

3 ACCA

THIRD AFRICA CONGRESS ON
CONSERVATION AGRICULTURE
5-8 June 2023 | Rabat, Morocco



INITIATIVE ON
Climate Resilience

BRIDGE
consortium



LISAH

Could the Introduction of Cover Crop provide Ecosystem Services? Case of a Mediterranean Citrus Orchard

Fida Temani, PhD in agroecology

Imène Mahjoub, Salah Benyoussef, Karim Barkaoui, Insaf Mekki,
Frédéric Jacob, Rim Zitouna-Chebbi

Theme:

Building a Resilient Future in Africa
through Conservation Agriculture and Sustainable
Mechanization



Organizers



In Collaboration with



Gold Sponsors



Silver Sponsors



Bronze Sponsor



Land degradation: High intensive inputs of chemical fertilizers and heavy mechanizations



Natural ecosystem

Agriculture Intensification
=> Converting forests to woodlands and crop monocultures

Conventional farming

Reduction of biodiversity
(Raj, A. et al. 2021)

Decline of soil fertility
(Raj, A. et al. 2021)

Yield losses
(Li et al., 2010)

3ACCA

THIRD AFRICA CONGRESS ON
CONSERVATION AGRICULTURE
5-8 June 2023 | Rabat, Morocco



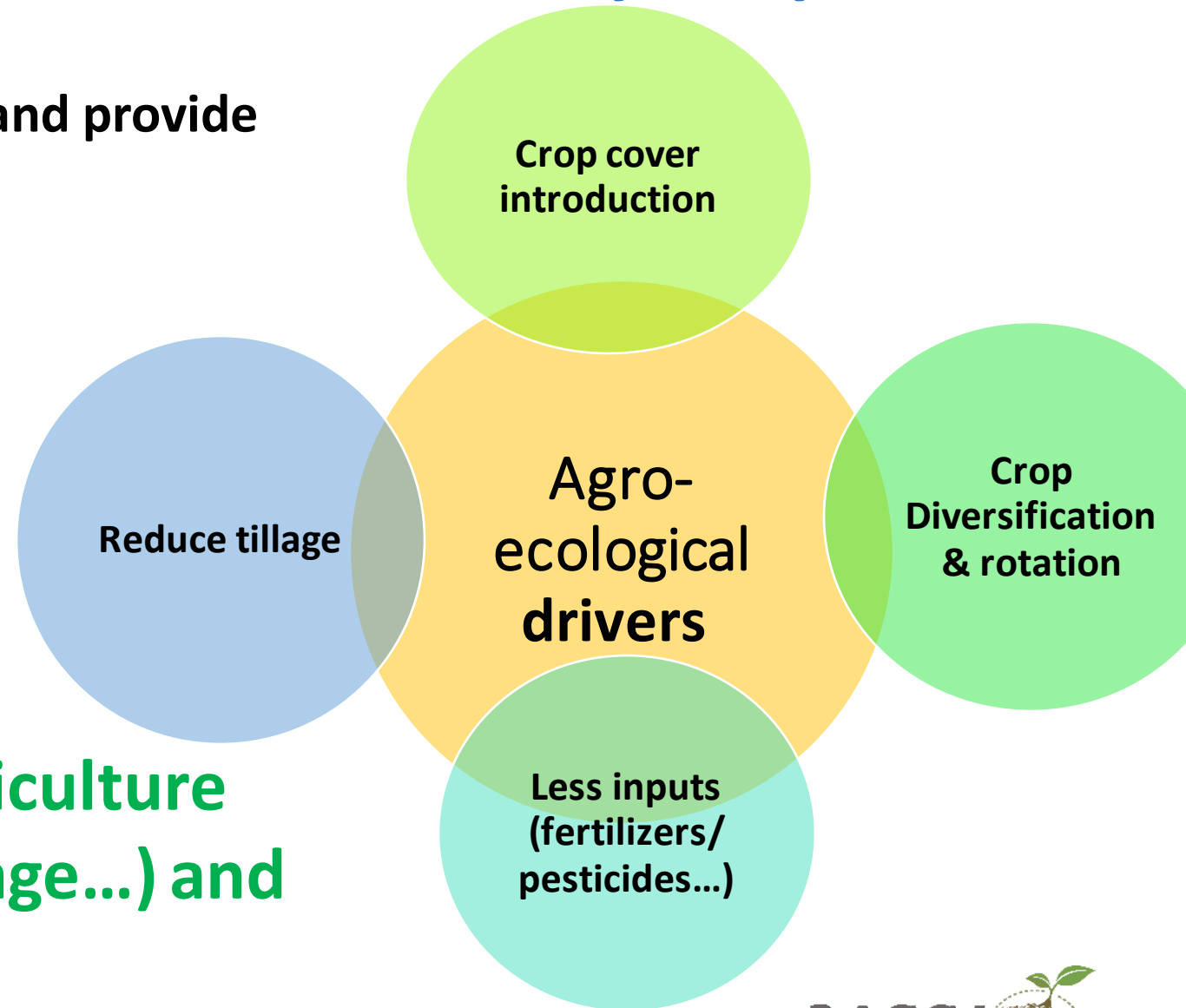
Agroecology implementation to enhance biodiversity and yields

Agroecology aims to enhance biodiversity and provide ecological services

=> Re-employment of traditional practices

=> Enhances agrosystem resilience

=> Integrating conservation agriculture principles (soil covering, no tillage...) and agroforestry practices





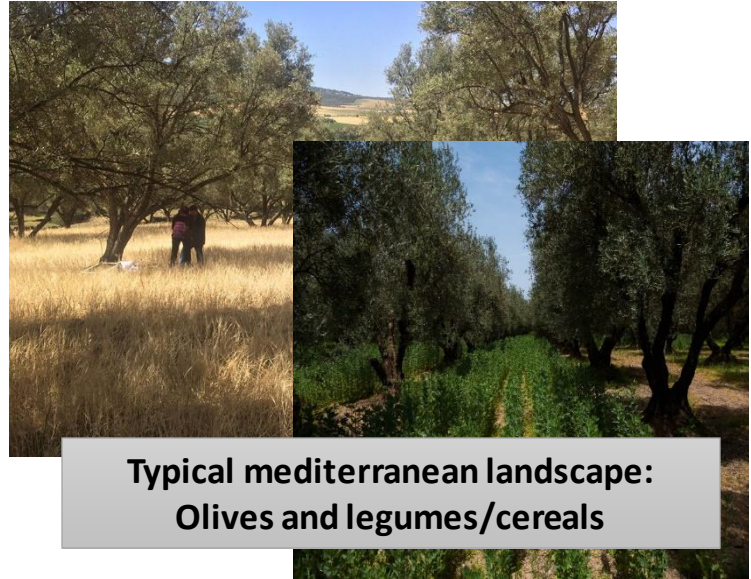
Walnut- Cereals/mulch



Apple trees - vegetables



Oasis system



Typical mediterranean landscape:
Olives and legumes/cereals



Orange/Legumes or
vegetables (Greece)



Orange / grass cover
in Sicily (Italy)



Mandarin/Legumes
(Spain)

An evolving system in the
Mediterranean where citrus are very
important



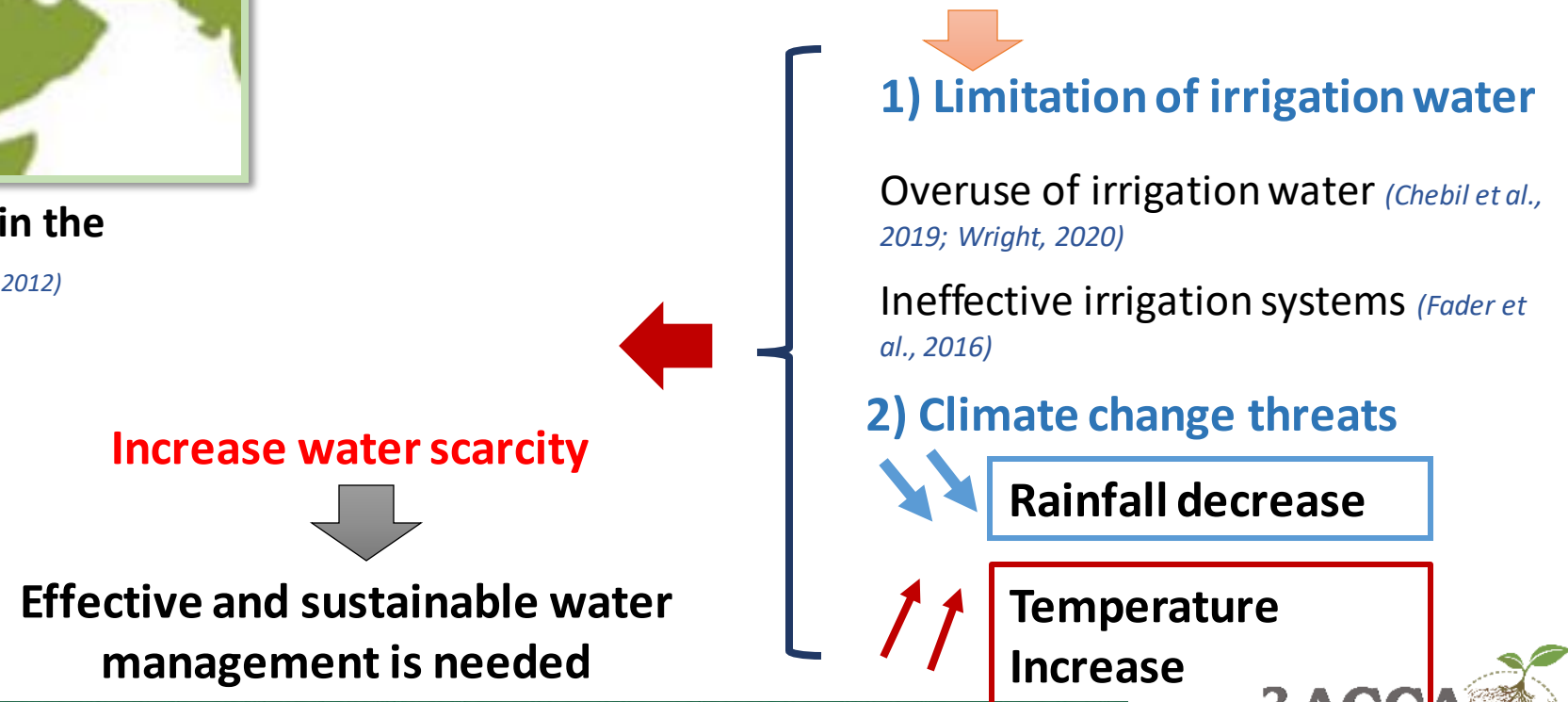
Mediterranean : leader of citrus-producing regions



The main citrus-growing regions in the Mediterranean (orange) *(Liu et al., 2012)*

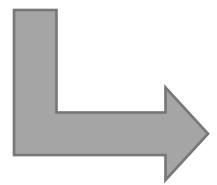
- Second biggest citrus producer with 20% of the world's citrus fruit production *(Imbert, 2014; Urbaneja et al., 2020)*
- 60% of the world fresh citrus market. *(Lacirignola & D'onghia, 2009)*

.....But these systems are subject to several threats

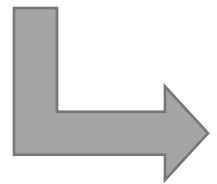


Work Objectives

- ✓ Develop a simple decision tool, which can help stakeholders to plan irrigation scheduled

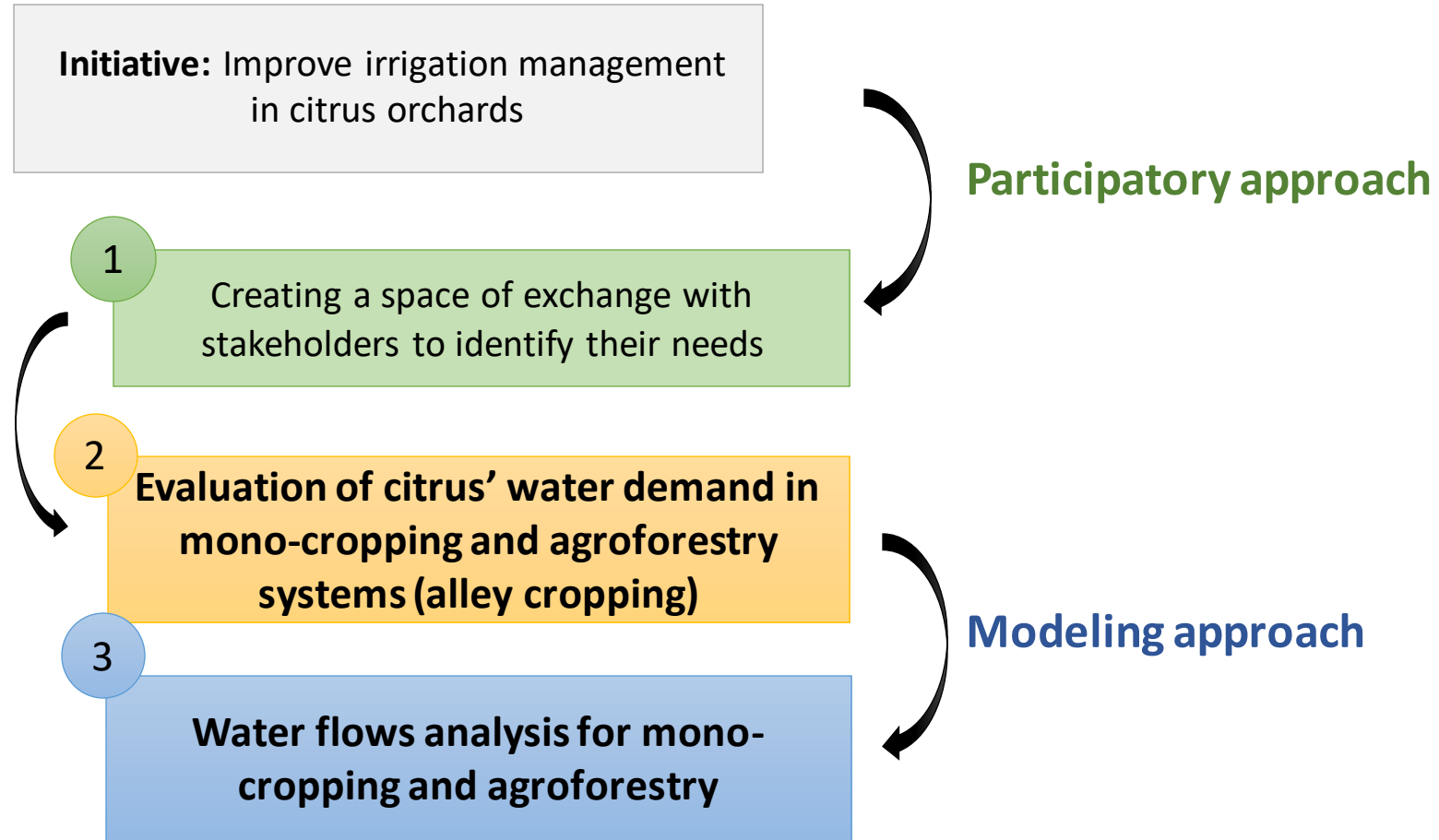


Sub-objective 1: Develop a free, user-friendly tool for conventional fruit orchards exp: citrus, based on [Fao 56 paper](#) Crop evapotranspiration - Guidelines for computing crop water requirements



Sub-objective 2: Introducing grass cover into citrus orchards as an agroecological transition => Need to take into account the technical and physical informations on grass cover

Work' approach

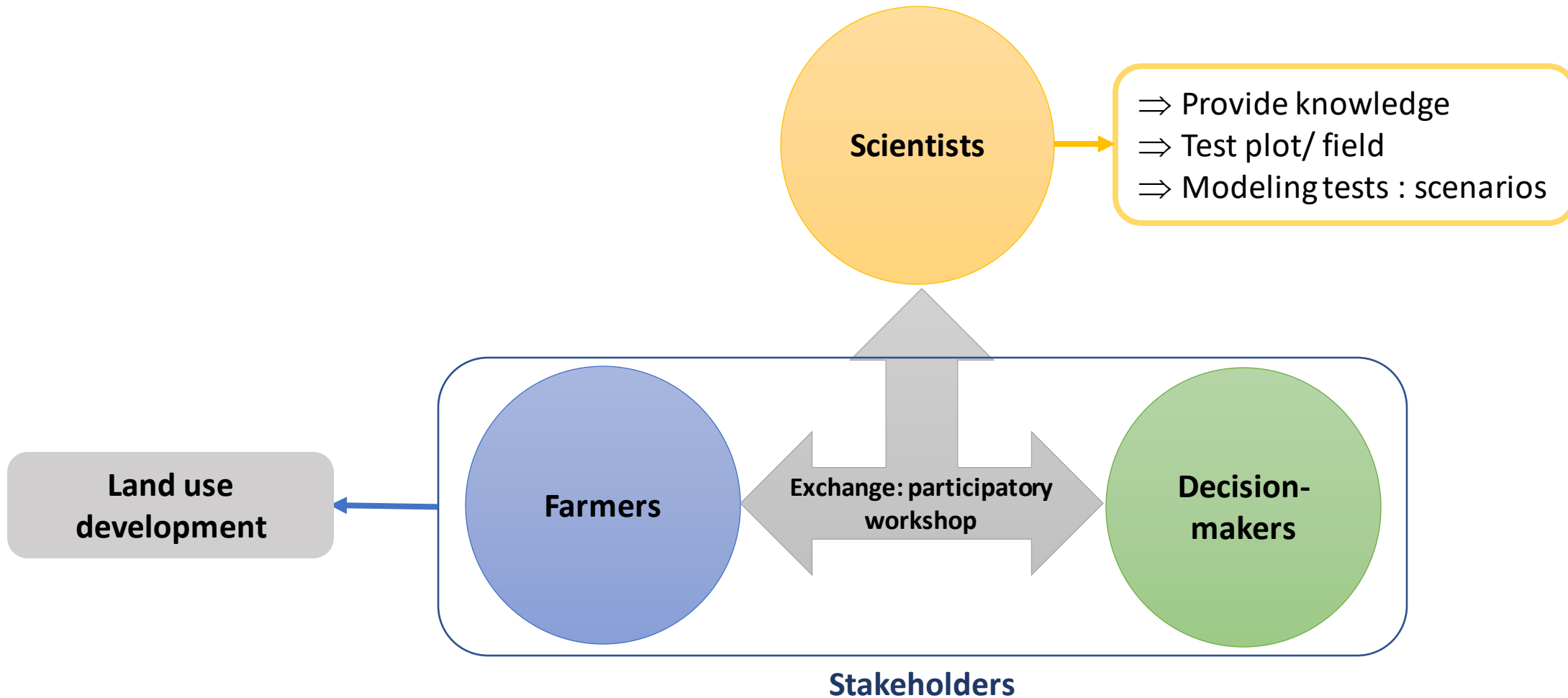


Participatory approach

1

Creating a space of exchange with stakeholders to identify their needs

3 pillar for sustainable development





Field surveys 2016



Workshop 2018: Workshop with stakeholders: need for a simple tool to be developed

Auteurs
Imene Mahjoub
Centre Technique des Agrumes
Rim Zitouna-Chebbi
Insaf Mekki

Revision
Abdelaziz Zairi
Institut National de Recherches en Génie Rural Eaux et Forêts

Irrigation localisée des agrumes: Calendriers prévisionnels au Cap Bon

Tableau 1.1. Calendrier d'irrigation moyen (débit d'irrigation en l/s) Pluviosité en l/s sur 2 rampes-goutteurs de 2,3 l/h - Acourtment 0,75 m

Mois	decade	1	2	3	4
Fevrier	1-10	18	19	20	18
	11-20	18	19	20	18
Mars	1-10	18	19	20	18
	11-20	18	19	20	18
Avril	1-10	18	19	20	18
	11-20	18	19	20	18

Tableau 2. Calendrier d'irrigation moyen (débit d'irrigation en l/s) Pluviosité en l/s sur 4 rampes-goutteurs de 4 l/h - Acourtment 0,30 m

Mois	decade	1	2	3	4
Fevrier	1-10	2	3	4	3
	11-20	2	3	4	3
Mars	1-10	2	3	4	3
	11-20	2	3	4	3
Avril	1-10	2	3	4	3
	11-20	2	3	4	3

2019: Publication of the technical leaflet

2015 First participatory Workshop with stakeholders : need to know irrigation times

CITRIG
Outil des calendriers annuels de doses et des heures d'irrigation pour les vergers irrigués au goutte à goutte

Paramètres à entrer par l'utilisateur

Caractéristiques du verger

- Age de la plantation: Pleine production (70%, 4m)
- Interplant (m): 4
- Interligne (m): 6

Caractéristiques du système d'irrigation

- Nombre de rampes par rangée d'ar: 2
- Ecartement entre goutteurs (m): 0,75
- Debit du goutteur (l/h): 2,3
- Efficacité du système d'irrigation: 0,8

Localité: Nabeul

Evapotranspiration de référence moyenne interannuelle de la decade: **D = 10 ETO Kc (2 ETI)**

mois	decade	Présence de couverture herbacée	Dose d'irrigation (mm)		nombre de cycles journaliers	durée d'irrigation (min)
			mois	decade		
Fevrier	1-10	oui	15	14,5	4	3:47 min
	11-20	oui	18	17,0	6	2:57 min
Mars	1-10	oui	19	16,5	6	3:12 min
	11-20	oui	22	20,0	6	3:18 min
Avril	1-10	oui	24	23,2	7	2:27 min
	11-20	oui	27	26,3	8	2:25 min

Mars 2019: Presentation/ test of the Citrig tool : an Excel file



Mars 2022: Presentation of the improved tool and discussion of possible diffusion forms



October 2022: Test of Citrig smartphone application and web site

**December 2022: CITRIG application
launched for citrus growers
(monocropping of citrus)**



**2022/23: Work objective: Adjust
Citrig for agroforestry systems
(citrus + cover crop / mulch)**



1) Rethinking citrus orchard



Participatory approach

**Septembre 2023: a planned workshop with stakeholders about
how we can diversify citrus orchards? Which species should
be sown? What is the purpose of the introduced species?
livestock feed, mulch ...**

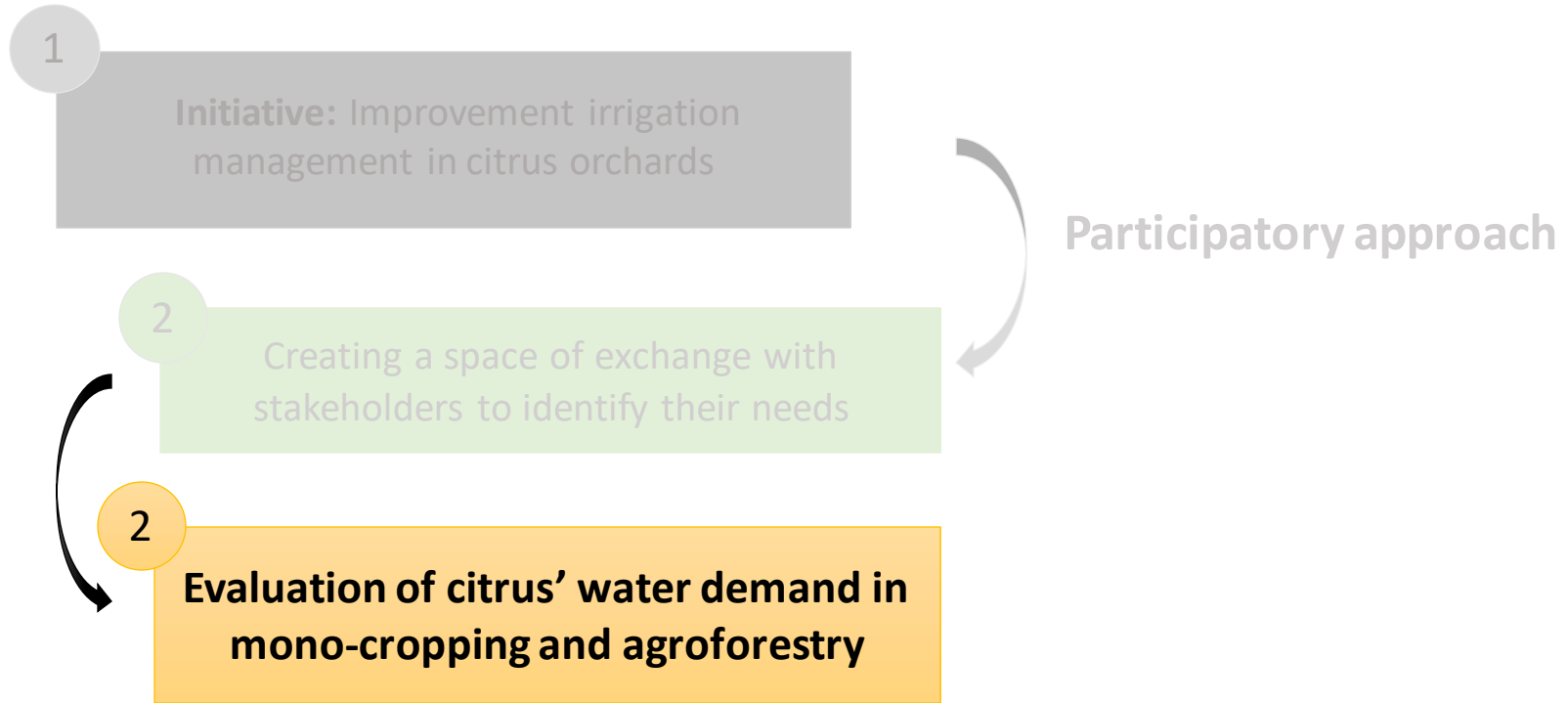


Biophysical analysis



2) Testing the water requirements of citrus in agroforestry
considering how to introduce the herbaceous component in
Citrig

Biophysical analysis



How we can improve citrus orchards durability in a context of a climate change ?

.... Diversifying is it a solution?!



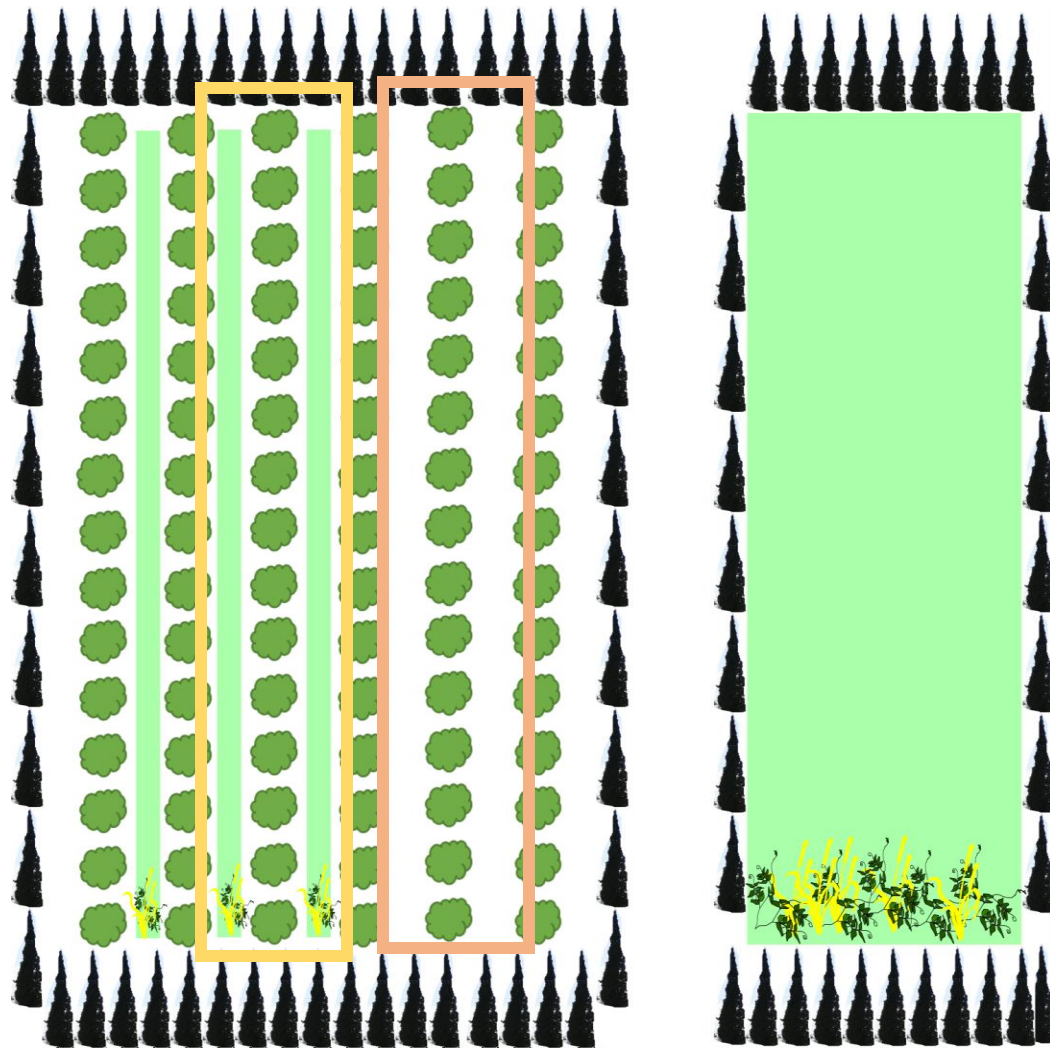
ACS: Citrus+SGC



CO: Citrus orchard



SGC: vetch+ triticale

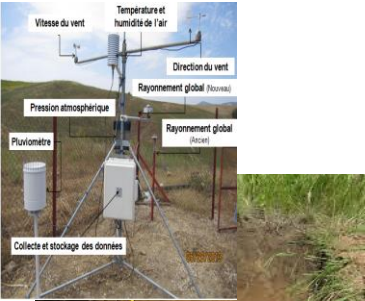
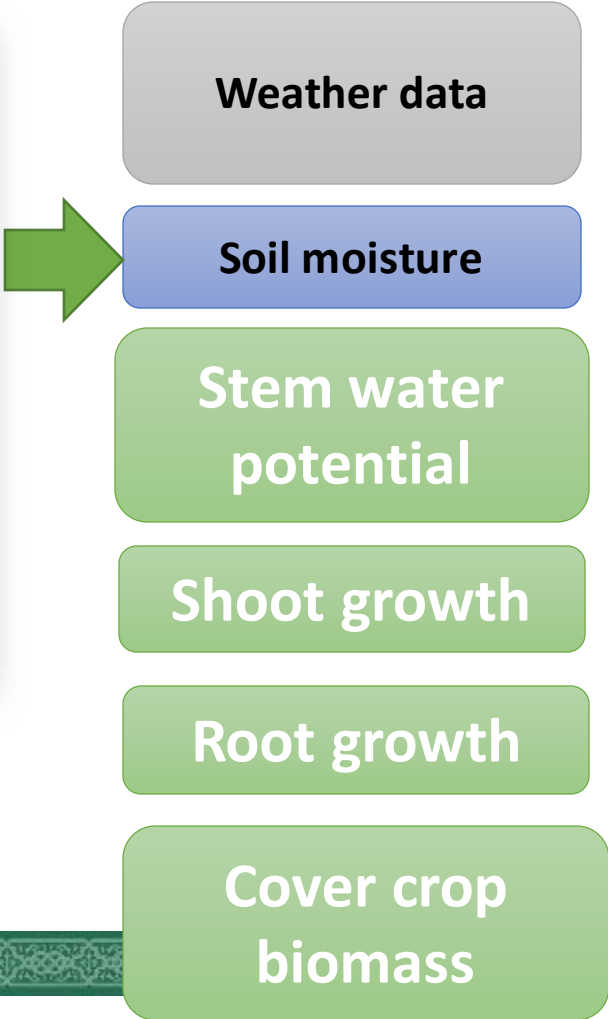


SGC: sown grass cover a mixture of vetch and triticale

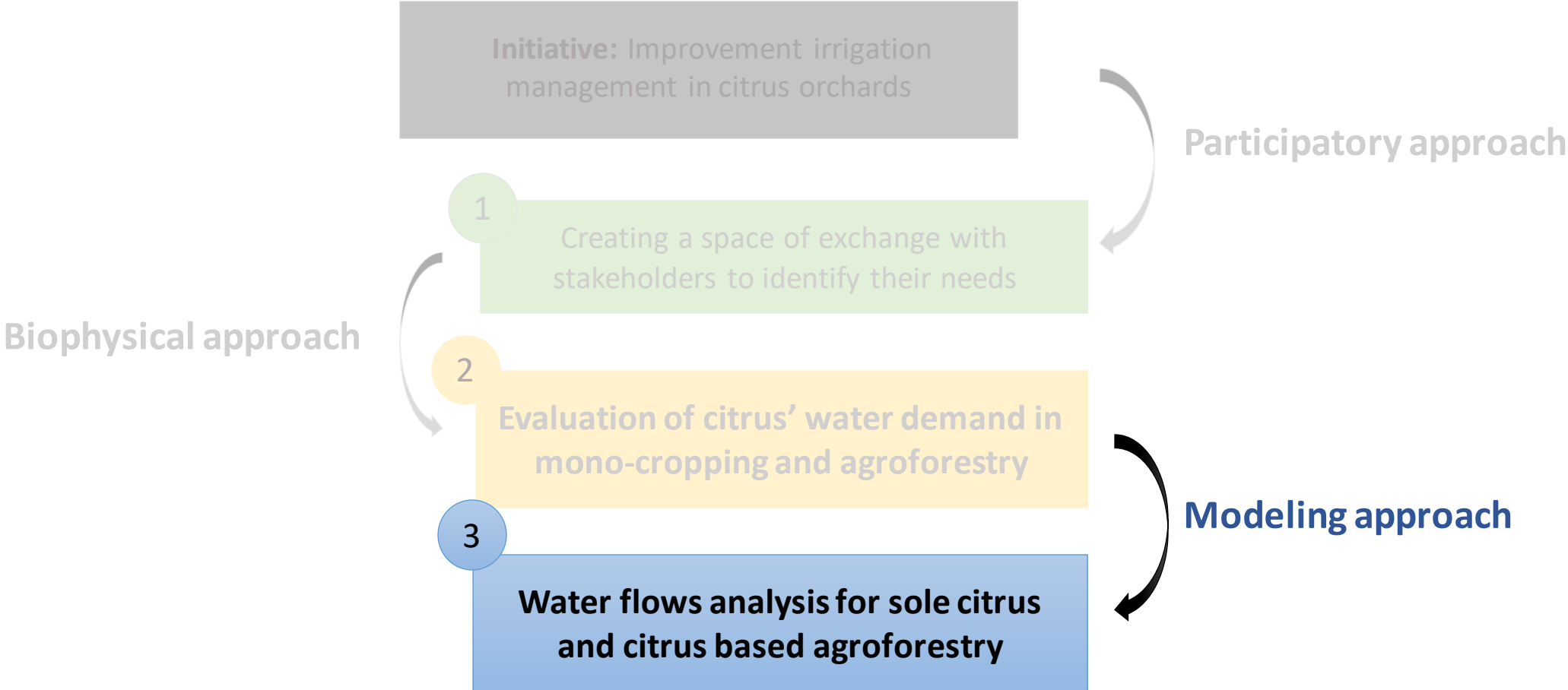
Experimental analysis of citrus based agroforestry system



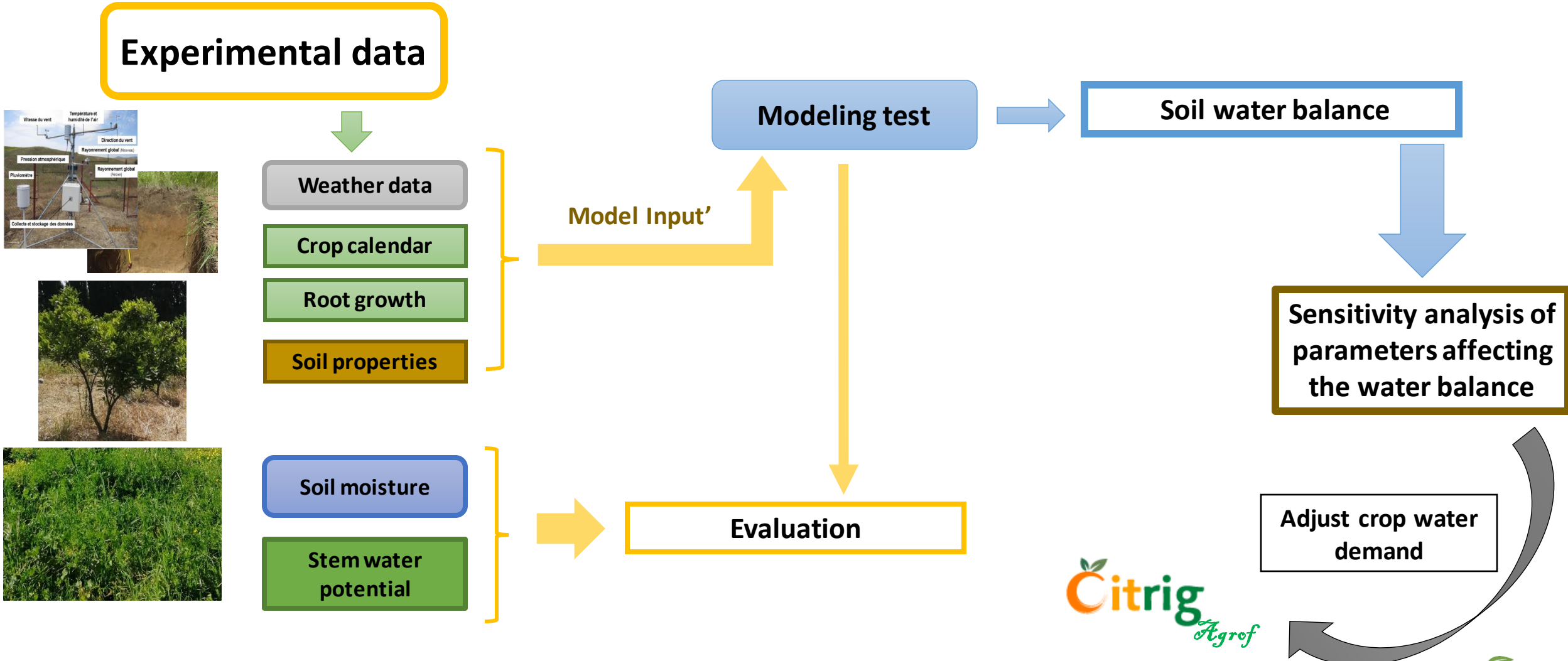
Experimental measurement



Further step



Estimate water demand for citrus based agroforestry system



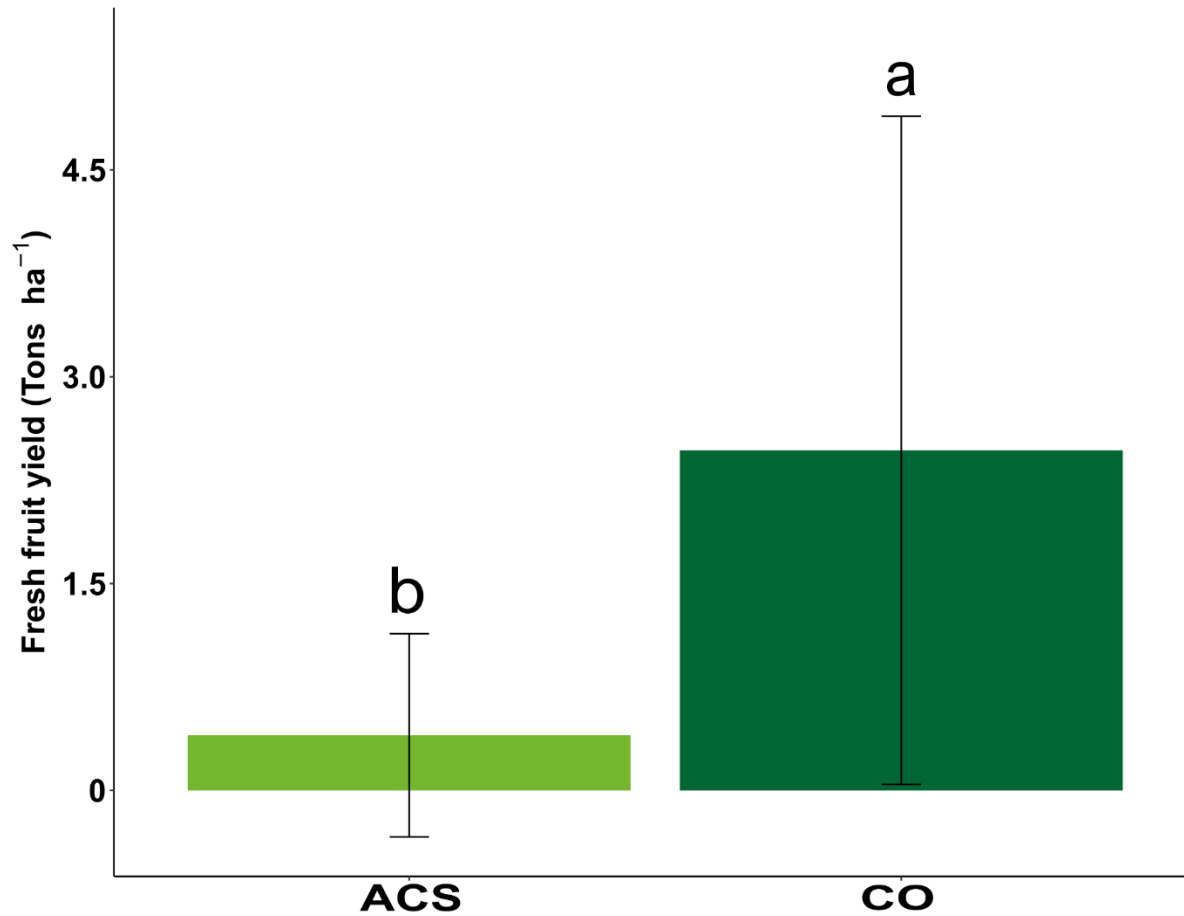
Preliminary ***results***

Citrus yields

**Cover crop
biomass**

**Stem water
potential**



Fruit yield was higher in Citrus orchard



High fruit yield variability due to fruit drop:

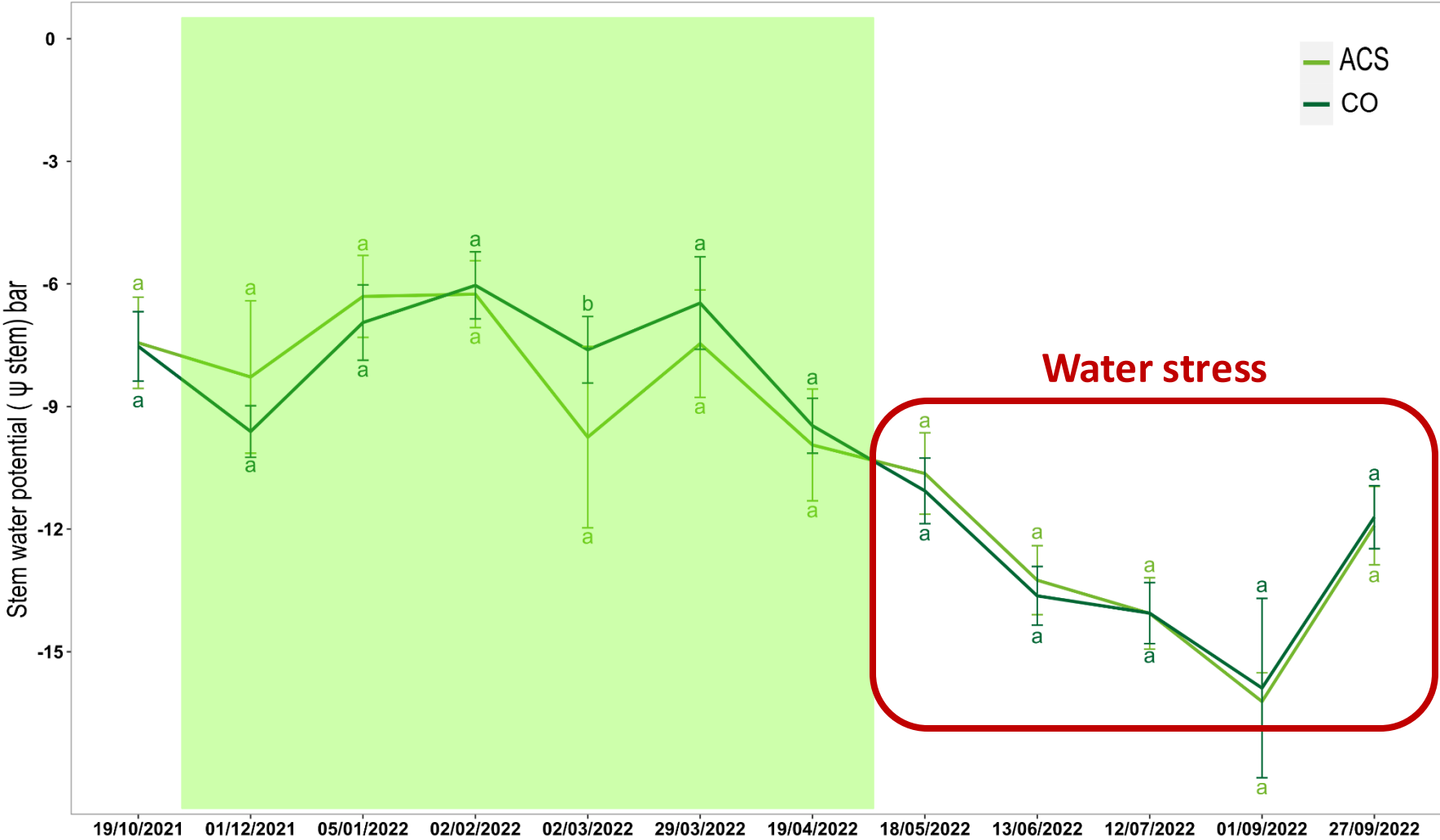
- Heat waves
- Fruit bursting

No effect of cropping systems on cover biomass

Date	Dry biomass g m ⁻²	
	ACS 	SGC 
29/03/2022	810±134a	1222±308a
05/04/2023	315,9±85a	243,2±149a

**ACS ≈SGC in both
2022_(p = 0.072) & 2023_(p=0,372)**

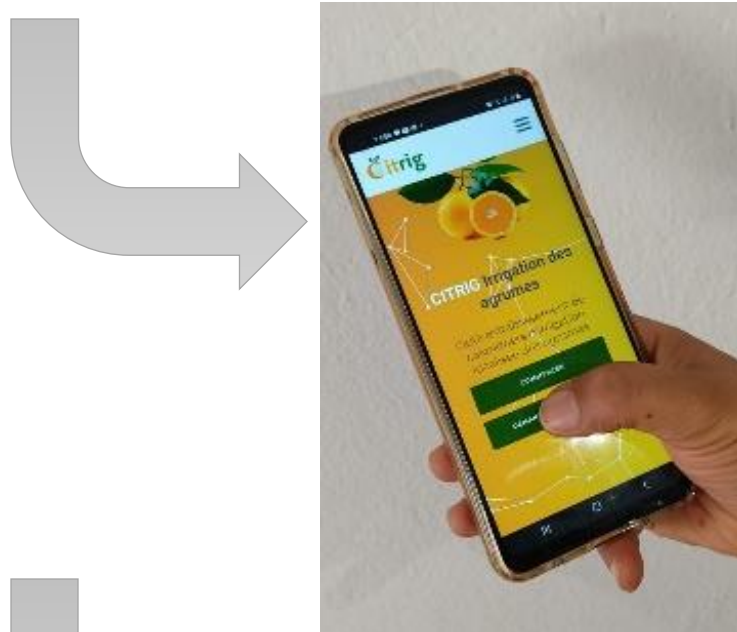
Presence of water stress in summer for both ACS and CO



ACS ≠ CO at cover crop flowering => a slight water stress ($\psi_s = -9.7$ bar) in ACS

Perspectives

- **Sub-objective 1:** Develop a free, user-friendly tool for conventional fruit orchards exp: citrus, based on Fao 56 paper



**Smartphone application:
scheduling irrigation**

**This step highlighted the importance of irrigation
system maintenance**

Perspectives

Sub-objective 2: Next participatory approach: Co-constructing of intercropped citrus orchard => discussion with stakeholders

- Adapt CITRIG for other regions and other fruit species and for other mediterranean agroforestry systems : e.g. olive trees (79 %, and 60% of Arbo areas in Tunisia and Morocco respectively). In Morocco, 75% of olive orchards are combined with annual crops). (*Gharbi et al., 2014, El Mouhtadi et al., 2014, Razouk et al., 2016*)

Thank you for
your
attention

3 ACCA

**THIRD AFRICA CONGRESS ON
CONSERVATION AGRICULTURE**

5-8 June 2023 | Rabat, Morocco



3ACCA Secretariat

African Conservation Tillage Network

P.O Box 10375, 00100 Nairobi, Kenya.

KALRO - KABETE, Waiyaki Way.

Website: <https://africacacongress.org>

Email: cacongress@act-africa.org