# BIO FUEL (with specific reference to *Jatropha Curcas* )

Jatropha, an oil-bearing plant which grows in wastelands and requires little care, has long been touted as a potential answer to India's energy problems. Yet, the idea of exploring the commercial possibilities of this hardy plant has hitherto remained confined to seminars and field reports in this country. In a tie-up with Central Salt & Marine Chemicals Research (CSMCRI), the makers of Mercedes Benz— DaimlerChrysler (DC)— acquired 30 hectares of wastelands in Orissa and Gujarat for the cultivation of Jatropha.

Bio fuel from Spanish Jojoba, which is compatible with automotive engines, is freely available in other parts of the world. What's the point of growing a substitute for it— Jatropha— in India?

The question is not so much of competing with the Spanish example as of opening up a new possibility in India. Since we have got both corporate presence and the necessary resources in India, we are looking at the possibility of 'exploiting' wasteland for the purpose of fuel, and, in the process, regenerating it. Because after 10 to 15 years of Jatropha plantations, the wastelands, we believe, will turn into good farming lands. This will lead to a larger green cover and more sustainable development. We will also find ecologically usable technology for setting up commercial activities.

According to the laws of nature, there is always a residue after something is burnt, even though it may not be visible to the naked eye. So how can you claim zero emission from your bio fuel?

No, zero emission is not possible and we have not claimed it. We can only minimize the emission level of carbon dioxide into a balanced, neutral form. Of course, we will not, in the combustion process, emit any more than what is currently acceptable in the case of cars. Besides, we'll reduce soot and noxious gas emission. But zero pollution level is impossible to realize. By demonstrating the viability of our ideas, however, we might be able to realistically catalyze the whole project dealing with the replacement of petro-diesel. But this is not our intention in the first place. What we want to do is to bring specific lands under plantation and produce an alternative to diesel.

*You've claimed that top Indian oil companies will join you in forging a sustainable level of production of the fuel?*

It is very important that we find a local partner from the oil industry — such as the Indian Oil Corporation— for the project right at the beginning. After all, we are only a car manufacturer and not really interested in producing bio-fuels in bulk. We are currently involved in discussions for future collaborations.

*You've claimed that your efforts in India will create jobs. What kind of numbers are we looking at?*

It's too early to project how many jobs will be created. Besides, as a car manufacturer it's not our job to make such predictions. What we can say is that with the kind of quality we have we can hope to create many openings. Our immediate target is to produce enough fuel to run two-three cars, and also to look for possible problem areas. It is a research project, and if all problems were already solved, we would not probably invest money in the project. But it may take three to five years to get the right specification for the biodiesel. As for the question of automotive compatibility, we feel the renewable fuel can be used without any major changes in engine specification. There is no need for any major modification. Indeed, some.

*Biodiesel Train on Track in India*

SolarAccess.com, 17 Jan 2003

The first successful trial run of a passenger train was conducted on December 31, 2002 when the Delhi-Amritsar Shatabdi Express used 5% biodiesel as fuel. Biodiesel will enable Indian Railways to save on its rising fuel bill while controlling pollution levels. Sulphur and lead emissions were reduced significantly when biodiesel was used, according to the Railways. Ultimately, the percentage of biodiesel would go up to 15% in unison with the accepted global norms. The new green fuel is extracted from the seeds of the Jatropha plant and Indian Oil is now engaged in laboratory tests of biodiesel. The plant can easily be grown on either side of railway tracks as it adopts itself well to arid and semiarid conditions, demanding low fertility and moisture. The other advantages are the fuel's contribution to the national energy pool and the potential of creation of jobs in rural sector.

**Jatropha activities in India (a short summary)**

01. The Tamilnadu Government along with the Forest Department has planned a project for cultivation of Jatropha in 150,000 hectares in Tamilnadu. Any farmer with land can make their lands available for the Jatropha project and the seedlings as well as technical assistance for grow-out will be provided by the Forest Department.

02. The Indian Railway is to raise Jatropha along the railway track and plan to plant Jatropha along 25,000 route kilometers on two sides of the track. They plan to replace 10% of their total petro-diesel consumption by Jatropha. The project has been started on a pilot scale.

03. A Tamilnadu firm is working on a project to grow 600,000 hectares of Jatropha on lands owned by farmers in various parts of Tamilnadu. They will provide farmers with the seedlings and Rs. 3,000 per hectare for land preparation and planting. They will contract with farmers to buy out their entire production of Jatropha seeds.

04. The Maharashtra Agro-forestry Department has been actively encouraging the raising of Jatropha in watershed development projects.

05. A similar project as in Maharashtra is being attempted in the State of Madhya Pradesh.

06. The Planning Board of Haryana Government. They are planning to grow Jatropha on 50.000 acres (5.000 acres every year) to attract farmers to Crop Cycle Diversification.

07. The Rural Community Action Centre (RCAC) in Tamil Nadu State is promoting the plantation and use of Jatropha.

08. The Gujarat Agricultural University is planning the plantation of Jatropha on wasteland for income generation.

## Jatropha oil for the Indian Railway?

In the Southern Railway, which covers the 4 south Indian states, plans are discussed to plant Jatropha along the railway tracks. The railways consume 10% of the country's total diesel and are keen to blend Jatropha oil into diesel to minimize their petro-diesel consumption.

## Daimler Crysler is starting a Jatropha biodiesel project in India

Daimler Crysler joins CSIR (Council for Scientific and Industrial Research) to use Jatropha oil for biodiesel production in Orissa and Gujarat. The objective of the project is to demonstrate the feasibility of the "Jatropha bio-diesel" as fuel in modern vehicles.

The oil plant *Jatropha Curcas* (L), commonly referred as Jatropha or physic nut is a multipurpose and drought resistant large shrub or small tree. Although a native of tropical America, it now thrives throughout Africa and Asia. It grows in a number of climatic zones in tropical and sub-tropical regions of the world and can be grown in areas of low rainfall and problematical sites. Jatropha is easy to establish, grows relatively quickly and is hardy. Being drought tolerant, it can be used to reclaim eroded areas, be grown as a boundary fence or live hedge in the arid/semi-arid areas.

The wood and fruit of Jatropha can be used for numerous purposes including fuel. The seeds of Jatropha contains (. 50% by weight) viscous oil, which can be used for manufacture of candles and soap, in the cosmetics industry, for cooking and lighting by itself or as a diesel/paraffin substitute or extender. This latter use has important implications for meeting the demand for rural energy services and also exploring practical substitutes for fossil fuels to counter greenhouse gas accumulation in the atmosphere.

These characteristics along with its versatility make it of vital importance to developing countries subjected to decreasing tree cover and soil fertility because of increasing population and development pressures. Nearly half the world's poorest people live on marginal lands with the number expected to increase from 500 million to 800 million by 2020. These areas are by definition isolated and fragile, with soils susceptible to erosion and subjected to environmental stresses of deforestation, prolonged droughts, and decreasing soil and ground water. Although southern Africa is rich in biodiversity and production potential, large areas are under semiarid and arid conditions with a moderate-to-high risk of drought. Plants species like Jatropha that can grow on lands not usually attractive for agriculture and supply raw material for industry, fuels for basic energy services and improve environment are therefore an obvious choice that needs to be assessed carefully and comprehensively.

Jatropha is not browsed, for its leaves and stems are toxic to animals, but after treatment, the seeds or seed cake could be used as an animal feed. Being rich in nitrogen, the seed cake is an excellent source of plant nutrients. Various parts of the plant are of medicinal value, its bark contains tannin, the flowers attract bees and thus the plant has honey production potential. Like all trees, Jatropha removes carbon from the atmosphere, stores it in the woody tissues and assists in the build up of soil carbon.

Seed production ranges from about 0.4 tons per hectare per year to over 12 t /ha /annum (a), after five years of growth (Jones N, Miller J.H. 1992). Although not clearly specified, this range in production may be attributable to low and high rainfall areas. In Mali, where Jatropha is planted in hedges, the reported productivity is from 0.8 kg– 1.0 kg of seed per meter of live fence (Henning R. 1996). This is equivalent to between 2.5 t. /ha /annum. and 3.5 t. /ha /annum. The practices being undertaken by the Jatropha growers currently need to be scientifically documented along with growth and production figures. The growth and yield of wood may be in proportion to nut yield and could be improved through effective management practices.

Woody biomass growth, unlike seed production, is not recorded in any articles to hand. Although it needs to be tested, it is possible that nearly one-third of net primary production (NPP) in *Jatropha Curcas* may be in the form of woody biomass. However, it needs to be tested if there is tradeoff between growing Jatropha plants for optimizing woody biomass vs. seed production for oil. Reportedly, Jatropha trees/bushes live up to 50 years or more. Like all perennial plants, Jatropha displays vigorous growth in youth that tails off gradually towards maturity.

Existing literature indicates that the Agricultural Research Trust of Zimbabwe (ART) has laid down trials of different provenance of *Jatropha Curcas*. Such research work is vital in determining the most appropriate provenance and optimum management systems and must be pursued. The current status of this work may give an important insight into the management and yield of Jatropha in Zimbabwe. Although non-toxic varieties of *Jatropha Curcas* were sent to Zimbabwe for planting, (Gubitz G. M. et al eds. 1997, page 203), their current locations are unclear. It is however possible that ART included these varieties in their provenance trials. Success of such varieties would make the seed cake following oil extraction suitable as animal feed without a need for its detoxification.

Although Jatropha is adapted to low fertility sites and alkaline soils, better yields are obtained on poor quality soils if fertilizers containing small amounts of calcium, magnesium, and sulfur are used. Mycorrhizal associations have been observed with Jatropha and are known to aid the plant's growth under conditions where phosphate is limiting. (Jones & Miller, 1992, p.7).

A perceived advantage of Jatropha is its capability to grow on marginal land and its ability to reclaim problematic lands and restore eroded areas. As it is not a forage crop, it plays an important role in keeping out the cattle and protects other valuable food crops or cash crops. Jatropha products from the fruit - the flesh, seed coat and seed cake - are rich in nitrogen, phosphorous and potassium (NPK) and are fertilizers that improve soil. Jatropha hedges and shelterbelts by improving the microclimate and providing humus and fertilizers to the soil can further enhance the productivity of other agricultural crops.

## 4. *Jatropha Curcas* as an Energy Source

### 4.1 Oil from Jatropha Curcas

Jatropha oil is an important product from the plant for meeting the cooking and lighting needs of the rural population, boiler fuel for industrial purposes or as a viable substitute for diesel. Substitution of firewood by plant oil for household cooking in rural areas will not only alleviate the problems of deforestation but also improve the health of rural women who are subjected to the indoor smoke pollution from cooking by inefficient fuel and stoves in poorly ventilated space. Jatropha oil performs very satisfactorily when burnt using a conventional (paraffin) wick after some simple design changes in the physical configuration of the lamp.

About one-third of the energy in the fruit of Jatropha can be extracted as oil that has a similar energy value to diesel fuel. Jatropha oil can be used directly in diesel engines added to diesel fuel as an extender or trans-esterised to a bio-diesel fuel. In theory, a diesel substitute can be produced from locally grown Jatropha plants, thus providing these areas with the possibility of becoming self sufficient in fuel for motive power. There are technical problems to using straight Jatropha oil in diesel engines that have yet to be completely overcome. Moreover, the cost of producing Jatropha oil as a diesel substitute is currently higher than the cost of diesel itself that is either subsidized or not priced at "full cost" because of misconceived and distorted national energy policies. Nevertheless the environmental benefits of substituting plant oils for diesel provides for make highly desirable goals.

The oil cake cannot be directly used as animal feed because of its toxicity, but it is valuable as a fertilizer having nitrogen content comparable to chicken manure and castor bean seed cake. The toxicity of the seeds is because of curcin (a toxic protein) and diterpene esters. Apparently seeds of Mexican origin have less toxic content and with proper processing they can be eaten. Although there are laboratory studies indicating detoxification, its feasibility and profitability on a large scale is yet to be investigated.

Ngorongoro Crater

Jatropha soap

Lamp for Jatropha oil

Cooker for Jatropha oil

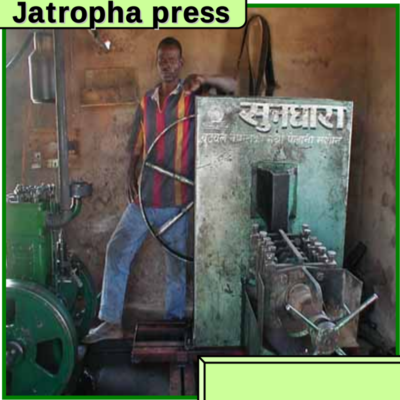
See more details about the Kakute project:

**Box 1. The role of jatropha in protecting the environment & income generating activities:**

Jatropha is an oil bearing plant, found throughout much of Mali. It is grown around crop fields and gardens to keep out animals, act as a windbreak, and to reduce soil erosion by wind and water. Jatropha hedges reduce the degradative effect of the wind and water, as soil collects at the bases of the hedges and these accumulations reduce erosion by surface runoff. It is very easy to grow, as a cutting taken from a plant, left to dry for 2 days, and simply pushed into the soil will take root. Jatropha needs only 400mm annual rainfall to grow, which means it can flourish even in Sahelian and semi-desert regions. Jatropha is very fast growing: plants grown from seed take 2 years to produce seed, those from cuttings take just 1 year. This means that jatropha can be an important weapon in the fight against desertification in the fragile Sahel environment. Traditionally the seed has been harvested by women and used for medical treatments and local soap production. The oil which can be pressed from its seed is non-edible. However, this oil can be used as an alternative fuel for diesel engines, due to its similar chemical properties. This is especially important in Mali because of the use of small diesel engines in multi-task platforms to provide basic energy services to rural people.

# Pressing of Jatropha

**Jatropha press**



**Jatropha plant with seed**

The seed is paid at a cost of 50 FCFA (7 dollar cents) per kilo. 3-4 kg are required to give 1l oil. This gives a raw material cost of up to 200 FCFA (30 dollar cents) per litre. The costs of pressing must be added to this, but the overall cost is less than diesel (50 dollar cents per litre).

**3-4kg seed is pressed**

**2-3kg residue produced (organic material with some oil content)**

**High grade organic fertiliser**

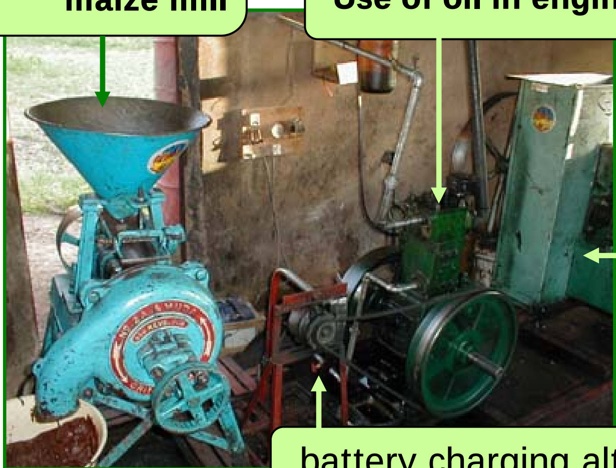
**1 litre of oil**

**Sedimentation to remove small particles**

**Soap production & income generation for women!**

**Shea nut press & millet & maize mill**

**Use of oil in engine**



Jatropha press

battery charging alternator

# PRESS RELEASE

7 August 2001

## South-South Technology Transfer brings Oil Press to Mali – and opens up possibilities for plant oil technology in West Africa

In the frame of the Sustainable Energy Advisory Facility, a new oil press has been put on the market in Mali. The effort has been co-ordinated by Mali-Folkecenter, in co-operation with CNESOLER/DNE (the Malian National Centre for Solar & Renewable Energy/ National Directorate of Energy), with ACM (Central Workshops of Markala) constructing the press. Based on the efficient, reliable Nepali 'Sundhara' press, it can be used to press jatropha (poughere) nuts or sesame seed for their oil. It is the first time such a press has been produced in West Africa, a represents a major breakthrough for the future of plant oil technology in the sub-region. (Fig. Original Nepali 'Sundhara' press, left, new Malian press, right).

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### The new Malian Jatropha press – regional implications

Jatropha (left) is an oil bearing plant, common in Mali, Senegal, Ghana, and other West African countries. It is often grown around crop fields as a living fence to keep out animals. It acts as a windbreak, reduces soil erosion, and the oil which can be pressed from its seed is non-edible. But it can be used as an alternative fuel for diesel engines.

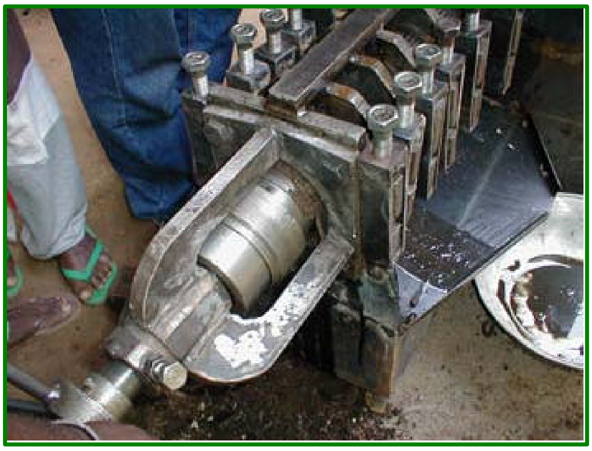
Throughout the sub-region, single cylinder diesel engines are used to provide mechanical power in rural areas. With the new locally produced press, Jatropha can provide the fuel, and a means for rural women to generate income.

The **Sustainable Energy Advisory Facility (SEAF)** is jointly implemented by UNEP Collaborating Centre on Energy & Environment and UNEP Paris Energy Programme. Funded by Danida, it is a pilot effort in developing countries

## Technical challenges

The critical elements: the original Nepali screw (below) and the Malian version (above)

Due to the high pressures involved, a press of this type represents quite a technical challenge. But with effective co-ordination, original drawings and press made available, a skilled team of engineers and a good workshop, the press was realised.



Production of oil and press cake by the Malian-made press

## The Multi-function platform concept

In the jatropha multifunction platform concept, a small single cylinder diesel engine is used to power a mill (for agricultural processing) and a jatropha oil press (to produce oil and press cake). After a simple conversion, the engine can use the jatropha oil as a substitute fuel.

The engine can also power a generator for battery charging or rural electrification, a water pump or a compressor.

Jatropha seed is collected by women and taken to the installation for sale and pressing to produce oil and press cake. The oil can be used as fuel or as the basis for soap production. The press cake can be used to make lower grade black soap or as fertiliser. Soap production allows women to start their own micro-enterprises, which means income generation and poverty alleviation. It benefits the women, and of course their children and families.

The engine is in the foreground, press in the background

SEAF is acting to remove the barriers to sustainability of multi-function platforms. Working in 5 villages in the south of Mali, two main barriers have been identified: management/organisational; and the lack of replacement presses and spare parts on the local market. A new platform management structure has been created that does not rely on voluntary work. Capacity building in the villages in the areas of maintenance and book-keeping has tackled the first barrier. Now, with Malian press

The mill, coupled to the engine for agricultural production

production, a basis for expansion of the system is in place.

Mali-Folkecenter will also promote the press among entrepreneurs who may be interested to move into the field of jatropha multi-function platforms on a commercial basis, in partnership with CNESOLER.

Without a doubt, the future of the jatropha multi-function platform in West Africa now looks distinctly bright.

For further information, please contact us.

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# Biofuels for Transportation

by Gunnar

Production of liquid biofuels for transportation is a field that attracts intense interest in many parts of the world, for environmental reasons as well as to substitute dwindling oil resources. World leaders are Brasil (ethanol/alchohol) and now also USA (both ethanol and biodiesel). While the benefits are obvious, biofuels also have drawbacks in the form of high prices relative to other bioenergy products, sometimes environmental problems because of intensive farming, an in some cases competition with other use of land and other uses of oil. Many of the crops that are used, are edible.

Biofuels are not used widely in South Asia, but as all countries are importing oil, there is an increasing interest in the region. In several states of India, biofuels are supported on the highest level as the prime minister is heading a programme (details to be included).
The potential use of biofuels is limited by the vegetable feed-stock that can be made available at prices that compete with fossil fuel prices. The demand for oil is not a limiting factor. Biofuel production is in rapid development, and it is difficult to estimate the potential production that can be made sustainably in South Asia without limiting essential food production.

Plant oil production can be made in a small scale as this example shows from the Nordic Folkecenter for Renewable Energy, Denmark.

**Important types of biofuels:**

- Ethanol produced from sugar cane, corn, sweet sorghum or other feed-stock. In its pure form it can be used in ethanol engines, a variant of petrol engines. Ethanol can be mixed with petrol in ratios up to 20% for use in normal petrol engines, replacing some other additives.
- ETBE (Ethyl-Ter Butyl-Ether) is a product that can replace petrol and that is produced from ethanol and isobutylen (a mineral oil derivate)
- Vegetable oil, produced (expelled) from oil crops. Also used cooking oil can be used after cleaning. Can be used in modified diesel engines (require heating of fuel to 60 – 160 ‘C), in special plant oil engines, and in some large diesel engines.
- Biodiesel, produced from vegetable oil. Can be used in ordinary diesel engines. Often used blended with mineral diesel.
- Second-generation biofuels. In USA and the EU countries strong research programs are ongoing to develop production of liquid biofuels from solid biomass (wood, straw) and wet organic waste. The technologies under development might also be useful in South Asia.

While the benefits of biofuels are obvious, the production is expensive, and the production also uses energy, which reduces the net benefit of the biofuels. The energy needed for agricultural inputs and to the production process can be over 50% of the energy in the produced biofuels; but in tropical conditions it usually lower.
The energy balance, and the economy of biofuel production depends to a large degree on the production processes and on the additional uses of the crop: sugar cane bagasse can be used for electricity and heat production, pressing cakes from oil plants can be used for animal fodder, biogas production, composting, or even as solid fuel.

**Costs and Requirements**
Worldwide, costs of biofuels are similar to costs of mineral oil with current prices (50€/barrel), but varies considerably. Local production can be cheaper, in particular direct use of vegetable oil in converted diesel engines.
A press to expel vegetable oil cost 1500 € or more. It can be driven by an electric motor or by a diesel motor, eventually running on plant oil. There is also need for storage of oil seeds as well as for the oil.
The oil seeds that are used should be practically free of weed seeds. Sorting of the seeds might be necessary; it can be done mechanically. Also the oil should be clean, free from particles from the pressing. Often the oil can be cleaned by letting the particles settle for a few days in a tank, and take the clean oil from the top. Filtration is also a possibility.

Conversion of diesel cars to run on vegetable oil costs around 1,000 € per car (they can still run on diesel after the conversion). Conversion sets are available for most types of cars; but it is not certain that the converted cars can run on all types of plant oil.

Production of biodiesel and ethanol is usually done on factories respectively destilleries. Biodiesel can also be produced in smaller facilities; but even the small facilities require large investments.

Biofuels are not always following exact specifications for petrol and diesel. Therefore car producers/dealers should be consulted before using biofuels. Biofuel quality varies with the production process.

**Maintenance and spare parts**: Depends on design

**Typical problems**
Particles from insufficient cleaning of the fuel can be a problem. Problems with fuel quality have been reported, mostly in the introduction phase.

**Simple Guidelines**
Castor oil plant (Ricinus Communalis) produces up to 1400 ltr oil/ha under ideal conditions, but in the average in India is only about 300 ltr/ha. 35-55% of the nut is oil.
Jatropha plants *(Jatropha curcas)* produces up to 1800 ltr oil/ha under ideal conditions; but in arid areas a realistic yield is about 650- 800 ltr/ha. About 35% of the nut is oil. Require at least 600 mm rain/year.
Macadamia nuts, yield up to 2200 ltr oil/ha under ideal conditions.
Oil palm, yields up to 6000 ltr oil/ha under ideal conditions.

Further reading, see http://journeytoforever.org/biofuel_library.html

# Bio diesel

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Bio-diesel is an eco-friendly, alternative diesel fuel prepared from domestic renewable resources i.e. vegetable oils (edible or non- edible oil) and animal fats. These natural oils and fats are made up mainly of triglycerides. These triglycerides show striking similarity to petroleum derived diesel and are called "Bio-diesel". As India is deficient in edible oils, non-edible oil may be material of choice for producing bio diesel.

## India's Initiative

Conscious of the advantages, Government of India is now working towards evolving a national policy on Bio fuels as environmentally friendly energy source and reduce dependence on import of diesel.

Further, Government of India has already established the National Hydrogen Energy Board to push the development of alternative fuel. The main objective of this board is to bring coordination and develop a national hydrogen energy roadmap with focus on development of alternative fuel for transport and decentralized production of power.

## Technical Feasibility

Jatropha Curcas can be blended in any ratio with petro-diesel. Existing storage facilities and infrastructure for petro-diesel can be used with minor alteration.

In India only 57% arable land is used today. The area is used mostly during the monsoons for a 3 months crop. This activity absorbs barely 15 days of family labour in the villages. Rest of the year, both the land and the people are idle which seems to be the main cause for rural poverty. This is equivalent to the population of the entire USA who is absolutely unemployed. This is an extremely difficult development problem and India certainly will never have adequate resources to create enough wage days for all of them. However if the land is utilized at all the 12 months (which is possible by growing three crops in a year). During the fallow period land may be utilized for the oil seed crop.

## Sources of Bio-diesel

All trees bearing oil (TBO) seeds, both edible and non-edible have the potential to be a source of bio diesel. Among edible oils seeds Soya-bean, Sunflower, Mustard Oil etc are source of bio diesel. Edible seeds can't be used for bio-diesel production in our country, as its indigenous production does not meet our current demand. Thus, India should focus on non edible oils like Jatropha Curcas, Pongemia Pinnata, Neem etc. Among non-edible TBO, Jatropha Curcas has been identified as the most suitable seed for India.

Jatropha Curcas has been identified for India as the most suitable Tree Borne Oilseed (TBO) for production of bio-diesel both in view of the non-edible oil available from it and its presence throughout the country. The capacity of Jatropha Curcas to rehabilitate degraded or dry lands, from which the poor mostly derive their sustenance, by improving land's water retention capacity, makes it additionally suitable for up-gradation of land resources. Presently, in some Indian villages, farmers are extracting oil from Jatropha. After settling and decanting it they are mixing the filtered oil with diesel fuel. So far the farmers have not observed any damage to their machinery.

The oil needs to be converted to bio-diesel through a chemical reaction - trans-esterification. This reaction is relatively simple and does not require any exotic material. IOC (R&D) has been using a laboratory scale plant of 100 kg/day capacity for trans-esterification; designing of larger capacity plants is in the offing. These large plants are useful for centralized production of bio-diesel. Production of bio-diesel in smaller plants of capacity e.g. 5 to 20 kg/day may also be started at decentralized level in villages.

From environment and emissions point of view it is superior to petro-diesel. It can provide energy security to remote and rural areas. It has good potential for employment generation.

Advantages of Jatropha: Jatropha Curcas is a widely occurring variety of TBO. It grows practically all over India under a variety of agro climatic conditions. Can be grown in arid zones (20 cm rainfall) as well as in higher rainfall zones and even on the land with thin soil cover. Its plantation can be taken up as a quick yielding plant even in adverse land situations viz. degraded and barren lands under forest and non-forest use, dry and drought prone areas, marginal lands, even on alkaline soils and as agro-forestry crops. It grows as a tree up to the height of 3 - 5 mt. It is a good plantation for Eco-restoration in all types wasteland.

Oil content in Jathropa Curcas is 35% to 40%.

Realising the urgency , and a great need for producing Bio Diseal in adequate quantities the Govt. of India has constituted National Oil Seed & Vegetable Oil Development (NOVOD) who were continuously working towards goal since inseption.

State-wise area undertaken by NOVOD for Jatropha Plantation

| **State** | **Area (hectare)** |
|---|---:|
| Andhra Pradesh | 44 |
| Bihar | 10 |
| Chhatisgarh | 190 |
| Gujarat | 240 |
| Haryana | 140 |
| Karnataka | 80 |
| Madhya Pradesh | 260 |
| Maharashtra | 150 |
| Mizoram | 20 |
| Rajasthan | 275 |
| Tamil Nadu | 60 |
| Uttaranchal | 50 |
| Uttar Pradesh | 200 |

**Economics (as per Planning Commission Report on Bio-fuels, 2003)**

| Activities | Rate(Rs. / Kg) | Quantity(Kg) | Cost(Rs.) |
|---|---|---|---|
| Seed | 5.00 | 3.28 | 16.40 |
| Cost of collection & oil extraction | 2.36 | 1.05 | 2.48 |
| Less cake produced | 1.00 | 2.23 | (-)2.23 |
| Trans-esterification | 6.67 | 1.00 | 6.67 |
| Less cost of glycerin produced | 40 to 60 | 0.095 | (-) 3.8 to 5.7 |
| Cost of Bio-diesel per kg | | | 19.52 to 17.62 |
| Cost of Bio-diesel per litre (Sp. Gravity 0.85) | | | 19.52 to 14.98 |

## Employment potential (as per Planning Commission report on bio-fuels, 2003)

Likely demand of petro diesel by 2006-07 will be 52 MMT and by 2011-12 it will increase to 67 MMT. By 2011-12, for 20% blend with Petro-diesel, the likely demand will be 13.4 MMT. To meet the requirement of 2.6 MMT of bio-diesel, plantation of Jatropha should be done on 2.2 - 2.6 million ha area.
11.2 - 13.4 million ha of land should be covered by 2011 - 12 for 20% bio-diesel blending. It will generate following no. of jobs in following areas.
Traditionally tribals and women collect seeds from the forest and dry lands and they could get more income by collecting the seeds.

| Year | No. of jobs in plantation | In maintenance | Operation of BD units |
|---|---|---|---|
| 2006-07 | 2.5 million | 0.75 million | 0.10 million |
| 2011-12 | 13.0 million | 3.9 million | 0.30 million |

National Oilseed and Vegetable Oil Development Board (NOVOD) are making the following efforts

- Systematic state/region wise survey for identification of superior trees and superior seeds.
- Maintenance of record on seeds/trees. Samples of high yield to be sent to National Bureau of Plant Genetic Resources (NBPGR) for accession and cryo-preservation.
- NOVOD has developed improved Jatropha seeds, which have oil contents up to 1.5 times of ordinary seeds. However, being in short supply, initially these improved Jatropha seeds would be supplied only to Agricultural Universities for multiplication and development. After multiplication these would be supplied to different states for further cultivation. This program is likely to take 3 - 4 years. It is also working for development of multi-purpose post-harvest technology tools like decorticator and de-huller, which would further improve oil recovery.

## Agencies & Institutes working in the field of bio-diesel

- National Oil seeds and Vegetable Oil Board, Gurgaon
- PCRA - Petroleum Conservation Research Association (MOP&NG)
- IOC (R&D) Centre, Faridabad
- Delhi College of Engineering
- Indian Institute of Technology, Delhi
- Indian Institute of Petroleum, Dehradun
- Downstream National Oil Companies
- Indian Institute of Chemical Technology, Hyderabad
- Center for Science and Industrial Reaserch

- Ministry of Non-conventional Energy Sources
- Central Pollution Control Board
- Bureau of Indian Standards
- Indian Renewable Energy Development Agency

**States, which have made some lead**

Uttar**anchal:** Uttaranchal Bio-fuel Board (UBB) has been constituted as a nodal agency for bio-diesel promotion in the state. The board has undertaken Jatropha plantation in an area of 1 lakh hectare. UBB has established Jatropha Gene Bank to preserve high yielding seed varieties and plans to produce 100 million liters of bio-diesel.

**Andhra Pradesh:** Government of Andhra Pradesh (GoAP) has encouraged Jatropha plantation in 10 rain shadow districts of AP. Task force for it has been constituted at district and state level. GoAP proposed Jatropha cultivation in 15 lakh acres in next 4 years. Initial target is 2 lakh acres. Irrigation is to be dovetailed with Jatropha cultivation. 90% drip subsidy is proposed. Jatropha cultivation to be taken up only in cultivable lands with existing farmers. Crop and yield insurance is proposed.

Chhattisgarh:6 lakh saplings of Jatropha have been planted with the involvement of State's Forest, Agriculture, Panchayat and Rural Development Departments. As per the Deputy Chairman, State Planning Board, the state has the target to cover 1 million ha of land under Jatropha plantation. Ten reputed bio-diesel companies, including the UK-based D1 Oils, have offered to set up Jatropha oil-extraction units and to buy the produce from farmers in Chhattisgarh. Companies like Indian Oil, Indian Railways and Hindustan Petroleum have each deposited Rs 10 lakh as security for future MoUs with the state government.

**Haryana:** Farmers in Haryana have formed NGOs and cooperatives for promotion of Jatropha plantation. These NGOs and cooperatives are raising nurseries for Jatropha plantation and supplying saplings to others for further cultivation. They have been blending directly Jatropha Oil into diesel fuel and successfully using this blend in their tractors and diesel engines without any problems. These NGOs and cooperatives are also organizing the practical demonstration of this usage in their demonstration workshops. They are organizing local seminars, workshops and conferences etc. to promote the usage of Jatropha oil. NGOs have also printed some booklets on Jatropha plantation.

## Current usages and trails of bio-diesel in India

1. Shatabadi Express was run on 5% blend of bio-diesel from Delhi to Amritsar on 31st December 2002 in association with IOC.
2. Field trials of 10% bio-diesel blend were also done on Lucknow-Allahabad Jan Shatabdi Express.
3. HPCL is also carrying out field trials in association with BEST.
4. Bio-Diesel blend from IOC (R&D) is being used in buses in Mumbai as well as in Rewari, in Haryana on trial basis .
5. CSIR and Daimler Chrysler have jointly undertaken a successful 5000 km trial run of Mercedes cars using bio-diesel as fuel.
6. NOVOD has initiated test run by blending 10% bio diesel in collaboration with IIT, Delhi in Tata Sumo & Swaraj Mazda vehicles.

Environment Protection Training & Rresearch Iinstitute – Hyderabad has been promoting by giving training to local NGO's SHG's and others interested in the production of Bio Diesel from Pongamia Pinnate and Jatropha curcas in the state of Andhra Pradesh. And according to them the cost of production works out to Rs.16.00 per liter and is thus cheaper than diesel. Further, its biproduct in the form of cake can be use as manure / fertilizer . Thus, bio fuels have tremendous potential as a cheap alternate fuel for rural energy needs even at the micro level. They have got the full training manual and the know how which they are willing to share if anybody interested.

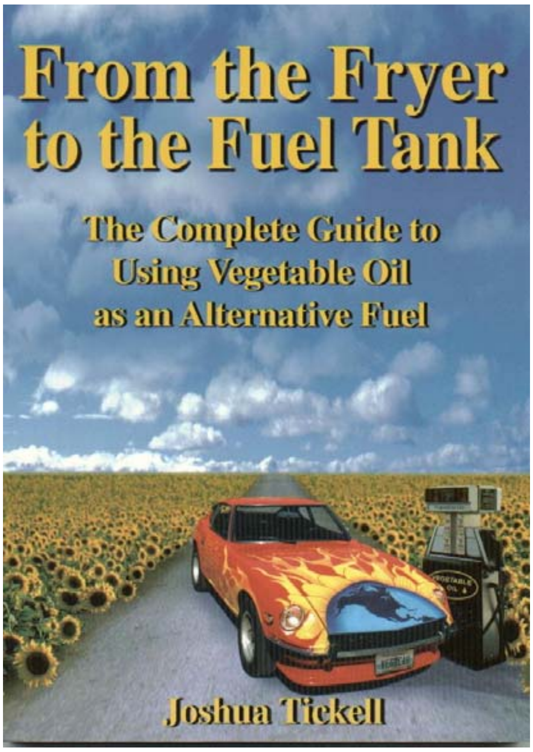
References :


1. Bio Diesel Plantations – The way forward to make productive use of wastelands - Mr. P.Prasad Rao
2. Biofuels India – Sustainable Fuel for the Energy & Transport Sector – Vol II , Issue V, March 2005.
3. Presentation made by Prof. U.Srinivas of SUTRA Karnataka
4. www.PCRA.org (Website of Petroleum Conservation Research Association, Ministry of Power , Government of India)

# GLYCERIN SOAP RECIPES

## Liquid Glycerin Soap

What to do with the byproduct of making biodiesel- glycerin. An excerpt from a biodiesel book which is full of great information like this... ***From the Fryer to the Fuel Tank***. We have this book available in eBook format with instant download from http://www.electricitybook.com/fryer




The glycerin byproduct from a biodiesel reaction will contain almost 100% of the catalyst used in the biodiesel reaction. Therefore, the glycerin and lye or KOH have already formed soap by the time the glycerin is drained from the biodiesel reaction container. The liquid or gelatinous glycerin soap is good for cleaning greasy hands or equipment.

During the biodiesel reaction, some un-reacted alcohol will fall into the glycerin. To make the glycerin into a nice hand soap, the glycerin must be heated past the boiling point of the alcohol used in the biodiesel reaction. This will cause the alcohol to evaporate, leaving only glycerin soap. If you used methanol in the biodiesel reaction, heat the glycerin past 148 deg F (65 deg C). If you used ethanol in the biodiesel reaction, heat the glycerin past 175 deg F (79 deg C). Do this in a well ventilated area in an open container and do not breathe the fumes. Allow the glycerin to stay heated for at least 10 minutes and then allow the glycerin to cool.

Essential oils and fragrances can be added to the liquid glycerin soap to enhance its smell. For each liter of glycerin, add 150 milliliters of manufactured fragrance oil or 50 milliliters of essential oil. In addition, you can add up to 300 grams of herbal powder and/or 300 grams of dried flower. The glycerin soap will usually be brown, but its color can be slightly altered by adding artificial colorants.

Heat the glycerin in a pot until it liquefies. If the glycerin came from dirty used cooking oil and it contains some food particles, filter the glycerin by heating it and pouring it through a mesh screen or some pantyhose. Pour in the fragrance oil, herbal powder, and dried flowers while the glycerin is in a liquid state. Stir lightly to evenly distribute the ingredients. Pour the glycerin into a plastic container and allow it to cool. Let the soap sit in the open air for a week. The resulting liquid soap should be mild and pleasant smelling.

## Hard Glycerin Soap

By adding more lye or KOH to the glycerin soap, the soap can be hardened and its lather will increase. In order to make the glycerin into hard soap, first evaporate the alcohol as described for liquid glycerin soap. Fragrances can also be added to the glycerin as described for liquid glycerin soap.

Next, divide the total number of grams of catalyst used in the biodiesel reaction by the number of liters of glycerin. For example, if a biodiesel reaction used 100 grams of lye and the reaction produced 4 liters of glycerin, you would divide 100 by 4 = 25. We will call this number (C) and it will represent the amount of catalyst in each liter of glycerin. If you used lye as the catalyst, subtract (C) from 70 grams. We will call this number (L). Following the example, you would subtract (C) from 70 grams to get (L) = 45. Now multiply (L) times the number of liters of glycerin produced during the biodiesel reaction. This is the total number of grams of lye you will need to add to make your glycerin into hard soap. In our example, (L) x 4 liters of glycerin = 180 grams of lye.

If you used KOH as the catalyst instead of lye, use the same formula, but subtract (C) from 100 grams. This number will be (K). Multiply (K) times the number of liters of glycerin produced during the biodiesel reaction. This is the total number of grams of KOH you will need to add to make your glycerin into hard soap.

Next, multiply the number of liters of glycerin times 340 milliliters. For example, if you have 4 liters of glycerin, multiply 4 x 340 milliliters = 1,360 milliliters or 1.36 liters. We will call this number (W) and it will represent the amount of water to use. Pour (W) milliliters of water into a pyrex, iron, or enamel cooking pot. Bring the water to 90 deg F (32 deg C). Slowly add (L) grams of lye or (K) grams of KOH to the water and stir the catalyst until it is dissolved. Keep the catalyst/water at 90 deg F (32 deg C). Wear gloves and protective clothing.

In a separate, large pot, bring the glycerin from your biodiesel reaction to 110 deg F (43 deg C). Pour the catalyst/water solution into the glycerin in a thin, slow stream. Continue to heat the mixture of glycerin, catalyst, and water as you stir slowly and evenly for 10-20 minutes or until the mixture begins to thicken. When the mixture thickens, pour the still warm mixture into a thick cardboard or wooden box or other container which has been lined with a damp cotton cloth. The cotton cloth should be soaked in water, wrung almost dry, and then placed in the box. Put the box in a pan in case it leaks. Once the soap mixture has been poured into the box with the cotton cloth, put a board on top of the box. Then put an old blanket or rug on top of the box to keep the heat in. Leave the box for 24 hours.

Remove the block of soap by pulling the sides of the cloth out of the box. Once the block of soap has been removed, it can be cut into smaller blocks. Allow the blocks of soap to sit in the open air for 2-4 weeks before using them.

Since each batch of glycerin produced during the biodiesel reaction is different, each batch of glycerin soap will also be different. You can experiment with more or less catalyst and water to change the consistency and lather of the soap.