FEASIBILITY STUDY OF BIOENERGY AND FOOD PRODUCTION IN THE REPUBLIC OF MOZAMBIQUE 2014
Summary

Project context & structure
Crops analyzed
Zoning results
Field Survey
Proposed Projects
Next Steps
PROJECT CONTEXT & STRUCTURE
FGV methodology combines the Brazilian experience in developing sustainable bioenergy and food projects
Motivation for bioenergy and food projects in the Tropical Belt

**Tropical Belt:** The majority of countries that face fuel and food shortages are located in this specific region.

Elaboration: GV Agro Source: BP Statistical Review of World Energy
MoU between Brazil and USA and between Brazil and EU:

- Technical cooperation agreement between Brazil and the European Union, for a feasibility study to produce biofuel and food in Mozambique, 2010
- Brazil-USA Memorandum of Understanding to Advance Cooperation on Biofuels, 2007

Results: 12 countries have received the feasibility studies of bioenergy project development: ethanol, biodiesel, electricity, steam and food projects.

The projects were financed by the following entities:
FGV methodology combines the Brazilian experience in developing sustainable bioenergy and food projects.

Methodology

Phase I: Feasibility Study
Phase II: Executive Project
Phase III: Financial Structuring & Road Show
Phase IV: Implementation
Methodology

Phase I – Feasibility Analysis

Crop Plants Aptitude (food & bioenergy)

Production Capacity

Recommendation

Phase II

Zones:
- Agroclimatic
- Edaphic
- Environmental &
- Social

Business Model:
- Raw material, crop inputs
- Clusters
- Supply and Demand
- Constraints and opportunities

Results
- Investments
- Regulatory framework
- Infrastructure
- Financial & Environmental questions
Methodology

Phase II, III & IV

Executive Project

Phase III

Phase IV

SUB-PROJECTS
- R&D&I (technology transfer, research, development and innovation)
- Business Plan - technology Package & sustainability
- Agriculture
- Industrial
- Social
- Finance
- Environment
- Regulatory framework & Legal
- Market Analysis
- Risk Analysis

FINANCIAL STRUCTURING & ROAD SHOWS
- Financial Structuring
- Investment Road Show:
  - Strategic partnership
  - Pension Funds
  - Stakeholders
  - Financial Market
  - CSR Banks;
  - EX/IM Banks
  - Local Governments

IMPLEMENTATION
- S.P.C.;
- Management;
- Leadership, Knowledge and Accountability
- Capacity building development;
- Designing of contracts:
  - Sales of product
  - Purchase of raw materials and supplies.
  - Corporate and cooperative structuring
Current Status

- **Guatemala**
- **El Salvador**
- **Honduras**
- **Haiti**
- **Dominican Republic**
- **St. Kitts & Nevis**
- **Senegal**
- **Guinea**
- **Guinea-Bissau**
- **Liberia**
- **Mozambique**
- **Zambia**
- **Tanzania**
- **Angola**
- **Papua New Guinea**

Colors:
- **Green**: Ongoing
- **Yellow**: Under technical and commercial negotiation
Information Generated

Over 240 million hectares studied
Over 25,000 km traveled on field survey

Over 10,000 georeferenced photos taken
Over 2,000 points of interest gathered
Information Generated

Up to **24** kinds of crops

**46 expeditions since 2007**

Over **100 local** meetings attended

About **2,400 soils samples gathered**
CROPS ANALYZED
CROPS ANALYZED

Bioenergy
- Sugarcane
- Castor Beans
- Napier grass
- Eucalyptus
- Jatropha curcas
- Sunflower
- African palm
- Cotton

Food
- Corn
- Rice
- Soybean
- Manioc
- Peanut
- Beans
ZONING RESULTS
Zoning

Zoning Methodology

- Climatic Parameters for Each Crop
- Soil Data
- Declivity Data
- Wet lands
- Protected areas

- 457 Weather/Climatic Stations
- Map Algebra
- Edaphic Zoning
- Climates Parameters for Each Crop

- Mathematical Models
- Agroclimatic Zoning
- Environmental Zoning

- Field Work
- Aptitude Maps
Example - Zoning

**Agroclimatic Zoning**
- Water deficit
- Evapotranspiration
- Average temperature

**Edaphoclimatic Zoning**

**Edaphic Zoning**
- Soils
- Protected areas

Example - Zoning
Example - Zoning

Edaphoclimatic Zoning

Agribusiness area

Family farming area

Forest area
Example - Zoning

Potential areas validation

- Degraded areas
- Suitable soils
- Rural diagnoses
- Infrastructure analysis
- Use and coverage
- Relief
- Existing projects
- Existing crops
- Cultivation forms
- Field evidence
FIELD SURVEY
Field Survey

- Real time navigation;
- Georeferenced photos;
- Analyzes performed:
  - Land use;
  - Agrarian structure;
  - Socioeconomic data gathering;
  - Conditions of logistics;
  - Soils samples gathering;
  - Interviews with local stakeholders;
  - Observations of environmental aspects.
- Gathering of points of interest
Field Survey

- Distance traveled: **2.578** km;
- **165** points georeferenced.
PROPOSED PROJECTS
**PROPOSED PROJECTS**

- **Project: Biomass (Elephant grass)**
  - **Region:** Nampula e Zambezia
  - **Project area:** 2,300 ha
  - **Total production:** 50,000 tonnes of biomass and 10 MW
  - **Estimated investment (agricultural and industrial):** USD 23 million
  - **IRR:** 22%

- **Project: Sugarcane (Sugar & Ethanol)**
  - **Region:** Zambézia.
  - **Area: 22.949 ha**
  - **Process:** 2 million tons per year
  - **CAPEX (agricultural & industrial):** USD 471.4 million
  - **OPEX (agricultural & industrial):** USD 27.7 million
  - **IRR:** 22%

- **Project: Soybean**
  - **Region:** Cabo Delgado.
  - **Area:** 66,000 ha
  - **Crush:** 37,620 tons per year of soybean oil; 156,420 tons per year of soybean meal
  - **CAPEX (agricultural & industrial):** USD 120.0 million
  - **OPEX (agricultural & industrial):** USD 41.4 million
  - **IRR:** 28%

- **Project: Biomass (Elephant grass)**
  - **Region: Nampula e Zambézia.**
  - **Area:** 1,520 ha
  - **Production:** 36.225 MWh/year
  - **CAPEX (agricultural & industrial):** USD 12.3 million
  - **OPEX (agricultural & industrial):** USD 1.1 million
  - **IRR:** 18%

- **Project: Biodiesel (Palm)**
  - **Region: Lugela, Milange ou Namarroi;**
  - **Area:** 12,000 ha
  - **Production:** 72,000 tons palm oil per year (top)
  - **CAPEX (agricultural & industrial):** USD 74.9 million
  - **OPEX (agricultural & industrial):** USD 19.8 million
  - **IRR:** 25%
## Fuel consumption - 2010

<table>
<thead>
<tr>
<th>Fossil fuel</th>
<th>Consumption (ton)</th>
<th>With biofuel production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel</td>
<td>438,000</td>
<td>Palm Oil</td>
</tr>
<tr>
<td>Gasoline</td>
<td>98,000</td>
<td>Ethanol</td>
</tr>
</tbody>
</table>

**Land necessary to be self-sufficient (ha)**
- Palm Oil: 90,000
- Ethanol: 15,000

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**Potential to be 100% self-sufficient on fuel production**

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## Energy Generation - 2010

<table>
<thead>
<tr>
<th>With</th>
<th>In</th>
<th>Generates</th>
<th>Generation Per Year</th>
<th>Economic Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugarcane</td>
<td>300,000 ha</td>
<td>600 MWh</td>
<td>4.18x10^6 MW</td>
<td>Total cost for generation US$ 417 million</td>
</tr>
<tr>
<td>Elephant Grass</td>
<td>50,000 ha</td>
<td>200 MWh</td>
<td></td>
<td>Total cost for Diesel as a fuel US$ 1,25 billion</td>
</tr>
</tbody>
</table>

**Total Avoided Cost**
- US$ 836 million

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**Source:** FGV
NEXT STEPS
Next Steps

EXECUTIVE PROJECT

• R&D (knowledge transfer & technology);
• Agriculture;
• Industrial;
• Logistics;
• Social;

• Financial;
• Environmental;
• Legal & Regulatory;
• Marketing;
• Risk analysis.
OBRIGADO!

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