

# African Transformation & Bioenergy

**Lee Lynd**

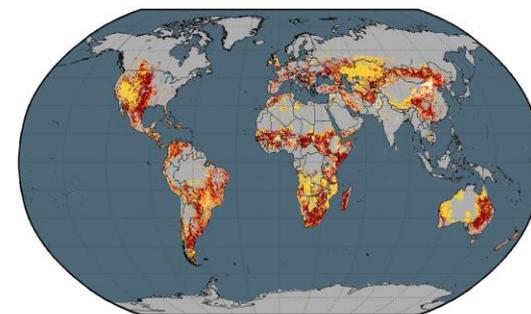
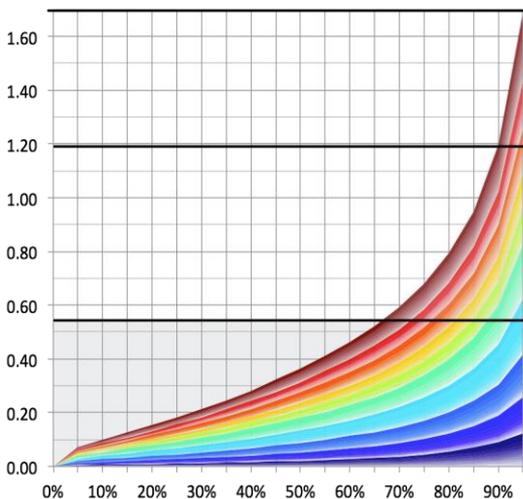
Thayer School of Engineering, Dartmouth College

Global Sustainable Bioenergy Project

Mascoma Corporation

Bioenergy Science Center

**GSB Workshop  
Oak Ridge National Lab  
June 12 & 13, 2013**



# Schedule and Objectives

## **I. Presentation & Discussion Relevant to the NEPAD/FAPESP Collaboration**

9:00 to 9:20: Geospatial analysis and modeling (Jansle Rocha)

9:20 to 9:40: NEPAD/FAPESP collaboration (Mosad Elmissiry, Emile van Zyl)

9:40 to 10:00: African Transformation & Bioenergy (Lee Lynd)

10:00 to 10:45: Brainstorm discussion

## **II. Overview & Updates (11:00 to 12:00)**

LACAF-I (Cortez, Horta)

Social (Andre Furtado)

Environmental (Lee Lynd)

## **III. Lunch/Discussion of Finalizing the Geospatial Analysis & Modeling Proposal (12:-00 to 2:00 PM Adjourn)**

# GSB Structure

	Geospatial Analysis			Social		Environmental				Integrated Analyses & Scenarios	
	Livestock Production	Energy Crop	Database Development	Food security	Social Welfare & Economic Development	Soil Fertility	Water	Climate	Biodiversity	Making Room for Bioenergy	Multiple benefits
Global											
Local, "LACAF"* Countries											

\*Latin America, Caribbean, and Africa

## Status

**Geospatial:** LACAF-I (sugar cane modeling). FAPESP proposal under development. Submission by the end of June targeted, 7 papers outlined. Published papers on crop models (Shujiang, Stan W.). Papers under development on livestock intensification (John), empirical crop models (Shujiang). Led by Jansle, with John, Beauclair, Keith, Shujiang.

**Integrated analysis.** LACAF-I work (diagnosis, production models & innovation). NEPAD/FAPESP collaboration & related paper. Soon to be submitted papers: Diet & land availability, Need for biofuels in a low-carbon economy. Lee & Horta leaders.

**Social:** Proposal under development. Led by Andre Furtado with Marcia Azanha, Jeremy.

**Environmental:** Preliminary discussions with potential Luiz Martinelli (potential leader), Suani Coelho, Oswaldo Lucon, and Gideon Wolfaardt (water), Heitor Cantarella (soil)

# Bioenergy: A Means Rather than an End

**Bioenergy Faithful.** Convinced that bioenergy is beneficial, they will ask  
“How do we make it happen?”

Few

**Others.** If we can get their attention, which may not be easy, they will ask  
“Does this serve my main priorities?”

Many

**To broaden support for bioenergy, *Social needs* → *Bioenergy* will often be more effective than the *Bioenergy* → *Social needs* path**

***Resolution of the African GSB Convention.*** Africa faces pressing human challenges associated with an interconnected set of issues involving poverty, food security, economic development, gender issues, health and energy security. Energy security is often interpreted at an international level, but when women and girls spend most of their days gathering firewood it has a much more local dimension. Bioenergy has clear potential to be developed in ways that contribute positively to meeting these challenges, including enhancing food security. However, bioenergy could also be developed in ways that exacerbate these challenges. A vision for bioenergy in Africa that is responsive to African challenges is both an urgent need and an opportunity.

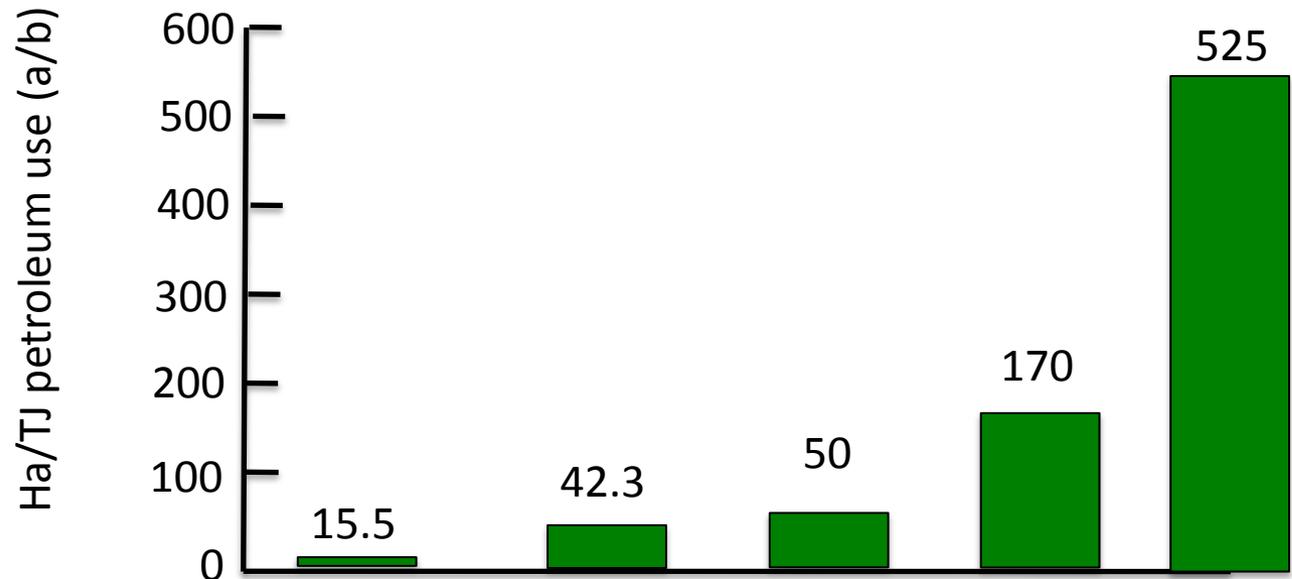
# Bioenergy & the Food-Insecure Poor

Availability of potentially productive land has often been seen as a liability for Africa

But in fact may be her greatest asset

... especially relative to demand

	European Union	North America	Asia	South America	Africa
a. Total land (ha capita <sup>-1</sup> )	0.9	6.0	0.8	4.5	3.1
b. Petroleum Use (TJ capita <sup>-1</sup> yr <sup>-1</sup> )	0.0581	0.142	0.016	0.0265	0.0059



[http://www.iea.org/stats/balancetable.asp?COUNTRY\\_CODE=11](http://www.iea.org/stats/balancetable.asp?COUNTRY_CODE=11)

<http://www.census.gov/ipc/www/idb/region.php>

<http://www.indexmundi.com/energy.aspx?region=sa&product=oil&graph=consumption>

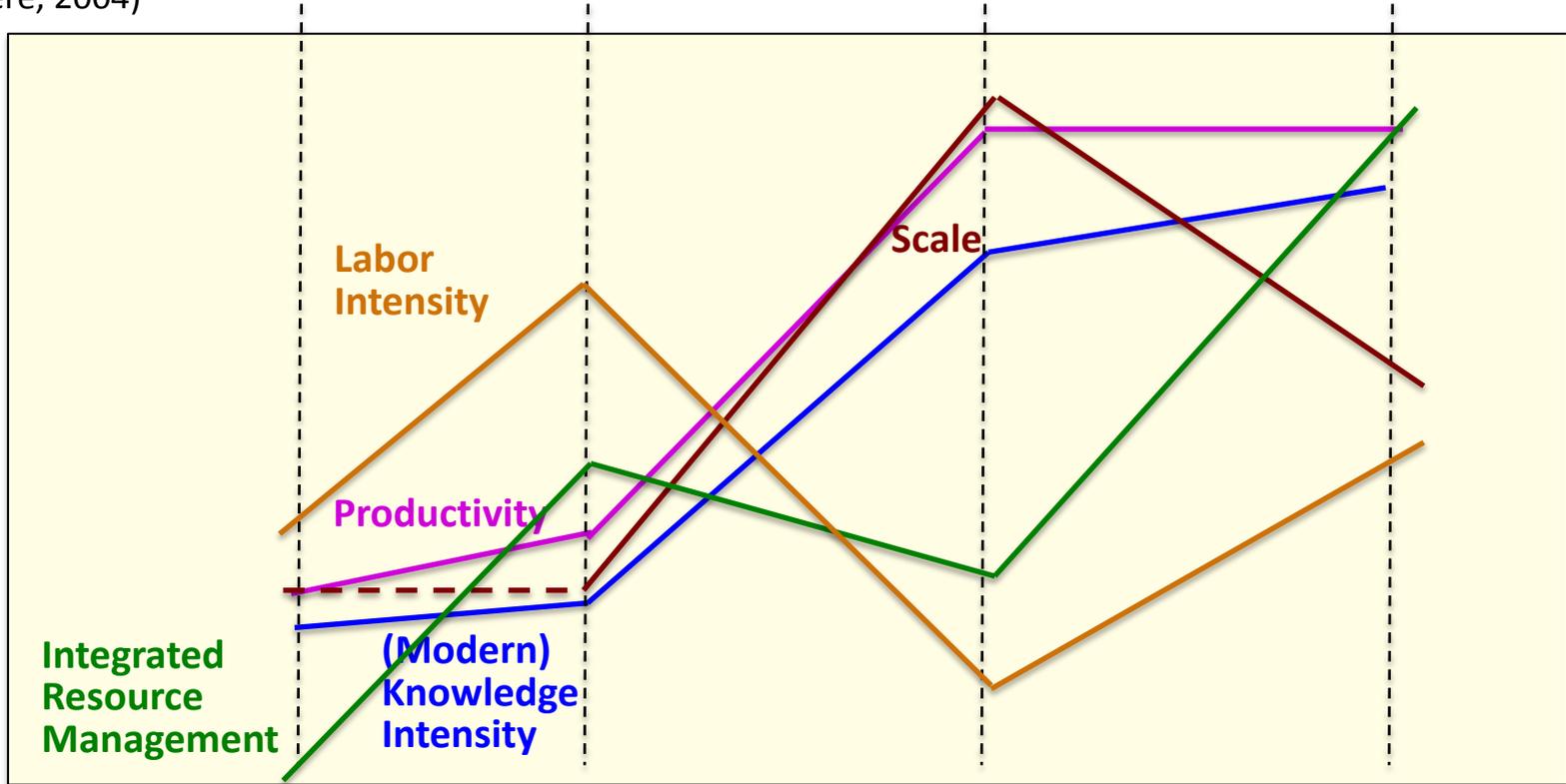
<https://www.cia.gov/library/publications/the-world-factbook/oeos/ee.html>

# Evolution of Agriculture



**Agricultural Mode** (modified from van Kuelen & Schiere, 2004)

**Expansive** (Long fallow periods)    **Low External Input** (Often with extensive integration)    **High External Input** (Usually specialized)    **New Conservation** (Extensive integration, knowledge intensive)



*Like cel phones, Africa might progress from the low external input/highly integrated mode to an African brand of new conservation agriculture bypassing some aspects of the high input/specialized mode.*

# Bioenergy & African Transformation: Possible Analysis Model

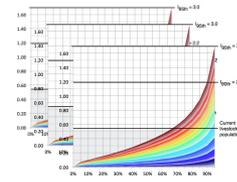
## What Is (for selected area)

- Climate
- Soil
  
- Land cover, use, & disturbance
- Current yield
- C/N flows, other services
  
- Social status & needs
- Supply and demand for food and energy
- Stakeholder input
- Land ownership

## Analysis

### Land use & management

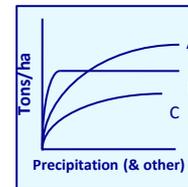
Crop & pasture yield curves



Management to increase yield

Available land

Energy crop models



Bioenergy production models & yields

### Social

What needs to be done to realize physical possibilities?

- Policies
- Education/extension
- Institutions (e.g. public/private partnerships)

## What could be

- More food
- More energy
- Improved fertility
- Cleaner water & air



- Economic development
- Distributed benefits
- Higher quality of life

# Bioenergy & African Transformation: Possible Analysis Model

## Important work underway in LACAf-1.

Diagnosis of food needs, analysis of land availability and physical potential, evaluation of alternative production models.

Pursued at a national level, currently for two African countries: Mozambique & SA

## Possible complementary focus of the NEPAD/FAPESP consortium

Analysis at the scale of individual feedstock catchment areas

Requires and fosters integrated analysis at a scale that likely will offer valuable insights

Relevant for motivating projects, which are at this scale

# Bioenergy & African Transformation: Possible Business Model

**Objective:** Simultaneously realize sustainable and widely-distributed social benefits and commercial viability.

## Alternative conceptual models

a) Find large available/unused fertile land areas to site a bioenergy facility

b) Make land available by first improving food crop yields

## Evaluation

- Widespread existence of such areas questionable
- Avoiding interaction with social systems is not the best way to serve them
- Larger potential land resource given Africa's abundant land and large yield gap
- Larger potential social impact
- More politically viable

**Observation:** Cannot add technical risk to risks inherent in application of a new business model in Africa. This must start with established (1<sup>st</sup> gen) technology, recognizing that there is a continuous path from sugar cane to cellulose.

# Bioenergy & African Transformation: Possible Business Model

**Objective:** Simultaneously realize sustainable and widely-distributed social benefits and commercial viability.

- 1) Develop spatially-explicit vision for coproduction of food and feedstock, and commercially viable bioenergy plant with maximum social benefits.
- 2) Increase food yields through agricultural extension (validated models readily available)
- 3) Plant bioenergy feedstocks on land made available by 2), construct bioenergy production facility.
- 4) Monitor and optimize social benefits, anticipating that these will be much greater than doing 2) alone.
- 5) Replicate.

## Key players

Communities

Companies

NGOs

Government (National and local)