Biosaline Agriculture (Haloculture) Pilot Complex

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Haloculture or Biosaline Agriculture: Terminology

- Biosaline agriculture,
- Integrated multi-trophic aquaculture (IMTA)
- Seawater greenhouse,
- Renewable energy production utilizing saline area potential,

World Experiences

Why Halocultural pilot is needed?

The novelty of the project and the lack of long-term experiences

It is necessary that some activities be first tested at small levels to evaluate the success of the plan. Then test different management practices at a larger scale.

Approach of the Project

The integrated activities and the production of various products

The output of a former unit can be used as an inflow of later unit.

- Renewable energy (solar energy, wind energy, and tidal energy) is being used to set up pilot solutions.
- The Halocultural Complex is a collection of techniques in effective communication with each other for development. As a result, it can be called an interdisciplinary activity.

Typical Halocultural complex process.

Society, economic and environment consideration must be seen in a sustainable project.

Reduction of final wastewater (ideally zero discharge) leads to efficient and environmental friendly complex.
Design patterns of the Halocultural complexes

- Four-phase pattern
- Three-phase pattern
- Two-phase pattern

Choosing and designing a suitable pattern depends on the water quality.

Four-phase pattern for use of saline water and soil

Increased salinity between 15 and 45 ds / m

Three-phase model of use of saline water and soil

Increased salinity between 45 and 65 ds / m

Two-phase model of use of salty water and soil

Increased salinity of more than 65 ds / m

Components of Halocultural Pilot

- Fishery and shrimp ponds
- Algae farms
- Halophyte plants farms
- Artemia ponds
- Water mixing pools
- Extraction of water from air and fog
- Pumping, pipelines and water supplies
- Evaporation ponds
- New energy related facilities
- Facilities and office buildings, workshops and laboratories
- Landscaping using halophyte and mangrove forests

Pilot Site Selection

Khuzestan Province:
- Chodeh Site
- Hendijan Site

Bushehr Province:
- Delvar Site
- Mond Site
There are numerous shrimp farms in the region.

Selected Site: Mond Site

Study the variations in salinity of the river’s water from the estuary to the upstream of the two tidal period and comparing the results.

Suitable Land for Pilot Project in Mond Region

General position of the haloculture pilot plant complex (site - 5 hectares)

Design processes of haloculture pilot complex

- The balanced model can be used for simulation of each activity input and output water quality and quantity.
- The minimum flow of water transfer is based on the needs for the farms and ponds in the complex.
- Using the evaporation and penetration rate which is evaluated based on the local region, the outflow can be calculated.
Haloculture through the lens of Nexus

- Food production is by far the largest consumer of global freshwater supplies.
- Agriculture is responsible for about 70% of freshwater consumption by humans in the world.
- Hence, agricultural activities can affect other parts of the society and mainly water resources.

Besides, environmental problems, global warming and water degradation, leads to consider any new proposed approach through the lens of Nexus.

The construction costs

<table>
<thead>
<tr>
<th>Items</th>
<th>The construction cost (1000$)</th>
<th>The percentage of cost (%)</th>
<th>Cost of operation and maintenance (1000$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish pond, Shrimp pond, Algae farm, Halophyte farm</td>
<td>50</td>
<td>41</td>
<td>10</td>
</tr>
<tr>
<td>Building</td>
<td>180</td>
<td>16</td>
<td>18</td>
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<tr>
<td>Dairy facility</td>
<td>100</td>
<td>3</td>
<td>10</td>
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<tr>
<td>Fuel facility</td>
<td>120</td>
<td>9</td>
<td>10</td>
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<tr>
<td>Desalination facilities</td>
<td>100</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Laboratory equipment</td>
<td>100</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Aeration and breeding equipment</td>
<td>15</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>1135</td>
<td>100</td>
<td>115.5</td>
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</tbody>
</table>

The incomes

<table>
<thead>
<tr>
<th>Items</th>
<th>Area (m²)</th>
<th>Production (kg/ha)</th>
<th>The gross annual income (1000$)</th>
<th>The percentage of the income (%)</th>
<th>The production cost (1000$)</th>
<th>The net benefit (1000$)</th>
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</thead>
<tbody>
<tr>
<td>Artemia</td>
<td>5000</td>
<td>200</td>
<td>652.5</td>
<td>8</td>
<td>393.5</td>
<td>261</td>
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<tr>
<td>Shrimp</td>
<td>10000</td>
<td>8000</td>
<td>35</td>
<td>35</td>
<td>168</td>
<td>112</td>
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<tr>
<td>Algae</td>
<td>10000</td>
<td>4000</td>
<td>75</td>
<td>37</td>
<td>180</td>
<td>120</td>
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<tr>
<td>Fish</td>
<td>20000</td>
<td>6000</td>
<td>35</td>
<td>15</td>
<td>90</td>
<td>60</td>
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<tr>
<td>Salicornia</td>
<td>15000</td>
<td></td>
<td>8</td>
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<tr>
<td>Total</td>
<td>50000</td>
<td></td>
<td>100</td>
<td>480.15</td>
<td>320.1</td>
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Results of Economic Indicators and Sensitivity Analysis

<table>
<thead>
<tr>
<th>Sensitivity Analysis</th>
<th>Present Net benefit (B-C) [1000$]</th>
<th>The B/C</th>
<th>EIRR</th>
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<tbody>
<tr>
<td>Discount rate (%)</td>
<td></td>
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<tr>
<td>7</td>
<td>569.5</td>
<td>1.19</td>
<td>12.3</td>
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<td>10</td>
<td>188.8</td>
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<td>15</td>
<td>-353.2</td>
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<tr>
<td>12.3</td>
<td>0</td>
<td>1</td>
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<tr>
<td>20% cost increase</td>
<td>258.4</td>
<td>1.08</td>
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<td>20% benefit decrease</td>
<td>-27.2</td>
<td>0.99</td>
<td>6.73</td>
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</table>

Conclusion

- 1. There is a positive outlook for the development of the southern shores of the country using Halocultural activities.
- 2. Different activities from aquaculture, cultivation of halophytes, new energy production, extraction of water from air and fog, and other environmental friendly activities can be included in the program for the construction of a Haloculture Complex.
- 3. Performing activities, especially integrated multi-trophic approach, requires testing using a pilot complex.
- 4. Pilots are scheduled for two years.
- 5. After two years, according to the results, the development plan of the complex of Haloculture is prepared.
- 6. Implementation of projects with the participation of investors and local stakeholders can be carried out.
- 7. Use of external experiences is necessary. ICBA is interested in mutual cooperation and knowledge transfer.

Thank you for your attention.