INITIATIVES IN MITIGATING CLIMATE CHANGE

Demonstration Areas B & C
Ayoó de Vidriales y San Mateo de Gállego

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OBJECTIVES:

- **Restore land** in degraded areas of Spain that lost fertility due to intensive monoculture and inefficient use of fertilizers.

- **Promote agroforestry practices** by combining agricultural crop growth with productive trees (timber, almond, pistachio, pine nut, etc.)

- **Improve the quality of soil** by changing pH levels and inoculating with microorganisms such as mycorrhizae, beneficial bacteria and fulvic/humic acids.

- **Mitigate climate change by obtaining a positive balance in CO₂ fixation**
Ayoó de Vidrailes (Zamora):

- 25 ha. Plot rainfed land: part of the 500 Ha owned by the City Council
- Area has been abandoned over 15 years ago, not even weeds grow there
- Low pH, acidic soils
- Maximum 500 ml annual intense rainfall, lasting only 30 days

Watch “Regreening the Planet” documentary

Soil recovery in Ayóo de Vidrailes (Zamora)
1) AGROFORESTRY PLAN DESIGN: Selection of plants

1. **Timber & Fruits.** Grafted Pistachio
2. **Timber & Fruits.** Almond v. GUARA & Jara pringosa
3. **Timber & Fruits.** Pine mycorrhized with Lactarius deliciosus & Jara pringosa (mycorrhized with boletus)
4. **Timber & Fruits.** Jerbo & Lolium spp, Trifolium repens
5. **Timber & Fruits.** Stone pine mycorrhized with L. deliciosus
6. **Timber & Fruits.** Chestnut & Bromus hordeaceus, Vulpia geniculata, & V. bromides
7. **Protection border.** Alcornoque, Endrino, Espino blanco, Rosa silvestre
8. **Agricultural crops.** Ryegrass, alfalfa, lupine, barley, wheat, vetch, oats, sunflouwer, camelina
9. **Testplot Switchgrass.** Panicum virgatum
10. **Safety buffer zone.**
3) CROP SELECTION AND IMPLEMENTATION:

- pH corrector application
- Vertical land preparation, soil decompaction
- Sowing with cultivation on ridges
- Intercropping (oats & vetches)
- Soil inoculation with endomycorrhizal spores, beneficial bacteria & humic/fulvic acid

- First year with cereals with microorganisms at 100% (A), at 50% (B) and 0% on the control (C)
- The 100% is on the worse land and the control is on the best land (we discovered only later)
4) TREE & SHRUB PLANTING:

- Buffer area against wind and wildfire and also as a wildlife corridor
- Technologies to support tree growth: water reservoir for tree growth without irrigation
The results of the trials (Zamora):

Harvest yield at Ayoó de Vidriasles (2013-2016)
The results of the trials (Zamora):

- After 2 years, the roots in the 100% zone are deeper than 1 meter and we can see the symbiosis with the mycorrhizae of the type ‘Glomus’.

- The yield in Zone A is double vs Zone C (control) even if this was a dry year.

- The survival rate of the trees is more than 98%. This is very high considering the very dry spring.

- For this year, we expect even better results especially in cases where we didn’t use chemical fertilizers like NPK and urea.
The results of the trials (Zamora):

Root depth capacity at Ayoó de Vidriales (2013-2016)
1. **Timber & Fruits.** Grafted Pistachio
2. **Timber & Fruits.** Almond v. Guara & Jara pringosa
3. **Timber & Fruits.** Pine mycorrhized with *Lactarius deliciosus* & semisanguifluus
4. **Timber & Fruits.** Jerbo & Bromus hordeaceus, Vulpia geniculata, V. bromides
5. **Timber & Fruits.** Oliva arbequina
6. **Timber & Fruits.** Quercus ilex mycorrhized with *tuber melanosporum*
8. **Agricultural crops.** Ryegrass, barley, wheat, vetch, oats,
9. **Test area Lavender.** Lavandula.
10. **Testplot Switchgrass.** *Panicum virgatum*
11. **Test area Vines/Vid**
12. **Safety buffer zone.**
### METHODOLOGY:

#### 2) DIVISION OF PLOTS:

<table>
<thead>
<tr>
<th></th>
<th>C1-100%</th>
<th>C2-50%</th>
<th>C3-0%</th>
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</table>

### CONSIDERATION IN PLANTING SITES

- The major wind direction
- Fire risks
- To enable biodiversity migration
- Easy access for machines
- Combining crops
- Plant spacing
- Cross pollination
- Diameter and growth trees
- Carbon calculation methodologies
- Potential species competition
- Species tolerant for shade
- The altitude and available water

- Approximately half (50%) of the area will be covered with agricultural (annual) crops, the other half with perennials (trees, shrubs).
METHODOLOGY:

Scoping of the areas and crop plan design

Green cover crops

Lupinus and vetch-oat (Altramuz y veza-avena)

3) CROP SELECTION AND IMPLEMENTATION:
- pH corrector application
- Vertical land preparation, soil decompaction
- Sowing with cultivation on ridges
- Intercropping (oats & vetches)
- Soil inoculation with endomycorrhizal spores, beneficial bacteria & humic/fulvic acid

4) TREE & SHRUB PLANTING:
- Buffer area against wind and wildfire and also as a wildlife corridor
- Technologies to support tree growth: water reservoir for tree growth without irrigation
The results of the trials (Zaragoza):

Harvest yield at San Mateo (2013-2016)

Yield (kg/ha)

<table>
<thead>
<tr>
<th>Year</th>
<th>Zone</th>
<th>Yield (kg/ha)</th>
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<tbody>
<tr>
<td>2013.V-A</td>
<td></td>
<td>6200</td>
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<tr>
<td>2014.Centeno</td>
<td></td>
<td>3800</td>
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<tr>
<td>2015.Cebada</td>
<td></td>
<td>4000</td>
</tr>
<tr>
<td>2016.V-A</td>
<td></td>
<td>4400</td>
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Campaña
The results of the trials (Zaragoza):

Tree survival rate
Ayoó & San Mateo (2015)

- Castaños (Chestnut)
- Pinos (Pine)
- Jerbos (Service tree)
- Olivos (Olive)
- Pistachos (Pistacho)
- Almendros (Almond)

Survival rate (%)
✓ Soil biology is essential, especially in the Mediterranean area where water is the limiting factor.

✓ Soil compactation is a big problem, there are vertical plows that can be used every 3 – 4 years. It is even better to work with crops, like vetch/oat, pulses and sunflower, that penetrate deep in the soil by themselves.

✓ Spending a lot on fertilizers in rain fed conditions is not profitable; it is therefore necessary to switch gradually from 100% chemical agriculture to 100% organic.

✓ Mitigate soil erosion due to water and wind with trees and Roman plough guarantees very interesting results.

✓ We are developing models for ecosystem restoration that have to guarantee economic, social and environmental returns; besides that we have to promote actions to help the local population change their mentality.
Thank you for your attention

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