International training course for the Design of Resilient Farming Systems in face of climate change in Dry Regions.

IAV-Hassan II- Morocco

12-15 November, 2018.

Context: As part of the **SemiArid** project funded by ERANET ArimNet2 (2017-2020), a group of lecturer-researchers from different Mediterranean institutions wish to set up a short international training course dedicated to the design of dryland farming systems. This training course follows several doctoral programs initially organised within the SEAMLESS project (2005-2010), then as part of the global FSD network (Farming System Design), which have trained more than a hundred international doctoral students. Until now, these courses aimed to prepare young scientists for the analysis and assessment of the sustainability of farming systems thanks to integrated approaches. The « SEMIARID » training course will focus on farming system design in dry regions (climate variability) in the context of climate change and food/nutritional security (referred to as « Climate-smart agriculture »). In its applications it will emphasize the role of diversities (intra-field, intra-farm and across-farms) in the efficiency and resilience of agricultural systems. It therefore falls within several national and international priorities programme of most dryland countries: « Feeding » and « Protecting ».

Participants: This training course aims for the participation of **25-30 doctoral or post-doctoral students and young researchers** of different nationalities, mostly from northern and southern Mediterranean countries, whose research studies deal with farming system design and modelling, within a context characterised by harsh and uncertain climatic conditions and limited resource access (water, land, labour, etc.). This course should also allow participation of **professionals and agricultural advisory from technical centres and cooperatives** to discuss, based on the integrated approach and precooked scenarios, different innovative production options and their associated incentives for more resilient systems.

This course will be conjointly organized by the SEMIARID project partners: IAV-Hassan-II-Morocco, ENSA-Algeria, INRA-Morocco, Montpellier SupAgro, INRA-France, CIRAD, CIHEAM-IAMM, **an international research centre of the CGIAR** (ICARDA), which contributes through staff-time and direct support to trainees, and **University of Mohammed VI Polytechnic-Rabat** and the **Office Chérifien des Phosphates (OCP-Morocco)** by sponsoring the participation of Moroccan and African PhD students.

Objectives: The training course seeks to prepare for methodologies of systemic analysis that make it possible to integrate different levels (plot, farm, region) into the design and multi-criteria assessment of resilient farming systems taking into account diversities at multiple scales. It specifically aims to:

> 1- Simulate and discuss the production and resilience of different ecosystem services (e.g., food production, land management, water resources…), and their trade-offs, with the help of biophysical modelling, using diversified cropping systems in terms of crops grown, rotations, crop combinations (including different annual and perennial crops and their spatial layout), in relation to resource management (water, nitrogen…). Various crop models will be used during the study, with an emphasis on simple models compatible with the data that

participants may easily access (notably SSM, Soltani & Sinclair, 2012 ; BISWAT, Bertrand *et al.*, in press).

2-   Simulate and discuss the integration and adoption of cropping systems that encourage diversity, using bioeconomic modelling (e.g. DHABSIM, Komarek *et al.*, 2017) and typologies for up and down-scaling, taking into account the expectations of the different stakeholders of the areas and sectors concerned.

Organization: The training course will include two phases:

1.   An initial period of distance learning (equivalent to 10 hours) for the core modules, using the teaching materials developed within the FSD, EMSACS and ModelEco projects (2015-2018, funded by the Labex Agro).

2.   The second stage will take place on-site (over a period of 4 days) at IAV-Hassan II **in Morocco**. It will offer in-depth lectures and practical exercises, which will encourage the use of conceptual and digital modelling. Moreover, it will give the opportunity for participants to discuss different options targeting the promotion of options for enhancing farming system resilience to face climate change and market uncertainty. A specific day (day 4, for more details see course programme) will allow for interactions between the trainees and Moroccan professional of the agricultural sectors to discuss the potential of the approach as decision aid tool.

Important dates:

1.   July 2, 2018: course announcement for receiving cv and motivation letter
2.   October 1, 2018: closing candidature.
3.   October 15, 2018 for the initial e-learning stage
4.   November12, 2018 for the on-site training stage in Morocco

Accommodation and fees:

- Registration fees are for free.
- The participants should take in charge their trip and accommodation.
- Lunches for the 4 days of the training course will be offered for participants by the organisation.

Registration procedure:

- Send your CV and motivation letter before October 1, 2018
- Contact for registration and information: Hatem Belhouchette, Belhouchette@iamm.fr

Training course programme

Day 1: Conceptual and scenario-based analysis of the role of diversities in the resilience of agricultural systems.

Trainers: L. Hossard, J. Wery.

This session will be organized in three parts;

1. Conceptualization of an issue into an agricultural system.

As a follow up of the pre-course on-line work the methodology of conceptual modelling of agricultural systems will be presented and discussed, to be further implemented in part 3.

2. Scenario-based analysis of innovation into an agricultural system.
After a rapid overview of the various concepts of scenario analysis in agriculture a method adapted to the design and assessment of innovative cropping systems in a changing environment will be presented, illustrated with examples and discussed. Its use in a participatory manner with stakeholder will be discussed from previous projects.

3. Where and how diversities can bring efficiency and resilience into the system.
This part will be addressed in group work applying the methods learnt in part 1 and 2 to a specific case study on diversification of Mediterranean cropping systems. Diversification at field level refers to the type of cultivar, crop, rotation, combination, or crop management to promote. At farm level, it refers to the access to resources (water, land, market) but also to the allocation of resources according to the production goal and to resource availability. Legumes (food and feed) in wheat-based systems will be used as an example. Each group will go through the following steps: i) represent the system to be analyzed, ii) identify the actors concerned and for what role, iii) identify the indicators of resilience/sustainability in relation to the objective of the study, iv) use the framework to assess the performance of these systems qualitatively, v) provide the actors involved some answers based on the results obtained (in the form of advice for strategic choices for example). Groups will report in a final plenary session the methodological implications for further implementation of the scenarios in numerical modelling and in a participatory approach.

Day 2: Modelling and analysis of the resilience of cropping systems; contribution of diversities.

Trainers : H. Marrou, K. Barkaoui, K. Daoui.

This session will be conducted in two stages:

1. A correspondence course starting on October 15th using the EMSACS on line Course (E-modules 1.1 and 1.4). This course mainly deals with four modules: the use of crop models in agriculture, an introduction to agrosystem modelling, and how to use data and statistics to parameterize, assess and use a model.
2. The classroom-based course will be composed of two parts :

2.1 How complex should my model be? A lecture will cover the complexity involved in choosing a model according to the structure of the system to be modelled, of the objective of the simulation and

of data availability. The lecture will be followed by a practical class reviewing different modeling approaches and exploring the relationship between model complexity, model equation, and model processes, and model error.

2.2 Modelling diversified cropping systems. Two types of exercise will be considered : i) each work group (duos) will be provided with an Excel table containing modelling output simulated with the SSM model by setting up various rotation types (with or without legumes, several climatic years, with or with little irrigation water, etc.). The challenge here is to answer important questions (to be identified and presented beforehand) concerning production, and the resilience of the different ecosystem services (e.g. food production, reduction of N leaching, resource use efficiency, contribution of N fixation to soil N net balance, etc.) in a semi-arid context. ii) Using BISWAT in order to simulate the water balance and water stress within an agroforestry system under contrasting water availabilities. Two objectives for this exercise: using examples from the literature, discuss the issues of agroforestry systems in relation to different types of ecosystem services with the participants, present the different modelling approaches to represent how these systems work, and present and use BISWAT with a simple example in order to simulate the water balance and water stress and their dynamics over time.

Day 3: Analysis of the resilience of farms in arid areas: methodological issues and examples of application.

Trainers : H. Belhouchette, A. Fadlaoui, Y. Yegezu, M. Latati, R. Chenoune

This course will consist of two parts:

1. **A correspondence course starting on October 15th using ModelEco course** (https://www.supagro.fr/wordpress/modeleco/). This course concerns two modules: the self-study of mathematical programming and the use of bio-economic modelling in order to analyze the resilience of Mediterranean production systems. Several concrete examples of modelling and formulation will be presented on this course.

2. **The classroom-based course on the assessment of the Mediterranean production systems resilience:** 3 case studies (France, Morocco, and Algeria) will be presented and discussed. The discussion will focus on the i) structure of the current production systems and the expectations of local stakeholders regarding standard ecosystem services: food production, preservation of water resources, reducing production risks, ii) modelling approaches used: selection of typical farms, development of various databases, selection of farm household model, selection of indicators, selection of agricultural activity, and iii) simulation results to see how extend it make it possible to meet the expectations of stakeholders.

Day 4: Integrated modelling as a support tool for strategic thinking (only morning)

This cession will be in French

Trainers : A. Bouaziz, J. Wery, H. Belhouchette.

This session targets ONCA agricultural advisors (5 to 10 participants) representing different regions and different cropping systems. But it will involve also the French-speaking trainees in order to provide them with a confrontation of their scientific knowledge and of the practices and expectation of professionals.

1. Present the importance of integrated modelling in proposing and assessing strategic choices in relation to the socio-economic and environmental issues which farms are confronted with nowadays. This part will be illustrated with the case study (diversification of cereal-based systems with legumes) used during the course.

2. Present a simple version of the global modelling approach (without describing the model) using a concrete example: compiling the issues from the farmers and agricultural advisors, using existing databases or databases to be developed regarding the concept of agricultural activity, choice of indicators and examples of results.

3. Discuss : i) the issues surrounding the use of these methods in relation to the questions which agricultural advisors raise today concerning their respective areas, ii) the difficulties linked to data acquisition for this type of modelling, iii) how should indicators be presented ? How can simulation results integrate/enrich their current agricultural advising approach? iv) What is needed to develop modelling tools for strategic thinking at the interface between farmers and advisors?

List of trainers.

Name	Staff category, discipline	Affiliation
Bouaziz, Ahmed	Professor, Agronomy	IAV Hasan II- Morocco.
Daoui, Khalid	Researcher, agrophysiology	CRRA Meknès, INRA Morocco
Fadlaoui, Abdelaziz	Researcher, Agro-Economy	CRRA Meknès, INRA Marocco
Barkaoui, Karim	Researcher, Agro-ecology	UMR SYSTEM, CIRAD, France/Morocco.
Wery, Jacques	Professor, Agronomy	DDG-R ICARDA- Egypt.
Yigezu, Atnafe Yigezu	Senior Agricultural Economist	ICARDA-Jordan.
Hossard, Laure	Researcher, Agronomy	UMR Innovation, INRA France
Marrou, Hélène	Assistant professor, Agronomy	UMR SYSTEM, Montpellier SupAgro
Latati, Mourad	Assistant professor, Agronomy	ENSA-Alger
Chenoune, Roza	Post-doc, Agronomy	CIHEAM-IAMM
Belhouchette, Hatem	Sc. Administrator, Agronomy	UMR SYSTEM, CIHEAM-IAMM, France