EO for Africa Symposium 2024

23 - 26 September 2024

ESA | ESRIN, Frascati (IT)

FAO Plan-T: Advanced Methodologies and Tools for Climate-Resilient Maize Cultivation Strategy Development

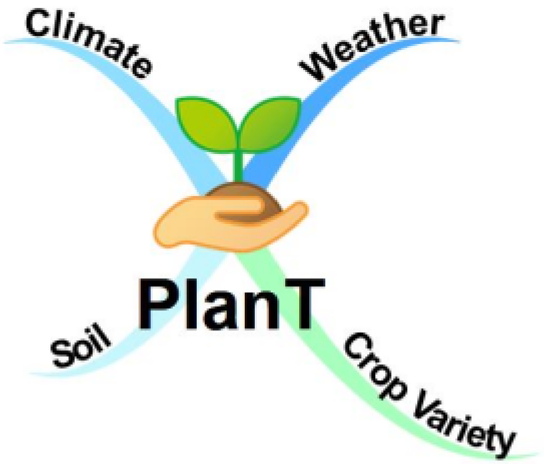
The issue

As **climate change** progresses, it's crucial to identify emerging patterns in **temperature, rainfall, and inter-annual variability** to help farmers adapt and maximize their return on investment.

FARMERS NEED ASSISTANCE TO SELECT ADAPTED CROP VARIETIES AND THE RIGHT TIME FOR PLANTING TO AVOID CROP FAILURE

SISTEMA ENVIRONMENTAL INFORMATION MINING

Amigo



PROVIDE ACTIONABLE FARM-LEVEL INSIGHTS IN REAL TIME

Develop a real-time climate adaptation tool for farmers:

- Map optimal crop varieties every 10 days at 250m resolution using weather data.
- Validate and calibrate the tool based on observed outcomes.
- Advise on planting dates and monitor climate stressors to assess crop loss risks, using real-time soil moisture and weather forecasts.

Which variety to plant in each location?

Identify maize varieties

↓

Selecting 3 climate scenarios (dry, average, wet)

↓

Computing yields for each variety in each pixel for 3 weather scenarios

Which variety to plant in each location?
STEP I

Identification of locally available maize varieties

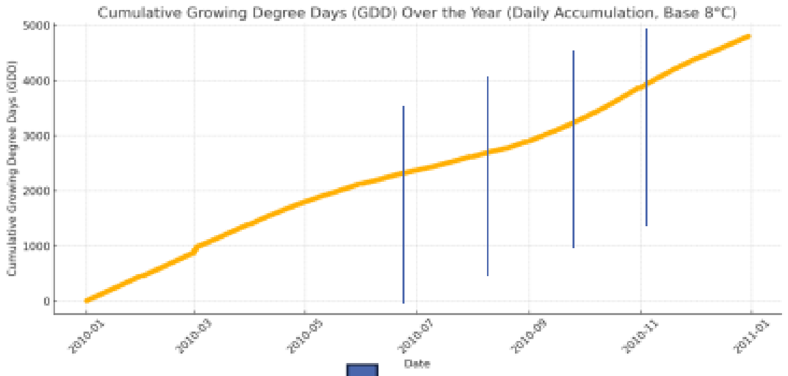
Maize Varieties	Maturity Group	Marketing seed company
SC513	Early	Seedco Ltd
DK8033	Early	Monsanto
PHB30G19	Medium	Pioneer Dupont Ltd
ADV637W	Medium	Advanta Seed Company
PAN 53	Medium	Pannar
AFR635	Medium	Stewards Globe (Afriseed)
ZMS 606	Medium	Zambia Seed Company
AFR 638	Medium	Stewards Globe (Afriseed)
ZMS 721	Late	Zambia Seed Company

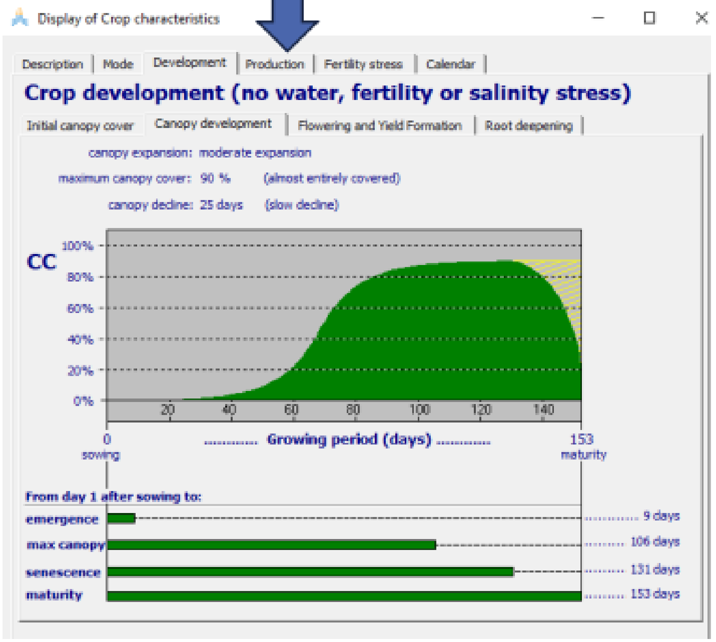
Which variety to plant in each location?
STEP I

Parametrization of the maize varieties

				Initial Stage	Mid-Season Stage				
Variety	Maturity Group	Days to maturity (calendar days)	Days to maturity (GDD)	Emergence	50% Tasseling number of days before about 50% of plants start shedding pollen	50% Silking	Anthesis-Silking Interval (ASI)	50% Anthesis (pollen production)	Yield potential
				Days from day 1 after sowing to end of phenological stage	Days from day 1 after sowing to end of phenological stage	Days from day 1 after sowing to end of phenological stage	Duration	Days from day 1 after sowing to end of phenological stage	
AFR635	Medium	126	1,290	5-7	58	66	1	65	6
ADV637W	Medium	128	1302	5-7	59	63	2	61	11
PAN 53	Medium	122	1,244	5-7	61	63	1	62	7
PHB30G19	Medium	124	1,270	5-7	63	65	2	63	11
SC513	Early	119	1,206	5-7	59	63	2	61	7.5-8
ZMS 606	Medium	128	1,302	5-7	57	62	2	60	8-10

...ISTICS OF SELECTED MAIZE VARIETIES in AER IIa by crop growth stage (ZARI field data, 2020/21 season





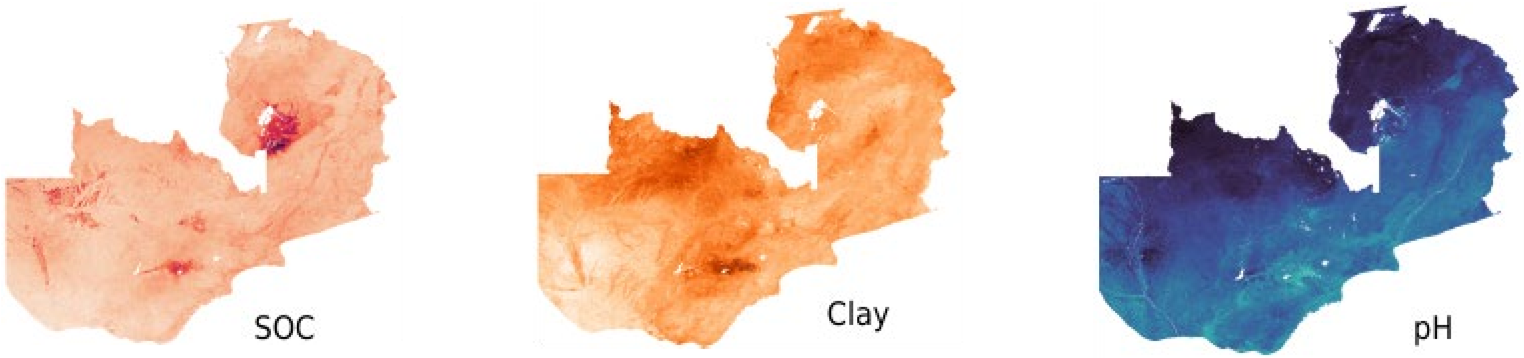
- We match the phenological stages of the different field trials with the Growing Degree Days
- We average the GDD across the trials and obtain the parameters in AquaCrop

Which variety to plant in each location?
STEP I

Creating environmental datasets - Soil

Texture and chemical properties from SoilGrids and Africa SoilGrids

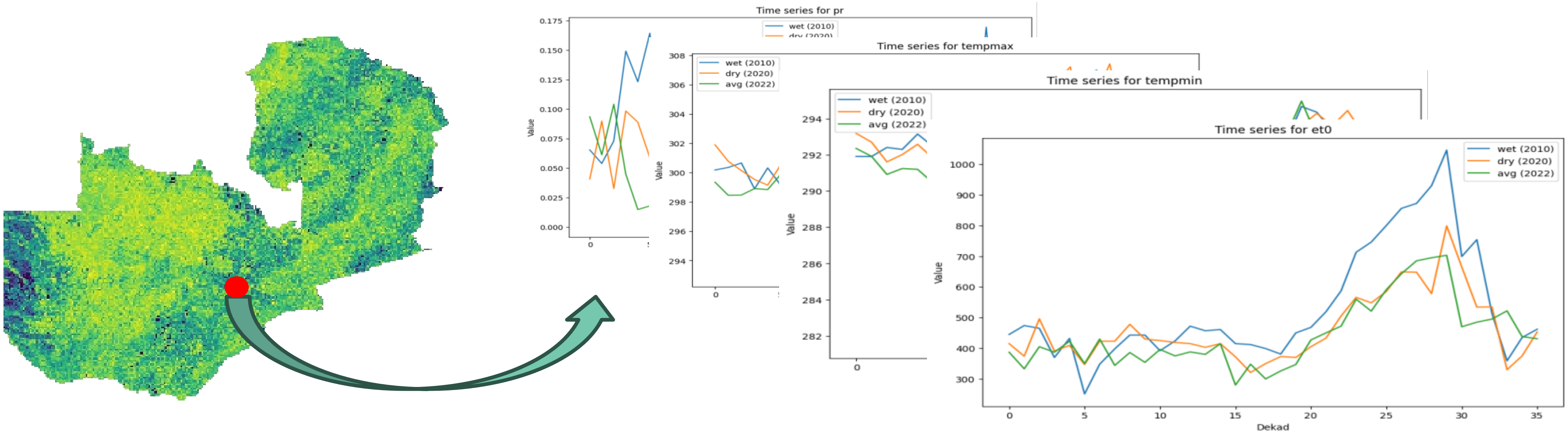
- Texture: Sand, Silt, Clay [%].
- Soil Organic Carbon: SOC, g/kg.
- Soil pH in water.
- Salinity: Electrical conductivity, dS/m.



Which variety to plant in each location?
STEP II

Selecting 3 climate scenarios

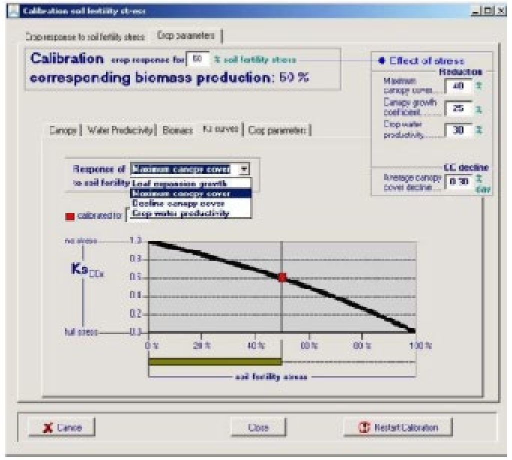
- Collect daily climate data (20-30 years) per 250m pixel from ERA5 Land and FAO Agroinformatics (ET0).
- Aggregate yearly precipitation data.
- Select an average year, 5th percentile (wettest), and 95th percentile (driest) for precipitation.
- For the 3 years, extract daily ET0 and min/max temperature per pixel.

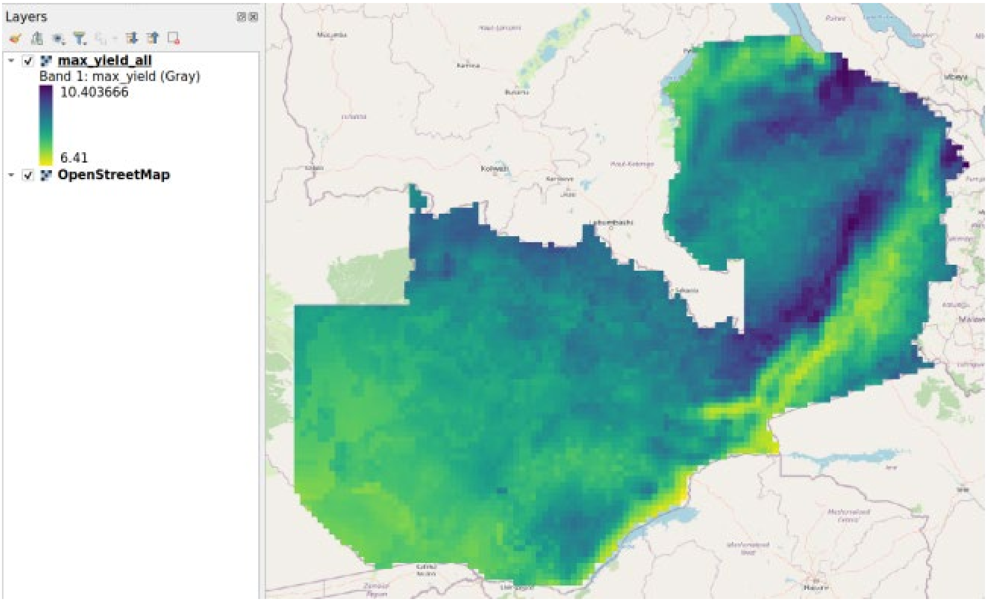


Which variety to plant in each location? STEP III

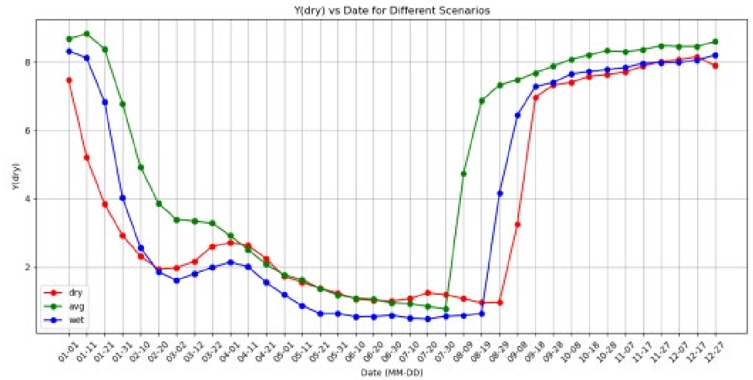
Computing yields for each variety in each pixel for 3 weather scenarios

1. **Identify Growing Season:** Select the 5th day of each dekad across 3 representative years totaling 36 dekads per year.
2. **Simulate Yields:** Use AquaCrop with daily weather data to simulate yields for 9 crop varieties over 36 dekads and 3 scenarios, resulting in 972 simulated yields per pixel.
3. **Average Yields:** Calculate average yield per dekad across the 3 years to represent yield under prevailing climate conditions.



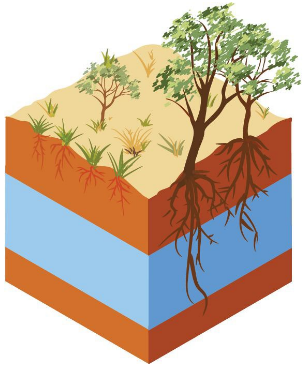


When to plant?



Identify Best Dekad for Yield

Calculate Water Needs



Compute Soil Water Balance

Choose Optimal Planting Day

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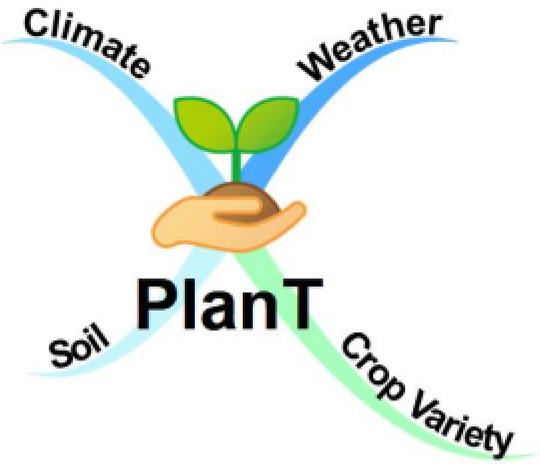
How can farmers do that?



Near real time monitoring of crop evolution through climate stressors

Evaluate the impact of climate stressors in crop productivity per Maize Variety per growing phase:

*Impact = Exposure * Hazard * Vulnerability*

Identify the Exposure using the crop coefficent (Kc) for each maize variety during each growth phase as the asset at risk.

Consider as Hazards the Cimate Stressors: Extreme Precipitation, Droughts, Heat and Cold Waves.

Estimate the Vulnerability as the coefficient assessing the effects of the Cimate Stressors per maize variety per phase.

$$\sum_{phase} K_c^{phase} \times \max_{CS} (v_{cs}^{phase} \times h_{cs}^{phase})$$

Phase	SPEI	Cold Spell	Warm Spell	CDD	Pd20mm
Phase 1					
Phase 2					
Phase 3					
Phase 4					

The **reduction in yield** for red, orange, yellow and green are resp. 80%, 60%, 40% and 20%

Conclusions

•**Innovative Methodology**: Introduced a novel approach for evaluating climate performance.

•**Project Progress**: Successfully completed the initial phase, paving the way for future research and applications.

•**Performance Evaluation**: Continuous assessment throughout the project has led to valuable insights and adjustments.

•**Next Steps**: Focus on refining the methodology and publishing the first version.