South-South Experiential Lessons in Biofuel Sustainability

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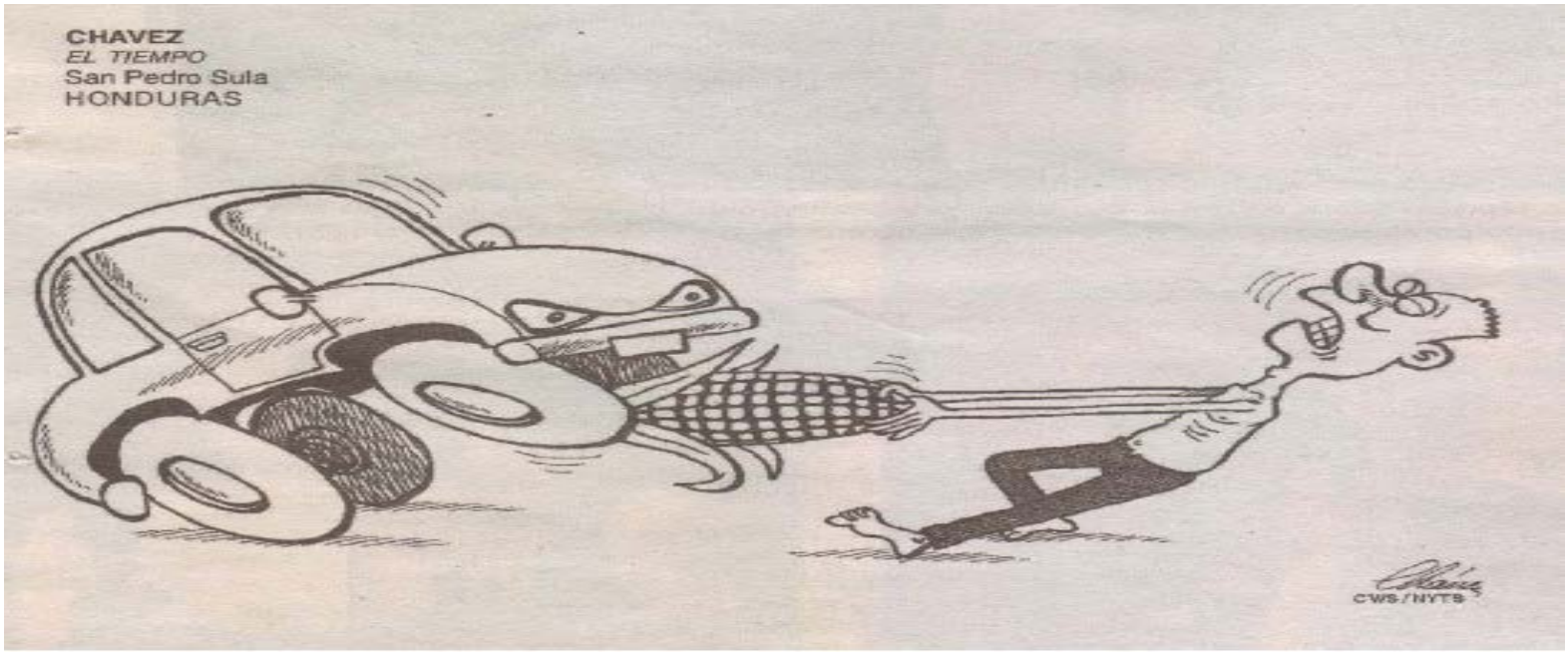
South-South Experiential Lessons in Biofuel Sustainability

- Excerpts from findings



Emmanuel Ackom,

Domestic Use of Energy (DUE) Conference, Cape Town, South Africa, 2nd - 4th April, 2013

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Definitions

- The work focused on **Liquid biofuels**

- IEA definition of Liquid Biofuels used in the study:
  Biofuels classified either as ***conventional*** or ***advanced*** *based on level of maturity*

- Conventional biofuel technologies= well established processes and biofuel being produced on commercial scale. Commonly referred to as 1st Generation. E.g. sugar based ethanol, starch based ethanol, oil crop based biodiesel and straight vegetable oil

- Advanced biofuel technologies = processes that are still in R&D, pilot or demonstration phase. Usually referred to as 2nd and 3rd Generation. Eg. biofuels from lignocellulosic biomass i.e. cellulose ethanol, biomass-to-liquids diesel, algae based biofuels.

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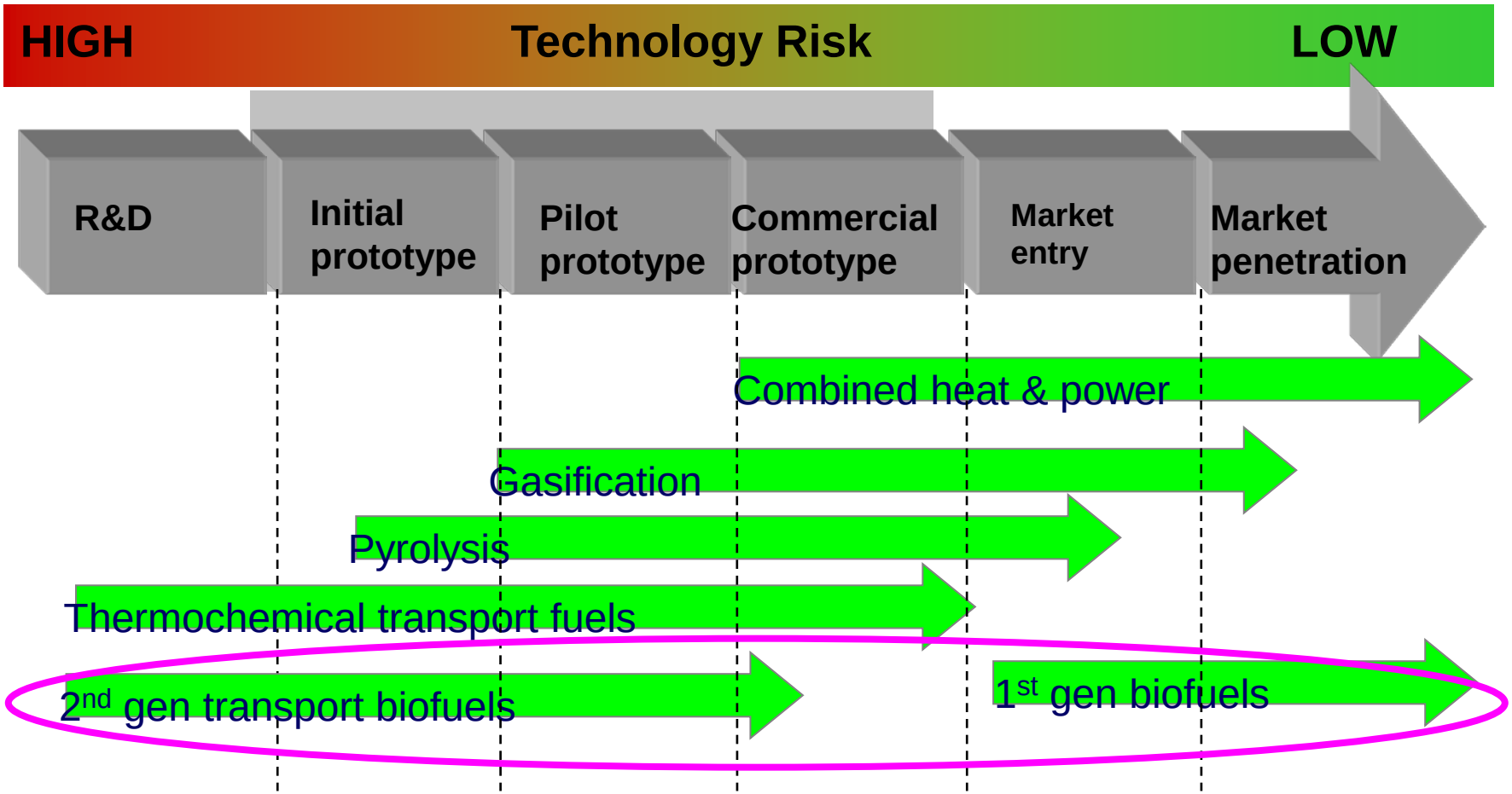

(Adapted from Ceres Ventures 2007 by IEA Task 39)

Need for policy support for 2nd generation bioethanol

Major ENVIRONMENTAL criteria

- Net GHG balances
- Land use change (direct & indirect)
- Net energy balances
- Water (use and consumption)
- Biodiversity
- Soil quality & health
- Pollution (air, water, soil) – responsible use of chemicals
- ….

Sources: Hill *et. al*, 2006; Searchinger *et. al, 2008*; Williams *et. al*., 2009; Ackom *et. al.,* 2010

Major SOCIAL principle & criteria

- Avoidance of competition with food
- Consultation & communication with local communities
- Biofuel production shall not take place on contested lands
- Compliance with national laws and ratified international laws on employment conditions and workers' rights
- Fair wages and compensations
- Employees are provided with fair legal contracts
- Workers are informed about their rights
- Proper subcontracting
- Working hours are not excessive
- Freedom of association and right to collective bargaining
- No child nor forced labour
- e.t.c.…

Sources: ILO, RSB, GBEP

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GNESD centres involved & studied countries

AIT Asian Institute of Technology → ***Thailand***

CENBIO, COPPE UFRJ — **CENBIO/CentroClima** → ***Brazil***

enda — **Energy, Environment, Development** → ***Senegal***

AFREPREN/FWD
Energy, Environment and Development Network for Africa → ***Kenya***

Fundación Bariloche → ***Argentina***

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Different aspects of Biofuel Sustainability in 5 selected countries

Country	Investigated topic
Thailand	Assessment of Thailand's liquid biofuel development
Brazil	Environmental zoning as a policy tool to increase the sustainability of sugarcane ethanol production in Brazil
Senegal	Policy considerations for biofuel implementation: A case study of *Jatropha curcas* in Senegal
Kenya	Potential of liquid biofuels in Kenya
Argentina	Sustainability indicators for biofuels in Argentina

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Assessment of Thailand's liquid biofuel development

- This paper provides an assessment of ethanol and biodiesel development in Thailand
  - type of feedstock being employed
  - production trends
  - planned targets and blending mandates
  - policies i.e. tax schemes
  - environmental and social sustainability considerations

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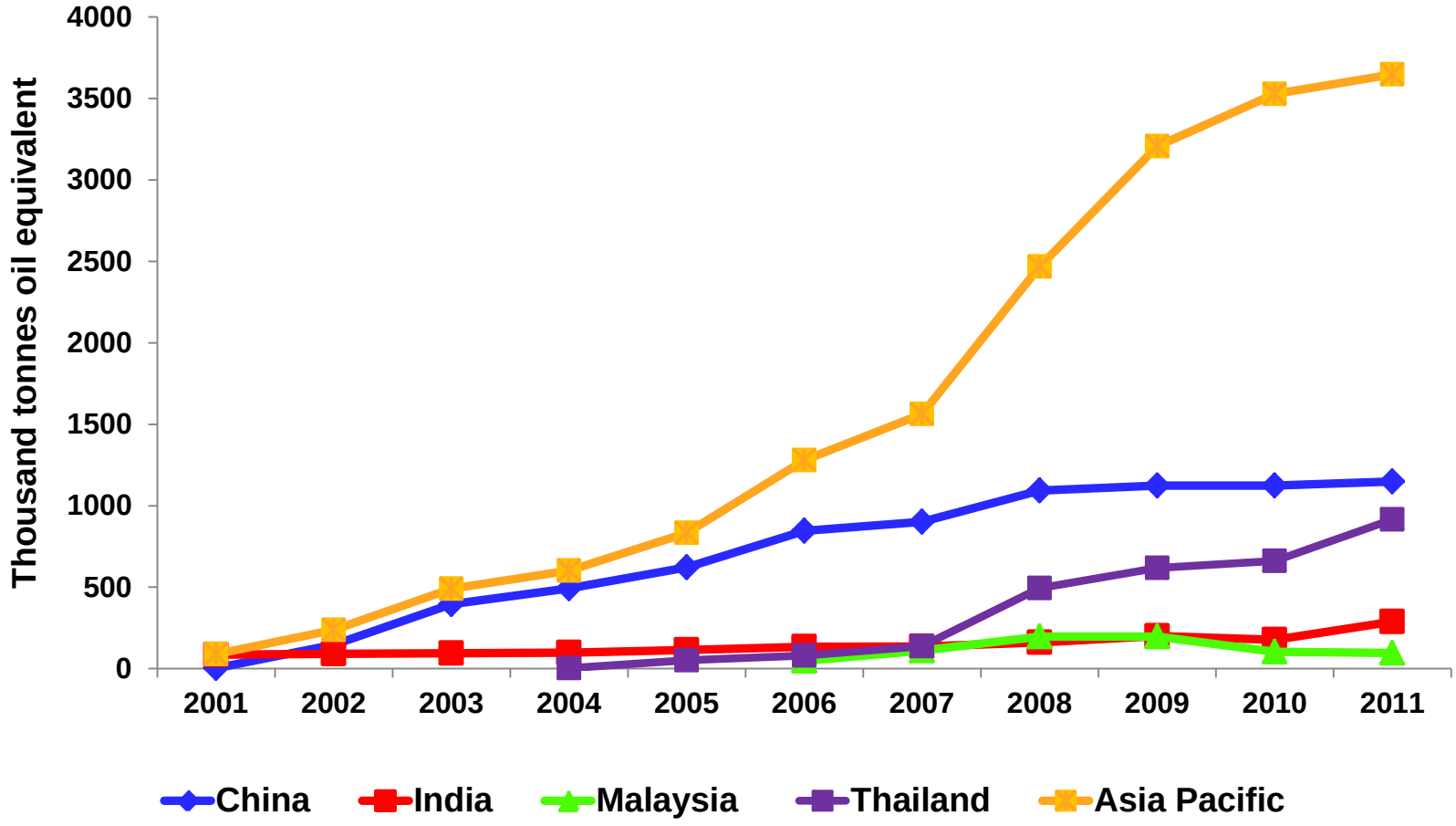
Thailand - a key player in liquid biofuel production in Asia



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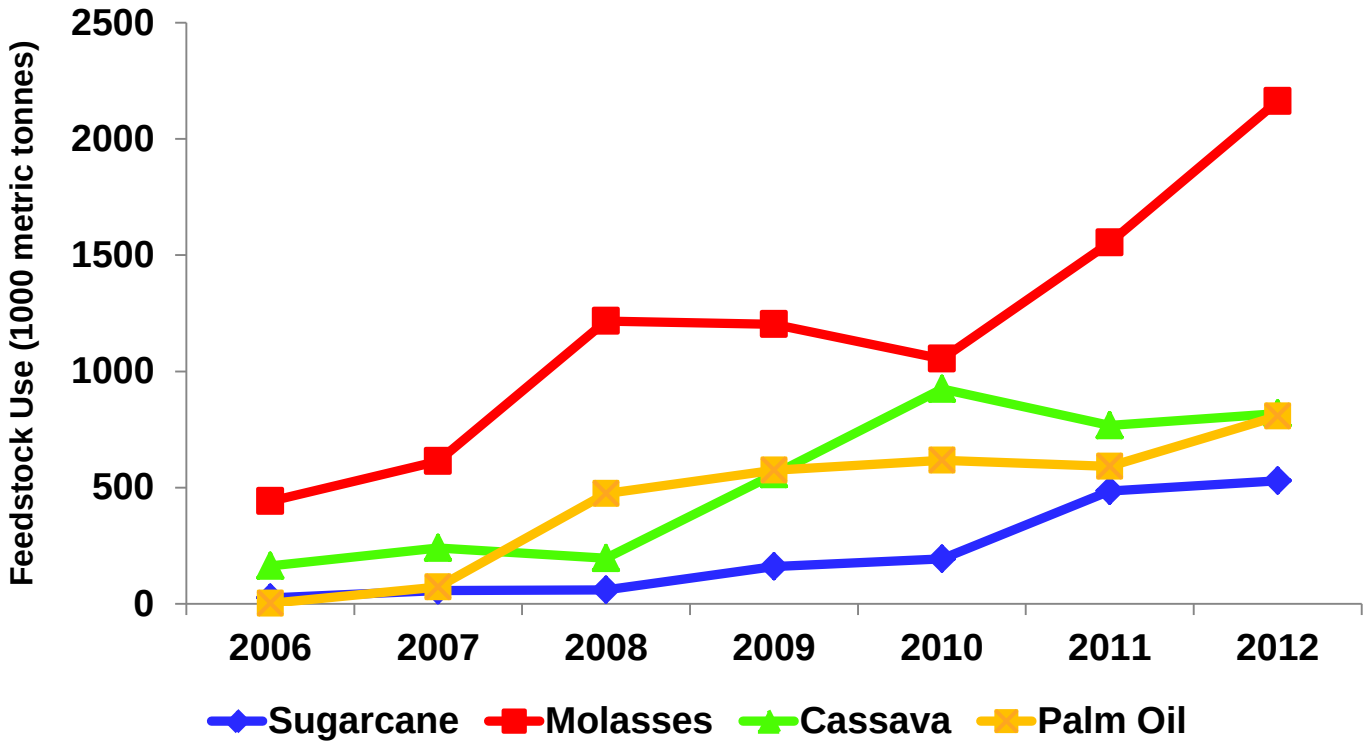
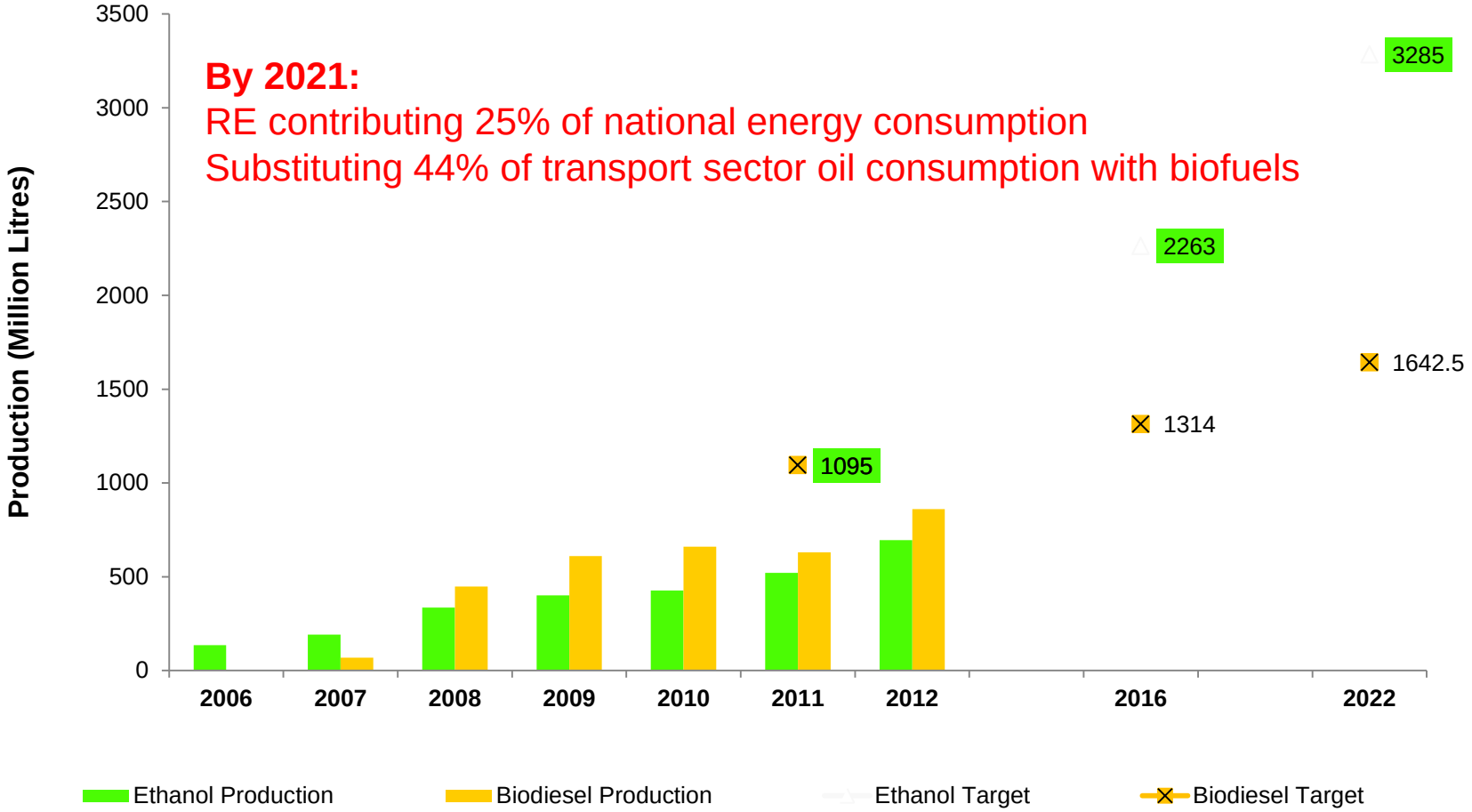
Thailand
– major feedstocks for biofuel production



Thailand
Policy –Alternative Energy Dev't Plan (AEDP) 2012-2021



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Thailand

2nd Gen biofuel potential from agricultural residues (2010) - GNESD

Crop	Residue	Prod	RPR	Res.	Sustain. Res.	Biochem. EtoH	BTL diesel
	type	(tonnes)		dry wt.	20% extraction	hydro. & ferm. (low) (litres)	F-T (low) (litres)
Maize	Stalk	4.5E+06	1.5	5.7E+06	1.1E+06	1.3E+08	8.5E+07
Rice	Straw	3.2E+07	1.5	4.0E+07	8.1E+06	8.9E+08	6.0E+08
Sorghum	Stalk	5.4E+04	2.62	1.2E+05	2.4E+04	2.7E+06	1.8E+06
Sugarcane	Bagasse	6.9E+07	0.3	5.2E+06	1.0E+06	1.1E+08	7.7E+07
Wheat	Straw	1.1E+03	1.2	1.1E+03	2.2E+02	2.5E+04	1.7E+04
Cocoa	Pods, husk	7.6E+02	1.0	6.5E+02	1.3E+02	1.4E+04	9.7E+03
Coconut	Husk	1.3E+06	0.6	7.0E+05	1.4E+05	1.5E+07	1.1E+07
Coffee	Husk	4.9E+04	2.1	8.7E+04	1.8E+04	1.9E+06	1.1E+06
Total					**1.0E+07**	**1.1E+09**	**7.8E+08**

Thailand – key messages

- Biofuels in Thailand – *remains a 'double edge sword'*
  - On the one hand well documented benefits been reported for Thailand's biofuels i.e. increased job creation, reduction of transportation fuel imports, increased GDP contribution etc.
  - On the other hand however, there are land use change issues as well as vulnerability to food access concerns for Thai's poor
  - Biofuel production will continue to rise in Thailand due in part to the AEDP
  - 2nd Gen. biofuel from agricultural residues & wastes recommended as providing preferred opportunities with low sustainability risks
  - However, considerable investment in 2nd Gen R&D, demonstration and pilot facilities will be required.

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Environmental zoning as a policy tool to increase the sustainability of sugarcane ethanol in Brazil

- This paper investigates and drawn lessons from Brazil's novel nationwide environmental zoning of sugarcane production in 2009:
  - This resulted from the experience & effort by the 2 largest sugarcane states in Brazil namely:

    Minas Gerais (in 2007)

    Sao Paulo (in 2008)

Brazil
Agro-ecological sugarcane production

Key Criteria:

- Environmental aspects, technological potential and productivity
- Exclusion of pristine ecosystem i.e. *Amazon and Pantanal biomes, Upper Paraguay River Basin.*
- Avoiding conflict with food production
- Preference for direct precipitation/rainfall over full irrigation
- Degraded pastures

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Brazil

2nd Gen biofuel potential from agricultural residues (2010) - GNESD

Crop	Residue	Prod	RPR	Res.	Sustain. Res.	Biochem. EtoH	BTL diesel
	type	(tonnes)		dry wt.	20% extraction	hydro. & ferm. (low) (litres)	F-T (low) (litres)
Maize	Stalk	5.5E+07	1.5	7.1E+07	2.2E+08	1.6E+09	1.1E+09
Rice	Straw	1.1E+07	1.5	1.4E+07	2.9E+06	3.2E+08	2.2E+08
Sorghum	Stalk	1.5E+06	2.62	3.4E+06	6.8E+05	7.5E+07	5.1E+07
Wheat	Straw	6.2E+06	2.0	1.0E+07	2.1E+06	2.3E+08	1.6E+08
Coffee	Husk	2.9E+06	2.1	5.2E+06	1.0E+06	1.1E+08	7.8E+07
Oats	Straw	4.0E+05	2.0	6.7E+05	1.3E+05	1.5E+07	1.0E+07
Sugarcane	*Bagasse*	*7.2E+08*	*0.3*	*5.4E+07*	*1.1E+07*	*1.2E+09*	*8.1E+08*
Total					**2.1E+07**	**2.3E+09**	**1.6E+09**

Brazil – key messages

- Agro-ecological zonings - a likely baseline for issuing permits/license for energy crop production in Brazil
- Brazil's experience with agro-ecological zonings provides valuable lessons for consideration and learning in other developing countries. E.g. COGEN Africa (with UNEP, GEF and AfDB).
- Agro-ecological zonings avoids competition of land from food and fuel purposes, as well as the prevention of the use of pristine ecosystems for biofuel production
- The Brazilian experience shows how policies could be effectively be applied in a complementary fashion to achieve maximum benefits. E.g. coupling command and control (i.e. zoning laws) with use of economic incentives (i.e. public development banks, international dev't agencies)

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Policy considerations for biofuel implementation. A case study of Jatropha Curcas in Senegal

- This paper reviews the NPJ progress, provides information on policies and institutions shaping biofuels in Senegal

- It also investigates Senegal's agro-environmental mapping exercise for bioenergy crops.

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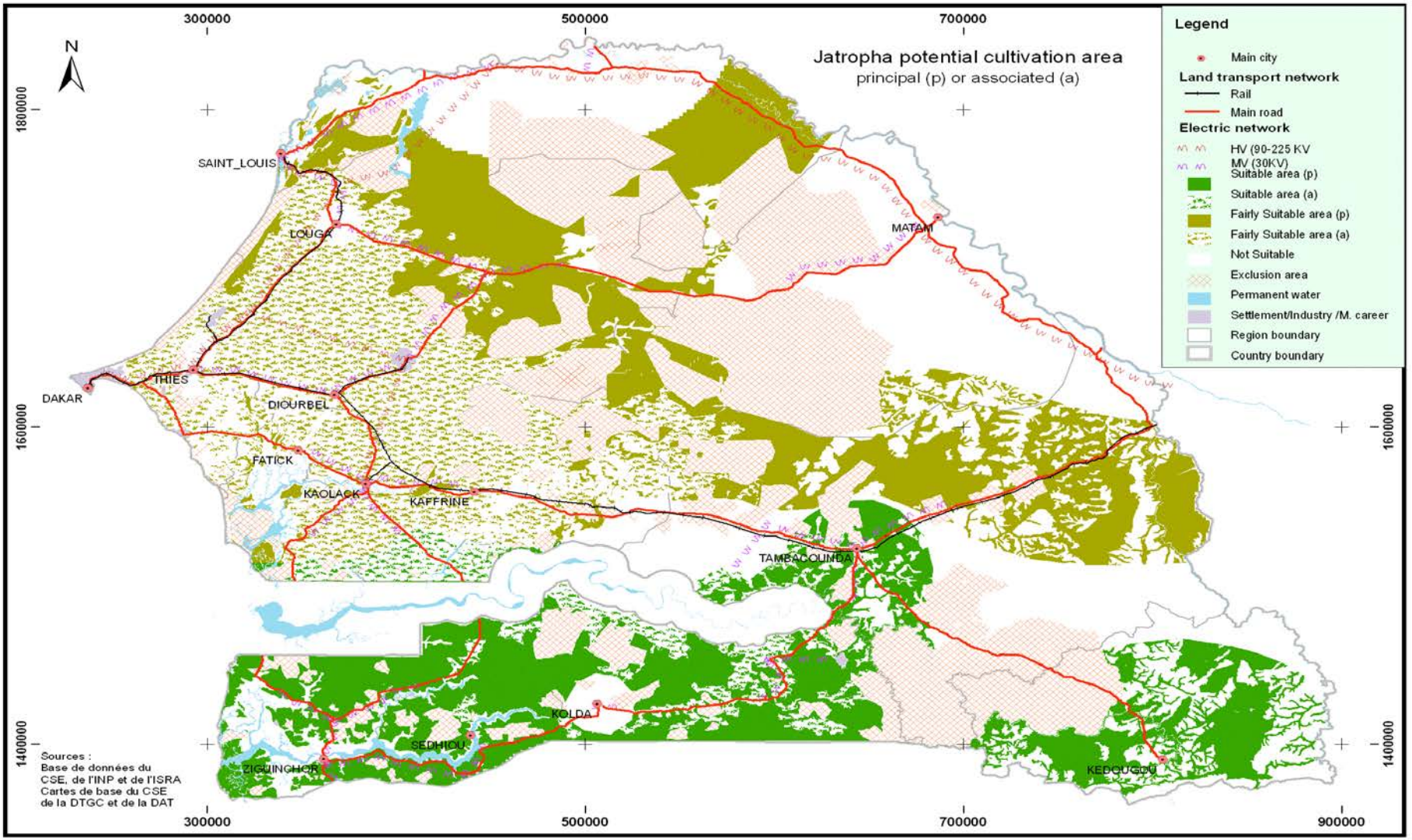
Agro-ecological mapping for biofuel (Jatropha) crop: Senegal case study



Senegal
2nd Gen biofuel from agricultural residues

Crop	Residue	Prod	RPR	Res.	Sustain. Res.	Biochem. EtoH	BTL diesel
	type	(tonnes)		dry wt.	20% extraction	hydro. & ferm. (low) (litres)	F-T (low) (litres)
Maize	Stalk	1.9E+05	1.5	2.8E+05	5.6E+04	6.2E+06	4.2E+06
Millet	Stalk	8.1E+05	3.0	2.4E+06	4.9E+05	5.4E+07	3.7E+07
Rice	Straw	6.0E+05	1.5	9.1E+05	1.8E+05	2.0E+07	1.4E+07
Sorghum	Stalk	1.6E+05	2.62	4.3E+05	8.5E+04	9.4E+06	6.4E+06
Sugarcane	Bagasse	8.5E+05	0,3	2.6E+05	5.1E+04	5.6E+06	3.8E+06
Coconut	Husk	5.1E+03	0.6	3.1E+03	6.1E+02	6.7E+04	4.6E+04
Total					**8.6E+05**	**9.5E+07**	**6.5E+07**

Senegal – key messages

- The mapping process lead to some very interesting findings beyond what policy makers had anticipated. For e.g. it was found out from the mapping exercise that 3-5 million ha exist for Jatropha compared to NJP otherwise thought ambitious target of 321,000 ha.

- Lack of scientific rigour pertaining to the choice of Jatropha by policy makers as the selected bioenergy crop compared to other candidates

- The mapping avoids competition of land from food and fuel purposes, as well as the prevention of the use of pristine ecosystems for biofuel production

- Lack of coordination at the local level involving private initiatives and NJP teams. Additionally, streamlining national institutional roles in bioenergy.

- Effective implementation strategy having clear principles & conditions for processing, distribution and use of the biodiesel is required.

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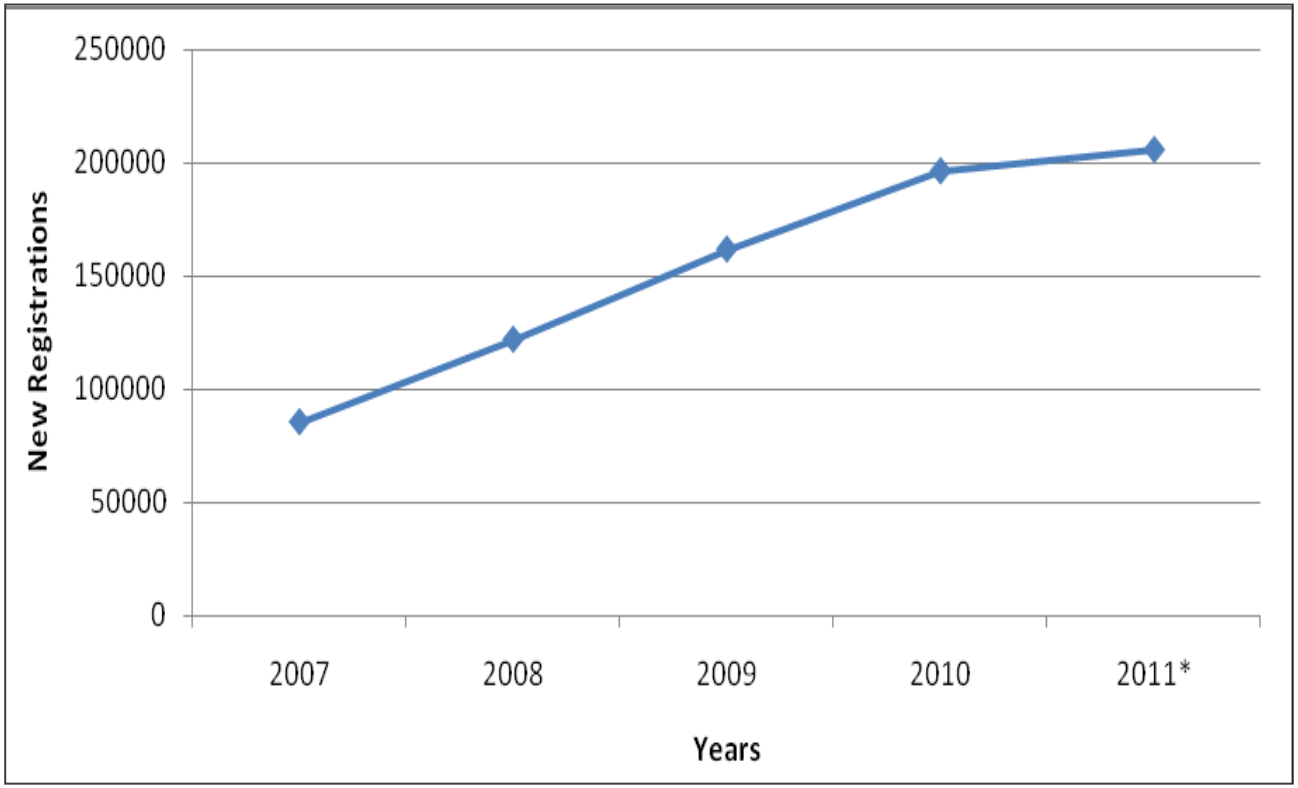
Potential for liquid biofuels in Kenya

- Key driving factors for Kenya's interest in biofuels
  - 25% of import bill goes to vehicular transportation fuel
  - Rising fuel cost
  - increase in no. of vehicles



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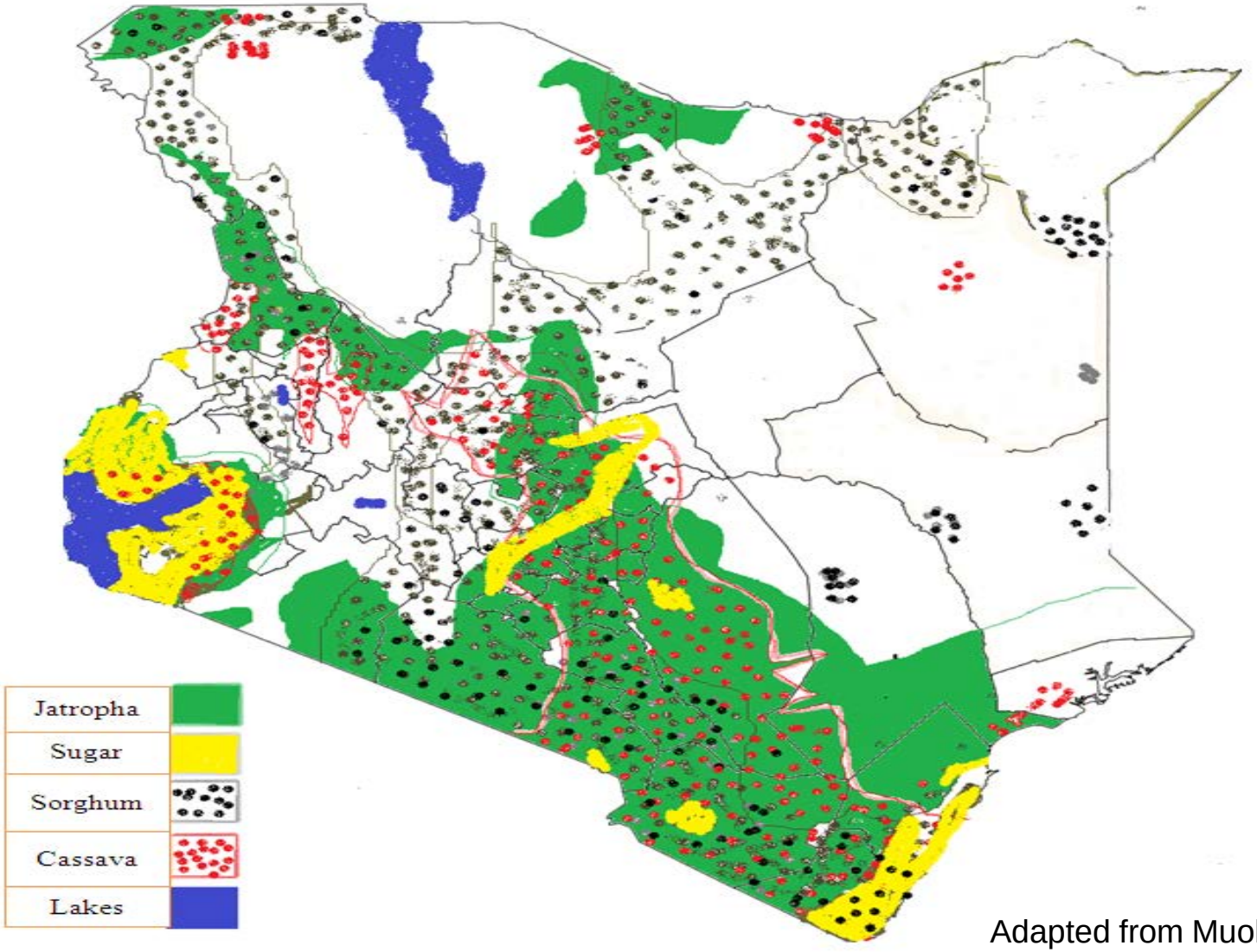
Agro-ecological mapping for biofuel crops: case study Kenya



Adapted from Muok *et. al.* 2010.

Kenya
2nd Gen biofuel from agricultural residues

Crop	Residue	Prod	RPR	Res.	Sustain. Res.	Biochem. EtoH	BTL diesel
	type	(tonnes)		dry wt.	20% extraction	hydro. & ferm. (low) (litres)	F-T (low) (litres)
Maize	Stalk	3.2E+06	1.5	4.1E+06	8.2E+05	9.0E+07	6.2E+07
Millet	Stalk	5.4E+04	3.0	1.4E+05	2.8E+04	3.0E+06	2.1E+06
Rice	Straw	8.0E+04	1.5	1.0E+05	2.0E+04	2.3E+06	1.5E+06
Sorghum	Stalk	1.6E+05	2.62	3.7E+05	7.3E+04	8.0E+06	5.5E+06
Wheat	Straw	5.1E+05	1.2	5.2E+05	1.0E+05	1.2E+07	7.8E+06
Coconut	Husk	4.4E+04	0.6	4.0+E04	7.8E+03	8.6E+05	5.9E+05
Barley	Straw	6,4E+04	1.7	9.3E+04	1.9E+04	2.0E+06	1.4E+06
Sugarcane	Bagasse	5.7E+06	0.3	4.3E+05	8.6E+04	9.4E+06	6.4E+06
Total					**1.2E+06**	**1.3E+08**	**8.7E+07**

Kenya – Key messages

- The need for agro-ecological mapping of areas for bioenergy cultivation
- Enforcement of mandatory blending is essential as it help eliminate uncertainty among biofuel investors
- The need to tap into international and regional financing facilities and initiatives
- Establishment of a national registry of feedstock availability, processing facilities and up-take in order to effectively avoid the mismatch between supply and demand
- Development of a regional and national biofuel standards and certification requirements that harmonizes with global standards .
- 2nd Gen. biofuel from agricultural residues & wastes recommended

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Sustainability indicators for biofuels in Argentina

- This paper examine trends in selected indicators associated with biofuels in Argentina:
  - GHG emissions
  - Land use
  - Glyphosphate use
  - Soil quality
  - Rural development

Argentina
2nd Gen biofuel from agricultural residues

Crop	Residue	Prod	RPR	Res.	Sustain. Res.	Biochem. EtoH	BTL diesel
	type	(tonnes)		dry wt.	20% extraction	hydro. & ferm. (low) (litres)	F-T (low) (litres)
Maize	Stalk	2.3E+07	1.5	2.9E+07	5.8E+06	6.4E+08	4.3E+08
Rice	Straw	1.2E+06	1.5	1.6E+06	3.2E+05	3.5E+07	2.4E+07
Sorghum	Stalk	3.6E+06	2.62	8.1E+06	1.6E+06	1.8E+08	1.2E+08
Sugarcane	*Bagasse*	*2.5E+07*	*0.3*	*9.4E+05*	*3.8E+05*	*4.1E+07*	*2.8E+07*
Wheat	Straw	1.5E+07	1.2	1.5E+07	3.0E+06	3.4E+08	2.3E+08
Barley	Straw	3.0E+06	1.7	4.3E+06	8.6E+05	9.5E+07	6.5E+07
Oats	Straw	6.6E+05	2.0	1.1E+06	2.2E+05	2.5E+07	1.7E+07
Rye	Straw	5.0E+04	2.0	7.6E+04	1.5E+04	1.7E+06	1.1E+06
Total					**1.2E+07**	**1.3E+09**	**8.9E+08**

Argentina – key messages

- Biofuels in Argentina from soybean – also *remains a‘double edge sword’*
  - On the one hand earnings from soybean exports have revitalized some agricultural communities ie. Santa Fe, Cordoba and Buenos Aires. On the other hand there has been displacement of rural populations due to increased mechanization of agricultural practices. Also displacement of other crops and traditional animal husbandary
  - Glyphosphate use in soybean cultivation has intensified resulting in increased environmental and health concerns
  - Emphasizes the need for careful analysis on both positive and negative impacts of biofuels as the basis for policy formulation and implementation.
  - The paper recommends land use planning and zoning for bioenergy cultivation nationally.

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Possible International Finance Sourcing Options

Africa	Asia	Americas
• AfDB - CECAFA • AfDB-CEIF • AfDB-I LOC • AfDB-I ALC • ECOWAS-EBID • ECOWAS (African Biofuels & RE Fund) • West Africa Dev't Bank	• ADB (Asian Development Fund) • ADB –CMI • ADB-EEI/CEFPF • ADB – REACH • ADB-STI	• IDB Infrastructure Fund (InfraFund) • IDB – SECCI Funds

GBEP, 2012

Summary - Experiential Lessons

- Agro-ecological mapping/zoning should be the preferred baseline for issuing permits/license for energy crop production in developing countries
  - Criteria should encompass environmental, social and economic issues
- Comprehensive biofuel (bioenergy) sustainability policy integrated into national development plans, where appropriate
- Biofuels derived from sugar cane and non-food based feedstock including residues were preferred options
- Increased support regarding:
  - research and development
  - access to finance
  - policy mechanisms i.e. mandates, blending targets, tax incentives

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Thank you very much

I welcome your questions and comments

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