Discussion on the experimentation in Baidoa & Bossaso, and way forward
Tottori Resource Recycling
June 2018
Simple installation of our soil amendment, Porous Alpha, realizes better water utilisation for 10 years

- Installation is so simple; just mixing Porous Alpha with soil (5L of Porous Alpha for 1m ridge)
- One time installation for 10 years
- Porous Alpha prevents part of the infiltration of the irrigated water
- Water loss is mitigated with Porous Alpha
We carried out pilot project in Somalia for the verification of the performance of Porous Alpha

- **Timeline**
  - Date of agreement for the project: November 2016
  - Training for Teachers at JKUAT: November 2016
  - Season 1 in Baidoa: April 2017 – September 2017
    - Collaboration with IOM and READO (Rural Education and Agriculture Development Organization)
  - Season 2 in Bossaso: October 2017 – March 2018
    - Collaboration with IOM and Ministry of Agriculture of Somalia

- **Objective**
  - Confirm the Porous Alpha’s performance on water-saving and yield increase
  - Confirm the non-existence of negative impact on soil and crop

- **Crops**
  - Orange fleshy sweet potatoes (OFSP) for Baidoa
  - Tomato, Spinach, Lettuce, Hot pepper, Bell pepper for Bossaso

  Lecture session on Porous Alpha and the Installation training in the field of JKUAT
In the preliminary test in Baidoa, the water-saving effect was identified

- Soil texture: Silt loam
  - Farmers avoid heavy clay soil for Orange fleshed sweet potato (OSPF) production due to the risk of insufficient root development

- Irrigation method: Flooding

- Result
  - 50% water reduction was realized by Porous Alpha
    - Four times a week without Porous Alpha -> Twice a week with Porous Alpha
  - Harvest was observed to be good under water-saving condition, but was not recorded quantitatively
The other experiment in Bossasos was carried out to qualitatively verify the effect of Porous Alpha.
Soil in Bossaso is clay-loam alkali soil

- Soil texture
  - Sand: 30%
  - Clay: 32%
  - Silt: 38%

- Soil alkali level
  - pH: 7.97
  - EC: 0.93 mS/cm
The harvest with Porous Alpha under 100% irrigation increases by 39% ~ 63%

Average harvest (8m ridge) of each vegetable with 100% irrigation

Harvest (kg)

Without Porous Alpha
With Porous Alpha

Porous Alpha has proved its effect to increase the yield without increasing any other input.
The decrease of harvest due to the limited water is smaller with the installation of Porous Alpha.

### Change of the harvest compared to the 100% irrigation without Porous Alpha

<table>
<thead>
<tr>
<th>Tomato</th>
<th>Sweet Pepper</th>
<th>Spinach</th>
<th>Lettuce</th>
<th>Hot pepper</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No PA</strong></td>
<td><strong>With PA</strong></td>
<td><strong>No PA</strong></td>
<td><strong>With PA</strong></td>
<td><strong>No PA</strong></td>
<td><strong>No PA</strong></td>
</tr>
<tr>
<td>Irrigation 70%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-12%</td>
<td>-10%</td>
<td>-33%</td>
<td>-31%</td>
<td>-13%</td>
<td>-6%</td>
</tr>
<tr>
<td>-32%</td>
<td>-31%</td>
<td>-38%</td>
<td>-48%</td>
<td>-64%</td>
<td>-50%</td>
</tr>
<tr>
<td>-53%</td>
<td>-50%</td>
<td>-53%</td>
<td>-62%</td>
<td>-75%</td>
<td>-63%</td>
</tr>
<tr>
<td>Irrigation 50%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-38%</td>
<td>-38%</td>
<td>-38%</td>
<td>-48%</td>
<td>-64%</td>
<td>-50%</td>
</tr>
<tr>
<td>-52%</td>
<td>-50%</td>
<td>-53%</td>
<td>-62%</td>
<td>-75%</td>
<td>-63%</td>
</tr>
</tbody>
</table>

**Without Porous Alpha** □ **With Porous Alpha** □

### Porous Alpha has proved its effect to mitigate the harvest decrease by the water-shortage.
Implication: Porous Alpha can contribute to improve the food safety and to mitigate the impact by water shortage

- Increase of food production under normal climate
  - With Porous Alpha, food production can be increased by more than about 30% without additional input

- Mitigation of the impact by short rain-fall
  - The reduction of the harvest by water shortage can be mitigated with Porous Alpha
    - If Porous Alpha is not installed, the harvest reduction of the water shortage of 30% is -36%.
    - However, if the Porous Alpha is installed, that reduction compared to the control condition is limited to -6%
    - In case of the water shortage of 50%, the decrease of harvest is 63% without Porous Alpha and 50% with Porous Alpha

- One time installation of Porous Alpha realizes food security improvement for 10 years
Way forward: Larger project for more beneficiaries

- As one-time installation of Porous Alpha realizes the effect for 10 years, there’s no need to install the product every year.

- Simple installation method with no maintenance after the installation ensures the long-term effect (no need to worry about after service such as maintenance, spare parts, etc...)

- More Porous Alpha installed in Somalia, higher autonomous food supply and more preparedness for unpredictable short rainfall and drought are realized.

- Porous Alpha can be applied not only for vegetables but also the others. For larger project, it would be better to use our product for the other crops such as cereal (e.g. wheat) or fruit trees (e.g. citrus, date palm, etc.)
Our contacts

- **Tottori Resource Recycling Inc.**
  - 583 Higashisono, Hokuei-cho, Tohaku-gun, Tottori, 689-2202, Japon
  - TEL: +81 858 49 6230
  - FAX: +81 858 49 6288
  - http://t-rrl.jp
  - info@t-rrl.jp

- **Tottori Resource Middle East for soil conditioners L.L.C**
  - PO BOX 78704, DUBAI, U.A.E
  - TEL: +971 50 2776635
  - info@t-rrl.jp

- **Tottori Resource Recycling Morroco S.A.R.L**
  - Avenue des F.A.R, Nr208, El Menzeh, Agadir, Morocco
  - TEL: +212 528 847 830
  - info@t-rrl.jp
Annex: Harvest of 3 ridges for all the conditions in Bossaso

Total harvest of each vegetable under each irrigation and Porous Alpha condition

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Irrigation</th>
<th>No PA</th>
<th>With PA</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomato</td>
<td>100%</td>
<td>16.2</td>
<td>24.7</td>
<td>52%</td>
</tr>
<tr>
<td>Sweet Pepper</td>
<td>100%</td>
<td>23.2</td>
<td>33.3</td>
<td>44%</td>
</tr>
<tr>
<td>Spinach</td>
<td>70%</td>
<td>52</td>
<td>85</td>
<td>63%</td>
</tr>
<tr>
<td>Lettuce</td>
<td>70%</td>
<td>49</td>
<td>74</td>
<td>51%</td>
</tr>
<tr>
<td>Hot pepper</td>
<td>70%</td>
<td>11</td>
<td>15.3</td>
<td>39%</td>
</tr>
<tr>
<td>Tomato</td>
<td>50%</td>
<td>14.3</td>
<td>19.5</td>
<td>36%</td>
</tr>
<tr>
<td>Sweet Pepper</td>
<td>50%</td>
<td>10.9</td>
<td>15.8</td>
<td>45%</td>
</tr>
<tr>
<td>Spinach</td>
<td>50%</td>
<td>35</td>
<td>55</td>
<td>57%</td>
</tr>
<tr>
<td>Lettuce</td>
<td>50%</td>
<td>34</td>
<td>44</td>
<td>29%</td>
</tr>
<tr>
<td>Hot pepper</td>
<td>50%</td>
<td>5.5</td>
<td>9.6</td>
<td>75%</td>
</tr>
<tr>
<td>Tomato</td>
<td>30%</td>
<td>7.7</td>
<td>10.1</td>
<td>31%</td>
</tr>
<tr>
<td>Sweet Pepper</td>
<td>30%</td>
<td>6.7</td>
<td>9.2</td>
<td>37%</td>
</tr>
<tr>
<td>Spinach</td>
<td>30%</td>
<td>24.3</td>
<td>32.4</td>
<td>33%</td>
</tr>
<tr>
<td>Lettuce</td>
<td>30%</td>
<td>18.5</td>
<td>25.3</td>
<td>37%</td>
</tr>
<tr>
<td>Hot pepper</td>
<td>30%</td>
<td>2.7</td>
<td>4</td>
<td>48%</td>
</tr>
</tbody>
</table>
Annex: Illustrative cost of Porous Alpha

- Dosage: 5L for 1m of ridge
- If there’re 20 ridges/ha and each ridge’s length is 100m, the required volume of Porous Alpha is 5L/ridge x 20 ridges/ha x 100m/ridge = 10 m³
- Unit cost of Porous Alpha: 400USD/m³ (CIF Mombasa)
- Cost of Porous Alpha/ha = 4000USD for 10 years
- Cost of Porous Alpha per year = 400 USD/ha
  (There’s another product type whose dosage is half of the above. If this applies, cost can be half)
Annex: Specification and applicable conditions of soil conditioning by Porous Alpha

- Applicable soil texture: Sandy soil and clay soil
- Application method

<table>
<thead>
<tr>
<th>Method</th>
<th>Crops cultivated with ridges</th>
<th>Crops cultivated without crops</th>
<th>Trees: Porous Alpha applied at plantation</th>
<th>Trees: Porous Alpha applied for planted trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dosage</td>
<td>10% of rooting zone (Porous Alpha Φ:3mm – 10 mm) or 5% of rooting zone soil (Porous Alpha in powder) * Rooting zone: Ridge volume x Root depth (e.g. For the ridge with width of 30cm and root depth is 15cm, the dosage is 5L/m (Φ3mm-10mm) or 2.5L/m in powder))</td>
<td>10% of rooting zone (Porous Alpha Φ:3mm – 10 mm) or 5% of rooting zone soil (Porous Alpha in powder) * Rooting zone: Field area x Root depth (e.g. For the crop with root depth of 15cm, the dosage is 15L/m² (Φ3mm-10mm) or 7.5L/m² (in powder))</td>
<td>10% of rooting pit (Φ3mm-10mm) or 5% or rooting pit (in powder)</td>
<td>10% of ditched soil (Φ3mm-10mm) or 5% of ditched soil (in powder)</td>
</tr>
<tr>
<td>Choice of spec.</td>
<td>If high soil pH is acceptable, the powder product is applicable. (e.g. The crop is resistant to alkaline soil or the soil pH is originally so high that the pH of irrigation water is lowered by acid additive) For the other case, the product of Φ3mm-10mm should be used</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Durability: More than 10 years (If Porous Alpha is applied to crops with ridge and the tillage is done horizontally to the ridge, the Porous Alpha can be scattered out of the zone of ridge. In that case, the Porous Alpha needs to be installed again)
- Our expert supports the best application method customized for each situation
Annex: Soil texture in Bosasso

RE: SOIL TEXTURE ANALYSIS (HYDROMETER METHOD) & MOISTURE CONTENT


<table>
<thead>
<tr>
<th>Sample Description</th>
<th>Soil Depth (cm)</th>
<th>Lab. No./2016</th>
<th>Sand %</th>
<th>Clay %</th>
<th>Silt %</th>
<th>Texture Grade</th>
<th>Moisture Content % (w/w)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>top</td>
<td>8988 &amp; 8989</td>
<td>30</td>
<td>32</td>
<td>38</td>
<td>CL</td>
<td>2.8</td>
</tr>
</tbody>
</table>

KEY:

CL – Clay Loam

I. V. Sijali: COORDINATOR, IRRIGATION, DRAINAGE AND MANAGEMENT OF PROBLEM SOILS RESEARCH PROGRAMME
### Annex: Soil physical and chemical analysis

SOIL TEST REPORT

- **Name:** Nyawira Kimondo
- **Address:** c/o IOM P. O. Box 1810 – 00606, Nairobi
  Bosaso, Puntland, Somalia
  Chillies, lettuce, tomato
- **Date sample received:** 04-11-16
- **Date sample reported:** 25-11-16
- **Reporting officer (through Director NARL):** A. Chek

#### Soil Analytical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab. No/2016</td>
<td>8087</td>
<td></td>
</tr>
<tr>
<td>Soil depth cm</td>
<td>top</td>
<td></td>
</tr>
<tr>
<td>Fertility results</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil pH</td>
<td>7.97</td>
<td>medium alkaline</td>
</tr>
<tr>
<td>Total Nitrogen %</td>
<td>0.09</td>
<td>low</td>
</tr>
<tr>
<td>Total Org. Carbon %</td>
<td>0.68</td>
<td>low</td>
</tr>
<tr>
<td>Phosphorus ppm</td>
<td>7</td>
<td>low</td>
</tr>
<tr>
<td>Potassium me%</td>
<td>0.48</td>
<td>adequate</td>
</tr>
<tr>
<td>Calcium me%</td>
<td>3.8</td>
<td>adequate</td>
</tr>
<tr>
<td>Magnesium me%</td>
<td>2.38</td>
<td>adequate</td>
</tr>
<tr>
<td>Elect. Cond. mS/cm</td>
<td>0.93</td>
<td>high</td>
</tr>
</tbody>
</table>

* ISO/IEC 17025 accredited