

The Jatropha Booklet



A Guide to the Jatropha System and its Dissemination in Africa

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1. THE JATROPHA PLANT IN AFRICA.....	5
2. SHORT DESCRIPTION OF "THE JATROPHA SYSTEM".....	5
2.1 ORIGIN OF JATROPHA.....	5
2.2 THE PLANT « JATROPHA CURCAS L. ».....	6
2.2.1 <i>Botanical Description</i>	6
Varieties.....	6
2.2.2 <i>The Hedges</i>	6
2.2.2.1 Hedges as a boundary marker.....	6
2.2.2.2 Hedges for protection against animals.....	7
2.2.2.3 The anti-erosion effect.....	7
2.2.3 <i>Jatropha plantations</i>	7
2.2.4 <i>The production of seed</i>	8
2.2.4.1 The production rate.....	8
2.2.4.2 The harvest.....	8
2.2.4.2.1 Collection of the Fruits.....	8
2.2.4.2.2 Drying.....	9
2.2.4.2.3 Dehulling.....	9
2.2.4.2.4 Drying and storage of the seeds.....	9
2.2.5 <i>Propagation of Jatropha</i>	10
2.2.5.1 Generative propagation (seeds).....	10
2.2.5.1.1 Direct seeding.....	10
2.2.5.1.2 Transplanting precultivated plants.....	10
2.2.5.2 Vegetative propagation (cuttings).....	10
2.2.5.2.1 Direct planting.....	10
2.2.5.2.2 Transplanting precultivated plants.....	11
2.3 ITS POSSIBLE USES.....	11
2.3.1 <i>The plant</i>	11
2.3.1.1 Jatropha as a medicinal plant.....	11
2.3.1.2 Boundary demarcation.....	12
2.3.1.3 Live fencing.....	12
2.3.1.4 Erosion control.....	12
2.3.2 <i>The seeds</i>	12
2.3.2.1 Jatropha fruit hulls.....	12
2.3.2.2 The seeds.....	13
2.3.2.3 Oil extraction.....	13
2.3.2.4 Press cake.....	13
2.3.3 <i>The oil</i>	13
2.3.3.1 Soap production.....	13
2.3.3.2 Oil for lighting / cooking.....	14
2.3.3.2.1 Jatropha oil lamp.....	14

2.3.3.2.2 Jatropha oil cooker	14
2.3.3.3 Oil as lubrication oil.....	14
2.3.3.3.1 Chain saw lubrication oil.....	14
2.3.3.3.2 Engine lubrication oil	14
2.3.3.4 Oil as diesel substitute.....	15
2.3.3.4.1 Pure raw oil	15
2.3.3.4.2 Transesterification.....	15
2.3.3.5 Other potential products	15
Cosmetic uses	15
Insecticides/molluscicides	16
3. JATROPHA PROMOTION.....	16
3.1 ESSENTIAL CONDITIONS FOR JATROPHA PROMOTION	16
3.1.1 <i>Buying all seeds</i>	16
3.1.2 <i>Making seeds available</i>	16
3.1.3 <i>Making caustic soda available</i>	17
3.1.4 <i>Making presses available</i>	17
3.1.5 <i>Soap marketing</i>	17
3.1.6 <i>Support of a local Jatropha centre</i>	17
3.2 JATROPHA FIELD DAY	18
3.2.1 <i>Place of demonstration / invitation</i>	18
3.2.2 <i>Preparing the equipment</i>	18
3.2.2.1 Ram press	18
3.2.2.2 Soap making	19
3.2.2.3 Information	19
3.2.3 <i>Explanation of the Jatropha System</i>	19
3.2.4 <i>Demonstration of oil extraction with the Bielenberg ram press</i>	19
3.2.4.1 Preparing / roasting 6 kg of seeds.....	19
3.2.4.2 Explanation of the ram press and how it works.....	20
3.2.4.3 Participants try their hand.....	21
3.2.4.4 Cleaning of the press.....	21
3.2.5 <i>Demonstration of soap making</i>	22
3.2.5.1 The danger of working with caustic soda.....	22
3.2.5.2 The components of soap making	23
3.2.5.3 Making the caustic soda solution	23
3.2.5.4 Mixing oil with solution	24
3.2.5.5 Pouring into moulds.....	24
3.2.5.6 Variations of soap components (perfumes).....	24
3.2.5.7 Cutting the soap	25
3.2.5.8 Storage	25
3.2.5.9 Packaging	26
3.2.5.10 Cleaning the material.....	26

3.2.6 <i>Demonstration of lighting</i>	26
3.2.6.1 Difference between Jatropha oil and paraffin.....	26
3.2.6.2 Using the paraffin lamp for Jatropha oil	27
3.2.6.2.1 Modified petrol lamp.....	27
3.2.6.2.2 Special lamp for Jatropha oil	27
3.2.6.3 The Binga lamp for Jatropha oil.....	27
3.2.7 <i>Plantation of Jatropha</i>	28
3.2.7.1 Planting hedges from seeds.....	28
3.2.7.2 Planting hedges from cuttings.....	28
3.2.7.3 Establishment of a plantation	29
3.2.8 <i>Follow-up</i>	29
3.4 SOAP RECIPES	30
4. ECONOMIC CALCULATIONS.....	31
5. USEFUL ADDRESSES IN SUDAN / AFRICA.....	34
5.1 PROMOTION.....	34
5.2 INFORMATION ABOUT RAM PRESSES / EXPELLERS	34
5.3 CAUSTIC SODA.....	34
5.4 OIL EXTRACTION	35
6 JATROPHA NETWORK SUDAN (JNS).....	36

1. The Jatropha plant in Africa

Jatropha curcas is an indigenous plant to Central America and is now distributed in almost all tropical and subtropical countries. It is widely used as a medical plant. Since the plant is not browsed by animals, Jatropha is used by the farmers to protect their gardens and fields against roaming animals.

It seems that the plant was introduced to Angola and Mozambique by Portuguese seafarers, from where it spread to the neighbouring countries. In the middle of last century it was cultivated in a large extend in Madagascar, Benin and Guinea, from where it was exported to France as raw material for the famous "Savon de Marseille".

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, for lighting 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. »



2.2.1 Botanical Description

Jatropha curcas is a drought resistant species which is widely cultivated in the tropics as a living fence. The seeds are toxic to humans and many animals.

The *Jatropha* plant is a small tree or large shrub which can reach a height of up to 5 m. The branches contain latex.

Normally, five roots are formed from seeds, one central (tap root) and four peripheral. Cuttings, when planted, do not form a tap root.

The plant is monoecious and flowers are unisexual. Pollination is by insects.

The life-span of the *Jatropha curcas* plant is more than 50 years.

Varieties

The *Jatropha* variety in Nicaragua has fewer, but larger fruits. The yield per ha seems to be the same.

A non-toxic variety exists in Mexico which is used for human consumption after roasting.

2.2.2 The Hedges

In most countries *Jatropha* plants are planted in the form of protection hedges, or as single trees for medical purposes.

2.2.2.1 Hedges as a boundary marker

In many cases *Jatropha* is planted in the form of hedges to demarcate fields or roads. This can reduce potential boundary disputes.

2.2.2.2 Hedges for protection against animals



Since even goats do not browse Jatropha, this plant is used worldwide to protect gardens and field crops from roaming animals. The protection hedges are planted from seeds or cuttings. Hedges from seeds need about 2 years (3 rainy seasons) to have a protective value. Cuttings can be arranged in the form of a fence, which has its protective function right from the beginning. The cuttings grow roots and form a living fence, which can live for fifty years.

2.2.2.3 The anti-erosion effect

If not cut Jatropha grows up to 5 m in height. In this way Jatropha hedges around gardens and fields reduce wind speed on the ground, and therefore wind erosion.

Since Jatropha plants have lateral roots near the surface, they can be used to fix small earth dams which reduce the flow of run-off water. Water erosion can be further reduced by planting Vetiver or Lemon grass between the Jatropha trees.

2.2.3 Jatropha plantations

Jatropha in the form of a plantation for seed production is not common. The farmers look for the dual advantage of crop protection combined with seed production. Plantations of several hectares have only been reported in Mali, West Africa, and in Nicaragua and Belize, Central America. Recently plantations are reported from Ghana, India, Nepal and Zambia.

2.2.4 The production of seed

The Jatropha plant has not yet been the subject of agricultural research to improve the yield. Figures given in the pertinent literature vary from 300 g to 9 kg per tree and plant.

2.2.4.1 The production rate

In Mali the production rate of Jatropha hedges was measured during different years and with different sizes of hedges. In general the harvest of seeds was 0.8 kg/year per m of length of a hedge.

Old hedges (not pruned) had a yield of 2 kg of seeds per year and per m of hedge.

In Nicaragua the yield of a Jatropha plantation is put at 5,000 kg per ha. In Mali only the yield of



hedges was measured, but these figures, converted, give a yield equivalent to 2,800 kg per ha and year.

2.2.4.2 The harvest

2.2.4.2.1 Collection of the Fruits

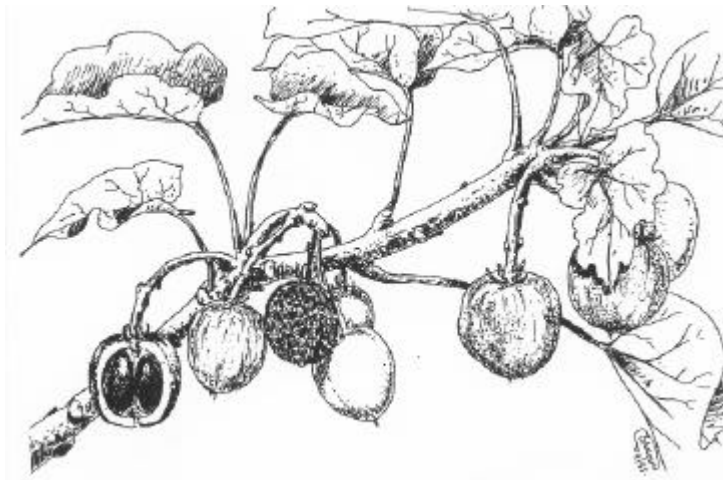
Ripe Jatropha fruits are yellow. The fruit dries and the hull becomes hard and black. The dry fruits remain on the branches.

The best way of harvesting the Jatropha fruits is to use some sort of a modified "apple picker", i. e. a long wooden stick with a circular comb with a cotton bag at one end. With this tool the dry fruits can be picked from the trees, the fruits fall into the bag and do not have to be found in the grass.

Without this "Jatropha picker" the fruits are hit with a stick. Then they have to be collected on the ground.

2.2.4.2.2 Drying

Before dehulling, the seeds have to be dried. The best method is a thin layer of fruits on a plastic sheet or on a surface of concrete. If the seeds are to be planted they should not be dried in full



sunshine, because the heat can reduce the germination rate. If the seeds are going to be used for oil extraction, they may be dried in full sunshine on a black plastic sheet. It is important to keep the seeds free of sand or small stones, because these are very bad for the extraction process of the manual press, they can even destroy the worm of the Sundhara expeller.

2.2.4.2.3 Dehulling

Dehulling (taking off the dried fruit hull to have the pure black seeds) by hand is a time consuming process. A small tool makes this task much easier.

The dry fruits are placed in a thin layer on a hard surface, i. e. on a table or on a concrete slab. If you move a small wooden board over the dry fruits while pressing it down, the fruit hulls split and the seeds come out.

Fruit hulls and seeds can be separated by winnowing or sieving.

2.2.4.2.4 Drying and storage of the seeds

Seeds should only be stored after careful drying, in a well ventilated shady room.

2.2.5 Propagation of Jatropha

2.2.5.1 Generative propagation (seeds)

2.2.5.1.1 Direct seeding

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

To plant a hedge, the distance between the seeds should be 20 cm or less. For a really thick hedge plant two rows 20 cm apart with seeds 5 cm apart.

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

2.2.5.1.2 Transplanting precultivated plants

Precultivation of Jatropha seedlings in poly-ethylene bags can accelerate the installation of a plantation by at least 3 months. Small plastic bags are filled with soil with a high concentration of organic material (compost) about 3 months before the beginning of the rainy season. One seed is planted in each bag. If well watered every 3 days, the seeds start germinating after about 10 days. After 3 months, at the beginning of the rainy season the 30 to 40 cm high plants can be planted out.



These plants can produce seeds after only 2 rainy seasons.

Because of difficulties of transport (weight of the bags) these plants are not suitable for hedges. For a Jatropha plantation a distance of 3 m between the rows is appropriate, and a distance of 2.5 m between the plants.

2.2.5.2 Vegetative propagation (cuttings)

2.2.5.2.1 Direct planting

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.

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.

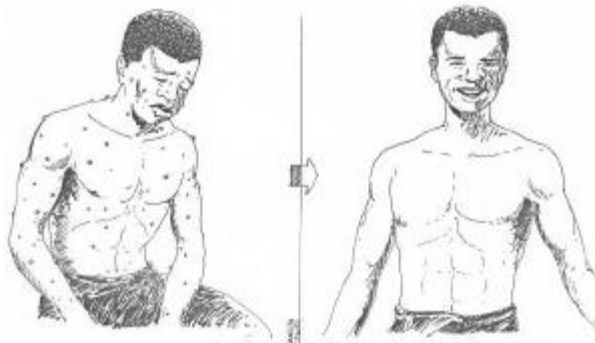
Cuttings can easily be kept in a shaded place for a few weeks, without drying. A cover of wax on the leaves and on the bark reduces the evaporation. The cuttings will start to rot before they dry out.

2.2.5.2.2 Transplanting precultivated plants

In principle cuttings can also be planted in plastic bags to accelerate the development of the plant after being planted outside.

2.3 Its possible uses

2.3.1 The plant



2.3.1.1 Jatropha as a medicinal plant

There is considerable documentation of the traditional medicinal uses of various parts of the Jatropha plant. Only some of these uses have been verified by research.

- ?? A decoction of leaves is used to relieve coughing and as an antiseptic after birth.
- ?? The sap (latex) has antimicrobial properties against Staphylococcus and Streptococcus

spp, also E. coli.

?? Latex from the stem is used to arrest bleeding of wounds.

?? The oil has a strong purgative action and is also widely used for skin diseases and to soothe pain such as that caused by rheumatism.

2.3.1.2 Boundary demarcation

Often the Jatropha plant is used to demarcate boundaries, because the plant is not browsed by animals and has a long life. Its branches and trunk have no use as firewood, but seeds or parts of the plant are collected for medicinal purposes.

2.3.1.3 Live fencing

The most common use of the plant world-wide is in the form of protective hedges for gardens and fields.

2.3.1.4 Erosion control

Because of its drought tolerance and its lateral roots near the surface the Jatropha plant is often used for anti-erosion measures, either in the form of plantation together with other species, or in the form of hedges to reduce wind speed and protect small earth dams or stone walls against run-off water.

Together with Vetiver or Lemon grass the Jatropha hedges can build up a filtering system that reduces the erosion of surface soil by run-off water. After only a short time terraces are formed.

2.3.2 The seeds

2.3.2.1 Jatropha fruit hulls

Fruit hulls have no significant value as fodder, so it is best to use them as mulch or compost.

They can also be burnt in fuel-efficient cooking stoves.

2.3.2.2 The seeds

The seeds can be processed (oil, press cake) or sold directly as seed or for industrial use.

Selling the seeds generates only a small profit, because agricultural prices are fairly low.

If the whole process of soap production is economically evaluated, a profit of about US\$ 0,50 per hour of work can be achieved (see economic calculations).

2.3.2.3 Oil extraction

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 a hand press like the Bielenberg ram press only 60 - 65 % of the oil can be extracted (5 kg of seeds give about 1 litre of oil).

2.3.2.4 Press cake

The press cake constitutes some 70 - 80 percent of the total mass of the seeds, depending on the extraction rate.

The press cake cannot be used in animal feed because of its toxic properties.

Because of its content of nitrogen (6 % N₂), phosphorous (2.75 % P₂O₅) and potassium (0.94 % K₂O), 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 per hectare.

Due to its residual oil content, the JCL press cake also has insecticide properties, and reduce the amount of nematodes in the soil.

2.3.3 The oil

2.3.3.1 Soap production

The most interesting and economically viable use of the Jatropha oil is soap production.

Jatropha gives a very good foaming white soap with positive effects on the skin, partly due to the glycerine content of the soap.

Jatropha oil is used for soap production on an industrial scale in India.

Soap production from oil is a very simple process. It is an appropriate technology for villages, where the entire value added then benefits the village community. Selling the soap for the same price as industrially manufactured soap brings a high profit for seed harvesting, oil extraction and soap production.

2.3.3.2 Oil for lighting / cooking

2.3.3.2.1 Jatropha oil lamp

Jatropha oil cannot be used in normal paraffin lamps because its chemical properties differ to those of paraffin.

Due to the physical properties of the oil, it cannot be used in the traditional paraffin lamps.

A very simple design for a Jatropha oil lamp was developed by the "Binga Trees Trust" in Zimbabwe. The central idea is the use of a floating wick. For details see 3.2.6.3.

2.3.3.2.2 Jatropha oil cooker

Research has been conducted into developing cookers that would run on plant oil, but no practical results have yet been achieved.

2.3.3.3 Oil as lubrication oil

2.3.3.3.1 Chain saw lubrication oil

Not yet available on the market.

2.3.3.3.2 Engine lubrication oil

A test at the TMW engine factory in Germany showed the suitability of pure raw Jatropha oil as a lubrication oil for low-revolution engines.



2.3.3.4 Oil as diesel substitute

2.3.3.4.1 Pure raw oil

Raw Jatropha oil can only be used in modified diesel engines. Modern multi-fuel engines are manufactured in Germany.

Raw Jatropha oil can be used by certain suitable engines (like the Indian "Lister type" engines) with few modifications (fuel filter).

2.3.3.4.2 Transesterification

The transesterification of plant oil into diesel fuel has probably received the most attention internationally and is a fuel-making process

which has become commercial in several countries (e.g. Germany, Austria, Hungary and Ghana).

The process is highly capital-intensive and technically complex and has not yet been simplified or miniaturised to the point where individuals or even rural cooperatives could produce it economically.

2.3.3.5 Other potential products

Cosmetic uses

Well-refined Jatropha oil is a good basic material for cosmetics. But it is not yet used on a larger scale.

Insecticides/molluscicides

Jatropha press cake and Jatropha oil have insecticidal and molluscicidal properties. The active component is a phorbol ester, which gives the Jatropha press cake and oil its toxic property.

A research project of the European Community is investigating the biological mechanisms involved. The overall aim is to develop a technology for the economic exploitation of this property of the Jatropha plant.

3. Jatropha promotion

This chapter contains technical descriptions of the exploitation of the Jatropha plant, as well as some hints and advice for the organisation of promotion activities.

3.1 Essential conditions for Jatropha promotion

To promote the exploitation of the Jatropha plant, some essential conditions should be met, and some special services should be available:

3.1.1 Buying all seeds

A Jatropha purchasing system should be organised, that is able to buy all seeds offered by the farmers.

Such a system of Jatropha purchasing could be organised in cooperation with the soap industry.

3.1.2 Making seeds available

In the districts where Jatropha is promoted, every farmer should be able to buy good Jatropha seeds for planting. The agricultural administration together with other interested parties (GTZ, NGOs), or district agricultural extension workers, should collect seeds from high-yield plants and make the seeds available for purchase. A better way, but more expensive, is the distribution of branches of high yield plants (vegetative propagation).

3.1.3 Making caustic soda available

Caustic soda is a limiting factor for soap production in rural areas. All other necessary tools or material can be found at village level. Caustic soda should thus be available in all district towns and in the shops of the bigger villages. A list with the addresses of shops where caustic soda is available should be prepared and distributed in the districts.

3.1.4 Making presses available

The manual Bielenberg ram presses are widespread in some of the African countries. Africare and ITDG in some countries disseminate them to produce cooking oil from sesame.

To give individuals with only a small quantity of seeds a chance to extract the oil, a system of communal use of this ram press (loan system) should be organised. A NGO, the district agricultural administration or a "Jatropha Task Force" of the district could be the initiator / organisator of such a loan system.

3.1.5 Soap marketing

As long as only small quantities of Jatropha are produced, it will not be difficult to sell. In most cases the soap will be sold within the neighbourhood.

As soon as some hundred pieces of soap are produced, some professional marketing has to be established. This can be organised by NGOs in collaboration with the agricultural administration.

An important task in this respect is the presentation of "The Jatropha System" at a "National Agricultural Show".

3.1.6 Support of a local Jatropha centre

A sort of a technical Jatropha centre should be established at one place in the country, where interested farmers, NGO's, development groups or agricultural extension staff can obtain information, material or technical advice. This centre could also lend ram presses for oil extraction.

3.2 *Jatropha* field day

This description is for a person in the Agricultural Service or a member of a women's or farmers' group, who has been trained in the understanding of the *Jatropha* System, in extracting *Jatropha* oil with the ram press and in soap making.

The technical description, remarks and advice are written in the form of a preparation paper for a demonstration of "The *Jatropha* System" at a rural location.

3.2.1 Place of demonstration / invitation

Together with the local Agricultural Extension Officer (Bloc Supervisor) select a place and date of the demonstration and make sure that the invitation is sent out. No more than 25 persons should attend the demonstration. You should start with the demonstration early, because you will need between 3 and 4 hours to present and explain the different aspects of "The *Jatropha* System".

The demonstration site should be a place with a large number of *Jatropha* trees. This makes it easier to explain the different aspects of the *Jatropha* system and the planting of hedges. After the



demonstration, each participant should be given some cuttings (and also some seeds) to plant around his house.

3.2.2 Preparing the equipment

3.2.2.1 Ram press

Make sure that a ram press is available at the demonstration site. Otherwise bring one with you.

Take with you a roasting pan large enough to take 2 kg of Jatropha seeds.

Take 1 litre of clear oil with you to exchange it for 1.3 litres of the freshly pressed oil (20 to 30 % of the raw oil will be sediment).

Make sure that all parts of the press are complete.

3.2.2.2 Soap making

Make sure that you have enough caustic soda with you. Better still, taken more than you need, so you can sell some of it to the participants.

You will need 2 three-litre bowls and a cup (approximately 125 ml) to measure oil, water and caustic soda.

3.2.2.3 Information

Make sure that you have enough copies of the information brochure with you.

3.2.3 Explanation of the Jatropha System

The explanation should be based on the information given in chapter 2 of this booklet. It is important that the explanation is accompanied by visual demonstration.

3.2.4 Demonstration of oil extraction with the Bielenberg ram press

The first part of the demonstration is the oil extraction with the ram press. Perhaps some participants are already familiar with the process of extracting oil from sunflower or other oil seeds. The extraction of oil from Jatropha seeds is a bit hard.

3.2.4.1 Preparing / roasting 6 kg of seeds

Oil extraction should be demonstrated with 6 kg of dry seeds, which are free of dust and sand. This will give about 1.2 l of oil.

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.

3.2.4.2 Explanation of the ram press and how it works

Perhaps some of the participants are already familiar with the ram press. For those without any experience, the press and its parts should be explained. The following parts should be explained in detail:

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 ram 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, 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).

3.2.5.4 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.

3.2.5.5 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.

3.2.5.6 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. See also the soap recipes in section 3.4.

3.2.5.7 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.

3.2.5.8 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.

3.2.5.9 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. See 2 examples from Zambia.



3.2.5.10 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.

3.2.6 Demonstration of lighting

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.

3.2.6.1 Difference between Jatropha oil and paraffin

Paraffin is a purified hydrocarbon which evaporates at about 60 °C. In a paraffin lamp it burns completely without any smoke at some distance from the wick. The wick itself does not burn.

Plant oil evaporates partly only at a temperature of more than 250 °C. A certain percentage of the organic molecules burn incompletely and form a deposit of carbon near the flame. Since the oil does not evaporate, the oil burns very near the wick and partly together with it. The viscosity of

the oil is more than 10 times lower than that of paraffin, so the distance between the surface of the oil and the flame has to be very small.

These physical differences between paraffin and plant oil make it impossible to use unmodified petrol lamps with plant oil.

3.2.6.2 Using the paraffin lamp for Jatropha oil



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

3.2.6.2.1 Modified petrol lamp

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 Zambia.

3.2.6.2.2 Special 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:

3.2.6.3 The Binga lamp for Jatropha oil

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 Jatropha light also repels mosquitoes.

3.2.7 Plantation of Jatropha

The plantation of Jatropha can only be demonstrated during a "Jatropha field day" in a very limited way. Only the principles can be shown.

3.2.7.1 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.

3.2.7.2 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 10 to 20 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.

3.2.7.3 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.

3.2.8 Follow-up

The explanation and the technical demonstration of the Jatropha system should not be seen as isolated activities. It is important that the participants have access to further information and advice. This should be organised by the District or Province Agricultural Administration.

3.4 Soap recipes

Different soap recipes had been successful. The different qualities of soap are achieved by:

- ?? Changing the amount of water. The water content of the soap can vary between 50 and 100 % of the quantity of the oil. The more water the softer is the soap.
- ?? Adding flower and starch. This absorbs the excess water. One to two spoons of flower and/or starch added during the soap making process give a hard soap even with oil and water at equal amounts.
- ?? Adding perfumes. This gives the soap a personal note.
- ?? Adding honey. This gives the soap a pleasant odour and a good feeling on the skin.

Ingredients	Soap 1	Soap 2	Soap 3	Soap 4
Oil	1 litre	7 litres	7 litres	7 litres
Caustic soda	150 g	1 kg	1 kg	1 kg
Water	0,5 l	7 litres	10 litres	3,5 litres
Additives		2 spoons flower 2 spoons starch	3 spoons flower 3 spoons starch	350 ml honey

4. Economic calculations

4.1 Oil Extraction from Jatropha Seeds

The economy of oil depends much on the price of seeds and the labour for oil extraction:

Description	Quantity	Unity	Price per unit	Amount in US\$
Seeds	12	kg	0,1	1,20
Oil	3	litres		
Labour oil expelling	5	hours	0,2	1,00
Depreciation of ram press per kg 5a, 2t/a, US\$ 240,		US\$/kg	0,024	0,29
Input for 3 l of oil				2,49
Price of Oil	1	l		0,83

Description	Quantity	Unity	Price per unit	Amount in US\$
Seeds	12	kg	0,08	0,96
Oil	3	litres		
Labour oil expelling	5	hours	0,15	0,75
Depreciation of ram press per kg 5a, 2t/a, US\$ 240,		US\$/kg	0,024	0,29
Input for 3 l of oil				2,00
Price of Oil	1	l		0,67

4.2 Economy of Soap Production with Jatropha Seeds

The economy of soap making depends much on the price of seeds. Here are two examples with a price of 10 and 20 US cent per kg

Description	Quantity	Unity	Price per unit	Amount in US\$
Seeds	12	kg	10	1,20
Oil	3	litres		
Caustic soda	0,5	kg	1,20	0,60
Labour oil expelling	5	hours	0,20	1,00
Labour soap making	4	hours	0,20	0,80
Depreciation of ram press per kg 5a, 2t/a, 240,- US\$			0,02	0,24
Water	3	litres		
Input for 60 pieces of soap				3,84
Price of Soap	1	piece à 100g		0,064
Seeds	12	kg	20	2,40
Oil	3	litres		
Caustic soda	0,5	kg	1,20	0,60
Labour oil expelling	5	hours	0,20	1,00
Labour soap making	4	hours	0,20	0,80
Depreciation of ram press per kg 5a, 2t/a, 240,- US\$			0,02	0,24
Water	3	litres		
Input for 60 pieces of soap				5,04
Price of Soap	1	piece à 100g		0,084

4.3 Monetary value of Jatropha seed processing

Description	Quantity	Unity	Price per unit	Amount in US\$
Seeds	12	kg	0,10	1,20
Oil	3	litres		0
Caustic soda	0,5	kg	1,20	0,60
Labour seeds picking	7,5	hours		0
Labour oil expelling	6	hours		0
Labour soap making	4	hours		0
Total labour	17,5	hours		
Depreciation of ram press per kg 5a, 2t/a, 240,- US\$			0,02	0,24
Water	3	litres		
Total material costs for soap pro- duction, 60 pieces of 100 g	60	pieces à 100g		2,04
Input for 1 piece of soap (without labour)				0,034
Possible labour wage per hour at a sales price of 350 per piece	350	294	17625	1.007
				is the possible payment for 1 hour work for Jatropha processing

5. Useful addresses in Sudan / Africa

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 Information about ram presses / expellers

Intermediate Technology Development Group, ITDG, Mr. Mohammed Majzoub Fidiel

P.O. Box 4172, Khartoum Central, Tel: 460419, 464168, 472002,

e-mail: majzoubm@sudanmail.net , itsd@sudanmail.net

5.3 Caustic soda

Usually caustic soda can be ordered in pharmacies or in shops for agricultural chemical products.

5.4 Oil extraction

?? Dissemination of the ram presses in different African countries

ATI (Appropriate Technology International), Headquarter
1331 H Street, N.W., Suite 1200
Washington DC, USA

?? Dissemination of the ram presses and organisation of campaigns to introduce oilseeds into the farming system in different African countries

Africare Zambia
P.O. Box 33921
Lusaka, Zambia
e-mail: africare@zamnet.zm

In Sudan, ITDG is disseminating the ram press:

Intermediate Technology Development Group, ITDG, Mr. Mohammed Majzoub Fidiel
P.O. Box 4172, Khartoum Central, Tel: +249-11-460419, 464168, +249-11-472002,
e-mail: majzoubm@sudanmail.net , itsd@sudanmail.net

In Mali, Enterprise Works, the successor of ATI, is promoting the ram press:

Enterprise Works Mali, B.P. 34, Bamako, Mali, +223 21 89 56,
e-mail: mali@enterpriseworks.org

6 Jatropha Network Africa (JNA)

see also: www.jatropha.org JCL-network

Burkina Faso	Mr. Heri Girard	Ferme Pilot de Guié	01 B.P. 551, Ouagadougou 01
Comore Islands	Mr. Said Omar Said Hassane	Inst. Sup. de Formation et de Recyclage, (I.S.F.R.)	B.P. 881 MORONI, COMORES isfr@snpt.km
Ghana	Mr. Onua Amoah	Anuanom Industrial Projects Ltd.	P.O.Box 14102, Accra, anuanom@internetghana.com
Malawi	Dr. Henry Phombeya	Resource Center	P.O. Box 2440, Lilongwe resourcecenter@malawi.net
Mali	Mr. Ibrahim Togola	Mali Folkecenter	B.P. E 4211, Bamako, Mali
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South Africa	David Sonnenberg	Africa Eco Foundation	P.O. Box 4810, 2129 Northcliff, 2195
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Tanzania	Mr. L. Manyanga	Alternative Resources Income for Monduli Women	P.O. Box 13954, Arusha kakute@tz2000.com
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Zambia	Mr. Mutebela	Africare Zambia	P.O. Box 33921, Lusaka africare@zamnet.zm
Zimbabwe	Jan & Titia Warndorff	Binga Trees Project	P.O. Box 82, Binga gwarndorff@healthnet.zw
	Geoff Oliver	Plant Oil Producers Association	P.O.Box GD 993, Harare popa@mango.zw
	Mr. Chiv. Chimombe	Biomass Users Network (BUN)	Private Bag 7768 Causeway Harare



A Jatropha hedge to protect a garden in a village



The Bielenberg ram press for manual oil extraction



Soap production by a women group



Simple lamp with Jatropha oil

Title photo: Jatropha oil extraction and soap production with Jatropha oil at Africare, Lusaka, Zambia

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

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see also the Jatropha web site in the internet: www.Jatropha.org
