

# "AGRIBUSINESS OF JATROPHA CURCAS: FROM VISION TO REALITY "

## EXTENDED ABSTRACT

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### BACKGROUND

The recent volatility in world fossil fuel prices has clearly made biofuels including biodiesel a viable technology option. The global interest in biofuel production is widening in scope to cover inedible vegetable oils with *Jatropha curcas* leading the field as a readily commercialisable crop.

The *Jatropha curcas* plant can grow in poor, marginal soils, including BRIS soils and withstand drought conditions not less than 600mm of rainfall. It cannot stand waterlogged and frost conditions and its distribution globally is bounded by the tropics.

*Jatropha curcas* has been traditionally grown in Central and South America, Africa, South and South East Asia, for its medicinal properties. As the crop grows on marginal land with minimal maintenance it is often used to combat desertification and as a hedge against predatory animals.

Given the South-East Asian climate and soil conditions, the near ability to plant *Jatropha* anywhere in the region is advantageous, and Malaysian expertise and experience in plantation management is expected to translate the agronomic potential of *Jatropha curcas* to superior harvests.

The ever-increasing demand for and the dwindling mineral fuel oil supply have stimulated the rapid expansion of the bio-fuel industry. The brisk development of the biodiesel industry for instance in the EU especially in Germany, has led to the growth of other sources of sustainable vegetable oil.

Rapeseed oil production in the EU for the raw material is only 5 million tonnes with half the amount for use in the food industry. This projected shortage has encouraged many vegetable oil producing countries to supply the potential biodiesel market in the EU.

Soya bean oil is the preferred choice of feedstock for biodiesel production in the USA and for other countries in North Asia. However, the signatories of the Kyoto Protocol are behind schedule in the reduction of greenhouse gases in Europe and as such the demand for biodiesel would continue to grow regardless of crude oil prices. Palm oil in this context is being promoted as a feedstock for biodiesel processing in South East Asia.

However it is uncertain how market forces would influence the dual uses of fuel and food especially when countries in the region are fighting to reduce their burgeoning subsidized fossil fuel costs for transport and industrial users on the one hand and the foreign exchange earnings from the exports of palm oil on the other.

In such a dilemma, Jatropha oil stands tall as an inedible, tropical oil to be developed solely for the biodiesel industry, compared to edible palm oil from Malaysia and Indonesia and other edible oils such as rapeseed, soybean, sunflower and other soft oils from the USA, Brazil and the EU.

## **COMMERCIAL CULTIVATION OF JATROPHA CURCAS**

The *Jatropha* plant is a small perennial shrub with smooth gray bark which when cut, exudes whitish watery latex. It grows between three and five meters in height and can attain a height of up to 10 meters. The plants bear fruits after about six months. However in commercial cultivation the plants are pruned regularly for higher seed production and for ease in harvesting.

Given its recent emergence as a crop of interest, its commercial viability as a large scale monocrop has not been fully established. Even though it is able to survive in the harshest of conditions over a wide geographical area, it seems to thrive best only when it receives an abundance of water and sunlight and especially if grown on fertile sites.

Due to the toxic properties of its seeds, *Jatropha curcas* can exclusively be used for the production of inedible products, including biodiesel and high quality fertilizer. Biodiesel made from *Jatropha* is known as *jatropha methyl ester* and is suitable as winter biodiesel due to its low pour point and does not risk price fluctuations based on market conditions of edible foods, as *jatropha* by-products cannot be base ingredients in foods. This also eliminates *Jatropha curcas* from the “food for the poor or fuel for the rich debate”.

The flower inflorescence yields a bunch of about 10 or more ovoid fruits which mature into yellowish-colour fruits ready for harvesting. The blackish thin-shelled seeds are oblong in shape and resemble small castor seeds. The oilseeds are easily crushed mechanically and can yield about 33% of inedible oil, which provides a much sought-after feedstock for further downstream processing (trans-esterification) into methyl ester or bio-diesel. This bio-fuel can be used in a variety of purposes especially as a blend in car diesel engines and directly in industrial diesel generators.

The plant can improve soil degradation, desertification and deforestation and at the same time increase rural incomes through large scale commercial plantations, smallholdings or contract farming in the upstream sub-sectors. On the downstream end, *Jatropha curcas* provides for agro-based industries such as soap manufacturing; organic fertilizer production from seed-cake; and its mainstay, in the production of biodiesel to blend with petroleum diesel.

*Jatropha curcas* can be grown both from seeds and cuttings. The gestation period to initial flowering and fruiting is short, ranging from five to six months. The yield per hectare is among the highest of tree-borne oil seeds. Seed production ranges from 6 tonnes to 12 tonnes per hectare per year depending on conditions and the oil extraction rates can range from 30% to 40%. Average labour requirement is about one person for every 2 hectares.

An important cost element of *Jatropha curcas* cultivation is the harvesting of the fruits, which at the moment has to be undertaken manually. Due to the staggered ripening cycle this entails a huge requirement for labour presenting a significant challenge in areas where there is labour deficiency.

However, in the manual harvesting of *Jatropha* seeds, any able-bodied person, including young adults, elderly and women are able to harvest these light-weight and golf-ball sized fruits dangling from the low pruned numerous branches of the *Jatropha* trees.

The cutting, carrying and transporting of the *Jatropha curcas* fruits from the trees are relatively non-physically demanding, compared to oil palm harvesting which requires reasonably strong and able-bodied harvesters to cut, carry and transport 20-25 kg fruit bunches out of the field.

The possibility of potential yield increment in the near future using high-yielding clonal materials in propagation is indeed high given the selection and breeding work being done in this area, thereby increasing productivity and correspondingly reducing the unit cost of production.

The cultivation of *Jatropha curcas*, as a default, can be promoted as a means of economic empowerment, social upliftment and poverty alleviation within the rural communities especially in the tropical and sub-tropical countries with under-developed and developing economies.

### **JATROPHA PLANTATION PROJECTS IN SOUTH EAST ASIA**

*Jatropha* plantation projects are however being promoted by a number of companies in South East Asia and these would involve cultivating *Jatropha curcas* either on commercial scale plantations, smallholdings or contract farming basis where the company concerned imparts the agricultural and technological inputs and oversee the necessary quantitative and qualitative compliances.

This approach would entail the setting up of nurseries, seed production farms or model farms at suitable locations both for large and small scale plantings, the provisions of necessary supporting infrastructures and amenities and liaison with the relevant local and federal authorities.

Downstream activities would involve the installing and commissioning of hydraulic mechanical crushers for expelling oil from the *Jatropha* seeds which are supplied either direct from the plantations and smallholdings or purchased from contract farmers on a regular basis. The oil can either be sold or processed into biodiesel according to the required specifications. The conversion of crude *jatropha* oil into biodiesel would involve the installation and commissioning of pre-processing facilities and appropriately-sized transesterification plants at strategic locations.

Malaysia's neighbours, namely Indonesia, Thailand and the Philippines are rapidly adopting *Jatropha curcas* as a biofuel feedstock crop. Malaysia has been a late adopter due to the prevalence and pre-occupation with oil palm which is a strategic valuable national asset.

However Malaysia runs the risk of being encircled by a large plantation and production base of inedible *Jatropha curcas* biodiesel feedstock outside of its jurisdiction if present trends continue.

It is therefore imperative that Malaysia develops a knowledge-based commercial capability in the cultivation of *Jatropha curcas* which could be utilized to catalyse improved *Jatropha curcas* commercial cultivation in South East Asia and thereby play an influential role in the production of crude *Jatropha* oil feedstock and other by-products as well as in trading and production of *Jatropha* based bio-diesel.

Such a capability can be seen as complementary to the palm based biofuel strategy that is currently being undertaken by Malaysia. Recent rises in CPO prices, concerns over use of food for fuel and for the environment have underlined the need for an alternative 'insurance' feedstock.

## **PLANTATION MANAGEMENT REQUIREMENTS**

*Jatropha curcas* has been cultivated on different scales of farms or plantations, but with varying success. Yields are lower than ideal, and no significant amount of *Jatropha* methyl ester has produced to cater for individual country needs, even less for the larger alternative fuel economy.

Given the present uncertainties about the crop, there is an urgent need for immediate research, development and innovation to determine the best practices to secure the best possible yields and revenues in various countries and agro-ecological locations.

Whether viable *Jatropha curcas* plantations in Malaysia can be established depends on addressing key issues such as land availability, labour requirement and mechanization. Malaysia is a high cost high expectation environment when it comes to investment in plantations. So far oil palm and rubber have performed superbly well and are role models for how an agribusiness industry should be developed.

Techniques such as crop suitability indices have to be developed, coupled with the appropriate agronomic interventions to be applied to *Jatropha curcas* cultivation to allow for higher efficiencies in plantation management and crop yield.

There is a need to supply state-of-the-art agronomic techniques and equipment for *Jatropha curcas* plantations; including continual supply of superior planting material, agronomic management and inputs, as well as harvesting, dehusking, expelling equipment and transesterification systems.

It is vital to provide the necessary infrastructure elements such as warehousing, logistics, education, and extension facilities that would be required for the establishment of an extensive contract farm administration structure to facilitate *Jatropha curcas* cultivation by small holders.

In terms of plantation management, distinctions have to be made between approaching *Jatropha curcas* as a monocrop and as in mixed cropping systems with other plantation crops to achieve agronomic and commercial synergies.

Emphasis will be made on the recycling of *Jatropha curcas* derivative products wherever practical throughout the supply chain. After expelling, seedcake can be recycled as organic fertilizer; crude *Jatropha* oil can fuel low revolution engines such as generators and farm equipment; and biodiesel can be used as a petrodiesel additive.

Various approaches for jatropha curcas in integrated systems such as biomass utilization, ancilliary activities such as apiary, fish and livestock farming are considered as potential options and the contributions such as of the jatropha press cake as fertilizer and use of crude jatropha oil directly need to be adopted.

An integrated agribusiness supply chain approach will certainly reduce the risk involved in establishing commercial plantations on a large scale given the uncertainties inherent in a developing a new industry.

## **RELEVANCE OF JATROPHA CURCAS TO MALAYSIAN PLANTATION COMPANIES: CONCLUSION AND RECOMMENDATIONS**

There is an urgent need for research, development and innovation and consideration of the regulatory and policy issues related to jatropha curcas by the Government. The interest in Jatropha curcas is driven by the need to find new sources of renewable energy and this could mean the crop emerging to be the next major economic crop in South East Asia after rubber and oil palm.

Given the level of interest in the crop around the world and especially around the South East Asian region it is fitting that Malaysian planters have taken up an interest, as a number has done so already, in the propagation of jatropha curcas. As plantation management is a key success factor, the success of this new industry will depend on the quality of the management involved in its projects.

There is a compelling case for the plantation community in Malaysia to work on Jatropha curcas to determine for themselves the best practices to secure the best possible yields and revenues in various countries and agro-ecological locations.

Whether viable *jatropha curcas* plantations in Malaysia and in the neighbouring countries can be established depends on addressing key issues such as land availability, labour requirement yield improvement and mechanization.

The first and foremost advantage of incorporating *jatropha curcas* as niche planting into existing plantations is to begin a process of familiarization with the crop as it appears to take on more importance in the next few years and to enable an evaluation phase which would be the basis of further research and innovation for its commercialization.

For many plantation companies making a study of the crop its most important priority would be the development of superior planting material. This is a process that needs to be initiated early as results would take a few years to come in. The development of appropriate agronomic management techniques and regimes for specific locations comes only second as this is for the moment the most important determinant of yield.

Plantation companies considering *jatropha curcas* as a monocrop may for the moment view it as too risky an investment given its uncertain and lower yield of oil per hectare. By including *jatropha curcas* as a mixed crop in a plantation the strategy can be viewed as an initial mitigation of risk. By incorporating *jatropha curcas* into plantations of crops that have long gestation periods such as rubber, the strategy can be viewed as shortening investment payback periods.

For plantations considering planting alternative crops in areas with the plantation that is not suitable for the main crop, it is a question of maximizing the use of the land and the question would be which would be the most suitable crop to grow. *Jatropha curcas* would have to be weighed against all the possible options.