

LCA for irrigated sugarcane produced in Pongola, South Africa

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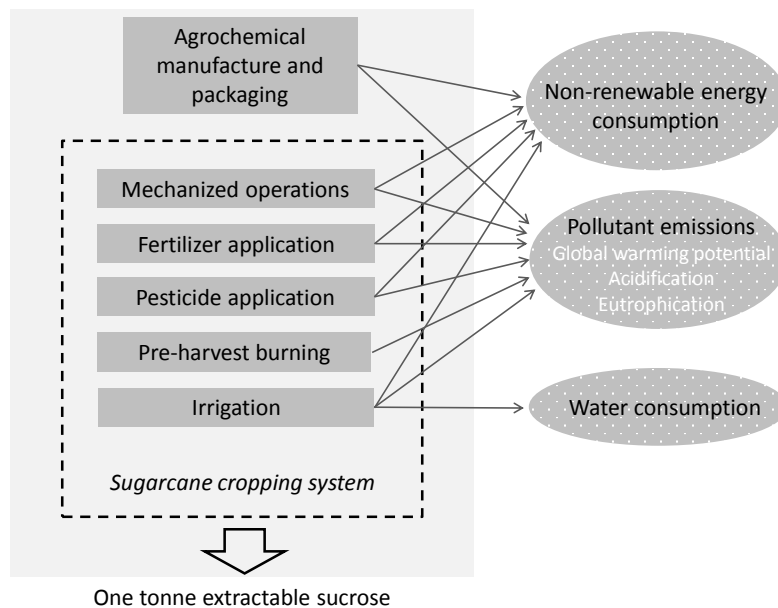
Introduction

- Due to the relatively high water and agrochemical inputs required to produce sugarcane in South Africa there are concerns on the environmental footprint of this crop
- Rising inputs costs (especially electricity & N) motivating farmers to manage water and N more intensively than in the past
- Can we quantify the multiple environmental benefits of improved water and N management by farmers?

Methodology

- LCA approach was combined with field scale crop modelling (DSSAT-Canegro)
- Scenarios:
 - **BASELINE** – representative of farmer intuition-based irrigation scheduling management, 150 kg N ha⁻¹
 - **SCENARIO 1** – improved irrigation scheduling based on a 25 mm depletion threshold, 150 kg N ha⁻¹
 - **SCENARIO 2** – improved irrigation scheduling (as for scenario 1) and optimised site-specific fertiliser N application rate as determined by model (100 kg N ha⁻¹)

System delineation and operations involved: a broad flow chart

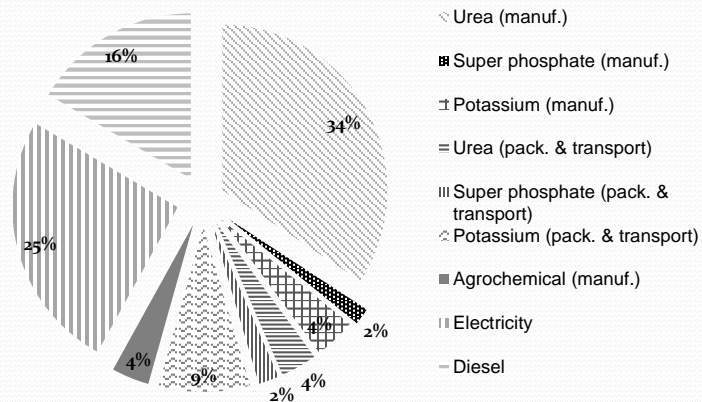


DSSAT-Canegro simulation outputs presented as growing season averages over the 16 year simulation period

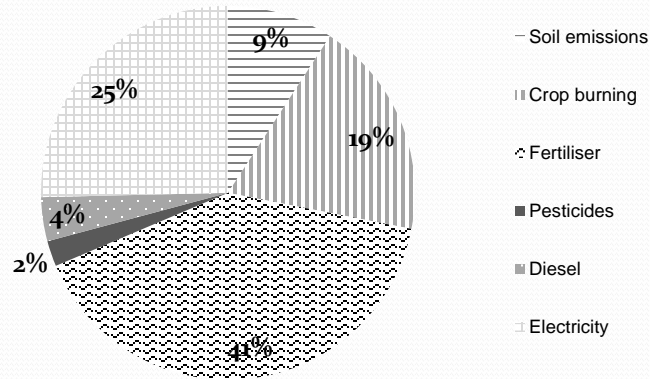
SIMULATION OUTPUTS	Unit	Baseline scenario	Management scenarios 1 & 2*
Green cane mass	t ha ⁻¹	116.9	121.8
Extractable sucrose yield	t ha ⁻¹	17.8	18.5
Trash mass (dry mass)	t ha ⁻¹	22.1	23.2
Evapotranspiration	mm	1173	1211
Irrigation	mm	1000	825
Rainfall	mm	758	758
Deep drainage	mm	432	236
Runoff	mm	155	122

* Simulated crop yield and water balance outputs were the same for management scenarios 1 and 2

Relative contributions of important sugarcane production processes to non-renewable energy consumption for the baseline scenario



Relative contributions of important sugarcane production processes to total global warming potential for the baseline scenario



Environmental impact indicators per functional unit (FU) according to management scenario

IMPACT CATEGORY	Unit/FU	Baseline scenario	Management scenario 1	Management scenario 2
Energy input	MJ	1685	1553	1349
Global Warming Potential (100)	kg CO ₂ -e	485	438	370
Acidification potential	g SO ₂ -e	7.8	7.6	7.6
Eutrophication potential	g PO ₄ -e	23.1	13.4	12.7
Blue water consumption	m ³	562	446	446
Green water consumption	m ³	97	209	209



Summary

- LCA and crop modelling successfully combined
- Non-renewable energy consumption per FU can potentially be reduced by 20%
- GHG emissions can potentially be reduced by 25%
- More intensive management estimated to reduce eutrophication potential by 45%
- Generic framework has now been developed to investigate the environmental impact of sugarcane