



FARMER'S HANDBOOK



**Advice for growing *Jatropha curcas*
in East Africa**

May 2012

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INTRODUCTION

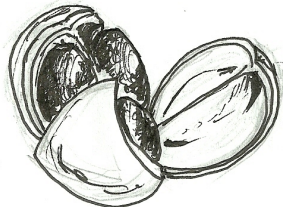
1. The *Jatropha curcas* plant

- *Jatropha curcas* is a tree that grows up to 6 m in height, matures within 5- 6 years and can live for more than 50 years.
- An openly planted seedling has one tap root and several lateral roots. Cuttings have no tap root and can last 8-10 years.
- In good conditions, small 2-4 year old trees may currently yield between 1 – 4kg of fruit a year, with very large single mature trees in optimal places known to yield up to 25-33kg.
- Growth in optimal conditions can be rapid. The main stem may reach 1 metre within 5 months and branches endings may flower within 6 months. *Jatropha* is unlikely to grow well or produce fruit in limiting conditions. Few areas in East Africa have the best starting conditions.
- Both male and female flowers occur on the same flower bunch. Female flowers are fewer and larger in size than male flowers. Female *Jatropha curcas* flowers are mostly pollinated by bees.



Figure 1: Male flowers Figure 2: Female flowers: (photos Ton Rulkens)

- The green fruits mature 3-4 months after flowering, turning yellow and then brown/ black as they age and dry.
- Flowering and fruiting can occur at the same time on a tree and continue over some months, depending on conditions.
- Each fruit contains 2-3 seeds, (rarely 4), which look like black beans of about 18mm length and 10 mm width. The seeds weight per 1000 seeds is usually between 650-750 grams. On average, the whole seeds contain about 30% oil by weight.



- *Jatropha curcas* sheds its leaves during the dry season.
- *Jatropha curcas* does not normally seed itself and so it does not become a weed. It has to be planted.

2. Benefits of growing *Jatropha curcas*

- It can provide good hedgerows.
- It can yield sufficient clean burning oil to replace kerosene in lamps and stoves for at least some months of the year.
- It can reduce dependence on fuel wood.
- It can be useful in reclaiming wasteland.
- By-products can be used as fertiliser, for making soaps and for medicinal use.

3. Risks of growing *Jatropha curcas*

- It is a wild undomesticated crop with variable seed quality and characteristics.
- It is also sensitive to different environmental conditions, all of which gives variable yields.
- Fast growth and good harvest dependent on adequate rainfall/watering, temperature and soil conditions, where it can compete with food.
- No commercial market.

4. Environmental Requirements

A *Jatropha curcas* tree stores water in its stem and so it is able to tolerate drought. *Jatropha curcas* can survive with as little as 250 mm to 300 mm of annual rainfall. However research shows that at least the following prevailing conditions are needed for good seed production:-

- Adapted reliable seed varieties.
- Optimum rainfall between 950 -1,500 mm per annum with 6-800mm spread evenly over the first growing season.
- Day temperatures between 25^oC and 32^o C.
- Few nights below 12-15 ^oC.
- Maximum sunlight, especially on flower bunches.
- No water logged soils and frosts.
- High organic soil content with all necessary bio-available nutrients.

5. Choosing when to plant *Jatropha curcas*

In areas with one long rainy season, start a nursery at least 6-8 weeks prior to the expected start of the rains. In areas with two rainy seasons, in warmer areas transplant out with the long rains, especially if there is an expectation of some showers or back up watering/ irrigation in June/ July and August. In higher cooler regions where June and July temperatures can be very low, it can be better to plant in the short rains in October or November as long as there is some back up watering/irrigation, or expected showers in December, January or February. In Western Kenya, where rains can start in August, and temperatures are warm enough, there are two possible transplanting windows in March and August. The map below shows different areas with different climatic conditions and the potential of each region can change when different planting out dates are chosen.

The potential for optimal *Jatropha curcas* growth in East Africa.

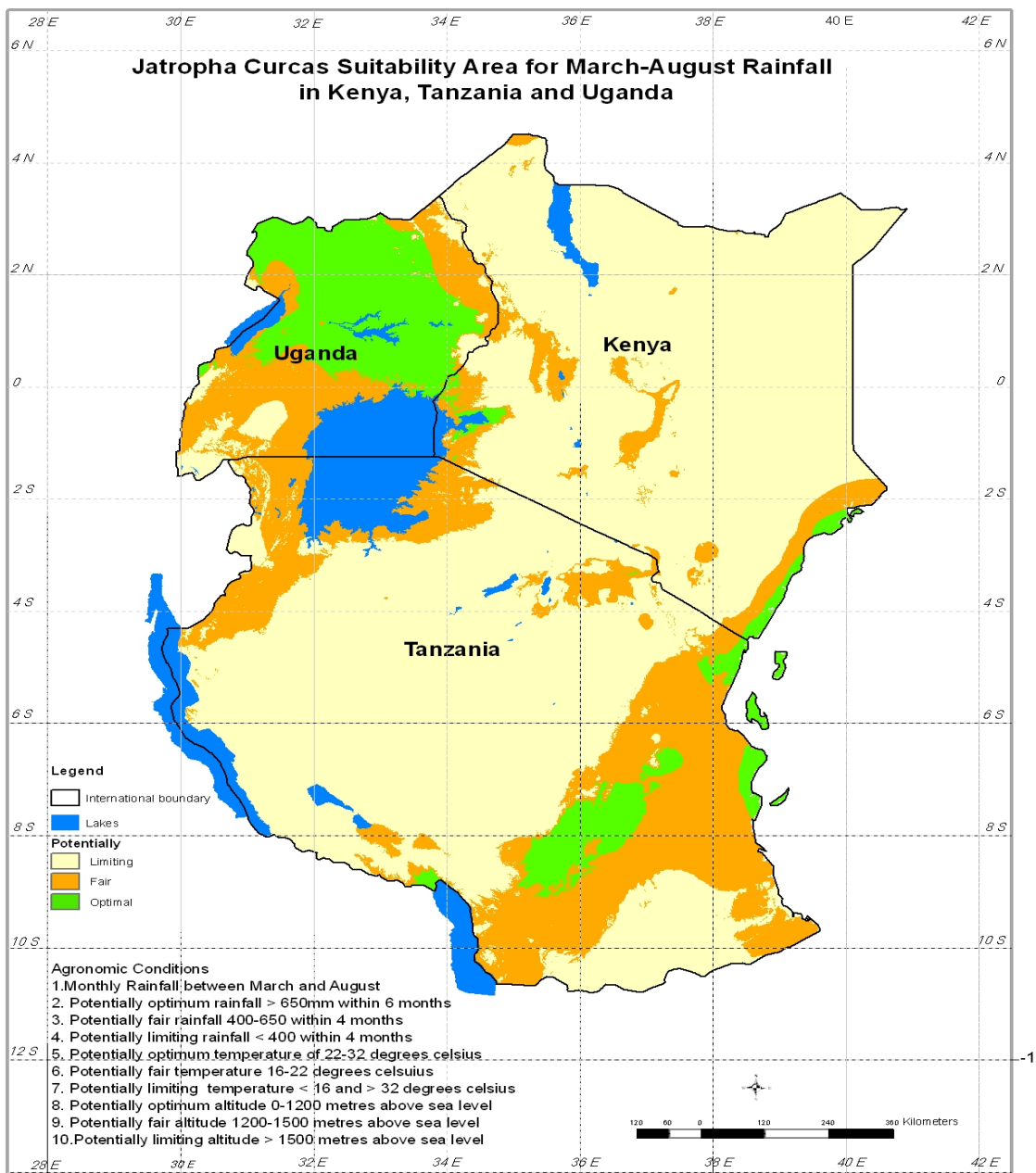


Figure 3: Map of potential conditions for planting out *Jatropha curcas* in March, based on monthly climatic averages since 2000 and criteria listed within the figure.

Green areas show potentially optimal areas, **brown** areas, fairly optimal and **yellow** areas show limited potential. The exact potential in any location depends on local conditions, as well as the ability to supply adequate water and soil nutrition with suitable temperatures and seasonal patterns.

Advice on growing *Jatropha curcas*.

6. Selecting seeds



Figure 4: Jatropha seeds

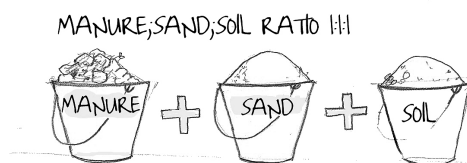
- Select large fresh seeds that are free from insect pests and diseases from a reliable source.
- Ideally select seeds from fruits that were picked when they were yellow and dried under the shade for a period of 4 to 5 days. It is best to re-plant seeds within 6 weeks of harvesting. Seeds that have been dried and stored well can remain viable for longer periods.

7. Nurturing seedlings

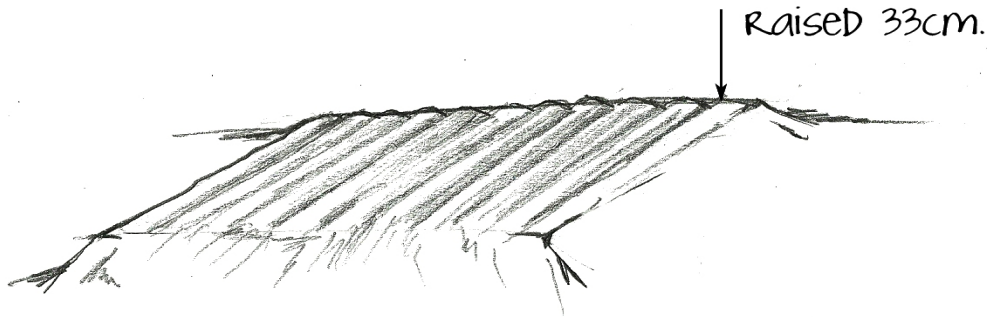
The potentially less expensive option for planting directly into the soils is possible in fertilised planting stations just before the rains. Growth may be slower than transplanting selected well-tended nursery seedlings and lead to the need for gap filling in the next season.

In order to create a nursery seedbed :-

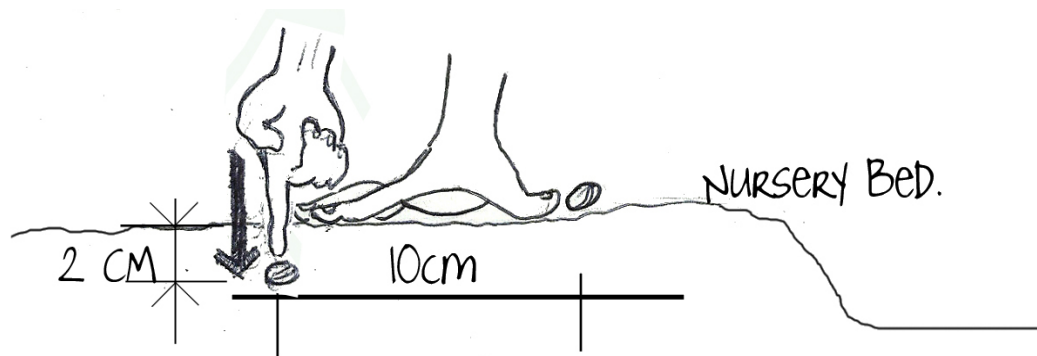
- Prepare the nursery seedbed 2 and 1/2 months before the start of chosen rainy season.
- Mix manure, sand, soil in the ratio 1:1:1.



- Raise the nursery seedbed to 33 cm.



- Soak the seeds for 12 hours before planting. Scrape or notch them if possible.
- Sow the seed at about 2cm deep and 10 cm apart on the seedbed. Place the seed horizontally to ensure that the seed cover remains in the soil when it germinates.

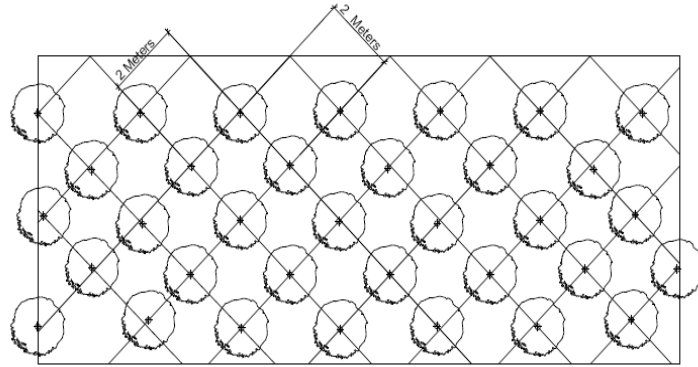


Push the seed into the ground making sure it is horizontal

- Maintain the soil temperature between 27–30 °C.
- If the temperatures drop below 20 °C at night, cover the seedbed with banana leaves, mulch straw or plastic paper.
- Keep the nursery bed continuously moist.
- Select the stronger seedlings that have germinated within 10 days after sowing, to use for transplanting.
- Transplant the seedlings 12 weeks after sowing in the nursery and ensure the seedlings have straight tap roots and are pest free.
- Transplant at the same depth as they grew in the nursery at the start of the rainy season for *Jatropha curcas* to benefit from rainfall for 3 months so as to get vigorous initial growth.

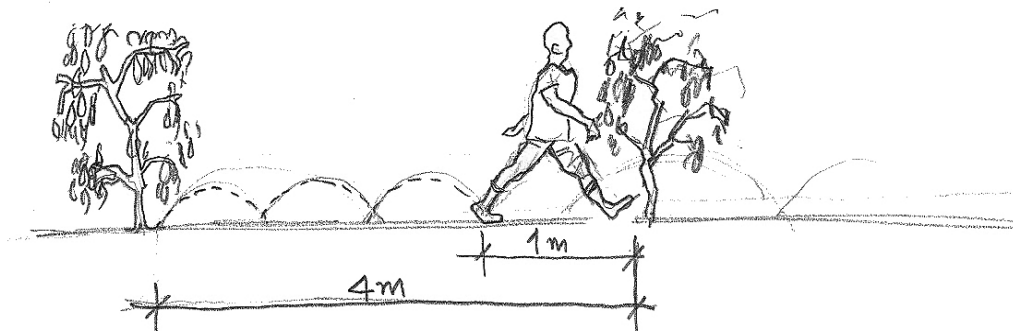
8. Choosing the place and spacing

- Grow *Jatropha curcas* in a sunny place where food does not grow.
- For windy arid areas, space the *Jatropha curcas* plants 2 metres x 2 metres apart.

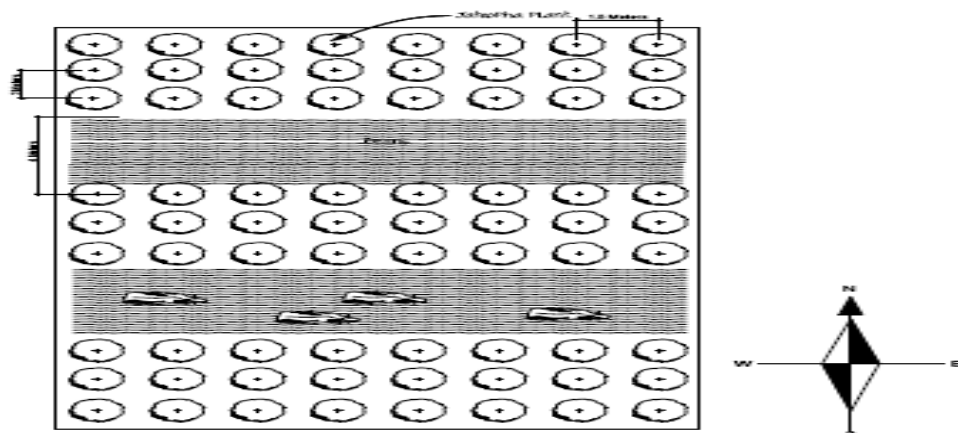


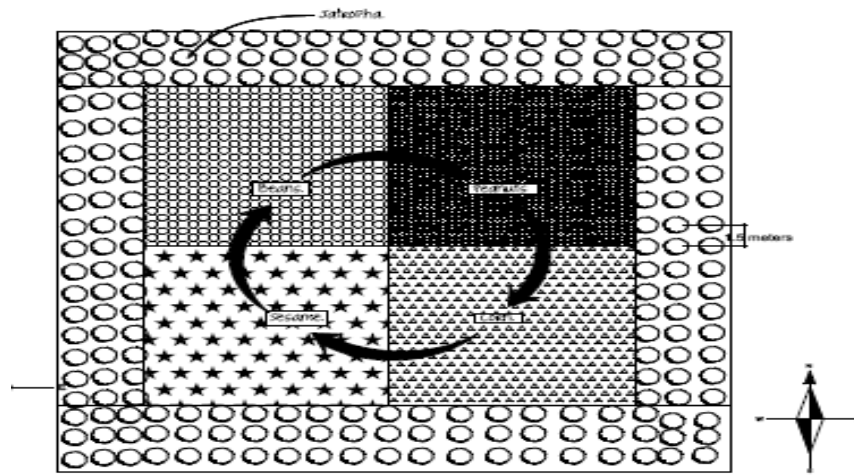
- Intercropping is especially useful with cover crops i.e. legumes and other food crops. For intercropping and mechanization, the pits can be spaced 1.5 m x 4 m or 3m x 4m apart in optimal areas.

PACING TO MEASURE FOUR METERS



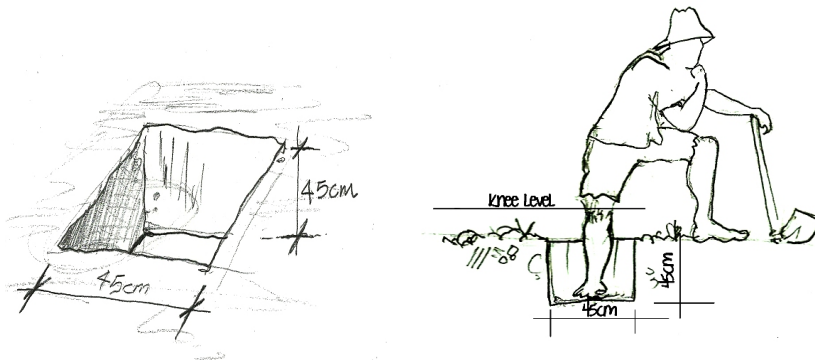
- You can also make hedgerows or border plantings with *Jatropha curcas* and rotating food crops inside the spaces created.





9. Planting and Tending

- The planting site is prepared by digging small square pits measuring 45 cm x 45 cm x 45 cm. Ensure the soil below is loose enough for a taproot depth of 1.5 metres. Avoid stony or compacted soil layers beneath.



- The pits are filled with soil and compost or organic manure.
- Apply fertilizer as needed based on soil analysis results. Jatropha can respond well to fertilizer application, usually N, P, and K in the early stages of development.
- Other nutrients, especially sulphur (S), iron (Fe) and boron (B), are needed for optimal fruit development and oil synthesis.
- In the first year, during dry and cold months, water each plant 5 litres once a week

10. Weeding

- Keep the jatropha field and trees free of weeds, especially at initial stages of growth.
- Intercropping initially with maize the first two years and afterwards, with ground crops, assists keeping the field and jatropha plants free of weeds and lessens beetle and insect attacks. *Jatropha curcas* seed cake or other manure can be spread as fertiliser to maintain nutrient levels and increase maize and other food crop yields.

11. Pests and diseases

- *Jatropha Curcas* can be subject to many pests and diseases in East Africa. These are listed on www.degjsp.com. Transplant seedlings when pests are few. Leaf eating and sucking insects can have annual cyclical patterns, often increasing after the start of the rains and understanding this can reduce spraying to once or twice a year. Many insect attacks will lessen after the first year, as pest predators come in and when the leaves are shed. Active prevention needs to be taken against root rot, mealy bugs, webbing insects and powdery mildew.

12. Pruning and pollination

- The stem and branches may be pinched at six months to encourage the development of side branches, or the main stem can be cut back at 30-40 cm. Pruning can be done at the end of the dry season to create enough branches. Each branch ending needs sunlight, and careful pruning can create an easy shape for harvesting seeds. It is recommended to have two beehives per acre to help in pollination. Mostly bees pollinate *Jatropha curcas*.

13. Flowering and fruiting

- Flowers and fruiting occur mostly at the branch endings. Three small branches may emerge from flower clusters. Flowering occurs from 6 months – 3 years after planting, depending on growth and environmental conditions. Flowering usually starts a few weeks after the start of the rains. Fruits are ready for harvest three months after flowering. Simultaneous flowering and fruiting can continue for some months, depending on the seed variety, seasons and climate.

14. Harvesting and drying

- The quality of seeds is best when fruits are harvested when yellow. The seeds can be dried in the warm shade with good air circulation or in the sun for three days. Store in a cool dry pest free place. Avoid moisture, fungus or mould.

15. Processing oil

- Fruit shells can be removed by a simple hand tool and the seeds partly crushed for pressing.

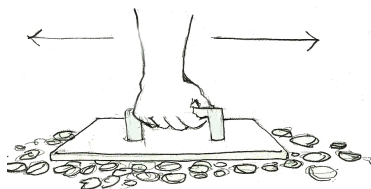


Figure 5: Manual seed crusher from TNAU Coimbatore India

- Warm the seeds (for instance, in a steam heater) for more than ten minutes before pressing to increase oil release. Do not exceed 40-45°C.
- A small hydraulic piston press can produce oil and briquettes at the same time. Small manual or powered screw presses can produce oil and seed cake. Pressing warm cake a second time can increase oil yield. Even when they are well maintained and calibrated, it is hard to release more than 20% oil using small-scale presses.



Figure 6: Small hydraulic piston press producing oil and briquettes and a Chinese manufactured diesel powered press producing oil and cake.



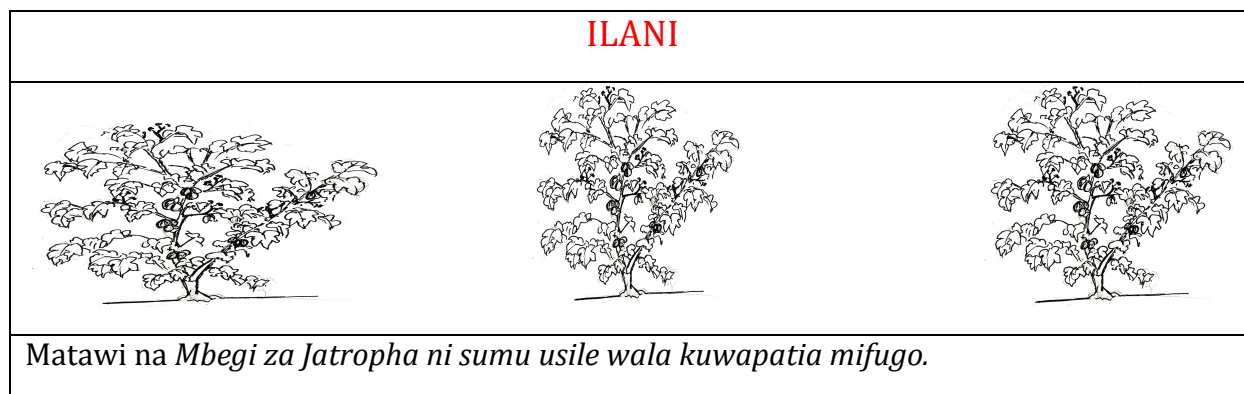
- Filtered raw *Jatropha curcas* oil can be used in an adapted 'akiba' lamp or stoves.

Figure 7: An adapted 'Akiba' lamp burning raw *Jatropha curcas* oil beside briquettes used for cooking.



Figure 8: Kakuta stove burning on raw *Jatropha* oil and a 'Binga' oil lamp

Remember *Jatropha curcas* is poisonous and should not be consumed by humans or animals.



16. Bibliography and further reading

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Peer Ab van (2010) Growing *Jatropha*; including propagation methods for *Jatropha Curcas* and production and use of *Jatropha* products. Available at www.jatropha.pro

DEGSJP Final report (www.degjsp.com)

Photos and illustrations

All illustrations by Seth Nyambere, Pipal Limited.

Figures 1 & 2 by Ton Rulken last downloaded on July 9th from

<http://www.flickr.com/photos/47108884@N07/4539647181/in/photostream/>

Figure 3: was developed by Meshak Nyambere of World Agroforestry Centre for Pipal Ltd.

Figure 5: The yellow seed crusher comes from TNAU Coimbatore.

Figure 8: The photograph of the Kakuta stove comes from the book 'Engaging Women in Small-Scale Production for Biofuels for Rural Energy' by Karlsson Gail. The photograph of the Binga oil lamp comes from the FACT Foundation (2010). *Jatropha* handbook 'From cultivation to application' (developed in Binge Tree Project Zimbabwe).

Special thanks go to Fritjof Boerstler, the GEF/ UNDP small grants project in Kaya Kuhaka for allowing photographs of the small hydraulic piston press and 'akiba' lamps in Figures 6 and 7. Also to Mike Lu of APPBM for the layout of the 'cartesian' boundary hedges with rotating intercropping inside. Acknowledgement and thanks go to all the principle partners of the DEGJSP and the input for the text from all the agronomists and researchers.