



Updated determination of climatically suitable growth areas in South Africa for macadamias under present climatic and projected climate change conditions

Challenges

- **Climate variability:** Macadamia production is sensitive to climate conditions, including temperature, rainfall, and humidity. Climate change is introducing greater variability in these factors, posing a possible risk to macadamia cultivation.
- **Water availability:** Macadamia trees require consistent access to water, and climate-related changes in rainfall patterns and increased temperatures can affect soil moisture and irrigation needs.
- **Temperature extremes:** High temperatures and frost events can negatively impact macadamia trees at various growth stages, affecting nut quality and yield.
- **Soil suitability:** Ensuring that macadamia orchards are established in suitable soils with proper drainage is crucial for long-term productivity.
- **Adaptation and irrigation:** Growers need to adapt their practices and potentially invest in irrigation systems to mitigate the impacts of a changing climate.

Aim

The primary aim of this project was to assess the potential challenges posed by climate change to macadamia production in South Africa and provide guidance for growers and stakeholders in the macadamia industry. The project aims to identify areas which may become less productive in future, or conversely, may become more favourable to macadamia production by:

- **Understanding climate-related thresholds:** Identify critical temperature, rainfall, and humidity thresholds that affect macadamia growth and production.
- **Assessing vulnerability:** Evaluate the vulnerability of macadamia production regions to changing climate conditions, considering factors like temperature, rainfall, and extreme events.
- **Guide decision-making:** Provide actionable recommendations for growers to adapt their practices, including irrigation strategies and timing, to better cope with climate change impacts.

Results

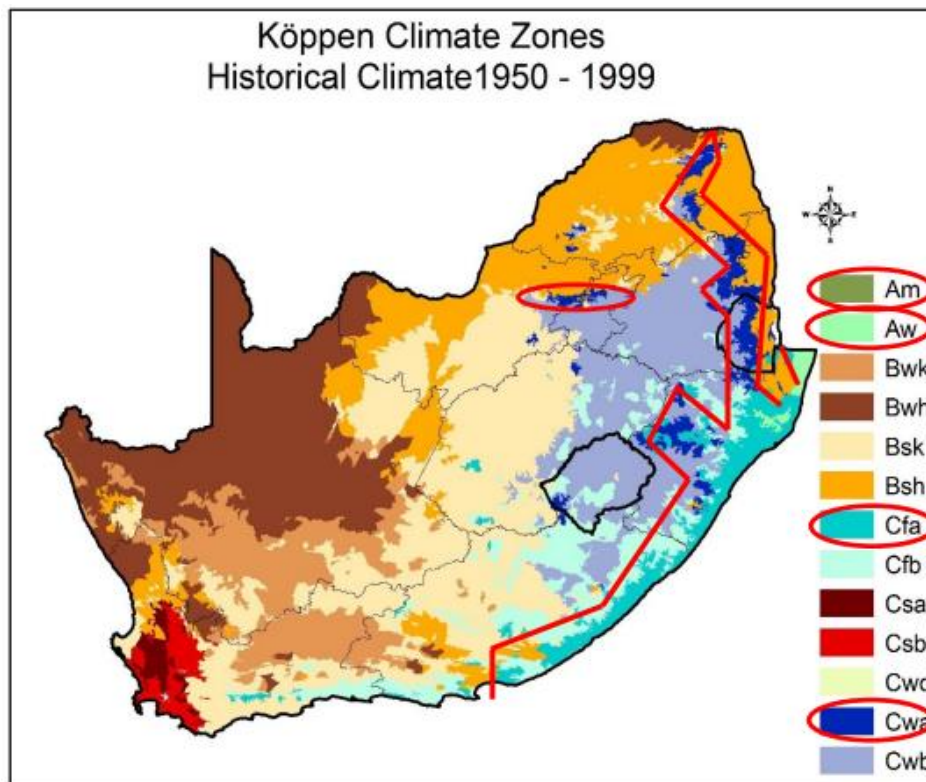
The project findings indicate several important outcomes:

- **Temperature sensitivity:** Macadamias are sensitive to temperature fluctuations, with impacts flowering initiation, nut growth, and maturation. Climate change is expected to alter these temperature-driven phenological stages. For example, changes in the distribution/extent of Köppen climate zones, heat unit accumulation during flower initiation, nut growth and nut maturation and changes in number of days of temperature extremes was predicted.
- **Rainfall patterns:** Changing rainfall patterns during critical phases like flowering and nut maturation can influence macadamia yields and quality. Excessive rainfall can lead to poor kernel recovery. For example, changes in mean annual rainfall, expansion of areas with heavy rainfall and changes in rainfall during critical phenological events was predicted in this study.
- **Water stress:** Drought conditions can lead to water stress in macadamia trees, affecting growth, photosynthesis, and nut development. Irrigation becomes increasingly important under changing climate conditions. For example, soil water stress at different stages of nut development will have different effects on the yield and nut quality, oil accumulation, premature nut drops, splitting of thinner shells, nut discolouration.
- **Soil and topography:** Soil type, drainage, and topography play significant roles in macadamia cultivation. Proper site selection and soil preparation are crucial. For example, slope gradient, row orientation and microclimates.
- **Adaptation and irrigation:** Growers may need to adapt by implementing supplementary irrigation and other climate-smart practices to maintain productivity and quality such as:
 - Integration of climate information into environmental data sets.
 - Preparing climate change related vulnerability or hazard assessments.
 - Factoring climate change into broad development strategies, as well as into macro policies and / or sector policies, institutional or organisational structures, or development project design and implementation.

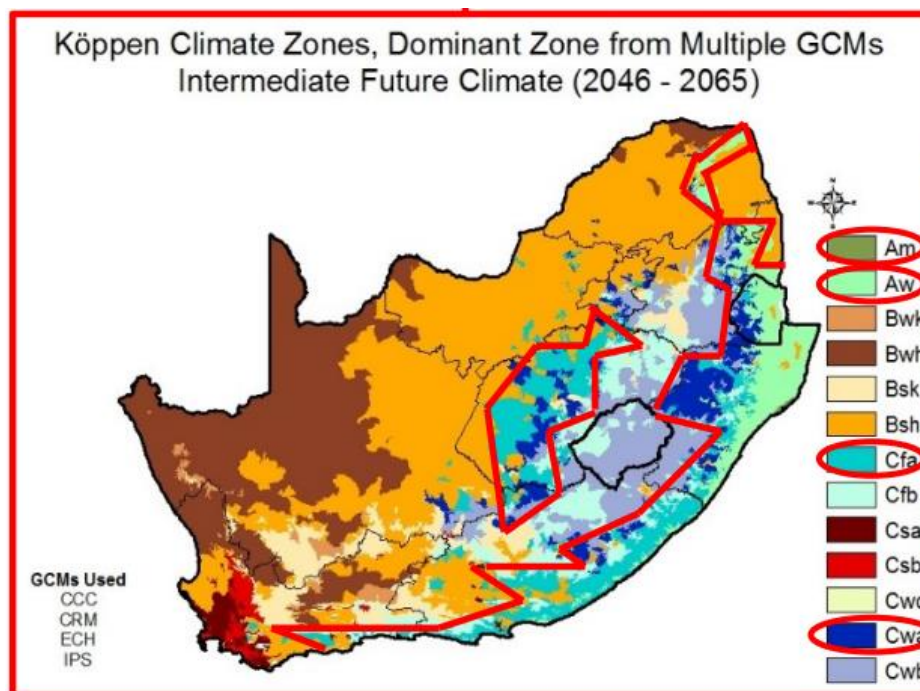
What Does This Mean

- This project highlights the critical relationship between climate conditions and macadamia production in South Africa. As climate change continues to impact temperature, rainfall, and extreme weather events, the macadamia industry faces challenges in maintaining consistent yields and high-quality nuts.
- Growers and stakeholders in the macadamia industry must be proactive in adapting their practices to changing climate conditions. This may include adjusting planting dates, implementing efficient irrigation systems, selecting climate-resilient cultivars, and enhancing soil management techniques in future.
- Government policies and support for sustainable agriculture practices and climate adaptation will also be essential for the long-term viability of macadamia production in South Africa.

- The outcomes of this study will be made available as a series of risk maps in the next phase of SAMAC Integrator.



Köppen Climate Zones within South Africa, with Am, Aw, Cfa and Cwa considered suitable for macadamia production under historical climatic conditions 1950-1999 (Kunz and Schulze, 2011)



1 Changes in the areas covered by the four Köppen Climate Classes associated with potential macadamia production areas from historical climate (right map) to the Intermediate Future with the latter derived from four CMIP3 Global Climate Models (Original mapping by Kunz and Schulze, 2011)