Integrating hydrological and economic modelling to assess the impacts of adaptation policies

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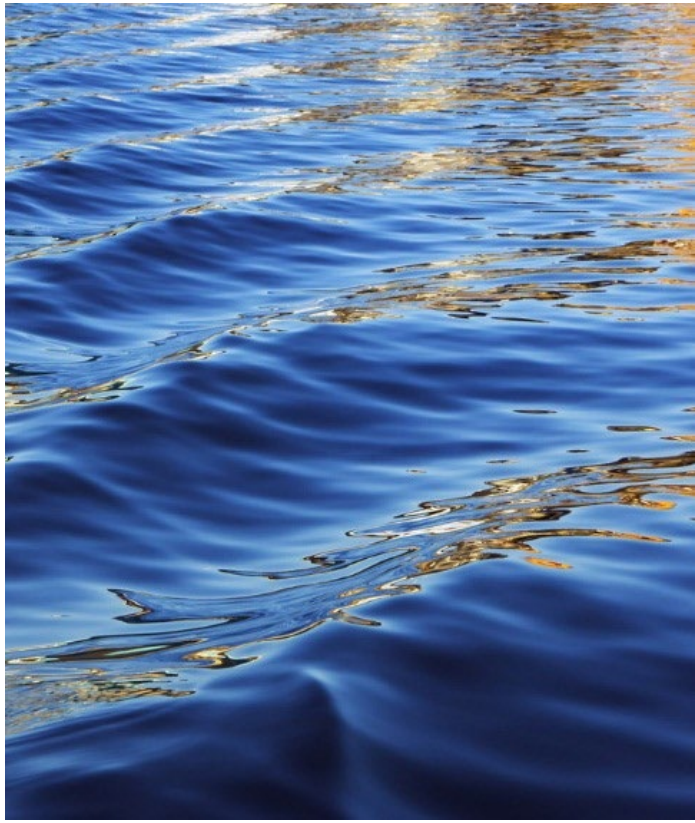

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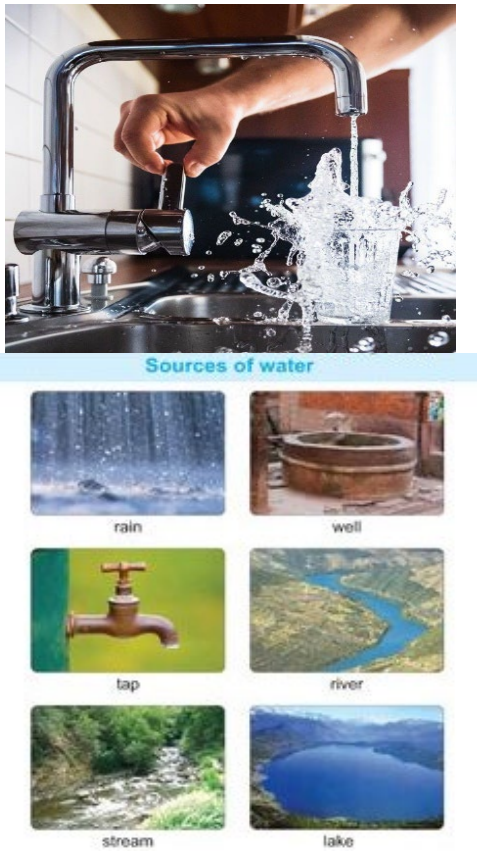
Introduction

- Drought can be defined differently in various parts of the world, depending on how much water is valued in different societies.
- Types of drought: meteorological, hydrological, agricultural, and socioeconomic
- Socioeconomic drought definitions are essential for managing water as an economic resource with significant consequences for households, communities, farms, and businesses.



The more water use

The less socioeconomic

Reserve resources

Reallocate available water

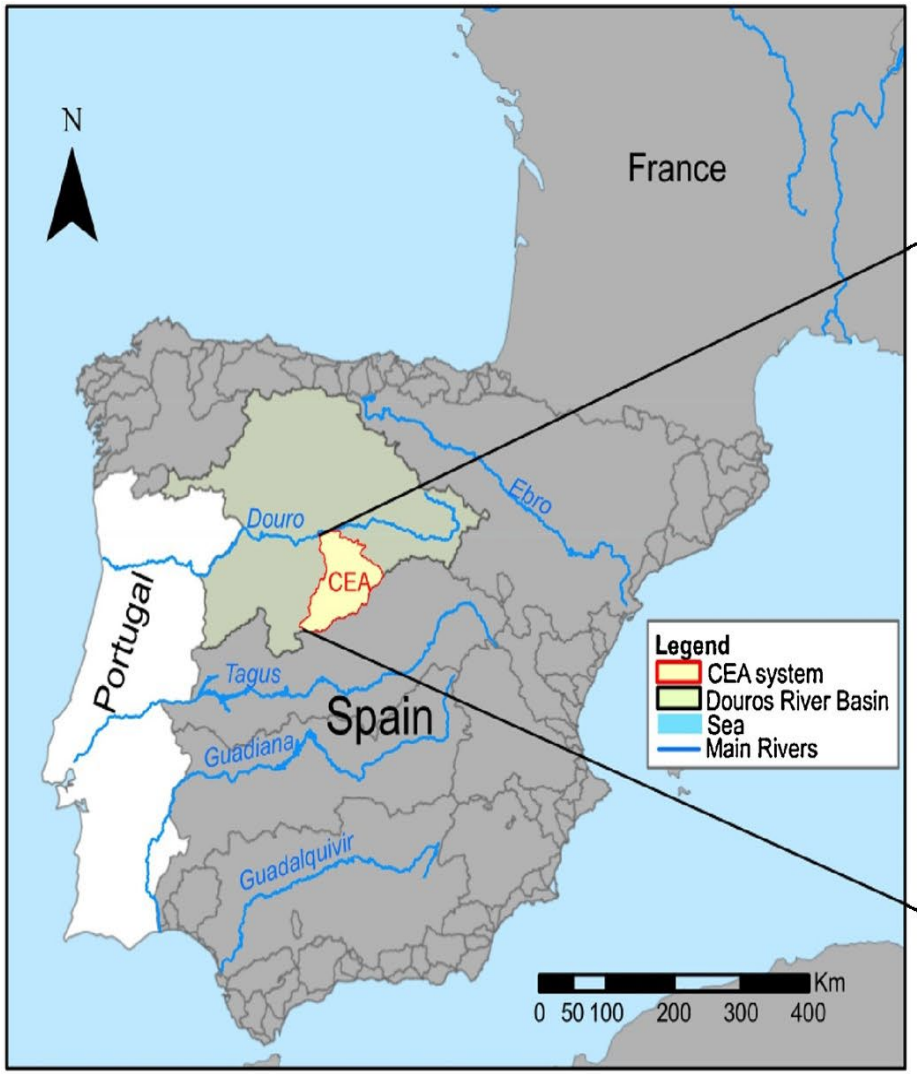
Previous Studies

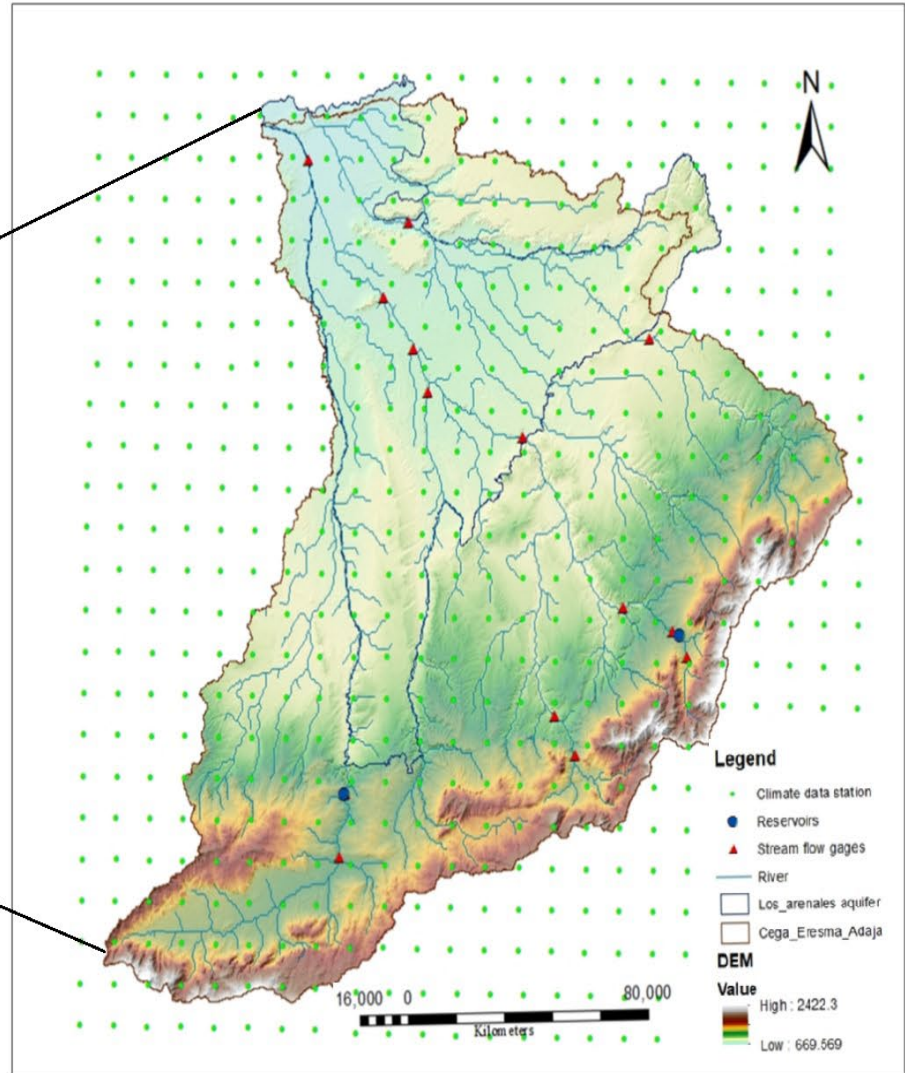
Table1. A review of selected studies which have coupled different models

Author	Year	location	Water resources (S, GW)	Model description	Models	Approaches
Essenfelder H., et al	2018	Spain	S, GW	Integration of the ecohydrological model SWAT with the microeconomic model PMAUP	SWAT/PMAUP	Simulation,Stochastic,Dynamic,Modular,Bidirectional
Hassani Y., et al	2019	Iran	S	WEAP-PMP	WEAP/PMP - Howitt (1995)	Optimization (economic)/Simulation (hydrologic),Stochastic,Static,Holistic,Bidirectional
Rajabi, D., et al	2019	Iran	S	PMP-MODSIM	MODSIM/PMP	hydrological,Stochastic,Static,Modular,Sequential looped,model (simulation) and the economic model,(optimization).
Groves, D.G., et al	2019	Peru	S, GW	WEAP model	Piecewise	Simulation / Optimization,Stochastic,Dynamic,Holistic,Bidirectional
Pérez-Blanco, C.D., et al	2020	Spain	S	SWAT - PMAUP	SWAT/PMAUP	optimization (economic model) simulation (hydrologic model),Stochastic,Static,Modular,Sequential
Pérez-Blanco, C.D., et al	2021	Spain	S	HEC-HMS coupled with PMAUP micro-economic Model	HEC-HMS/ PMAUP	Simulation,Deterministic,Dynamic,Modular,Bidirectional
Gil-García, L., et al	2023	Spain	S	AQUATOOL - HEC-RAS - PMAUP	AQUATOOL - HEC-RAS/PMAUP	Simulation,Stochastic,Static,Modular,Bidirectional

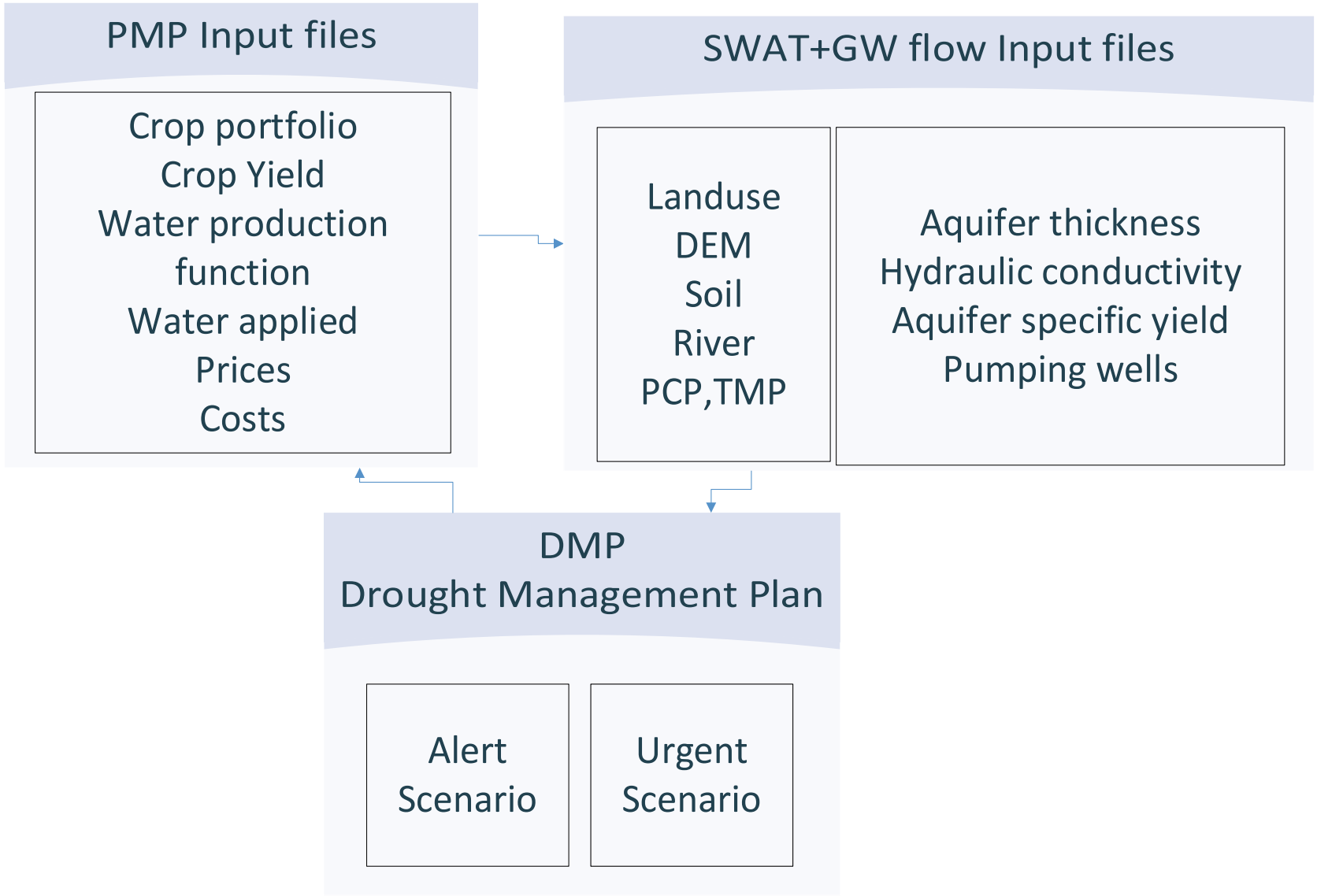
Case Study

- CEA (Cega-Eresma-Adaja) basin (7904.46 km2)
- Los Arenales (2398 km2) are located in the central north of the Iberian Peninsula.





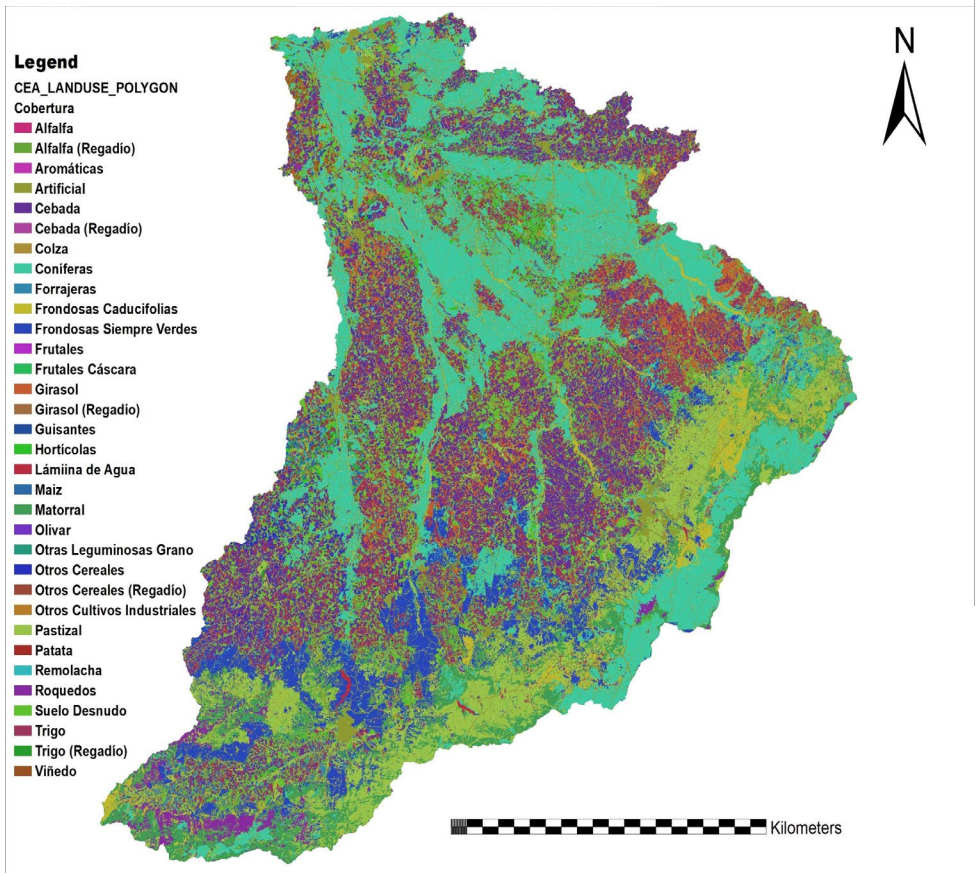
Methodology

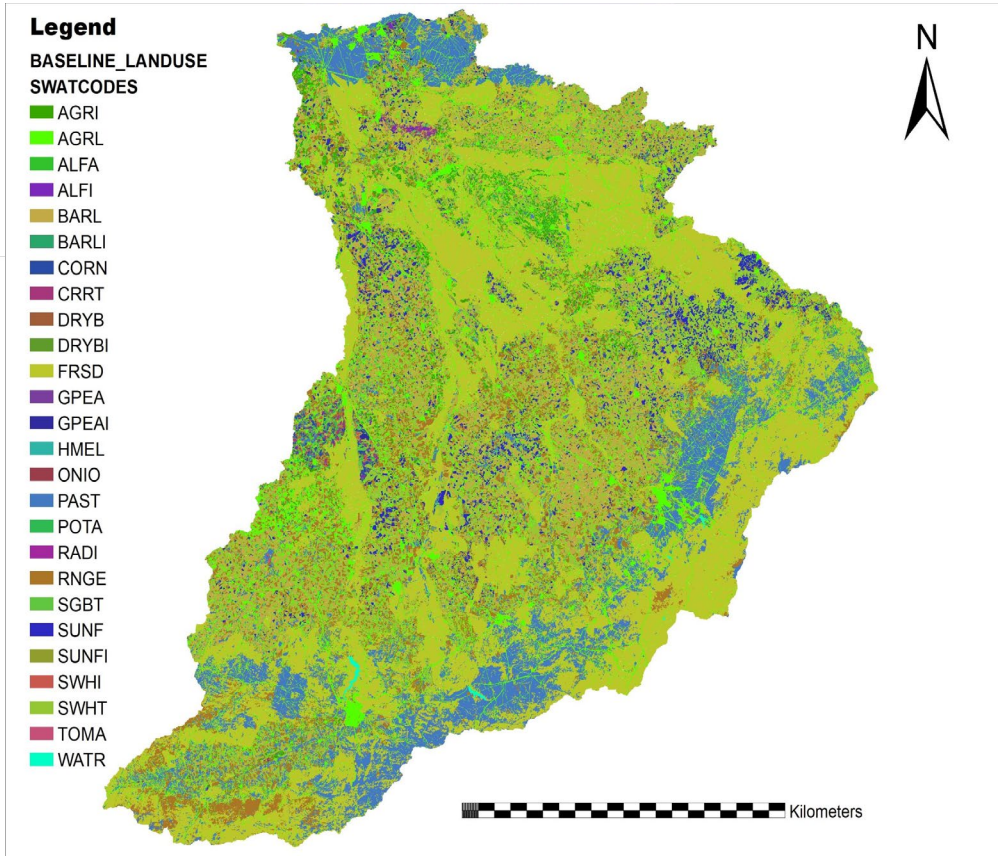


Methodology - Crop Selection and Land Use Changes

Top crops were selected according to their value, water demand and area, then changed in land use according to the water allocations.

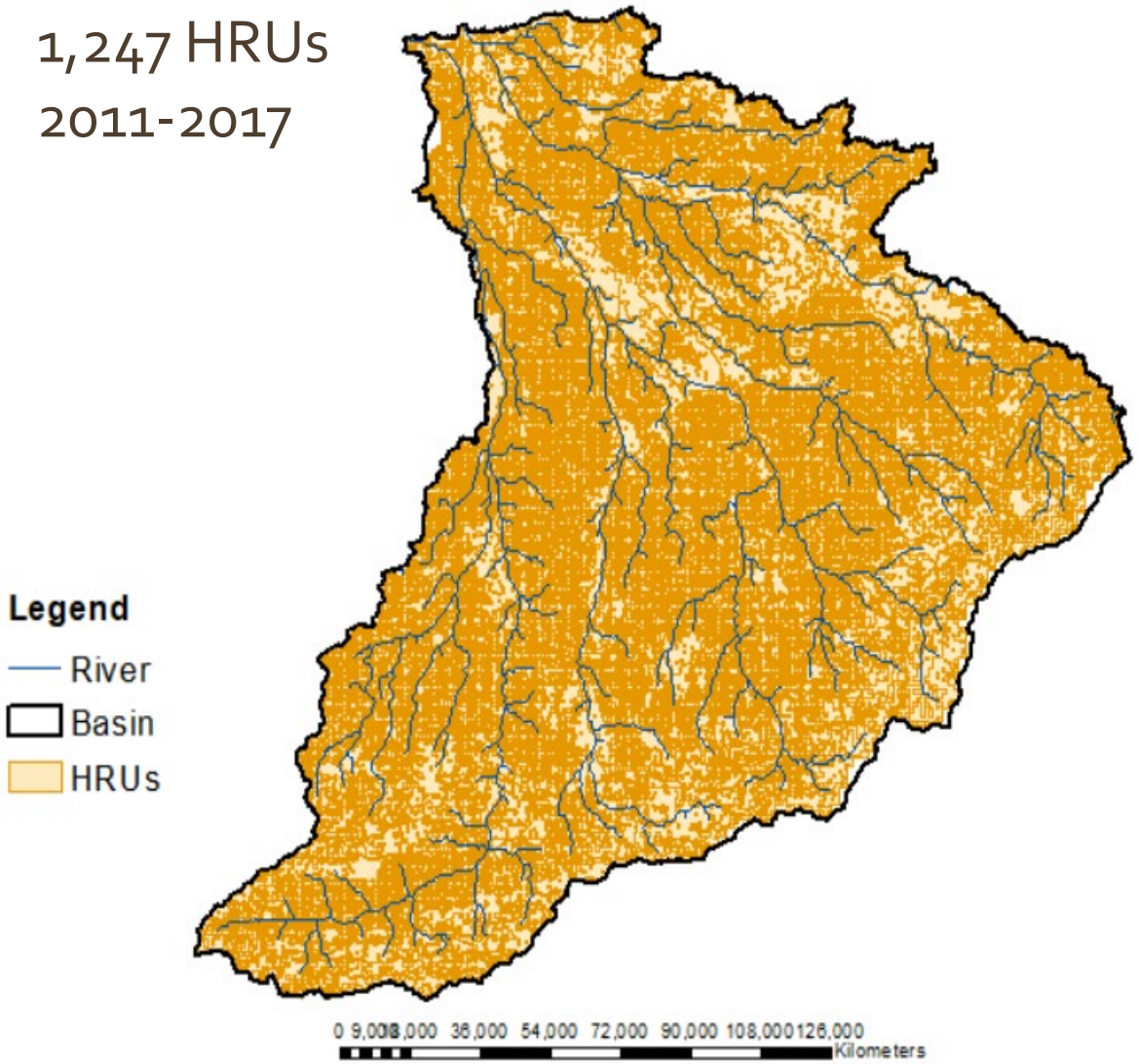
Alfalfa	Green peas
Barley	Beans
Onion	Carrot
Melon	Potato
Corn	Beet
Wheat	Garlic
Sunflower	Tomato

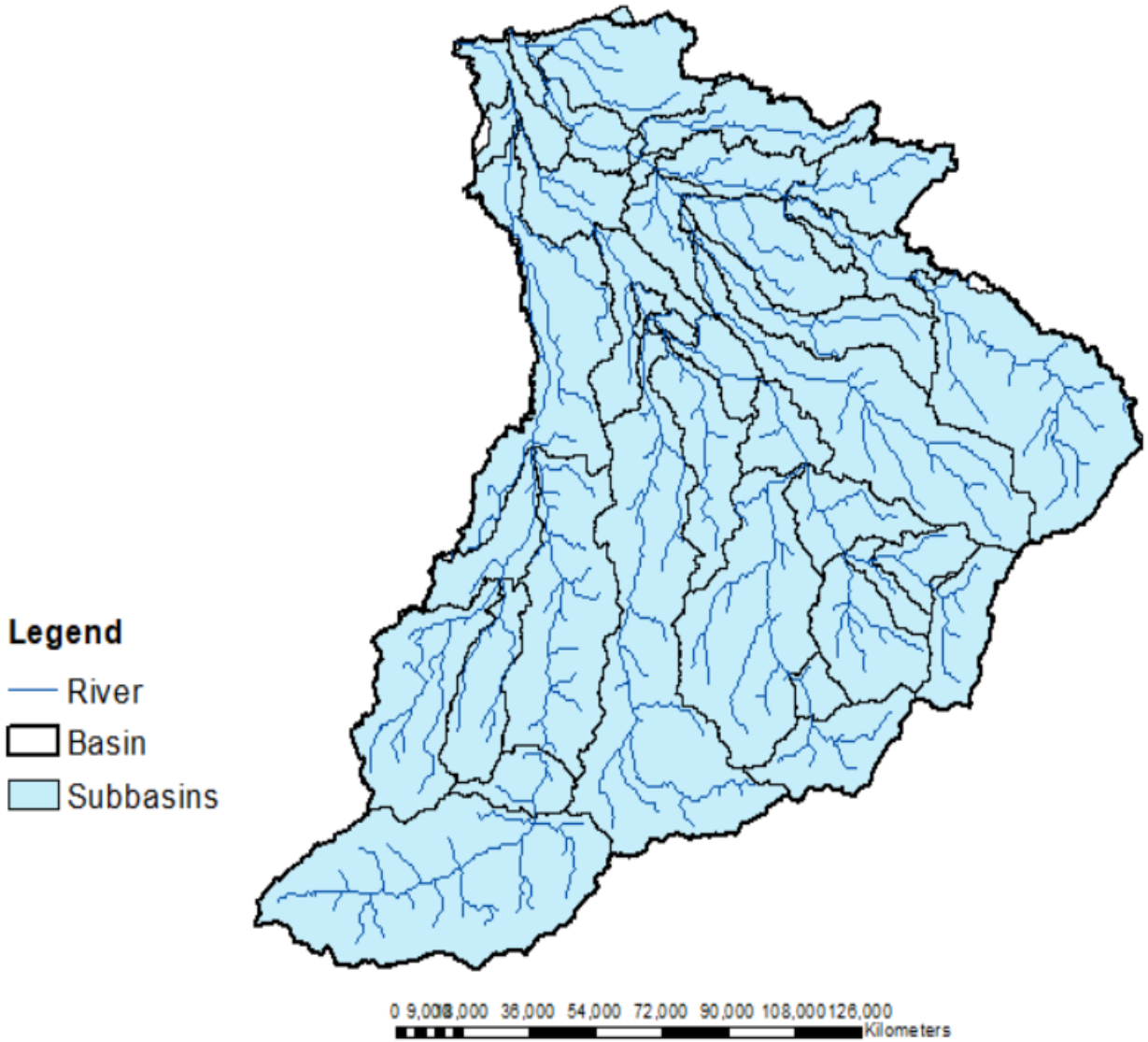




Methodology - Model Implementation

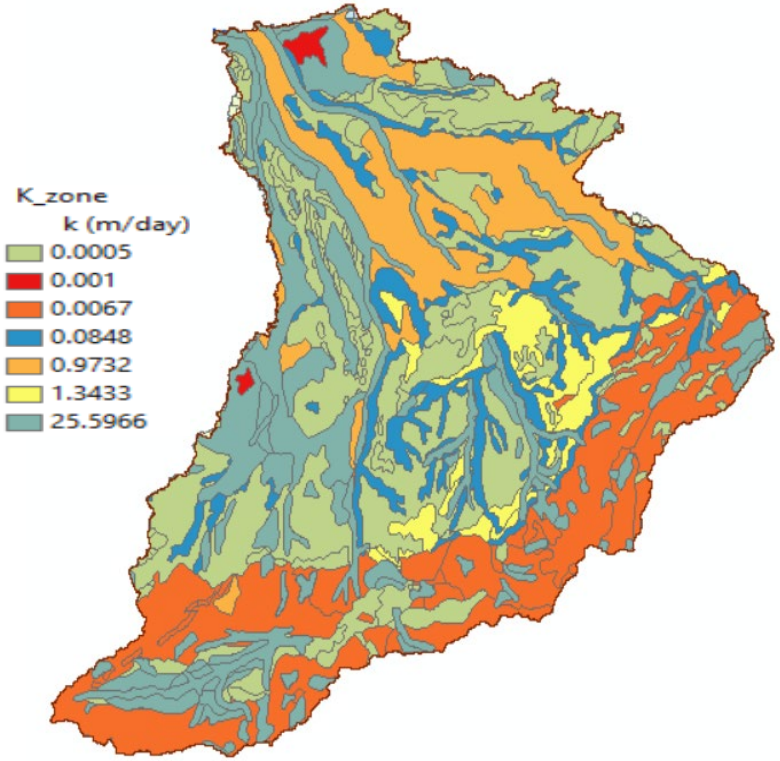
- 43 subbasins
- 1,247 HRUs
- 2011-2017

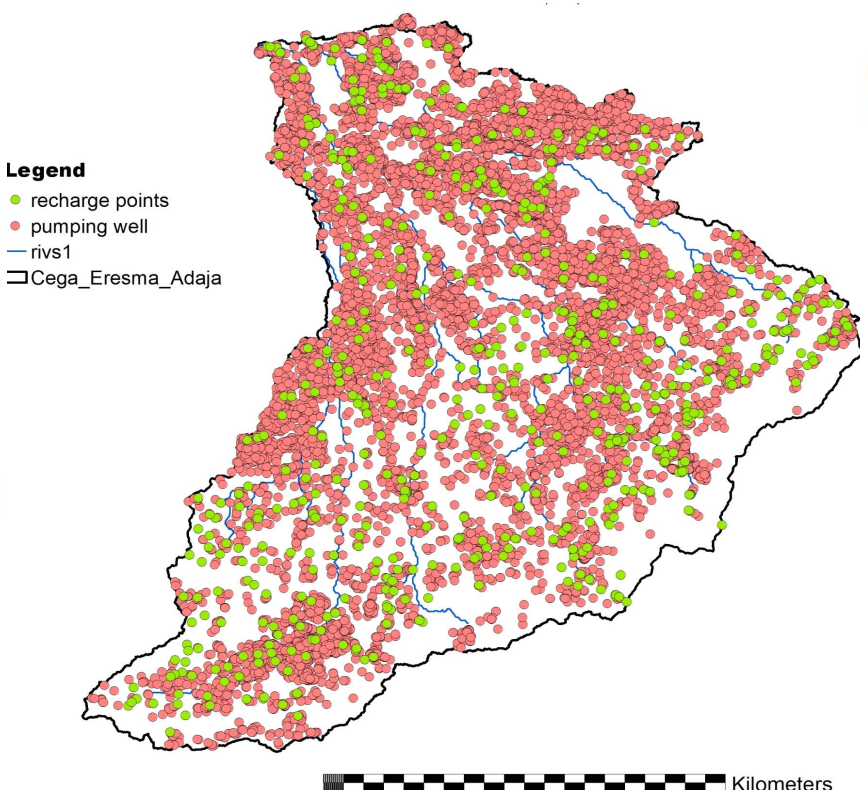


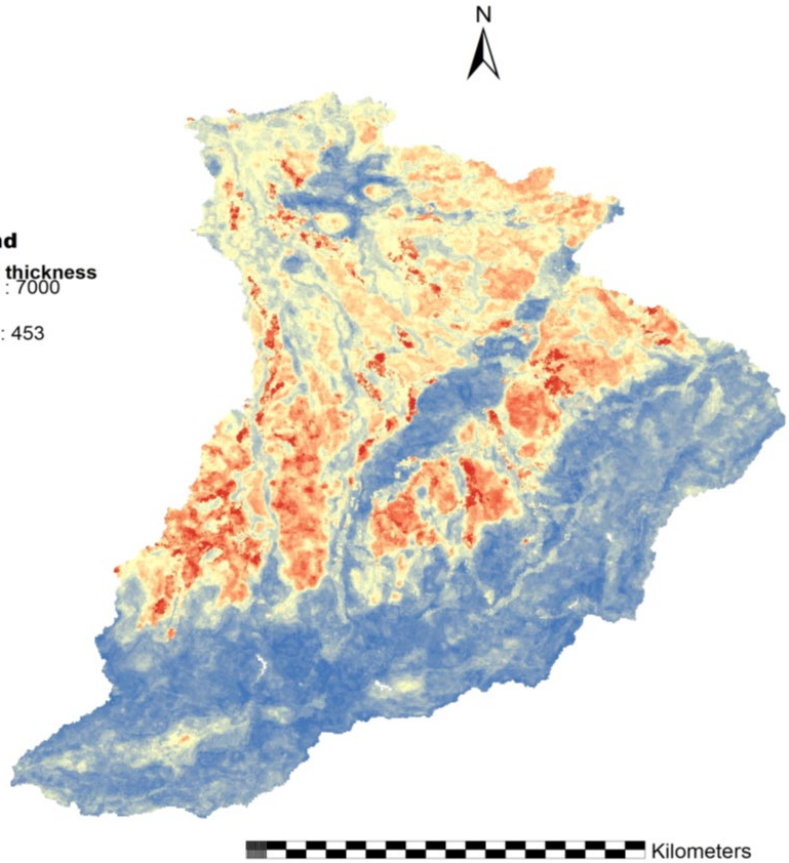


Methodology - Model Implementation

- Pumping wells 4067
- Points for return flow 159
- Zone for K and Sy 310





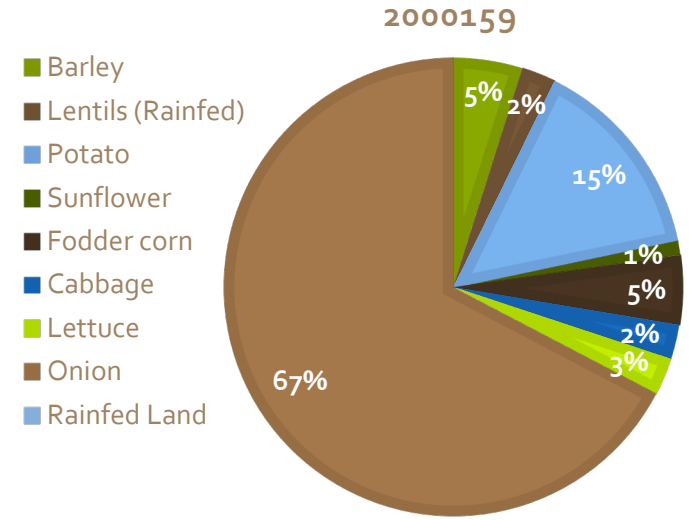


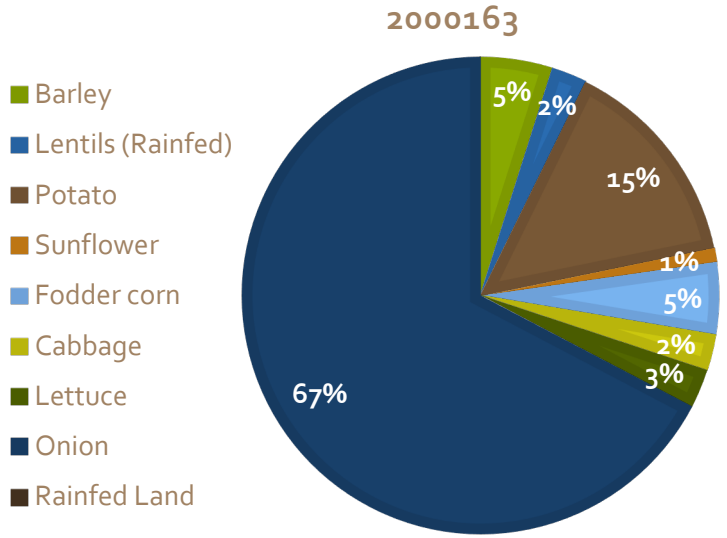
Scenarios

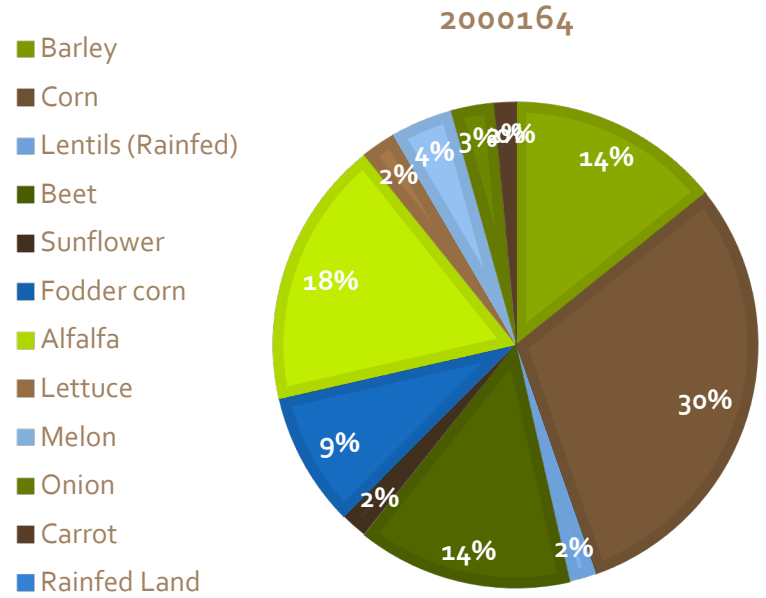
Drought management plan (DMP)

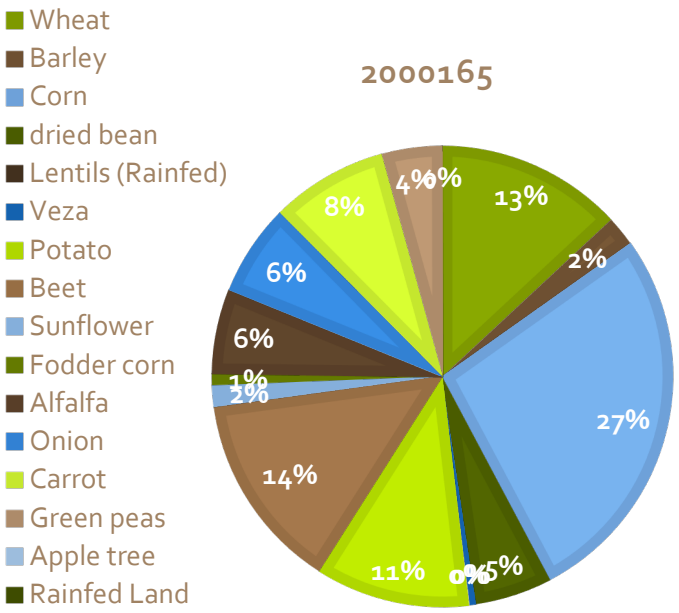
GENERAL MEASURES	Shortage Index			
Indicator	Inability to meet demands			
	1 - 0.50	0.30 - 0.50	0.15 - 0.30	0 - 0.15
Status situations	Lack of shortage	Moderate shortage	Severe shortage	Serious shortage
Scarcity scenarios	**NORMAL**	**PRE-ALERT**	**ALERT**	**EMERGENCY**
Type of measures to be activated	General planning and monitoring	Awareness, savings and monitoring	Management measures (demand and supply), and control and monitoring (art. 55 of the TRLA)	Intensification of measures considered on alert and possible adoption of exceptional measures (art. 58 of the TRLA)
Measures on demand	General planning and monitoring	Awareness, savings and monitoring	Effective reduction of demands, except for supply, of **up to 50%** of what is established in the Hydrological Plan, even when they have been the subject of the concession	Effective reduction of demands, except for supply, of **up to 100%** of what is established in the Hydrological Plan, even when they have been the subject of the concession

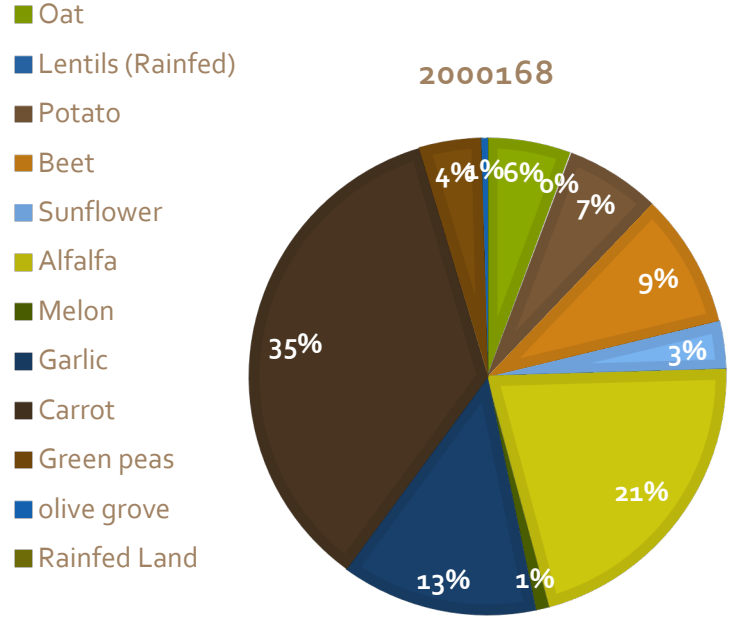
Results - Baseline Scenario

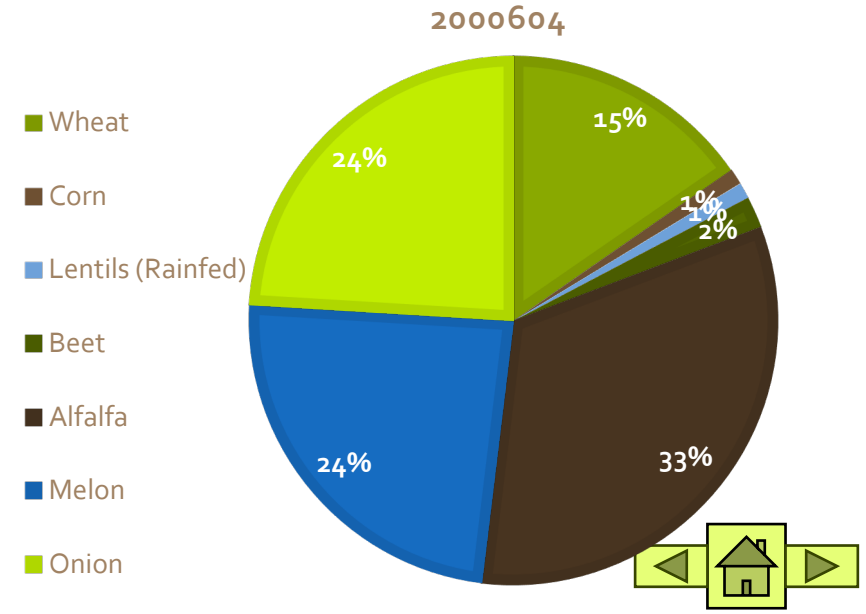




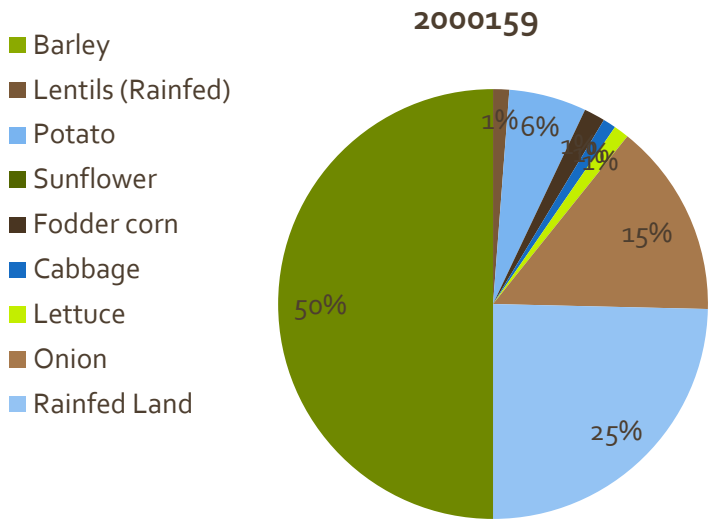


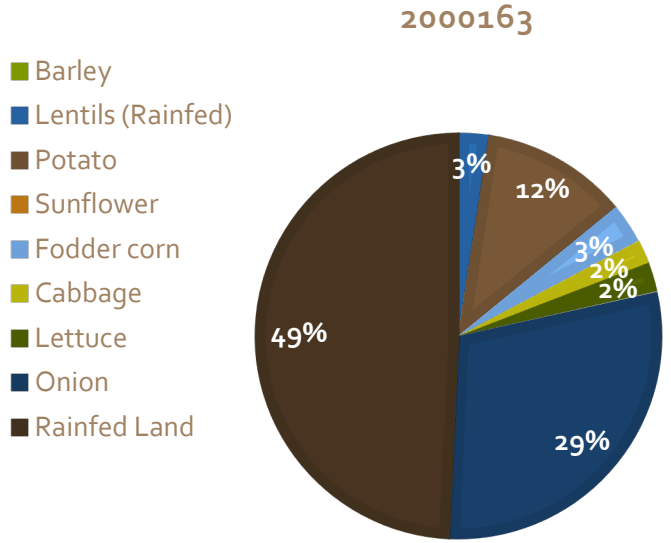


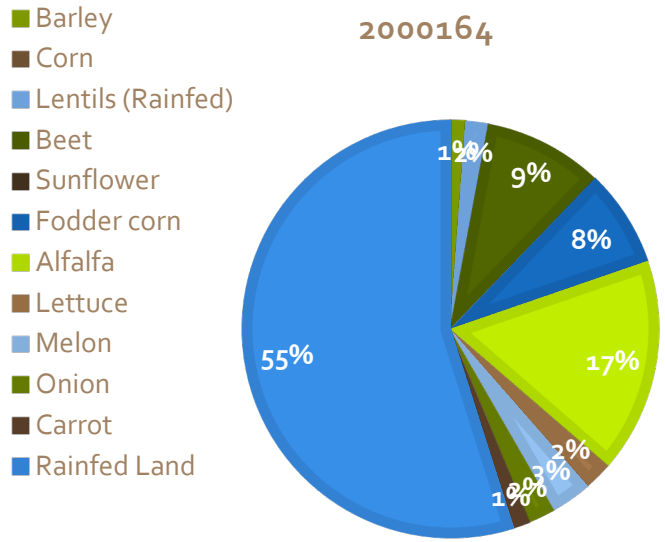


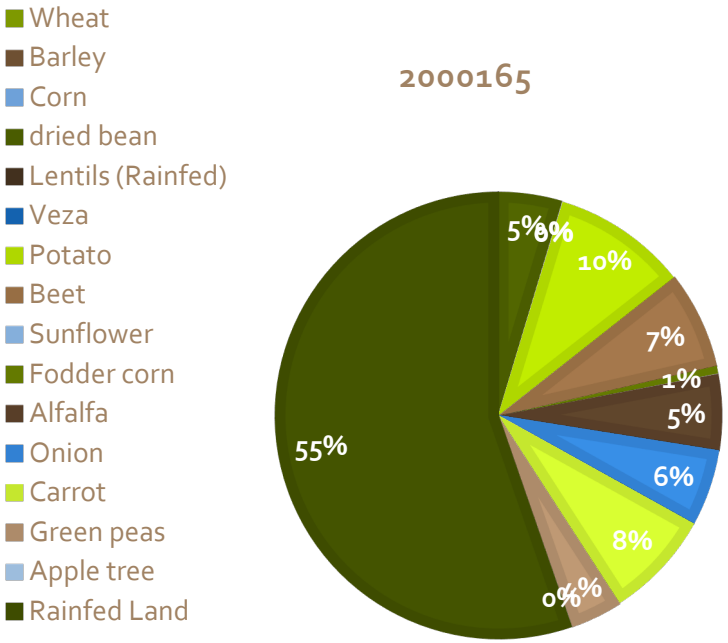


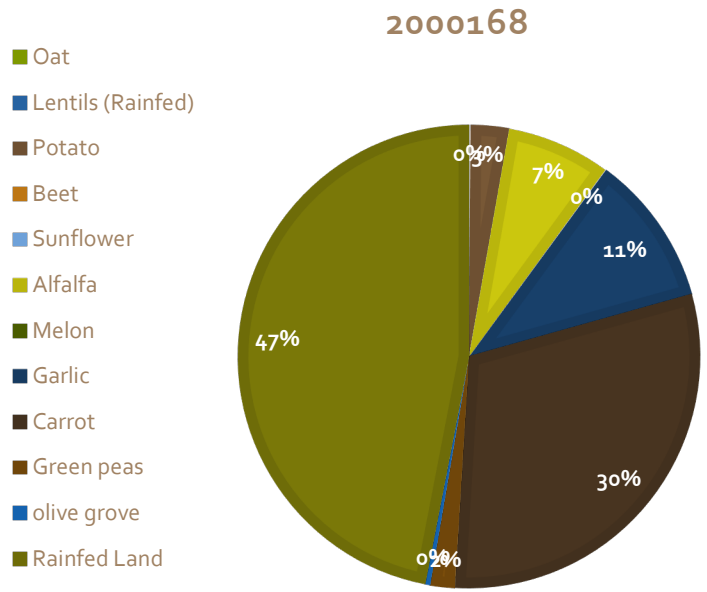
Results - 50% Reduction Scenario

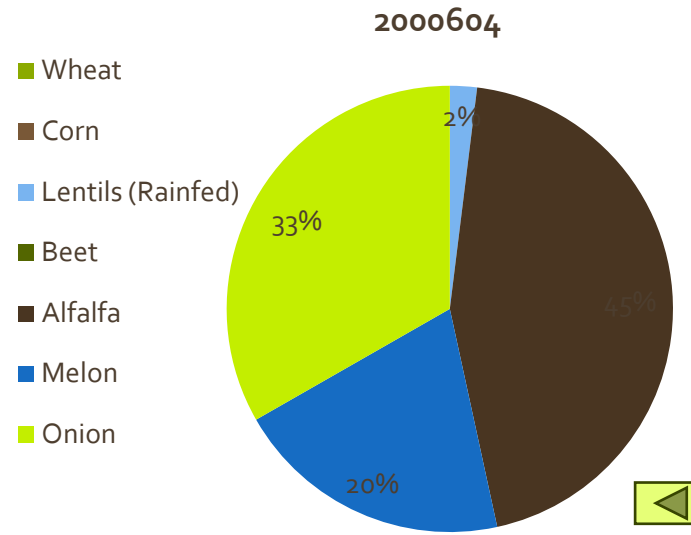




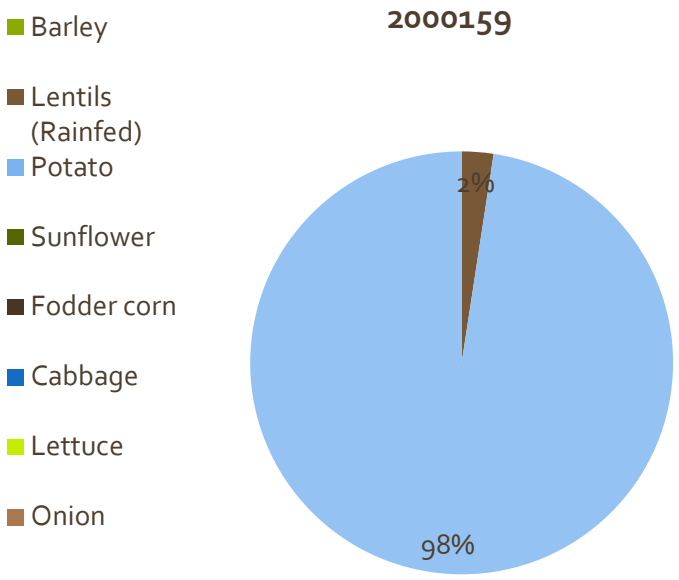


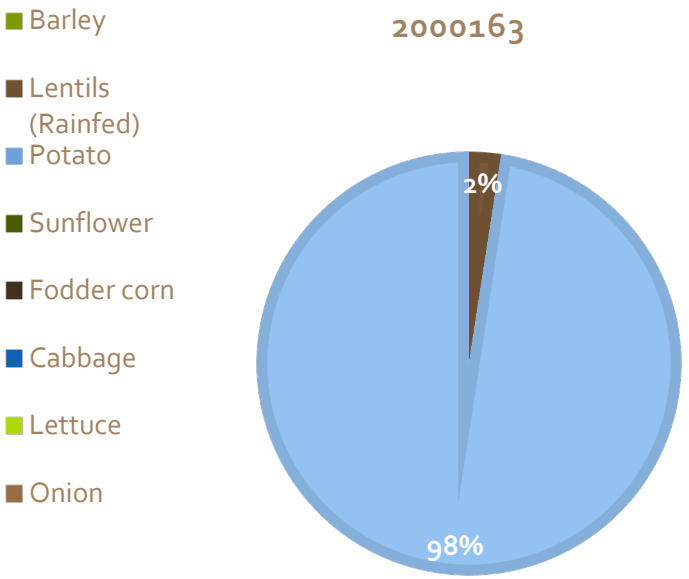


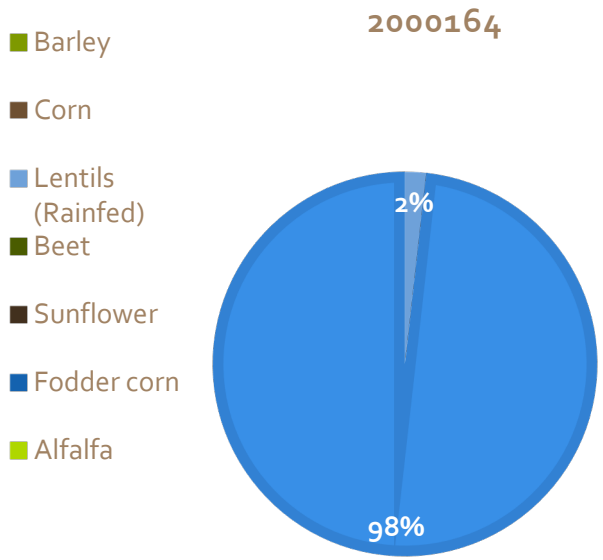


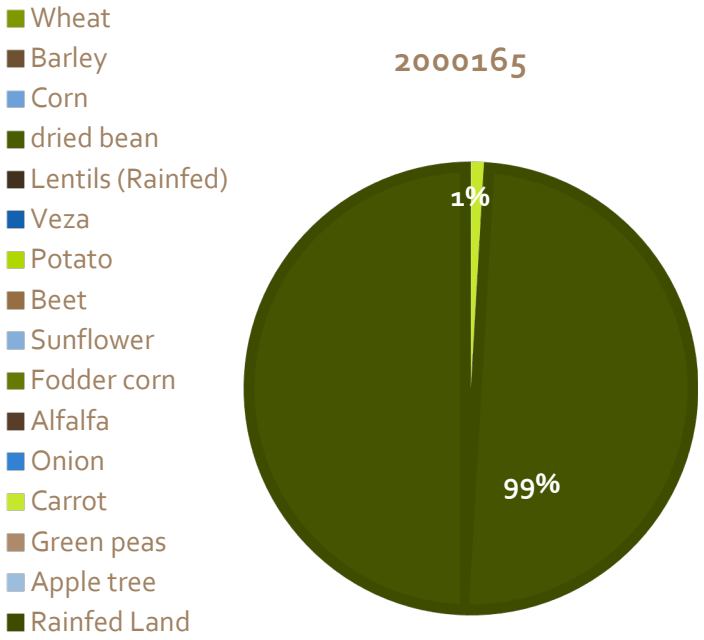


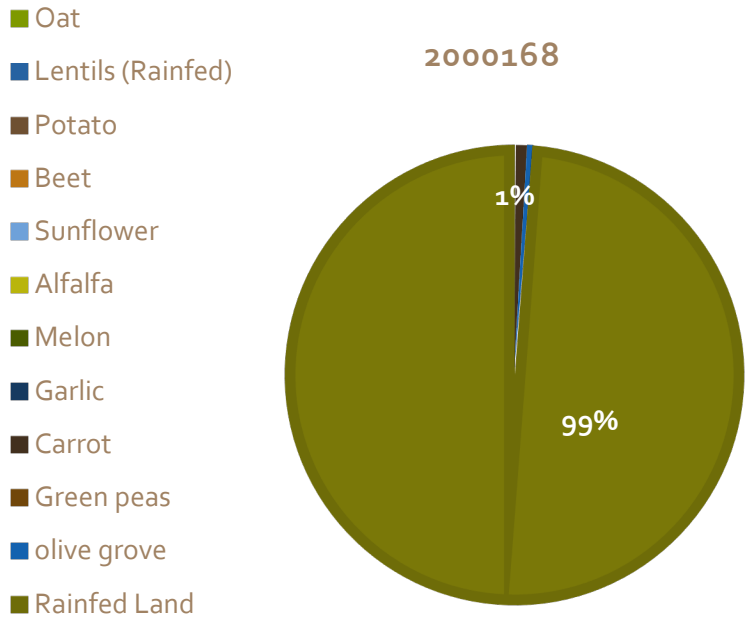
Results - 100% Reduction Scenario

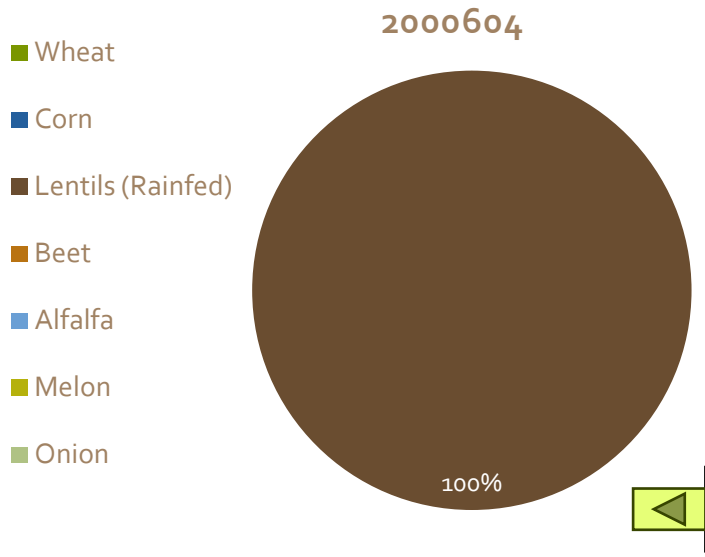












Conclusion

•Our study highlights the importance of integrating hydrological and economic modeling.

•This integration is crucial to assess the impacts of adaptation policies on water resources.

•Findings suggest that careful management and allocation of water resources are vital for mitigating drought effects.

Limitations of the study include:

•Data availability.

Future research should:

•Improve data accuracy.

Recommendations for policymakers:

•Consider these insights to develop effective drought management strategies.

Thank you for your attention