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

Navin Sharma
World Agroforestry Centre

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

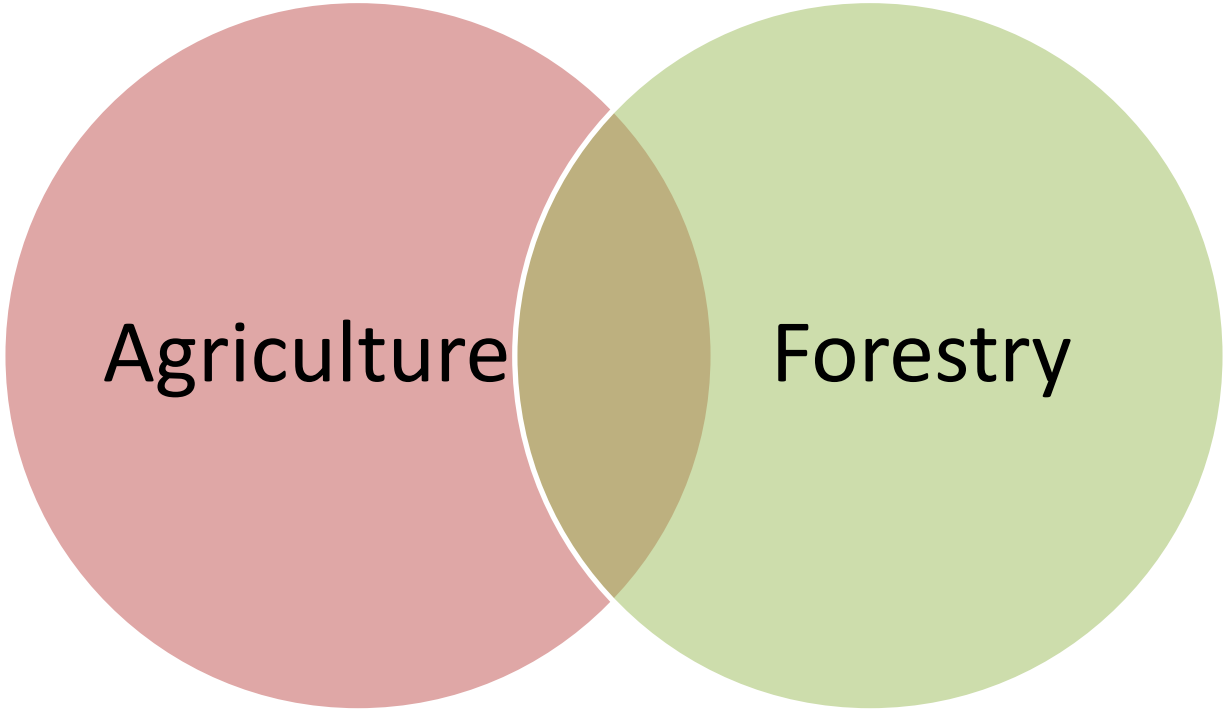
According to IEA

- "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. "

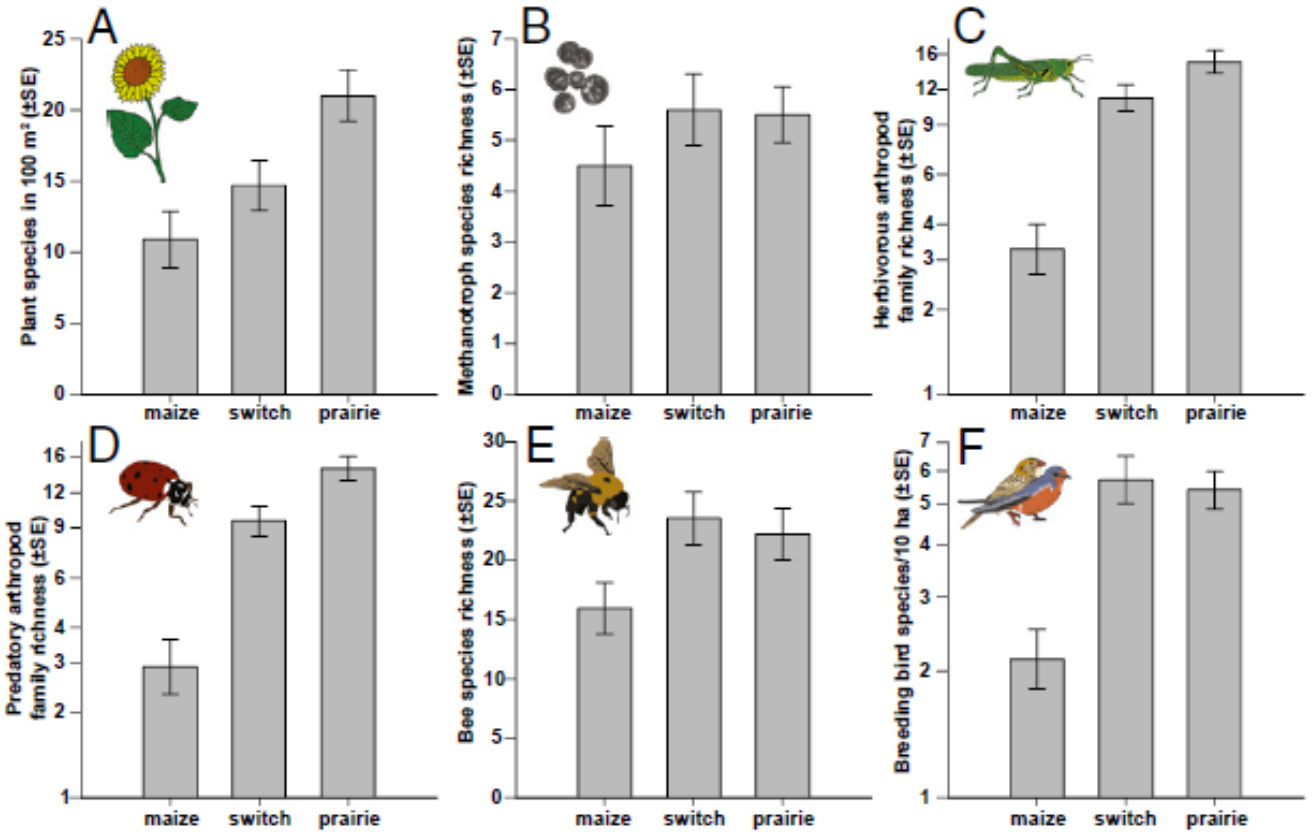
Where can they come from? AGROFORESTRY



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).

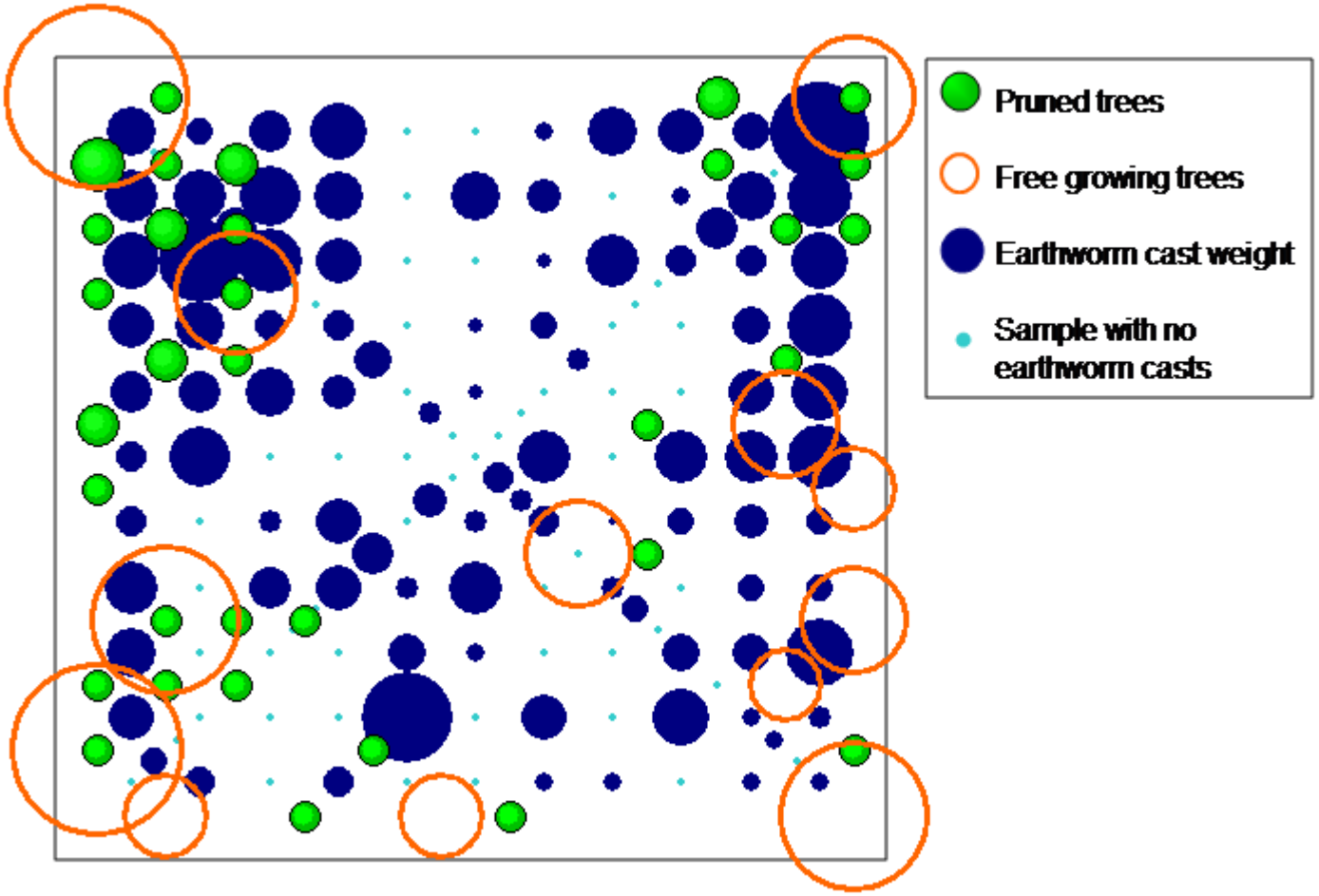
Use of Perennials & Multiple Species Increase in Biodiversity

- 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

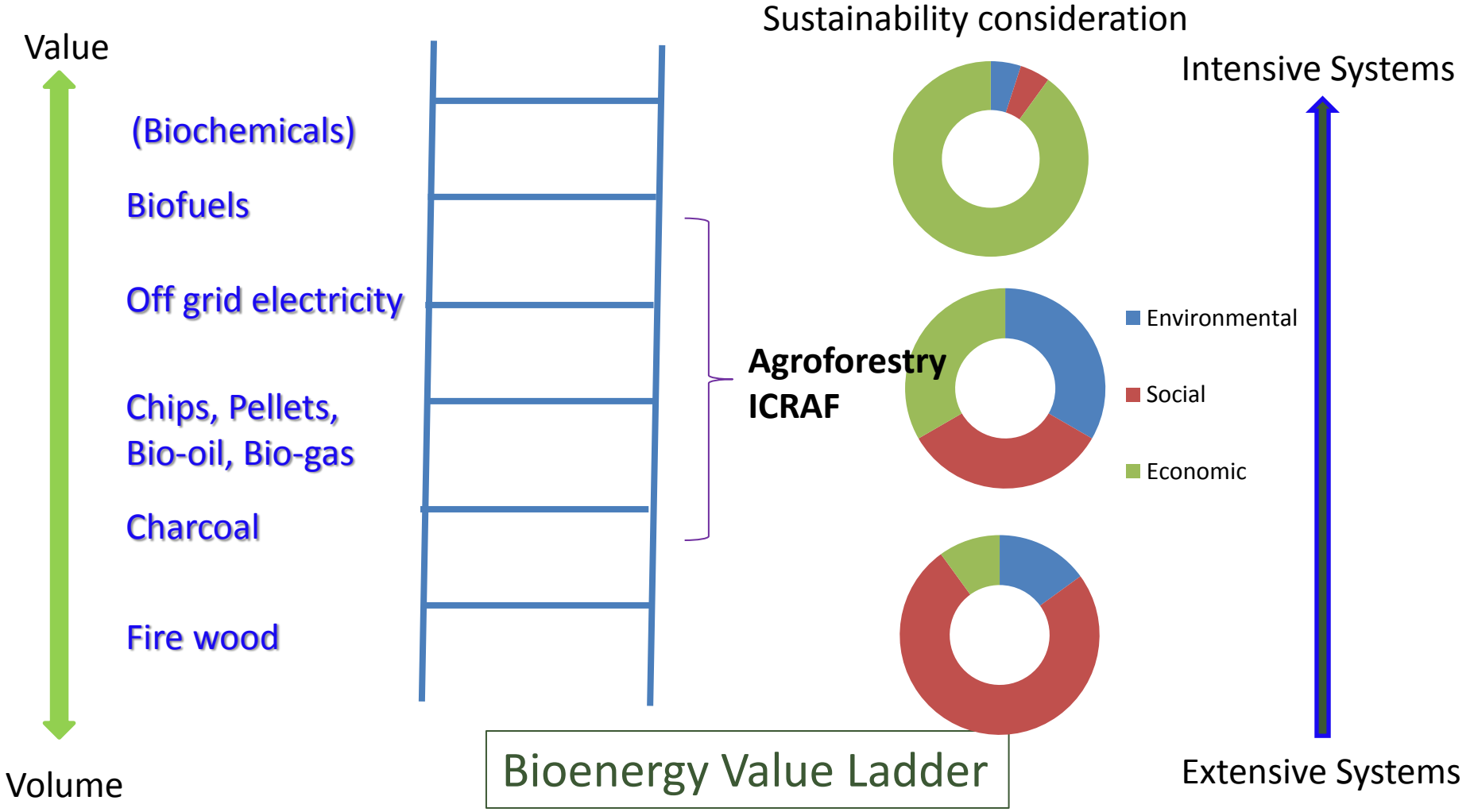
Agroforestry increases soil fauna



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?

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

Value Chains





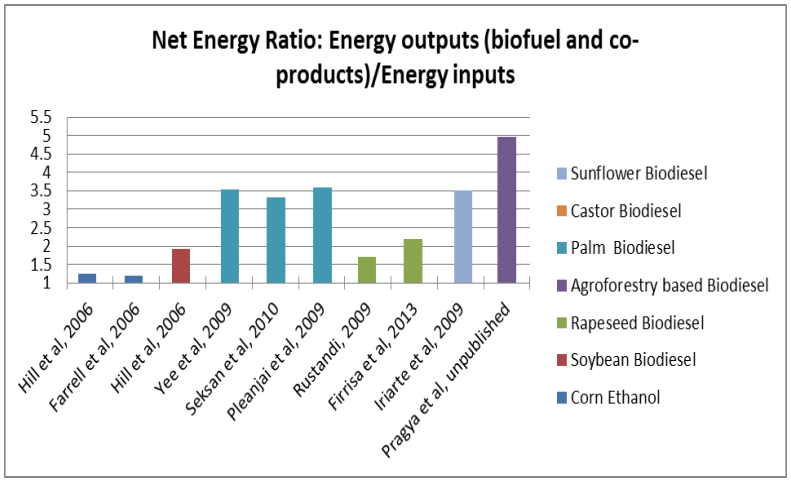


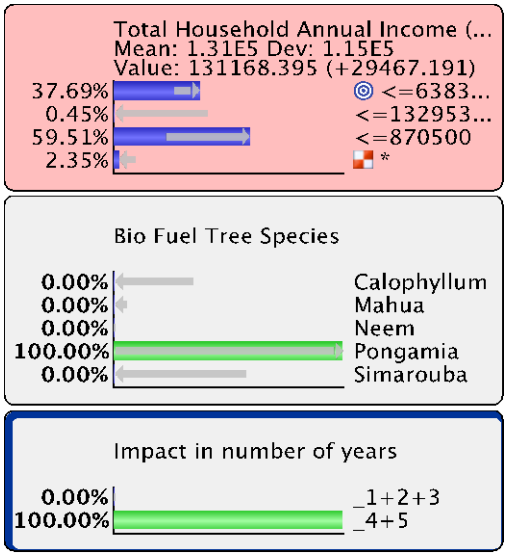


From Planting Material to Agroforestry System to Local Energy Provision to Market

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

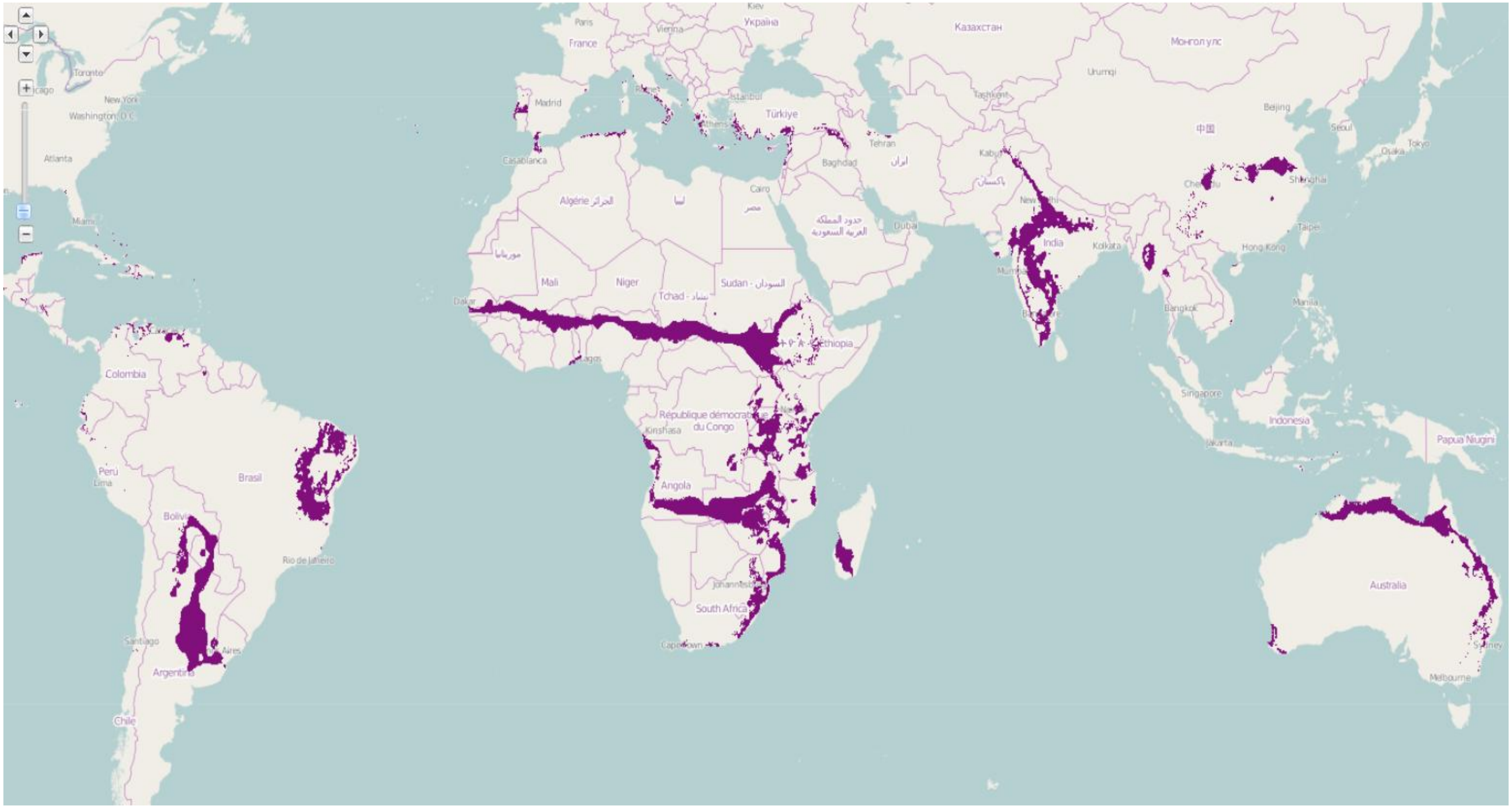
Need to be scaled up and scaled out

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	

Simarouba

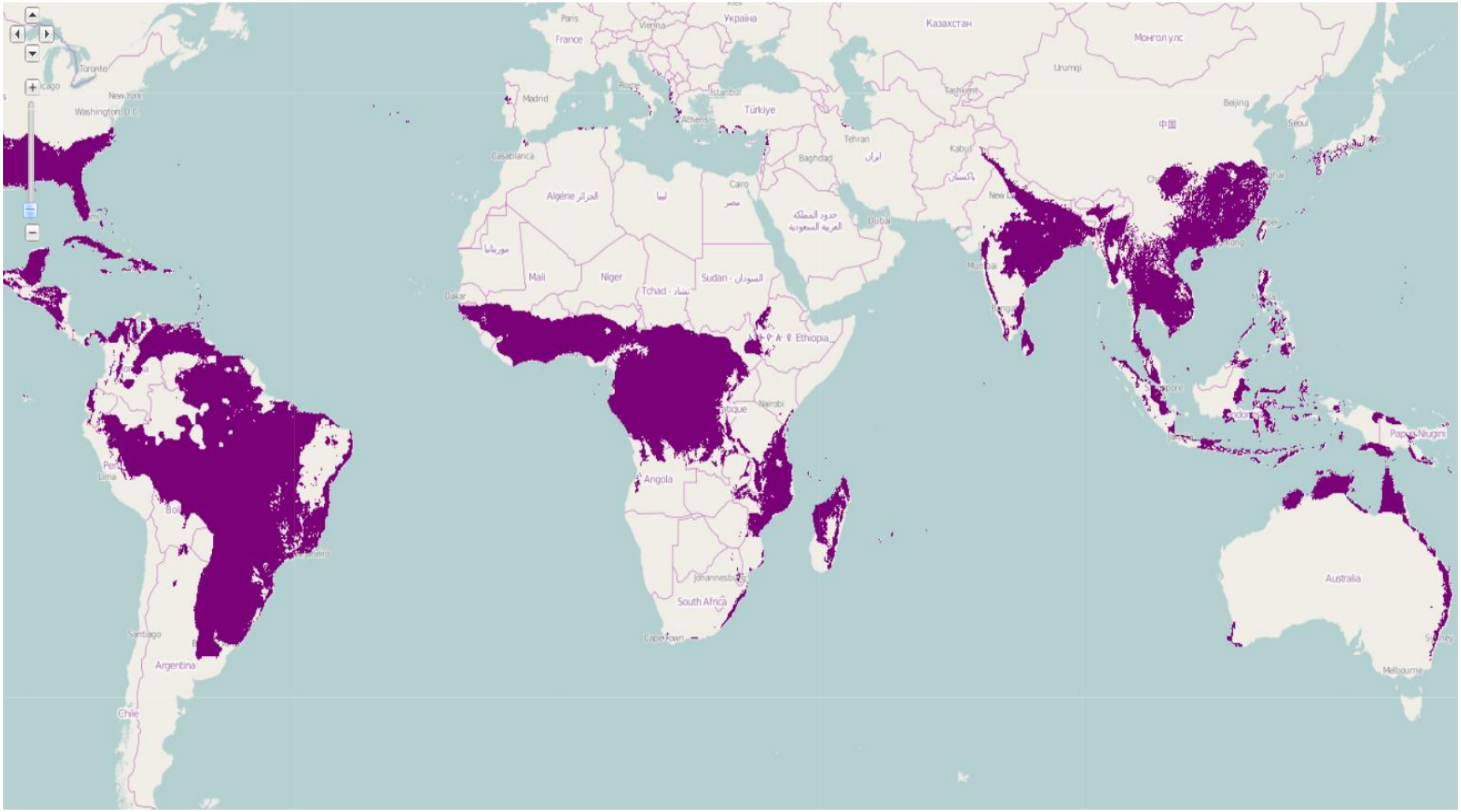


Paris
France
Vienna
Україна
Kiev
Казахстан
Монгол улс
Urumqi
Toronto
New York
Washington, D.C.
Atlanta
Miami
Madrid
Casablanca
Istanbul
Türkiye
Tehran
Baghdad
Tashkent
Kabul
Beijing
中国
Seoul
Tokyo
Osaka
Shanghai
Algérie الجزائر
ليبيا
Cairo
مصر
Dubai
Mali
Niger
Tchad - تشاد
Sudan - السودان
Dakar
Ethiopia
India
Kolkata
Hong Kong
Taipei
Bangkok
Manila
Colombia
Brasil
Perú
Lima
Bolivia
Rio de Janeiro
Santiago
Argentina
Chile
République démocratique du Congo
Kinshasa
Angola
Johannesburg
South Africa
Singapore
Indonesia
Jakarta
Papua Niugini
Australia
Sydney
Melbourne

World Agroforestry Centre

Calophyllum

CGIAR RESEARCH PROGRAM ON Forests, Trees and Agroforestry



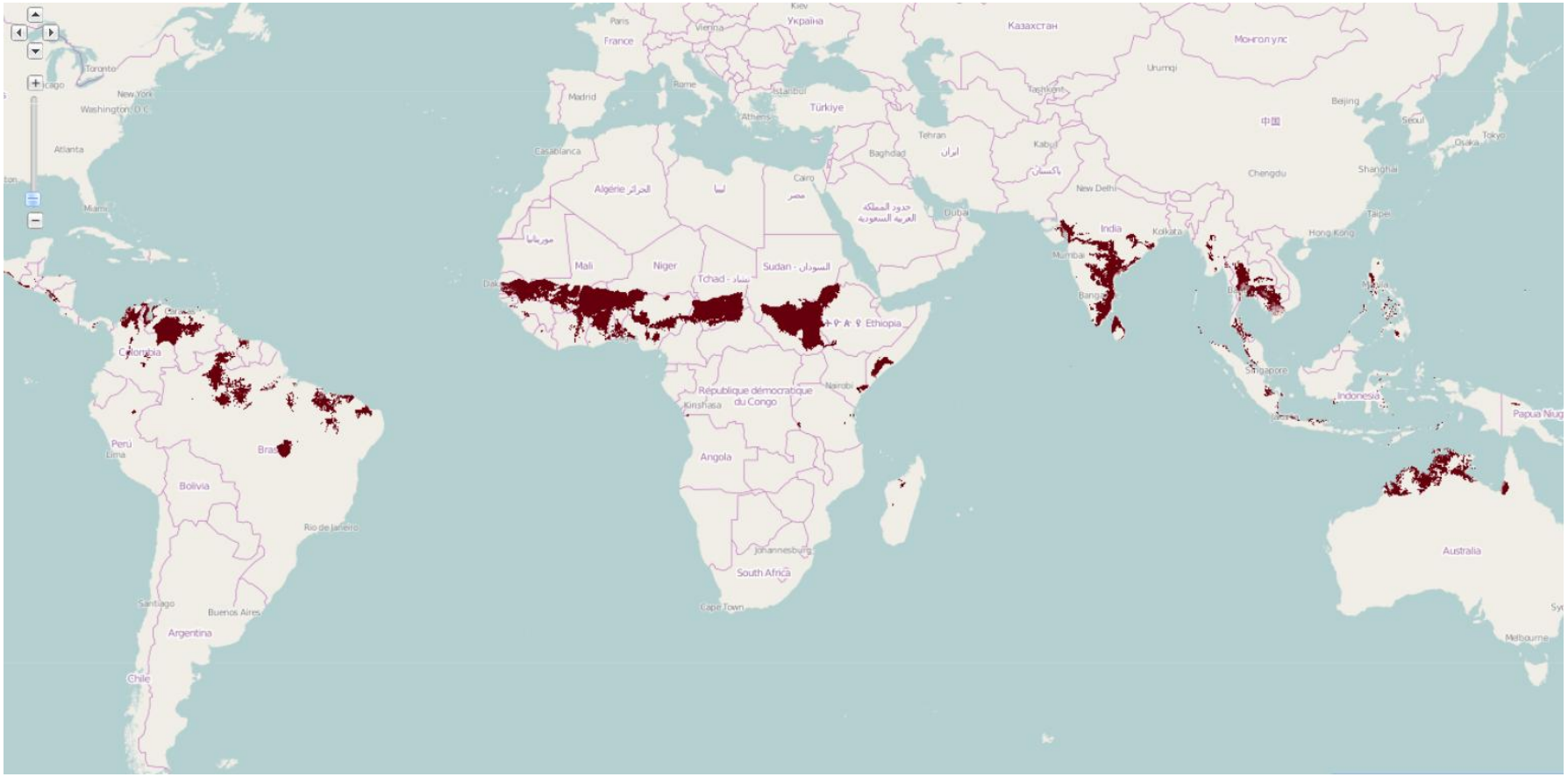
Neem


Amsterdam
Berlin
London
Paris
France
Kiev
Україна
Vienna
Казахстан
Монгол улс
Urumqi
Toronto
Chicago
United States of America
New York
Washington D.C.
Madrid
Rome
Istanbul
Türkiye
Tashkent
Beijing
Athens
Seoul
Atlanta
Tehran
Kabul
Baghdad
ایران
پاکستان
Casablanca
Houston
Algérie الجزائر
ليبيا
Cairo
مصر
Chengdu
Shanghai
New Delhi
Miami
حدود المملكة العربية السعودية
Dubai
India
Kolkata
Taipei
Hong Kong
Mexico City
موريتانيا
Mali
Niger
Tchad - تشاد
Sudan - السودان
Dakar
Bangkok
Manila
Caracas
Ethiopia
Lagos
Colombia
Singapore
Nairobi
République démocratique du Congo
Kinshasa
Indonesia
Jakarta
Perú
Lima
Brasil
Angola
Bolivia
Rio de Janeiro
Johannesburg
South Africa
Cape Town
Santiago
Buenos Aires
Argentina
Chile

World Agroforestry Centre

Pongamia

CGIAR RESEARCH PROGRAM ON Forests, Trees and Agroforestry



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

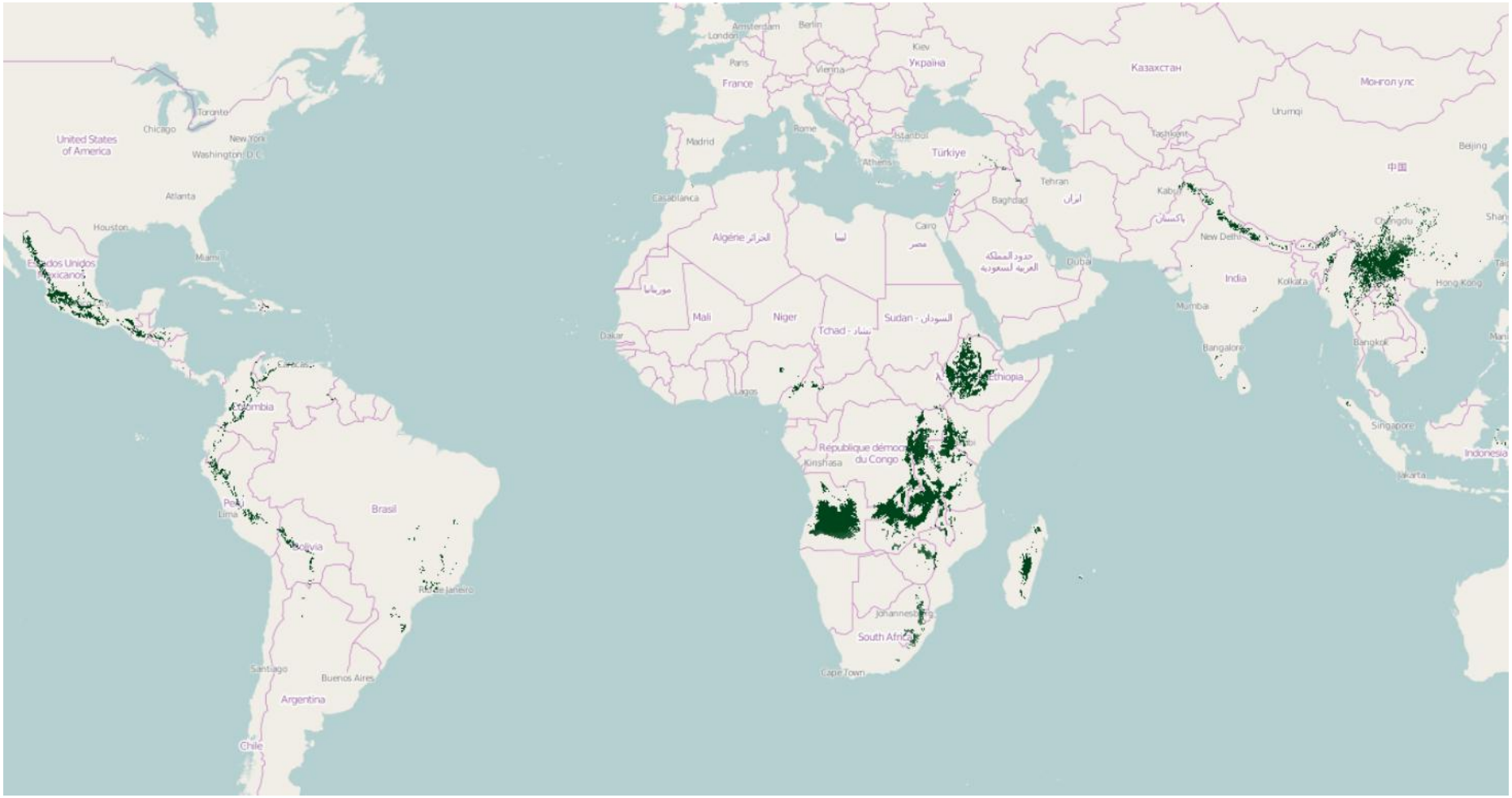
- Biofuels for cooking solutions
- Briquetting for Local energy
- MOU with Ecofuels, Kenya

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.

World Agroforestry Centre

Croton

CGIAR RESEARCH PROGRAM ON Forests, Trees and Agroforestry

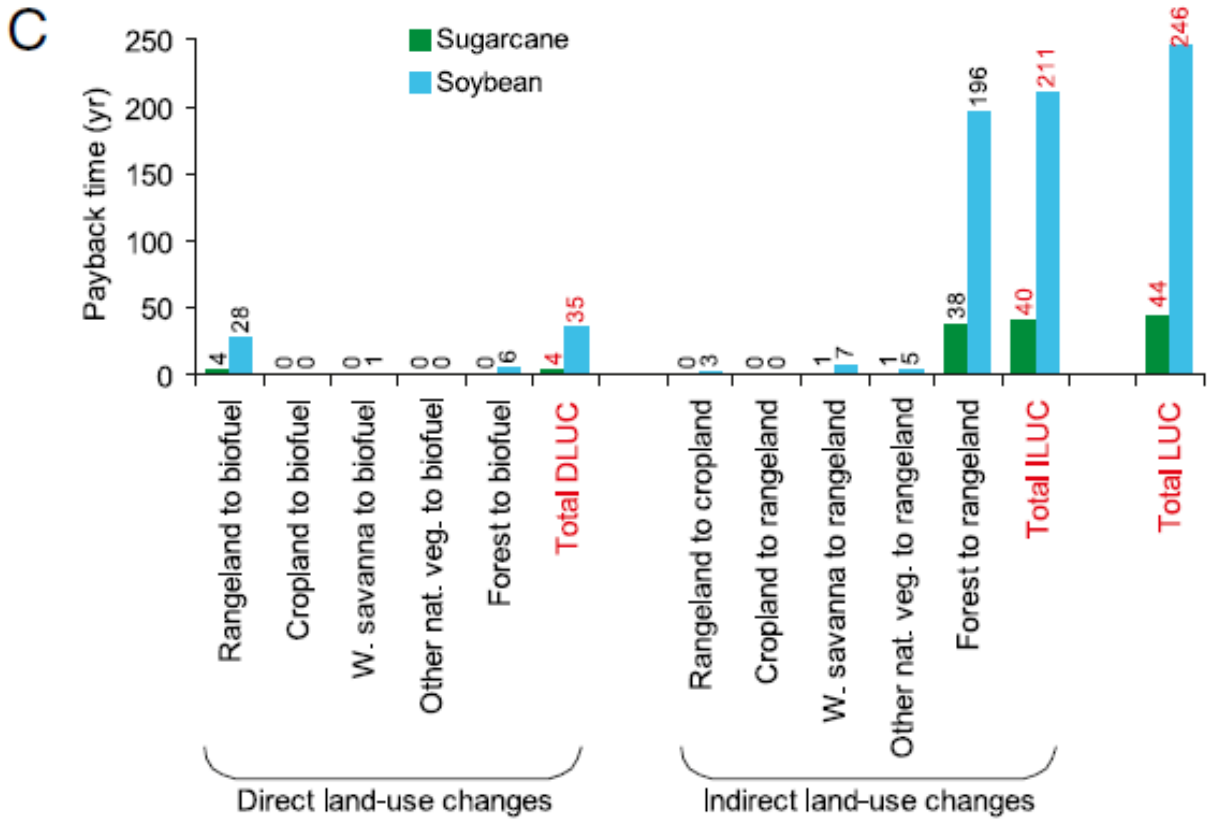


Intensive large scale plantations

LUC & Carbon Debt : Brazil 2020

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

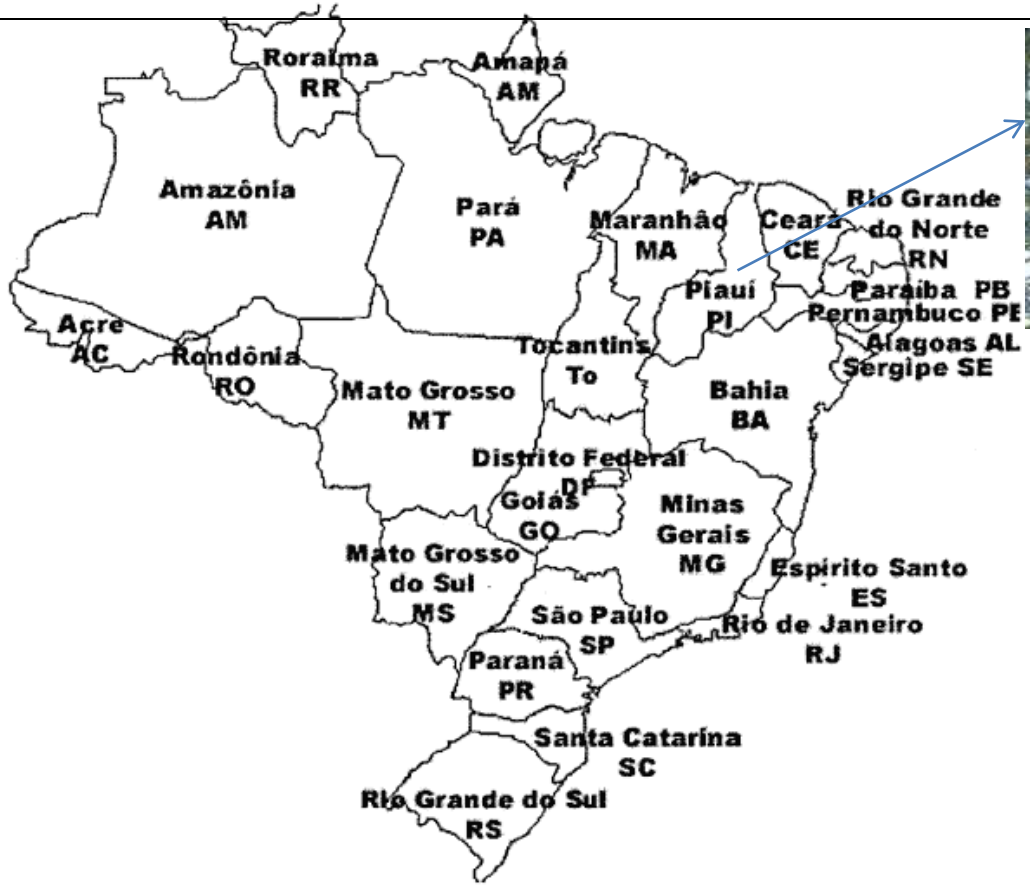
Lapola D M et al. PNAS 2010;107:3388-3393



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

Pilot 3: Intensive Production System



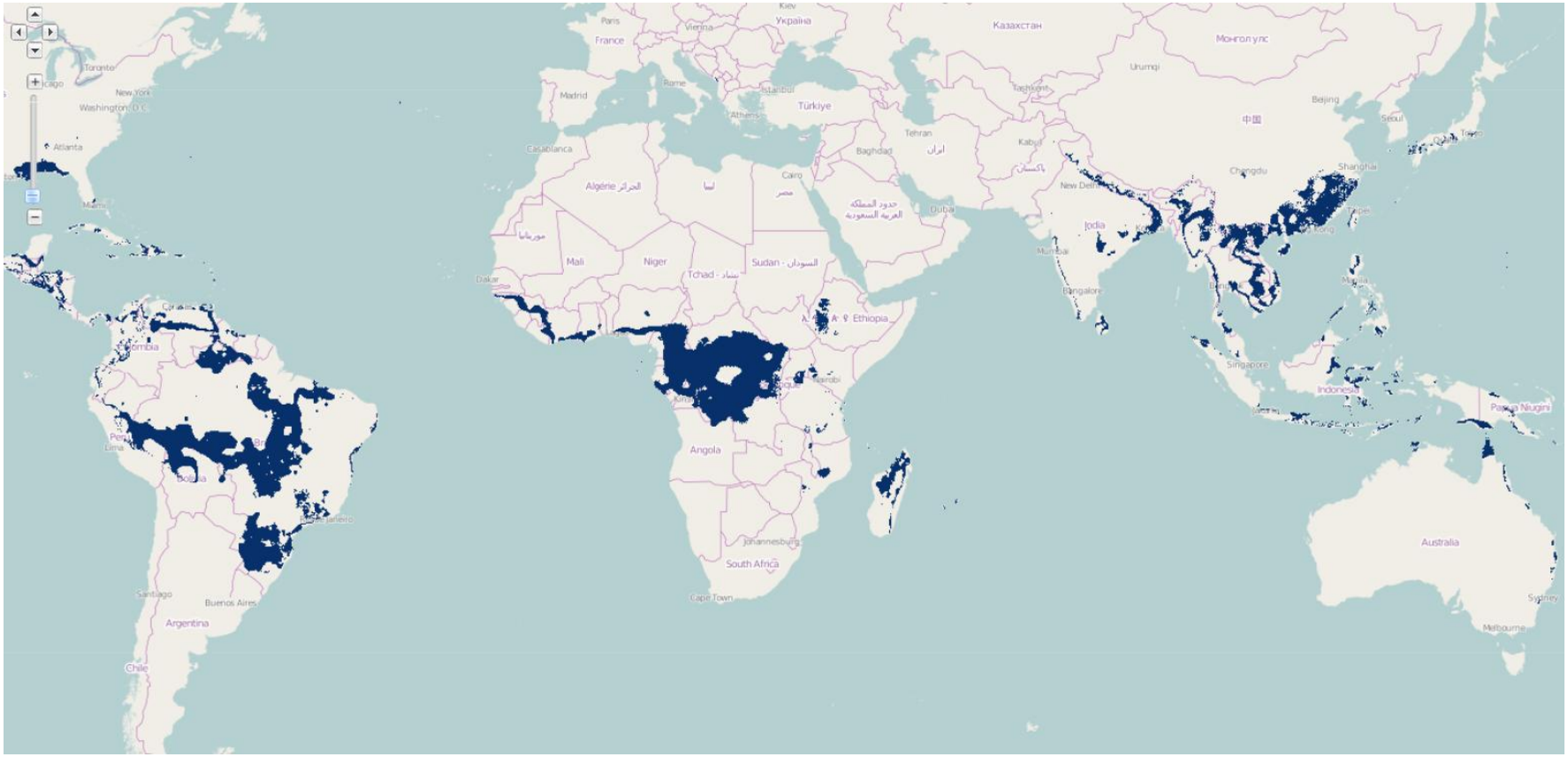
Develop Macauba value chains
For small holder farmers of
North East Brazil

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

World Agroforestry Centre

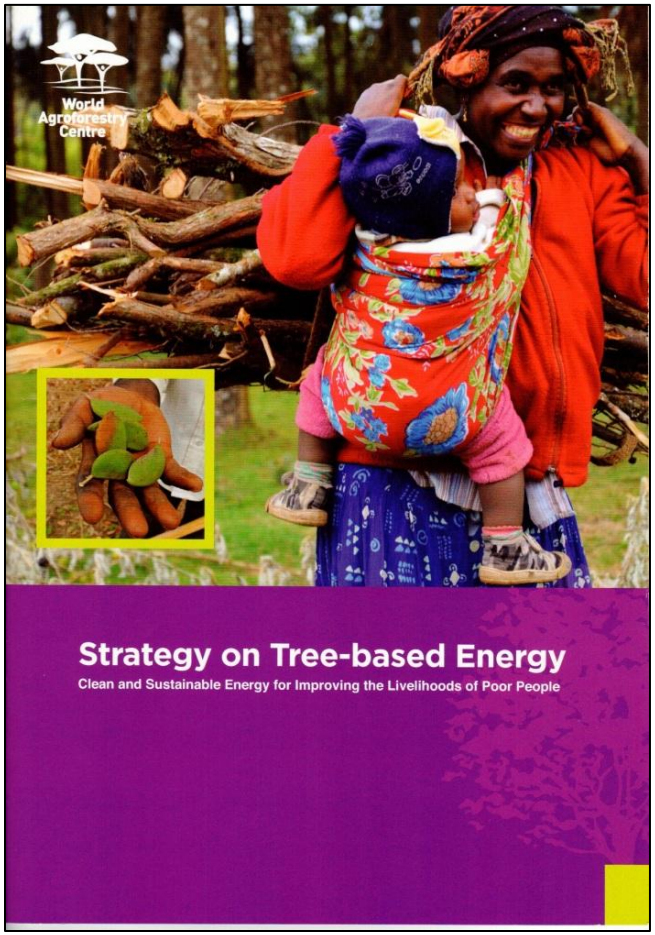
Macauba

CGIAR RESEARCH PROGRAM ON Forests, Trees and Agroforestry



Bioenergy & CGIAR

CoA 5.3 How to sustainably produce bioenergy in developing countries



How can renewable bioenergy from FT&A effectively and efficiently support energy sufficiency and equity and generate rural income in developing countries

Activities:

- Analysis of current status of bioenergy types
- Analysis of international and national drivers of bioenergy development
- Assessments of the potential of bioenergy production on degraded land
- Analysis of the impact of bioenergy on social and environmental outcomes
- Studies of demand and supply, costs, social and environmental impacts, carbon footprints, synergies/trade-offs with food production (a key CGIAR question)

CoA 5.3 supports predominantly the sub-IDOs 10.3/A1, Reduced net GHG emissions from agriculture, forests and other forms of land use; and 3.2, Increased livelihood opportunities.

What do we hope to achieve?

Platform – help to set agendas on key global issues

- Energy Security: At local and national level
- Climate Change: Mitigation and adaptation
- Livelihoods: Income, energy and food security
- Agriculture: Sustainable intensification in ag. Landscapes

Potential – identify the opportunities for 'win-win' situations

- Identify potential for scaling up/improving existing models
- Identify policy levers/bottlenecks to facilitate change & growth
- Identify potential to adapt models to different ecosystems

Promise – identify the finance and investment opportunities

- Action research to develop bioenergy value chains

Performance – technologies to deliver on promise and potential

- Improve resilience through diverse tree species portfolios
- Enhance productivity through quality planting material
- Enhance productivity of the entire (agroforestry) system