JatroSolutions: Jatropha oil for biofuel and more

Jatropha is an extremely hardy and frugal plant species native to tropical and subtropical areas where it grows on wasteland. Jatropha seeds contain large quantities of oil that can be processed into a variety of products such as biofuels, animal feed, cosmetics and organic fertiliser. However, few Jatropha species have been properly domesticated, and the yields of the plants that grow in the wild are too small to be economically viable. Jatropha experts from the consulting company JatroSolutions from Stuttgart-Hohenheim are seeking to change this and since 2007 have been focussing on ways to make Jatropha cultivation economically profitable, as well as ecologically and socially acceptable. The first Jatropha varieties that meet the required criteria were placed on the market in 2014.
The company JatroSolutions Bioenergy Consulting was spun out from the University of Hohenheim in 2005 as a result of a cooperative research project between the University of Hohenheim and the German energy producer EnBW. The director of the Institute of Animal Nutrition and Rangeland Management in the Tropics and Subtropics, Prof. Dr. Klaus Becker, was instrumental in establishing the start-up. Becker, who has since retired from his positions at the University of Hohenheim and as managing director of JatroSolutions, continues to support the company as a freelance consultant, while the company's two other cofounders, Klaus Tropf and Ralf Scholz from EnBW, remain at the helm. According to company management, JatroSolutions is the leading Jatropha company in the world and now has two subsidiaries; EnBW became the majority shareholder of JatroSolutions in January 2015.

One of the subsidiaries, JatroSelect Bioenergy Breeding, is involved in the optimisation of plant breeding. The other, JatroGreen Bioenergy Madagascar, uses an R&D plantation on Madagascar to assess Jatropha cultivation and processing methods. JatroSolutions is also a founding member of the Aviation Initiative for Renewable Energy in Germany e.V. (aireg) which promotes production and use of alternative aviation fuels. Through the work it does, JatroSolutions aims to contribute not only to climate protection and sustainable global energy supply, but also to socially and ecologically sustainable development of rural areas.

Jatropha – an oil plant that also grows well in desert areas
Jatropha (Jatropha curcas L.) – also known as physic nut or laxative nut – is cultivated in tropical and subtropical regions across the world. It is adapted to arid conditions and can easily grow several metres tall and live for up to 50 years. Jatropha is a genus in the spurge (Euphorbiaceae) family, which produce toxic substances that protect them against animals and other pests. Jatropha seeds can have an oil content of up to 43 percent. The composition of Jatropha oil is similar to that of rapeseed and thus considered high quality. However, due to its toxic constituents, Jatropha is not suitable for human consumption and is instead used to produce a broad range of industrial products. Other parts of the plant such as leaves, stems, root or plant juice are also valuable raw materials.

“Jatropha is native to Central America and, due to its antiseptic effect, has traditionally been used for treating wounds,” says Dr. Brigitte Bohlinger, agricultural engineer and senior consultant at JatroSolutions. In addition to its medical effects, Jatropha plants can easily be grown on nutrient-poor and arid wasteland soils, therefore not requiring the clearing of primeval forests.

Over the last few years, researchers from JatroSolutions and the University of Hohenheim have been intensively studying the various uses of Jatropha and have developed a remarkable value chain: fruit and seed shells can be processed into pellets for burning, Jatropha seed meal (which is a residue of oil pressing) can be processed into industrial products such as packaging foils. However, the major product derived from Jatropha is the golden seed oil that can be used to produce biodiesel, biokerosene, cosmetic products (e.g. soaps) and pesticides. The side product of oil pressing, i.e. seed meal, can be used as a substrate for biogas plants or returned to the fields as an organic fertiliser. If detoxified, the seed meal is also suitable as animal feed due its high protein content of up to 50 percent. However, the oil’s greatest economic and ecological importance lies in the ability to process it into biofuels, thus creating another alternative to fossil resources.

First suitable Jatropha variety placed on the market in 2014

China and India have been using Jatropha oil for producing biodiesel for many years. However, the seeds used are mainly derived from undomesticated Jatropha tree species, hence the productivity and quality of the oils can vary considerably and economic use of the plant is rather difficult. JatroSolutions experts therefore decided to take a closer look at the plant’s genetic potential. “It was the first time researchers seriously considered the possibility of domesticating and breeding Jatropha,” says Bohlinger.

The researchers, who were aiming to increase both oil yield and quality, achieved their objective in 2014 and the company was able to add the first high-yield and high-quality Jatropha varieties to its product portfolio. “These varieties produce seed yields of 3 to 3.5 tons, which produces around a ton of oil per hectare,” says Bohlinger. “The press cake is used in biogas plants or, after detoxification, for producing high-quality protein feed.” In order to place the first varieties on the market, comprehensive breeding programmes were run for several years during which 370 genotypes were analysed and the most promising selected for breeding. The genotypes selected were subsequently tested at 14 locations worldwide under different climatic conditions.

Field trials at research stations around the world
Jatropha is an extremely hardy and frugal plant species native to tropical and subtropical. Jatropha plants can easily be grown on nutrient-poor and arid wasteland soils, therefore not requiring the clearing of primeval forests. Jatropha can be used to recultivate nutrient-poor soils.

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JatroSolutions assesses the cultivation of Jatropha plants in Madagascar through its subsidiary JatroGreen which has been running a breeding station and pilot plantations on Madagascar for around seven years now. JatroGreen has the capacity to test different cultivation methods on an area of around 1,000 hectares. The company is specifically working on optimising planting procedures, synchronising flowering time, assessing different cutting techniques, fertiliser trials and improving soil quality. It also focusses on the optimisation of harvest and post-harvest processes and the analysis of ecological and socio-economic effects of the different cultivation methods. One of the principal activities is the production of vegetable oil and its local use as a substitute for fossil fuel.

In addition to the pilot plantation in Madagascar, the company has access to pilot plantations in Argentina, Paraguay, Cameroon and India through its subsidiary JatroSelect (all these countries have large surface areas and huge demand for renewable resources). The climate and soils in these countries are representative of those of many countries around the world and perfect for assessing the potential of growing Jatropha on tropical and subtropical wasteland areas. The productivity of potent genotypes selected will be assessed over several years and further optimised.

Following the R&D phase, which was completed at the end of 2014, JatroSolutions is now mainly focussed on providing comprehensive technical and economic advice. This core business ranges from feasibility studies to concepts relating to the establishment and management of Jatropha plantations. Another major focus is the sale of high-quality seeds.

Criticism is directed against the large-scale cultivation of wild plants

However, there are critics who argue that the commercial cultivation of Jatropha on degraded and arid land is impossible and that arable land which is required for food production will have to be used. “Although it is possible to grow wild plants on large areas, such plantations produce little or no profit at all. As far as the cultivation of Jatropha is concerned, I do not believe that the cultivation of wild plants on degraded land areas will lead to the high yields people are hoping for,” says Jatropha expert Bohlinger, going on to add, “it is like comparing a VW Beetle with a Porsche. The performance of the Porsche would be that of a high-yield crop variety, and the wild species would resemble little more than the first car ever made or an old VW Beetle. Our first Jatropha variety is somewhere at the VW Golf stage.”

The company’s latest project is the establishment of a 1,000-hectare Jatropha plantation in Africa where its own high-yielding varieties will be grown based on results obtained on the pilot plantation in Madagascar. These plantations are demonstration models for future customers. EnBW supports this project financially. The plan is to use the oil of marketable high-yield varieties for the production of biokerosene, which could be used by airlines, and enable a significant reduction of CO₂ emissions from their planes.

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Bioeconomy: a new model for industry and the economy