Climate Resilience in Moroccan Dryland Wheat Agriculture: *a Modelling Study on Food Security*

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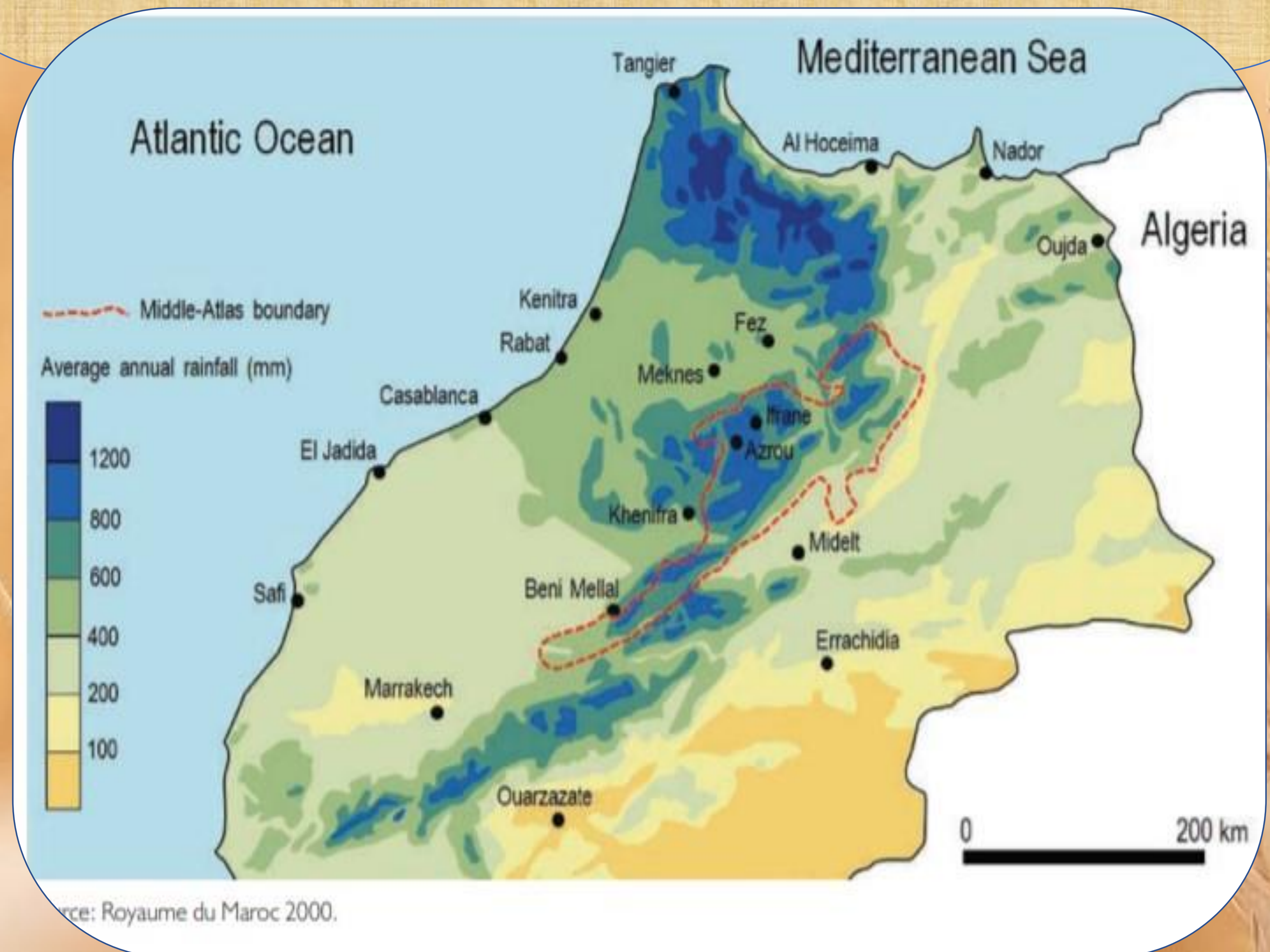
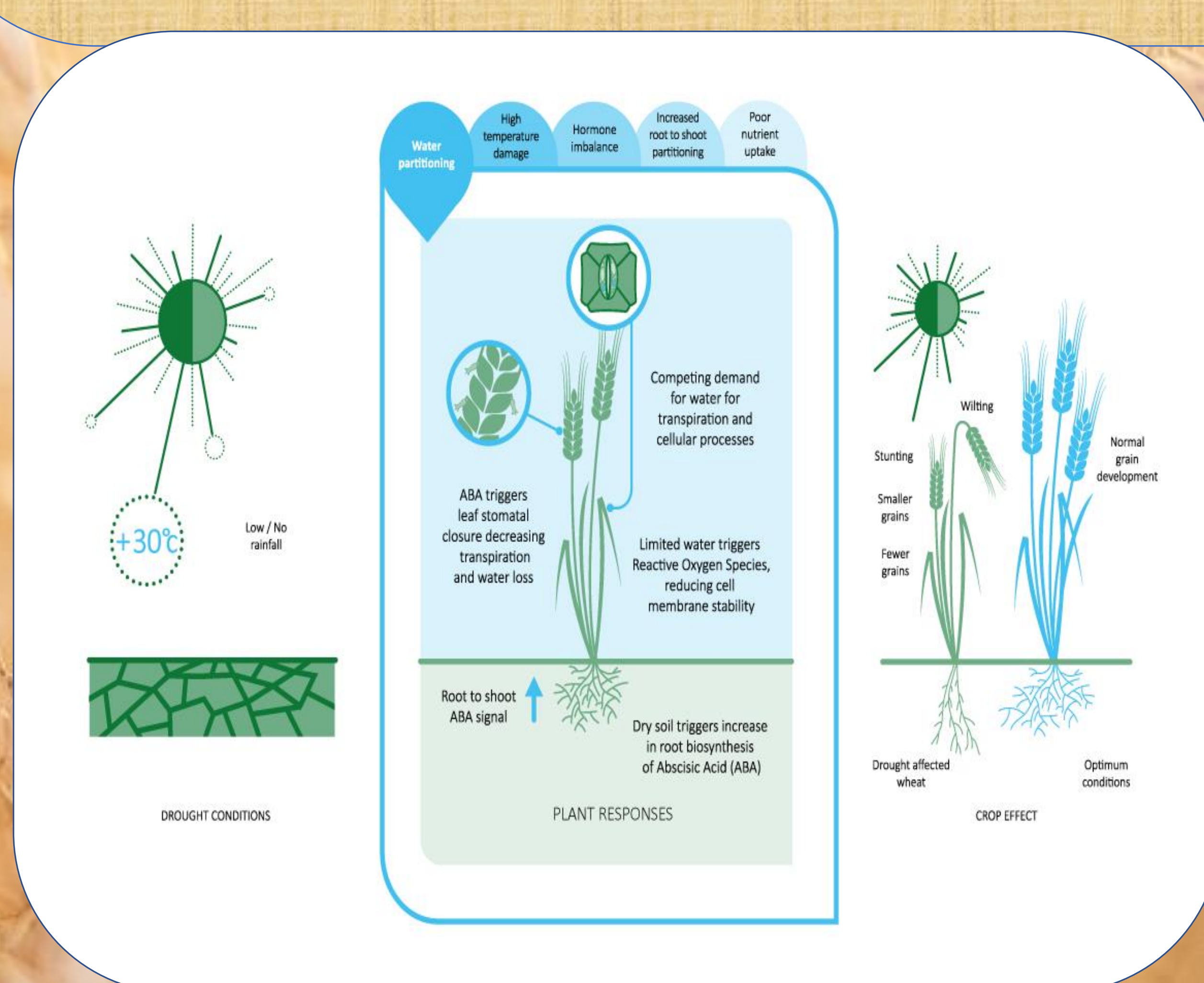
Impact of climate change on agriculture
The Food and Agriculture Organisation of the UN defines security as when everyone in the world reliably has enough to eat. To keep up with population growth food production a huge increase in agricultural production is need by 2050 (FAO, 2012). It is widely accepted that the global temperatures and warming, and this has already affected agriculture (IPCC, 2014). This combination of circumstances creates a great challenge for the farmers of the future. Much agricultural land at lower latitudes is classified as 'dryland' and will be disproportionately affected by rising temperatures and decreasing rainfall, increasing stress on crops. However rising concentrations of carbon dioxide have the potential to increase photosynthesis, which may offset some of the losses due to heat and drought stress.

My project will use AquaCrop with field trial data from ICARDA and projected future scenarios from climate models to project the future performance of different wheat cultivars and irrigation practices

The case of Morocco and crop research by ICARDA
Morocco has Mediterranean climate with long, hot, arid summers and rain falling mostly in winter and this expected to become more extreme under climate change (FAO, IPCC). Most of Morocco's agriculture is on marginal land with only the minimum of soil quality and rainfall to sustain crops, so it is immensely vulnerable to changing weather patterns. A drought between 2015-16 resulted in a 70% drop in wheat production (FAO, 2020). ICARDA is a crop research initiative which has carried out successful efforts to improve grain quality since the 1970s, and is has carried out many field trials on superior new varieties of crops which are now commonly used around the world. They have also investigated the possibility of adding small amounts of water to rain-fed crops during moisture stress to improve yield, and this is known as supplemental irrigation (Oweis and Hachum, 2012).



AquaCrop and the Role of Models
Computer models are simplifications of real systems which can help us understand their behaviour. Crop and climate models are both immensely complex, as they have to simulate a great many dynamic variables. There have been many previous studies on the impact of climate change on crop production, both at the regional and global level (Liu, 2018; Challinor 2014). It is thought that rising temperatures and CO^2 levels have the potential to benefit crops in temperate regions, but arid regions such as Morocco may see a decline. AquaCrop is a modelling programme developed by the FAO to assess crop production when water is the main limiting factor. It has been applied in many contexts, including to assess climate change at a regional level.

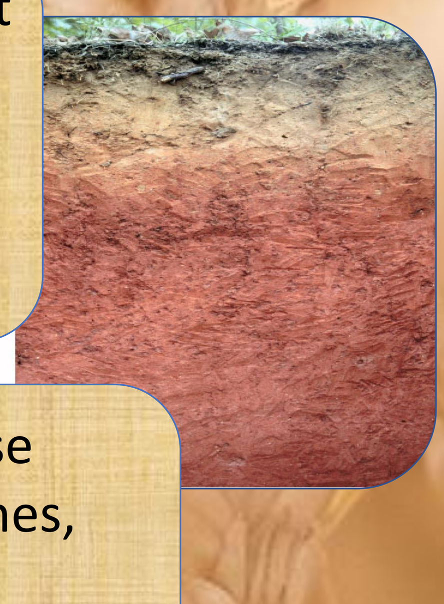


Methodology: how does AquaCrop work?

Inputs:

Climate Data: from local weather stations for the past and down-scaled from climate models for the future:
- Min / Max temp
- Rainfall
- CO^2 concentration
- Evapo-transpiration

Soil: Many different soil properties can be simulated. In study area it a mix of clay and loam



Management: These include planting times, irrigation practices, mulching, weeding, fertiliser application

Crop parameters: Some are generic to all forms of wheat and are preloaded in AquaCrop. Cultivar specific parameters such the time to reach maturity are obtained from field trial data

Outputs
- Yield
- Water productivity
- Soil moisture
- Harvest index

Aims and objectives
- Calibrate AquaCrop with field data, and test its ability to accurately simulate the study area
- Use climate model data to assess a range of future scenarios in the region
- Use AquaCrop to assess the performance of different irrigation methods and wheat cultivars
- Make a positive contribution to future food security in Morocco

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