



# Jatropha - A Greenergy perspective

Jatropha is a tree that can grow on low grade land and is therefore being promoted as an alternative biofuel feedstock to crops that require prime agricultural land. There are a number of conflicting opinions regarding how viable an option jatropha actually is on a large commercial scale.



## Summary

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Greenergy is a significant producer and supplier of petroleum and biofuels into the UK transport fuels market, supplying over 15% of the UK's overall petrol and diesel market and approximately one third of the biofuels market. The company has extensive worldwide sourcing experience, with manufacturing operations in the UK and a blending facility in Rotterdam from which we supply customers across Europe.

In this Perspective, Greenergy presents the following:

Jatropha is a relatively new biodiesel feedstock which is being promoted by some within the industry as a 'sustainable' alternative to other biodiesel feedstocks such as soy, palm and rape. However, there are a number of issues which need to be considered before large-scale commitments to jatropha are made:

- Commercial scale production of jatropha is relatively new, so it is currently undergoing a significant development stage to determine its productivity.
- Jatropha is a hardy plant which can survive and grow in marginal environments and particularly in arid areas. However, as with all plants it will give higher yields if grown on more fertile land so if demand increases there is significant potential for it to displace other crops on more fertile land.
- Jatropha is a tree that produces oil yielding seeds every 3 – 8 years over a period of up to 40 years. As such it is less flexible in terms of land use than the annual arable crops more commonly used for biodiesel production.
- The lack of reliable performance characteristics for jatropha seeds, along with no reliable production and harvesting data, means there is currently no assurance of yield.
- Unlike other biodiesel feedstocks such as rape oil or palm oil, the products of jatropha are poisonous to humans and animals. Therefore, existing vegetable oil supply chains cannot be used for jatropha oil which must be kept separate from all food-grade oils requiring new supply chains to be developed.

Once progress has been made on the above and jatropha oil becomes available on a commercial scale, Greenergy will consider incorporating it as part of its feedstock mix.

# 1 What is jatropha

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## Perspective

*Jatropha (Jatropha curcas)* is a tree that bears oil yielding seeds, which is increasingly being considered for use as a biodiesel feedstock.



Jatropha is a hardy tree that can grow on barren, eroded lands under harsh climatic conditions and is considered resistant to drought<sup>1</sup>. It is a perennial crop and takes six to seven years before it can be harvested. The jatropha tree has a long lifecycle of around 30 to 40 years.

The fruit, foliage and bark contain curacas - a poison to humans and animals, and a possible carcinogen<sup>2</sup>. It is therefore not cultivated as a food crop, but instead for its oil bearing seeds. The oil content of jatropha is 35 – 40% in the seeds and 50 – 60% in the kernel. The oil contains 21% saturated fatty acids and 79% unsaturated fatty acids.

Historically, the oil from the seeds has been used to make soap, the dye from the bark can be used a colourant for cloth and meal is often re-used as an organic fertiliser. Increasingly, jatropha is being considered as a biodiesel feedstock.

<sup>1</sup> Francis, G., R. Edinger and K. Becker. A concept for simultaneous wasteland reclamation, fuel production, and socio-economic development in degraded areas in India: Need, potential and perspectives of *Jatropha* plantations. *Natural Resources Forum* 29 (2005) 12-24.

<sup>2</sup> <http://www.fao.org/docrep/x5402e/x5402e11.htm>

## 2 Worldwide production

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### Perspective

Cultivation of Jatropha is increasing rapidly on a global scale.

Jatropha originated in Mexico and South America. It is now increasingly being planted around the world including in Asia (mainly India, Indonesia, and China) and Africa (mainly Egypt, Malawi, Swaziland and Zambia).

It is claimed that India has 11 million hectares of land being cultivated for jatropha for biofuel<sup>3</sup>, and a single fuel company has reported plantings of 95,000 hectares in India, 47,000 hectares in Africa and almost 50,000 hectares in Asia<sup>4</sup>.

There is however, one country in Africa that is concerned about this rapid increase in jatropha production. In South Africa it is now illegal to plant or propagate jatropha without a permit. The South African Agricultural Department does not consider jatropha to be a viable option as a biodiesel feedstock and is concerned that information gathered from elsewhere in the world is contradictory, and has to be tested locally to ensure limited environmental impact and sustainability before it is introduced to a region. There is also some concern that to increase jatropha production to commercially viable levels, more favourable growing conditions are required. Priscilla Schoole from the Agricultural Department explained: "The area that can be classified in South Africa as sub-tropical (and therefore more suitable for optimum jatropha cultivation) is limited and the agricultural crops grown in those areas have a much higher income potential than jatropha."<sup>5</sup>

<sup>3</sup> [www.jatrophabiodiesel.org](http://www.jatrophabiodiesel.org)

<sup>4</sup> <http://www.d1plc.com/agronomyPlanting.php>

<sup>5</sup> Mail and Guardian online, 25th September 2007 [www.mg.co.za](http://www.mg.co.za)

### 3 Production and yields

#### Perspective

There is a lack of reliable data on yield and production of jatropha on low grade land which may result in lower yields, as compared to production on prime land.

It is currently estimated that after the first five years of cultivation the average annual yield per tree is 3.5kg of beans. Approximately 4kg of beans is required to make one litre of biodiesel, so on this basis one hectare should yield around 2.2 to 2.7 tonnes of oil<sup>6</sup>. However on poor grade land the yield may be significantly lower.

**Table 1: Feedstock production per hectare**

Feedstock	Country	Yield/hectare (kg)
Soya oil	USA	375*
Rapeseed oil	Europe	1000
Jatropha oil	India	220 <sup>7</sup> - 2700
Palm oil	Malaysia	5000

Source: Centre for Jatropha Promotion<sup>8</sup>

Recently advisors to the Roundtable on Sustainable Palm Oil (RSPO) have stated it would take five years of intensive research before jatropha could achieve the productivity level that would make its cultivation economically viable<sup>9</sup>.

Opinion is split over how long it actually takes before the jatropha tree can be harvested. This is partly due to the fact that there are currently no plantations in full production. Some reports indicate that it can be harvested three years after planting, but others state jatropha plants need four to five years before a full harvest can be achieved<sup>10</sup>. This is a slow cultivation period when compared to annual arable crops, which can be harvested after months rather than years.

<sup>6</sup> [www.reuk.co.uk](http://www.reuk.co.uk)

\* Soya oil is given a low yield because the soya meal accounts for the majority of the crop, with the oil collected as a by-product.

<sup>7</sup> Neelakantan, 2006

<sup>8</sup> [www.jatrophabiodiesel.org](http://www.jatrophabiodiesel.org)

<sup>9</sup> M.R Chandra, Reuters, 12th September 2007 <http://uk.reuters.com/article/oilRpt/idUKHKG7593720070912>

<sup>10</sup> Henning R. K "Identification, selection and multiplication of high yielding jatropha curcas plants and economica key points for viable jatropha oil production costs". 11th April 2008 <http://www.ifad.org/events/jatropha/agronomy/henning.pdf>

The cultivation of jatropha on a large scale is a relatively new development, which has potential implications for the quality of the crop. Unlike cereal crop seeds which are certified according to their performance characteristics; there are currently no certified seeds available for jatropha; with no reliable performance characteristics which means there can be no assurance of the yield<sup>11</sup>. It has been observed that there is great variability in seed production between plants<sup>12</sup>, which has serious implications for current estimates of production. Jatropha is also considered a 'wild' plant, and as such it has not yet undergone selection and improvement for agricultural use.

Considerable interest has been generated in the potential to grow jatropha on low grade or waste land, which is seen as a benefit because it is thought to actively contribute to restoration of degraded lands, and will not displace food production. However, there are a number of factors that can affect the yield of a crop which will vary according to geographical location. These factors include temperature, climate, and the quality of the soil among others. Initial trials have indicated that yields on poor quality land may be as low as 220 kg oil per hectare<sup>13</sup>. Therefore, despite its potential to grow in harsh climatic conditions it may be more profitable to grow it on prime land. This may drive production away from low quality land.

The UN is concerned that the potential yields of jatropha and similar crops on degraded or waste lands are not yet known. Yields from palm oil are five times higher than those from rapeseed and three times higher than those currently known from jatropha<sup>14</sup>.

Indeed, even proponents of jatropha agree that although the crop can do well on land that may not be ideal for food crops, it is likely that with selective breeding, modest amounts of water and fertiliser it will perform even better<sup>15</sup>.

Currently, there are other biofuel feedstock crops that offer more flexibility as they can be diverted to either food or biofuel production<sup>16</sup>, offering a more secure future for participants in the value chain.



Photo by R. K. Henning [www.jatropha.org](http://www.jatropha.org)

<sup>11</sup> Shukla, S. Chhattisgarh Biofuel Development Authority, India

<sup>12</sup> Sharma et al., 1997

<sup>13</sup> Neelakantan, 2006

<sup>14</sup> Woods J & Black M "Local land use change impacts and opportunities" May 2008

<sup>15</sup> Lord Oxburgh, "All party parliamentary renewable transport fuels group newsletter", October 2007

<sup>16</sup> For example, soy oil is cultivated for use in consumable food products, cosmetic products, plastics inks and solvents, and biofuel.

## 4 Environmental and social impact

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### Perspective

There is considerable interest in the potential of jatropha to be a 'sustainable' alternative to other bioenergy crops. However this has yet to be demonstrated in practice and the potential negative impacts need to be explored further.

There is growing evidence that jatropha may have a place in arid regions where local employment generation and restoration of degraded land are priorities<sup>17</sup>. However the UN FAO has voiced concern that a rush into jatropha on the basis of unrealistic expectations will not only lead to financial losses, but also undermine confidence among local rural communities<sup>18</sup>.

Jatropha is a very labour intensive crop which is harvested by hand. It typically requires 200 people per hectare to harvest and as demand grows even more man power will be required to manage its growth. In some parts of the world, for example various African nations, these necessary increases in labour are regarded as a positive social impact on local communities.

However, there is concern that jatropha initiatives are being funded and subsidised before mass cultivation of the crop is fully understood<sup>19</sup>. Because of the long harvest cycle, it is difficult for producers to respond to market demand. It is argued that a premature push towards jatropha cultivation on a large scale could lead to unproductive agriculture<sup>20</sup>, which could have widespread implications for local economies and livelihoods of farmers, not to mention profitability for investors.

If there are significant yield gains from production on prime land (a likely scenario), production is likely to move to high quality arable land and replace food production. This has implications for food security. Unlike other biofuel crops, jatropha oil is not fit for human or animal consumption, and thus cannot be diverted for food usage. Also, because jatropha has a long harvest cycle (unlike other biofuel crops such as rape or soy, which are annual crops), growers have less flexibility to divert to other crops.

<sup>17</sup> UN-Energy; Sustainable Bioenergy: A Framework for Decision Makers

<sup>18</sup> Ghosh, P. Central Salt & Marine Chemicals Research Institute

<sup>19</sup> [www.checkbiotech.org](http://www.checkbiotech.org) 11th October 2007

<sup>20</sup> [www.checkbiotech.org](http://www.checkbiotech.org) 11th October 2007

## 5 Supply chain

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### **Perspective**

Jatropha cannot be transported along with any food crops or other vegetable oils, limiting its possibility to become a mainstream biodiesel feedstock.

Currently all vegetable oils are transported using the same infrastructure whether for food consumption or fuel. However, because jatropha is poisonous, it would require a completely segregated supply chain. This means that at least in the short to medium term, the supply of jatropha will be limited to local production and esterification processes. This could affect the ability of jatropha to become a mainstream biodiesel feedstock on an international level.

## 6 Case study: India

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### Perspective

India is looking to jatropha as a fuel crop because it is deficient in edible vegetable oil production and cannot afford to divert any edible oils to biodiesel production<sup>21</sup>. It has also been hailed as a reliable source of income for India's poor rural farmers, providing energy self-sufficiency<sup>22</sup>.

Currently, India has eleven million hectares of land being cultivated for jatropha for biofuel<sup>23</sup> and is planning on increasing this in near future. Former Indian President Dr Abdul Kalam is a strong advocate of jatropha and in 2006 he announced that out of 60 million hectares of wasteland, over 30 million hectares are suitable for jatropha cultivation.

However, some local Indian farmers are protesting against government land policies regarding jatropha cultivation claiming this is land they currently farm for food<sup>24</sup>. Some commentators agree and are wary that this programme for mass cultivation of jatropha has been launched without its feasibility being tested, and without consulting the people whose lands are being acquired<sup>25</sup>. As jatropha is a tree rather than an annual crop, the consequences of moving forward so quickly could have serious repercussions on the availability of land in India that is used for food production.

<sup>21</sup> Bellarmine K.C, "Investment opportunities for creating new sources of livelihoods in Nagapattinam, India" August 2008

<sup>22</sup> Institute of Science in Society (ISIS), 15th October 2007

<sup>23</sup> [www.jatrohabiodiesel.org](http://www.jatrohabiodiesel.org)

<sup>24</sup> <http://www.channel4.com/news/articles/society/environment/why+wonder+plant+fuels+heated+debate/959862>

<sup>25</sup> Roy. A China Confidential, 25/10/07

## 7 Greenergy and jatropha

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Greenergy does not currently use jatropha oil as a feedstock for biodiesel for a number of reasons:

- Jatropha oil is not commercially available at present.
- Complications in the supply chain: Jatropha cannot be transported with edible vegetable oils. This means it would require different ships, tankage, lines and processing facilities.
- Concerns over current yield projections: There is limited information about the performance of yields and guaranteed supply of jatropha oil on a large scale, making it a high risk investment, particularly given the availability of other feedstocks.
- Concerns over social impacts: The potential displacement of food crops, lack of flexibility of the crop in changing market conditions and unproven long term production data may have serious implications for local livelihoods and food security.

Once progress has been made on the above and jatropha oil becomes available on a commercial scale, Greenergy will consider incorporating it as part of its feedstock mix.