Land and water productivity for maize crop

Galana Kulalu Irrigation scheme, Kenya

The Galana Kulalu Food Security irrigation project was initiated by the government of Kenya with main aim of mitigating the problem of food shortage in the country brought about by re-current drought conditions (NIA, 2021). Main cropping started in 2015 with maize crop and has continued to 2021. The objectives of this study were; i) to characterize the status of water use and water productivity in the Galana Kulalu irrigation scheme through use of the WaPOR database and ii) to identify opportunities in the use of remote sensing to provide information for assessing performance of irrigated agriculture at Galana Kulalu. This approach will be valuable to inform decision making about irrigation management, crop productivity and to establishing reliable monitoring mechanisms. The WaPOR project of FAO is a portal with data sets for monitoring Water Productivity through open access of remotely sensed derived data over Africa and the Near East countries (FAO, 2018).

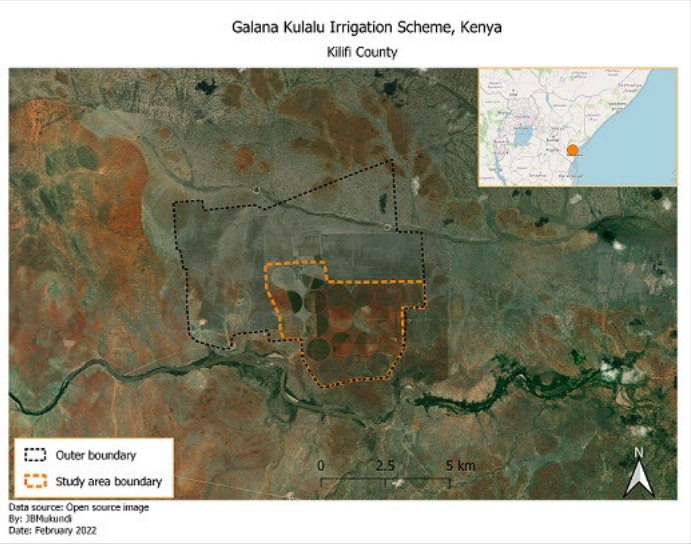

Figure 1: Galana Kulalu irrigation scheme

- Location: Kenya, Kilifi county
- Climate: Tropical, Semi-arid (Jaetzold, 2006)
- Irrigation method: Centre pivots (5000 acres)
- Main crop: Maize (DK90-89, Panar 7M-81)
- Water source: Athi-Galana Sabaki River
- Cropping seasons: 1/4/2018-31/3/2019, 1/4/2019-31/3/2020, 1/4/2020-31/3/2021, 1/4/2021-31/3/2022

Methodology

The following steps were followed;

(i) remotely sensed derived data from WaPOR portal, local data acquired and processed using WaPORWP python scripts and QGIS

(ii) seasonal water consumption and above-ground biomass production were calculated

(iii) analysis of irrigation performance indicators across crop seasons

(iv) crop water productivity, yield gap exploration

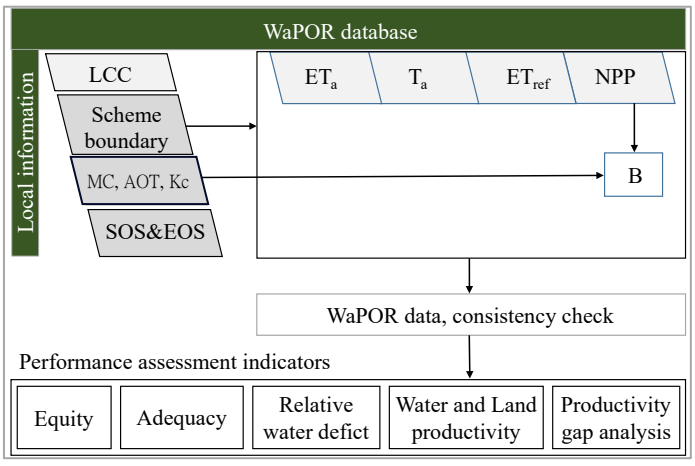

Figure 2. Flow chart for calculating indicators for irrigated maize at Galana Kulalu[1]

[1] ET_a is actual evapotranspiration, T_a is actual transpiration, ET_{ref} is reference evapotranspiration, NPP is Net Primary Production, LCC is land cover classification, MC is moisture content in fresh biomass, AOT is above ground over total biomass, Kc is crop coefficient, SOS is start of season, EOS is end of season and B is above ground biomass

Assumptions and uncertainties: For purpose of irrigation performance analysis and comparison between seasons, the cropping season was assumed to be 12 months (Apr 1st – March 31st). The actual start and end dates for individual lots would actually be different. The mask LCC used was coarse for the study scale and same for all the seasons. Cloud cover also could affect the image quality

Results

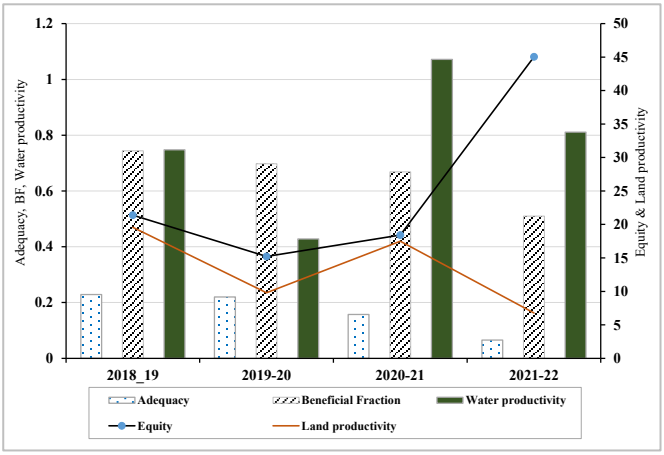

Figure 3. Irrigation performance indicators and water productivity for irrigated maize at Galana Kulalu

Irrigation and performance analysis

The performance indicators varied markedly between the seasons and were lowest in the 2021-22 cropping season, for all indicators. Uniformity was in particular low and rated poor in the 2021-22 cropping seasons showing lack of evenness in water supply between the center pivot sites. While this could be attributed to non-uniform irrigation practices, other underlying factors could also be at play. Adequacy, the measure of relative evapotranspiration, and beneficial fraction were clearly varied between the cropping seasons. Sites of concern were identifiable which calls for more focused investigation and diagnosis of specific center pivot sites.

Land productivity

Although land productivity was lowest in the 2021-22 cropping season, crop water productivity (WPy) was 2nd highest in relative terms. Spatially, high performing CPs (such as nos. 9, 10, 14, 16, 18) were distinguished from the low performing CPs (1, 4, 22, 23, 24). Mean WPy was 0.81 kg/m^3 and with 95th percentile target of 1.19 kg/m^3. Reported yield gaps for maize in Kenya range at above 50% which could apply, in this study. Unlocking yield potential per unit land size of the affected low performance CP sites, requires more investigation into certain biophysical factors such as soil fertility, salinity, agronomic practices and economic factors related to operations of the irrigation infrastructure.

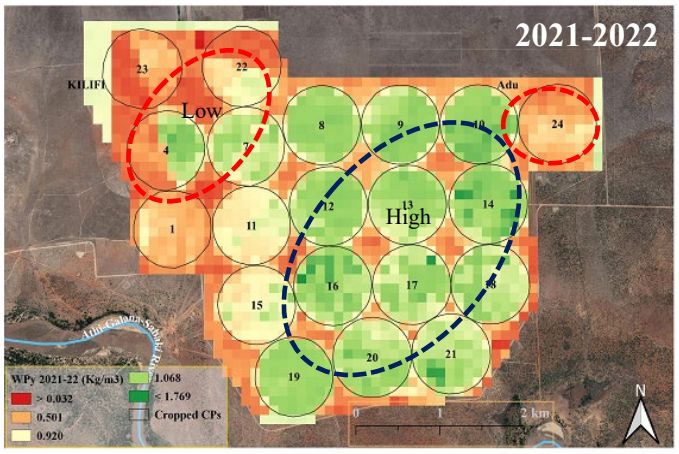

Figure 4. Spatial distribution of maize water productivity

References

- Jaetzold, R., Schmidt, H., Hornetz, B., & Shisanya, C. (2006). Farm Management Handbook of Kenya (Vol. 2/C1). Nairobi: Ministry of Agriculture.
- National Irrigation Authority (2021). Galana Kulalu Irrigation Development Project. Retrieved from: https://irrigation.go.ke/index.php/projects/flagship-projects/galana

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