Dealing with the Supply Chain

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The development of biomass agnostic Biorefineries has opened new horizons for agriculture in areas which are not the most fertile of the world.

Chemtex and Beta Renewables have invested worldwide in developing new supply chains and work with States and NGOs to progress a new agriculture.
Supply Chain for a Biorefinery

- Support of the clients on supply chain issues;
- Selection of best feedstock for specific projects;
- Definition of agricultural practices;
- Set up and support for field trials;
- Support to start up and manage supply chains;
- Relationships with and evaluation of suppliers.
An advanced technology like Second Generation Biorefineries imposes important requirements to the supply chain, which must deliver feedstock:

- In large volumes;
- With stable quality;
- On a continuous flow;
- With a high degree of reliability.
The control of the supply chain is a key success factor (1)

- Relying on the market or a complete outsource to third parties result in a high risk profile and cost position for the whole project.

- **Biomass-based projects** must ensure a certain level of control on their supply chain.
The control of the supply chain is a key success factor (2)

- Securitization through:
  - Ownership;
  - Long term concession;
  - Long term lease.

- Agronomic plan and tight control of operations;
- Third parties for execution, only if reliable providers are available, otherwise direct execution.

- Planning and control;
- Direct management of hubs;
- Third parties for transports (usually available in all countries).
Requirements for Agronomic Research

**Requirements**

- Specific needs for Biorefineries.
- Additional requirements for economic sustainability.
- Additional strategic requirements.

**Drivers of Analysis**

- Cellulose content;
- Decay rate of harvested matter.
- Yield (MT/ha);
- Cost of operations;
- Energy density.
- No competition with food productions.
New Horizons outside Brazil

Although the wonderful climate and the land availability make of Brazil the Eldorado for biotech, Second Generation Biorefineries make their inroads everywhere and make non-food biomasses attractive worldwide.
Biomasses Scouted
Academic research, backed by self conducted tests, led to selection of biomasses

<table>
<thead>
<tr>
<th></th>
<th>Arundo Donax</th>
<th>Miscanthus</th>
<th>Switch grass</th>
<th>Fiber Sorghum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Climate conditions</strong></td>
<td>Temperate climates</td>
<td>Cool climates</td>
<td>Temperate climates</td>
<td>Temperate climates</td>
</tr>
<tr>
<td><strong>Type of propagation</strong></td>
<td>Agamic by rhizomes, mp, or stems</td>
<td>Gamic by seeds or agamic by rhizomes</td>
<td>Gamic by seeds</td>
<td>Gamic by seeds</td>
</tr>
<tr>
<td><strong>Minimum soil requirements</strong></td>
<td>Damp soils, either fresh or moderately saline</td>
<td>Soils ranging from sands to those high in organic matter</td>
<td>Moderately deep, dry to poorly drained, sandy to clay loam soils are best</td>
<td>Deep, fertile, well-drained loamy soils</td>
</tr>
<tr>
<td><strong>Sensitivity to drought</strong></td>
<td>Low sensitivity</td>
<td>Low sensitivity</td>
<td>Medium sensitivity</td>
<td>High sensitivity</td>
</tr>
<tr>
<td><strong>Sensitivity to salinity</strong></td>
<td>Low sensitivity</td>
<td>Medium sensitivity</td>
<td>Medium sensitivity</td>
<td>High sensitivity</td>
</tr>
<tr>
<td><strong>Yield (in NW Italy’s climate) DT/ha</strong></td>
<td>35</td>
<td>20</td>
<td>18</td>
<td>25</td>
</tr>
</tbody>
</table>
Arundo: An Environment Friendly Crop

- Resistant to draught, no need for heavy irrigation
- Grows on any soil, gives acceptable yield on marginal land
- Little fear for weeds and parasites, no need for herbicides and insecticides
- Can serve as remediation for polluted spray fields

As a result of the efficiency of the biomass AND the technology, impact on environment is outstanding:

80% GHG reduction!
Beta Renewables Experience Worldwide

Data gathering from others’ experiences:
- Central America
- North Africa
- Hungary

Directly managed plantations / test fields:
- Italy
- USA
- Mexico
- Ukraine

Test fields for potential clients:
- Bulgaria
- Ireland
- Thailand
Structure of Supply Chain

**Direct management / operations contracted to third parties**

- Rhizomes nursery
- Rhizomes
- Plantation
- Harvest and transport

Long term leases

**Micro-propagated**

- External labs
- External farmers
- Straws/Woodchips

**Ethanol plant**

*Spot contracts, longer terms agreement, where available.*