# Agricultural Niche Construction in Roman North Africa

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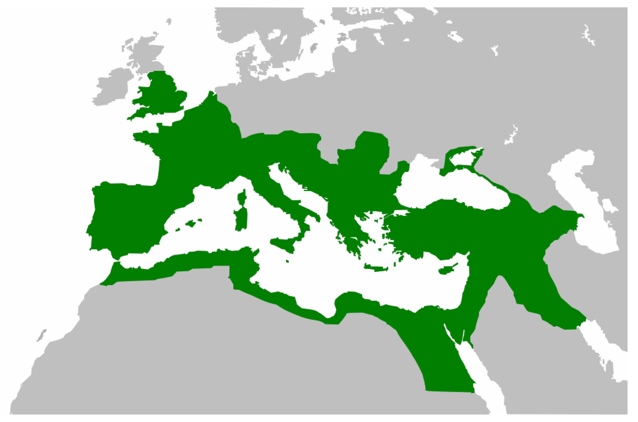
## Introduction

Two millennia ago, the province of Africa Proconsularis in North Africa – roughly modern day Tunisia, Algeria, and Libya – was the breadbasket of the Roman Empire. Today, cereal agriculture is found only in a narrow coastal strip of this semiarid region. **Was North Africa's past productivity due to a briefly favorable regional climate, human management of the local environment, or feedbacks between the two?**

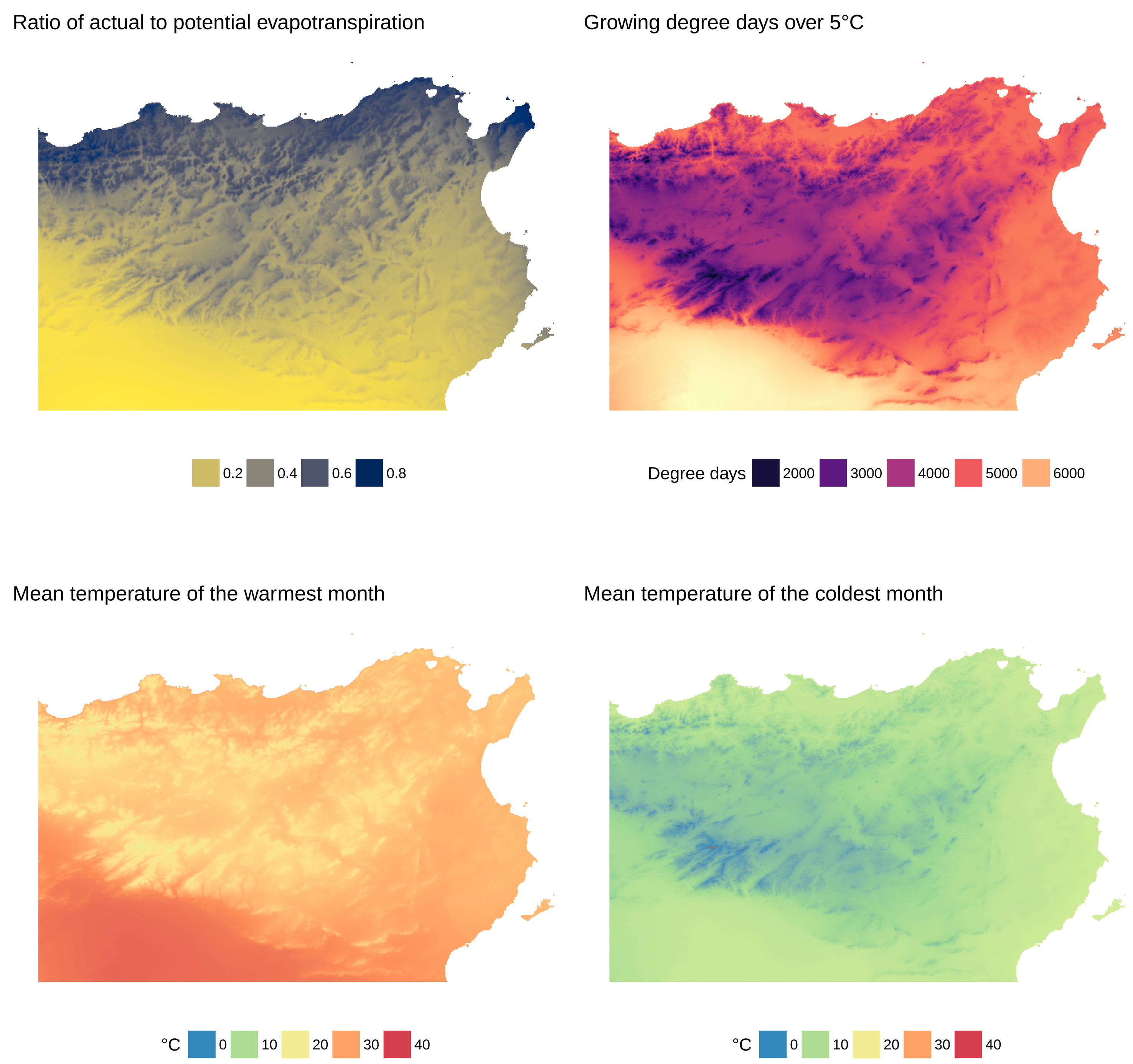


## Methods

Reconstructing the Roman agroecosystem of North Africa proceeded in two steps. First, paleoclimate simulations of the last 2,000 years were used to estimate climate and potential natural vegetation at approximately 200 CE. Then, these environmental data were input into a multi-agent simulation of Roman agricultural production, to investigate emergent patterns of human-environment coevolution.

### Climate Modeling

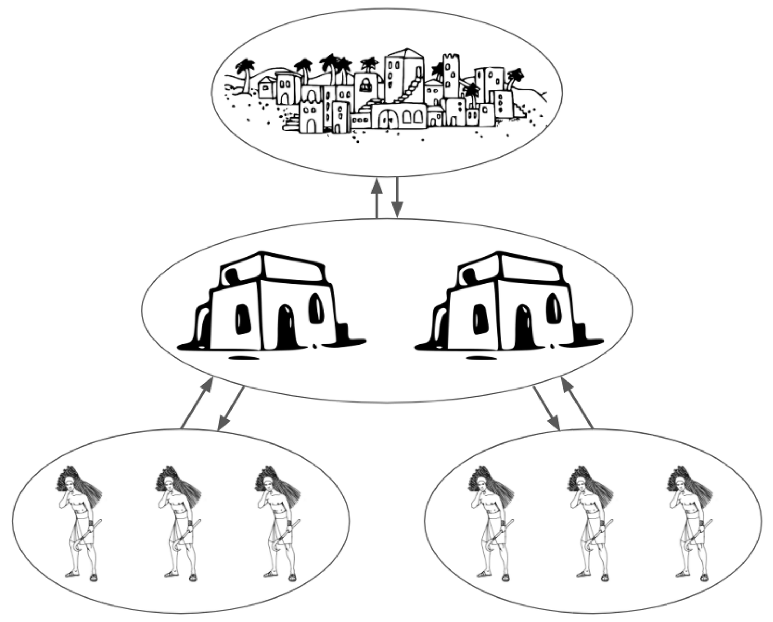
Estimates of monthly precipitation and temperature from the century bracketing 200 CE are extracted from a previously-run **paleoclimate simulation** (Jahn 2018, unpublished data) and used to calculate functional predictors of vegetation growth [1]:



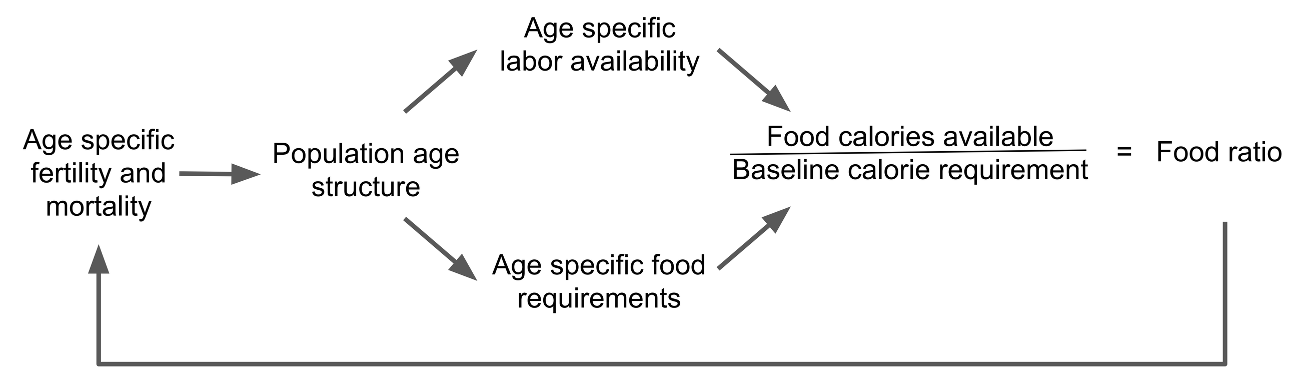

A **nonlinear multinomial logistic regression** [2] using these predictors is then trained on satellite-derived estimates of present-day vegetation cover [3], and used to hindcast potential natural vegetation (i.e. land cover absent anthropogenic influence) in North Africa at 200 CE.

## Social simulation

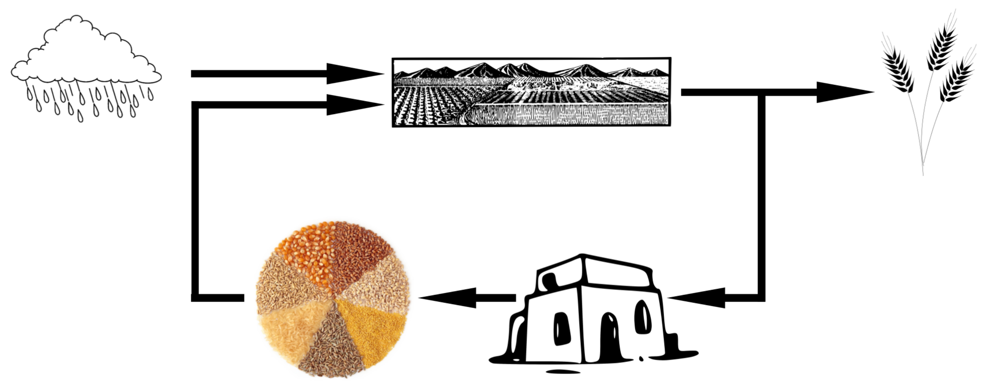
**Multilevel modeling** – computing processes on separate scales while allowing for feedbacks across scales – is an efficient means of simulating the dynamics of populations of millions of people simultaneously. Here the scales are individuals, households, and settlements.



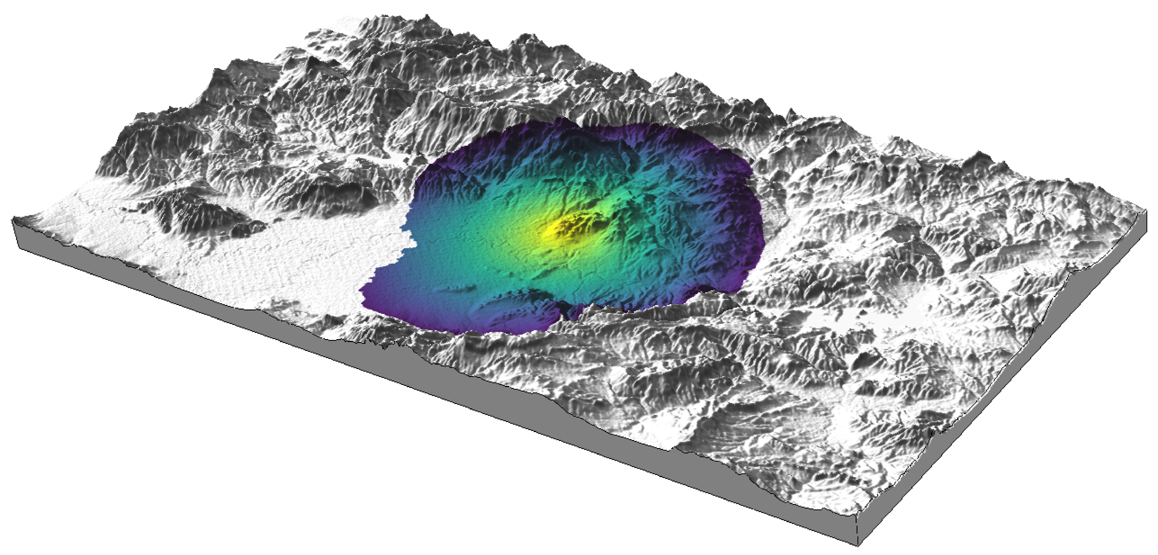
**Individual**-level demography depends on age and household-level food production [4].



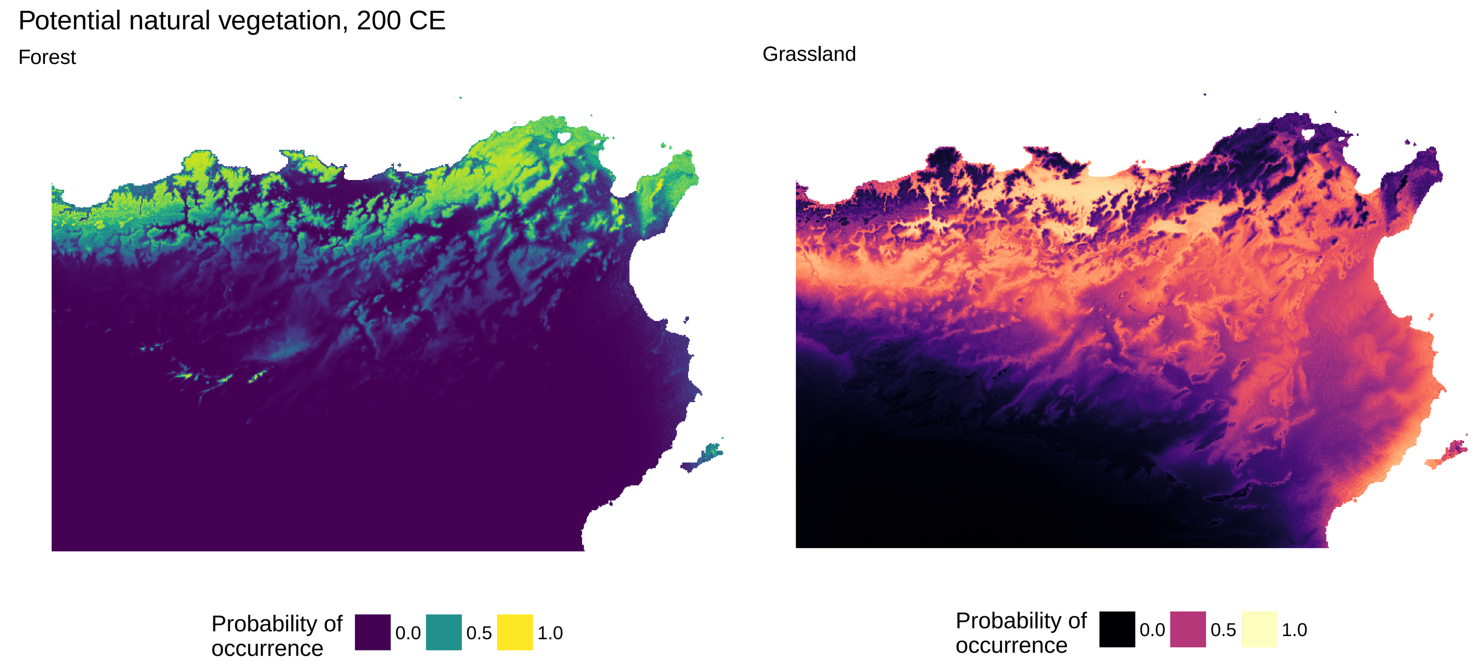

**Households** are boundedly rational, using local information and simple heuristics to allocate limited land, labor, and capital.

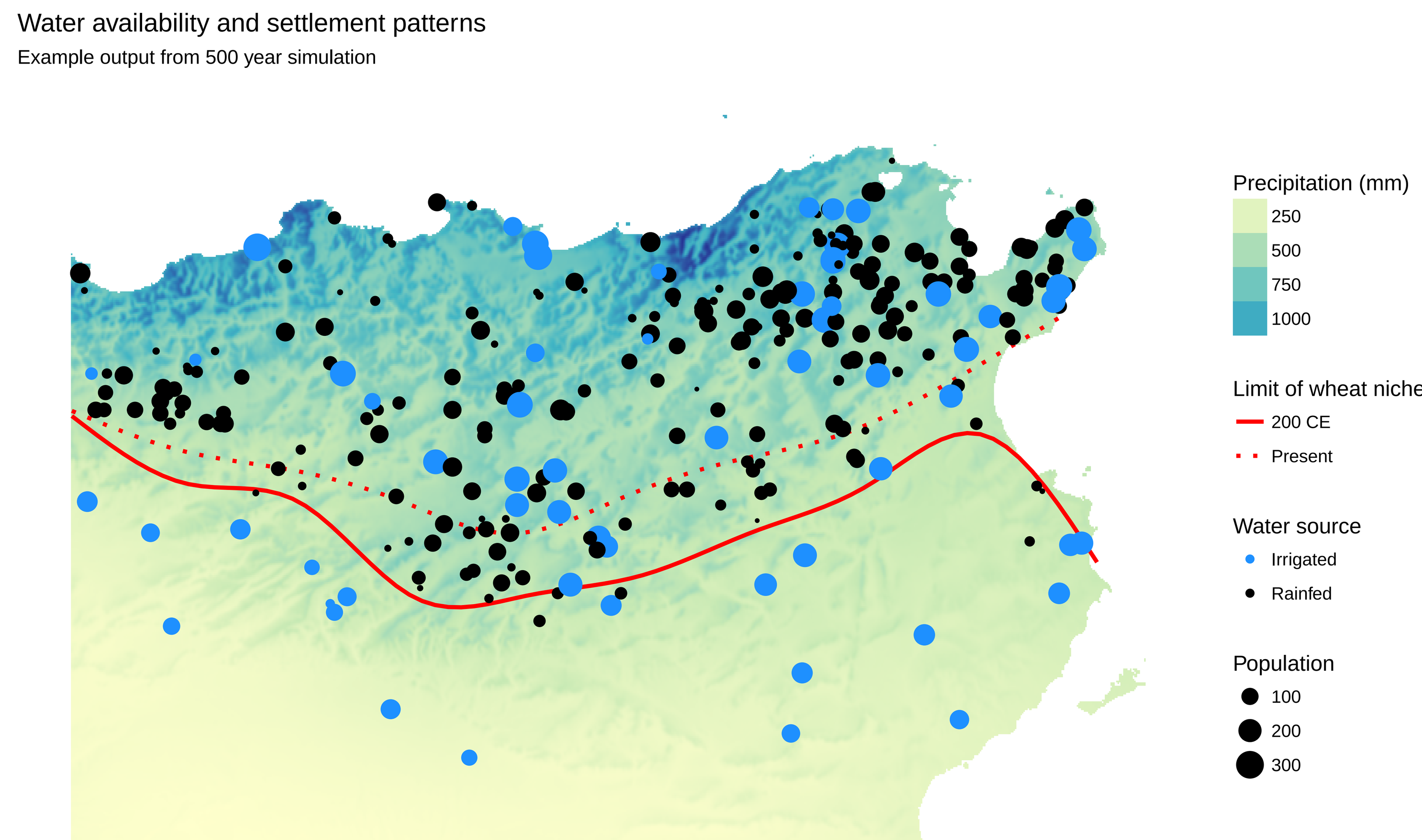


The size and location of **settlements** influences the spatial distribution of land use.



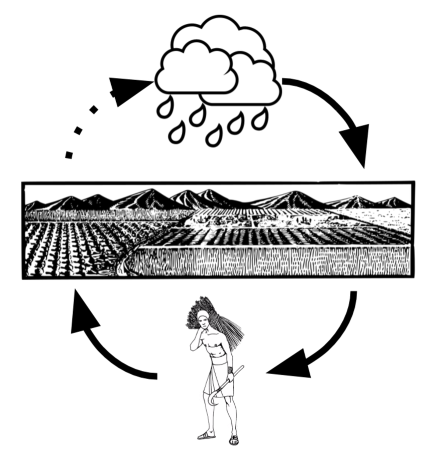
## Results




## Next Steps

Connect the climate and land-use models directly, allowing agriculture, deforestation, and irrigation to feed back onto regional climate via changes to local ecohydrology.



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## References

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