Bioenergy from agroforestry can lead to improved food security, climate change, soil quality and rural development

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Our Working Hypothesis
Food vs fuel: A false dichotomy

- The choice cannot be between food and fuel. We can make good use of both.
- Biofuels, if produced sustainably, can be an effective means to increase food security by providing poor farmers with a sustainable and affordable energy source.

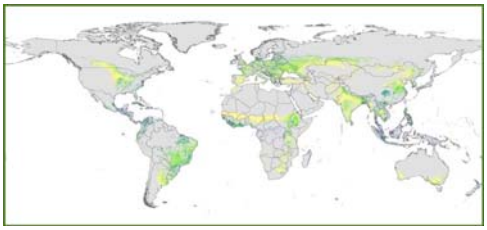
ROAD MAP

According to IEA

- "It is estimated that 27% of transport energy needs worldwide could be met with biofuels by 2050 resulting in a cumulative saving of 20 billion tonnes (Gt) of carbon dioxide emissions over the next 40 years – all without affecting food security.
- By 2050, the roadmap assumes 32 exajoules of biofuel production, split 50:50 between crop-based and waste-based fuels, and that the crops will require 70 million hectares (Mha) of land to grow.
- How to get 70 Mha of land carbon free?. 70 Mha is more than the area of Germany and Poland together. "

Where can they come from?
AGROFORESTRY

Zomer et al 2016. Scientific Reports (In revision: submitted May 9, 2016).



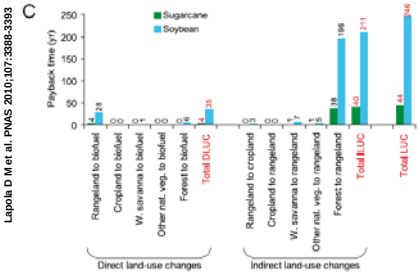
Nearly a billion hectares of agricultural landscapes already have more than 10% tree cover and 1.6 billion hectares of land worldwide has the potential to be under agroforestry (Nair and Garrity, 2012).

Intensive large scale plantations

LUC & Carbon Debt : Brazil 2020

Projected Demand 8.0 Billion gallons (E20-25; B5)

Lapola D M et al. PNAS 2010;107:3388-3393



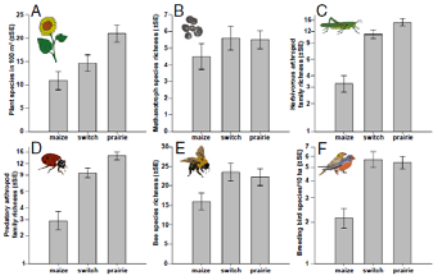
Macauba based agroforestry

- Long payback times if forests are converted to rangelands with sugarcane and soybean
- With perennials like oil palm grown in range lands payback time reduces to 4 years only

Use of Perennials & Multiple Species Increase in Biodiversity

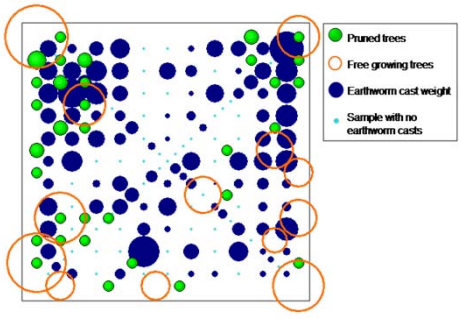
- Biodiversity and ecosystem services dependent on the choice of bioenergy crop and also on its location relative to other habitats.
- Bioenergy landscapes enhances multiple services in food & energy crops

Werling et al. (2014): PNAS



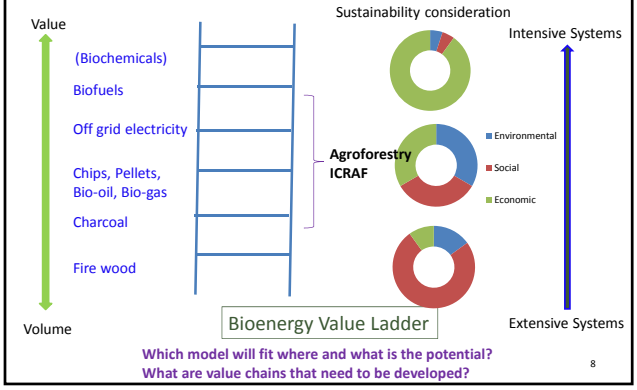
Agroforestry increases soil fauna

Pauli et al (2010) Pedobiologia 53 127–139



Increased earthworms nearer the trees

The Bioenergy Value Chain perspective



Which model will fit where and what is the potential?
What are value chains that need to be developed?

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Pilot 1: Integrated Food Energy Solutions

Non toxic Jatropha

Scaling Out

Multi indigenous species

Despite a policy in place – the sector is fragmented, no forward marketing linkages Remains a 'push – model'. States like Karnataka and Rajasthan lead with a separate body to over see the sector. Biofuels come under state oil companies. R&D gaps – Short rotation, high yield, high survival, assured market

Use of multiple feed stocks

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

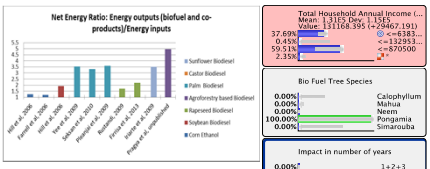
Combination of above to get year round supply of seeds / Biodiversity

Value Chains

From Planting Material to Agroforestry System to Local Energy Provision to Market

Smart Agroforestry Systems

Sustainable Bioenergy Landscapes



- Integrated Food-energy system
- Multiple species: year round supply of feed stocks
- Several co-products: oilcake, SVO
- Livelihood improvements
- Potential GHG savings

INR 96,958

+

INR 29,467

Need to be scaled up and scaled out

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Yield Improvements through Oilcake application: Chilli

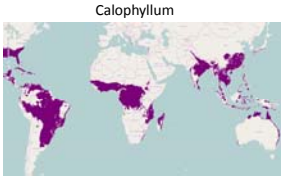
Farmer name: Niranjan S/o Nanjappa
Village: Thalalthore
Cakes given: Pongamia - 10 kg
Neem- 10 kg
Simarouba-10 Kg
Date of planting- 16-11-2014
Date of cake application: 15-12-2014

Tr. No	Treatments	No. sec. branches	Yield per plant (kg)	Total yield (kg)	% increase in yield
T1	Pongamia	12.6	3.86	138.96	**10.28**
T2	Neem	11.5	3.81	137.16	**08.80**
T3	Simarouba	14.75	4.2	151.2	**20.00**
T4	Control	10.8	3.5	126	

Global Suitability of species

Simarouba

Calophyllum



Neem

Pongamia

Pilot 2: Extractive Production System

Fig 1. From left to right: croton nuts, husks, seeds, seedcake, organic fertilizer produced from seedcake, and croton oil.

Croton Based Agroforestry systems
- Biofuels for cooking solutions
- Briquetting for Local energy
- MOU with Ecofuels, Kenya

Over emphasis on Jatropha resulted in set backs, ethanol prices crashed in international Market making it unattractive business model (Clean star). Focus mainly on biofuels From first generation. Croton appears to be an ideal candidate.

Croton

Pilot 3: Intensive Production System

Develop Macauba value chains
For small holder farmers of
North East Brazil

Embrapa

Area of activity – North East Brazil with small holder farmers. Mecauba, Jatropha and other Species. In silvi pastoral system. Germination and demonstration of Mecauba potential (Inocas) Embrapa for silvipastoral system and value chains

Macauba

Gliricidia – Coconut Agroforestry Electricity Generation – Sri Lanka

- Tokyo Power recently opened its second biomass power plant in Sri Lanka to supply the largely rural region of Mahiyanganaya with 5MW of energy.
- Tokyo Power launched the Mahiyanganaya plant after successfully piloiting a plant in Sri Lanka for 10MW of energy to their factory in Trincomalee.
- 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

1 ha or 8000 trees → 30t fuelwood (Rs 60000) → Digester → 1971 M2 Biogas (Rs 28000)

In Summary

- Covers the whole value chain → Landscape Approach for Business Model
- Development of alternate and non-food crop or cropping system (Agroforestry)
- Combinations of crops for sustainable production throughout the year
  → based on agroclimatic / ecosystem
- Addresses the needs of the poor, especially on marginal land
- Addresses environment, enhancement of income for poor, and development of sustainable business models

Agroforestry Challenges

- Selection of Appropriate Species (Ecosystem based)
- Quality planting material
- Short rotation crops
- Remunerative to small farmers: land scape approaches

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Thank You
"Biofuels are a very important solution, one that needs to be evaluated on what the fuels are today and what they will be tomorrow, and not by looking in the rear window to 10-year-old technologies," (Anonymous)
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