Enhancing Maize Production in Irrigated Crop Systems: Optimizing Water and Nitrogen Application for Sustainable Agriculture in Zambia

Mwape, M.[1,2,3], Said Ahmed, H.[1], Phiri, E[3], Dercon, G.[1]

[1]Soil and Water Management & Crop Nutrition Laboratory, Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, Department of Nuclear Sciences and Applications, International Atomic Energy Agency, Seibersdorf, Austria

[2] Zambia Agriculture Research Institute, Chilanga, Zambia

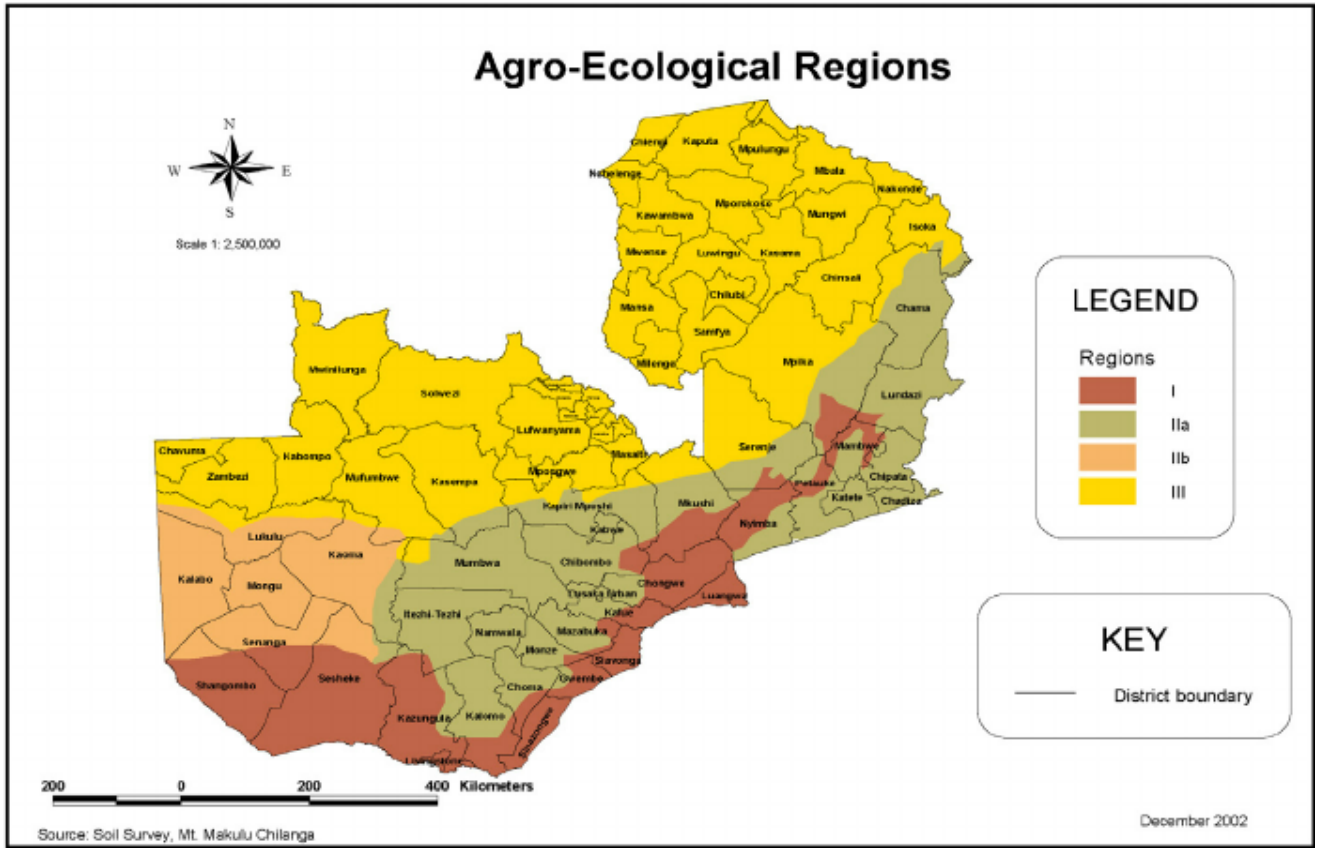
[3]The University of Zambia, Lusaka, Zambia

Outline

- Background
- Methodology
- Results
- Discussion and conclusion

Background

- Reduced rainfall has been identified as a highly probable consequence of climate change in certain regions of Zambia.
- Mostly in regions I and II are hit with drought and unreliable distribution of rainfall
- Small-holder farmers, who heavily rely on rainfall and are the primary producers of the country's staple food, maize.



Methodology

- Appreciating the problems currently being faced and recognizing the potential of irrigated agriculture to improve food security and sustain production levels, the Zambian Agricultural Research Institute (ZARI) has been actively engaged in research since 2021.

- The main aims was to identify the optimal and sustainable water and nitrogen application for achieving maximum maize production in irrigated crop systems.

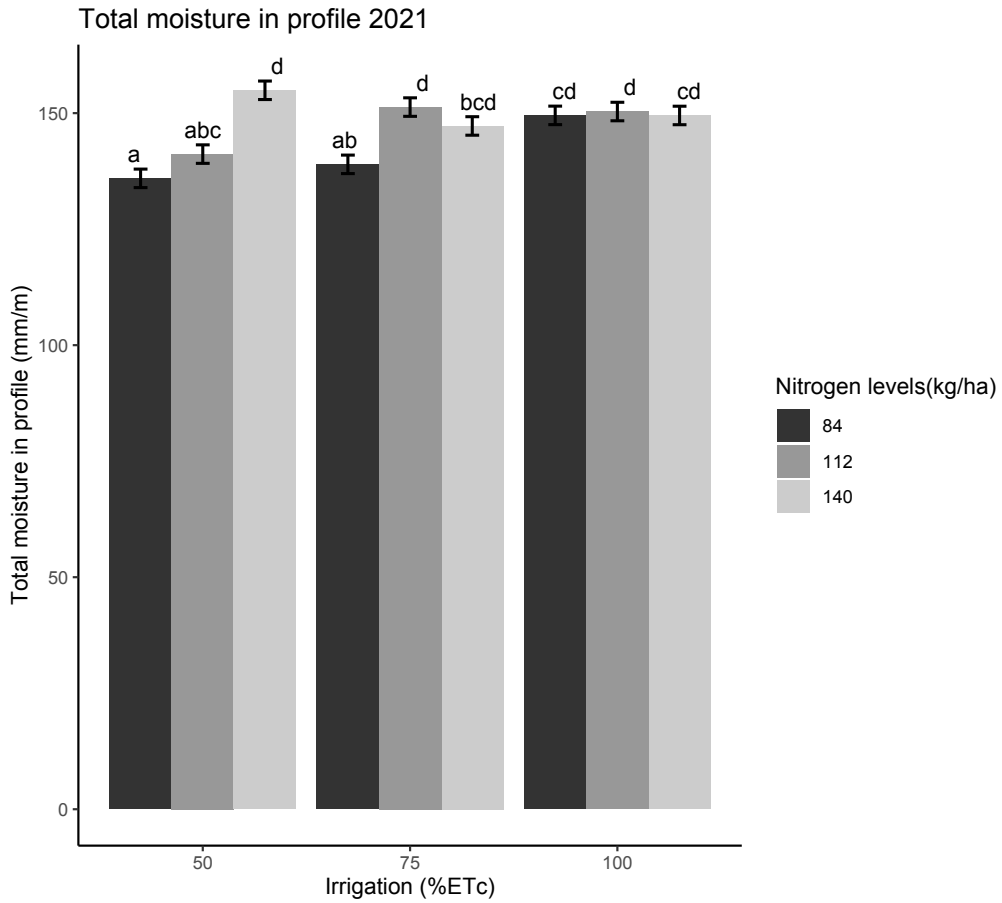
Methodology

- Three levels of water (50%, 75% and 100% of Evapotranspiration, ETc) and three levels of nitrogen (84, 112 and 140 kg/ha) were applied to field plots of 100 m^2 per treatment

- Drip irrigation was used and the widely practiced methods of application of N fertilizer was done

- Soil moisture to a depth of 1 m was monitored before and after irrigation on a weekly basis

Results



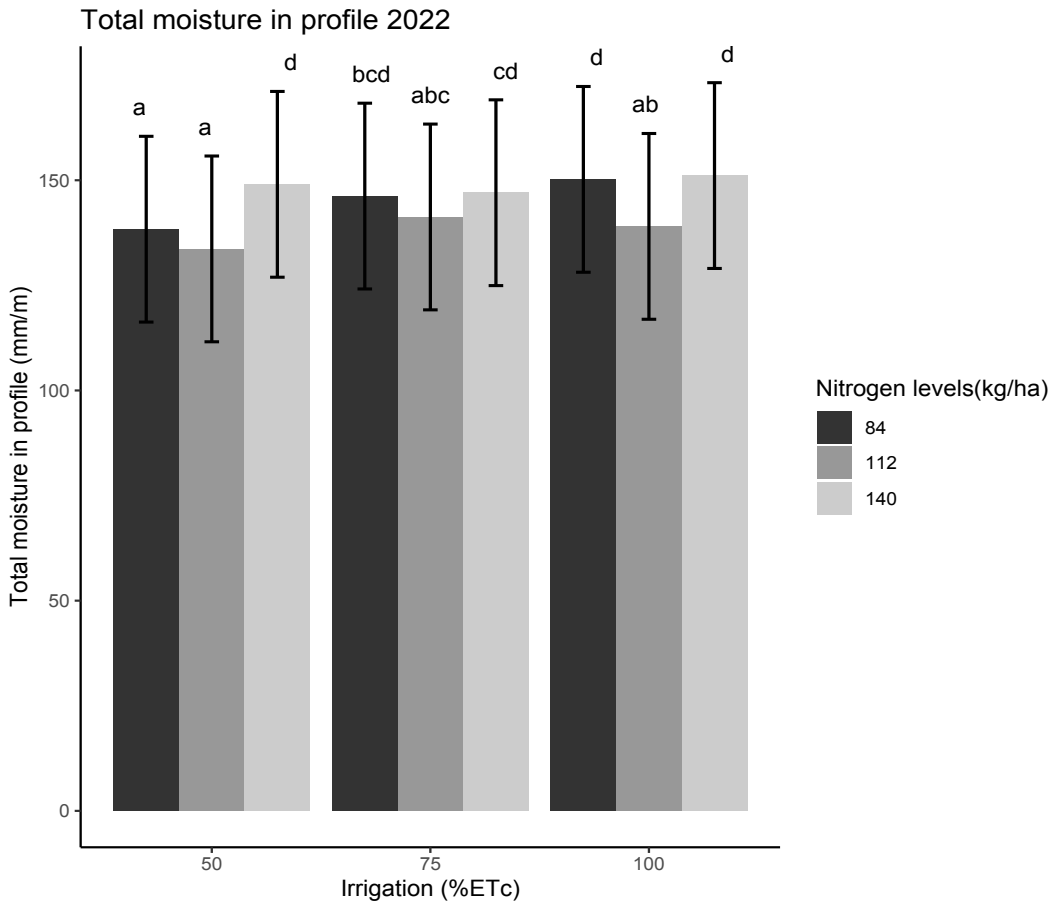


Figure 1: Average soil moisture storage in 2021 and 2022 cropping seasons

Results

- In the 2021 season, the results indicate that significantly more water was retained averagely throughout the growing season in treatments with higher nitrogen levels, especially under reduced irrigation water applications (50% and 75% ETc) (Figure 1, season 2021)

- A similar trend was observed in the 2022 season, albeit only for 50% ETc (Figure 1, season 2022)

Discussion

- The increased stover yield, which is a characteristic of increased nitrogen use, may have contributed to reduced evaporation, thus minimizing losses

- As nitrogen application levels rise, the ability to store soil water in the profile appears to increase

Conclusion

- The plan for the development of the irrigation sector for the research particular area or any area with similar soils and weather conditions can be initiated with deficit irrigation as the target water irrigation level as soil profile storage was significantly higher in both years of research

- Recommendation: Further analyses of soil moisture depth and root systems are needed to determine whether excess water in deficit-irrigated treatments is obtained from lower depths or if (and how much) water is lost in optimally irrigated treatments