Fuel, fertilizer and family income:

Steps towards a new approach to conservation and development

Progress report from Shirika la Uendelezaji Teknolojia, Sutek

on development ofJatropha-fueled lamps and stoves under funding from Worldwide Fund for Nature, WWF, Arusha, Tanzania, 16 March 1998

Summary

SUTEK is a registered Tanzanian non-profit company dedicated to the development and dissemination of technologies that improve productivity and raise income, especially for rural households. In May 1997 Sutek secured a small but very significant grant from WWF Tanzania, the first external funding towards development of a lamp and cookstove based on a source of fuel that is locally available, relatively cheap and totally renewable: oil from the common hedgerow shrub *Jatropha curcas*.

Work actually began in 1996 by an informal group of development workers concerned with the rapidly deterioration caused by deforestation, and its impact on wildlife habitat, biodiversity, water catchments and other aspects of the environment. They decided to explore whether an alternative fuel source might help alleviate pressures on woody biomass resources. Investigations centered on Jatropha oil because of its clean burning quality, the potential to use its seedcake as an organic fertilizer, and the potential of *Jatropha curcas* in land reclamation.

The vision is decentralized production of home-grown liquid fuel that provides domestic energy for lighting and cooking, a fuel of diesel engines, organic fertilizer as a by-product, and income for rural households. The first steps towards this vision are the development of efficient, affordable prototype models of a lamp and cookstove fueled by Jatropha, and investigation of this plant, i.e., where is it widely grown in Tanzania, and experiences in other counties using plant oils for domestic energy. It was decided to postpone an equally vital investigation of socio-economic issues until working models of the lamp and cookstove were available to demonstrate to potential users, especially women in rural households.

To a large extebt the objectives of this initial grant were achieved. A functioning lamp and stove now exist, and some useful data has been gathered. The prototype lamp works well and is ready for field testing. The cookstove prototype can serve to demonstrate the potential for this kind of fuel, but further development and testing are required to overcome certain design challenges.

This report discusses the project's accomplishments, findings and next steps. Those of us involved are pleased by progress made to date. Yet we are also impatient to move this important work forward at an accelerated pace. This will require additional funding.

Jatropha is not a panacea for the enormous environmental and food security problems facing Tanzania and other counties. However, it does appear to be a complementary alternative in renewable energy, organic agriculture and rural income generation.

SUTEK and the Jatropha working group are grateful for the financial assistance provided by WWF and for the intellectual and moral encouragement proved by many others. By wide circulation of this preliminary report, we continue our commitment to networking. Advice and commentary from all interested parties is most welcomed:

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Background

This project is at the intersection of several key challenges and opportunities:

- Energy: Over 90% of Tanzania's domestic energy comes from firewood and charcoal, directly contributing to the country's alarming rate of deforestation [1)]. Most Tanzanians live without electric lighting and few can afford kerosene for lanterns; darkness limits evening activities like homework for students or adult education classes, and makes rural living less attractive than the 'city lights' of urban centers.
- Soil fertility: Tanzanian farmers' application of chemical inputs is extremely rare and supplies of manure and other organic fertilizers are woefully inadequate. Years of continuous cropping without replacing soil nutrients has led to soil depletion and a general decline in agricultural productivity, especially as population pressures shorten fallow cycles and push farmers onto more marginal lands.
- Renewable resource: Like many other tropical countries, the euphorbia *Jatropha curcas* is widely distributed in Tanzania as a hedgerow or marker plant. It is known as *mbono* or *mbono kaburi* in Kiswahili. The seeds of this plant contain a bright, hot burning oil that has been used for centuries in central America and elsewhere in floating wick lamps. The Tanzania Jatropha group believes that Jatropha oil can be developed as a cooking fuel for household energy, thus reducing reliance on rapidly dwindling forest resources. Pressing Jatropha seeds yields a by-product of seedcake -- a rich organic fertilizer, comparable in mineral content to chicken manure.
- Technological development: The 1985 invention and subsequent improvement of the manual ram press in Tanzania means that efficient, affordable processing of oilseeds now brings quality cooking oil and income to rural households. Over 2,500 ram presses have been manufactured in Tanzania and perhaps 10,000 across Africa, which are mainly used for edible oils like sunflower and sesame. Since press owners typically use their presses only for a few months each year at harvest time when annual oilseeds are available, processing Jatropha or other plant oils will increase the utility and profitability of this equipment. [On a different technical level, Jatropha oil has proven to be an efficient fuel for diesel engines, and recently powered a regular car that was modified by Jatropha advocate and ram press inventor Carl Bielenberg.]

In 1996 a group of development workers based in Arusha decided to explore the possibilities of Jatropha [2)]. Using their own resources they began to investigate the needs in Tanzania, while also searching for practical lessons from further afield.

They learned that Jatropha is used in countries from Mexico to Nepal for a great many purposes, from erosion control and live fencing, to soap making and medicinal applications. They also found numerous recommendations for development of oil from *Jatropha curcas*, as in this World Bank study:

> "Curcas oil has shown promise as a source of energy. Seed harvesting, oil extraction and processing can be accomplished in a decentralized, rural environment providing opportunities for business cooperatives and small businesses. Production of a renewable

> energy source on a local-scale can lead to self-sufficiency or a decrease in dependency on fuelwood gathering (particularly benefitting women) which is often a cause of environmental degradation in many areas (as well as a time consuming task)." **3)**

More findings on Jatropha's potential are in Annex A. **Although some two billion people rely on traditional fuels**, **our searches have yet to uncovered evidence that anyone has successfully used Jatropha or other plant oils to mitigate domestic energy demands that threaten environments.** In fact, when colleagues in other countries were contacted, their typical response was to urge the Tanzania group to develop this potential and then share findings. Still, the search continues.

In early 1997, under the umbrella of the SUTEK, the Jatropha group requested a modest grant of US$4,868 from the Tanzania office of Worldwide Fund for Nature, WWF. The grant was meant to help secure a supply of Jatropha seeds, test their use in the ram press, and take the first steps towards developing local models of a Jatropha-fueled lamp and cookstove.

WWF was able to make a grant under this request, but due to funding constraints it was only for about 75% of the requested amount, i.e., $3,667. Nonetheless, the budget was adjusted to fit the situation, and this start-up funding allowed the work to go ahead much faster.

Accomplishments

The objectives of the WWF grant were have been reached in large part. It took several months longer than anticipated, and was less complete than optomistic projections, but certainly represents real progress. Technical and logistical obstacles were overcome, and a functioning lamp and stove were developed. Here is a summary of the project's technical findings. (See Annex B for Erwin Protzen's complete report.)

The transportation line item was eliminated when the budget request was reduced, so seeds were collected on an opportunistic basis, i.e., while pursuing other activities in rural areas. The resulting delay in seed procurement threw off the timing of planned lamp and stove development, with the interesting result that researchers opted to experiment with other plant oils in addition to Jatropha oil. These tests were mainly done with the prototype lamp which is now ready for field testing. Unfortunately, the lack of transport meant little progress was made in studying Jatropha distribution in Tanzania or in learning about other aspects such as seed maturity in different zones or seed yields per plant or per land unit.

Successful modification of simple kerosene lamps did not carry over directly to the cookstove development. Two lines of stove development were undertaken, an oil-and-water stove and modifications of existing models of kerosene cookstoves. While the oil-and-water model did function adequately with Jatropha oil, its size and relative complexity make it applicable only for large kitchens like schools or restaurants.

The work on modification of existing kerosene cookstoves did produce a working model that demonstrates the principle of Jatropha as a household cooking fuel. At the same time, several problems indicate the need for further research. These concern the limited wicking capacity of this somewhat viscous oil and the tendency of standard textile wicks to 'coke up' with carbon deposits after several hours, reducing heat production.

Promising directions for renewed research include: finding ways of increasing air supply, testing new options for wick materials, burning whole seeds either crushed or as pre-burned 'charcoal', and perhaps a different approach altogether, such as a low-tech pressure stove, among other ideas.

Concurrent with these partially funded activities, the Jatropha group continued a number of related efforts using their own resources during this past year. These can be summarized briefly as follows:

* The Jatropha concepts were presented to various development professionals and Tanzanian government officials, engendering considerable interest including the express support of Prof. Iddi, Director of Forestry and Beekeeping.

* Harald Peeters, an Belgian agricultural engineer with ACT/Incofin in Mto wa Mbu was encouraged to plant a long hedge of Jatropha cuttings in May 1997 which began producing seeds by the following November. Mr. Peeters recently introduced the project's prototype Jatropha-fueled lamp to a local women's group whose members are now gathering seeds from the abundant hedges surrounding that area's irrigation fields to begin modest oil production for use in these new models of lamps.

* A network of interested parties in a dozen countries has slowly been gathered by the Tanzania Jatropha group, including foresters, agroforesters, seed specialists, oilseed processors, renewable energy experts, appropriate technologists, and researchers in various fields.

* Sharing Tanzania proposals for Jatropha use with colleagues working on oilseed processing in Zambia appears to have contributed to their securing funds to allow Zambian farmers to begin exploiting Jatropha more fully.

* A visit to Mali in January 1998 produced information about activities there that focus on use of Jatropha oil as a 'biodiesel' petroleum substitute in stationary engines like grinding mills, and the reported planting of 2,000 km of Jatropha hedges to protect fields from animals.

* An international symposium on Jatropha was held in Nicaragua in 1997. The papers presented at this event dealt with sophisticated processing and use of the oil, and not with direct application for domestic energy purposes.

* On-going literature and internet searches continue to yield interesting connections and to widen the network. For example, pursuit of references in a 1985 stoves manual regarding work on liquid fuels resulted in a forthcoming collaboration with the Renewable Energy Development Institute in Geneva to test Jatropha oil in some experimental, inexpensive pressurized burners.

Observations

Progress on the lamp is very exciting. Some people, including colleagues working in southern Sudan and Uganda, have suggested that **the lamp alone is reason enough to begin promotion of Jatropha in the vast areas of Africa that are in the dark 10-14 hours a day**, because kerosene is not dependably available or is not affordable by most rural households.

The stove development, testing and refinement is more complex and will take more time than the lamp. It is likely that several models will be developed for different situations, and that different plant oil fuels may prove preferable in various locations **4)**. It is crucial that all stoves be designed to work within the existing cultural and cooking patterns of women who prepare food, but also bear the burden of fuel procurement.

The energy crisis is intricate, with great variations in impact and intensity within a country. Household energy systems often involve a number of fuels and strategies for their procurement and use. These strategies certainly have changed in recent years as dead firewood becomes more and more scarce, and scavenging or even buying of firewood takes more and more of women's resources. The lingering belief that firewood is a 'free' good, despite ever increasing burdens on women to procure it, has historically hampered efforts to promote planting of fuelwood tree species or the use of 'improved' woodstoves in rural areas. In many cases the solution to a problem that seemed obvious to outsiders' analysis does not match the short-term, survival-oriented priorities of rural households [5)].

In order for Jatropha or any promoted species to take hold rapidly, it needs to fit into and enhance the existing production system: agriculture, agroforestry, agropastoralism or some other combination of land uses. As a multi-use species, Jatropha's attraction to producers lies in its combined contribute to crop protection, soil fertility, domestic lighting, cooking fuel and household income through sale of excess oil. For people living without access to 'free' firewood, Jatropha might offer other advantages, such as cheaper, cleaner and safer cooking and lighting. Site-specific, participatory research would increase understanding of the energy needs of specific populations.

It would be wise to consider the needs of Tanzania's burgeoning urban and peri-urban populations for whom domestic energy is a purchased commodity. Energy marketing channels are already very well established and are potentially amenable to new fuels. For example, one Arusha charcoal retailer readily agreed to handle sale of Jatropha oil if it was priced competitively with other cooking fuels and if there was a market for it.

Jatropha's ability to grow in arid and semi-arid conditions gives it a possible role in rehabilitation of degraded lands. It is often in these marginal areas with few economic opportunities that people turn to charcoal production, thus further exacerbating environmental deterioration. As awareness of the long term costs of these practices increases (and as authorities take steps to limit unrestricted or licensed tree felling) these people could shift from destructive and inefficient energy production using woody biomass, to truly renewable and sustainable energy production using Jatropha plantings that simultaneously revive barren lands.

To date the work of the Jatropha group has been undertaken on a piecemeal basis, fitted around other commitments. It has depended on voluntary contributions of time and material, with the valuable exception of the first WWF grant. **Clearly it would be much more effective to generate core financial resources to move forward in a coordinated, accelerated and thoroughly professional manner.**

Next steps

Near term work over the next six months needs to continue and intensify on several fronts. Field testing of the lamp and initial steps towards regular Jatropha seed collection and processing, such as ACT is attempting in Mtu wa Mbu, is essential. Likewise, tackling the stove design issues of enhanced air intake, better wicking performance, and exploring other approaches should not be delayed. The networking and literature/internet efforts, although sporadic and unsystematic to date, have produced important results. They must be expanded and become more methodical.

An important step that has not yet been undertaken for lack of financial resources is to conduct field studies to examine key economic, cultural, marketing and institutional issues in preparation for a pilot project. Some of these issues are outlined in Annex C. This feasibility/design exercise will involve an inter-disciplinary team. One responsibility of this exercise will be the recommendation of possible sites for a pilot activity, using such criteria as: perceived local needs, current plantings of Jatropha (or other plant oil species), on-site collaborating agencies and donor interest.

If these near term pre-project tasks can be completed in a timely fashion, it will be possible by the second half of 1998 to present a detailed proposal for the first phase of concentrated development and field testing of technologies, training local artisans in lamp and stove manufacture, agricultural extension, and practical research of Jatropha through a demonstration program in an environmentally threatened area.

Cost implications still have to be worked out in detail but indicative figures can be given for the near-term tasks. Stove design and testing to address the issues noted above can be accomplished for as little as US$14,000, given the existing base of experience in Arusha. At a cost about US$28,000 the feasibility/design exercise (US$24,000) and networking/internet research (US$4,000) will involve both national and international expertise. Thus, SUTEK is now looking for total funding in the range of US$42,000 to carry forward this exciting work.

ANNEX A

Information on Africa's fuelwood crisis and uses of Jatropha oil

Excerpts from documents dealing with Africa's fuelwood crisis and the potential of alternative fuels, especially Jatropha oil.

On environmental degradation: "Rapid population growth without corresponding improvements in agricultural technology, has increased pressure on the limited arable lands of Africa. ... Populations growth also generates more need for fuelwood, building materials and other products traditionally extracted for the natural vegetation. The result has been growing deforestation, increased wind and water erosion and declining productivity of agricultural lands, in what appears to be an ever-widening spiral of environmental degradation." "Agroforestry in Sub-saharan Africa: A Farmer's Perspective", Cynthia C. Cook and Mikael Grut; World Bank Technical Paper no. 112, 1989.

On limits to fuel from tree planting: "Africa's needs for wood cannot be met from her remaining forest resources. Most of the demand for wood comes from people living in agricultural areas. A large part of the urban wood demand is also for fuelwood and charcoal rather than timber and pulpwood ... **Agroforestry cannot be expected to solve the fuelwood crisis in Africa; other solutions must be actively sought to meed domestic energy needs**." [Emphasis added] Ibid.

On growing Jatropha: " Jatropha Curcas is adapted to a wide range of climates and soils. It can grow in almost any type of soil whether gravelly, sandy, of saline and thrives even in the poorest soils and rock crevices. Climatically Jatropha prefers the warmer regions of tropics and sub-tropics, although it does well in slightly cool conditions and can withstand a light frost. Its water requirements are extremely low and withstands long periods of drought by shedding most of its leaves to reduce transpiration losses. ... Because of the hardy nature of the species and the fact that is can be propagated easily by branch cuttings or direct seed sowing, it makes an ideal choice for the ecological and economic rehabilitation of wastelands in the tropical and sub-tropical regions of the world. "Jatropha Curcas", Indian Council of Forestry Research and Education; undated booklet, no author indicated

On Jatropha as a fuel source: "Jatropha can be profitably grown as a perennial non-edible oil crop. ... Jatropha oil is an environmentally safe, cost effective, renewable source of non-conventional energy. It may be used as an alternative to diesel, kerosene, coal, L.P.G. and fuelwood to meet the energy needs of daily household chores and agriculture and village small industries. ... **The economic exploitation of its oil yet remains to be investigated systematically. Progressive research for development of a suitable technology for its use as a fuel [remains to be done]** ...". [Emphasis added] Ibid.

On jatropha seedcake uses: "Jatropha oil cake can, hopefully, replace chemical fertilizers if made available in the requisite quantity. Jatropha oil-cake as an organic fertilizer is superior to cow-dung manure and is in great demand by agriculturists. Also it does not compete with food crops for land area. On the contrary, the rich organic manure obtained from Jatropha enriches soils for increased food production." Ibid.

On Jatropha oil in energy strategy: "Vegetable oils from previously agriculturally unsuitable, marginal soil can become fuel. ... The fact the JCL [Jatropha Curcas L.] adapts to ecologically deprived areas means that it can easily be integrated into reforestation and ecologically sustainable programmes. From this environmental development a fuel strategy can be derived." "Members' Handbook", Zimbabwe Jatropha Curcas Producers' Association; undated, author unknown

Vegetable oils as fuel and Jatropha's role: "The world is approaching an era where energy is increasingly important. Unfortunately, few developing countries have been able to adjust their energy consumption and production in time. This inability to adapt is responsible for the stagnation of certain forms of development, notably that of agriculture. ... The search for new and renewable energy sources becomes more and more urgent. Using vegetable oils as fuel substitutes is an interesting departure, in particular if this consists in non-food oil crops. Jatropha curcas is one of them. ... Research has been done on this plant for over 40 years, in particular during the last world war. It was abandoned because the international situation has evolved. Perhaps the moment has come to establish a small research programme for this plant." "Curcas oil (Jatropha curcas L.): A possible fuel", G. Martin and A. Mayeux; Agritrop, vol. 9 no. 2,1985

Need to invest in Jatropha: " There is a need for additional scientific research and financial inputs into the establishment of economically and technically feasible and safe extraction and processing systems for decentralized use in rural areas. Not only to improvements in use as diesel fuel substitute warrant additional attention, but **further investigation into other fuel uses is required such as for cookstoves, lighting and heating**..The possibilities for jatropha to serve as a fuel oil [are] virtually unexploited at this time." [emphasis added] "Jatropha curcas: A Multipurpose Species for Problematic Sites", by Norman Jones and Joan H. Miller; The World Bank, Asia Technical Development Department, 1991

ANNEX C

Areas of investigation in the feasibility/design study fall into several broad categories, all of which are aimed at gathering core data for large-scale promotion.

It is anticipated that several methodologies will be used to generate a detailed picture of the potentials and likely approaches for promoting Jatropha as a fuel, fertilizer, and income generator.

1) **Economic issues**. Although fuelwood is not yet widely marketed for use in rural areas, what is the perceived value (opportunity costs) of women's time and labor in obtaining fuel for cooking? How does that compare to the estimated value in time, labor and investment to use Jatropha oil in cooking instead of fuelwood? What level of benefits would make switching to this new fuel source worthwhile to rural households? What are the economic parameters of the rapidly expanding urban markets that now uses wood, charcoal, kerosene, electricity or a mixture of fuels for domestic energy?

2) **Cultural and gender issues**. What social or cultural obstacles are there to using Jatropha-fueled cookstoves in place of metal stoves or other cooking arrangements? What are perceived advantages and disadvantages to a locally-produced liquid fuel and the technology to use it? In what ways can public (e.g., environmental) benefits and social benefits (e.g., reduction of women's onerous work loads) be valued in decisions of whether and how to foster the use of renewable alternative fuels?

3) **Marketing issues.** What is the potential market for Jatropha oil and liquid fuel stoves, in rural and urban areas? What are the options for introducing this technology? How might local distribution networks for farm and household tools, or current domestic fuels like charcoal and kerosene, be tapped for this new fuel and cookstove? How can rurally produced oil be distributed in urban and peri-urban markets, or in the particular situation of refugee camps? How might export marketing be carried out?

4) **Technical issues.** Computerized databases and informal networks in agroforestry and renewable energy will be used to explore plant oils for alternative energy. A rudimentary prototype cookstove has been developed for demonstration purposes and to prove the principle, but it needs improvement. What is the state-of-the art in other countries? Who are the major players and what research is underway? What research has been done on low-cost cookstoves for plant oils? How can these research findings be adapted and applied in east Africa? What other oil-producing species, e.g., *Moringa oleifera*, might be promoted in areas where Jatropha is not common, and what is known of their properties and requirements?

5) **Institutional and policy issues**. How will governments' policies impact on development of Jatropha as an alternative cooking fuel? What public, private sector and non-profit agencies are involved in forest resource management, wildlife conservation, renewable energy, or rural enterprise development, and thus might be useful in development of this project? What are the most powerful institutional arrangements for promotion of plant oils as a fuel source in cooking?

In order to answer these and other related questions the team will develop interview tools for use with various populations. Participatory Rural Appraisal (PRA) techniques will help examine perspectives, constraints and attitudes of rural resource users. Other interview and research techniques will be used with project personnel, business people, government officials and donor agencies, among others stakeholders.

Footnotes:

1. Particularly severe tree losses are noted in high population density areas (urban and rural) and arid/semi-arid zones, and through encroachment into forest reserves and other gazetted areas. Two examples are the devastating charcoal production in wildlife disbursal areas of Simajiro district near Taranguire National Park, and the elimination of trees around Mtu wa Mbu and along vital wildlife corridors of Lake Manyara National Park and disbursal areas to the north. Tanzania is one of Africa's most biodiverse countries in terms of mammals, birds, butterflies and plants. This rich biodiversity and Tanzania's high number of endemic species give global urgency to maintaining its unique environments. The accelerating loss of trees also has a profound impact on the forests' ability to play their key role in the hydrological and nutrient cycle, with additional watershed implications for mountainous forests. In these areas agricultural encroachment has led to cultivation of steep slopes with virtually no remaining trees, while trees are poached from the dwindling high-canopy forests for fuelwood and other uses.
2. The core members of this informal group in Tanzania are: Jonathan Otto who launched the concept and does networking, Erwin Protzen who leads technical developments, and SUTEK Managing Director Dallas Granima who provides project supervision. Many others in Tanzania and elsewhere have contributed ideas.
3. "Jatropha Curcas: A Multipurpose Species for Problematic Sites", by Norman Jones and Joan H. Miller; The World Bank, Asia Technical Development Department, 1991.
4. One example is the oil-rich seeds of the *Alanblackia stuhlmanii* tree which grows in the highland forests of the Udzungwa and other eastern arc mountains. Establishing renewable non-timber uses for forest trees contributes to their conservation.
5. These contentious issues are treated at length in the literature on policy and strategy in the forestry, energy and environmental sectors. One good example is "The Fuelwood Trap: A study of the SADCC Region" by B Munslow with Y. Katerere, A. Ferf and P. O'Keefe, Earthscan, London, 1988.

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On the Development of a Prototype Jatropha-Oil fueled Jiko and a Jatropha-Oil fueled Lamp

by Erwin Protzen, November 1997

e-mail to the author

Introduction

Development work took off in mid-May 1997. The guiding idea throughout has been that any designs for Jatropha jikos and lamps should, to simplify the exercise, at least start from existing standard designs for spent engine oil and kerosene.

A functioning prototype jiko and two functioning prototype lamps have been developed. The work has not been as easy as was originally anticipated. The lamps can be sent to the field for testing, but some development work in connection with wicks and air supply still needs to be conducted in the case of the jiko.

Unfortunately Jatropha oil has not been as available for development activities as would have been hoped. All that was available, were four litres of Jatropha oil and most trials were done with substitutes that perform similarly.

Vegetable Oils as Fuels for Jikos and Lamps

Some simple basic research has been conducted on burning vegetable oils using standard textile wicks. This research has been done on one hand, to find a substitute for Jatropha oil that would allow work to continue despite its scarcity, and on the other to get an understanding of vegetable oils as fuel. The cheap standard jikos and lamps, available in Tanzanian shops, all have wicks.

Experiments were done with oils from the following plants in addition to Jatropha:

- Sunflower
- Safflower
- Sesame
- Macademia
- Mexican Poppy
- Wild Borage

The findings can be summarized as follows:

- Vegetable oil is hardly transported by a wick alone. When lit, the flame needs to be very close to the oil. The shallow oil lamps of the ancient Greeks and Etrurians respected this principle.

- By placing a wick into a loosely fitting tube, transport properties are improved considerably. Standard round and flat wicks (∅ ¼", flat ½") placed in a loosely fitting tube will comfortably transport oil 4cm upwards to allow for a satisfactory adjustable flame at the top. At 6cm, transport is insufficient, to an extent that a flame cannot be sustained.
- Because of the bad transport properties of a standard textile wick, it needs, when new, to be soaked in oil for at least half an hour prior to being lit up.
- In use with vegetable oils, wicks coke up quite quickly. They form coke in the burning zone which prevents satisfactory combustion. The time taken for a wick in a tube to coke up depends on the fuel (for a ∅ ¼" wick: sunflower oil: 2 hours, wild borage , sesame, safflower and jatropha oil: 4 hours, macademia oil: 6 hours) .
- It takes longer for a wick to coke up if the tube into which it is placed is wrapped with overlapping edges (wild borage, sesame, safflower and jatropha oil: 6 hours). Possibly oil transported by capillary force in the gap between the overlapping edges prolongs the life of the portion of wick in the burning zone.
- Performance improves the thicker the wick is (a tubed ∅ ¼" wick in sunflower oil cokes up in 2 hours, whereas a ∅ ½" wick cokes up in 4 hours).
- The removal of coke is not difficult, it is simply knocked off the top of wick (even while it is still burning).
- The brightness of a flame on a given wick and a given setting is about the same for vegetable oil and kerosene.
- The fuel consumption for a given wick and a given setting is about the same for vegetable oil and kerosene.
- An open vegetable oil flame does not put up to wind as well as an open kerosene flame.
- A good vegetable oil for a jiko is not necessarily a good oil for a lamp.

Experiments have been conducted primarily with a very simple lamp. A ∅ ¼" copper tube is cut to the length of a small glass and a ∅ ¼" wick is fed into it.

The tube with the wick in it is placed into the glass which is filled with oil. Incidentally this lamp is simpler than the kerosene "kibatari". Since vegetable oil does not readily ignite, the reservoir (glass) does not need a cover. The tube with the wick simply stands in an open container with oil.

Originally it was thought that all findings made with the lamp can be transferred automatically to the jiko. This is not absolutely the case, so oils have had to be tried again in the "Butterfly" jiko once it had been modified for use with vegetable oil rather than kerosene.

Oil	Performance in Jiko	Performance in Lamp
	(Modified Butterfly)	**(∅ ¼"copper tube with ∅ ¼" wick dipped in oil)**
Jatropha	**Burns 2 hrs, smokeless**	**Burns 4 hrs**
Wild Borage	**Burns 2 hrs, smokeless**	**Burns 4 hrs**
Mexican Poppy	**?**	**Burns 2 hrs**

Sunflower	**Burns ¾hrs, smoke**	**Burns 2 hrs**
Safflower	**Burns 2 hrs, smoke**	**Burns 4 hrs**
Sesame	**Burns 2 hrs, smoke**	**Burns 4 hrs**
Macademia	**?**	**Burns 6 hrs**

The Development of a Prototype Vegetable Oil Fueled Jiko

There are a number of directions that might be taken in the development of a simple and cheap Jatropha-fueled jiko. As far as the conditions of the current assignment have permitted, two such directions have been looked at in some detail:

1. the oil-and-water principle, and
2. the modification of existing cheap Chinese kerosene stoves of the adjustable wick type ("Wheel’’ brand models 57, 656, 641, 643, 62 and 657) or of the adjustable fuel flow type ("Wheel" brand model 12, "Butterfly" brand).

The Oil-and-Water Principle

The principle made use of here, is that if water is added to oil with a temperature higher than that of the boiling temperature of the water, the water will evaporate instantly and disperse oil in the form of fine droplets which will burn easily if ignited.

In a jiko that makes use of this principle, oil and water are dribbled onto a cascade of hot steel plates in its combustion chamber. The water evaporates instantly and in so doing disperses a mist of oil that readily burns in air that is drawn into the chamber by a chimney.

An informal artisan in Arusha manufactures quite large jikos of this type for cooking and baking with spent engine oil. A smaller prototype copy as seen on next pages has been made for use with vegetable oils.

How to Fire the Prototype Oil-and-Water Jiko forVegetable Oils

When the jiko is fired for the first time, the two tanks at each side are filled with water and oil respectively. The door at the front of the combustion chamber is opened, the bench forming a simple cascade is withdrawn, and some ashes are strewn onto the bottom of the chamber. A little kerosene is poured onto the ashes, the bench is replaced, and fire is set to the kerosene. When after about thirty seconds to a minute the bench is hot, the oil and water valves are set to allow a very fine stream of oil and about thirty to sixty drops of water to enter the chamber through the funnel onto the upper plate of the bench. The oil will start to burn with a sizzling noise and after a while the door can be partially closed. Cooking takes place on the hot plate covering the opening on top of the jiko.

To extinguish the the fire, water and oil are simply turned off.

For any subsequent firings, the level of oil and water in the tanks is checked and kerosene is poured onto the ashes which are already in place at the bottom of the combustion chamber.

Modification of a Chinese Adjustable Wick Wheel Brand Stove Model 641

The Wheel Brand Stove Model 641 is very easily available in all places in Tanzania in which kerosene is available. The modification of this stove has consisted of lowering the wick adjustment mechanism into the oil reservoir so that the combustion zone is just above the oil level when the tank is full.

After the modification, the chimney which sits on the wick mechanism, obviously also comes down. The bottom edge of the chimney actually fits into the tank and is just above the oil. For any sensible results the outer mantle of the chimney has to be removed from the inner perforated core and raised to allow air to circulate freely. In actual fact the outer mantle was raised by 35mm with wooden blocks, sowith bringing it back to its original position under the cooking ring.

Modification of a Chinese Adjustable Fuel Butterfly Brand Stove Model 2413

The Butterfly Brand stoves are difficult to get in Tanzania but they are popular in Kenya. The modification has been very simple.

The flat wick of this stove, which is made from some metallic material interwoven with asbestos, lies in a groove that contains fuel, the level of which is maintained by an inverted bottle. This level has been raised by 8mm with leather spacers placed between the bottle and its holder.

To adapt the air supply to the requirement of Jatropha, openings have on one hand been cut into the bottom of the chimney core, and on the other, the whole chimney has been lifted by 3.5mm from its seat with metal strips.

How to Fire the Modified Adjustable Fuel Butterfly Brand Stove

The standard special wick for this type of stove is designed for longevity with kerosene as a fuel. Evidently it cokes up and becomes useless very quickly with vegetable oils. For the purpose of experimentation, cheap disposable 5/8" flat textile wicks have been used. They were cut to pieces of 30mm length for placing upright into the fuel groove.

When the jiko is fired up for the first time, the fuel bottle is filled and placed up-side-down into its retainer and onto the leather spacers. The three metal strips for lifting the chimney are pressed onto the outer lip of the chimney holder, the fuel valve is opened fully, twelve wicks are stood upright in the fuel groove (four to a partition between strips), and when they have properly absorbed fuel they are lit. After about a minute, the wicks are burning properly and the chimney can be placed over them. After a further few minutes, a blueish yellow flame emerges at the top of the chimney.

Producing very little smoke, the flame will burn for about two hours. It is possible to bring a litre of water to the boil in 15 minutes. After that, it will start to diminish, the wicks have coked up. At this point the fuel valve is turned off.

Prior to a subsequent firing, the jiko needs to be cleaned up. The chimney is removed and its bottom edges are cleaned up by scraping. The burnt out wicks are removed and thrown away. Coke and tar are removed from spacer strips and the fuel groove.

Comments on the Performance of the Various Prototype Jikos for Vegetable Oils

As a prototype each one of the jikos made or modified has its advantages and disadvantages. Lessons have been learnt with each one.

Experiments were conducted with a number of oils, whereby Jatropha and Wild Borage have proved to be superior to others.

The oil-and-water jiko is very simple, but it produces quite a lot of smoke that needs to be drawn off by a stack. It might be difficult to miniturize this type of jiko and therefore, if considered for further development it would be developed for larger kitchens as is already the case with the jikos fueled by spent engine oil.

The modified adjustable wick jiko can be adjusted to burn free of smoke, but wicks coke up the same as they do with the adjustable fuel jiko. It does not develop enough heat for any sensible cooking.

For the time being, the modified adjustable fuel jiko is the most exciting to demonstrate that it is possible to use vegetable oils such as Jatropha oil as a cooking fuel, despite the coking up of wicks after about two hours and some little smoke production.

The Development of Vegetable Oil Fueled Lamps

Development work has led to two lamps, both of which work quite satisfactorily.

1. The "kibatari" type lamp, similar to the "kibatari" for kerosene which is used widely in Tanzania by all who cannot afford to buy a proper lamp.
2. A modified Chinese kerosene lamp of the type as available in village and town shops all over Tanzania.

The Kibatari Type Lamp

A simple tool has been made for wrapping sheet metal from old tins to form tubes that will accommodate standard ½" flat textile wicks. After wrapping, these tubes are kept from springing open with some wire which also serves as a hanger for the tube in the oil container.

A lamp made in this fashion can be used as is or with a standard lamp glass placed over it to protect the flame from wind.

The Modification of a Chinese "Moon Light" Brand Kerosene Lamp

Important for any modifications are the findings on vegetable oils as fuel presented at the beginning of this report. For for a lamp, this means specifically:

1. The oil must be brought as close to the burning zone of the wick as possible, and the wick needs to be contained in a tube.

The wick advance mechanism is taken apart.

The inner actual advance is turned round

Remove 10mm from the bottom of the outer shell and likewise from the perforated (new) bottom of the advance mechanism, leaving three stays.

Bend the stays outward and reassemble the mechanism. Solder the stays to the outer shell.

One is left with a shorter advance mechanism that has a tube sticking out of the bottom.

2. The oil level in the fuel tank must vary as little as possible over time, so the fuel tank should be as broad as possible and as shallow as possible.

Mark the original level of the base of the wick advance mechanism on the uprights of the lamp. Go up 10mm and cut the tank away.

Make a new tank from old tin cans about 1½" high and 6" in diameter, with openings for the wick and the screw cap from the original tank.

The modification of the advance mechanism creates a circular groove at the bottom. Bend a ring from ∅ 2mm wire to fit into this groove and solder it onto the new tank at the opening for the wick. On one hand the ring centres the advance mechanism and on the other it prevents oil from spilling out of the tank when the lamp is being moved around. Also solder the screw cap into the new tank

3. The air requirements for vegetable oils and kerosene are different. Cut away the air quide from the bottom glass holder.

4. Drill an air hole into the screw cap.

Some General Comments on the Performance of Developed Lamps

A wick is drawn into the tube of the "kibatari" type lamp and then it is hung into a contianer of oil and lit up. Especially with a glass over it, the performance of this lamp is very rewarding. Because of the overlapping edges of the sheet metal the lamp burns for about six hours before coking up.

Once all modifications have been undertaken on the "Moon Light" lamp it is assembled quite normally, filled with oil and lit up. This lamp burns for about three hours before coking up. Once this happens the flame gets smaller and the light gets dimmer. In this case, the glass is tilted away, the coke is knocked off with a match stick, the flame is reset and the glass is replaced.

As can be imagined from elaborations at the beginning of this report, both lamps perform satisfactorily with a number of vegetable oils, especially Jatropha, Wild Borage, Safflower, Sesame and Macademia.

Some Concluding Remarks and Recommendations

The work reported on has shown how vegetable oils can be utilised for lighting and cooking purposes.

Whereas the developed lamps can be put to test in the field immediately, some more development needs to take place with the jikos.

The results obtained with the modified adjustable fuel stove are very promising, but the need for a thorough clean-up and to replace wicks after each firing is disturbing. Following topics must be investigated further:

a) Air supply

- The combination of adjustable wick and adjustable fuel
- The size of air holes in the chimney core
- Size of openings at the bottom of the chimney core

b) Wicks

- The combination of adjustable wick and adjustable fuel
- The the introduction of other wicks than textile wicks

As far as the lamps are concerned a poor man’s version and a wealthy man’s version have been developed.

The Chinese stoves are relatively cheap at Tsh 14’000 for the adjustable wick version and Tsh 25’000 for the adjustable fuel version. Nevertheless they are unaffordable for the poor man.Therefore some more investigation needs to take place in the direction of different principles.

c) Different principles

- Burning of the whole Jatropha nut in something like a sawdust stove

This list of topics that need to be looked at further is by all means not exhaustive. If the started work were to be continued, some more thought would need to be put into it.

Attachment 3, Technical Sketches for Oil-and-Water Jiko

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e-mail to one of the authors
Erwin Protzen

back to
plant oil stoves

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Actual research in

Plant Oil Cooking Stoves

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FAKT		• **Vorabklärung für die Entwicklung eines pflanzenöltauglichen Brenners in Mali**
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Sutec, Tanzania		• **Fuel, Fertilizer and Family Income** • **On the Development of a Prototype Jatropha-Oil fueled Jiko and a Jatropha-Oil fueled Lamp**
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		• **Plant Oil as Cooking Fuel: Development of a Household Cooking Stove for Tropical and Subtropical Countries**

<table>
<tr><td>Subtropics</td><td>
last version of the plant oil cooker (2002), now on field test in Guatemala</td><td>Kurze Beschreibung (mit Bildern) des neuen Pflanzenöl-Druckkochers (2002) als .pdf-Datei zum Herunterladen
Short description (with pictures) of the plant oil cooker (2002) as pdf-file for downloading</td></tr>
<tr><td colspan="3">Other links to plant oil burners / cookers:</td></tr>
<tr><td>Babington Oil Burner for WVO (waste vegetable oil)</td><td>Multi Fuel Burner</td><td>Manolo WVO Burner (waste vegetable oil)</td></tr>
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bagani GbR
last modification 12.02.03

PLANT OIL AS COOKING FUEL:

DEVELOPMENT OF A HOUSEHOLD COOKING STOVE FOR TROPICAL AND SUBTROPICAL COUNTRIES

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ABSTRACT

In rural areas of tropical and subtropical countries wood is still the main energy source. Steadily rising wood consumption for cooking purposes results in deforestation of large areas creating severe ecological, economical and sociological problems. In order to protect the environment it is urgently required to substitute the utilization of firewood for cooking purposes. Plant oils are a promising alternative energy source offering a variety of economical and ecological advantages. A variety of oil plants originate in developing countries and their oil can be produced locally even in remote areas. Existing cooking stoves for liquid fuels, however, do not allow utilization of plant oils as fuel.

At Hohenheim University a new pressure cooking stove was developed, which can be operated on different pure plant oils like Jatropha oil or Canola oil. According to the chemical, physical and combustion properties of plant oils, a new vaporizer, a new burner head and a new tank as well as a novel start-up device were designed.

1. INTRODUCTION

Household energy, especially cooking energy, often counts for a big part of the overall energy consumption in many developing countries. In Nepal, for example, over 70 % of the total energy consumed is used for cooking purposes only. In general, wood is still the main energy source in the rural areas of tropical and subtropical countries [1]. Steadily rising firewood consumption for cooking purposes results in deforestation of large areas creating severe ecological problems. In order to protect the environment it is urgently required to utilize alternative methods for cooking purposes. Introduction of fuel-efficient stoves can reduce the firewood consumption significantly [2]. However, decrease in consumption will soon be compensated by the fast growing population.

Electricity is still restricted mainly to urban areas. Use of solar cookers and utilization of biogas are limited because of technical and handling problems [3]. Dissemination of conventional cooking stoves utilizing fossil fuels is restricted due to limited availability of those fuels especially in rural areas. Furthermore, import and subsidization of those fossil fuels burdens the budgets of developing countries.

Utilization of plant oils as cooking fuel presents an interesting alternative to yet known cooking methods and offers a variety of ecological, economic and sociological benefits.

A vast variety of oil plants originate in tropical and subtropical countries. In general, all plant oils liquid at ambient temperatures can be utilized as cooking fuel. Many oil-bearing plants grow on low grade surfaces or in marginal locations, which are unsuiztable for food crops while their oils are often toxic to human beings. Those plants are often cultivated on waste lands in order to prevent further erosion and inhibit desertification. Energetic utilization of their oils will not compete with food production [4], [5]. Exemples of those oil plants are the physic nut tree (Jatropha curcas L.), the castor oil plant varieties (Ricinus communis L.) and the babassú palm (Orbignya phalerata Mart.) [6], [7].

Traditional methods for harvesting the fruits from oil plants and extracting the oil already exist in many regions of tropical and subtropical countries [8]. This local oil production strengthens decentralized structures providing employment and income opportunities for local population and ensures sustainability [9]. A long-term supply of heat energy can be secured. Plant oils are bio-degradable and handling is both simple and free of danger. The burning of plant oils is carbon dioxide neutral since the CO_2 was originally acquired by the plants from the atmosphere through photosynthesis. Utilization of the plant oil stove will relieve women from the suffering due to eye and lung diseases caused by open fires in often poorly ventilated rooms. In addition, collection time and purchase costs of fire wood, respectively, will be reduced considerably. Moreover, the presscake as a by-product of the oil processing can be used either as fodder or as high-quality fertilizer.

2. LIQUID FUEL COOKING STOVES

Kerosene is the most well-known liquid cooking fuel within developing countries today. Its chemical structure consists of hydrocarbon molecules with chain lengths of C_8 or C_{10}. Plant oils are tri-glycerols of fatty acids whose chain lengths range mostly from C_{12} to C_{18}. In general, plants oils are regarded as suitable substitutes for fossil fuels since their gross calorific value per volume is only 5 percent lower than the gross calorific value for kerosene or diesel fuel.

Nevertheless, due to the different chemical structure plant oils have distinct physical and chemical properties and show a different combustion characteristics than kerosene. The flash point, for example, ranges around 180 to 300 °C in comparison with the flash point of kerosene at 80 °C. Moreover, viscosity of plant oils is at least 30 times higher than viscosity of kerosene.

Liquid fuels can be burned in wick and pressure stoves [10]. Generally, production as well as maintenance costs of wick stoves are lower than of pressure stoves. Pressure stoves, however, have higher power outputs and higher efficiencies. In most cases, the power of pressure stoves ranges from 0.8 up to 3.5 kW with an efficiency of 45 – 52 % whereas power output of wick stoves ranges from 0.8 to 2.2 kW with an efficiency of 38 – 47 %. Combustion in pressure stoves is a higher quality combustion producing less emissions. Nevertheless, the emissions of both stove types a very much lower than the hazardous emissions of open wood.

Wick stoves utilize the capillary effect of fluids. However, plant oils cannot be used in common stoves with cotton wicks. Due to their high viscosity, the flow velocity of plant oils in those wicks is very low. Therefore the wicks cannot maintain the oil supply and the flame extinguished consequently. Therefore, investigations on utilization of plant oils as cooking fuel have been focused on combustion in pressure stoves.

In those stoves pressure is induced in a tank through application of a small hand pump. The liquid evaporates in a vaporizer and emits through a nozzle into a burner head where the jet mixes with ambient air. While leaving the burner head through openings the fuel-air-mixture burns in a pre-mixed flame. The power is adjusted with a valve which regulates the fuel flow. The function diagram of a pressure cooking stove is shown in Figure 1.

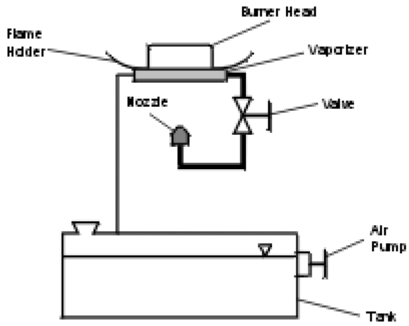

Figure 1: Function diagram of a pressure stove

In earlier investigations by other research groups plant oil was used as fuel in modified kerosene pressure stoves. Those stoves needed an admixture of at least 50 % of kerosene to the plant oil in order to perform satisfactorily [12]. Nevertheless, residues of the fuel mixture clogged the vaporizer and left the cookers unusable after short operation time [13].

3. PROTOTYPE OF THE PLANT OIL STOVE

At the Institute for Agricultural Engineering in the Tropics and Subtropics of Hohenheim University a plant oil pressure stove has been developed which enables continuous operation and repeated ignition with divers pure plant oils. Next to the plant oils, the prototype can also be fueled with plant oil esters, kerosene, diesel fuel as well as gasoline. The prototype is realized as a one-flame cooker and can be produced using simple means and materials which are available in developing countries.

Since handling of the plant oil cooking stove is similar to the known kerosene pressure stoves, it will be easily introduced even in rural areas of developing countries. Regarding power output and efficiency as well as emissions, the plant oil stove is comparable to kerosene stoves. Utilization of plant oils as fuel, however, prevents users from severe operating risks related to the easy inflammation of kerosene.

Research is based on investigation of chemical and physical properties of plant oils at high temperatures which led to a completely new design of the cooking stove. The cooker frame consists of 3 steel tubes with an diameter of 60 mm which are connected among each other. The frame serves as pot support as well as tank. It can get filled through an opening at the upper side of one tube. After filling the tank, the hand-pump is screwed into this opening and a pressure of around 1.2 bar is induced into the tank. Due to this pressure, the fuel flows into the oil line. This oil line has a diameter of 12 mm taking into account the high viscosity of plant oils. The fuel flux is regulated with a valve included within the oil line.

The vaporizer is a stainless steel tube with an inner diameter of 6 mm and is connected to the oil line. Within this tube vaporization of the fuel takes place due to the heat of the cooker flame. Since plant oils have high flash points, retention time of the fuel within the flame is increased considerably in comparison to kerosene stoves. However, during vaporization process, cracking of the plant oil molecules takes place. Hence, recombination products are deposited at the inner wall of the vaporizer and have to be cleaned mechanically. Therefore, the vaporizer can be opened and cleaned with an external brush while the stove is turned off.

The vaporizer is connected to the side of the gas expansion chamber. At the upper side of this chamber the nozzle is screwed in. Therefore, the trajectory of the hot gas flux is changed abruptly within the chamber. Consequently, impurities within the gas flux like small coke particles will be deposited at the bottom part of the gas expansion chamber. The chamber serves moreover as heat accumulator as well as gas buffer in case of uneven evaporation. Within the gas expansion chamber, the nozzle cleaning device is located enabling a cleaning of the nozzle during burning of the stove.

The nozzle has a diameter of 0.4 mm. After leaving the nozzle the stream of vaporized plant oil mixes with ambient air. The fuel-air-mixture is gathered in the gas collection tube of the burner head. The gas collection tube has an inner diameter of 12 mm. Within the burner head complete mixing of the fuel gas with the air as well as spatial distribution takes place. While leaving the openings of the burner head, the fuel-air mixture incinerates and burns.

To ensure a proper flame distribution without lifting off, a flame baffle plate is used which also conducts the flame towards the bottom of the cooking pot.

For incineration of the cooker a new start-up device was designed enabling a low emission incineration with pure plant oils. It is fixed to the stove support right beneath the gas expansion chamber. The start-up device consists of a flame holder as well as a bottom metal sheet with 24 air holes and a ring groove serving as wick holder. The wick is made out of fiber glass mat, since cotton or other organic material would burn itself while being ignited with plant oil.

For starting the cooker plant oil is poured over the wick and incinerated with a match or a lighter. Afterwards, the flame holder is placed above the wick. The plant oil vaporizes on the wick and the fuel gas burns in bluish flame.

The heat of this flame is sufficient for starting the vaporization process within the vaporizer. After the stove has been started, the flames of the start-up device are extinguished.

The prototype is shown in top view in figure 2 and in side view in figure 3 [14].

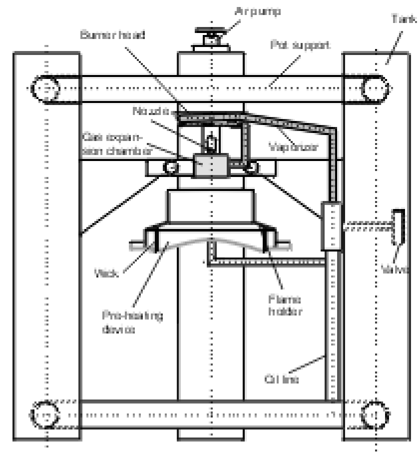

Figure 2: Side view of the plant oil stove prototype

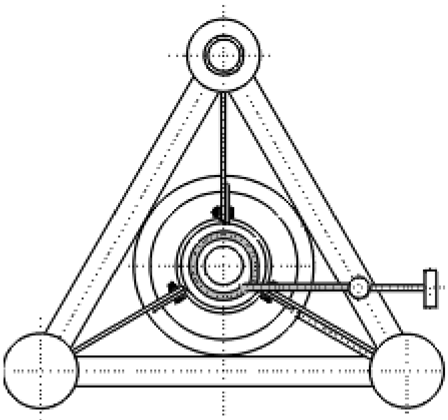

Figure 3: Top view of the plant oil stove prototype

Current research is carried on optimization the vaporization process in order to enhance the homogeneity of vaporization as well as to lower the occurrence of deposits. Moreover the combustion process of vaporized plant oil is investigated closely. Later on, the prototype will be tested within a field test in a developing country.

4. ACKKNOWLEDGEMENT

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bagani GbR

Jatropha curcas

Uit Wikipedia, de vrije encyclopedie

De **Purgeernoot** of **Schijtnoot** (***Jatropha curcas***) is een giftige struik die behoort tot de familie van de wolfsmelkachtigen (*Euphorbiaceae*). De zaden van de plant leveren jatropha-olie, die als biobrandstof gebruikt kan worden.

De struik is gemiddeld 5 m hoog en kan een maximale hoogte van 8 m bereiken. De plant heeft groen tot vaalgroene bladeren. De plant heeft zaden die circa 30% olie bevatten. De zaden zijn rijp op het moment van verkleuren van groen naar geel. De zaden groeien uit tot vruchten, die meestal in de winter rijp zijn. In sommige gebieden zijn meerdere oogsten per jaar mogelijk.

Jatropha curcas is van oorsprong afkomstig uit Midden-Amerika. De plant wordt echter in andere gebieden met een (sub-)tropisch klimaat aangeplant. Dit aanplanten gebeurt in delen van Afrika, India en Midden-Amerika. De plant groeit goed op arme grond, wat het aanplanten in veel gebieden mogelijk maakt.

Jatropha curcas

Taxonomische indeling

Rijk:	*Plantae* (Planten)
Stam:	*Embryophyta* (Landplanten)
Klasse:	*Spermatopsida* (Zaadplanten)
Clade:	Bedektzadigen
Clade:	'nieuwe' Tweezaadlobbigen
Clade:	Fabiden
Orde:	*Malpighiales*
Familie:	*Euphorbiaceae*
Geslacht:	*Jatropha*

soort

Jatropha curcas
L. (1753)

Inhoud

Gebruik

De plant werd in het verleden voor medicinale toepassingen gebruikt. De Nederlandse naam is afgeleid van purgeren, wat een synoniem is van laxeren. Vroeger werd van de plant een laxeermiddel gemaakt maar door de hoge giftigheid wordt dat nu niet meer gedaan.[1]

Sinds enkele jaren wordt de zaden van deze plant gebruikt voor de productie van jatropha-olie, een plantaardige olie. Jatropha-olie kan direct in een motor gebruikt worden of er kan door verestering biodiesel van gemaakt worden. Olie van deze plant is giftig en is niet geschikt voor menselijke consumptie.

In verschillende subtropische landen zijn programma's gestart om de teelt van Jatropha curcas te bevorderen. Voorbeelden hiervan zijn India, Indonesië, Ethiopië en Tanzania. De plant levert na ongeveer 9 maanden zijn eerste zaden. De struik groeit ook op arme en zeer droge grond en hoeft daarmee geen concurrent te zijn van voedselgewassen.


zaden

Externe links en referenties

In het Nederlands

- *Dossier Jatropha*
- *Kansen groeien voor diesel uit jatropha*, Trouw, 9 januari 2007

In andere talen

- **(en)** *Jatropha curcas evaluation, breeding and propagation programme*, onderzoeksprogramma van de Universiteit Wageningen.
- **(en)** ITIS 28335 — *Jatropha curcas*
- **(en)** *Jatropha system*
- **(en)** *Greening the earth, earning the resources for rural masses*
- **(pt)** *Pinhão manso : uma planta de futuro*
- **(fr)** *Jatropha curcas : l'or vert du désert*

Referenties

Referenties:

1. ^ **(de)** *Purgiernuß (Jatropha curcas)*, giftpflanzen.com

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