



IMPACT OF CROP-WEED COMPETITION ON YIELD GAP: A FIELD-BASED APPROACH IN SUGARCANE ON RÉUNION ISLAND

Elise Laine*,
Aude Ripoche*, Nathalie Colbach**,
François Affholder***

*CIRAD, PERSYST-UPR AIDA, Saint-Denis, La Réunion

**INRAE, Institut Agro, Univ. Bourgogne, Dijon, France

***CIRAD, PERSYST-UPR AIDA, Maputo, Mozambique

- **Sugarcane = Major crop** in Réunion island → **54%** of Agricultural Land^[1]
- Main problem → **weed management** → **Herbicides only** but current regulations require to **decrease** herbicides → threat for farmers and industry
- AIMS : **(1)** Determine the proportion of yield loss that can be attributed to the presence of weeds among the various other constraints that can impact yield.
(2) Understand how the weed impact can be affected by the other constraint

1 POTENTIAL CONSTRAINTS ON SUGARCANE IN REUNION ISLAND

- List all the constraints possibly affecting the sugarcane yield in Réunion Island.
- Source of information were :
 - Available literature review
 - Local stakeholders (growers, technicians and scientists).



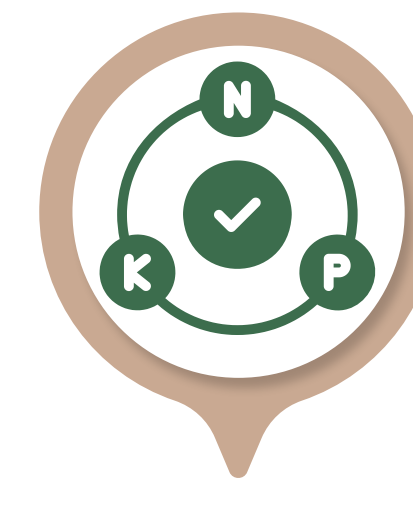
WATER DEFICIT

- Lack of rainfall
- Irrigation
- Nature of the soil



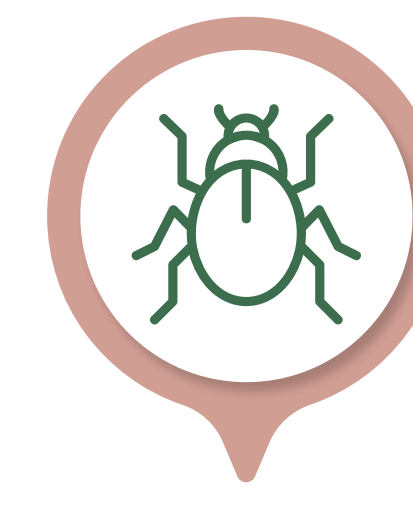
WEED COMPETITION

- Quantity (coverage, biomass)
- Species



LACK OF NUTRIENTS AVAILABILITY

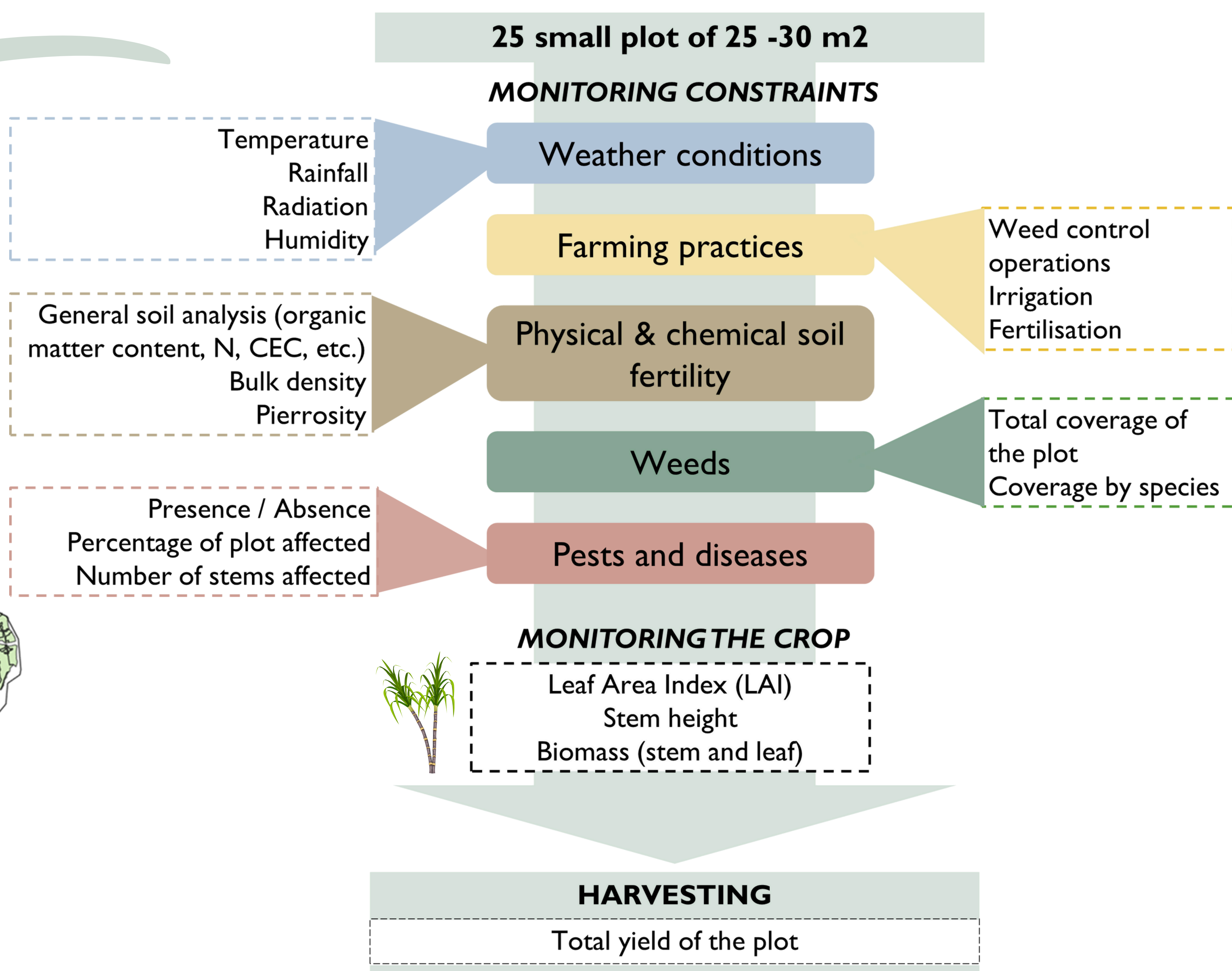
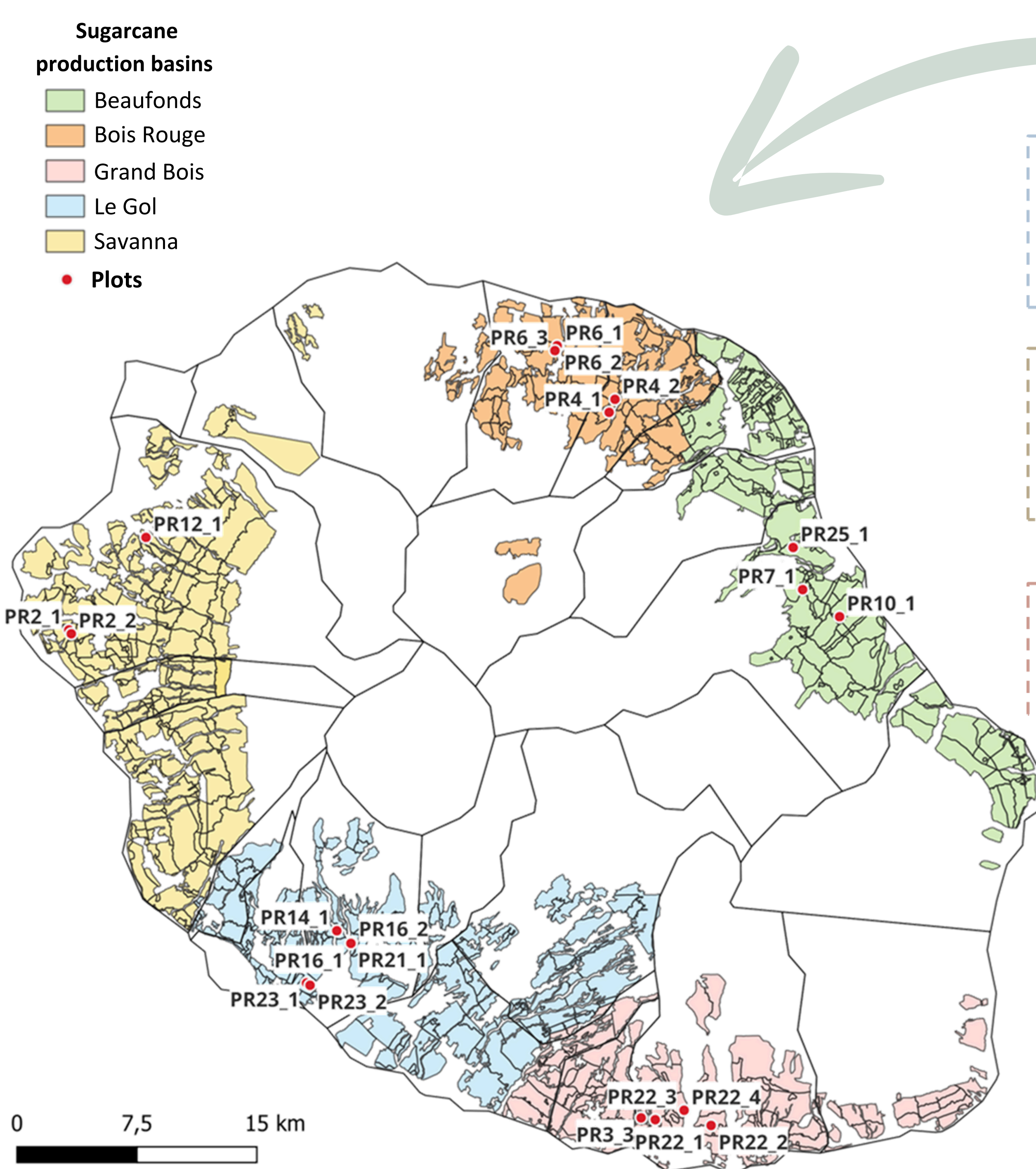
- Fertilization
- Nature of the soil
- pH
- Pierrosity



PEST AND DISEASE DAMAGES

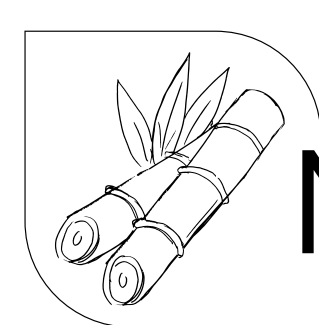
- Stem borer
- Sucking pests & virus
- Hopelochelus marginalis

2 MONITOR THESE CONSTRAINTS ON CONTRASTED CROP SITUATIONS



3 SIMULATE THESE CROP SITUATIONS

Use two crop growth simulation models adapted to sugarcane and the context of Réunion. These models **only take into account some of the abiotic constraints** :



MOSICAS

Model adapted only to sugarcane. Simulates daily sugarcane growth at field scale, for one cycle of 12 month^{[2], [3]}



Model adapted to a large number of crops, including sugarcane. Daily simulation of the soil-crop system at field scale, over one or several cycles.^[4]



Temperature, radiation and water stress.

Temperature, radiation, water stress and availability of nutrients in the soil



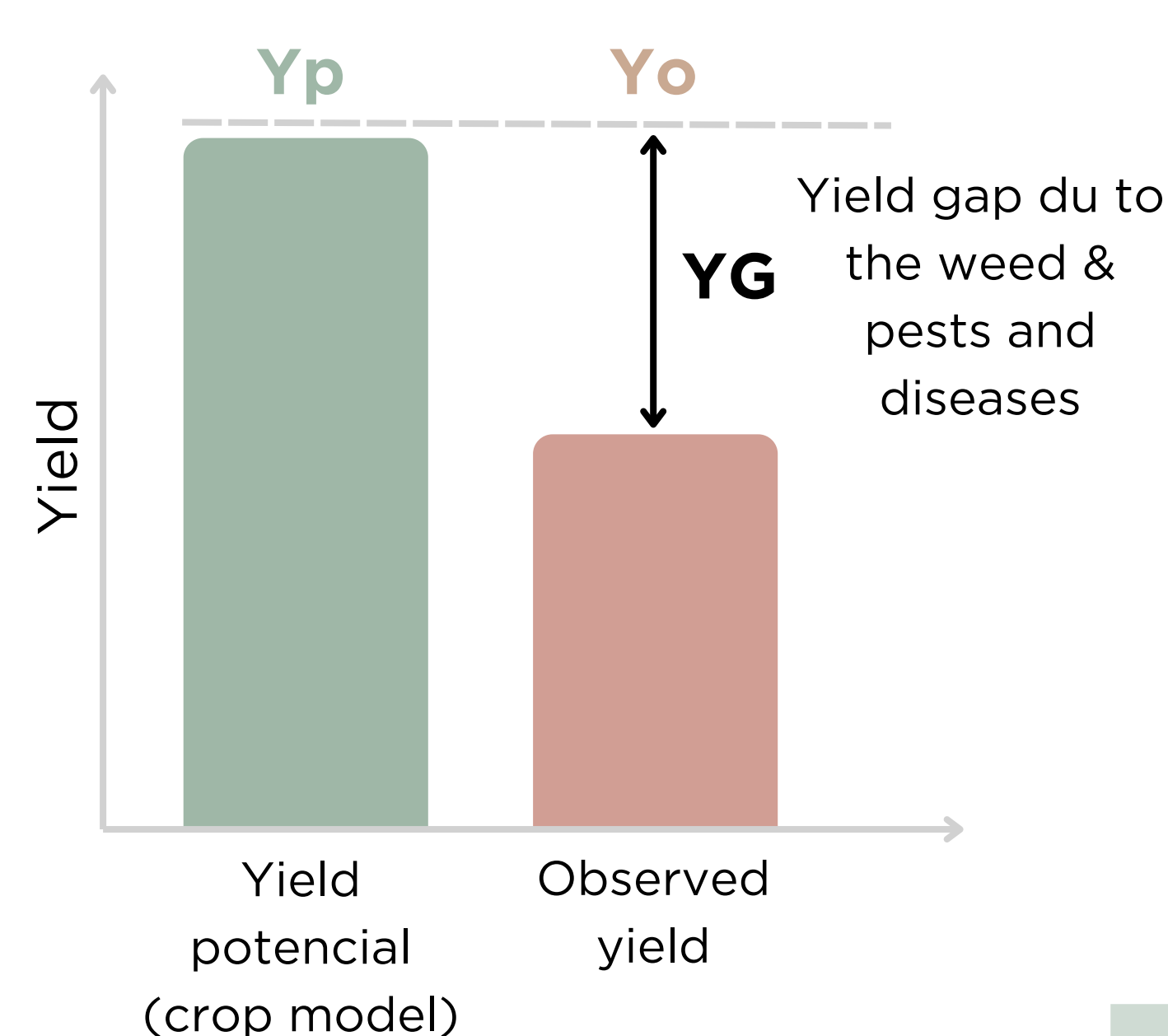
Fertilizer stress & biotic stress (weeds, pests and diseases)

Biotic stress (weeds, pests and diseases)

The choice of model used will depends on :

- ✓ Importance of fertilisation pressure in the situations monitored
- ✓ Adaptation of the model to the cane context in Réunion (calibration, varieties, precision of the parameters required)

4 IDENTIFY THE WEIGHT OF THE WEED IMPACT



Calculate the **yield gap** for each crop situation as :

$$YG = Yp \text{ (total above dry biomass predicted by the selected model) - } Yo \text{ (total above dry biomass observed)}$$

Proxy of the impact of biotic stress on the sugarcane yield

Use linear models to explain this yield gap by the biotic constraints
ex: yield gap (YG) ~ weed cover + percentage of plot affected by the pest + ...

Select the better variables to describe weed competition (weed cover, species present, ..)

Identify the weight of weed impact, and the crop situations where this impact explains significantly the yield gap

[1] Agreste La Réunion (2023) *Memento 2023*.
[2] Christina, M. et al. (2019). *Proc Int Soc Sugar Cane Technol*.
[3] Martiné et al. (2002). *Revue Agricole et Sucrière de l'île Maurice*.
[4] Brisson, N. et al. (2009). Conceptual Basis, Formalisations and Parameterization of the Stics Crop Model.