



Sustainable Modern Biomass Energy Development

Bioenergy for Livelihoods

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World Agroforestry Centre (ICRAF) **mission:**



“To generate science-based knowledge about the diverse roles that trees play in agricultural landscapes, and to use its research to advance policies and practices, and their implementation, that benefit the poor and the environment”

ICRAF’s **headquarters** are in Nairobi, Kenya, with five regional offices located in Cameroon, India, Indonesia, Kenya and Peru.

We receive our **funding** from about 50 different investors; including governments, private foundations, international organizations and regional development banks.

Our work is conducted with **partners** from a range of scientific and development institutions.

ICRAF is a **CGIAR** Consortium Research Centre

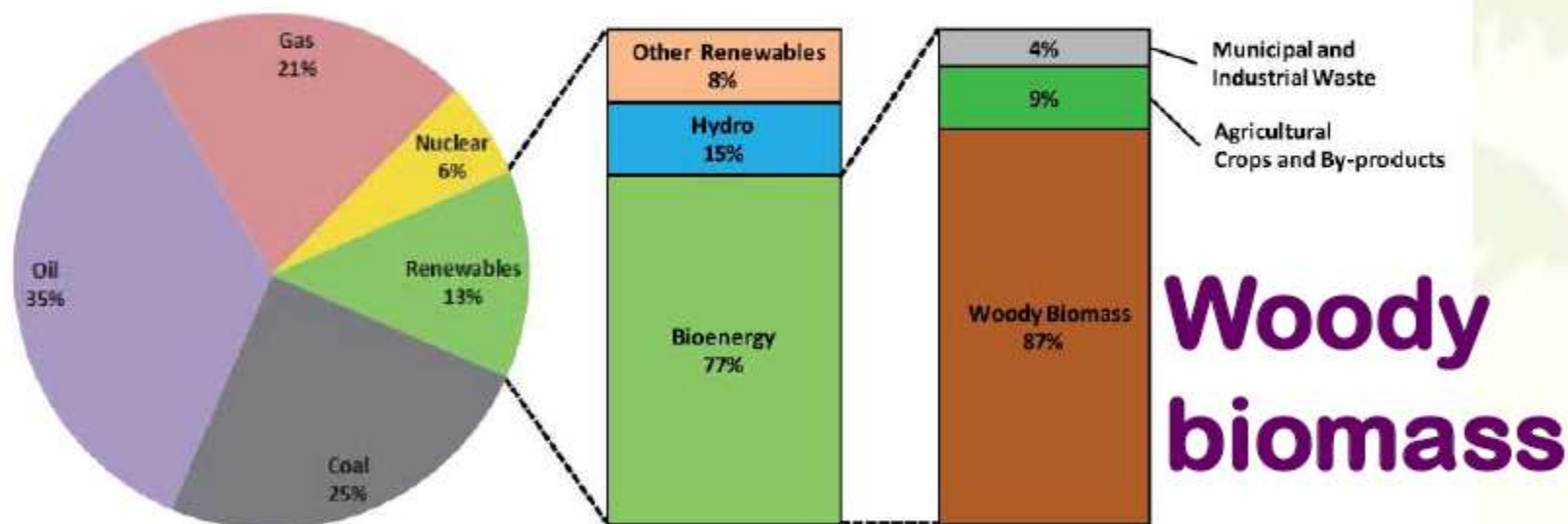
CGIAR is a global partnership that unites organizations engaged in research for a food secure future.



The name **CGIAR** comes from the acronym for the **C**onsultative **G**roup on **I**nternational **A**gricultural **R**esearch.

The CGIAR Fund is administered by the World Bank, as Trustee

World's greatest renewable but are we expecting too much?

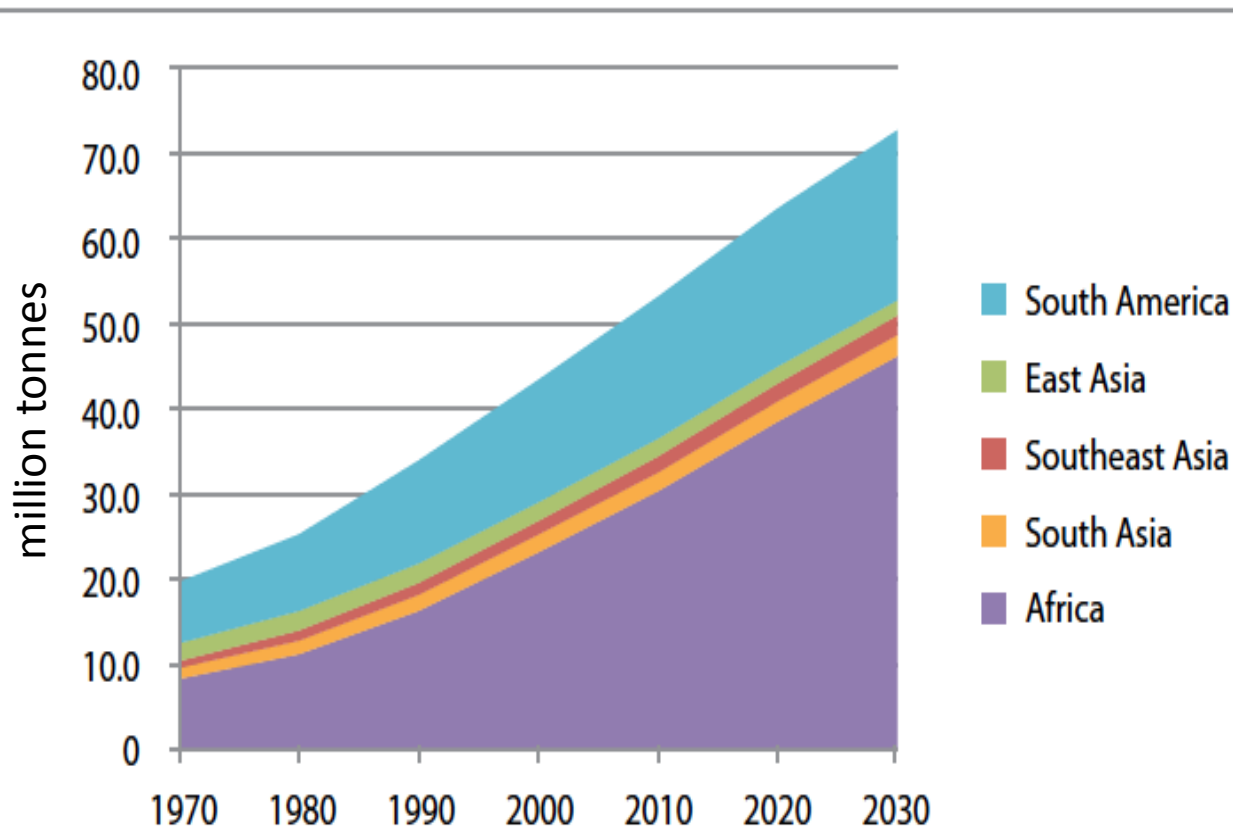


Source: IEA Bioenergy 2009

Bioenergy : Current Status

- **Currently**, energy from biological sources makes up only **10%** of global use, although it has been estimated that bioenergy has the **potential** to provide **50%** of global energy by 2050.
- **Trees** currently provide only the most **basic energy** services for poor people, namely cooking, warmth and some rudimentary lighting.
- However, **trees** have the potential to provide all of the forms of energy needed to **drive development**.
- Woody biomass can easily be used in **gasification** systems that provide fuel to drive machinery and generate electricity.
- These systems are cost-effective and already widely used in both **developed** and **developing** countries. They can be effective at large scales, such as the major electricity woody biomass generating plants used in developed countries and in smaller, community scale installations that are already in use in developing countries.
- Trees have a major potential to provide **liquid biofuels**, both biodiesel and ethanol, and will become more important as techniques for converting the lignin and cellulose of trees directly into ethanol improve.

Charcoal : Will continue to be an important source of energy



Charcoal requirements in Africa will continue to grow

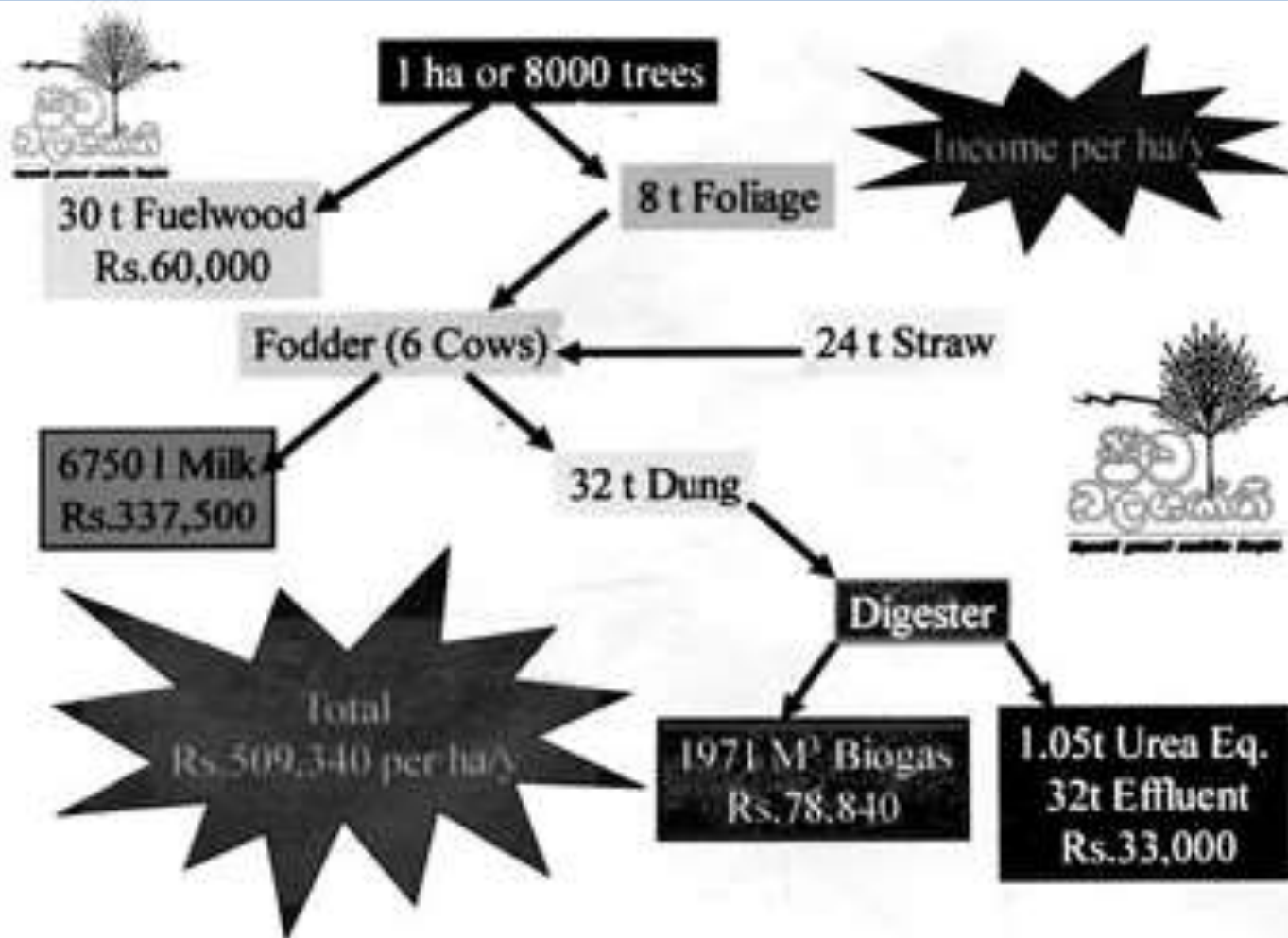
Gliricidia – Coconut Agroforestry Electricity Generation – Sri Lanka

- Tokyo Power launched the Mahiyanganaya plant after successfully oiloting a plant in Sri Lanka for 10MW of energy to their factory in Trincomalee
- Tokyo Power recently opened its second biomass power plant in Sri Lanka to supply the largely rural region of Mahiyanganaya with 5MW of energy.
- The new 5MW Dendro power plant is expected to contribute approximately 40 million kWh annually to the national grid using *Gliricidia*.
- The fuel-wood is obtained from plantations of *Gliricidia sepium*, or from farmers in the region through an out-grower agricultural program.
- The expected energy capacity to reach an additional 30,000 rural households,



**Grown by smallholder farmers for fodder
And wood for gasifiers**

Gliricidia



Potential In come from 8000 Gliricidia Trees (1 Ha plantation)

1 ha or 8000 trees → 30t fuelwood (US\$462) → Digester → 1971 M³ Biogas (US\$216) 8

Biomass Briquettes : Kenya



Plate 1: Community based fuel briquettes-making from charcoal dust bound with ash at Kibera (left) and from sawdust bound with gum arabic at Naru Moru (right).

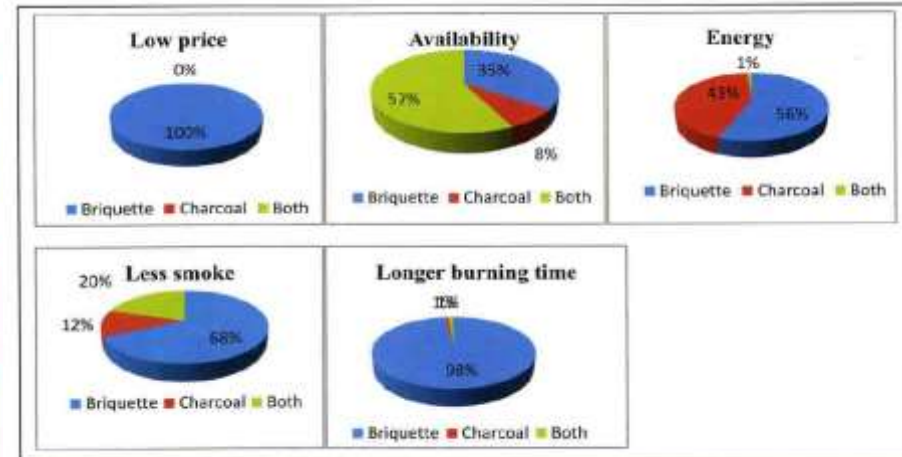


Figure 1. Percent household preferences of fuel briquette compared to wood charcoal

- Some of the most successful community groups in Kibera, Kahawa Soweto, and similar low-income neighbourhoods in Nairobi were making up to \$2000 monthly from the sale of charcoal briquettes, and women were slashing their cooking-fuel costs to a tenth or less (the International Journal of Renewable Energy Development)
- By saving trees that would otherwise be cut down for charcoal or firewood production, briquetting is protecting the country's forest, savanna and dryland habitats, and contributing towards the country's reaching its 10% forest cover target by 2030 (ICRAF).

Coconut Shell : Sustainable Source for Charcoal - India



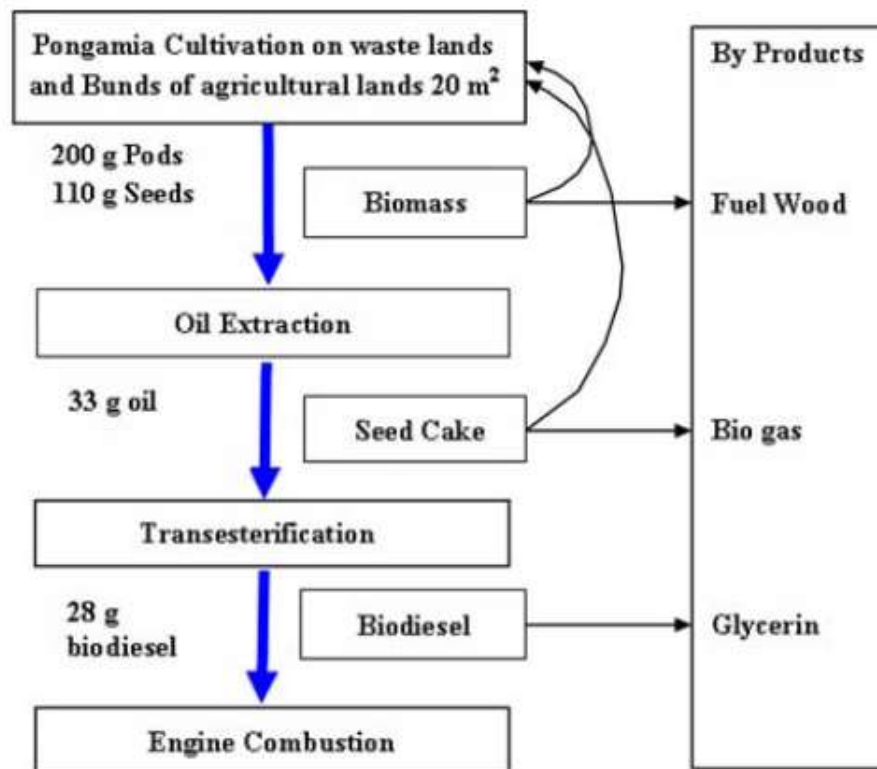
- Coconuts shells comprises 12 per cent of the weight of the coconut
- Commercial production of charcoal from the coconut shell provides for an increasingly important export market for coconut producing areas.
- Carbonization of one tonne of coconut shells produces of the order 300 kg of charcoal,

Pongamia pinnata



Liquid Biofuels







Livelihood Main Product - India



Non-food multiple use oilseeds



Use of multiple feed stocks

Name of the species	Flowering	Fruiting	Yield / Tree and Oil %	
<i>Pongamia pinnata</i>	May-June	January to March	30-150 Kg (27- 42%)	
<i>Jatropha curcas</i>	March – September	April- May October- November	0.5 – 2Kg (30-35%)	
<i>Madhuca indica</i>	March - April	July- August	30-200 Kg (28-38%)	
<i>Neem (Azadirachta indica)</i>	March - April	June July	20-35 Kg (30 -39%)	
<i>Simarouba glauca</i>	February	April-May	15-30 Kg (20-25%)	
<i>Amoora rohituka</i>	September- January	November- April	30 Kg (40-46%)	
<i>Calophyllum inophyllum</i>	March - May	October- November	25-50 Kg (45-70%)	

Combination of above to get year round supply of seeds / Biodiversity

Biofuels for Running Irrigation Pump



The state of Tamil Nadu faces problem of frequent load shedding in rural areas, a farmer, Mr. C. Rajasekaran, from Vettaikaran Irruppu of Kilvelur taluk in Nagappattinam uses oil from tree seeds (*Calophyllum inophyllum*) to operate his five hp motor pump for irrigating his five acres.

His farm became unfit for any cultivation, after the tsunami struck, is now home to nearly 35 different tree varieties. Mango, Guavas, Lime, Teak, Cashew, amla, tamarind, and jack are all flourishing

Gender and Biofuels



Village: Bendigeri Galli, Bijapur (India), Women Group collects 520,000 Kg neem seeds .
Selling Price Rs 10 / Kg = US\$ 0,17

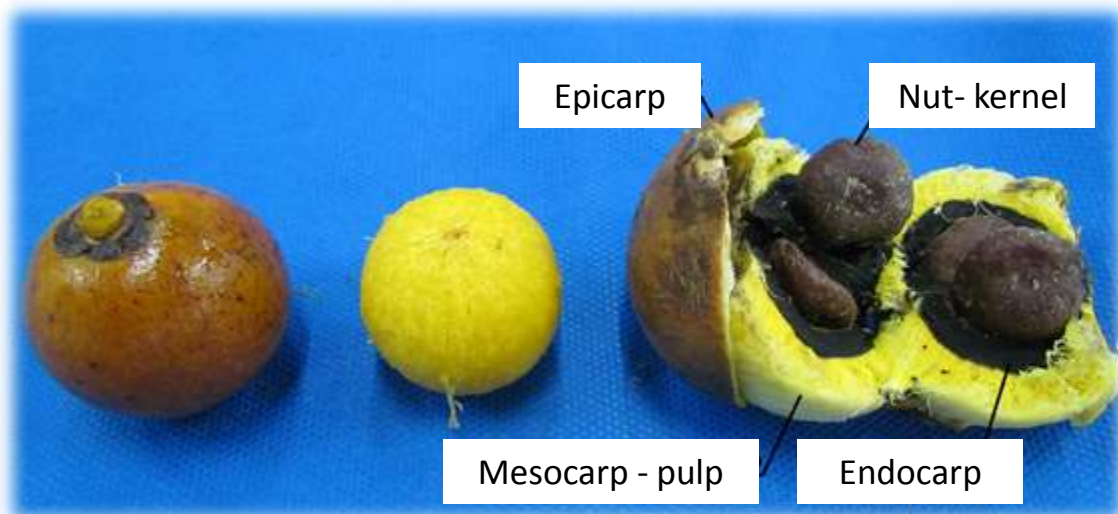
Biofuels for running Agriculture Equipment



- Farmers in the Hassan District of Karnataka State use **Straight vegetable oils** (SVOs) to run tractors and other farm equipment.
- Less health risks and considerable saving (Rs 25000 per annum)

Coming next - Brazil

Acrocomia aculeata - Macauba



nut oil

pulp oil





Policy challenges

- At the global level, the potential of **wood-based energy** must be taken into account in **policy debates** such as Sustainable Development Goals.
- At **national level**, wood-based fuels must be considered positively in national energy policy debates so wood as a **renewable form of energy** can play its proper role among other sources of energy in available energy mixes.
- Many **policies around the world are perverse** in terms of encouraging the use of wood.
- **Forests policies** often **prevent** farmers from **growing**, cutting down and selling trees.
- **Charcoal is usually only barely legal** in developing countries, preventing the establishment of a properly regulated industry. Instead, it becomes a rent-seeking enterprise, with much of its value accruing to corrupt officials and even terrorist groups.

Policy challenges

- Need exists for **official recognition of charcoal** production and marketing by national energy policies. Energy policies for many countries in Africa tend to put more emphasis on commercial energy, biomass based energy often gets missed out.
- **Lack of coherence:** For instance, although energy policy in Kenya favours development and promotion of improved charcoal cookstoves and sustainable farm forestry for fuelwood, **charcoal** making remains **illegal** in the country.
- **Community engagements:** community development initiatives including capacity building in farm forestry methods, charcoal-making and stove fabrication, charcoal trade and entrepreneurship be realized.
- **Land tenure:** land tenure policy in many countries in sub-Saharan Africa need to be streamlined. Land tenure is a key source of conflicts. But when a household has rights over a given land area, it can confidently develop it further through activities including modern farm forestry methods

[Law nº 12.805, de 29.april.2013](http://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2013/Lei/L12805.htm)

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National Policy: **Integração Lavoura-Pecuária-Floresta (iLPF)**

Integration Agriculture-Husbandry-Forestry

Program of Low Carbon Agriculture – Agriculture Ministry

- High potential for carbon sequestration
- Increase the content of organic matter into soil
- Reduction in greenhouse gas emission
- Target: 1,2 millions ha currently, to 4millions ha till 2020,
avoiding the emission of 18 - 22 millions ton of CO₂ equivalent

- India adopted an agroforestry policy. Launched February 10, 2014
- Policy removes constraints on agroforestry. **Specific mention of Bioenergy**
- Promoting sustainable agroforestry for renewable biomass based energy

“Emphasis needs to be on raising fast growing trees / bushes / grasses on marginal and degraded farmlands keeping in view their uses for meeting various energy requirements for making profitable agroforestry practices. This is of particular significance for meeting various energy needs of agroforestry itself, such as for irrigation, motive power, farm machines and processing industry. Therefore, it should be considered in conjunction with making of the provisions for financial incentives, especially for setting up of various renewable energy systems / devices. “

ICRAF Played Key Role in Policy Framing

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