Situation Analysis on Biofuels Industry in Tanzania

Worldwide Biofuels and SWOT analysis

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Study Objective

To carry out a situation analysis on biofuels industry in Tanzania and elsewhere around the world and its existing and potential strengths, weakness, opportunities and threats to environment, bio-diversity conservation and socio-economic aspects in Tanzania as a whole.

Methodology

- **In-depth literature review**
- Reviewed documents related to biofuels development in Tanzania and around the
- world - for a broad understanding of the sector;
  - National policy documents were obtained from the line ministries (e.g. MEM, MoAFC, VPO, MoLHS, MNRT, etc)
  - Reports on previous biofuels studies in Tanzania
  - Global biofuels development were obtained from the internet.

- **Structured interviews with key sector stakeholders**
  - Key government officials
  - Members of the National Biofuels Task Force and officials from Tanzania Investment Centre (TIC).
  - District officials of Kisarawe, Kilwa and Meru;
  - Officials of biofuels companies
  - Officials from NGOs, CBOs
  - Local communities.

- **Strength, weakness, opportunities and threat (SWOT) analysis**
  - Potential feedstock for biofuels
  - Ethanol and biodiesel
  - Biofuels

Biofuels Worldwide

World on the verge of unprecedented increase in production/ use of biofuels

- Decisions made today will determine the positive and negative impacts of biofuels for a long time to come
- Net energy balance highly important
- If made from low yielding crops that need high inputs of petroleum based fertiliser they could generate more GHG than petroleum fuels do

What are biofuels?

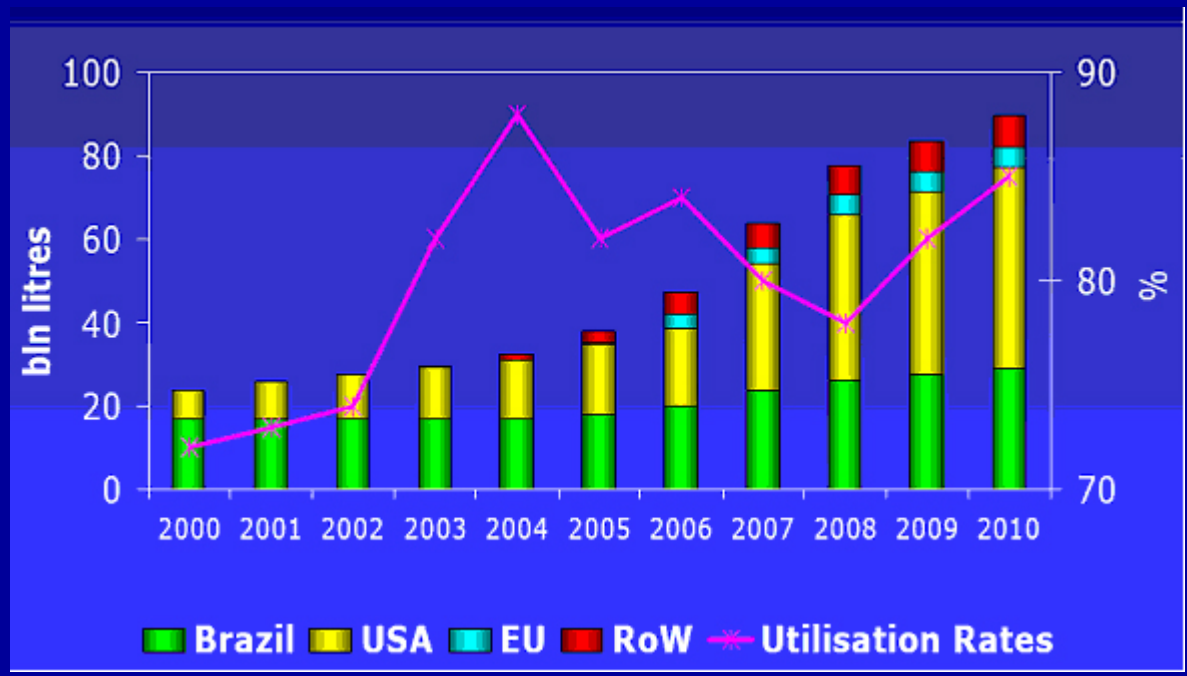
- *Biofuels are defined as energy carriers derived from the conversion of biomass to provide sustainable inputs for heat, power and transport applications. Biofuels can be liquid, solid or gaseous. The principle sources of biomass are agriculture and forestry.*

  UNIDO

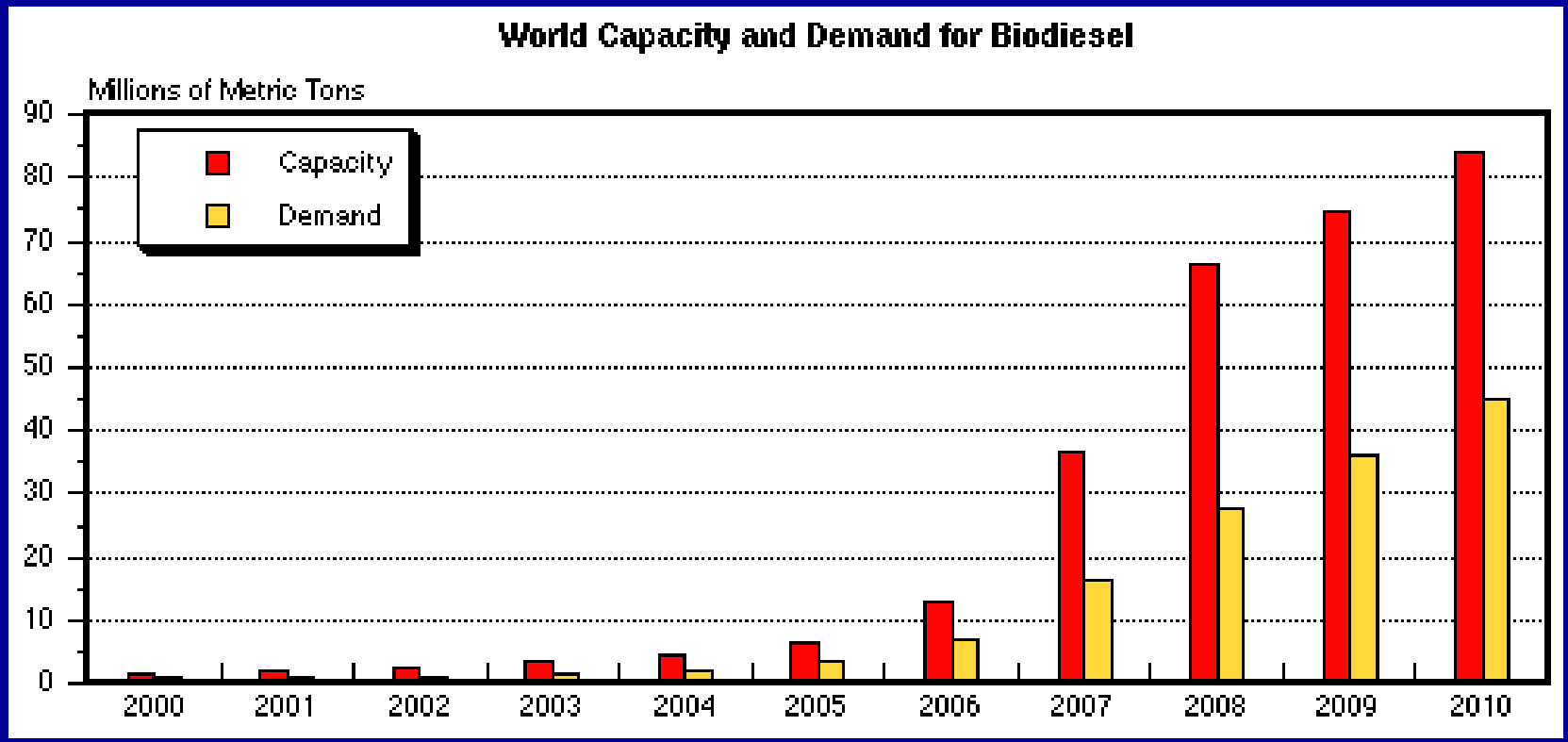
What are biofuels?

- **Bio-ethanol** (blended with petrol)
- **Ethanol**

  Can be produced from:
  - Starch such as maize, sorghum, rice, millet, cassava, etc.
  - Root crops like as cassava, potatoes, etc.
  - Sugarcane and sugarbeet.



Bio-diesel (blended with diesel)
rape, sunflower, jatropha, soya, and oil palm



2nd generation biofuels

- Cellulosic conversion technologies
- Use biomass from wood, tall grass and crop residues may include woody crops such as willow, hybrid popular, and eucalyptus.
- Tall perennial grasses such as miscanthus and switchgrass
- Ready for 2015?

Potential of ligno-cellulosic biomass for ethanol production

Feedstock	Liters ethanol ton -1
Sugarcane bagasse	500
Maize/sorghum/rice stover	500
Forest thinnings	370
Hardwood sawdust	450
Mixed paper	420

Source: Planning commission.nic.in/reports/genrep/cmtt_bio.pdf

Why now?

GHG emissions

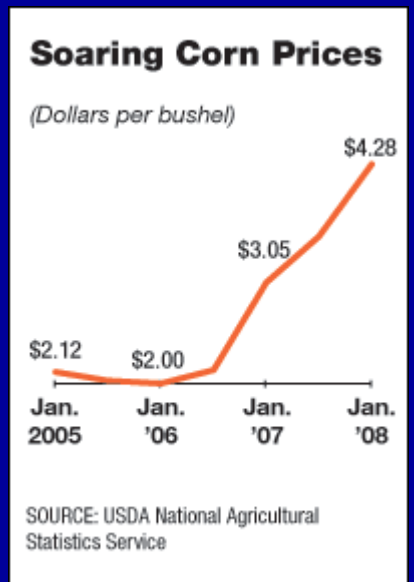
Oil price increase to $124 USD

World economy at risk if oil supply at risk

Bioethanol from sugar cane may still be economically feasible if oil prices stay above $50 US per barrel

Biofuels and Food prices

- Biofuels debate has become polarised
  - Miracle or menace?
- Many arguing link between biofuels and food prices
  - Evidence for this?
  - The price of corn has more than doubled in the last two years, boosted in part by demand for ethanol.



» World Bank President Robert Zoellick -Demand for ethanol and other biofuels is a "significant contributor" to soaring food prices around the world. However droughts, financial market speculators, oil prices and increased demand for food also responsible.

Key Issues globally

- Biodiversity
  - Type of land cleared
  - Introduced species
- The environment
  - Soil
  - Water
  - Energy
  - Emissions
- Social Issues
  - Food crops
  - Farmers
  - Land

European Union

- EU top producer of bio-diesel, 4.5 billion litres (72%) of global production
- Favourable fiscal and regulatory policies
- Sweden
  - Over 1000 stations selling bio-ethanol
  - High sustainability standards
- Germany
  - was producing 50% of the world's biodiesel
  - Biodiesel made from rapeseed

EU policy

- Target of 5.75% market share for biofuels by 2010
- Target set to 10% by 2020
- But now having reservations about these targets
- Currently drawing up sustainability standards

Brazil

- Pioneers in bioethanol
- The government have supported bioethanol from sugar cane since the 1970s
- Brazil is the number 1 cane producer in the world
- Flexible-Fuel Vehicles (FFVs) in Brazil can use different mixtures of ethanol and petrol
- Energy independence
- Sugar cane industry employs 1 million people

USA

- World leaders in bioethanol
- Maize
- Production 18 billion liters in 2006, 23 billion 2007
- Subsidies and incentives
- Clean air act
- Aim 28.4 billion litres by 2012
- US Dept of Energy initiative for cellulosic ethanol
- Biodiesel industry much smaller 1 billion litres produced in 2006

Malaysia and Indonesia

- Malaysia and Indonesia account for 84% global palm oil production
- Palm oil driver of deforestation, resulting in the loss of 10 million hectares of primary rainforest
- Rural peoples displaced
- Many undesirable impacts due to lack of regulation of industry
- Resulted in a chinese investment of 8 billion US in Malaysia being blocked

Thailand

- Sugarcane/molasses, cassava
- 150 million litres produced in 2006
- Blending plan of using 10% ethanol in all government vehicles
- Aim to increase gasohol consumption to 20 million litres by 2011
- Out growers programs

India

- Produced 1.65 billion litres of ethanol in 2006, 200 million used for fuel
- Molasses and sugar cane
- E5 blending policy for part of country, increased to E10 by October 2008
- Biodiesel from jatropha and pongamia
- Biodiesel production 100 million tons in 2007

Ethiopia

- Currently 8 million litres produced per year bioethanol
- Molasses, potential
- Aiming to blend 5% ethanol into country's petrol pipeline
- UNDP project looking at using ethanol for home cooking
- Ethiopian government wants to commit 24 million hectares of land (more than 20%) to Jatropha
- Less than 1,700 hectares committed by plantation developers

Mali

- Mali-Folkecentre (MFC) has been developing “energy service centres”
- 20 hectare jatropha plantations provide local energy for activities such as millet grinding and battery charging
- Multi-Functional Platform (MFP)
- 15 year program to use 1000 hectares of *Jatropha* to provide power to 10,000 residents
- Mali Biocarburant company aiming to create an economically viable biodiesel company without central plantation

South Africa

- Accounts for 70% of total ethanol production in Africa from coal and gas
- Has adopted a national biofuels strategy
- Planning 3 large biodiesel plants with a total production of more than 300 million litres per year
- Biofuels industrial strategy
  - Biofuels target of 2% petroleum consumption in 5 years
  - Blending ratio 2% for biodiesel, 8% ethanol
  - Expects biofuels to create 25,000 jobs
- Proposed crops sugarcane and sugar beet for ethanol
- Sunflower, rapeseed and soya for biodiesel
- Maize and Jatropha excluded

Malawi

- Ethanol production started in 1982 at Dwangwa sugar mill
- 2004 Nchalo sugar mill
- Combined production of 30 million litres per year

Nigeria

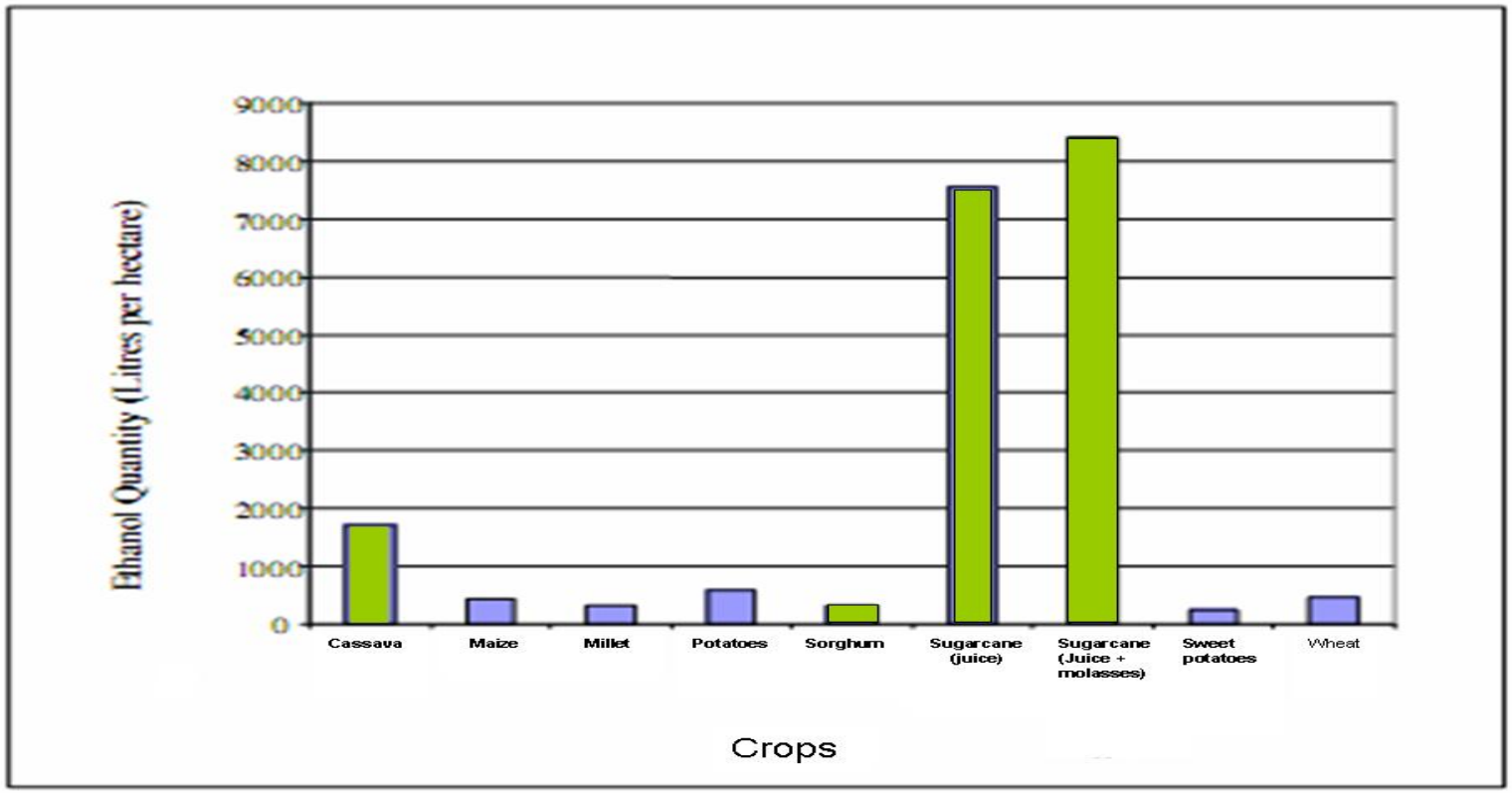
- Producing ethanol since 1973
- 10% blending policy
- Cassava (yields of 15 tons per hectare)
- Nigeria Yeast & Alcohol Manufacturing 30 million litres in 2006
- Plan to build $200 million ethanol plant, with annual production of 30 million tons

Kenya

- 1978 Agro Chemical and Food Cooperation started but collapsed in 1990s
- 2001 - Sector revived, with current production 60,000 litres per day of industrial ethanol
- Sold to local market and Uganda, Rwanda and Central Africa

Potential Feedstock for Biofuels Production

Agricultural crops like sorghum, cassava and sugarcane as potential feedstock for ethanol production in Tanzania (GTZ,2005).



Biodiesel

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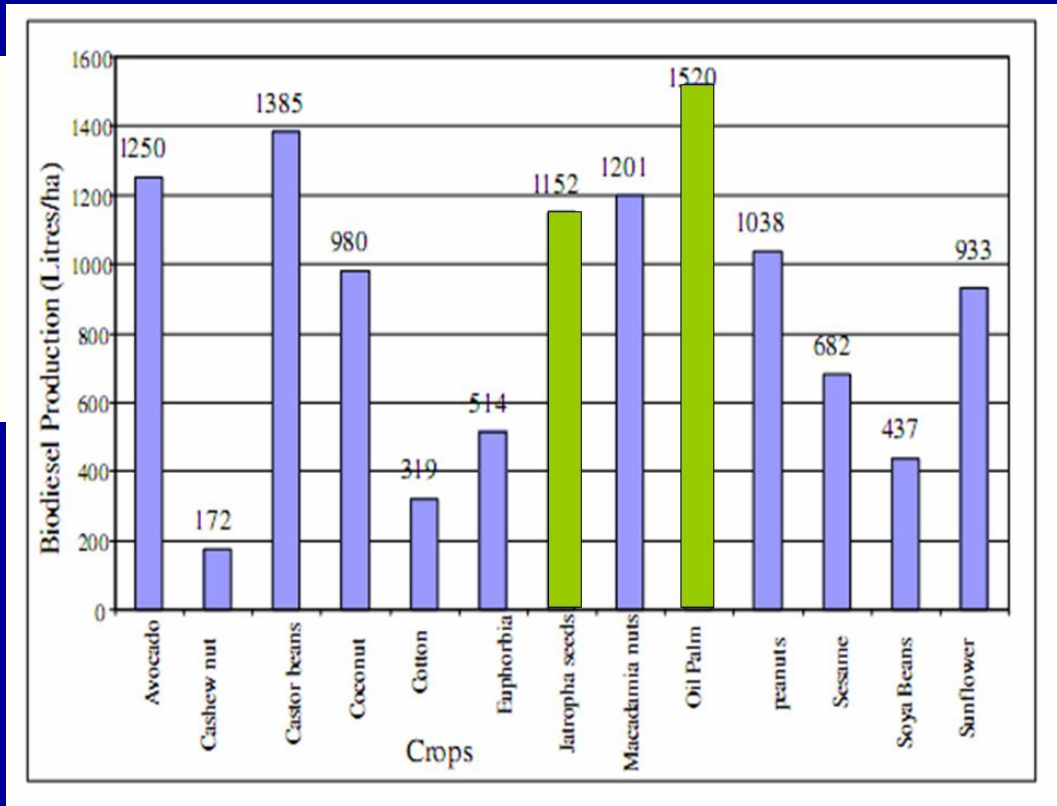
At the moment, oil palm, *Croton megalocarpus* jatropha and palm oil are potential feedstock for biodeisel production in Tanzania.



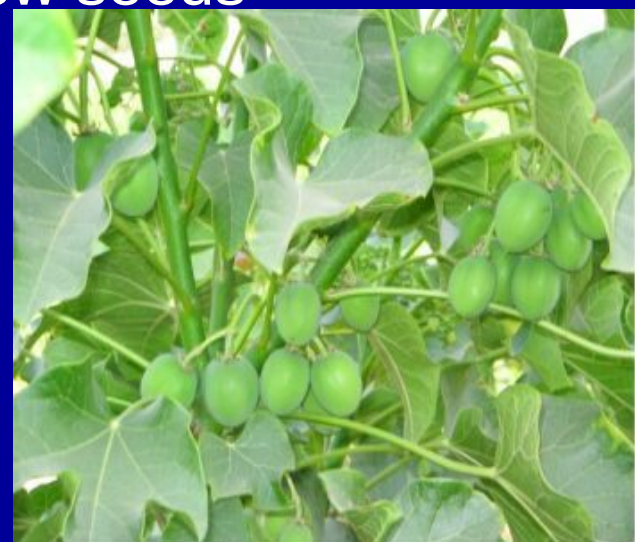
III SWOT analysis Method

- Strategic planning tool used to evaluate strengths, weaknesses, opportunities and threats primarily in business
- Here we evaluate the different biofuels crops in relation to biodiversity, the environment and socio-economic impacts in Tanzania

Jatropha

- *Jatropha curcas*
- Originally from Central America
- Inedible
- Known in Tanzania as mmbono kaburi or nyonyo kaburi
- Plant needs 4 to 5 years to mature, only few seeds produced before maturity

Recovery rates of oil from seed show 15-20% from limited studies in Tanzania



Jatropha

Strengths	Weaknesses
Survives arid environments	Needs water and fertilizers/ pesticides to achieve profitable production
Yields of 32% Jatropha oil recorded in India.	Lack of reliable data on Jatropha
Out growers schemes	Inefficient conversion to biodiesel
Opportunities	**Threats**
Locally produced energy and MFP	Deforestation for planting
Restore degraded habitats	Food security
Intercropping with food crops and livelihood activities eg. bee-keeping	Areas cleared for unsuccessful crop

Sugar Cane

Genus - *Sacharum* 6 to 37 species depending on taxonomy

Brazil, India largest producers

Bagasse produced

has multiple uses

Sugar cane

Strengths	Weaknesses
Efficient conversion to bio-ethanol - power from bagasse	Blending petrol and ethanol produces emissions
Detailed research and experience	High water requirements
High productivity	Energy for drip irrigation
Opportunities	**Threats**
Locally available bio-ethanol	High water demand
Out grower schemes eg Swaziland	Forest clearance
Can be grown with low amount of agricultural inputs	Replace rainforest

Maize

Zea mays

Many varieties

– Promise of tropical maize

Origin Central America

But water requirements mean its not an option in Tanzania

Oil Palm

- Genus *Elaeis*
- The African Oil Palm *Elaeis guineensis* is native to west Africa

Oil Palm

Strengths	Weaknesses
Cultivated for long period of time	Negative environmental impact in South East Asia
Multi cropping	Infrastructure built around plantations has large impact
Some biodiversity can survive on plantations	Production of bio-diesel from pail oil is energy-intensive.
Opportunities	**Threats**
Out growers scheme	Palm oil industry is estimated to have led to the destruction of 10 million hectares of rainforest - what for Tanzania?
Palm oil available for cooking	Land displacement in Asia may set a precedent

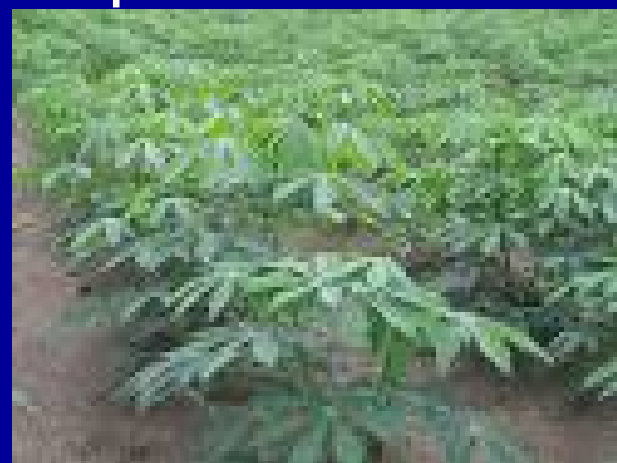
Cassava

Manihot esculenta

Second most grown crop in Africa

Production in Tanzania around 3 tons per hectare

- But yields of 25 tons per ha reported from Thailand and 15 in Nigeria



Cassava

Strengths	Weaknesses
No irrigation needed	Yields of ethanol lower than sugar cane
Traditional small holder crop	Labour intensive
Proven crop	Processing complex
Opportunities	**Threats**
Yields can be increased	Food security - Important food crop being used for fuel
Develop local knowledge	Diseases
Out growers schemes	Forest clearing

Sorghum

- Genus *Sorghum*
- Origin - Egypt/ Africa
- Many varieties
- Annual grass
- Sweet sorghum
  - Harvested/crushed in similar way to sugar cane

Sorghum

Strengths	Weaknesses
Drought/ saline/ temp tolerant	May need irrigation in dry season
Potentially 2-3 crops per year, growing period 3-5 months	Sucrose peak shorter for sweet sorghum
Adequate experience/ research	Vulnerable to stem borer and shoot fly infestation
Opportunities	**Threats**
Food and fuel - sugar from stem and grains can be used	Important food crop
Capability of high energy varieties to be efficient bio-energy crop	Chemical runoff

Croton megalocarpus

- Tree native to Tanzania
- Nuts reported to contain 32% oil by volume

Croton megalocarpus

Strengths	Weaknesses
Native species to Tanzania	Little scientific research carried out on large scale cultivation
Drought resistant	Diseases
Detailed local knowledge of the crop	
Seed oil content reported to be 30%	
Opportunities	**Threats**
Derivative products glycerol, biogas, animal feed	Seeds edible by local fauna - potential conflict
Reclaim degraded lands	Clear land for food crops
Agro forestry	

Fossil energy balance

Fuel (feedstock)	Fossil energy balance (approx.)
Cellulosic ethanol	2-36
Biodiesel (palm oil)	9
Ethanol (sugar cane)	8
Biodiesel (waste vegetable oil)	5-6
Ethanol (sweet sorghum)	1
Diesel (Crude oil)	0.8-0.9
Gasoline (Crude oil)	0.8

Biodiesel

Strengths	Weaknesses
Biodegradable	Processing uses large quantities of water
Lower emissions than diesel, esp. sulphur, hydrocarbons, CO and toxins	Processing needs methane more imported petrochemicals
Byproducts of manufacturing such as soap	Emissions from processing - hexane
Low toxicity	Increased emissions of $No_{x,}$ linked to acid rain
Opportunities	**Threats**
Non petroleum based fertilizers	Spills
Reduce imports of oil	Burning glycerin for energy has high environmental risks

Bioethanol

Strengths	Weaknesses
Sugar easily processed to alcohol	Low blends of ethanol can increase emissions of volatile organic compounds
Extensive experience of bioethanol in Brazil	Characterised by high vapour pressures
Contains no sulphur, olefins and benzene	Processing uses large quantities of water
Small amounts not toxic, biodegradable	Increased emissions of No_x linked to acid rain, depends on feedstock
Opportunities	**Threats**
Non petroleum based fertilizers	Large volumes of nutrient rich waste water - eutrophication
Local energy security	Spills

Biofuels in general

Strengths	Weaknesses
Improve Tanzanian energy security	Yields/ crop varieties
Promotion of rural development	Lack of government coordination
Carbon sequestration and emissions reduction	Land clearance
Opportunities	**Threats**
Out growers schemes	Land acquisition/ communities lose land
Planned agricultural development that has wildlife corridors	Fluctuations in oil price - biofuels market could crash like sisal

Key issues highlighted by SWOT analysis

- Lack of government coordination
- Unknown crops with unknown risks
- Land clearing
- Water and energy
- False promises (Ghana); employment generation, out grower schemes