

## **Jatropha Oil for Local Development in Mozambique**

### ***Project Summary***

#### **BACKGROUND - Current status on biofuels in Mozambique**

Mid 2005, a start has been made with growing Jatropha for harvesting its oil-containing seeds in Mozambique. The country's climate and soil conditions are very suitable for Jatropha. There is a number of sites with mature trees, which were planted by the Portuguese about 20 years ago.

The local organisation *Ajuda de Desenvolvimento de Povo para Povo (ADPP)*, which is the envisaged counterpart for this proposal) and the international non-governmental organisation *Caritas* have already started tree nurseries and small estates, in co-operation with ADPP's programme for teacher-training colleges (EPF) and with small farmers. The estimated area planted with Jatropha over the past six months is approx. 150 hectares. The targeted beneficiaries are the vulnerable small farmers, who have few other options to generate additional income.

There is presently no market for biodiesel, but one should mention an initiative by the local farmer Brendon Evans (originally from Zimbabwe), who produces biodiesel from cotton seed for propelling his own tractor.

#### Policy

Currently there is no national policy regarding biofuels; an intergovernmental working group on this matter has been created however.

#### Degree of local organisation

The most solid organisations that were present at the workshops and which can be considered to co-operate with, are:

- Ajuda de Desenvolvimento de Povo para Povo (ADPP)
- Caritas
- IIAM (Mozambique Agricultural Research Institute)
- ICRAF (World Agroforestry Centre)
- Environtrade (a UK-based NGO)
- Bio-oleo (Brendon Evans' local company)

#### Possible production modalities

Modality 1: A larger farmer who is the investor in the equipment and plantations and relies on a group of small farmers who supply him the seeds for oil extraction.

Modality 2: Farmers Clubs, which are a good alternative for cooperatives (the latter are not well accepted in Mozambique).

Modality 3: Introduction as part of school programmes (such as the current EPF colleges).

#### Market

There are strong market conditions that will trigger further upscaling. First, there is the existing local energy demand which can be met with Jatropha (whether as biodiesel or for electricity production); hence a local product for local use. The demand for affordable biodiesel remains large because conventional diesel is expensive: one litre of conventional diesel costs more

than 1 US dollar in Mozambique, which should be compared to the average income of around US 60 dollar per month.

Second, there will be an increased export to supply the European market, which is policy-driven. The EU member states are obliged to blend a 2% green component in transport fuels by the year 2005, and this share is to be increased to 5.75 % in 2010. Sweden has more ambitious targets and strives at an exclusively bio-based market for transport fuels by the year 2020. The European countries however, cannot produce the volumes of biofuel required to meet this obligation, primarily because of a lack of available land and suitable climate conditions. Import from other countries is therefore needed.

It is still uncertain if biodiesel from *Jatropha* can evolve into a sustainable export product<sup>1</sup>. Without external regulation (from the Netherlands or the European Union), microeconomic considerations will play a key role and *Jatropha* will have to compete with other, large-scale energy crops that are not so sustainable, specifically palm oil and soya oil. Decisive factors will then be the cost of production of the energy crop, including transport, processing and logistics, as well as the potential for upscaling and homogenisation of the crop production. Nevertheless, the potential market for vegetable oils is huge and by its very matter equal to the current market for fossil petroleum.

#### Use of the press cake

Local research revealed that no artificial fertilizer is used for growing *Jatropha*, since this is too costly. It is possible to use the press cake (i.e. the residue after pressing the seeds) for this purpose at low costs. The cake can also be fermented previously, but no experience has been gained with this technique in Mozambique.

### **THE PROJECT – FACT Proposal**

FACT Foundation (Fuels from Agriculture in Communal Technology; see Annex) has elaborated a project proposal targeted at *Jatropha* production by the poor farmer population in Mozambique.

#### Objective

FACT's long-term goal is to make a tangible contribution to the development of biofuels in developing countries, enabling local communities to benefit from this renewable energy source also when supplying the world market on the medium term.

The objective of this pilot project is to build an infrastructure and capacity to enable the autonomous upscaling of the activities after termination of the project. The project will initiate the local production of *Jatropha* seeds and develop a local market of end-users of the oil. The creation of capacity among the local small farmers and technicians is an important component of the project.

#### Project elements and expected results

A first element, the project will create between 250 and 500 ha of land cultivated with *Jatropha* after 3 years. The sites will be located in 5 different areas spread over Mozambique (from north to south), in which the local counterpart ADPP has had a long-lasting presence.

The production of *Jatropha* will be done by small farmers who are united in 25 farmer organisations (the so-called "farmers clubs"), which are supported by ADPP and will be coordinated by FACT. The national research institutes IIAM and ICRAF will carry out "on farm

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<sup>1</sup>

One can consult for example the report compiled by AIDEnvironment "*Betere biomassa: achtergronddocument en principes voor duurzame biomassa*" (April 2006, in Dutch). The discussion about the import of energy crops ranks high on the agenda in the Netherlands; a commission led by Jacqueline Cramer has been designated to bring clarity in this matter by end 2006 or early 2007.

research” to investigate different varieties, pests, diseases, and the use of biological pesticides with the aim to achieve a balanced production of the Jatropha crop.

The second essential element of the project is the development of a local market for the oil, which can be used to operate diesel generators for schools, to run corn mills and as a fuel for (a few) vehicles equipped with a diesel engine. Local technicians will receive training on how to convert diesel systems for plant oil operation, which involves the assistance of experts from abroad. The oil will be pressed at 10 different sites (within 5 schools and 5 small enterprises) to create an guaranteed initial market for the farmers to sell the seeds and the oil. Another option is the use as lamp oil for lighting in the villages and as a prime material for soap production.

It is expected that at the end of the project a market will have been created for 25 diesel engines distributed over 25 villages. The knowledge acquired from this project will be disseminated and the experiences and local revenues will generate new, comparable projects.

### Project activities

The activities composing the present project are, in synthesis:

1. Development of an agricultural infrastructure for Jatropha:
  - Recruitment and selection of 25 farmer organisations (out of a potential group of 180);
  - Training of farmers and extension workers on the production of Jatropha;
  - Base line measurement among 250 households to determine the penetration of Jatropha oil after two years;
  - Installation of 50 irrigation systems (wells plus water pumps);
  - To make available and to plant Jatropha, initially on 25 outgrower / research plots and, in a later stage, on an area of 10-20 ha per farmer organisation (25);
  - To harvest the Jatropha seeds;
  - Monitoring, field visits and meetings by / for the project participants.
2. To bring Jatropha oil on the local market and enable its use for self-supply:
  - Selection and training of 20 small entrepreneurs and 30 technicians for processing biodiesel and for maintaining diesel engines (generators);
  - The installation and adaptation of 10 diesel generators and 2 cars to run on biodiesel;
  - The procurement and installation of 5 oil presses;
  - The development of a transport and local trade network for biodiesel;
  - To monitor performance of the technology, maintenance and stock of spare parts.
3. Project upscaling based on the created infrastructure:
  - To create stocks of seed samples covering 5-15 varieties of Jatropha, including the execution of tests;
  - The economic analysis of the preliminary results, including determination of the price conditions for further upscaling within subsequent projects;
  - The exchange of experiences with Jatropha production in Mozambique with other countries, such as Zimbabwe and Zambia;
  - The development, coordination and monitoring of a research programme targeted at upscaling.
4. Promotion and dissemination of results:
  - Development and distribution of training material (covering radio broadcasting, video movies, books and leaflets) on the cultivation of Jatropha and the adaptation of diesel engines;
  - The dissemination of “best practices” using newspaper articles and a website;
  - To execute 2 seminars and training courses for several target audiences.

### Environmental results

- The project will lead to an overall CO<sub>2</sub>-reduction of between 2,500 and 5,000 ton per year. The avoided amount of CO<sub>2</sub> per hectare will be approx. 10 ton.

The total CO<sub>2</sub>-reduction of the project is modest but in line with its size. It would be fair to value its upscaling potential after 3 years, which is not included in the figure. One should further bear in mind that *Jatropha* plants can reach an age of 50-70 years, producing oil seeds year after year.

#### Scope of the project

The final scope of the project is large. It is envisaged that the project will be a showcase for further upscaling.<sup>2</sup> The first step comprises:

- 25 villages (communities) with 1,250 households, equivalent to approx. 6,000 people, who will obtain additional income from producing *Jatropha*. There are an additional 2,000 to 4,000 people who will have a nett income yield from the reduced expenditure on diesel (the corn millers) or who will experience improved living conditions from electric lighting (powered by the diesel generator sets). The costs in the first three years will be sufficient to achieve a larger scope. It is expected that on the longer term (10 years) this will be ten times higher.

#### Risks for the target group

Farmers may be reluctant to grow *Jatropha* if they fear that pests and diseases are transferred to other crops (specifically cassava, which belongs to the same family). Research into this matter has a high priority for this reason.

The risks for the vulnerable farmers are low. In case of a loss of harvest (due to an insect plague, a drought or whatsoever), the farmer will only lose the invested labour. The absence of fertilizers and costly irrigation equipment in the *Jatropha* production scheme prevents the farmer from ending up with a debt he cannot pay for. In this respect, there have been several negative experiences in Mozambique, in particular with the production of sesame, tobacco and cotton.

## **ORGANISATION**

### ***FACT***

FACT will coordinate the project and take the lead in disseminating and exchanging the gathered knowledge, expertise and information. In the current proposal, FACT will collaborate with a fixed group of three organisations, which in turn work jointly with the local partners:

- Arrakis works in Mozambique with Ajuda de Desenvolvimento de Povo para Povo (ADPP). ADPP combines knowledge transfer and education with the practical application thereof and has offices all over the country.
- RR Energy collaborates with Mali Folke Center (MFC), which is an NGO involved in renewable energy and rural development. MFC already administers an area of 150 ha cultivated with *Jatropha*. The seeds are used for producing derived products such as soap and lamp oil. MFC is an independent organisation, but was originally founded by the Danish Folkecenter for Renewable Energy.
- STROhalm works with the Fundación Hondureña de Investigación Agrícola (FHIA), which is a knowledge institute focused on agricultural export products.

#### FACT's primary role in this project will be:

- To execute project and financial management;
- To carry out monitoring and evaluation;

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<sup>2</sup> In his article *Poverty Alleviation as a Business* (2000) Urs Heierly shows that the initial cost is high for this type of projects, but will finally be exceeded by the output for all involved partners.

- To provide the required experts for training on agricultural and technical aspects (oil pressing and conversion of diesel engines);
- To select and procure the required hardware (typically the oil presses and conversion kits for the engines);
- To support the market development component;
- To coordinate and monitor the research components;
- To collaborate with information processing and promotion;
- To actively follow-up the upscaling phase.

### ***Ajuda de Desenvolvimento de Povo para Povo (ADPP)***

ADPP is a non-governmental organisation for development and has been active in eight African countries, including Mozambique, for approx. 25 years. ADPP operates under the umbrella of Humana People to People, a Danish institution which is active worldwide supporting organisations such as ADPP. Financial resources are obtained from the recollection of clothing, and also by running large farms in, for example, Brazil.

ADPP has acquired a strong position in Mozambique as a result of its Teacher Training Colleges programme (Escolas Para Futuro, EPFs). The colleges are commonly run for a number of years by Danish citizens with experience in education who are highly dedicated to this task. The EPFs are supposed to be partly self-supporting, which is an important element of the programme. They achieve this by establishing small companies linked to the school, such as a carpentry workshop to produce school furniture in Bilibiza, corn mills, etcetera. The school staff supports the enterprises by contracting them.

Another strong point of the EPF programme is the extension of the curriculum with methodologies and techniques acquired through ongoing projects, such as for water supply; the schools obtain a pump and training on irrigation and crop production for self-supply. The production of *Jatropha* will also be introduced in this way.

#### ADPP's primary role in this project will be:

- To support the "farmer clubs" which are currently being created by ADPP. Farmer clubs are groups of max. 50 small farmers who work individually but mutually support each other;
- To mobilise the farmers to plant *Jatropha* and provide support to them by giving training, extend seeds, hand pumps and cement to reinforce the wells. Therefore, ADPP's "community workers" will frequently visit the farmers;
- To support market development for bio-oil, ADPP will select the owners of diesel engines who are willing to adapt them to plant oil.

### **FINANCIAL**

The total project budget is:	EUR 432.000,-
<i>Stichting DOEN</i> has compromised a contribution of:	EUR 150.000,-

**BUDGET:**

<b>Jatropha oil for local development in Mozambique</b>	<b>Subtotals</b>	<b>Totals</b>
<b>EXPECTED MAIN RESULTS</b>	<b>BUDGET (in EURO)</b>	
<b>1. Rural communities producing seeds on at least 250 ha for energy use.</b>		84.500
- selecting and training 25 farmer clubs	28.100	
- installation rope pumps for nurseries	17.500	
- planting seedlings and training cultivation	15.000	
- planning and review meetings	11.000	
- monitoring Jatropha research plots	12.900	
<b>2. A market created in 25 communities for use of Jatropha oil in 25 diesel engines.</b>		131.550
- selecting diesel engines	2.400	
- training and installing fuels systems (schools)	62.800	
- procure and install 5 oil presses	62.350	
- monitoring performance, maintenance engines	4.000	
<b>3. Knowledge of: (a) most efficient Jatropha varieties and cultivation of these, (b) the case of Jatropha acting as host for pests and organisms, and (c) combat thereof with known natural pesticides</b>		51.400
- test and evaluate yield potential under various cultivation systems of 5 to 15 varieties	18.000	
- conduct survey and set up trial plots to evaluate potential of Jatropha being host for disease and pest organism	14.250	
- conduct economic analysis of Jatropha oil production to calculate an on-farm price	19.150	
<b>4. Information (in the form of training and information material) and stories of best practices on the communal energy self-supply model, made public through manuals, leaflets, internet, radio programme, video films and conferences.</b>		51.000
- Produce training material for community mobilisers, etc.	6.000	
- Produce a number of newspaper articles	9.000	
- Produce a booklet, radio programme and a video film.	16.000	
- Hold two dissemination seminars	6.000	
- Hold training course for project technicians	14.000	
<b>5. Large scale proposals developed and submitted together with governmental authorities to upscale and out scale this rural energy self supply model.</b>		35.000
- Conduct study on the viability of SMEs running stationary diesel engines equipped with dual fuel systems for plant oil from various sources	11.000	
- Assess possible positive and negative environmental impact of scaling up production of plant oil	10.000	
- Agree on cooperation with other governmental and non-governmental partners	7.000	
- Find funding opportunities together with the selected partners	7.000	
<b>6. Other expenses- not directly related to project activities</b>		46.500
- Annual audits	9.000	
- Mid-term and final evaluation	5.000	
- Local travel, food and accommodation for participants	12.000	
- Motorbikes and bicycles	8.000	
- Office equipment	12.500	
<i>Sub total</i>		399.950
Administration costs (8 %)		32.050
<b>Total</b>		<b>432.000</b>

## **FACT-ADPP Project:**

### **Jatropha Oil for Local Development in Mozambique**

*(See: FACT\_ADPP\_voorstel\_Moz\_aug\_2006 in Dutch)*  
FACT-Arrakis, J. de Jongh, 5 dec 2006

#### **Extension components:**

##### **No 7: Expansion of capacity building activities of Jatropha production in northern rural Mozambique, Bilibiza and Itoculo.**

Since the major group of 25 Farmer Clubs who will start with Jatropha production will be located in central Mozambique, with Chimoio and Nhamatanda as major centres, knowledge of most efficient Jatropha varieties and other agricultural knowledge will be generated in this region during the first years. It is therefore more efficient to start in the far-out rural areas in the north after 2 years only and benefit from the knowledge gathered in the central region.

Activities will concentrate on building up capacity among the local farmers, the agricultural schools in Bilibiza and Itoculo, government extension workers, etc. This will be done both in the field and in the classroom. Training will also be given on processing and use of Jatropha oil. Village mechanics will be trained to adapt stationary diesel engines for operation on both diesel and plant oil. Entrepreneurial villagers will be trained in making of soap and fabricating simple oil lamps for Jatropha oil, with which they can set up small local businesses.

##### **No 8: Set-up of a Training Centre on bio-fuels in Nhamatanda, Central Mozambique**

The main objective of this component of the Jatropha project is to establish efficient training of technicians to master the skills related to Jatropha production, processing and use. There is hardly any experience in Mozambique related to Jatropha. But there is a great interest from the Government, large commercial companies and private farmers to start production. It is therefore the right time and very convenient to establish this Training Centre as an extension of the Jatropha activities that will be started. This will be a great support to the many Jatropha farmers united the Farmers' Clubs and to their activities. It will also contribute greatly to the future biofuel development in Mozambique.

A main issue - at least for a number of years - will be the rapid multiplication of good yielding varieties that are well adapted to the local conditions. This will be a high-priority issue within the training. The project will enter into contact with a Chinese company that is using a fast-cloning system which does not require laboratory equipment in order to acquire this technology. It will also attempt to acquire expertise on the inoculation of Jatropha cuttings and seeds with the right kind of mycorrhiza - in order to ensure more effective uptake of nutrients from the soil.

The Training Centre will also give training on processing and use of Jatropha oil. In order to be ahead of the development and by showing (through model systems) that there is a market, it will convince and encourage more farmers to plant Jatropha. The technologies the participants will be trained in need to be low-cost and appropriate for the reality of Mozambique. The training will therefore concentrate on village mechanics to make simple adaptations to stationary diesel engines, so that they can run mainly on Jatropha oil. The participants will learn how the oil is pressed; how it should be treated before it can be used as a fuel; how it can be mixed with diesel in smaller quantities; and what kind of unmodified diesel engines this

mixture can be used with. The participants will also learn to produce biodiesel - in a small-scale biodiesel unit, which will be set up at the training centre.

The training facilities will be established at the Vocational School of Nhamatanda. The school centre at Nhamatanda is already involved in Jatropha activities through a small grant from the Global Environment Facility, and about half of the Farmers Clubs in the FACT programme will be in the Nhamatanda area.

An important issue is to find a capable teacher to be in charge of the Jatropha training in Nhamatanda. This person must be responsible for all the Jatropha activities at Nhamatanda and be a good trainer as well. The person will be trained during shorter courses in Mozambique, or within other organisations in neighbouring countries, such as Tree Africa in Zimbabwe, Golden Valley Research Centre in Zambia, Dilligent in Tanzania, etc. A specific training programme will be made to ensure that the teacher quickly becomes a local expert in Jatropha. From the beginning the teacher will start up the activities at Nhamatanda – hence it will be a combination of being trained and training others. FACT Foundation and the GAIA-Movement will - in cooperation with ADPP - develop the training and educational material needed for the training courses.

#### Target groups

The training will be included as part of the curriculum for the vocational trainees - young people who are taking their 9<sup>th</sup> grade exam at the same time. 60 agricultural students will be trained as Jatropha technicians (over a 3-year period). After graduation they will be able to work as technicians in other NGOs, start their a micro-enterprise or produce Jatropha.

Besides the training of vocational students, there will be short term courses targeted at village level technicians, government extension workers, staff from other NGOs involved in rural development, etc. It is planned to train 40 technicians annually in the form of 1-2 week courses.

The school centre has currently limited space available for accommodation and training. The project will therefore carry out rehabilitation of some existing buildings. This will make it possible to accommodate 10-15 people. The project will also establish a workshop. This workshop will be used to train technicians in adapting diesel engines to dual fuel systems. They will also be trained to produce simple cook stoves for Jatropha oil made of sheet material.

Workshop staff will also produce low-cost rope pumps, which will be used to irrigate Jatropha nurseries. Village technicians will be trained to install and maintain these simple pumps.

The participants will also be trained in setting up low-cost bio-digesters of the tubular plastic system currently used in Tanzania - and possibly the fixed dome type made of bricks used in China and Nepal.

#### **No 9: Coordination exchange project experience between Honduras and Mozambique.**

The difference between the conditions in the countries where the FACT pilot projects will take place (Honduras, Mozambique and Mali) will lead to differences in experiences and best practices as well. This project component promotes the exchange of experiences between FACT project leaders and transfer thereof between the countries. Because of the affinity in language, this component will be limited to Mozambique and Honduras. The FACT project leaders will visit each other's projects during short periods, recollect best practices and incorporate them into their own projects. These practices will further be made public by presentations in international seminars.

<b>BUDGET: Jatropha oil for local development in Mozambique; WITH EXTENSION COMPONENTS</b>	<b>Sub-totals</b>	<b>Totals in EURO</b>
<b>Latest Modification: 5 Dec 2006</b>		
<b>EXPECTED MAIN RESULTS</b>		<b>BUDGET x 1000</b>
1. Rural communities producing seeds on at least 250 ha for energy use.		85
2. A market created in 25 communities for use of Jatropha oil in 25 diesel engines.		132
3. Knowledge of a)most efficient Jatropha varieties, cultivation of these, b) the possibility of Jatropha acting as host for various agricultural pest organism, and c) combat of these with natural pesticides known		51
4. Information in the form of training and informational material, stories of best practices on the communal energy self supply model made public through manuals pamphlets, internet, radio programme, video films and conferences.		51
5. Large scale proposals developed and submitted together with governmental authorities to upscale and out scale this rural energy self supply model.		35
6. Other expenses- not directly related to project activities		46
7 Expansion of jatropha production capacity building activities, in rural Mozambique.		30
<i>providing training to farmers and others, Cabo Delgado &amp; Nampula Provinces</i>	24	
<i>providing equipment, for processing, making soap and lamps</i>	6	
8. Setting up of Bio-fuel Training Center on bio-fuels in Mozambique.		179
<i>Capacity building of TC head, TC teachers, and future experts-teachers</i>	25	
<i>Guest experts from China &amp; India, ect, providing training in advanced topics, cloning, mycorrhiza etc. plus FACT experts inputs.</i>	36	
<i>Developing curriculum and training material</i>	12	
<i>Improving existing school building into center and mechanical workshop</i>	35	
<i>Purchasing and installation of equipment, such as: oil press, bio-diesel production unit, biogas tank, cab truck modified to plant-oil/bio-diesel.</i>	50	
<i>Establish 20 ha jatropha model plantation at the TC</i>	4	
<i>Training and other expenses</i>	17	
9. Coordination Exchange project experience between Honduras and Mozambique		20
<i>Exchange visits of Moz. project leader to Hond., 2d and 3 d year</i>	13	
<i>Preparing and giving presentation in International seminar</i>	7	
Sub total		628
Planning, Monitoring & Evaluation FACT 4 %	0.04	25
Administration costs FACT (7,4 %)	0.074	47
<b>Total Budget</b>		<b>700</b>