POTENTIAL FOR BIOETHANOL PRODUCTION IN ZAMBIA

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Introduction

- Zambia is faced with an energy crisis from importation of large amounts of crude oil and the high cost of fuel and petroleum products
- The Zambian economy has experienced shocks due to the volatile and high petroleum production prices.
- This is making economic development unattainable.
- In addition most of the crude oil tends to be generally obtained from an unstable region of the world.
- Crude oil is also a finite resource. The United Nations estimated in 1994 that existing known reserves of petroleum would be enough for 75 years from 1994.

- The energy crisis and environmental pollution from use of fossil fuels have become more serious globally.
- In the case of Zambia there is need to:
  - Move towards a sustainable development path,
  - Explore the use of biofuels as cheaper and cleaner alternatives to fossil fuels.

- The higher production costs of alcohol, however, are an obstacle to the production of this energy source.
- Selection of crops with higher yields and higher sugar content and at lower cost is, therefore, essential to cut down costs of ethanol production.
- Crops with high photosynthetic potential and which produce high biomass should be selected.

- The crops include sorghum, maize and sugarcane.
- The genus sorghum includes grain sorghums noted for their high grain yields and efficiency of starch manufacture and sweet sorghums
- Sweet sorghum differs from grain sorghums by only a few genes, those controlling plant height; the presence of juice in the stems; and the presence of sugar in the juice.

- The main advantage of sorghum over maize and sugarcane is the lower cost of ethanol production as follows:
- Shorter growth period of 3 – 5 months compared to about 18 months for sugar cane.
- Two crops can therefore be produced per year where irrigation is provided.
- Sugar cane is propagated from cuttings, requiring 4,500 – 6000 kg/ha of cane,

- Sweet sorghum, on the other hand, is propagated from seed, requiring a minimum of 4 – 7.5 kg /ha of seed.
- The quantity of water needed by sweet sorghum is only one third of that needed by sugarcane.
- Has a high water use efficiency and is drought tolerant
- Tolerates some degree of , alkalinity and poor drainage.

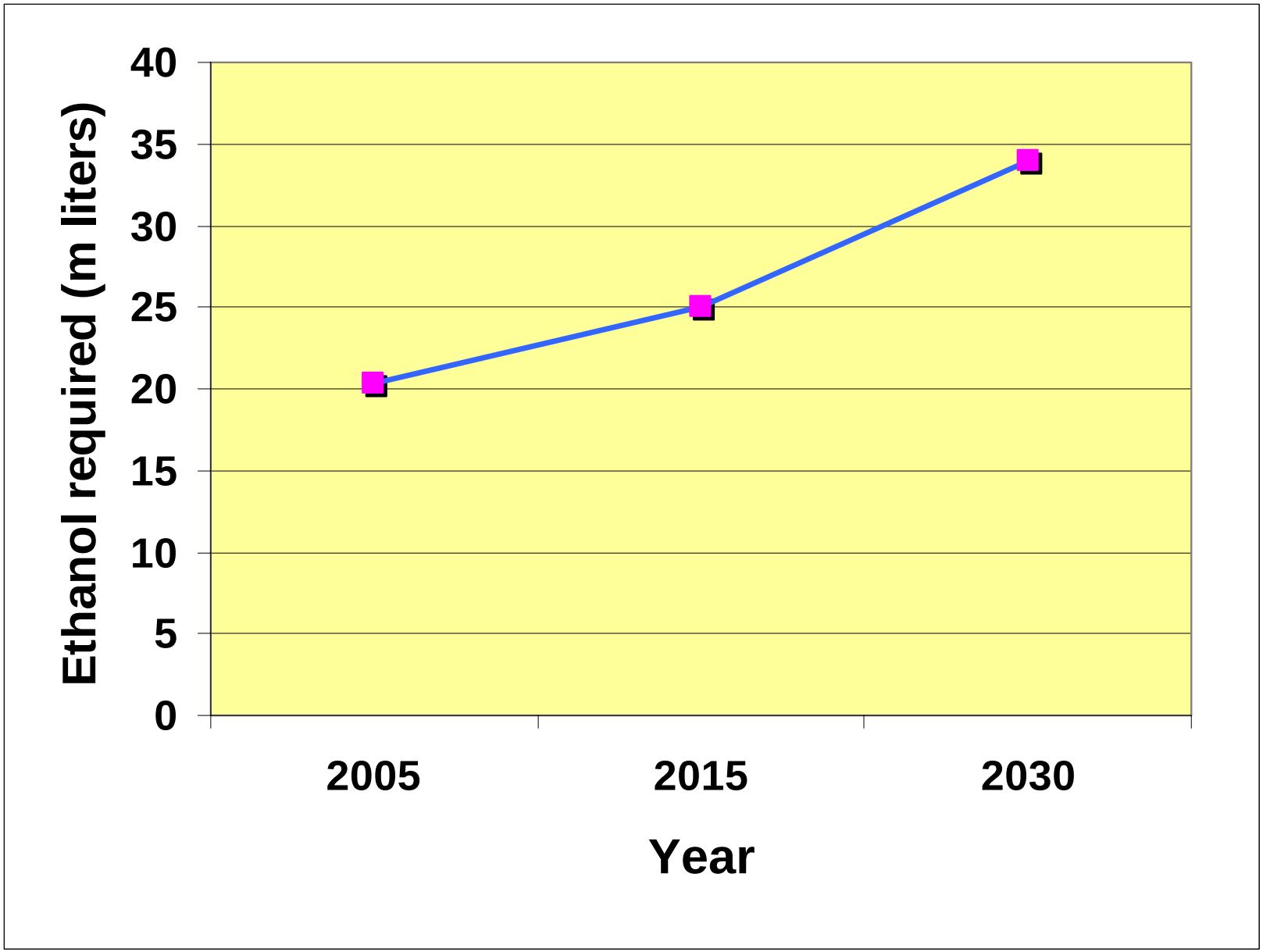
Determining potential

- The potential of bioethanol production from sweet sorghum was evaluated by the University of Zambia:
  - ✓School of Agricultural Sciences,
  - ✓School of Engineering, in collaboration with
  - ✓Centre for Energy, Environment and Engineering Zambia Limited

- The Agronomic component evaluated the performance of sweet sorghum varieties in three Agro-ecological Regions of Zambia and on major soil types of the country with respect to:
  - ✓Biomass production;
  - ✓Sugar content, and
  - ✓Optimum time for stem harvest.
- The energy component evaluated sweet sorghum as a supplementary bioethanol feedstock.

Sweet sorghum at unza farm

Requirement for Ethanol

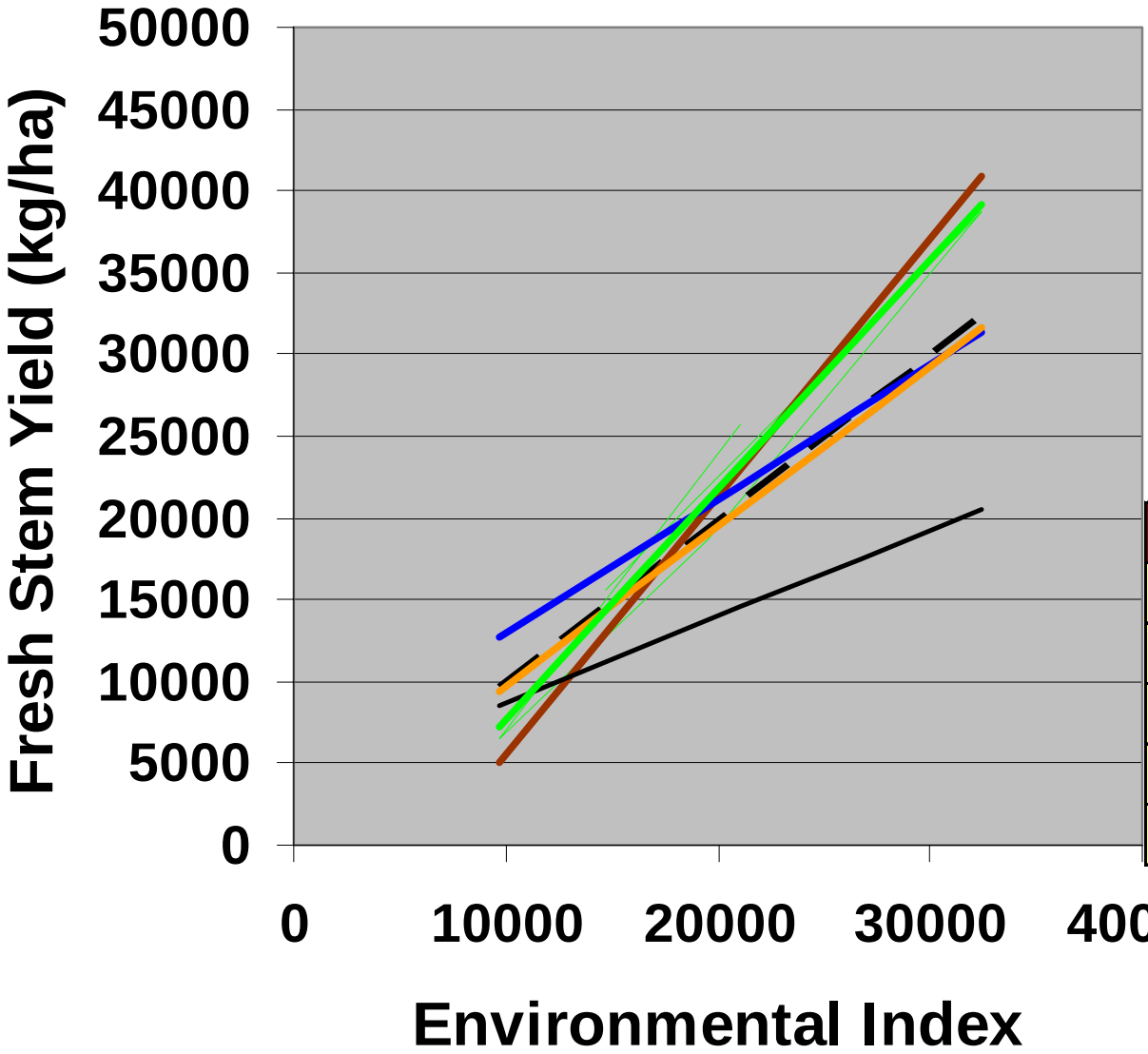


- To meet this demand a number of strategies are, therefore, required to be put in place:
  - ✓Use of high-yielding varieties
  - ✓Varieties adapted to soil types
  - ✓Improved soil and crop management
  - ✓Increased area of production
  - ✓Increased proportion of area grown to sweet sorghum
  - ✓Crop improvement

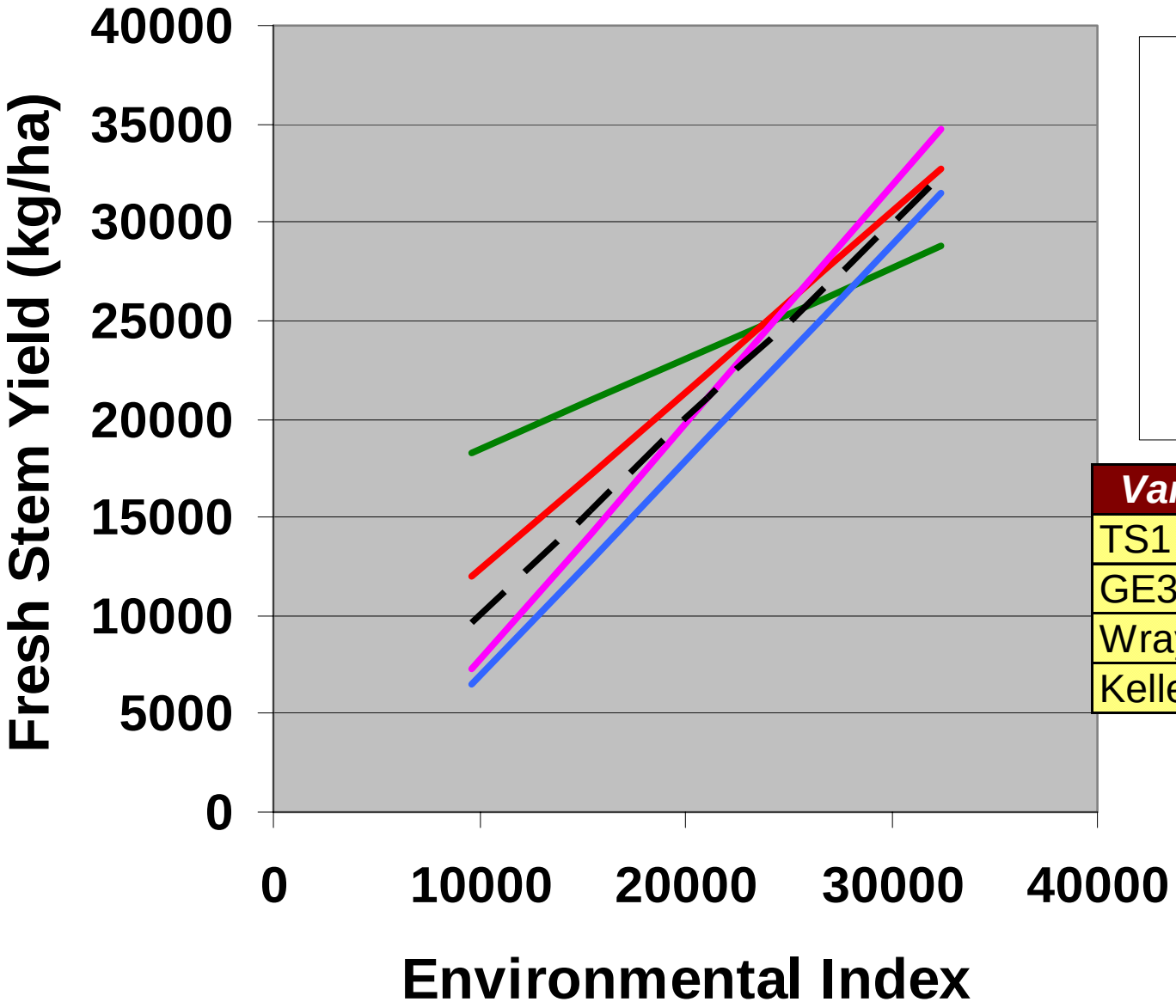
Rainfed with Supplementary Irrigation

	Millable Stalk (Mt/ha)		Ethanol production (m liters)	
Variety	Single crop	Double (ratoon) crop	Single crop	Double (ratoon) crop
GE3	82.5	165.0*	38.2	76.3 *
Cowley	71.4	142.8	33.0	66.1
Wray	70.2	140.4	32.5	65.0
TS1	51.7	103.4	23.9	47.8
Madhura	41.8	83.6	19.3	38.7
Praj-1	40.7	81.4	18.8	37.7
GE2	40.3	80.6	18.6	37.3
Keller	35.8	71.6	16.6	33.1
Sima	22.2	44.4	10.3	20.5

* Estimated



Variety	Slope	Dev Regr
Sima	0.528	0.104
Madhur	0.977	0.319
Praj 1	1.404	0.129
GE2	1.578	0.185
Cowley	0.818	0.402



Variety	Slope	Dev Regr
TS1	1.105	0.443
GE3	1.213	0.272
Wray	0.462	0.354
Keller	0.916	0.449

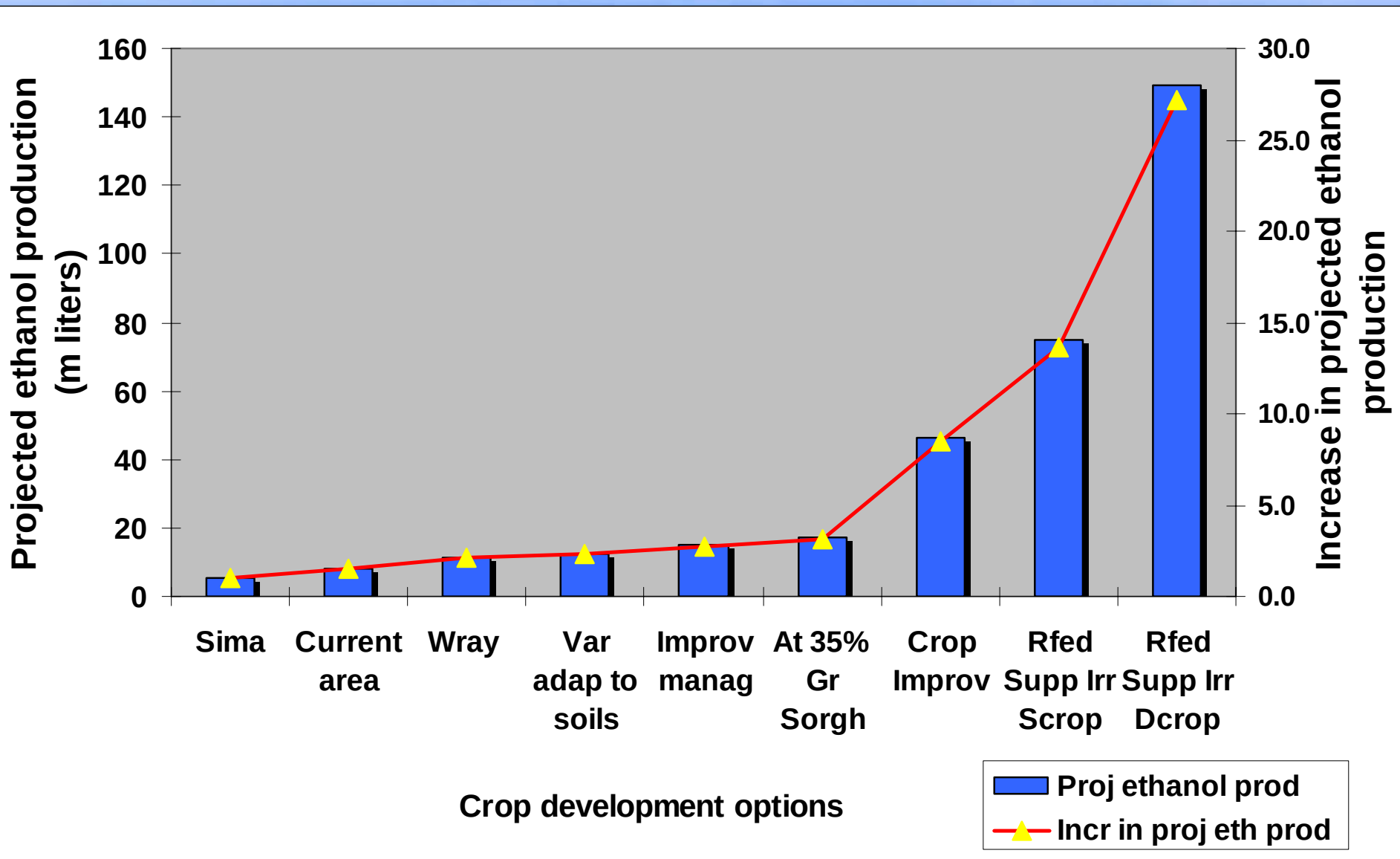
Juice and Ethanol Recovered

Variety	Juice Extracted (Mt/ha)	Ethanol recovered l (72.7%)
Wray	27.3	3.9
GE3	33	3.2
Madhura		1.2

Food science Lab

- When the average millable stalks and ethanol recovery of the highest yielding varieties of sweet sorghum of about 150 t/ha and 7,110 liters/ha for the two crops is compared against 85 to 90 t/ha of green cane of sugar cane and 5,600 liters/ha of ethanol produced, the bioethanol produced from sweet sorghum was highly competitive.

From Different Crop Development Scenarios



Control of pests and diseases

- Control of pests, especially stem borers.
- Control of diseases of economic importance