DETERMINE WATER USE OF THE CANNABIS TREE IN THE EASTERN CAPE AND KWAZULU-NATAL PROVINCES

A Water Research Commission Project (C2021/2022-00442)

Project lead: K Smart / SK Mantel

Collaborators: AR Palmer (IWR), S Gokool (UKZN), A Clulow (UKZN), K Chetty (UKZN), S Tesfay (UKZN), T Mabhaudhi (UKZN), R Kunz (UKZN)

April 2021 – March 2025

Interest in *Cannabis sativa* as a feasible, high-value crop for emerging small-scale farmers is growing. *Cannabis sativa* is a multipurpose crop that can be grown for fibre, seed, oil and medicinal properties, as well as having bioenergy potential, and numerous other environmental benefits such as phytoremediation. Despite being one of the oldest cultivated crops, little is known about the water use of the crop except for the consensus that it is a water thirsty crop.

The proposed project aims to produce new knowledge and information to guide a growing interest in *C. sativa* in response to the changing legal and regulatory requirements as well as an increasing drive to follow environmentally sustainable development pathways (e.g. bioenergy). Water use estimates will be determined through field-based trials, and pot experiments. The field-based trials and pot experiment data will be used to parameterise the AQUACROP model, and national scale model runs will be undertaken to provide simulations of crop yield, water use and water productivity. These will be combined with bioclimatic suitability mapping using the MAXENT model; with the resultant product mapping areas of high to low *C. sativa* production potential.

Distribution maps of the current areas of *C. sativa* will be produced using high resolution hyperspectral imagery. Additionally, complementary maps of potential target areas for *C. sativa*, where dual environmental and economic benefits may be recognised, will be produced. These aspects will be included in a preliminary framing document to guide stakeholders at all levels and decision makers across the agricultural, water and development sectors. This project will provide the needed understanding of the production potential of *C. sativa* and, more importantly, the potential knock-on impacts on the water resources and downstream water availability. Without this knowledge, adequate water provision for citizens and sustainable development could be compromised if continued expansion of *C. sativa* cultivation occurred.

The aims of the WRC project were:

1. To conduct a scoping review of available literature on the water use, distribution and agronomic management and value chain of *C. sativa* crops for both fibre and oil production.
2. To map the extent and distribution of *C. sativa* stands as well as identify suitable growth areas.
3. Determine the water use and yield of *C. sativa* for either fibre or oil production using field based measurements.
4. Undertake multi-scale modelling of the water use, yield and potential hydrological impacts of *C. sativa*.
5. Undertake a preliminary socio-economic feasibility assessment based on value chain principals including suitable areas for growth and best management practices.

The project commenced in April 2021. Short summaries of two recent deliverables submitted to the WRC are listed below:

Deliverable 3 (Initial *Cannabis sativa* distribution maps): This deliverable is linked to Aim 2 and included an assessment aimed to demonstrate how the power of geospatial cloud computing can be leveraged to exploit the unique characteristics of Sentinel-2 imagery for the purpose of mapping *C. sativa* within the Eastern Cape province of South Africa. In order to model and predict the 7 broad LULC classes, some of the commonly used machine learning classification algorithms available in GEE were deployed. Overall, the best performing classification algorithm was the Gradient Tree Boosting (GTB) classifier, and the average class-specific producer accuracy (PA) and user accuracy (UA) for the GTB classification were 89.29 % (± 9.41) and 89.86 % (± 8.47), respectively. The result of the mapping is shown in Figure 1.

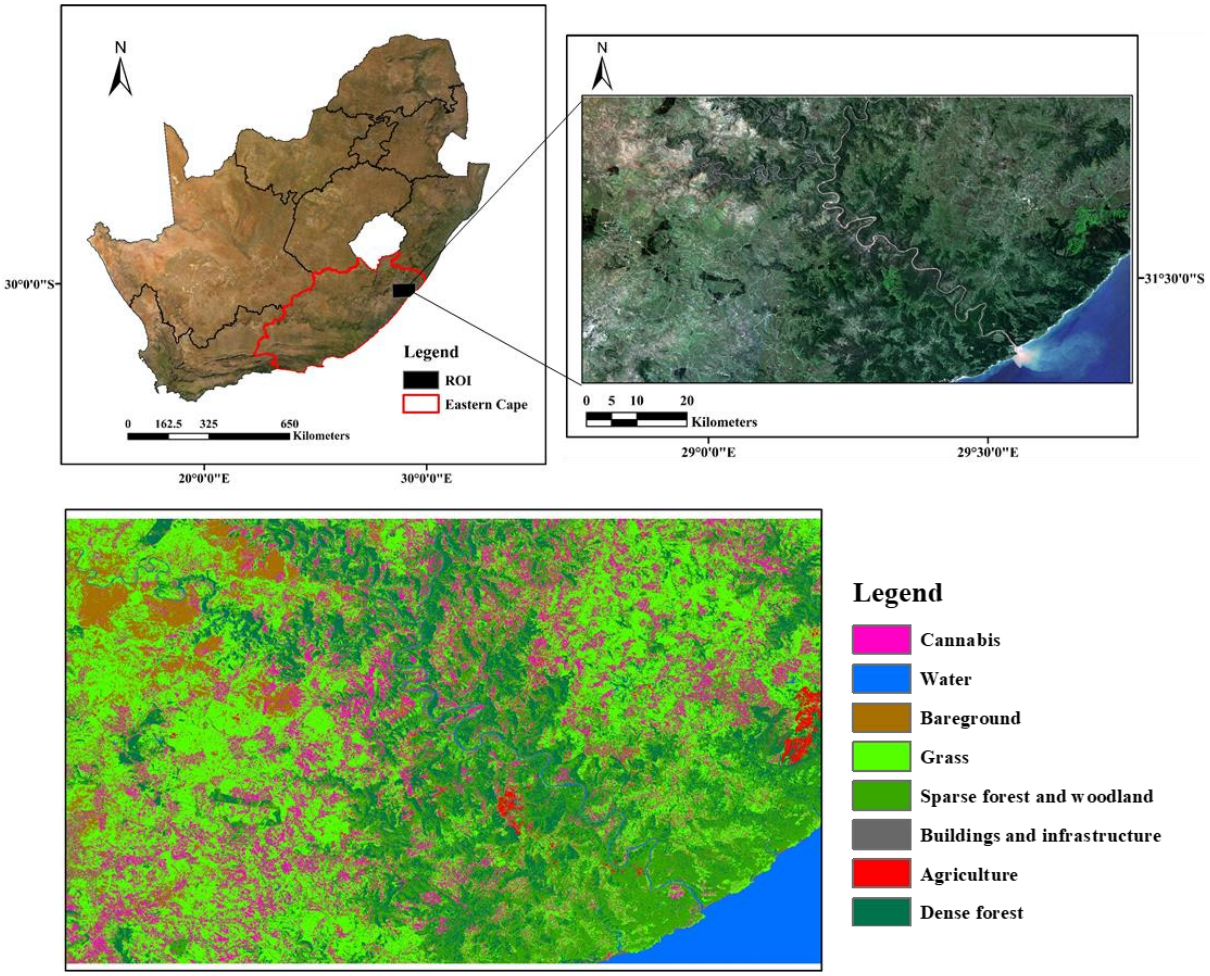

Figure 1 LULC classification result for the study region at a 10-meter spatial resolution, with the Sentinel-2 RGB composite shown on the top right. (Agriculture=Cultivated land, without C. sativa).

Deliverable 4 (Progress on *C. sativa* growth environment report): *Cannabis sativa* is the most extensively trafficked and sought-after illicit drug worldwide. This has led to a great deal of interest in mapping *C. sativa* to rapidly and more efficiently detect the growth of illicit plantations which can then be destroyed, ultimately resulting in reduced

consumption. However, perceptions regarding the use of *C. sativa* continue to evolve, particularly around its use for medicinal purposes. Thus, improving upon existing detection and mapping techniques has taken on added significance as it allows for the improved planning and management of legalized crops that are regulated within certain countries. Thus, this deliverable identified and mapped bio-climatic regions deemed suitable for *C. sativa* production in South Africa using limited ground data and literature guidelines on suitable habitat conditions.

Although hemp is well adapted to the temperate climatic zone and will grow under varied environmental conditions, it grows best under warm growing conditions, an extended frost-free season, highly productive agricultural soils, and abundant moisture throughout the growing season. We conducted mapping suitable growing locations for Cannabis in South Africa using two different methods:

a) ArcGIS Predictive Analysis Tool using the climate datasets derived from the South African Atlas of Climatology and Agrohydrology, and

b) Species distribution modelling using high-resolution satellite-derived climate datasets in Google Earth Engine.

The result using the ArcGIS Predictive Analysis Tool (shown in Figure 2) indicates that very limited areas are ideal for growing *Cannabis*.

The project is supporting three MSc projects, with one of them hosted at IWR (Kamva Zenani), and the other two who are studying at UKZN.

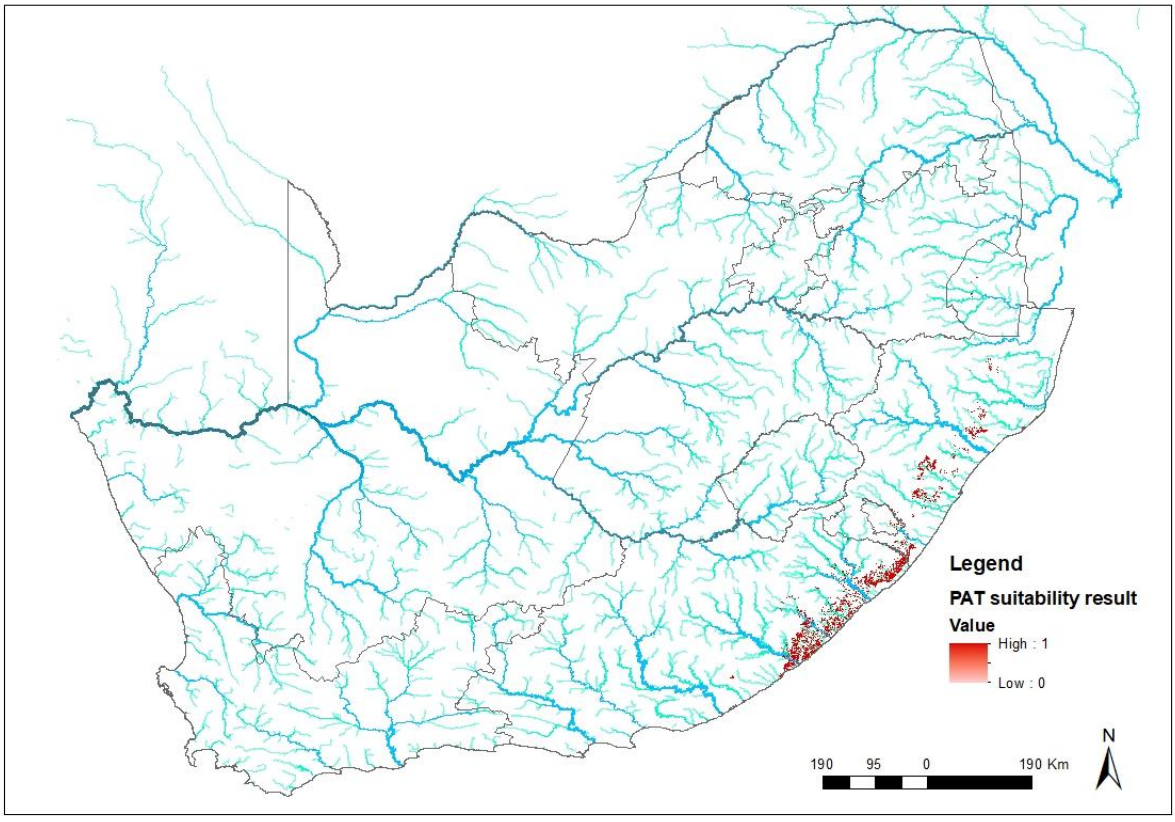

Figure 2 Result generated by the ArcGIS Predictive Analysis Tool for suitable growing areas in South Africa.