

# Sustainable Bioenergy Development Opportunities and Challenges in Research & Policy for Africa

Miyuki Iiyama  
August Temu  
Cristel Munster  
Ramni Jamnadass

World Agroforestry Centre (ICRAF)  
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# Background

## Global Bioenergy Development Discourses

- Climate change & energy insecurity have driven boom on liquid agrofuel
- Speculations have led to concern over food security/poverty
- LCA studies have started questioning efficiency

## African Bioenergy Development Discourses

- Bioenergy regarded as a win-win-win option (above 2+econ development)
- Some small-farmers regarded it as new “cash” crops
- Some expat. investors regarded it as large investment chances

## African Experiences so Far

- Agronomic solutions require lots of research and development
- Value chains of agrofuels have not yet well developed
- Some land grabbing occurred with negative socioecon & env. impacts
- Critical importance of woodfuels is completely forgotten

# African Energy Portfolios

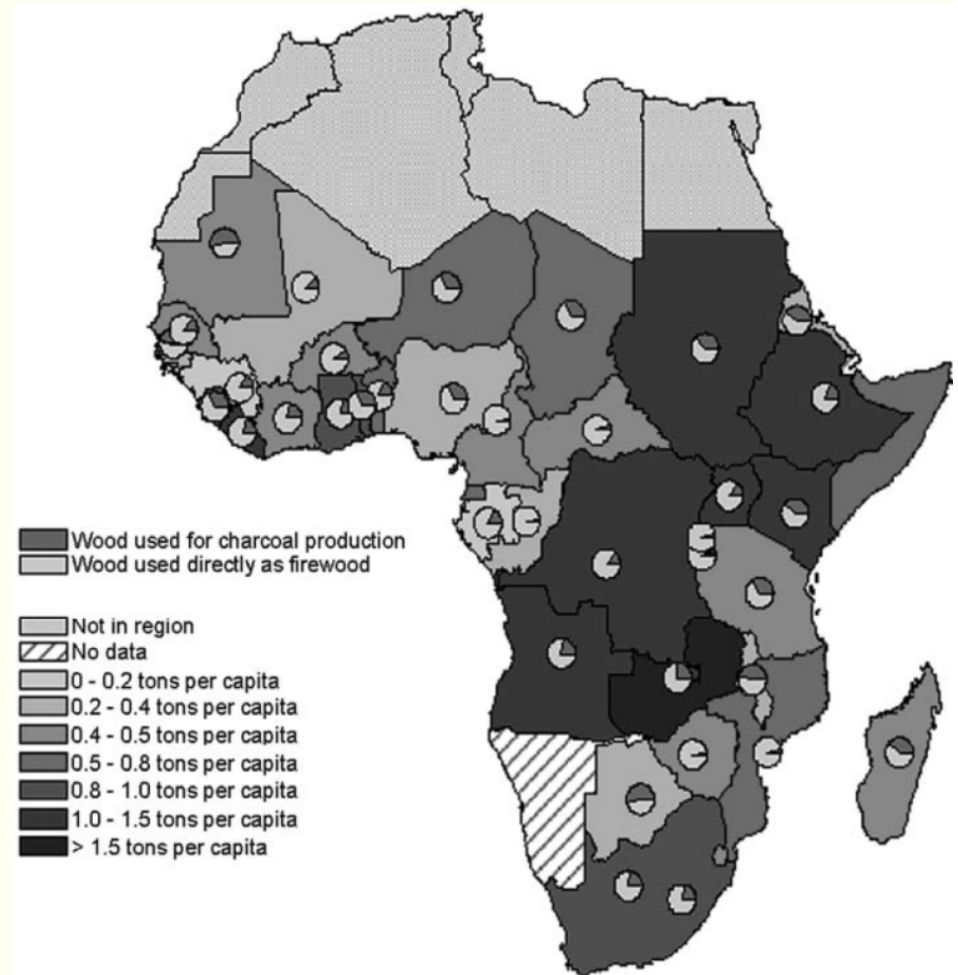
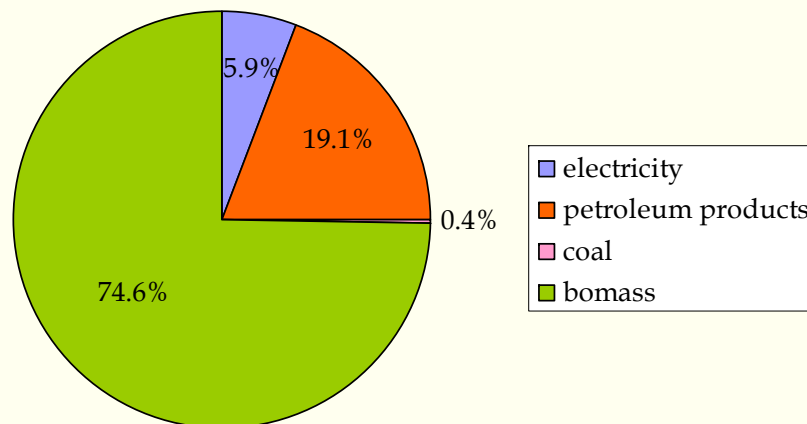
## Limited Modern Energy Provision

- Transport sector depends on imported fossil fuels, creating fiscal burden
- Electricity provision often depends on hydro, unreliable in dry years
- Majority of urban & rural HHs cannot have access to modern energy

## Traditional Biomass

- As a result, 70% to 90% of population in rural areas, depend on fuelwood and charcoal
- They cause deforestation & env. degradation as well as pollution

energy supply by source in Kenya (IAEA 2007)



# **Africa - Economy, Agriculture, Resources**

## **Economy & Poverty**

- Industrialization is constrained due to inadequate modern energy
- Economy is heavily dependent on agricultural sector with poor farmers
- Bioenergy can boost industries & alleviate poverty
- However it must not compromise primary needs of feeding populations

## **Agricultural Productivity & Natural Resources**

- Highly suitable areas are overpopulated, ASALs less productive
- NR bases (soil, water) are fragile and threatened under pop. pressure
- Farmers practice extensive rain-fed agriculture with little inputs
- Productivity remains low, as farmers cannot afford risky investment

## **Therefore...**

- Increasing agricultural productivity rapidly would require intensification, including use of agro-chemicals and organic matters
- NR bases needs to be well managed more than before (In view of CC)
- Investment in capacity & infrastructure (irrigation, roads, etc.) are crucial

# Sustainable Bioenergy Development

## Opportunities

### *Demand side - Energy Security*

- Clean & modern energy access for the majority
- Stable energy supply for econ development

### *Supply side - Rural/Agricultural Development*

- Productive land use
- Employment/income opportunities

## Goals

*Demand side* - Enhancement of sustainable bioenergy portfolios

*Supply side* - Viable rural sector development

## Critical Conditions

- Assurance of local ownership
- Assurance of socio-econ & environmental sustainability

# Conceptual Framework

## Bioenergy Diversification Matrix - FAO UBET

production, supply	common groups	users side, demand examples
Direct woodfuels Indirect woodfuels Recovered woodfuels Wood-derived fuels	<b>WOODFUELS</b>	<b>solid:</b> firewood, charcoal briquettes <b>liquid:</b> black liquor etc. <b>gasses:</b>
Fuel crops Agric by-products Animal by-products agro-industry BPs	<b>AGROFUELS</b>	<b>solid:</b> straw, bagasse, etc. <b>liquid:</b> ethanol, SVO, diesel 2 <sup>nd</sup> + generation (cellulous), etc. <b>gasses:</b> biogass
<b>Municipal by-products</b>	<b>MUNICIPAL BY-PRODUCTS</b>	<b>solid/liquid/gasses</b>

## Heterogeneous Opportunities & Challenges

...can complicate identifications of gaps in research & policy

- Demand: Value Chain/Technology

- Supply: Land & Resource Use/ Socioecon & Environmental Sustainability

# Value Chain & Technology

## Opportunities

- Access to cleaner & modern energy for the poor
- Diversified thus stable supply of energy for econ. development
- Import substitution & surplus for export

## Challenges

- technology needs improvement, R&D
- Woodfuels with incentives, agrofuels with supply bottlenecks

groups	WOODFUELS		AGROFUELS	
FORM	solid		liquid	
TYPES	firewood	charcoal	ethanol	SVO & diesel
<b>SECTOR</b>				
<i>Domestic</i>				
HH	high D	high D	high P	high P
Commercial	D	high D	high P	high P
Industrial	D	D	P	P
Transport	-	-	high P	high P
Heat & power	-	high P	P	P
<i>Export</i>	-	-	P	P
<b>VALUE CHAIN</b>				
Production	existing, but informal & inefficient		yet fully developed	not yet developed
Collection				
Processing				
Distribution				
End-use device				
<b>REGULATIONS</b>				
Product quality	no effective regulations		blending mandate? license/standards?	
Product safety				

\* D...demand: P...potential

# Value Chain -Woodfuels

Value chains exist but remain informal & inefficient...

firewood  
livelihoods burden

charcoal  
inefficient tech.

briquettes  
recycling option

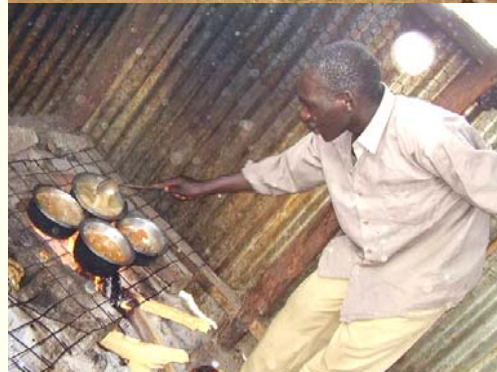
*Feedstock/  
Production*



*Distribution/  
Processing*



*End use/Final  
Consumption*



# Value Chain - Agrofuels

Value chains yet developed, local accessibility/affordability crucial

plantation for export bypassing locals? wild-growing trees SVO price sensitive

Smallholder farmers

*Feedstock/  
Production*



*Distribution/  
Processing*



No value chain developed/  
few technologies for HH available at this moment

*End use/Final  
Consumption*



# Land Use & Sustainability

## Opportunities

- Productive land use
- Income & employment creation

## Challenges

- Issues can be diverse across types / scales, with lots of uncertainties
- Sustainability can also be case specific, need careful evaluations
- Harmonization of cross-sector policies
- EIA/zoning mandates

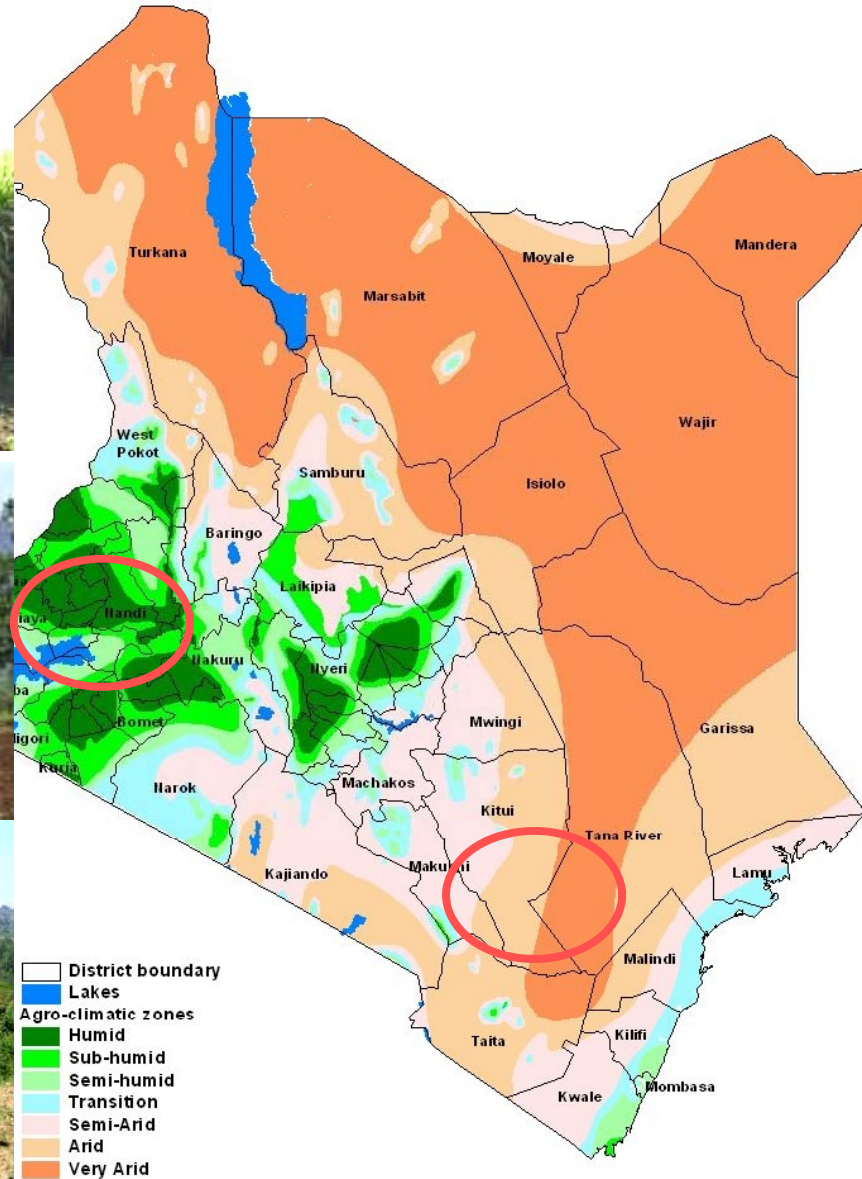
Groups	WOODFUELS		AGROFUELS	
TYPES	firewood/charcoal		ethanol, SVO/diesel	
SCALE	forest	non-forest AF	large scale plantation	small scale plantation
<b>SUSTAINABILITY ISSUES</b>				
GHG	highly N	P?	?	?
Deforestation	highly N	P?	?	P?
Food security	?	?	highly N	?
Livelihoods/habitat	?	P?	?	P?
Biodiversity	highly N	?	highly N	?
Water & soil quality	highly N	?	N?	?
<b>RELATED SECTORS</b>				
Energy	O	O	O	O
Agriculture		O	O	O
Lands/Investment			O	
Forestry	O	O		
Water	O	O	O	O

\* P...positive: N...negative: ?...ambiguous

# Land Use - Socioeconomic Sustainability

## Food Security, Habitat, Pastoralist Land Use

Food vs. Fuel



Pastoral Land Use

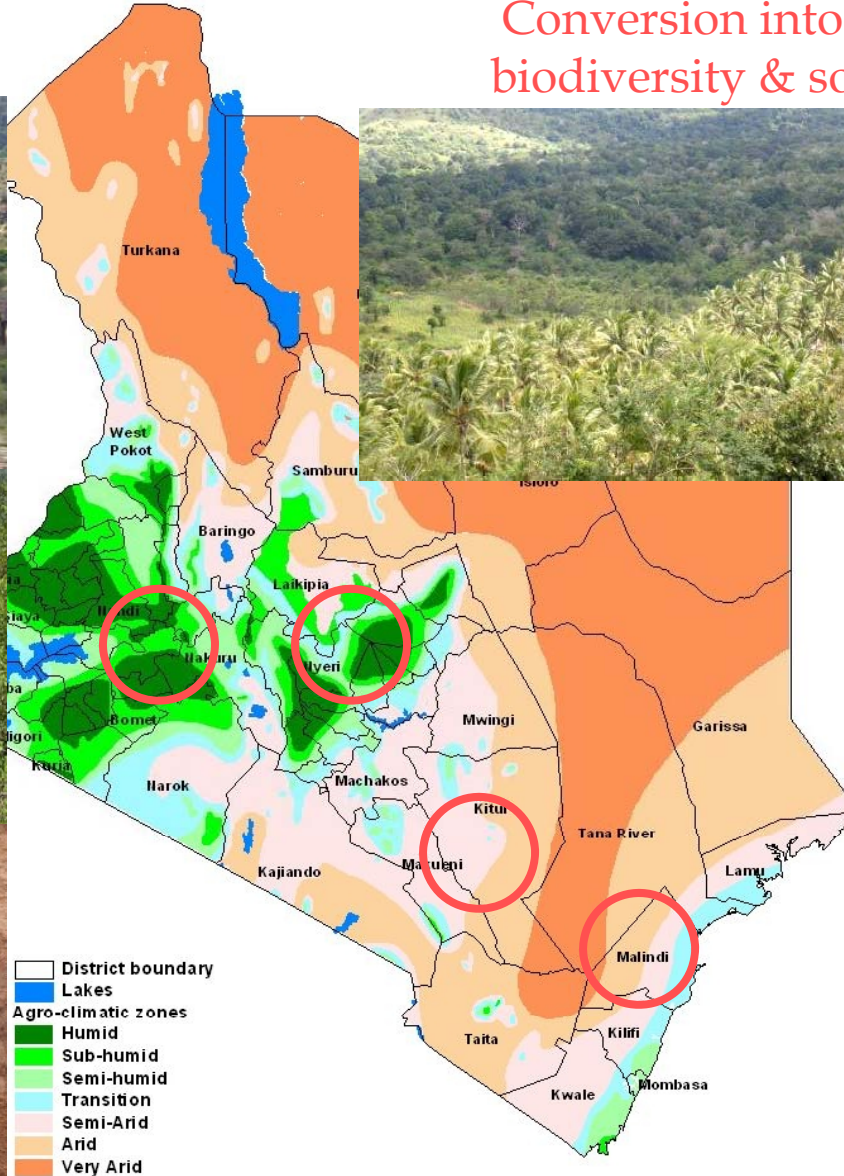


# Land Use - Environmental Sustainability

## Deforestation, Biodiversity Loss, Carbon Debt

Deforestation affects water tower & climate

Conversion into farm land leads to biodiversity & soil loss, carbon debt



# Gaps in Research

**Need to coordinate multi-disciplinary research at national levels**

	RESEARCH ISSUES	RESEARCH ACTIONS
<b>Domestication</b>	identification of optimal species/feedstocks at various agro-ecological conditions	baseline survey analysis on genetic diversity provenance & silvicultural trials
<b>Productivity</b>	optimal management AF impacts on water/soil	geographical/biophysical suitability
<b>Soil quality</b>		carbon sequestration
<b>Climate change</b>	possibility of CDM  technology R&D/transfer incentives/regulations	CBA & LCA  across diverse feedstocks as well as diverse socio-econ & agro- ecological conditions
<b>Value chain, business models</b>		
<b>Env. services</b>		

# Gaps in Policy

Need to balance bioenergy development goals & other primary goals

	WOODFUELS	AGROFUELS
Support for inputs	<ul style="list-style-type: none"> <li>• Input subsidies</li> <li>• <b>Quality germplasm availability</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Land tenure policies</b></li> <li>• <b>Careful Zoning/Mapping</b></li> <li>• Input subsidies (i.e. fertilizer etc.)</li> <li>• Energy &amp; water pricing</li> </ul>
Support for production	<ul style="list-style-type: none"> <li>• <b>Legalization/formalization of woodfuel production</b></li> <li>• <b>Tax exemptions/incentives for woodfuel AF</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>General support to agriculture</b></li> <li>• Agricultural subsidies</li> <li>• Farm income support</li> <li>• Trade policies</li> </ul>
Support for processing & marketing	<ul style="list-style-type: none"> <li>• <b>Mandate quality requirements</b></li> <li>• <b>Incentives for investment</b></li> <li>• Production linked payments</li> <li>• Tax credits, exemptions</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Incentives for investment</b></li> <li>• <b>Mandate use requirements</b></li> <li>• Production linked payments</li> <li>• Tax credits, exemptions</li> <li>• Trade policies</li> </ul>
Support for consumption	<ul style="list-style-type: none"> <li>• <b>Incentives for fuel-efficient stove/ cooker/jiko purchase</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Incentives for flex-fuel vehicle &amp; device purchase</b></li> <li>• Subsidies for purchase</li> <li>• Tax exemptions (road tax)</li> </ul>

# Conclusion

- Filling in the policy gaps – major challenges are inadequacy of our current knowledge
- Completing the fundamental research – may require up to 10 years to fully develop
- Using other biomass (uncultivated vegetative materials) – may raise issues of sustainability and ecosystem resilience
- Net GHG emission from different bio-fuels – a monitoring challenge.

A close-up photograph of a tomato plant. Several round tomatoes are visible, some yellow and some green, hanging from the green stems. The background is filled with green leaves and a bright, sunny sky. The text "Thank You" is written in a bold, blue, serif font across the center of the image.

**Thank You**