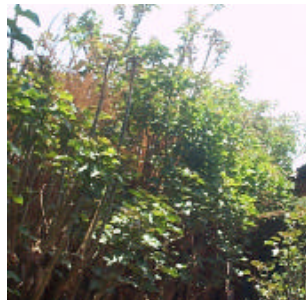




# The Jatropha Manual

A guide to the integrated exploitation of the Jatropha plant in Zambia



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## 1. The Jatropha plant in Zambia



Jatropha curcas is not an indigenous plant to Zambia, but it is known all over the country in small quantities. Only in Eastern, Western and North-Western Province are areas where it is abundant. Since the plant is not browsed by animals, Jatropha is used by the farmers to protect their gardens against roaming animals.

In the other parts of the country the Jatropha plant is used only as an ornamental plant, and is not exploited commercially.

It seems that the plant was introduced to Zambia from Angola and Mozambique, where the plant is widespread.

In Southern Province it seems that returning workers from Zimbabwe took seeds with them and planted them around their houses.

## 2. Short description of "The Jatropha System"

The Jatropha System is an integrated rural development approach. By planting Jatropha hedges to protect gardens and fields against roaming animals, the oil from the seeds can be used for soap production and as fuel in special diesel engines. In this way the Jatropha System covers 4 main aspects of rural development:

- promotion of women (local soap production);
- poverty reduction (protecting crops and selling seeds).
- erosion control (planting hedges);
- energy supply for lighting and stationary engines in the rural area;

The obvious advantage of this system is that all processing, and thus all value added, can be kept within the rural area or even within one village. No centralised processing (like in the cotton industry) is necessary.

### **2.1 Origin of Jatropha**

*Jatropha curcas* originates from Central America and was distributed by Portuguese seafarers via the Cape Verde Islands to countries in Africa and Asia.

### **2.2 The plant « *Jatropha curcas* L. »**

The *Jatropha* plant is a small tree or large shrub which can reach a height of up to 5 m. The life-span is more than 50 years. The plant is a drought resistant species which is widely cultivated in the tropics as a living fence, because it is not browsed by animals. The seeds are toxic to humans and many animals.

Because of its properties in most countries *Jatropha* is planted in the form of protection hedges.

#### **Yield**

Figures given in the pertinent literature vary from 300 g to 9 kg per tree and year. On a hectare basis, this is between 2 and 5 tons per hectare

#### **Generative propagation (seeds)**

The best time for direct seeding is the beginning of the rainy season. The seeds are sown in the soil at a depth of 2-3 cm.

After 2 years, or 3 rainy seasons, the *Jatropha* plants produce new seeds.

#### **Vegetative propagation (cuttings)**

*Jatropha* is very easy propagated from cuttings, which are placed about 20 cm into the soil. The cuttings should be older than 1 year, already lignified and about 60 to 120 cm long. The best

planting time is 1 to 2 months before the beginning of the rainy season, in Zambia in September/October.

For live fencing the cuttings can be planted like a fence of dead wood, one cutting beside the other. The cuttings should be 20 cm in the soil, on the top they are fixed with horizontal branches. The protection function is thus achieved immediately and within a few weeks the cuttings start to grow. If well maintained, this kind of live fence can even keep chicken out of gardens.

Cuttings can easily be kept in a shaded place for a few weeks, without drying. A cover of wax on the leaves and on the bark reduces the evaporation. The cuttings will start to rot before they dry out.

### ***2.3 Its possible uses***

- The plant is widely used as a source of local medicine.
- Besides of this in almost all countries it is used for boundary demarcation and for live fencing.
- Together with stone walls, small earth dams or Vetiver grass it is very useful to fight erosion
- The seeds can be processed (oil, press cake) or sold directly as seed or for industrial use.
- The Castor Company of Zambia (CCZ) also seems to be interested in buying Jatropha seeds for industrial purposes.
- The seeds contain 32 to 35 % of oil. With mechanic oil expellers (like the Sundhara press) up to 75 - 80 % of the oil can be extracted. With the Yenga hand press about 60 - 65 % of the oil can be extracted (5 kg of seeds give about 1 litre of oil).
- Because of its mineral content, which is similar to that of chicken manure, it is valuable as organic manure. In practical terms an application of 1 t of JCL press cake is equivalent to 200 kg of mineral fertiliser.

- Due to its residual oil content, the JCL press cake also has insecticide properties, and reduce the amount of nematodes in the soil.
- The most interesting and economically viable use of the Jatropha oil is soap production. Jatropha oil gives a very good foaming, white soap with positive effects on the skin, partly due to the glycerine content of the soap.
- To use Jatropha oil for lighting the paraffin lamps have to be converted, as Africare did. Or a floating wick can be used, as it was invented by the Binga Trees Trust. A cooking stove for Jatropha oil has not yet been developed.



### 3. Exploitation of the Jatropha plant

#### 3.1 Oil extraction

##### 3.1.1 Preparing / roasting 6 kg of seeds

To prepare the seeds for oil extraction, they should be heated, either in full sunlight on a black plastic sheet for several hours or in a roasting pan for 10 minutes. Careful: the seeds should be heated, but not burnt. This process breaks down the cells that contain the oil, allowing the oil to flow out more easily. The heat also liquefies the oil, which improves the extraction process.

**The hopper** guides the seeds to the piston. Because of its small diameter, the flow of seeds is often blocked. With a thin stick the seeds should be pushed into the tube and the piston. Usually there is a thin iron bar fixed at the lever of the press, which does this automatically.





**The piston** creates the pressure to force the oil out of the press cake. Sometimes the piston gets stuck and is difficult to move. Then the press has to be taken apart and the piston and its cylinder have to be cleaned thoroughly.

**The cage** is welded from iron bars with a fine gap between them. Before starting the pressing make sure that the gaps are free.



**The outlet** is the regulation part of the ram press. The more it is closed, the more difficult it is to press the cake through the gap, the more oil is extracted (higher extraction rate). The outlet should be regulated in such a way that one person can push down the lever without too much force (not "hanging" on the lever).

There are three ways to **purify the oil**:

- **Sedimentation**

This is the easiest way to get clear oil, but it takes up to one week until the sediment is reduced to 20 - 25 % of the volume of the raw oil.

- **Boiling with water**

The purification process can be accelerated tremendously by boiling the oil with about 20 % of water. The boiling should continue until the water has evaporated (no bubbles of water vapour anymore). After a short time (a few hours) the oil then becomes clear.

- **Filtering**

Passing the raw oil through a filter is a very slow process and has no advantage in respect of sedimentation. It is not recommended.

### **3.2.4.3 Participants try their hand**

An important aspect of the demonstration of oil extracting is that participants get a chance to try operating the press. Each participant has to move the lever about 10 times to get a feeling of the force necessary. More than 1 litre of raw oil must be produced to replace the oil which is used for the soap making demonstration.

### **3.2.4.4 Cleaning of the press**

After extracting Jatropha oil with the Yenga press, the press must be cleaned very thoroughly before it is used to extract oil for cooking. At least one kg of edible seeds must be extracted (and the oil thrown away) before the press can be used normally for edible oils.

## **3.2.5 Demonstration of soap making**

For soap making, purified Jatropha oil has to be used. Since the purification takes some time to produce clear oil, the necessary amount of purified oil should be prepared and taken to the demonstration site. The oil produced during the demonstration of the Yenga press can replace some of this oil.

### **3.2.5.1 The danger of working with caustic soda**

Working with caustic soda is dangerous. Some basic precautions must be scrupulously observed. The solution of caustic soda is specially dangerous for the eyes. Wearing glasses reduces this risk.

Attention: Drops of the caustic soda solution make holes into your cloths.

Since the solution of caustic soda is very aggressive, gloves should be worn when working with caustic soda. Once the oil is mixed with the solution of caustic soda, the mixture is no longer dangerous.

If you get any caustic soda on your skin or in your eye, wash it immediately, carefully with a lot of warm, clean water.

**Attention ! ! ! - Danger ! ! ! - Watch your eyes ! ! !**

**Caustic soda is very aggressive and makes holes in your clothes ! ! !**

**! • Never pour water onto the caustic soda - always caustic soda into water • !**

### 3.2.5.2 The components of soap making

The soap formation is a chemical reaction between the oil and the caustic soda. The main components are:



**Plant oil**



**Water**



**Additives like**  
perfumes,  
honey, flower,  
starch



**Caustic soda**

### 3.2.5.3 Making the caustic soda solution



The components for soap making are:

- 1 litre of oil,
- 0.75 litre of water
- 150 g of caustic soda per litre of oil

If no scale is available, the components can be measured by volume, for instance: cups:

- 8 cups oil
- 6 cups water
- 1 cup caustic soda

To prepare the solution of caustic soda, To prepare the solution of caustic soda, calculate the amount of caustic soda and put the soda into the water. **Never pour water onto caustic soda!**

Stir the solution until the caustic soda is dissolved. The solution will get hot. To continue the work, wait until the solution cools down (you can accelerate this by standing the bowl with the solution inside a larger bowl filled with cold water while you stir).

### 3.2.4 Mixing oil with solution

Pour the oil into a bowl and put it beside the bowl of caustic soda solution.

Pour the caustic soda solution slowly into the oil stirring all the time. You will see a reaction immediately: the mixture will go white and very soon (after a few minutes) it becomes creamy.

Continue stirring until the mixture is like mayonnaise. Then you can add perfumes or other additives to improve the soap or to give it an individual touch.



### 3.2.5 Pouring into moulds

If the consistency is still creamy, you should pour the mixture into a mould, where it can harden overnight.

The moulds can be made from a wooden tray or a cardboard box, lined with a plastic sheet.

To make some other forms, you can also use yoghurt cartons or any other plastic container as a mould. Some of these plastic containers (water bottles) have interesting designs at the bottom, which give nice soap forms, if only the bottom part is used as a mould.

### 3.2.6 Variations of soap components (perfumes)

An important factor to change the properties of the soap is the water content. It can differ by 100 %. The above mentioned quantities give a medium-hard soap. If the quantity of water is only

half the quantity of oil, the soap becomes very hard. If the water quantity is equal to the quantity of oil, several spoonfuls of flour and starch will have to be added to obtain a soap which is hard enough. Without the flour the soap stays too soft.

Economically it is a big advantage to add flour and more water, because more pieces of soap can be produced with the same amount of oil and caustic soda.

### 3.2.7 Cutting the soap

The time needed for the hardening process depends on the ambient temperature. At about 30 °C the soap hardens overnight and can be cut into pieces the next morning. At lower temperatures this process can take some days.

If the soap has become too hard it has to be cut with a saw.

For marketing purposes the pieces of soap should not be too big. 100 to 150 g seems to be a size which fits nicely into the hand.

A piece of soap 8 cm long, 5.5 cm wide and 2 cm thick weighs about 100g. It is big enough to put a label on.

### 3.2.8 Storage

The soap making process is a chemical reaction which is very fast at the beginning and continues for some time more slowly. Therefore, the soap should be left for at least 2 to 3 weeks on a shelf (to ripen) before being used .

Since the soap contains a surplus of water, it will lose some weight during storage in the dry season.

### 3.2.9 Packaging

If the soap is to be sold outside the village, it should be wrapped in some nice paper, or in transparent plastic with a label.

### 3.2.10 Cleaning the material

Since the oil is toxic and the caustic soda a very aggressive chemical product, all material should be cleaned thoroughly after the demonstration using a lot of water.

### 3.2.11 Soap recipes

## 3.3 *Lighting with Jatropha oil*

Lighting is a basic need and paraffin is not always available in rural areas. So people use diesel instead. It smokes badly and many people cannot stand the smell. Health hazards too have been reported.

Taking into consideration the differences between *Jatropha* oil and paraffin, two lamp designs for *Jatropha* oil have been developed:



### 3.3.1 Using the paraffin lamp for *Jatropha* oil

The body of a normal petrol lamp is modified: the mechanism to move the wick is fixed inverse to the reservoir to reduce the height between surface of the oil and flame. This design is promoted by Africare in Lusaka.

### 3.3.2 The Binga lamp for *Jatropha* oil

A simple and very appropriate design of an oil lamp has been developed by the "Binga Trees Trust" on the Zimbabwean bank of Lake Kariba. This design works very well and can be assembled in each

village. See detailed description below:

The "Binga-Oil-Lamp" is made of a simple glass (jam jar, drinking glass), filled with oil up to 3 - 5 cm below the rim. On the oil floats a small cork disc (or a disc of a maize spindle) wrapped in



aluminium foil to prevent the cork burning. In a hole in the centre of the disc a cotton wick is fixed.

The floating wick holder is centred using match sticks or pins. Thus the flame of the oil lamp is only some 1 or 2 mm above the surface of the oil and the flame gives a quiet and steady light. It seems that the smell of this light also repels mosquitoes.

### **3.4 Plantation of *Jatropha***

#### **3.4.1 Planting hedges from seeds**

Seeds are planted at the beginning of the rainy season.

To get a dense hedge to protect gardens against browsing animals, a seed should be planted every 5 cm. The germination should be controlled and missing plants replaced by new seeds.

To achieve a dense hedge it is also possible to plant the seeds alternately in two rows, 20 cm apart. The seeds themselves should be 10 to 15 cm apart.

Since the young *Jatropha* plants have not yet developed their repellent smell, they might be eaten by roaming animals, so they should be protected during the first year with some tree branches.

After three rainy seasons the plants are big and dense enough to protect the crops.



#### **3.4.2 Planting hedges from cuttings**

It is better to plant a hedge from cuttings, if they are available.

The best time to plant cuttings is during the dry season, 1 to 2 months before the beginning of the rainy season. The cuttings should be already lignified, i. e. more than 1 year old. Old branches of some years of age can also be used as cuttings.

The cuttings can be placed 3 to 5 cm into the soil

and fixed 1 m above the soil with a horizontal wooden bar. The protective function is thus achieved right from the outset and the fence will start living during the rainy season.

Old and strong branches can also be used as poles for fencing with barbed wire, because the poles start growing and are less likely to be attacked by termites.

### 3.4.3 Establishment of a plantation

To start a Jatropha plantation the above mentioned planting methods can be used.

The plants should be 2.5 m apart with a distance of 3 m between the rows. If the plants are too close together you will find it difficult to harvest the seeds.



## 5. Useful addresses in Zambia

### 5.1 Promotion

- **Africare**  
P.O. Box 33921, Lusaka  
Tel: 29 36 34, Fax: 29 36 31, e-mail: africare@zamnet.zm
- **Castor Growers Association of Zambia (CGAZ)**  
Attn. Mr. Mutebela, Chairman  
Off Makishi Road, 26 Mwalule Crescent  
P.O. Box 38376, Lusaka  
Tel: 23 76 18, Fax: 23 76 18 or 29 09 37

### 5.2 Production of oil presses / expellers

- **Jung**, Producer of the Sundhara press in the Copperbelt
- **Yenga & Sunflower Association of Zambia**

### 5.3 Caustic soda

- **Farmers Barn Ltd**,  
P.O. Box 37254, Chiparemba Road, Lusaka  
Tel: 223671, Fax: 225352, Cell: 703151,
  - Branch Lusaka: Opp. New City Market Soweto Area, Tel: 286607
  - Branch Choma: Tel: 032 20344
  - Branch Kabwe: 05 221478
  - Branch Ndola: Chisokone Avenue, P.O. Box 71270, Tel: 620439
- **Yaweh's Pharmacy Ltd**,  
P.O. Box 670479, besides Commercial Bank,  
Mazabuka, Tel: 03 30847

### 5.4 Oil extraction

- **M. A. Deliverance Agro-Industries**, Oil expellers,  
P.O. Box 670285, Mazabuka, Tel: 300530, Mr. Sharma

### 5.5 Buying seeds

- **Castor Company of Zambia Ltd (CCZ)**  
Attn. Mr. Mukutu, Chairman  
Off Makishi Road, 26 Mwalule Crescent, P.O. Box 38376, Lusaka,  
Tel: 01 23 76 18, Fax: 23 76 18 or 29 09 37
- **Castor Growers Association of Zambia (CGAZ)**  
Attn. Mr. Kaula Mutebela, Chairman  
Off Makishi Road, 26 Mwalule Crescent, P.O. Box 38376, Lusaka,  
Tel: 01 23 76 18, Fax: 23 76 18 or 29 09 3

**Title photos:** Jatropha hedge, oil extraction and soap production with Jatropha oil in Southern Province, Zambia. Jatropha oil lamp of the Binga Trees Trust, Zimbabwe

**All photos** by Reinhard K. Henning, bagani GbR, Germany

**Drawings** by Mohamed Traoré, Bamako, Mali



**Jatropha plant in the Zambezi valley attacked by white ants.**

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