Policy Dialogue Conference
The Role of Renewable Energy Policy in Africa for Poverty Alleviation and Sustainable Development

22 - 24 June 2005

Moevenpick Royal Palm Hotel, Dar es Salaam

"Sweet Sorghum as a Supplementary Feedstock to Ethanol Production"

Prof. F. D. Yamba and Dr. K. Munyinda
CEEEZ
Private Bag E721, Lusaka, ZAMBIA
Tel/Fax: +260 - 1 - 240267
Email: ceeez@coppernet.zm

CEEEZ

Centre for Energy, Environment and Engineering Zambia Limited

1

INTRODUCTION TO BIO-ETHANOL

- Agriculture biomass can be converted into a variety of fuels, such as ethanol, which can be used as a transport fuel
- Ethanol can be made directly from sugar-bearing crops, and indirectly by converting the cellulosic portion of biomass into sugar.

2

DRIVING FORCES FOR PRODUCTION AND USE OF ETHANOL

- The need to move towards a sustainable development path including poverty reduction against global expectations of safeguarding the environment
- The finite in nature and corresponding environmental effects of fossil fuels
- Sustainability and competitiveness of sugar industry in Southern Africa
- Environmental concerns from both local and global perspectives
- Benefits which include financial and environmental
- Uncertainty in the global crude oil price movements

3

PROSPECTS AND OPPORTUNITIES FOR ETHANOL PRODUCTION IN SOUTHERN AFRICA

- Ethanol can be produced from sugarcane and sweet sorghum
- Key elements required to ensure bioenergy fuels programmes succeed:
  - Technology
  - Availability of feedstocks, at low cost
  - Land availability, if a large scale bioenergy fuels programme is planned
  - Bio-ethanol blending / use economics

4

BENEFITS TO USE OF BIO-ETHANOL(1)

- **Socio-economic**
  - Job creation from agriculture, processing and marketing (poverty reduction/incomes)
  - **AGAMA study:** Bio-ethanol (6.6 jobs/GWh); Bio-diesel (32.6 jobs/GWh)
  - **Example:** in South Africa, bioethanol can create 62,000 jobs, while biodiesel can create 288,000 jobs
  - Rural development (communication infrastructure, health centres, schools)
  - Reduction in petroleum imports, leading to FOREX savings and improved domestic investments

5

BENEFITS TO USE OF BIO-ETHANOL (2)

- **Environmental**
  - Ethanol can be used to replace lead, a dangerous pollutant, as an octane enhancer
  - Reduction of CO_2 emissions (a greenhouse gas), which contributes to global warming resulting in droughts, floods, etc

6

MARKETS: POTENTIAL ETHANOL DEMAND AT 10% BLENDING(1)

Country	Gasoline Consummed (million litres/yr)	Lead concent-ration (g/litre)	Total lead used (t/yr)	Ethanol Equiv. (million litres/yr)	Ethanol Availability (million litres)	Ethanol Deficit (million litres)	GHG Saving (tonnes)
Mozambique	71	0.5	40	7.1	3.6	(3.5)	15756.8
Namibia	331	0.4	180	33.1	-	(33.1)	73457.7
South Africa	10,358	0.2	2100	1035.8	216.0	(819.8)	2298714.6
Zambia	187	0.7	130	18.7	19.0	-	41500.3
Zimbabwe	433	0.8	350	43.3	38.0	5.3	96094.2
TOTAL	**11,380**		**2800**	**1138**	**273.0**	**(861.7)**	**2525523.5**

7

MARKETS: POTENTIAL ETHANOL DEMAND AT 10% BLENDING(2)

- **The deficit may be met by two possible routes:**
  - **Expansion of sugarcane estate (limited to 2% growth rate), which cannot meet the demand above**
  - **Sweet sorghum can be used as a supplementary feedstock (e.g. 400,000–500,000ha is required to meet the deficit above)**

8

Potential of Sweet Sorghum Production

9

Potential of Sweet Sorghum Production

- The potential for Sweet Production in Zambia was evaluated by the University of Zambia, School of Agricultural Sciences and School of Engineering.

10

Potential of Sweet Sorghum

- **Objectives**
  - To evaluate the agronomic performance of sweet sorghum in three Agro-ecological Regions
  - To evaluate sugar content at different growth stages.
  - To determine suitable harvest time

11

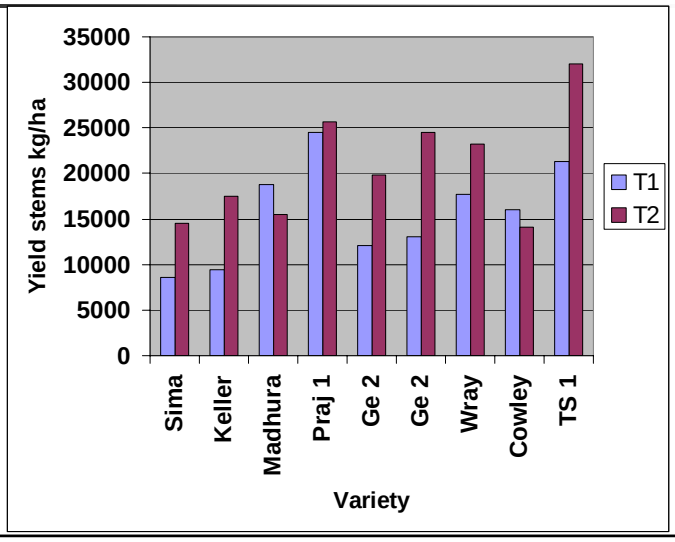
Potential of Sweet Sorghum

Major Findings

- The Agronomic performance of Sweet Sorghum was evaluated in three Agro-ecological Regions
- Nine exotic varities were compared with a local released variety of Sima.
- Sima is a dual purpose sorghum for Grain as well as sweet stems.

12

Performance of Sweet varieties at UNZA



13

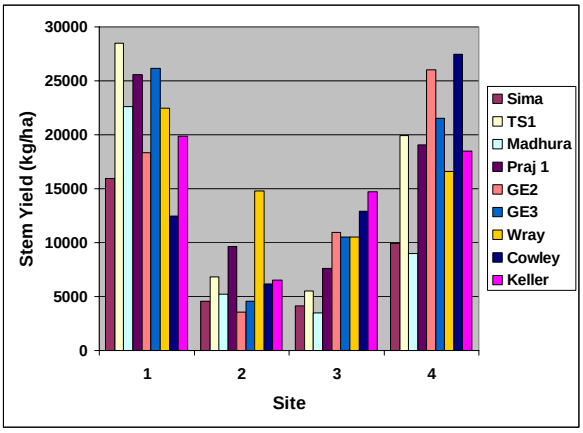
Potential of Sweet Sorghum

- The yields obtained are comparable to other places, especially that these were obtained under partial drought conditions experienced in Zambia in the 2004/2005 season.

14

Potential of Sweet Sorghum

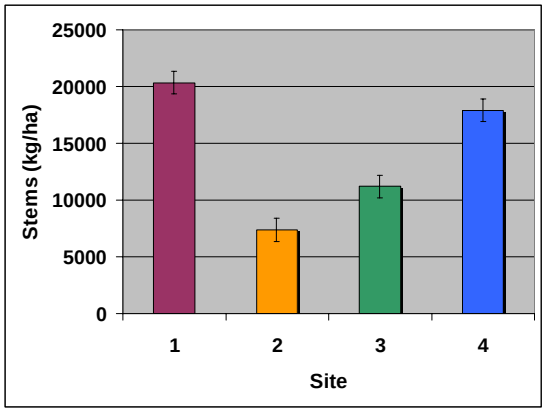
- Yield of Sweet Sorghums varied with location (variety x environment interaction)
- In general similar yields were obtained in Region II and I.



15

Potential of Sweet Sorghum Production

- There was a reduction of about two times in stem yield in Region III (the high rainfall region) compared to the other two Regions.
- This is attributed to soil type (acidic soils) and photoperiodic response.
- There was also an influence of soil type in Region II. Yield was low on shallow and infertile soils compared to more fertile soils.

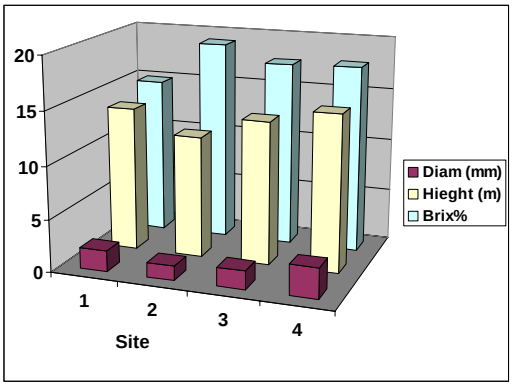


16

17

Potential of Sweet Sorghum Production

- Stem diameter and hieght also varied with locality, soil type and population density.
- The higher population density, the thinner the stems and therefore prone to lodging as had occurred with Madhura.
- Brix% was highest at Mpongwe and lowest at UNZA



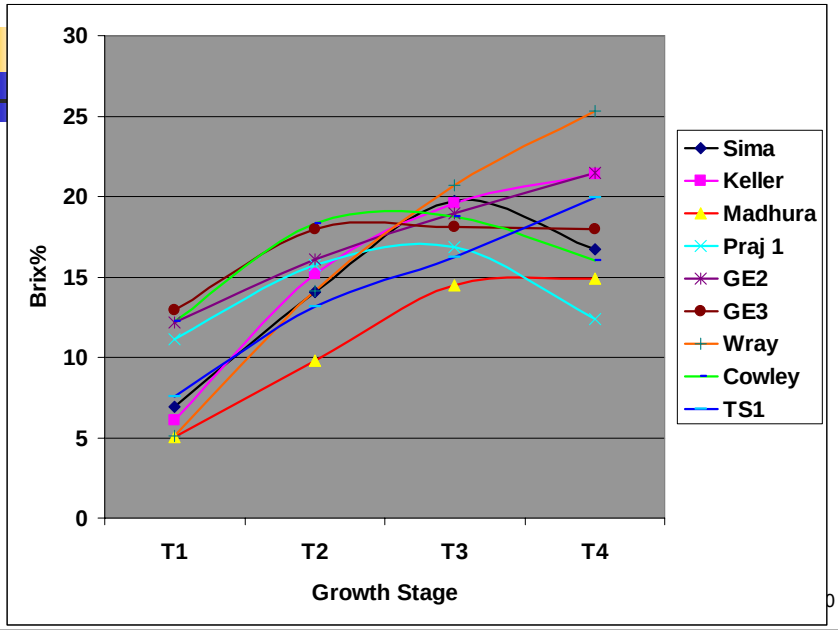
18

Accumulation of Sugar

- Sugar content as measured by the Brix% varied with variety and stage of growth as well as environment.
- Most varieties had peaked in sugar content by milk to dough stage, while Wray, GE2 and TS1 were still increasing. These are long season varieties whose growth was interupted by the drought.
- Hieghest values of sugar content were obtained with Wray, Keller, GE2 and TS1, and lowest with Madhura.

19

Accumulation of Sugar



21

Recommendations

Potential for sweet production can be increased through:

- **Selection and development of adapted cultivars especially for Region III.**
- **Selection of sites:**
  - **Hgher fertility soils should be utilized**
- **Use of irrigation. This could mitigate the effect of fertilizers.**

22

Recommendations

- Use of recommended fertilizers and pesticides (particularly for resource-poor farmers)
- Evaluating appropriate population density.
  - Thicker sweet sorghum stems could be problematic for small scale growers.
- Production of at least two per season

23

TECHNICAL/ECONOMIC ASSESSMENT – ethanol (1)

Analysis of Actual Pricing – typical factory sizes

Factory Size (tonne/cane hr)		100	150	250	300	350	400	500
Scenario	BAU (UScents)	21	21	17	16	13	10	12
	CDM Spread (UScents)	19	19	16	14	11	8	10
	CDM Advanced Payment (33%) (UScents)	18	18	15	13	10	5	9

24

TECHNICAL/ECONOMIC ASSESSMENT

Comments…

- Larger factories give lower prices
- Ethanol has an economic advantage to gasoline since at an IRR of 20% its price is around USCents 20 against the gasoline price of US Cents 43
- This price can further be reduced to US Cents 15 if the project is implemented under CDM of the Kyoto Protocol

25

CONCLUDING REMARKS

- There is a ready market for bio-ethanol
- Prices from analyses competitive at the int'l market
- Southern Africa has great potential to benefit from use of its natural resource endowment base to produce transport fuels, and if implemented will go a long way in contributing to a sustainable energy path and also contribute significantly to poverty reduction through creation of numerous jobs from agriculture, processing and marketing
- To achieve this requires a conducive policy framework, with supporting awareness and information programmes

26