applications

---

[Table 3: Mineral content of quinoa and selected foods, mg/100g dry weight]

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Quinoa</th>
<th>Maize</th>
<th>Rice</th>
<th>Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>148.7</td>
<td>13.1</td>
<td>6.9</td>
<td>50.3</td>
</tr>
<tr>
<td>Iron</td>
<td>3.2</td>
<td>2.1</td>
<td>0.7</td>
<td>3.8</td>
</tr>
<tr>
<td>Magnesium</td>
<td>244.6</td>
<td>137.1</td>
<td>73.5</td>
<td>168.2</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>393.7</td>
<td>252.5</td>
<td>137.8</td>
<td>342.7</td>
</tr>
<tr>
<td>Potassium</td>
<td>926.7</td>
<td>277.1</td>
<td>118.3</td>
<td>378.3</td>
</tr>
<tr>
<td>Zinc</td>
<td>4.4</td>
<td>2.9</td>
<td>6.6</td>
<td>4.7</td>
</tr>
</tbody>
</table>

Source: Researchers
https://iop.biosaline.org/

---

Food For the Future II
5. Building Sustainable Networks and Unleashing Entrepreneurial Potential in Farming Communities living in Marginal Areas (cont’d.)

- **Quinoa**
  - Quinoa trials in New Valley
  - Quinoa trials
  - Quinoa trials in New Valley
  - Quinoa trials
  - Quinoa condiment mixed with herbs and spices
  - Quinoa biscuits

- **Salicornia**
  - (primarily as feed)
  - Salicornia trials in two locations at the Red Sea Governorate

Food For the Future II

6. Inland integrated agri-aquaculture farms developed by ICBA

![Diagram of ICBA's Inland Modular Farm](https://www.biosaline.org/projects/expo-live-project-phase-ii-desert-farm/value-chain-development-innovative-halophyte)

**Expo Live Innovation Impact Grant Program**

6. From Desert Farm to Fork: Value chain development for innovative Salicornia-based food products (cont’d.)

**Partners**

- Food Innovation Center
- Global Food Industries LLC
- Max Planck Institute of Molecular Plant Physiology

**Objectives**

- Add value to the reject brine from desalination growing Tilapia and Salicornia
- Development of Salicornia-based food products
- Environmental and economical assessments

**Mr. Efstathios Lampakis**, Fish Expert

**Prof. Meis Moukayed**, Clinical Scientist

**8 farms in UAE**

**Halophytic dishes 2018**

- Rock samphire smoked tilapia with quinoa
- Jelly of Salicornia
- Crackers of Salicornia and rock samphire
- Salicornia juice
- Salicornia and rock samphire bread

**Expo Live Innovation Impact Grant Program**
Halophytic Kitchen Lab Program (2019 - 2020)

https://www.emiratessoilmuseum.org/education-programs/university-programs/halophytic-kitchen-lab

...to raise public awareness on halophytes

Expo Live Innovation Impact Grant Program

Halophytic products (2019 - 2020)

Salicornia burger

Salicornia cheesecake with camel milk and cheese

Salicornia biscuit

Salicornia crackers

Salicornia smoothie

Expo Live Innovation Impact Grant Program
“Saline Agriculture Goes Beyond Nice Stories. It Can Be A Tangible Reality In Salinized Areas…”

Dionysia-Angeliki Lyra

Center of Excellence looking at Agriculture for Tomorrow

Thank you!

ICBA is a founding member of the Association of International Research and Development Centers for Agriculture (AIRCA)

www.biosaline.org