FLR Expert Group Meeting (Bangkok, Thailand, 14-16 Nov 2018)

# Integrating landscape restoration and bioenergy in the tropics

Himlal Baral

Bangkok, 15 November 2018

CIFOR

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CGIAR RESEARCH PROGRAM ON Forests, Trees and Agroforestry

# Talk Outline

- CIFOR's current work on FLR
- Degraded lands around the world
- Restoration targets and costs
- Growing interests on bioenergy
- Example – Indonesian case
  - Background aim
  - Key activities
  - Initial results
  - Future plans
- Concluding comments

# Global Landscapes Forum

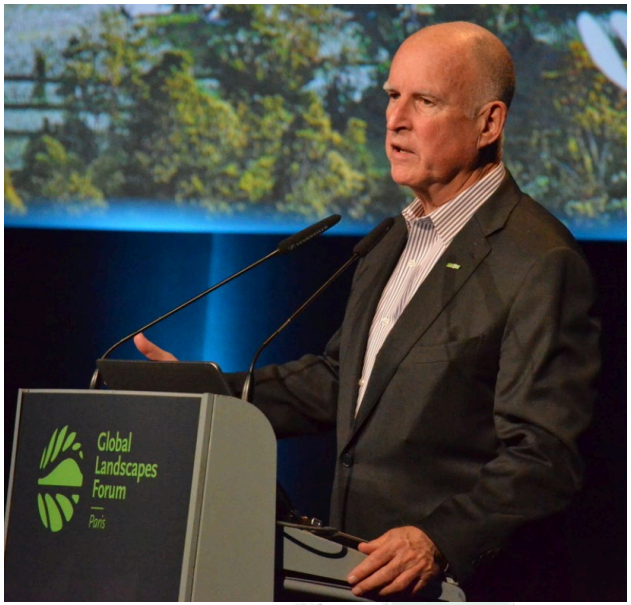
Led by CIFOR alongside founding partners UN Environment and the World Bank, with core funding provided by the German Government, the GLF:

- accelerates action towards the creation of more resilient, equitable, profitable, productive and healthy landscapes, and

- the achievement of the UNFCCC Paris Agreement and Sustainable Development Goals (Agenda 2030).

# Global Landscape Forum Today

The **world's largest knowledge-led forum on integrated, sustainable land use.** We have connected **3,900** organizations, **150,000** people attending from **150 countries**– reaching **231.5 million** on social media and 250 million+ through global media.



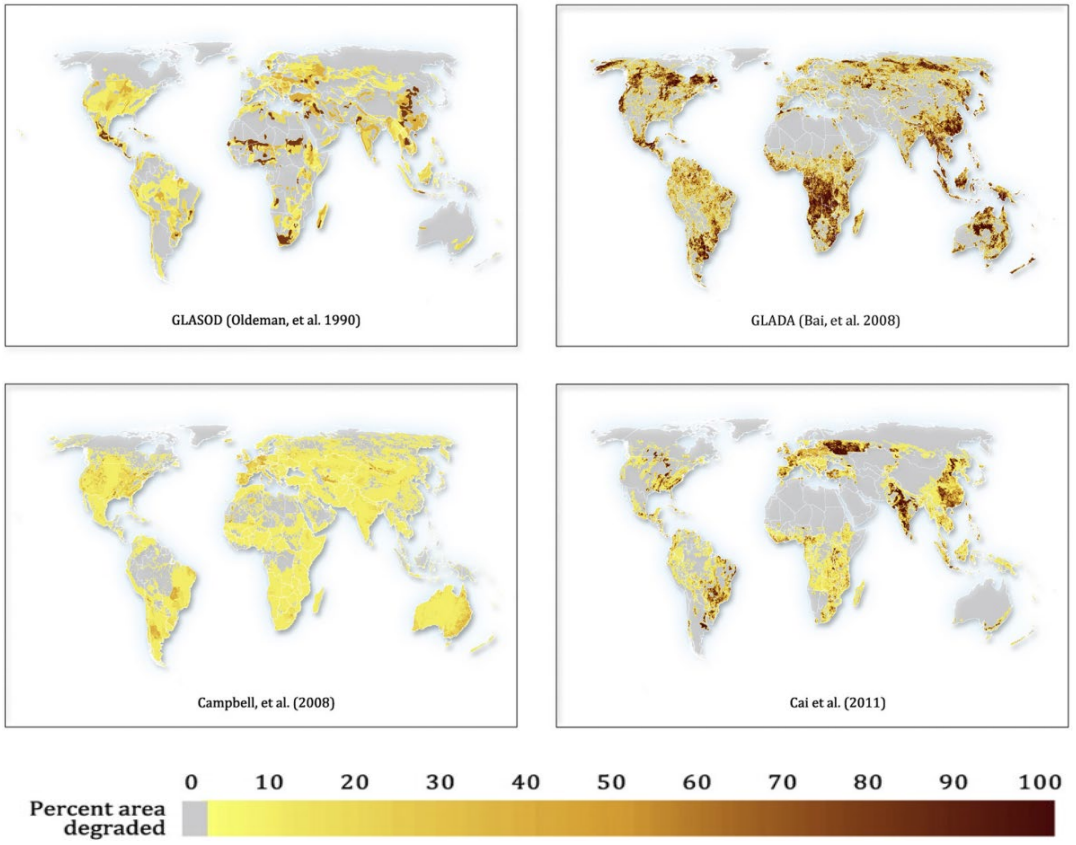

***Warsaw, Lima, London, Paris, Marrakech, Jakarta, Bonn, Washington D.C, Nairobi, (coming) Bonn, Katowice, Kyoto, Seoul, Luxembourg, Bonn…*** .

# CIFOR's recent work on Forest Landscape Restoration

- Monitoring and measuring FLR outcomes;
- Institutional and governance issues related to FLR – to actualize the commitments;
- Food security and FLR – conceptually and in practice;
- Gender, equity, tenure issues related to FLR;
- Estimating mitigation potentials in the tropics through FLR
- FLR and delivery of multiple ecosystem services;
- FLR for Biomass and Bioenergy;
- Geographic focus:
  - South/SE Asia
  - Sub-Saharan Africa
  - Latin America

# Global area of degraded land

- Current estimates of degraded lands are hindered by missing and sometimes unreliable information
- Global estimates of total degraded land range widely from 1 - 6 billion ha.




**Land degradation is a pervasive, systemic phenomenon: it occurs in all parts of the terrestrial world and can take many forms.** *IPBES, 2018*

Maps of land areas (percent of cell area) affected by degradation; each panel represents one of the methods described, all shown with common legend and 20 km grid

Gibbs and Salmon, 2015 Applied Geography

# FLR targets and estimated funding required

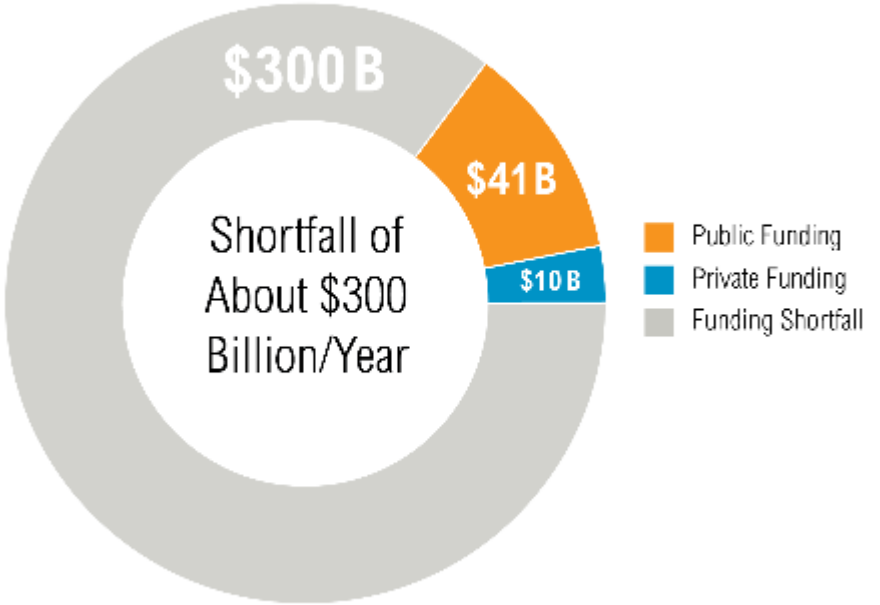
| Restoration target / priority | Description | Steward/driver | Estimated budget required (billion USD)* | |
|---|---|---|---|---|
| The Bonn Challenge | 150 million hectares to be restored by 2020 | IUCN & GPFLR (2011-2020) | 359 | 36 |
| Initiative 20*20 | 20 million hectares to be restored by 2020 in Latin America. | Latin American Countries & WRI (2014-2020) | 48 | 8 |
| New York Declaration on Forests | 100 million hectares of degraded landscapes in Africa under restoration by 2030. | United Nations Climate Summit (2014-2030) | 837 | 49 |
| AFR100 | SDG 15: combat desertification, and halt and reverse land degradation and halt biodiversity loss. | African Countries & World Resources Institute (2015-2030) | 239 | 16 |
| Sustainable Development Goals | Land degradation neutrality (SDG Target 15.3) | United Nations (2015-2030) | 4780 | 318 |

*using TEEB fig – US$2390/ha

# Who should / How to finance restoration?

*The challenge for advocates of forest restoration is to make it financially viable.*

**Global Funding for Conservation and Restoration**




WORLD RESOURCES INSTITUTE

# Restoration: an economic activity?

$6.3 trillion lost per year to land degradation

Net benefit $0.7 - $9 trillion by achieving Bonn Challenge

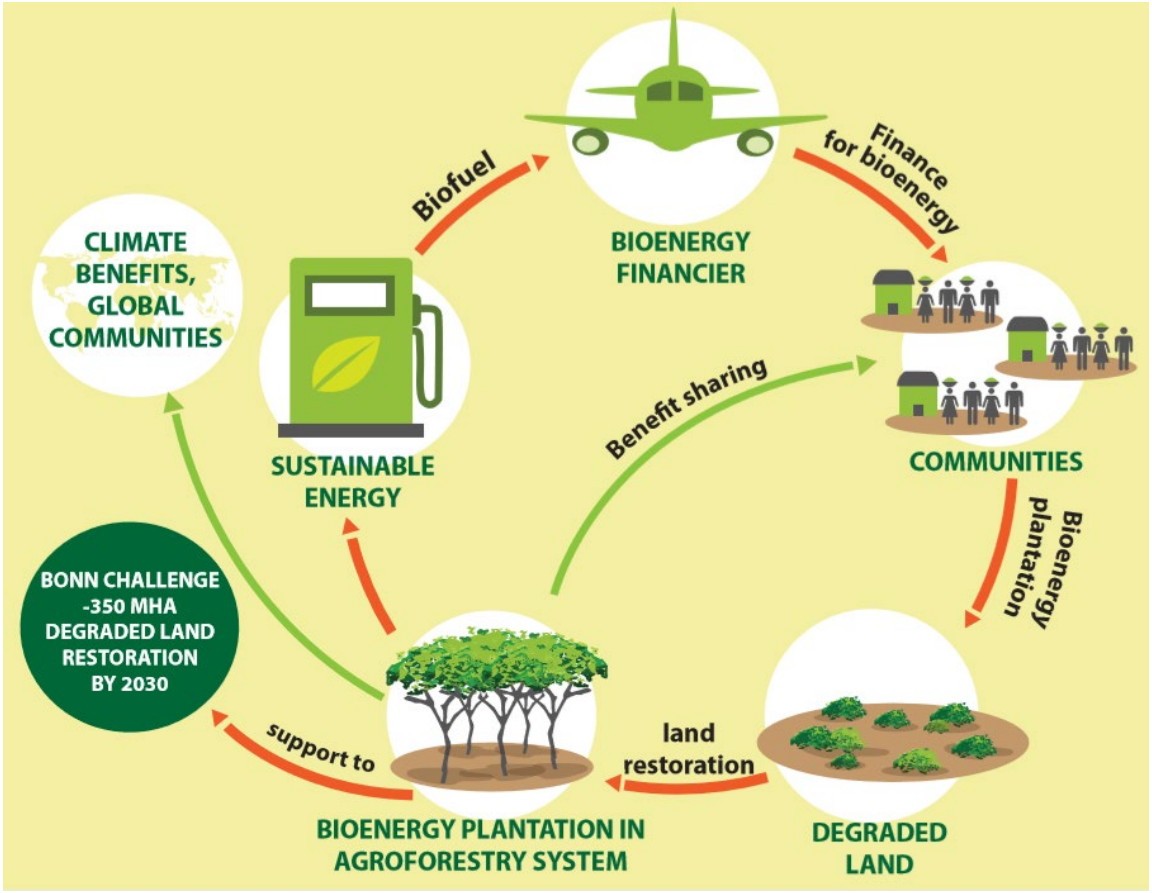
$7–30 in economic benefits for every dollar invested

**HUGE COSTS TO SOCIETY…**
**IMPRESSIVE RETURNS…**

***WHY ARE WE NOT DOING IT ?***

*WRI, 2017;*


# Bioenergy




Baral and Sharma, in prep

- Bioenergy is the most versatile form of renewable energy and the most widely used today. It can be used to generate electricity, to supply heat for industrial processes and buildings, and to provide liquid fuel for transport.

# GROWING INTEREST ON BIOENERGY

- 30% rise in global energy demand to 2040 (IEA, 2016)
- Hundreds of millions of people will still left in 2040 without basic energy services (IEA, 2016)
- The Paris Agreement on CC – 'transformative change in the energy sector' is key to reach the agreement
- SD is not possible without access to sustainable energy – SDG 7
- National goal/target related to renewable energy including bioenergy… e.g., Indonesia 23% by 2025…


# KEY ISSUES WITH FIRST GENERATION BIOENERGY

Source: www.actripity.com

- Food, Fuel and Environment trilemma
- Low net energy balance
- LULC – related issues
- Water, Erosion, Herbicide and pesticide

# Degraded land for bioenergy production

Potential win-win solution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NEWS

## Biofuel-friendly trees may boost landscape restoration efforts in Indonesia

*Research shows nyamplung could be most adaptive bioenergy tree for peatlands*

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NEWS

## Beyond oil palm: tropical trees for bioenergy and restoration of degraded lands

*Food, energy and environment in the balance*

Share Tweet

# CIFOR – NIFOS collaborative project on: Restoring land and growing renewable energy

# Background, problem and opportunity

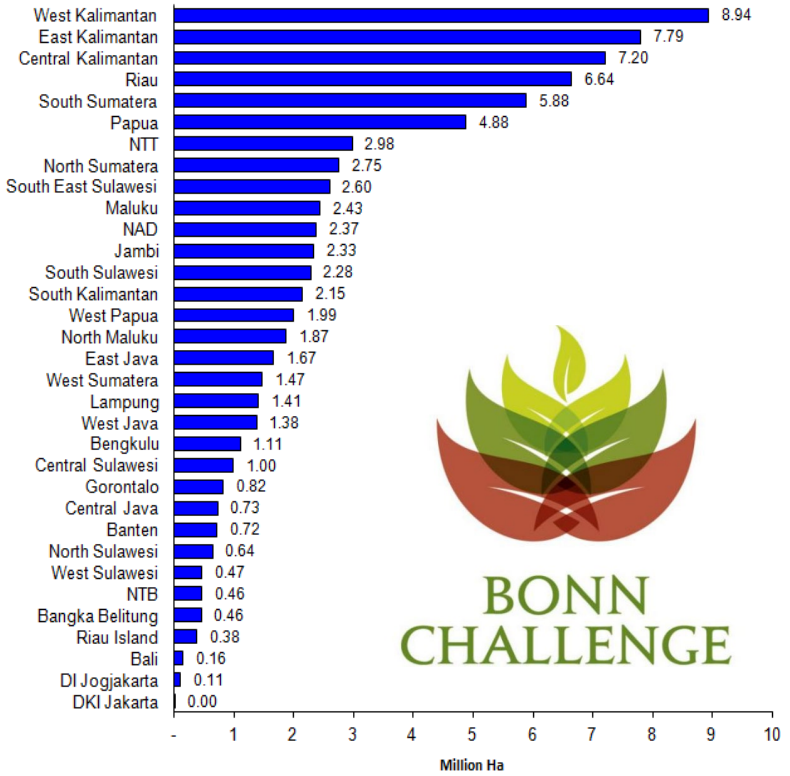
- Indonesia's national energy policy highlights: the importance of **diversification, environmental sustainability**, and **enhanced deployment of domestic energy resources**;

- The contribution of **NRE (including bioenergy**) to the nation's energy supply is mandated to reach **23% by 2025**;

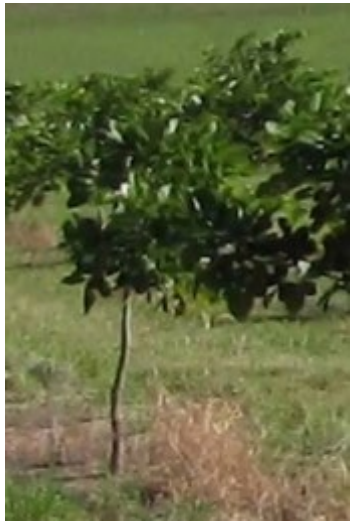
- Negative impacts if not **developed and deployed properly** known as:

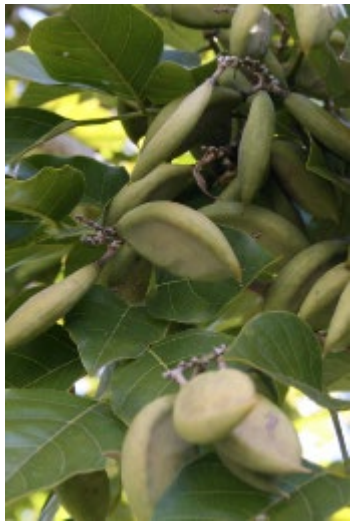
  **'Food-energy-environment trilemma'**

- Opportunity to restore in line with **the Bonn Challenge** while producing energy !




Source: *Critical Areas Map of Forestry Planning Agency*





# KEY QUESTIONS

- Q1: How can **sustainable bioenergy** be developed to avoid the **food-energy- environment trilemma** with alternative feedstocks while **restoring degraded** lands in Indonesia?

- Q2: What are the **most promising species** to achieve **efficient bioenergy** production from degraded land in Indonesia? Species characters, **productivity** and additional **environmental values**?

- Q3: What are the **socio-economic and environmental benefits and challenges** of bio-energy plantation on degraded land?

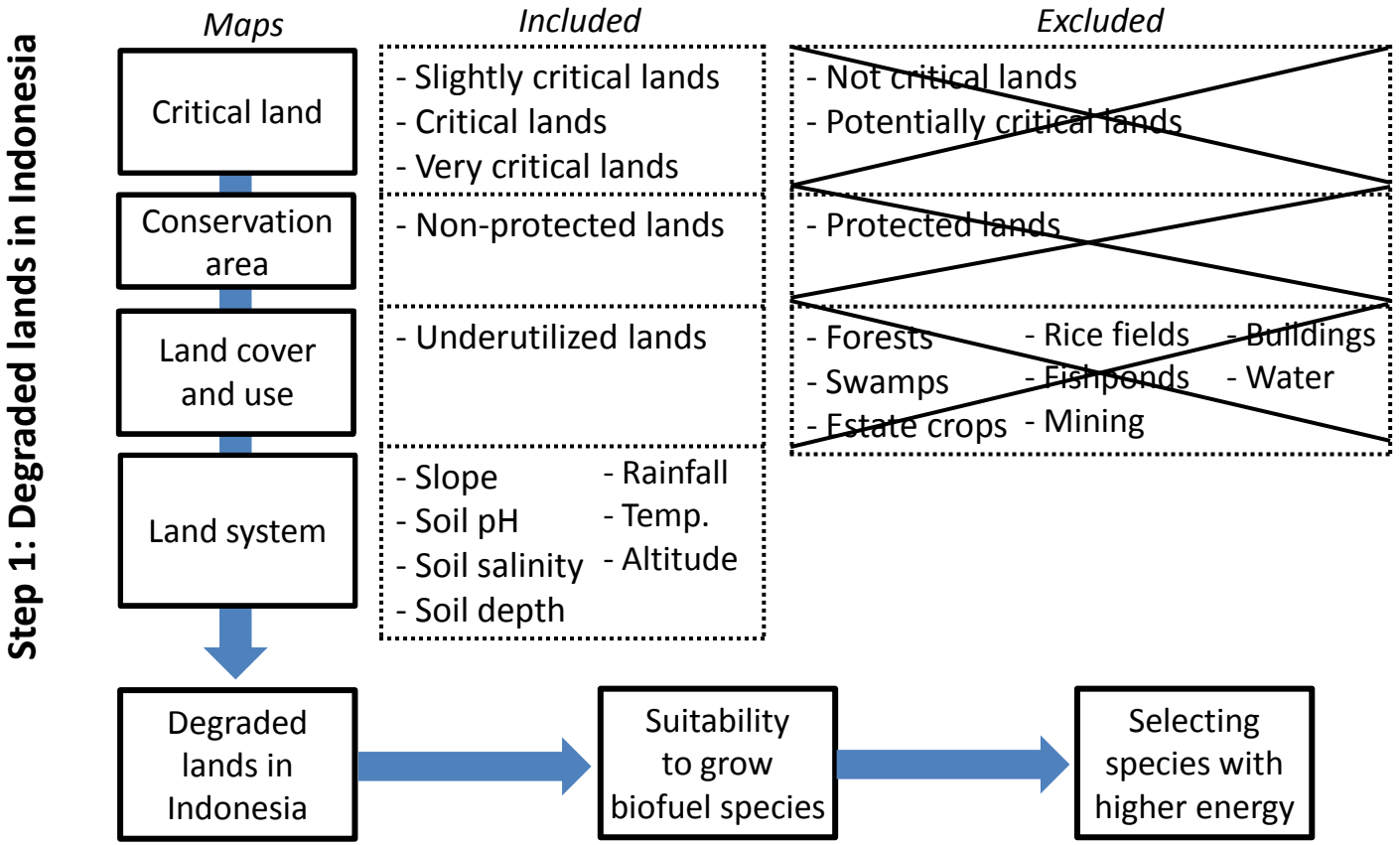
# Project activities/components...

- **Component I:** Reviewing/mapping policies, land availability, species suitability, potential productivity, community perceptions – opportunities and challenges;
- **Component II:** Establishing research/demo trial of key bioenergy species (trees not herbaceous plants) on degraded land in Central/East Kalimantan, South Sumatera;
- **Component III:** Laboratory/chemical analysis – fuel/energy productivity/efficiency and suitable business model for smallholders/SMEs
- **Stakeholder engagement and capacity building:** work with local/national partners – universities and community groups
- **Potential for scaling up** these activities and linking to restoration of degraded land for biomass production – private and corporate investors

Photo: CIFOR

Review/stakeholders perception → Action research/ field trial and learning → Laboratory/chemical analysis, Business model → Potential for scaling up

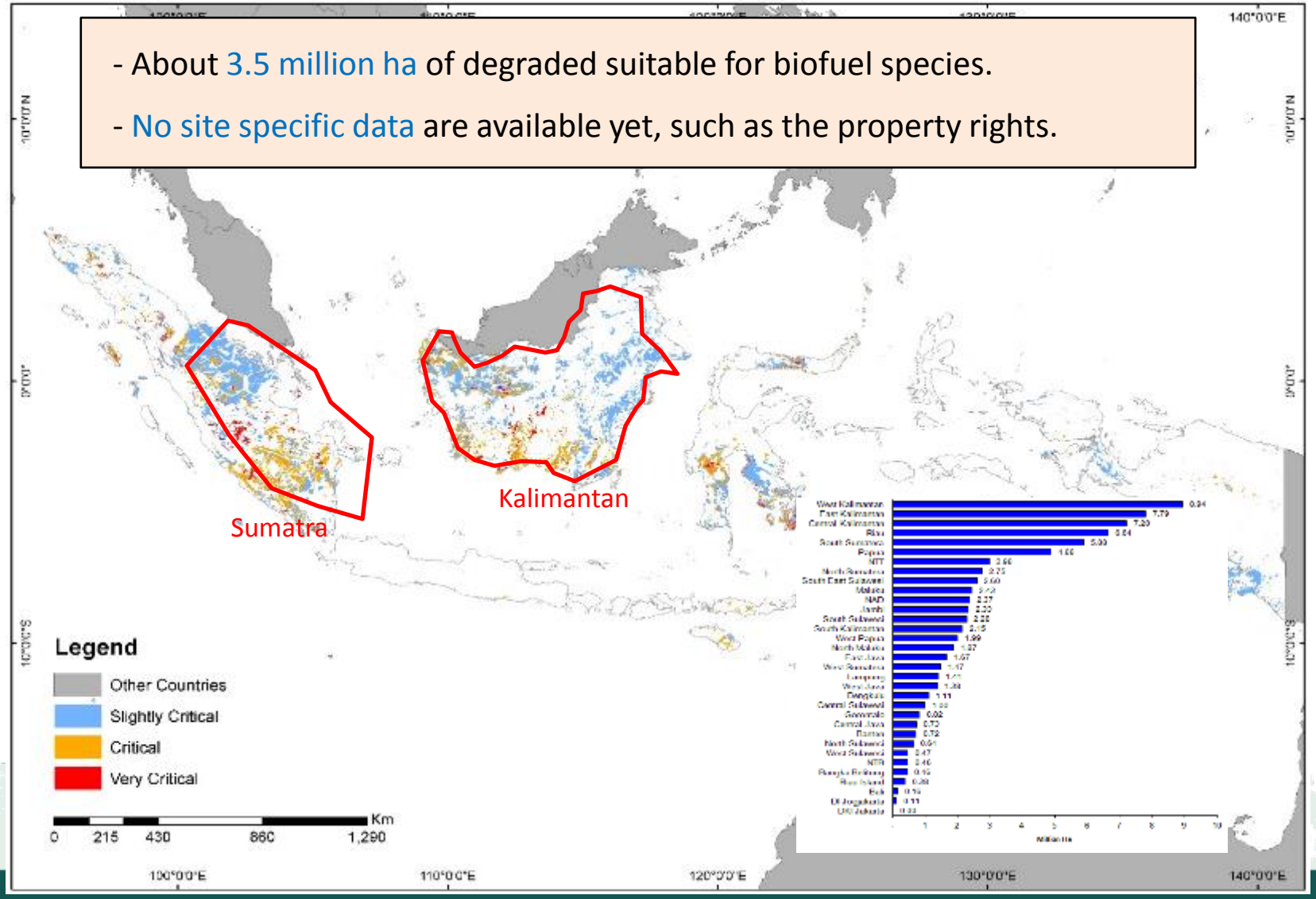
# Spatial analysis of degraded land in Indonesia




**Step 2: Suitability of degraded lands to grow biofuel species**

# Degraded land in Indonesia potentially suitable for bioenergy plantation

- About 3.5 million ha of degraded suitable for biofuel species.
- No site specific data are available yet, such as the property rights.

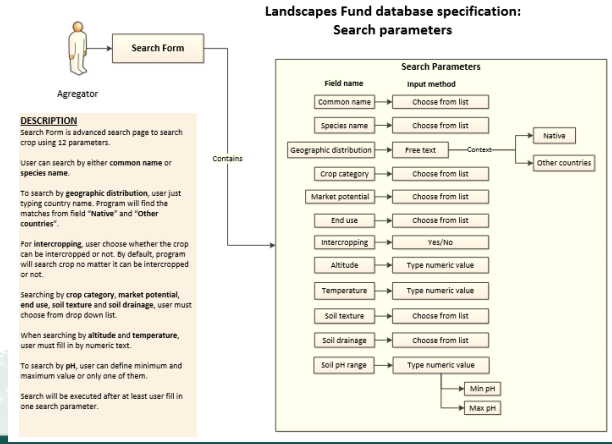


# Site-specific species selection for restoration and bioenergy

- Identified wide range of tree species suitable based on climate, soil requirement

- Research is underway – in various types of degraded land such as, drained and burned peatland,
  - 5 trial sites in Central/ East Kalimantan, South Sumatera
  - 15 ha, 10 species
  - Integrated food and energy production model
  - Monitoring, soil, carbon, water and biodiversity

- Partnership – Govt, private and public universities, private sector, local communities



# EXAMPLE I: CALOPHYLLUM INOPHYLLUM (NYAMPLUNG)

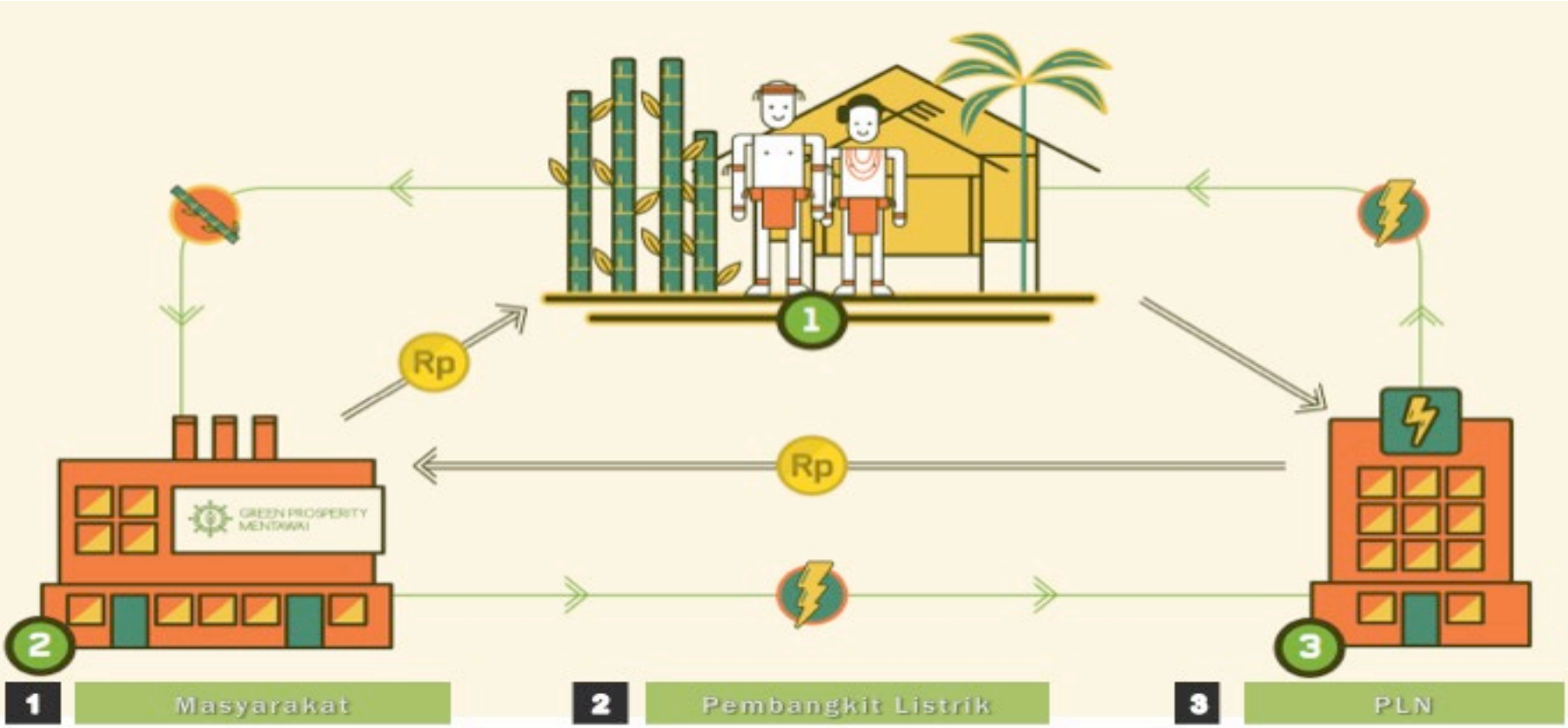
- Grows in coastal regions and lowland areas;
- Tolerates **various types of soil** including degraded land;
- **Agroforestry potential** – for the first few years;
- Multiple uses such as – **landscape restoration, honey prodn, high quality wood**;
- Early results indicate promising species for peatland.

# EXAMPLE II: PONGAMIA PINNATA

- Fast growing, medium sized evergreen tree,
- Yields from 9 to 90 kg seed/tree
- Can produce up to 42% oil per seed suitable for biodiesel production
- Other uses – honey prodn, wood, seed cake, medicine

Ph

# Partnership with private sector : Example Clean Power Indonesia (CPI)




**Local community**

Local Village will provide biomass for power plant and minority shareholder of power plant.

**Power Plant**

**CPI** will develop the project from design, technology selection, construction and access to climate change funding

**CIFOR's** role as science partner – scientific inputs on social and environmental issues.

**PLN**

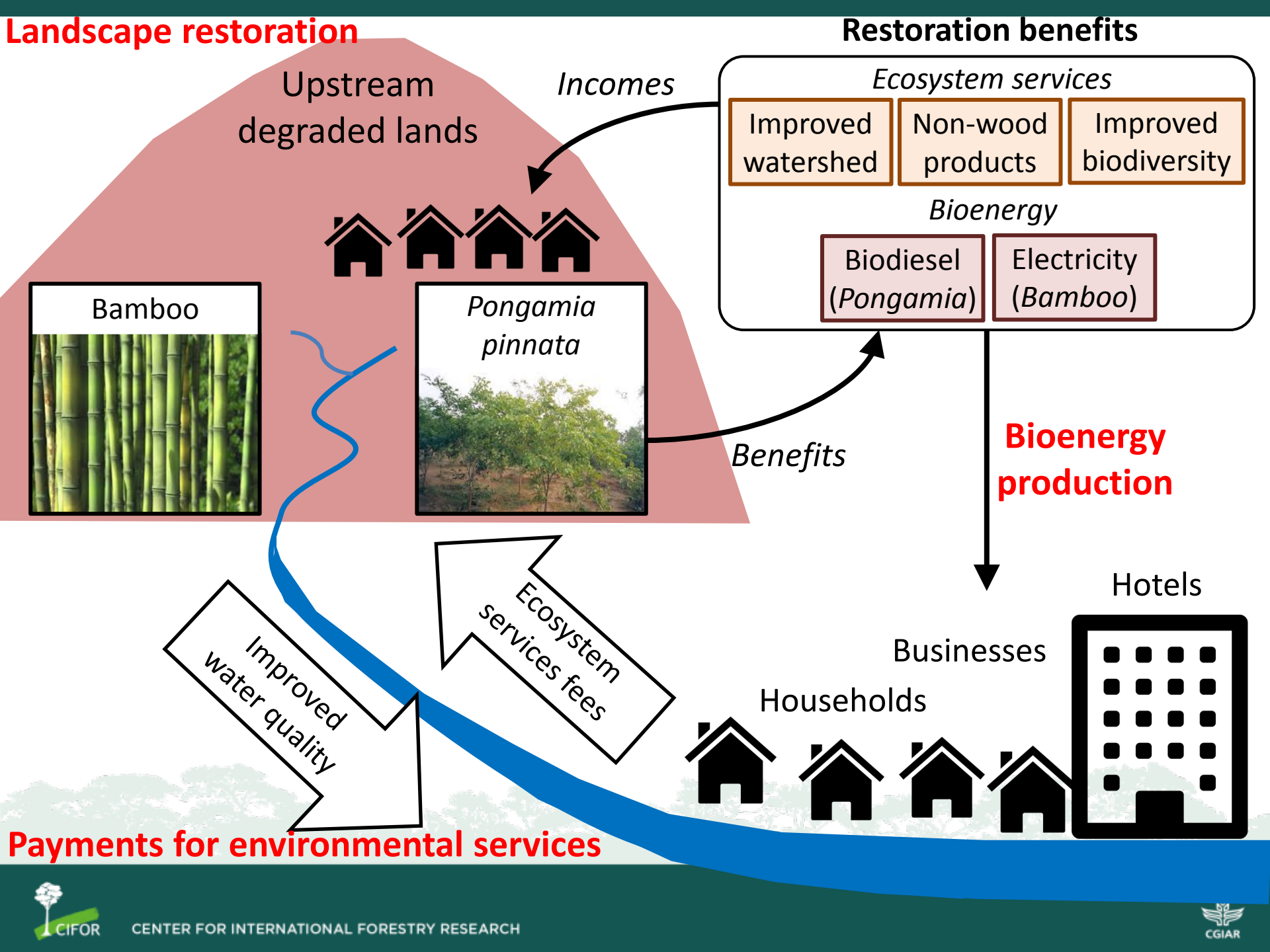
PLN will provide off-taker guarantee and distribute government's subsidy to local communities

# Future work: scenarios of managing peatlands and trade-offs among multiple ecosystem services

Business as usual

Intensive agriculture

Paludiculture


Landscape restoration
Restoration benefits
Upstream degraded lands
Incomes
Ecosystem services
Improved watershed
Non-wood products
Improved biodiversity
Bioenergy
Biodiesel (Pongamia)
Electricity (Bamboo)
Bamboo
Pongamia pinnata
Benefits
Bioenergy production
Hotels
Businesses
Households
Improved water quality
Ecosystem services fees
Payments for environmental services


# Concluding comments

- Restoring land for bioenergy could play an important role in meeting **the Bonn Challenge** to restore degraded landscapes to productive use;
- Integrating bioenergy and food production on degraded land can provide **opportunities for social and economic development** in rural communities which contributes to several SDGs;
- The potential competition for land and for raw material with other biomass uses must be carefully managed.

forests

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*Short Note*

# Screening Potential Bioenergy Production of Tree Species in Degraded and Marginal Land in the Tropics

land

*Article*

## Assessment of Suitability of Tree Species for Bioenergy Production on Burned and Degraded Peatlands in Central Kalimantan, Indonesia

**Siti Maimunah [1], Syed Ajijur Rahman [2,*], Yusuf B. Samsudin [2], Yustina Artati [2], Trifosa Iin Simamora [2], Sarah Andini [2], Soo Min Lee [3] and Himlal Baral [2]**

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## CIFOR talks landscape restoration and bioenergy at Indonesia's House of Regional Representatives

15 SEP 2017

*sustainability*

MDPI

*Article*

# Spatial assessment of degraded lands for biofuel production in Indonesia

**Wanggi Jaung [1,*], Edi Wiraguna [2,3], Beni Okarda [4], Yustina Artati [4], Chun Sheng Goh [5,6], Ramdhoni Syahru [3], Budi Leksono [7], Lilik Budi Prasetyo [3], Soo Min Lee [8] and Himlal Baral [4]**

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## Integrating bioenergy and food production on degraded landscapes in Indonesia

CIFOR 25th ANNIVERSARY FORESTS MATTER

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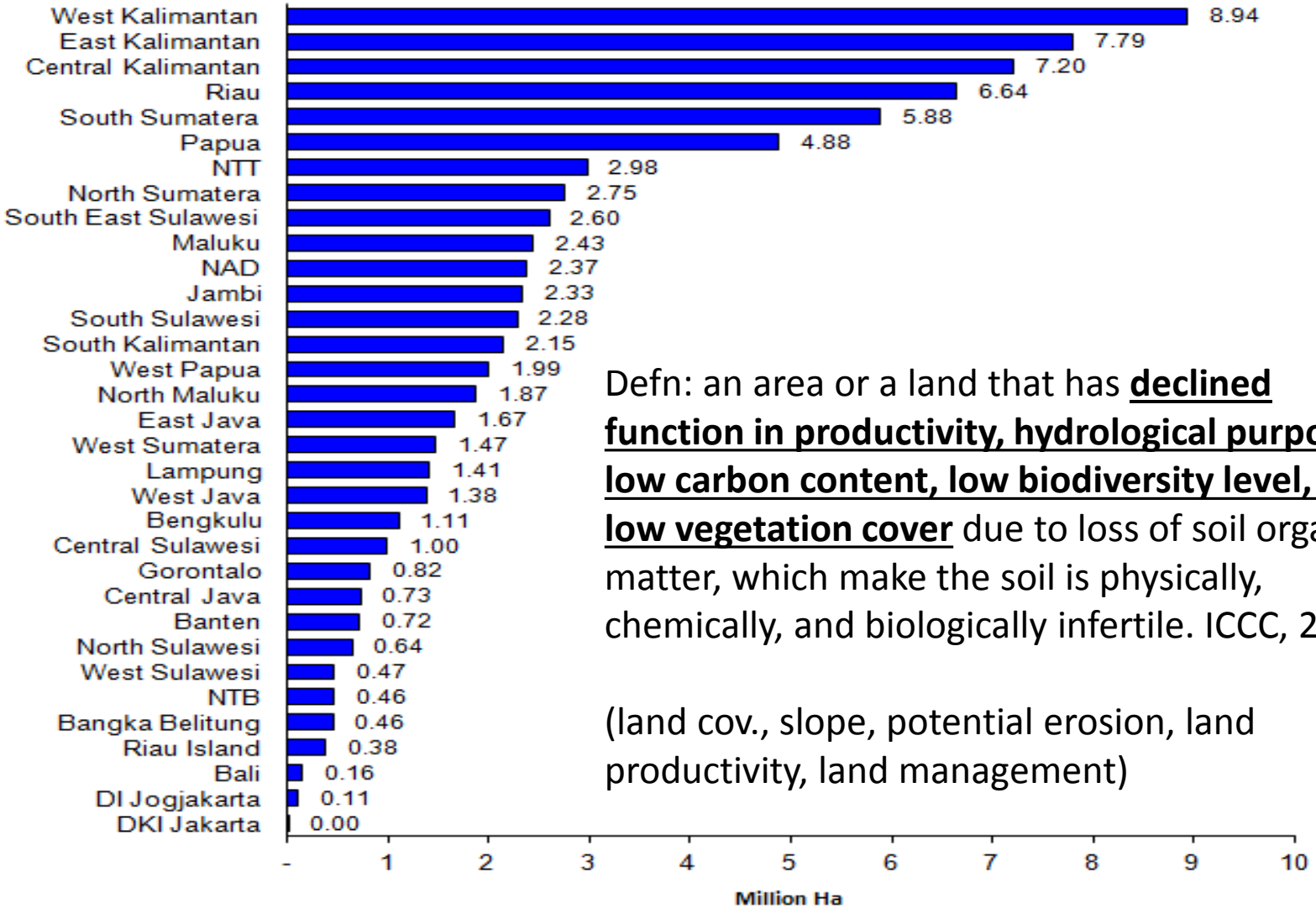
# Additional slides for discussion

# Degraded land in Indonesia



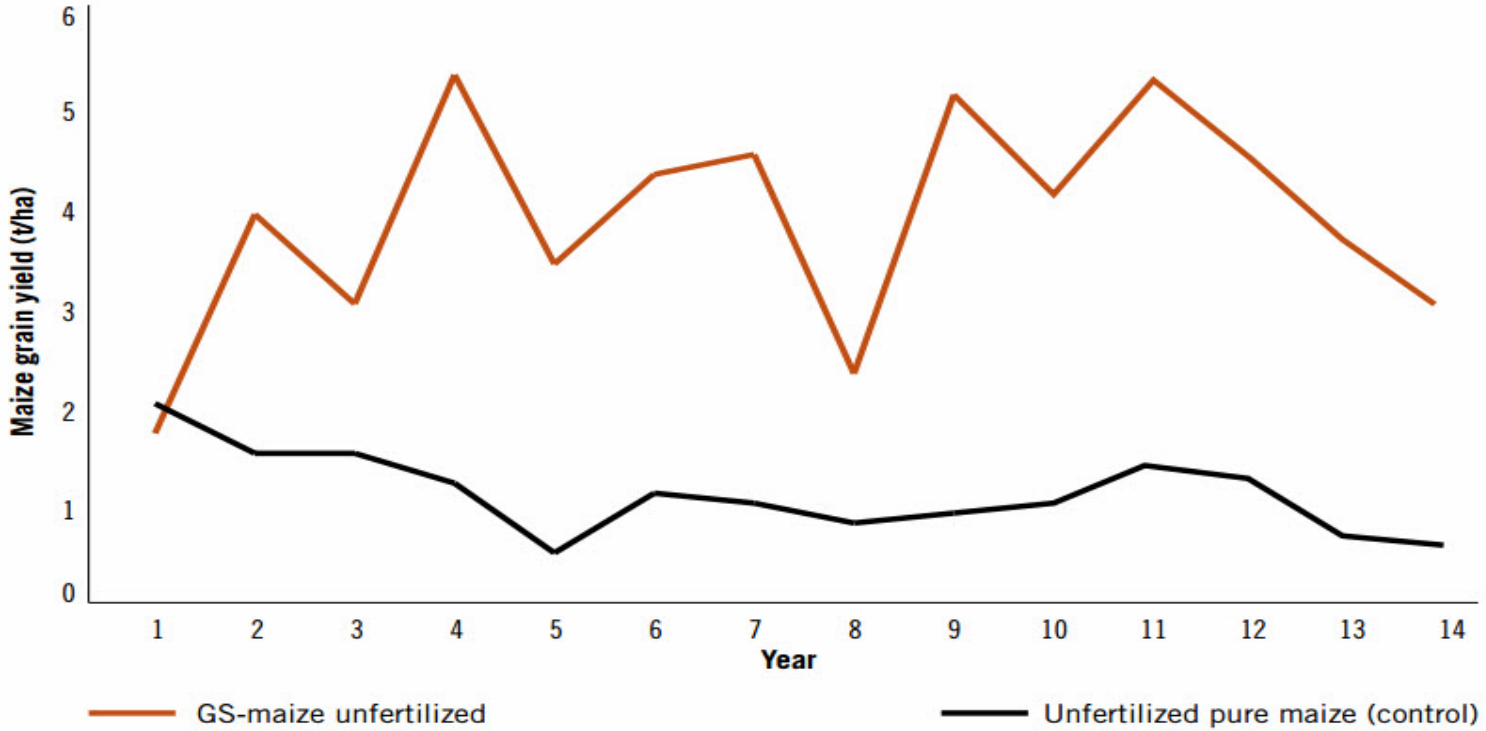

Defn: an area or a land that has **declined function in productivity, hydrological purpose, low carbon content, low biodiversity level, and low vegetation cover** due to loss of soil organic matter, which make the soil is physically, chemically, and biologically infertile. ICCC, 2014

(land cov., slope, potential erosion, land productivity, land management)

Source: *Critical Areas Map of Forestry Planning Agency/ICCC, 2014*

The advantage of the intercrop over the improved fallow is that the trees need to be planted only once, although they require multiple prunings during the year. Yields have been shown to be consistently higher with the *Gliricidia* system than those of continuous cropping with no fertilizer. Figure 3 shows a comparison of those yields over 14 years in Malawi.

**FIGURE 1.3. MAIZE YIELDS OF *GLIRICIDIA* INTERCROP AND MAIZE MONOCROP SYSTEMS OVER 14 YEARS IN MAKOKA, MALAWI**

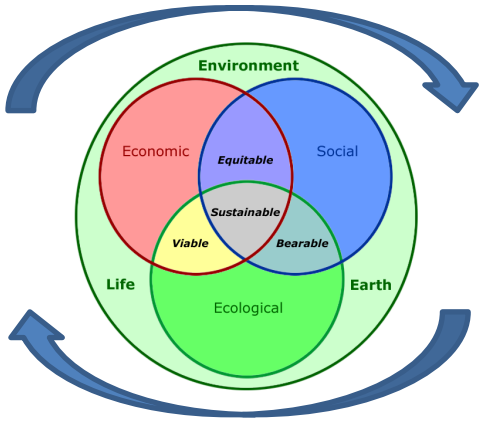



*Source:* Akinnifesi, A., W. Makumba and F.R. Kwesiga, 2006.

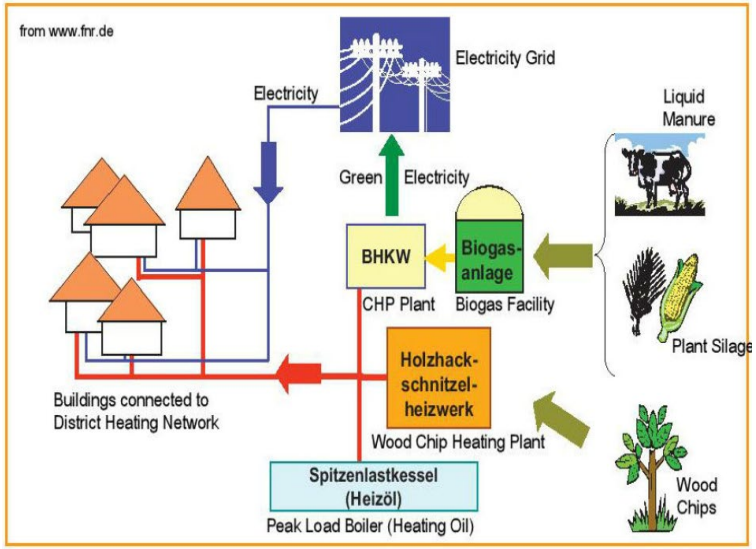
*Note:* t/ha = tonnes per hectare

# Forest landscape restoration and bioenergy linkage

Produces biomass




Justifies the cost



# 1st generation biofuels

(using mostly edible feedstocks)

**Bioethanol** from
- sugarcane
- maize
- wheat

**Biodiesel** from
- vegetable oils
- palm oil
- rape seed oil
- sunflower oil

**Biogas** from energy crops
- maize
- sugar beet

**BtL** (biomass to liquid) from wood
- Thermochemical process with **pyrolysis/gasification**
- produces syngas

## Characteristics of 2nd generation biofuels

**Nonfood feedstocks:**
Residues from already existing biomass stocks e.g.
- Food waste
- Farm slurry
- Chicken litter
- Abatoir waste
- Waste wood

**Improved conversion technology:**
- More complete conversion of cellulosic plant fraction
- grown on marginal land

**Improved GHG performance:**
Compared to 1st generation

Gredmaier, 2016