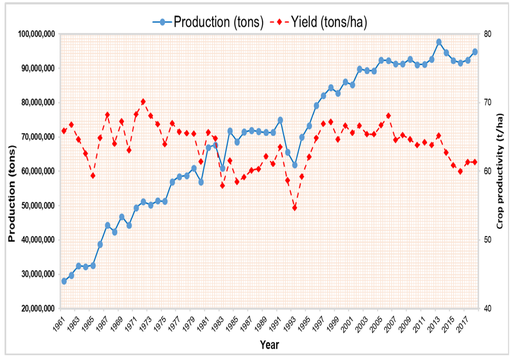
Impacts of Irrigation Heterogeneity on Sugarcane Yields, Water and Energy use in Sub-Saharan Africa

Mavuto Banda

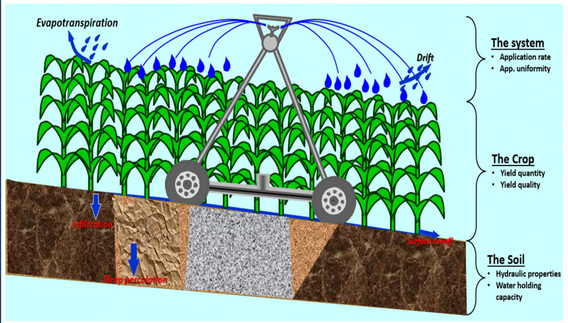
Research Background

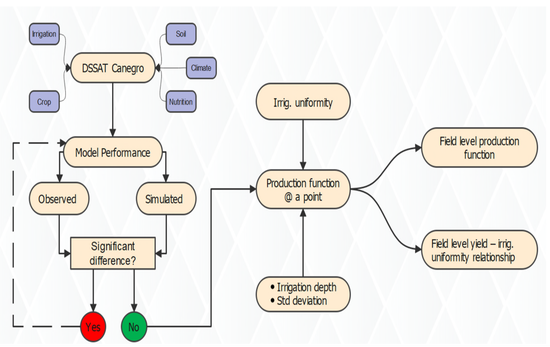
- Cane yield decline trend over the past 60 years (FAOSTAT, 2020), calls for need for intervention
- Irrigation offers a way of improving crop yield as irrigated yields are 3 folds higher than rain-fed yield (Hess et al., 2016)
- However, increasing the water scarcity driving interest towards more efficient utilization of the water resources
- Improving water application uniformity has potential to improve efficiency of water use and productivity but its impacts on cane yields, water productivity, water and energy uses, in SSA, are not understood.
- Thus, this research is aimed to assess the implications of water application uniformity on cane yields, water and energy use and water productivity



Sugarcane production (t) and yield (t/ha) trends in Africa (1961 to 2018) adapted from FAOSTAT (2020).

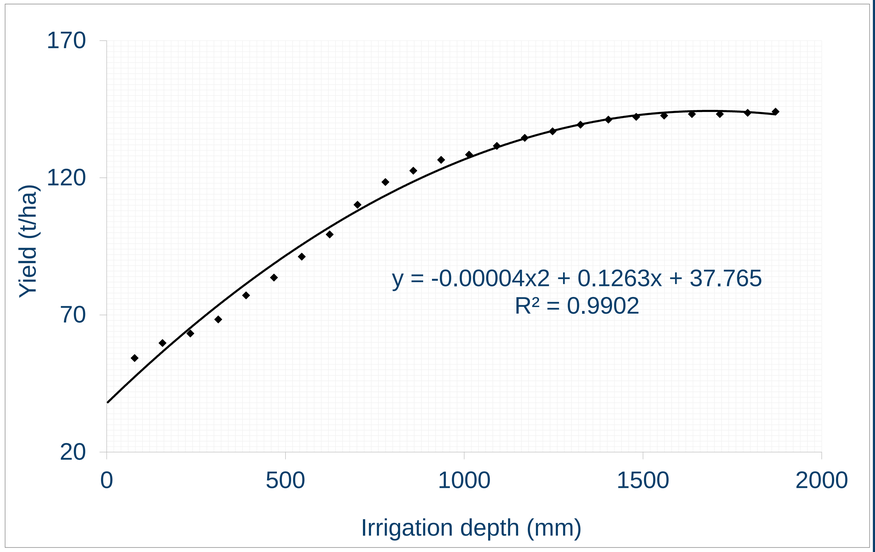
Methodology





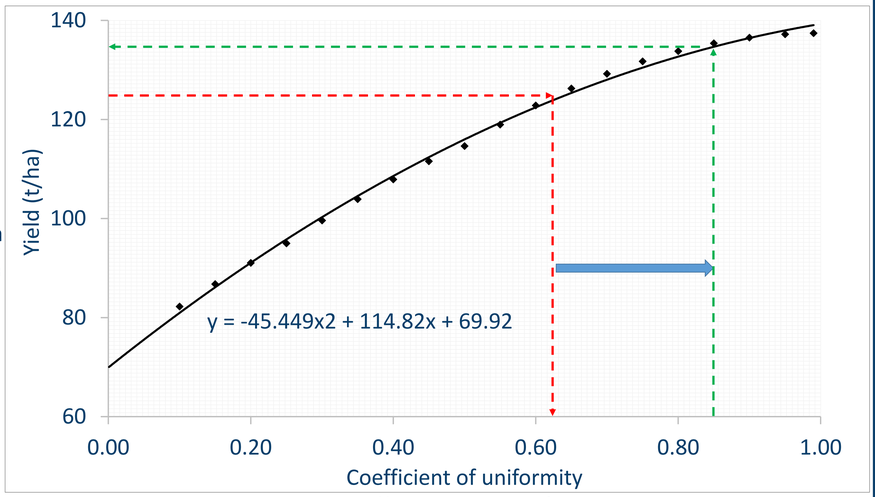
Results

- **Full irrigation:** 1559 mm
- **Average yields:** 143 t/ha
- **WP** = 9.2 kg/m^3
- **Observed irrig. & yield** = 1800mm vs 99.2 t/ha
- **Observed WP** = 5.5 kg/m^3



Yield response to water

- **Unit change in CU:** 0.61 t/ha
- **Unit change in CU** = 30.2 m^3 change in irrigation water volume
- **Observed CU:** 65%
- **Acceptable:** 85%



Yield response to irrigation uniformity

Selected References

- Clemmens, A. J., & Molden, D. J. (2007). Water uses and productivity of irrigation systems. *Irrigation Science*, *25*(3), 247–261. https://doi.org/10.1007/s00271-007-0067-y
- Clemmens, A. J., & Solomon, K. H. (1997). Estimation of Global Irrigation Distribution Uniformity. *Journal of Irrigation and Drainage Engineering*, *123*(6), 454–461. https://doi.org/10.1061/(ASCE)0733-9437(1997)123:6(454)
- FAOSTAT. (2020). *FAOSTAT statistical database*. http://www.fao.org/faostat
- Heermann, D. F., Duke, H. R., Serefim, A. M., & Dawson, L. J. (1992). Distribution Functions to Represent Center-pivot Water Distribution. *Transactions of the ASAE*, *35*(5), 1465–1472. https://doi.org/10.13031/2013.28754
- Hess, T., Aldaya, M., Fawell, J., Franceschini, H., Ober, E., Schaub, R., & Schulze-Aurich, J. (2014). Understanding the impact of crop and food production on the water environment—using sugar as a model. Journal of the Science of Food and Agriculture, 94(1), 2–8. https://doi.org/10.1002/jsfa.6369

Acknowledgements

We extend a word of appreciation to the Sue White Fund and the Douglas Bomford Trust for funding the research project. We also sincerely thank, Illovo Sugar (Africa) for allowing this study to be done at their estates and more importantly the management of Dwangwa and Nchalo estates in Malawi, Kilombero estate in Tanzania, Nakabmaala estate in Zambia, Ubombo estate in Eswatini and Maragra estate in Mozambique for the support and provision of valuable datasets which has made this study a possibility