Biodiesel for rural development: lessons from Guatemala on how to increase livelihoods for the poor

ECOSOC – 2008 High level segment
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TechnoServe is an institution with global presence. TechnoServe’s offices:

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- Honduras
- Nicaragua
- Guatemala
- Perú
- Ghana
- Kenia
- Mozambique
- Sur África
- Tanzania
- Swaziland
- India
WHO WE ARE

Our mission: TechnoServe helps entrepreneurial men and women in poor rural areas of the developing world to build businesses that create income, opportunity and economic growth for their families, their communities and their countries.

- A U.S.-based, nonprofit economic development organization.
- Philosophy: Private enterprise can drive economic growth and positive social change; a hand up is better than a handout.
- History: Founded in 1968 by businessman Ed Bullard, who pioneered the private-enterprise approach to solving poverty.
- Staff: Talented business advisors, many of them former management consultants or industry experts.
- Partners: Leverage the expertise of strategic corporate, non-profit and government partners.
- Funding Sources: U.S. and foreign government agencies, multi-lateral organizations, corporations, foundations and individuals.
Jatropha was selected due to its adaptability and potential for economical and social impact.

- Excellent alternative to marginal areas: low watering need, high adaptability to soils with low nutrient concentrations
- High oil content: aprox. 1900 l/ha
- Low implementation costs, with long lifespan (30 – 50 years)
- Common in Guatemala, where it is used in fences
- High economical value: biodiesel and Sub-products (organic fertilizer, briquettes, biogas)
- New opportunities for the women in the communities, who are responsible for the sub products
GUATEMALA IS HIGHLY DEPENDENT ON FOSSILE FUELS; PLANTING JATROPHA MAY BE A VIALBLE ALTERNATIVE

Fossil fuels consumption
Millions of Gallons / year (2007)

<table>
<thead>
<tr>
<th>Total 1,121</th>
<th>Diesel 366</th>
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</thead>
<tbody>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Bunker</td>
<td></td>
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<tr>
<td>Petcoke</td>
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<tr>
<td>Kerosene</td>
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<td>335 mill gal</td>
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<tr>
<td>Gasoline</td>
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<td>Superior</td>
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<td>Regular</td>
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<td>Aviationón</td>
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<td>GLP</td>
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<tr>
<td>420 mill gal</td>
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<tr>
<td>Diesel</td>
<td></td>
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<td>366 mill gal</td>
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Potential do produce 260 million gallons (6 million barrels) of biodiesel per year, substituting 80% of the imported diesel

Source: Dirección General de Hidrocarburos, MAGA, TechnoServe
TNS BIOFUEL’S APPROACH: A THREE PILLAR STRATEGY ALONG THE VALUE CHAIN

Pillar 1: Small producers
- Partners: USAID, AEA
- Projects: Biodiesel for rural development, Combined production systems (tilapia + biodiesel)

Pillar 2: R&D
- Partners: ICTA, FAUSAC, Univ. del Valle, Bayer
- Projects: Fodecyt, Multicyt, Subproduct development, Technological packs (agriculture and industrial)

Pillar 3: Large scale investors
- Partners: Jatroil, Other investors
- Projects: Financial models, Central America comparison
EXPERIMENTAL R&D FIELD WITH ICTA

INVESTIGATION
- 2 Jatropha varieties
- Propagation Method: seed, cuttings, “pilon”
- Densities: 2x2, 3x3, 4x2
- Fertilizacion: 7 different levels
SUCHITEPÉQUEZ
Municipalidades Objetivo
E: Cuyotenango
F: Mazatenango
G: Santo Domingo

RETALHULEU
Municipalidades Objetivo
A: Retalhuley
B: Champerico
C: Santa Cruz Muluá
D: San Andrés Villaseca

Four communities already integrated to the program

Extractora comprada en India y a instalar en Agosto 2008

Área total de influencia en la cosecha de los cercos

Socio industrial comprará aceite bajo convenio

3 Comunidades bajo convenio
EXECUTIVE SUMMARY

• The Guatemalan biofuels program can have a significant impact in the country’s development, by reducing poverty, providing opportunities to strengthen gender equality, diversifying the country’s energy matrix into sustainable alternatives and creating a base to propel development in other areas through the reduction of imports.

• Currently, small rural producers focus on planting corn, and farming cattle, both directed to subsistence consumption. The productive areas are not enough to generate income to lift families out of poverty. However, by introducing Jatropha in marginal areas, not substituting food production, these new cash crop can generate additional income for the rural families.

• A sustainable industry can be built on marginal areas, when based in a vegetable oil production clusters. In this model, producers are organized to generate scale for the industrial process, without utilizing areas previously allocated to food crops.

• Policy makers interest in fostering a biofuels program should, among others, foster smart incentive programs distributed over several steps of implementation, including scalable vegetable oil production in marginal lands by communities, re-forestation programs utilizing Jathropha (fixes Nitrogen), Sub-products production and commercialization (fertilizer, Brickets) and combined closed loop systems. Special care needs to be taken on environmental impact at each step of implementation.

• Early taxation of this nascent industry will avoid growth
CURRENTLY, SMALL PRODUCERS ARE TRAPPED IN SUBSISTANCE MODE. HOWEVER, JATROPHA CAN PROVIDE ADDITIONAL INCOME

![Image of small producer land distribution]

**Representative land distribution for small producer (total 3 ha.)**

<table>
<thead>
<tr>
<th>Productive land: 55% (1.7 ha.)</th>
<th>Cattle: 10% (0.3 ha.)</th>
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<td>Marginal: 35% (1.0 ha.)</td>
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**Corn economics in Guatemala:**
small producer on 1.7 ha.

- **Production:** 6,000 kg (40% for own consumption)
- **(x) Sales:** $0.18 / kg
- **(=) Income:** $1,100 (60% of production)

**Jatropha opportunity on marginal lands (1 ha.), including sales of organic fertilizer**

- **Oil Production:** 385 gl.
- **(x) Oil Sales:** $2.40 / gl
- **(=) Oil Income:** $930
- **Fert. Production:** 4,100 kg
- **(x) Fert. Sales:** $0.15 / kg
- **(=) Fert. Income:** $620
- **Total income:** $1,550

**Additional income (cattle, construction work, etc.) brings total income to $1,500 / year, or approx. $0.7 per person per day*.**

**Total income, including jatropha on marginal areas, comes to $2,765 / year, or approx. $1.25 per person per day*.**

* Considering average family size of 6 members

Source: FAO (Maiz para Guatemala, 2005), Interviews, Technoserve
TO CREATE A MODEL BASED ON MARGINAL LANDS, PRODUCERS MUST BE ORGANIZED TO PROVIDE SCALE

“Communal extraction” Value Chain

- Investment of $10,000 for extractor, with capacity of 3 tons seeds/day
- To produce seeds to operate extractor 270 days/year, 200 ha. of mature plantations are required
- This implies organization of 200 producers per extraction center

Total economical value

- Total sales of Sales of $310,000 per year ($186.00 from oil and 124,000 from fertilizer*), at full capacity
- Agricultural costs of $0.35/gl., extraction costs of $0.40/gl., marginal costs for fertilizer production.
- Investment can be paid in 3 years, by “charging” 5% on sales to repay investment (considering 5 year sales ramp up according to plantation maturity)

Model characteristics

Advantages:
- Producer captures the extraction margin
- Focus on farming
- Sense of community though joint ownership
- Efficient use of extractor
- **Potential for oil export** – scale and single point of pick up

Disadvantages:
- Requires good communal organization
- 200 producers must be in reasonable radius to facilitate seed transport

* Besides fertilizer, other viable subproducts that could be sold include wood briquetts and natural insecticides

Source: TechnoServe
INCREMENTAL PROFIT OPPORTUNITIES FOR ORGANIZED COMMUNITIES WITH SCALE

Seed Farming | Plantation & Harvest | Oil Extraction/Sub-products | Refinery | Local sales

5.0 $/gl
3.75 $/gl
2.5 $/gl
1.25 $/gl
0 $/gl

Model assumptions:
• Self-employed farmer (no labor costs)
• Sales of oil and organic fertilizer
• Produces own seeds
• Mature plantation (5 years)
• Community-owned extractor, operating at full capacity
• Biodiesel produced for local consumption (no distribution costs, sale at 90% of diesel price)

Diesel: 5.30 $/gl
Fertilizer: 1.60 $/gl
1.65 $/gl
0.70 $/gl

Agricultural costs
Extraction costs
Producer Profit (oil + fertil.)
Refining costs
Refinery margin (15%)
Sale price (90% of diesel)

0.35 $/gl
1.60 $/gl
1.50 $/gl

Source: TechnoServe

• Additional margin to be captured by advancing and integrating the value chain
• Profitable operation of extractor and refinery requires minimum scale
ADITIONAL OPTIONS BEING DEVELOPED TO INCREASE INCOME DIVERSIFICATION AND LEVERAGE BIOFUELS

Example: combined jatropha and fish (tilapia) production

- High complementary between jatropha and tilapia production systems:
  - Estimation of up to 30% costs reduction, by substituting diesel for straight vegetable oil to operate tilapia tanks
  - Over 40% increase in jatropha seed production by watering with water disposed from ponds (rich in nutrients from fish excrements)

Pilot being implemented in Baja Verapaz, to validate the economical model

Source: TechnoServe - Guatemala
POLICY MAKING FOR SMALL PRODUCERS CAN BE STRUCTURED IN THREE PHASES OF IMPLEMENTATION

**Phase I: Straight vegetable oil development**
- Marginal Land criteria
- Re-forestation incentives via Jatropha
- Certified seeds for Jatropha reproduction/incentives for nursery propagation
- Incentives for Sub-products production/scalable combined systems
- Vegetable oil cluster production incentives/export incentives
- Strict regulation of transesterification (wet process)
- Incentives for SVO technology

**Phase II: Biodiesel production and scale up**
- Expansion of producing capacity
- Incentives for large scale cluster developments, including plantations with private sector
- Incentive for “dry washing” process in transesterification (e.g. thru the use of resins to substitute water)
- Large scale seed production, including basic and certified seeds

**Phase III: Commercial distribution**
- Development of a demand based system for retail
- Policy making and regulations for commercial distribution (e.g. taxes, quality assurance)
OVERALL CONCLUSIONS TO CONSIDER WHEN FOSTERING THE CREATION OF A BIOFUELS INDUSTRY

• A detailed mapping and identification of unproductive arable areas suitable for jatropha crops can ensure that investments are directed toward marginal areas and ensure that no food substitution or deforestation occurs.

• The transesterification process produces as a deject water that should be “cleaned” before it can be reintegrated to the environment. This can be substituted by a “dry washing” method, which should be encouraged. To ensure the correct environmental precautions are taken, transesterification plants should be operated by large players, with incentives to comply with regulators and that can be inspected/certified.

• Additional research opportunities are related to substituting the methanol required in a economical way (currently it is not economical interesting to substitute the methanol for ethanol).

• The taxation of different components of the supply chain can make biodiesel not competitive (price-wise) with petroleum derived diesel, or reduce margins throughout the production chain that would limit the benefit received by small producers. As an example, in Mozambique biodiesel can be produced at a cost of $0.76/liter. However, after taxation (fuel tax and VAT), the cost of selling is $1.09/liter, while regular diesel is sold for $0.97/liter (2007).

• Sub-products (organic fertilizers, etc.) are needed to ensure the economical attractiveness of jatropha production, and their use and commercialization should be promoted. Additionally, they provide an opportunity to integrate women into the production chain, thus strengthening their social position.

• The creation of a complete, nation-wide and sustainable industry must be constructed in timed steps, initially assuring that the model is economically validated thru pilots and that sufficient research is done, then scaling up until the industry is stable and demand driven.

Source: TechnoServe