

## Case Study: The Smallholder Model of Biofuel Production in Tanzania



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## ***Preface***

This case study report examines the experience of Diligent Tanzania Ltd. providing an outline of lessons learnt by the project, and reflects on other important aspects that might be taken into account by policy makers or industry practitioners while executing similar projects in the Southern African Development Community. It has been commissioned by GTZ and ProBEC for the SADC Energy Secretariat.

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<sup>1</sup> Picture on the front: Diligent Tanzania Ltd. Factory in Arusha

## **EXECUTIVE SUMMARY**

### *Background*

The experience of Diligent Tanzania Ltd reflects the operations of a commercial project however initial seed funding came from a Dutch government grant. It also received additional subsidies from a range of sustainable energy or development focused funding bodies. At this moment, 4 years after the start up, sufficient cash flow is generated to cover most Tanzania based operating expenses, however break even for overall activities has not yet been reached. Criteria used for choosing certain regions within Tanzania included availability of existing *Jatropha* plants and accessibility of the area from the Diligent processing and logistic facility in Arusha.

### *Operations*

Diligent has two main activities, firstly to purchase seeds from existing *Jatropha* trees through collection centres and secondly to promote planting using an outgrowers model. A 'field team' engages communities, and builds strong and lasting relationships with local farmers and decision makers. Pricing is determined by the market price for biofuel, as well as the amount one person can pick in a day. The processing facility consists of several modules therefore enabling more flexible processing. The market for the *Jatropha* oil, biodiesel and seedcake by-products exists both within Arusha and internationally.

### *Sustainability aspects and international best practise*

The Dutch RIVM<sup>1</sup> used Diligent as a case study for calculating the greenhouse gas balance, using Diligent oil to generate electricity in the Netherlands. Calculations show a reduction of greenhouse gas emissions of at least 60% compared with more conventional energy sources<sup>2</sup>. The general conclusion is that the model used by Diligent is positive for environmental conditions and meets the Cramer criteria for sustainability. Environmental impacts are monitored as precisely as possible, and data is put in a central database. Production in this manner is expensive and makes the oil more expensive than fossil diesel. However, it is a necessary initial evaluation when access to European markets is desired, and subsequent promotion of the model becomes easier.

### *Conclusions and Lessons learnt*

It is easy to underestimate the time required for setting up a business using the smallholder model, obtaining enough feedstock is a challenge. The agricultural sector in Tanzania is poorly developed and the taxation regime is unclear. It is important to disseminate new lessons and keep outgrowers close to the company with up to date information. Diligent has experienced frequent market distortions in the *Jatropha* seed market which troubled the trust relationship between outgrower and company. Acquiring additional funding to overcome years of investment without sufficient return is quite difficult.

### *Recommendations*

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<sup>1</sup> The Dutch National Institute for Public health and the Environment

<sup>2</sup> From: J. Struijs (2008) Shinda Shinda. Option for sustainable bioenergy: a *jatropha* case study - RIVM rapport 607034001, <http://www.rivm.nl/bibliotheek/rapporten/607034001.pdf>

Key variables for success include:

- Choose a biofuel crop that already exists in the country
- Apply accepted sustainability criteria to ensure support from donors, local governments and access to the market
- Identify a farmer community that is (or can be) organized
- Gain support from the government
- Be able to attract investors who accept that the return on investment takes longer than with other projects (>4/6 years)
- Ensure a strong management team on the ground with cultural knowledge and sensitivity capable of bridging cultural differences (there are over 120 different tribes in Tanzania, so it is necessary to employ field officers from different tribes)
- Have a strong link in the Netherlands, to know the sector and any changes in it (for example the sustainability criteria, developing countries could take those criteria on board as well)
- Develop strong links with local government

The dissemination of lessons learnt between all stakeholders in the sector is of crucial importance. Governments could facilitate this development by encouraging industry cooperation through starting up a national biofuel producers association. They would then also have a platform for communicating new policies or other important decisions to the stakeholders. If there is no government policy on biofuels a statement from the government stating the government position could assist investors in their decision whether or not to invest in the sector. A government stimulation programme for agriculture could assist in disseminating all agricultural lessons to the local population.

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## **Background**

The experience of Diligent Tanzania Ltd reflects a commercial project. The company's vision is to generate enough cash flow from selling biofuel and other derived products to be financial viable. However, since this is hard to realize from the beginning, the project started using PSOM<sup>3</sup> funding provided by the Dutch government. This funding was established to focus help on projects in new, difficult and emerging markets. The funding paid for the creation of a pilot project, after which follow-up financing would be required to allow further company growth.

In 2005 the company was registered in Tanzania as Diligent Tanzania Ltd. To be eligible for the PSOM subsidy it was required to have a local business partner, Multiflower, a flower company with more than 10 years of experience in Tanzania fulfilled this role. The funding covered 60% of all hardware investments and a significant proportion of operating overheads and other expenses. The total project investment is around € 1M. After four years of operation there is a substantial cash flow generated, which covers part of the costs made by the project. However, the break even point has not yet been reached.

The Tanzania Investment Centre (TIC) helps foreign companies to register in Tanzania. Being registered at the TIC can enable duty free import and provide assistance in obtaining work permits and other operating licenses.

The flower company was working with local smallholders (small scale farmers in the area around Arusha and further) to grow flower seeds using an outgrower model (this model is explained later). The same model was applied with Diligent and initially field officers from the flower company helped to interact with the community to explain new possibilities from farming Jatropa.

Quite a large number of farmers were already familiar with Jatropa as a crop because it is traditionally used as a fence. There was also one NGO already training groups about the benefits of Jatropa; however the market was still limited in scale. Initially areas were chosen to train people using a range of criteria: it had to be reachable from Arusha by a field officer, so not more than one day travel away, the area had to be very dry and farmers needed to be present themselves to enable seminars to be given.

In this part of Tanzania many NGO's work in a similar way. A seminar is organized, people gather for the seminar (and are often paid a so called 'sitting allowance') and are trained by one or more trainers. This means people were already used to receiving seminars from either NGO's or government officers. However, the village leaders always have an important influence in the final acceptance and overall possibility of organizing a seminar. Therefore it is very important to follow the bureaucratic government structure. After registering the company, and starting initial operations with field officers from the flower company, considerable effort was put in positioning the company with policy makers. Visits were made to government officials at all levels, national ministry officials, regional commissioners and local agricultural officers were all approached in order to get



**Figure 2: Diligent Tanzania office in Arusha**

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<sup>3</sup> PSOM means Programme for Cooperation with Emerging Markets, this programme is no longer available. The successor to this programme is PSI, Private Sector Investment Programme. For more info: [www.evd.nl/psi](http://www.evd.nl/psi).

a chance to explain the business model. The company is following the triple P bottom line, meaning the company has to be good for the People, for the Planet and has to make sufficient (not maximum) Profit. Having these company goals from the outset made it easier to convince central and local government officials about the good motives of the company. The project has very strong chain effects as it relies on the supply of Jatropha from an extensive network of local producers and collection points. Also, since the company was not looking at acquiring large plots of land (often seen as a colonial act of 'land grabbing') but focusing on providing an extra income to the farmers, the cooperation and interaction with the local community was often relatively easy. In fact, Diligent actually benefitted from a privileged position of cooperation and collaboration with the government compared with large scale plantation initiatives.

Since the start of the project the working area was amended slightly from the initial areas of Diligent Tanzania activity. Areas with vast amounts of Jatropha being cultivated over the last 40 years were discovered during several fieldtrips. The easiest way to convince farmers to grow extra Jatropha was found to be by using the following steps. Firstly, buying all Jatropha seeds already available by establishing collection centres, and secondly, after sufficient trust between the company and the community was gained, field officers would train the local community to plant additional Jatropha. Also, as the number of Diligent field officers increased, the work area expanded. Even regions on the other side of Tanzania could now be targeted.



Figure 3: Diligent demonstration plot

The limiting factors were now that: \*Jatropha had to be present in the region, \*the area had to be accessible by road and a minimum frequency of trucks passing through was important. This last factor was added because the transport expenses are a very important part of the business model, and by using (often empty) returning trucks, logistics costs could be minimised. Visits to National and Local governments remained useful, particularly as some officials were transferred or changed, and it was important to keep a close link with them. Some high ranking officials were very enthusiastic about the potential of the Diligent business model, in turn this helped encourage greater cooperation from lower ranked officials. Also the Annual Farmers Day (August 8<sup>th</sup>) promoted by the national 'Nane-Nane'<sup>4</sup> agricultural fair in Arusha where Diligent has a permanent demonstration farm helped to gain greater understanding and acceptance for the model.

## Operations

The business model used by Diligent Tanzania consists of two main activities. One is to buy all existing Jatropha seeds through collection centres and the other activity is to train contracted farmers to plant Jatropha following the outgrower model.

## Collection Centres

Because Jatropha is traditionally grown in Tanzania, seeds are readily available. This is a huge advantage compared with establishing a plantation where the average time for Jatropha to yield is around three years. Purchasing the seeds from local communities has many benefits, notably it creates trust between the communities and the company, and it generates a cash flow in the factory.

A collection centre can be a local shop, a farmhouse or a rented space

<sup>4</sup> This is Swahili for 8<sup>th</sup> of August



Collection centres are established in areas with many *Jatropha* trees. These collection centres consist of a 'main' collector who is often well-known in the region, usually a village chairman or elder. The only requirement is that there is a room available to store the seeds, and preferably they need to have a bank account to be able to coordinate seed purchasing from one central point. The coordination is done from Arusha where a field coordinator regularly contacts the collector to gain information on the amount of seeds collected and identify any problems experienced. The collection centre system works with an advance money system. Field officers who establish the collection centre provide the centre with cash money, in the season, to allow the centre to buy from seed pickers. There is a contract between the collection centre and the company; however the system is also based on trust. In the contract it is also stated that the collectors should not buy seeds from young children, however this is difficult to monitor. Often the additional cash earned by selling seeds is used for paying school fees. The longer a collection centre is collecting for Diligent, or the more seeds they are bringing in, the larger the cash advance amount will be. They also have access to other benefits, like acquiring mobile phones on a loan system from Diligent, with seeds being used to pay off the loan. Ideally every village should have one collection centre.



**Figure 4: Collection Center**

### **Outgrowers mode**

Stimulating the planting of *Jatropha* (as well as expanding the collection network) is done using a field team. Several field officers are part of this team, and cooperation agreements with various agricultural extension agencies (their field officers can be involved) can be an addition cost factor. In a seminar the way Diligent works, the agronomy of the plant, as well as the contract, is explained. Every 'outgrower' contract farmer will receive initial seeds for planting for free, in addition to training provided by Diligent. In return they sign a contract which states that they should offer all seeds to Diligent first. The contract states an absolute minimum guaranteed price (100 Tsh) which Diligent will pay for a minimum of 10 years. The price can increase depending on the oil price and transport expenses. Farmers are required to bring seeds to the nearest collection centre; however Diligent will make sure there is a centre in every village. The contracts are signed by the farmer, a government representative (often the Village leader) and a manager of Diligent. This ensures nothing is done without the approval of government officials. In the Diligent office there is a database where all information gathered by field officers is entered. This data shows the GPS location of the farm as well as pictures of the growth of the plant. Estimates on the time of yield can be made using this system, as well as providing information concerning the best performing plants. Special forms have been designed to acquire data easily. Up to 2009, about 1500 small and larger farmers have been formally contracted as a supplier. This allows current and future production regions to be examined and compared.



**Figure 5: *Jatropha* seminar for potential outgrowers**

Special forms have been designed to acquire data easily. Up to 2009, about 1500 small and larger farmers have been formally contracted as a supplier. This allows current and future production regions to be examined and compared.



## **Pricing**

The price for the seeds is established by calculating in two directions, from the farmers' point of view and from the company's perspective. Different regions have different prices, the longer the transport, or the higher the expenses for transport, the lower the price for the seeds. Collectors are always given the option to bring seeds to the factory gate (for a 'factory-gate-price'), if not; Diligent will organize and pay for the transport of the seeds. Diligent has a network of transporters and storage facilities in order to facilitate the transport of seeds. For processing, an average of 4 to 5 kg of seeds is needed to gain 1 litre of oil, in Tanzania around 500 Tsh has to be added to cover taxes (road toll and excise duty), however there is no legal excise framework present yet. The selling price of Jatropha oil should not exceed the price of fossil diesel, in order to ensure a local market. According to this calculation, 4 to 5 kg is needed for 1 litre with transport around 100 Tsh/kg and together with processing and overhead, the price for seeds should not exceed 150 Tsh to remain equal to the fossil diesel price. However this is susceptible given fluctuations in oil prices and taxation regulation and the value of the Tanzanian shilling. At the moment the market price for Jatropha oil is much higher than that of fossil diesel. This is because demand is high and availability low which makes higher prices for Jatropha oil possible. The Jatropha oil is currently sold for around € 1,50/litre, while prices paid for seeds to farmers range between 100-200 Tsh/kg. However, once availability of seeds (and so oil) is higher, the price for Jatropha oil will be substantially lower, due to economics of scale. The anticipated inflation of the Tanzanian Shilling will make sure the price paid for seeds can remain between 100-200 Tsh/kg. The price for seeds paid to individuals depends on the transport expenses. Farmers who bring seeds at the factory gate are paid 200 Tsh/kg, farmers/collectors in regions far from Arusha (like Mwanza which is around 700 km further) are paid 150 Tsh/kg. The minimum price for farmers as stated in the contract is always 100 Tsh.

Calculated from the viewpoint of a farmer, one person can pick an average of around 40 kg per day, multiplied by the price of seeds/kg this amount should equate to at least twice the minimum wage. The price Diligent pays for seeds lies between 100 and 200 Tsh/kg.

## **Processing Jatropha**

### *Products*

The Diligent factory processes Jatropha seeds into several products. Firstly and most importantly; Jatropha oil (SVO, Straight Vegetable Oil). This oil can be used in a mixture with diesel or can be used in a modified engine. Secondly Diligent also produces Jatropha biodiesel (Jatropha oil mixed with methanol becomes a liquid with similar properties as fossil diesel). There is also an important by-product, Jatropha seedcake. This seedcake is further processed into Jatropha briquettes (the seedcake is compressed to form a block) and Jatropha charcoal (the seedcake is processed in a similar way as the production of charcoal from wood). Part of the seedcake is also used in a Biogas digester, to generate biogas. This gas is used for cooking. Seedcake can also be sold directly, if there is a need to use it as biomass directly, one possible use is in boilers.

### *Factory*

There is a core team of factory staff, and more staff is trained and available on stand-by agreements to support production during peak times. The equipment in the factory is based on a module-system. Not one big machine but several smaller machines. Not only

does this minimise the risk of failure, but also allows for flexible processing. There is a cleaning machine for the seeds, several cold screw presses of different capacities (from 100kg to 400 kg/hour) to process the oil, a biodiesel unit, a briquetting machine and a charcoal oven. Several storage containers (with a capacity up to 1000 litres), and a tank filling system for putting the oil in a container or car. The location of this factory is Arusha, this location benefits from the local availability of trained staff and the existence of a local market for *Jatropha* products. The equipment has been purchased from different countries, from Tanzania, the Netherlands, Germany and India. All processing equipment installed uses the same technology, screw expelling. The smallest processing unit is the local machine produced by the Vyahumu trust in Morogoro. Though efficiency of the other machines is a bit higher they are also more costly. Screw expellers are often used in developing countries, and are widely available. The FACT foundation (Fuels from Agriculture in Communal Technology) has published a *Jatropha* handbook on their website in which more information is available on processing equipment and dealers. See [www.fact-foundation.com](http://www.fact-foundation.com) to download this handbook.



**Figure 6: Processing equipment in Diligent factory**

There is also a back up generator, as the electricity supply from the municipal utility is often unreliable. To be able to comply with required quality standards (see Annex) there is a laboratory, with a chemical engineer, where tests are performed to make sure quality is always guaranteed. These tests need a special environment, as working with the chemicals and the ingredients for biodiesel are sometimes volatile and hazardous. This is another reason to be located in Arusha and not in a more remote rural area.

### **Market for the products**

The clients for the oil, biodiesel and seedcake products are found in the immediate area of Arusha as well as internationally. All product sales have been direct 'over-the-counter' type of sales, i.e. without formal contract. By 'Word of mouth' many clients find their way and contact Diligent themselves. Most quantities sold are for testing purposes. There are two safari companies who have modified some of their cars and regularly buy fuel. They use this in positioning their tours with clients, and offer 'green eco-safari's'. Internationally the largest client has been a consortium of Boeing, Air New Zealand and Terasol. Diligent was the largest and only African supplier of *Jatropha* oil (SVO) for this flight, a Boeing 747 test flight in New Zealand. A film crew has visited Diligent to make a movie to be able to communicate to their stakeholders and passengers that this *Jatropha* oil was produced in a sustainable way. More information about this flight can be found at the website of Air New Zealand; <http://www.airnewzealand.eu/aboutus/biofuel-test/default.htm>. Up to 2009 around 35,000 litres of *Jatropha* oil has been produced by Diligent and sold to various clients.

Other sales include; seeds for planting purposes, press cake, *Jatropha* biodiesel (only in very limited quantities), charcoal but also services like consultancy and training.

In the direct neighbourhood of the factory there are several big industries with a large biomass demand, they often burn sunflower cake or wood and do not require any modification to their equipment to use *Jatropha* seedcake.

Due to the binding biofuel mandate of the European Union whereby a minimum of 10% of the fuel consumption should be derived from biomass based fuels in 2020, (and a binding EU target of a 20% share of renewable energies in overall EU energy consumption by 2020)<sup>5</sup> the demand within the European Union is expected to provide considerable business interest in the future and is already substantial.



**Figure 7: Transport of collected Jatropha seeds**

For Diligent a local market for the products is preferred, however as financial sustainability is important as well, the price that can be obtained for the products is most important. If exporting the oil can generate a higher price, it will be exported. At the moment the price is higher on the international market, this is due to a large demand and low supply. However if supply of Jatropha oil will increase (as many projects worldwide are planting Jatropha) the price will most likely decrease and production and transport expenses will become more important as pricing factors. The price of fossil diesel is almost equal in Tanzania and Europe and biofuel has to be competitive with fossil diesel. If transport is then taken into account, it means it will make selling on the local market more profitable, if the price is equal. A major uncertainty in this field is the taxation policy of Tanzania. At the moment it is officially illegal to fuel a car with any other fuel than the fuel sold at fuel stations for which an excise duty and road toll is paid. It is unclear whether biofuel will have similar taxation scheme's as fossil fuel, or that the Tanzanian government will promote biofuel by lowering these taxes. This limits the possibility of making clear local market analyses at the moment.

### ***Sustainability aspects and international best practise***

The project as a whole is designed to improve environmental conditions. Biofuel derived from Jatropha is sold as an alternative to fossil fuel, with the aim of reducing the contribution of fuel consumption to global warming. The secondary product, press cake products, if used as a charcoal substitute, reduces the burden on forests, where trees are often cut illegally for charcoal production. Jatropha can be produced in an extensive and environmentally friendly manner, with no pesticide or fertiliser used and limited use of machinery made. However it is the individual farmers that have to work according to these specifications. Vehicles of Diligent Tanzania also use Jatropha biofuel. Since Jatropha is a non-edible crop it does not directly compete with food. This was an important factor for Diligent management, to avoid investing in an energy crop in Africa if it was also a food crop.

During every seminar farmers are told that they can plant Jatropha but only as a fence around their field, using only fallow land or as intercropping. The farmers are also told that they should not cut any trees for the purpose of planting Jatropha, nor stop any food production. Water use is also noted.

To monitor the environmental impact as much as possible, a database was designed. This database combines range of data, such as pictures of the plants (ideally every year), an overview picture of the farm (to be able to see crop management, other crops planted etc.) and additional questions concerning water use, harvest and food production. Field

<sup>5</sup> [http://www.bioenergywiki.net/index.php/European\\_Union](http://www.bioenergywiki.net/index.php/European_Union)

officers have a set form on which they have to fill this information. It is then put in the central database in Arusha. Some students made reports examining the socio-economic impact on selected communities cooperating with Diligent. These reports can be seen as a base-line study and include for example interviews with farmers<sup>6</sup>. The database and

Since smaller, more subsistence oriented households are reluctant to adopt Jatropha in plantation form, and tend to prioritise food crops in allocating labour, domestic food security is not currently at risk.

Among larger land-holders, the displacement of crops in favour of Jatropha is dependent on the perceived viability, based chiefly on the price per kilo relative to other crops, and adequate yields. (Mitchell, 2008)

these documents can also be used as proof later that any soil erosion, famine or other disasters are not caused by the project.

The European Union has been working on sustainability guidelines for biofuel, but even before that The Netherlands have made criteria for producing biofuel in a sustainable matter. These are the so called: Cramer Criteria, launched in 2006<sup>7</sup>. It was anticipated by Diligent that only sustainable fuel will be allowed on the Dutch market. This was not the most important, but certainly an additional reason to produce sustainably. However, in order for clients to sell 'Diligent-oil' as environmental friendly oil, it is needed to have a certificate where this claim is confirmed by an independent third party. So to be able to sell on the Dutch market, it is necessary to have some kind of certification. A fair trade labelling organization (FLO, Max Havelaar) was invited and after initial positive feedback they are now incorporating sustainability criteria in their certification. It is expected that this process will take at least another year, after that it is possible to obtain such a certificate.



**Figure 8: Jatropha oil ready for transport**

The business model of Diligent Tanzania has been the subject of a case study carried out by SenterNovem and RIVM<sup>8</sup> on request of the Dutch Ministry of Environment (VROM). The objective of the study, carried out in response to much debate on the sustainability of imported biofuels, was to demonstrate that biofuel production in developing countries can also have positive impacts on social and environmental issues. Various visits and seminars have been held in the Netherlands and Tanzania concentrating on the business model of Diligent. In general both Dutch and Tanzanian governments, as well as various societal organisations, viewed Diligent's business model as very positive. The calculations in the report, whereby they use Diligent oil to generate electricity in the Netherlands, show a reduction of greenhouse gas emissions of at least 60% compared with more

<sup>6</sup> Not all of these reports are public, available is: Mitchell, A. (2008). The implications of smallholder cultivation of the biofuel crop, *Jatropha curcas*, for local food security and socio-economic development in northern Tanzania. [Anthropology & Ecology of Development](#). London, University of London. **MSc**.

<sup>7</sup> The Cramer Criteria include: Greenhouse gas emissions, competition with food, biodiversity, environment, prosperity, and social well-being. (more info: [http://www.snm.nl/pdf/1000\\_060714biomassarapportciecramerjuli2006.pdf](http://www.snm.nl/pdf/1000_060714biomassarapportciecramerjuli2006.pdf))

<sup>8</sup> The Dutch National Institute for Public health and the Environment

conventional energy sources<sup>9</sup>. The general conclusion is that the model used by Diligent is positive for environmental conditions and meets the Cramer criteria for sustainability. Diligent Energy Systems is also actively involved in the Working Group on Jatropha that has recently been established under the umbrella of the Roundtable on Sustainable Biofuels, Europe.

The RIVM report measures the sustainability in three dimensions: ecological, economic and social/ethical. For each dimension some illustrations are given<sup>9</sup>;

**1. Ecological dimension**

- More biomass on land is generated. This leads to a positive greenhouse emission balance;
- The residue can be digested. This leads to the formation of biogas which can be used in kitchens as a fuel. The nutrients from the digesting can be used in agriculture as fertilizer.
- Less firewood is needed which leads to less damage on biodiversity.
- The oil from Jatropha is important for the development of climate neutral transportation.
- The production of Jatropha can be done by means of intercropping. This means that there is a win-win-situation between the production of Jatropha and associated production of food.

**2. Economic dimension**

- More inhabitants of Tanzania get access to energy services, which is of major importance for future development of the country.
- More investments will be done in infrastructure, in facilities for the treatment of Jatropha and in irrigation. This leads to more economic activities and more important knowledge is generated.
- Carbon credits can be generated providing additional potential income.

**3. Social/ethical values**

- The income of farmers will increase. This money can be used for schooling of children and for buying more food. Additional revenue use has been surveyed in selected regions.
- The local people will get a role in the primary processes of the biomass-chain, and therefore an access to the market.

The decision to work with outgrower contract farmers had several reasons. Firstly obtaining land as a foreign company is very difficult in Tanzania. Land issues are politically sensitive and there are examples of foreign companies waiting three years before they can lease land. Working with outgrowers avoided this problem. Later when the Cramer Criteria became more and more the norm for producing sustainably, acquiring large plots of land and replacing forests or other crops would have made it impossible to comply with those criteria. The outgrowers of Diligent were already cultivating their land, so there is no change in land use. A third reason was that the initial investment costs are much lower while working with outgrowers than when working on large scale plantations. However, the negative side of working with outgrower farmers is that it has a higher risk of not getting enough feedstock to run the processing unit. Therefore acquiring small plots of land, for example 50 acres in each region or village, would be the ideal combination according to the lessons learned. These plots could also serve as a demonstration plot for farmers in the direct neighbourhood of this field. Diligent has so far established around 3 demonstration plots, whereby Diligent pays for maintaining the field (weeding, harvesting). These plots are about 1 to 3 acres in size.

The Tanzanian government has copied similar sustainability criteria to the Cramer criteria into their Biofuel guidelines which are currently submitted to the parliament for approval.

<sup>9</sup> From: J. Struijs (2008) Shinda Shinda. Option for sustainable bioenergy: a jatropha case study - RIVM rapport 607034001, <http://www.rivm.nl/bibliotheek/rapporten/607034001.pdf>

These are: namely food security, energy security, poverty reduction, environment conservation and people's participation<sup>10</sup>.

Producing using the Diligent model is quite expensive. An extensive 'field team' consists of field officers, field coordinators and subcontracted organizations that assist in collecting data for the database and distribute planting material. As the database work and monitoring does not contribute directly to the cash flow of the company, these expenses have to be considered as overhead expenses. To give an idea a 'promotion fieldtrip' meant for initial contacts with regional and local governments requires a budget of around \$2000. The expenses of the development of a region (depending on the size and distance of that region, and the number of persons working in the team) are around 600\$/month, and in the case of Shinyanga region 2 motorbikes were purchased. Furthermore, it requires around a week of time for the manager and field team and often some amounts of money are requested before a meeting is possible. This whole procedure has to be repeated on a regular basis to ensure continued cooperation. The cost price of Jatropha oil produced in this way will probably be more expensive than oil coming from a large scale plantation, or, at least at the moment, fossil diesel.

### ***Conclusions and Lessons learned***

The Diligent project has produced several conclusions and lessons learned which can be used for similar projects.

The **time** required to get production up to scale has been significantly underestimated. It has taken longer than anticipated to teach farmers how to set up planting properly, even with field officers based in farming areas. Farmers had less resources and know-how than was anticipated and needed more support. As a result, early planting has been less successful than expected in establishing healthy Jatropha trees. Along with many other Jatropha investors, Diligent relied on available literature to estimate harvests per plant and per hectare. These figures have since proven to be significant overestimations, both in terms of yields at maturity and concerning the time it takes for plants to reach maturity. Diligent Tanzania has worked hard to produce Jatropha biofuel in larger quantities, including a large shipment to an international project consortium testing the suitability of Jatropha oil as jet fuel for a Boeing-747 test flight. This consortium received 14,000 litres of Jatropha oil in July from Diligent, and has requested even larger amounts. Diligent was the largest (and only) African Producer of Jatropha oil for this flight. The demand for Jatropha oil is still high, but the main challenge remains the availability of feedstock.



**Figure 9: Jatropha Curcas L.**

**Poor development of agricultural sectors** and of agricultural sector development programmes is limiting a quick adoption. Farmers in Tanzania are poorly organised, in part due to negative experiences in the past with 'farmer cooperatives' that were imposed by governments and did not work in the interests of farmers. Government

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<sup>10</sup> From Presentation by Hon. W. Ngeleja, Minister for Energy and Minerals at the 3<sup>rd</sup> German-African Energy Forum, April 2008

([http://www.afrikaverein.de/\\_uploads/media/1896\\_William%20Ngeleja\\_Tanzania\\_2.pps](http://www.afrikaverein.de/_uploads/media/1896_William%20Ngeleja_Tanzania_2.pps))



agricultural assistance has been limited in the last few decades, and where extension officers have been appointed they do not have the means to operate effectively

There is to date an **unclear taxation regime for biofuel**. The Tanzania government has established a task force to elaborate a biofuel policy for Tanzania, but this body has not provided guidelines yet (although draft guidelines have been written). They have held participatory stakeholder meetings to discuss these guidelines. One area of particular concern for Diligent is the taxation regime, which is open to various interpretations with regard to the local use of vegetable oil as a fuel. This can significantly impact the market price that Diligent can assume for the future, and makes it more difficult to invest in such a long-term project as Jatropha biofuel. The market for Jatropha oil produced by Diligent at the moment is still mainly from clients who want to have a 'green image'. The local market in Tanzania could be expanded only with assistance from the Tanzanian government. There have been talks of blending biofuel with fossil diesel at the fuel station that would open up a huge local market. Diligent is actively approaching the government, and is a stakeholder in the National Biofuel Taskforce, but cannot push this development more. The biofuel guidelines should become available which would enable similar projects to know the tax regime. Not knowing what kind of taxation scheme will be applied to biofuel makes development of pricing models for the local market very difficult.

It is important to **disseminate new lessons** on the plant management of Jatropha. Sometimes lessons were learnt from individual farmers but the capacity to disseminate this further amongst all farmers was lacking. To continue to visit farmers regularly strengthens the relationship and trust between the project and the farmer and is important. Sometimes farmers were uprooting Jatropha when they were not visited regularly. With continued growth of number of outgrowers and regions within Tanzania, there is a risk of 'forgetting' earlier outgrowers. It is a challenge to keep all outgrowers close to the company with up to date information.

**Market distortions** were rather frequent. When other projects needed planting material they would go into the field and buy Jatropha seeds for a price considerably higher than prices paid by the project. This led farmers to believe that the project (Diligent) was paying too little and they sometimes became reluctant to plant additional plants or even to harvest the seeds.

Diligent acquires a cash flow by selling oil, but still receives additional funding from donor organizations. The Shell Foundation and DOEN Foundation were willing to invest in the company in 2008. The expectation is that for the next 2 to 3 years **additional funding** will be needed before cash flow generated reaches break even point and covers expenses within Tanzania. A business plan has been written to expand activities. The target is to reach 10,000 hectares of Jatropha cultivation using outgrower farmers and up to 200,000 hectares by 2016. For these targets additional funding is required in the form of equity investment or alternative sources of finance. Tanzania has ratified the Kyoto Protocol, this means in theory CDM (Clean Development Mechanism) projects avoiding CO2 emissions related to planting Jatropha or using Jatropha oil, could be funded. However no actual CDM projects have been implemented yet and no methodology for carbon sequestration by planting Jatropha or avoiding fossil fuel by using Jatropha oil has been approved yet. Nevertheless there is a voluntary carbon credit market as well, access to funds from this market is supposed to be easier.



More observations from the Diligent project;

- without stimulation programmes from the government (e.g. subsidies) the biofuel produced in this way will become more expensive than fossil diesel with current prices
- other activities of diligent (selling seeds, consultancy services) enabled the project to survive, as it could not continue through selling of oil alone
- trust of the farmers is easily broken, therefore many follow up visits were needed
- external financier is difficult to find for these kind of projects, since the return on investment comes only after at least four years
- it is essential that sustainability criteria are embedded in the business model from the beginning as this makes it easier to 'advocate' the model. Biofuel has received a poorer public image due to environmental and social risks associated with biofuel production. Although Diligent's fuel is much less susceptible to these risks, it remains Diligent's responsibility to prove this and position its 'brand identity' accordingly.
- there are many students who are looking for projects to be able to conduct their research. With proper supervision these reports can be used as proof documents later if any questions may arrive over the sustainability or impact of the project.
- transport expenses are important to be monitored, if a region is hardly accessible, transport expenses will be higher as well. This could make collecting seeds from this specific region too expensive.
- if initial seeds are given for free, the outgrower will not feel very responsible for the plants
- make sure there is a continuous investment in the relationship with the outgrowers. Having formal contracts will help to ensure responsibility.
- plant management lessons should be derived from different demonstration plots as soon as possible (pruning, diseases, best practice for using pesticides, replant methods etc.).

### ***Recommendations***

From analyzing the Diligent Tanzania project, several variables can be identified which contributed to the success of developing a sustainable production facility.

Key variables for success:

- Choose a biofuel crop that already exists in the country
- Apply accepted sustainability criteria to ensure support from donors, local governments and access to the market
- Have a farming community that is (or can be) organized

- Gain support from the government
- Be able to attract investors who acknowledge that the return on investment takes longer than with other projects (>4/6 years)
- Have a strong management team on the ground with cultural knowledge to bridge cultural differences (there are over 120 different tribes in Tanzania, so it is necessary to employ field officers from different tribes)
- Have a strong link in the e.g. Netherlands, to know the sector and any changes in it (for example the sustainability criteria, developing countries could take those criteria on board as well)
- Have strong links with local government

Consideration of Jatropha as a potential biodiesel feedstock requires the following to be done first<sup>11</sup>:

- Formulation of policies that would guide farmers as well as investors
- Coordination of activities of all the stakeholders to avoid duplication of research work
- Making the contracts enforceable to enhance responsibility among contracted farmers.
- Involve local government partners in all stages of introduction of new plant species
- Encourage farmers to use the previously introduced agricultural management practices
- Hold effective training seminars to educate the farmers on good land management practices
- Supply inputs such as pesticides in good time
- Ensure the provided inputs are used for Jatropha and not for other crops.
- Research should be carried out to look for solutions to identified pests and diseases and identify resistant species.

The Diligent Tanzania project has benefitted enormously from learning from other firms and bodies across the region on what should be done and what should not be repeated. A considerable amount of time was spent passing on advice and understanding to Tanzanian farmers and NGOs seeking to get involved in biofuels, particularly Jatropha, but for whom working alone would have been ineffective, inefficient and likely to fail. To stimulate the dissemination of lessons learnt is very useful for the whole sector.

Governments could facilitate this development by providing a stage for starting up Biofuel Producers Associations. Best practices can then be established and projects with difficulties in a certain area could learn from others. When the government has an announcement to make, the same body could be used.

If governments do not have biofuel guidelines available, a statement with the intentions of the government (either pro-biofuel or not) could help to convince early investors to invest in this sector.

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<sup>11</sup> From: report of the cost benefit analysis in shimba hills, Violet Moraa Mogaka, University of Nairobi/ICRAF, 2009.

A government stimulation programme could assist in disseminating all agricultural lessons to the local population. The same government field officers could be used for this. In Tanzania the government has a system whereby agricultural extension officers, employed by the ministry train farmers on agricultural best practices. In some cases Diligent worked together with these field officers, however only after paying them a daily allowance. Since the labour for promotion of planting is seasonal, these field officers could help substantially. In the future, Diligent envisages expanding its support to farmers, by working with these intermediate structures such as SACCOs (Savings and Credit Cooperative Organizations) and other cooperative structures that represent farmers' interests. Also other farmers associations and saving societies are helpful to be linked to. If the farmers are organized in a group, not only is it easier to train them, disseminate new lessons, establish a central collection point, have a bank account etc. but also for the farmers as they will have a better saying in interactions with the company.

In case of a (new) taxation regime, it is essential to communicate this as soon as possible amongst the stakeholders. Since it could possibly influence the whole chain, thorough investigations on the effects in every stage should be executed.

Creating a body like a National Biofuel Taskforce, made the Tanzanian government very transparent. Also, it became clear that Tanzania is taking biofuels seriously. The participatory stakeholder meetings were very encouraging. But communication after the draft biofuels guidelines were given out was little. Hopefully all developments for the biofuel sector will be communicated amongst all stakeholders.

## ANNEX I : Quality Standard for SVO

Properties / Contents		Unit	Limiting Value		Testing Method
			min.	max.	
<i>characteristic properties for Rapeseed Oil</i>					
Density (15 °C)	kg/m <sup>3</sup>	900	930		DIN EN ISO 3675 DIN EN ISO 12185
Flash Point by P.-M.	°C	220			DIN EN 22719
Calorific Value	kJ/kg	35000			DIN 51900-3
Kinematic Viscosity (40 °C)	mm <sup>2</sup> /s		38		DIN EN ISO 3104
Low Temperature Behaviour					Rotational Viscometer (testing conditions will be developed)
Cetane Number					Testing method will be reviewed
Carbon Residue	Mass-%		0.40		DIN EN ISO 10370
Iodine Number	g/100 g	100	120		DIN 53241-1
Sulphur Content	mg/kg		20		ASTM D5453-93
<i>variable properties</i>					
Contamination	mg/kg		25		DIN EN 12662
Acid Value	mg KOH/g		2.0		DIN EN ISO 660
Oxidation Stability (110 °C)	h	5.0			ISO 6886
Phosphorus Content	mg/kg		15		ASTM D3231-99
Ash Content	Mass-%		0.01		DIN EN ISO 6245
Water Content	Mass-%		0.075		pr EN ISO 12937

The so-called Weihenstephan or RK2000 standard summarizes the criteria that determine the quality of PPO as an engine fuel<sup>12</sup>.

<sup>12</sup> Henning (2001) - Manual for *Jatropha curcas* L in Zambia

## **ANNEX II: Contacts**

### **Key Diligent Contacts**

Director: Ruud van Eck, [Ruud@diligent.nl](mailto:Ruud@diligent.nl)

General Manager (Tanzania): Hayo de Feijter, [Hayo@diligent-tanzania.com](mailto:Hayo@diligent-tanzania.com)

### **Key Government Contacts**

#### *National Level*

NationalBiofuel Taskforce

Members:

- Ministry of Planning, Economy and Empowerment (Chair),
  - Ministry of Energy and Minerals (Secretary)
  - Ministry of Agriculture, Food Security and Cooperatives,
  - Ministry of Labour, Employment and Youth Development,
  - Ministry of Finance,
  - Vice President's Office –Division of Environment
  - Ministry of Water and Irrigation
  - Ministry of Lands, Housing and Settlement Development
- Government Institutions and Private sector representatives:

- Attorney General's Chambers
- Tanzania Investment Centre (TIC)
- Tanzania Petroleum Development Corporation
- Community Finance Limited
- Tanzania Sugar Producers' Association

- 1) Mr. Mwhihava, Mr. S. Rwebangila and Mr. P. Kiwele (principal forest officer) are approachable for the ministry of Energy
- 2) Mrs. Esther Mfugale is approachable for the ministry of Agriculture

The following institute is important for executing and/or supervising an Environmental Impact Assessments:

- NEMC ( National Environmental Management Council)

NEMC

Sokoine Drive,  
TANCOT House,  
2nd and 3rd Floor,  
P.O. Box 63154  
Dar es Salaam, Tanzania

More info at: <http://www.nemctan.org/>

Minister of Energy & Minerals: Hon. William N. Ngeleja

Commissioner of Energy: Mr. Mrindoko

Assistant Commissioner of Energy: Mr. Mwihava

Permanent Secretary  
Ministry of Energy and Minerals  
Sokoine/Mkwepu Street  
P.O. Box 2000/9152  
Dar es Salaam

*Regional and local level*

The following hierarchy should be followed on regional and local levels when trying to set up a project or work with local communities;

1. Regional commissioner
2. District commissioner
3. DALDO (District Agricultural and Livestock Officer)
4. Village Leader
5. Farmers