



AGRICULTURE ECOLOGY ENERGY (AEE)

***A Rural Development Paradigm* for international and national NGOs, Governments, and donors that focus on the sustainable development and redevelopment of rural communities in environmentally challenged nations and regions**

Many issues have to be resolved if the human species is to have a (sustainable) future:

- The hunger and income gap, especially in Africa and Asia
- The destruction of natural and agricultural ecosystems
- The finite supply of mineral oil
- Climate change/sea encroachment/extreme weather events thought by many (most?) to be related to an increase in atmospheric 'green house gases'
- Uncontrolled urbanisation
- Illnesses that could be cured but are not
- Water and sanitation deficiencies, and
- Pollution of the air, land, fresh water and the sea

These constraints to wellbeing are well known, and there are many more location specific issues such as those created by isolation and poor communication facilities.

Most of these are particularly relevant in less developed nations or less developed parts of the more developed world. In the case of climate change, the less developed nations may well be the victims of the industrialised nations – but they are perhaps able to contribute most to the mitigation of the problem, as explained below.



TREE OILS AUSTRALIA

Surprisingly, the solution to many of these problems can be embodied in one process:

Investment into Agro-ecosystems centred on Oil Seed Trees

Oil seed trees provide:

- A viable and fully renewable substitute for fuels derived from mineral oil
- The foundation of stable agro-ecosystems that support food production on marginal or degraded land
- The re-establishment of *functional biodiversity* in natural and agricultural habitats
- Land stabilization in the context of wind and water erosion
- Significant income and credit worthiness for rural communities from the sale of biofuels and the marketing of produce and by-products
- Money to invest into medical facilities, water, education, communication, and other infrastructure for producer communities, and
- An economically sound reason for urbanised rural families to return to their ancestral lands

Greenhouse gases

Oil seed trees are a huge carbon sink. After 8 years, 1 ha of a typical oil tree plantation will have converted >40 MT of carbon into biomass which is equivalent to over 140 MT of carbon dioxide.

The Rationale – with a focus on Africa and South and East Asia, parts of Latin American and the Caribbean: Governments and the private sector know that products made from mineral oil will continue to increase in inflation-adjusted price as the world's oil stocks are depleted. They and their financial supporters are, or will be, willing to invest into the production of renewable fuel sources that will reduce their burden of debt, especially when there are parallel benefits of comparable value from this investment.

The case is for:

A small investment (loan) to cover the start up costs for land preparation, seed purchase and nursery establishment. It may also be necessary to organize the relatively simple infrastructure needed to store run-off water during the rainy season, or to access and pump groundwater, and then to reticulate the comparatively small amounts of water required...

- to initiate small to large agroforestry enterprises, that are...
- based on the establishment of oil tree plantations, and that ...
- support alley cropped rain-fed agriculture that is boosted by the additional water, and ...
- supply the means to create the functional biodiversity that provides fire wood, building materials, fruit, bush food, and wildlife corridors...
- ***on land that does not currently support conventional crop or livestock production, because it is eroded, overgrazed, devegetated, or desertified, thereby...***



TREE OILS AUSTRALIA

- giving natural ecosystems that have been degraded by this kind of human activity the opportunity to regenerate – and to stop or at least slow desertification where this is a significant challenge.

Note: *This model of tree oil production does **not encroach onto productive farmland** – on the contrary, **it extends food production activities into 'waste' or marginal land.***

Which oil trees? Local solutions to regional problems...

There are many annual crops and tree species that have seeds containing oils of varying qualities and a range of quantities. Not all have been fully investigated, and more candidates for commercialization will undoubtedly emerge. Research is on-going and will continue for many years. The key characteristics of the species that have emerged from R&D processes have these characteristics:

- Seed oil that is comparable in quality to the fuel required, unblended or blended, for diesel powered land vehicles, electricity generation, and rail, air, and marine transport
- Seeds with more than 30% oil w/w
- Per hectare seed yields that justify the investment of human and all the other resources
- Trees live for 25 to 100 or more years and are resistant to pests
- Seeds mature simultaneously and are potentially machine harvestable
- Simple to separate the oil from the seed by physical means
- Good storage qualities
- Compatible with co-crops and livestock
- Significant other benefits (valuable by-products, regenerate or improve the soil, erosion control, soil ameliorants, stock food supplements, secondary food source, native to specific regions of interest, wide genetic base, adapted to a wide range of soils, drought tolerance, salt tolerance, cold tolerance, heat tolerance, etc.).

International collaborative research has identified a number of species with these characteristics, and international field operations have commenced. The tree species in the first cadre are adapted to a range of environments from cold temperate North China, Korea, Canada and the Northern USA (yellowhorn *Xanthocerus sorbifolium*) to the arid and semi-arid conditions and soils typical of much of the hinterland of Africa and Asia (*Croton* spp. [already the basis of an East African industry], candle nut trees *Aleurites* spp and *Madhuca longifolia*). The ones that tick most boxes so far are the oil trees *Mellittia (Pongamia) pinnata* and *Moringa oleifera*. They are all drought resistant by virtue of an extensive sub-surface root system and deep tap roots.

Most of these species also provide products that have a prominent role in naturopathic and ayurvedic medicines across the world. The oil from one species (*Moringa*) is of such fine quality that it is exploited for cosmetics and in food preparation.



TREE OILS AUSTRALIA

Holism: The approach to employing the trees is holistic. At the farm and community level, it is in essence a manifestation of the well established process of intercropping aisle trees and crops – agroforestry - but absorbs the whole rural development process. Foci are:

- enhancing crop production (evaluating alternative varieties, optimising crop rotation, composting and mulching, etc.)
- one species is a tree legume so that, as a matter of course, it enriches the soil by means of the nutrients released by the nitrogen fixing bacteria in the root nodules
- oil production and processing for community use (e.g. electricity generation, pumping water, local sales for income), and
- environmental improvement by adding well-known alley trees into the mix, e.g., *Calliandra*, and *Glyricidium* for fodder, firewood, and mulch, bamboo for construction, fruit trees, and fodder legumes to attract pollinators and the natural enemies of insect pests
- This functional diversity is extendable to the extent of recreating wild life corridors and regenerating gallery forests

In addition:

- Re-treeing the landscape will mean that the temperatures are lowered, the bush is not plundered for firewood, desertification is reversed
- Low-External Input Sustainable Agriculture (LEISA) will ensure that as much as possible of the organic matter produced in the farming system will be returned to the soil
- Schools and colleges are targeted as the means of bringing new technologies into the communities

The application of the AEE paradigm at the small holder – community – village levels has clear advantages. *But can the model be expanded to a district or even a national level? ...Yes*

Take a hypothetical Central African Nation...

It is large and landlocked in the region that forms the southern reaches of the ever expanding Sahara Desert. It has an area of 1 500 000 sq km (= 2 x Texas or 45% of India) with a population of 15 million, of which 40% is urban. That means the population of rural areas is <2 people per sq km. Only 4% of the land is classified as 'suitable for cultivation' (arable). The North of the country is desert or close to desert, so that the rural population has been forced further and further South and is denuding the few remaining riparian forests. One of the country's major problems is a shortage of firewood. Another is the cost of diesel fuel.

The nation consumes 600,000 MT of imported diesel fuel per year. How can oil seed trees reduce the import burden this represents?

Applying a conservative (worst case) production estimate:

- One mature tree can be expected to produce 20 kg of pods per year. The dehulled seeds weigh 9 kg and will yield about 3 kg of oil or 500-600 kg/ha



TREE OILS AUSTRALIA

- Ten thousand hectares is perceived as a commercial unit. It could produce 5,000 MT of oil a year – that is over 5 000 000 litres
- Eleven such units, covering 'only' 1100 sq km (or 0.22%) of that vast country, would supply 10% of the annual diesel fuel requirement, feed the population and supply firewood and construction material – and contribute to pushing back the desert
- Once started why would the process stop? In time the Nation could be self sufficient while other countries pay heavily for the diminishing supply of mineral diesel

That is a big program, but the ***trees will live and produce for 100 and more years***, so the investment into such an enterprise would have a profound influence for the long term. Clearly there would be no reason to stop planting – especially as better adapted varieties will appear and production methods will improve over time. Compare this open ended lifespan to a fossil fuel extraction enterprise where the lifecycle of a well is normally less than 10 years.

Rice production in Asia and wheat production across Europe and America are much larger endeavours – but no one would ever challenge their feasibility. And rice and wheat 'only' produce food and employment.

Oil seed tree plantations provide:

Food + Fuel Energy + Carbon Sequestration + Essential Co-products + Environmental Restoration

John Wightman, PhD

Sreenivas Ghatty, MAgr