Monitoring Irish Potato Production

Case Study: Nyandarua County

Nyandarua County, is one of the Kenya highland regions, located on the western slopes of the Aberdare Ranges in central Kenya. The region (*Figure 1*) supports about 40% of the country's potato production, while providing employment to about 7,000 households, majority being small-scale farmers and embracing the crop as a cash crop. Following the increased demand for potatoes production, and the increasingly erratic climate conditions in the country, the government through the county government is encouraging farmers to embrace irrigation as a measure to improve the production. Therefore, in order to ensure more efficient water use while boosting production, there is need for targeted efforts in provision of irrigation water and storage capacities for irrigation infrastructure in the area.

Country: Kenya

Climate: Tropical cool Highlands climate

Crop(s): Potatoes (Irish Potatoes), Horticulture crops (peas, cabbage, carrots)

Total Area: 328,861 ha /3,288 km^2; Approximate area under potato cultivation ≈ 37000 ha

Water source: Rainfed and surface water from water pans, drilled boreholes and rivers

Irrigation method(s): Sprinkler and Drip irrigation

Study period: Seasonal data over 5 growing seasons within the period 2021 – 2022, since Potatoes is a short cycle three – four months crop.

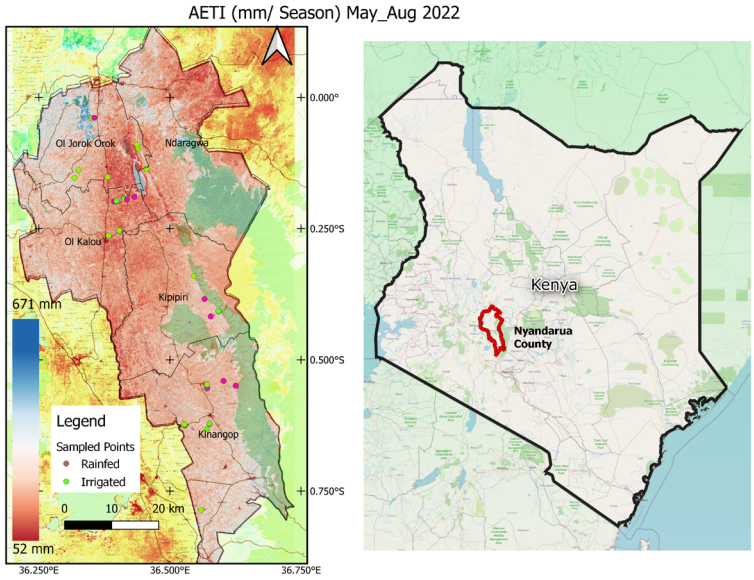


Figure 1: Nyandarua County Map

The main objective of the study was to monitor potato production with an aim of providing insight into areas for targeted irrigation expansion while measuring the effectiveness of the irrigation expansion efforts made (e.g. provision of water pans to support irrigation within the county), in the wake of increased climate variability and drought events.

Methodology

The methodology involved special consideration of the small-scale farms thus required mapping of the land cover using Sentinel-2 cloudless image in order to obtain the crop mask. This was followed by identification of areas under irrigation using field work visits, identification of green areas using satellite imagery taken in dry months and analysis of WaPOR Portal spatial seasonal data to compare where seasonal actual evapotranspiration (AETI) exceeded the seasonal precipitation. In addition, field study aided the collection of local data which included among them, Start and End of Season (SOS, EOS), crops planted, the determination of different seasons when either irrigation or rain-fed agriculture was practiced. This was followed by analyses involving seasonal water consumption, potential crop water requirements, above ground biomass production and estimated crop yields for both rain-fed and irrigated farms using the WaPORWP scripts[1]. Finally, an assessment of water application performance indicators for both rain-fed and irrigated areas was carried out in order to aid understanding of the

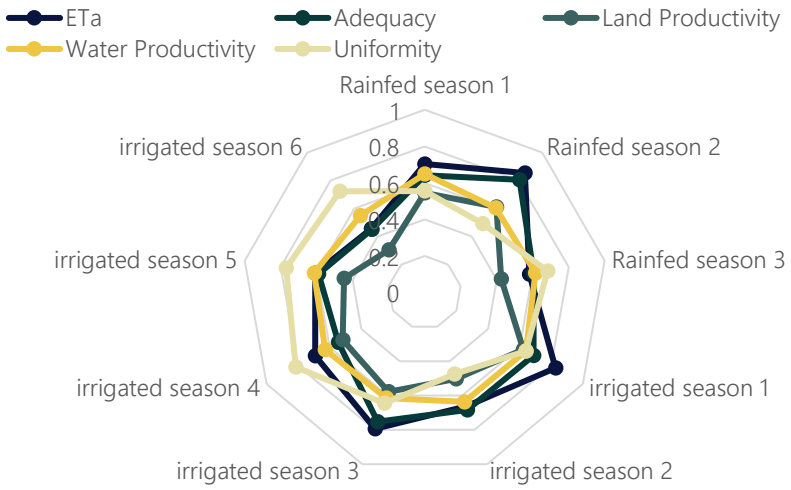
[1] https://github.com/wateraccounting/WAPORWP

efficiency of the irrigation methods while understanding rainfall water use efficiency hence aid targeted measures in improving both water and land productivity.

Assumptions and Uncertainties: Cropping season was assumed to be 4 months, some periods falling within the long and short-rainy seasons. Majority of the irrigated fields had different start and end dates. The study area location is predisposed to cloudy conditions hence, clear images to aid crop mask mapping could only be obtained during dry spells, hence areas with high NDVI were associated with irrigated fields while some bare lands were associated with rainfed agriculture areas.

Results

The results of the land and water productivity, and water application performance indicators under both rainfed and irrigated conditions are summarized in Fig. 2. As expected the land productivity increased with availability of water consumed (ETa) under both rain-fed and irrigation conditions. However, increased water uptake with lack of regard on improving uniformity translated to reduced water productivity. Similarly, measures to improve relative water deficit and beneficial fraction through better practices for both rain-fed and irrigated conditions may on the overall have a boost effect on the land and water productivity. In general, rain-fed conditions translated to better uniformity compared to irrigation systems. This could be attributed to the fact that the irrigation lands are spatially distributed in small scale and relying on different water sources. Hence, individual schemes needed to be isolated in order to evaluate their irrigation performance and provide conclusive report.



Rainfed	season 1	2021/03/01-2021/06/30
	season 2	2021/09/01-2021/12/31
	season 3	2022/05/01-2022/08/31
irrigated	season 1	2020/12/01-2021/03/31
	season 2	2021/04/01-2021/07/31
	season 3	2021/08/01-2021/11/30
	season 4	2021/12/01/-2022/03/31
	season 5	2022/04/01-2022/07/31
	season 6	2022/08/01-2022/11/30

Figure 2: Performance Indicators of Irish Potatoes in Nyandurua County under rain-fed and irrigated conditions

Comparing the degree of agreement between the available water and the amount of water required by the crops, i.e. the adequacy, under both rain-fed and irrigated conditions, it is observed that since December of 2021, the irrigation conditions scored much lower values compared to rainfed conditions. This may indicate a higher demand for water among competing uses, hence reducing the amount of available water for irrigation. Consequently, this is reflected in reduced land productivity although the water productivity doesn't show much variation except for the last irrigated season. On average the land productivity per season for Nyandarua under rainfed and irrigated conditions is 17.5 and 16.5 ton/ha, respectively. These yields estimation using WaPOR data vary within -14% to -9% when comparing with the average seasonal yield data of the county. On the other hand, the water productivity is averaged at WPy of 6.2 and 6.1 kg/m^3 under rain-fed and irrigated conditions respectively. While there is need to boost land productivity in order to meet food demands as well as realize economic value of farming as an investment, target measures around increasing land productivity without necessarily increasing the overall water consumption (ETa), boosting adequacy and water productivity through proper scheduling and farm management practices need to be considered.

More information on this case study and land productivity, go to our webpage

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