



Morocco-Netherlands Centre of Excellence in Horticulture of Agadir

Final report project MAS1MR01

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Rapport WPR-1292

Referaat

Het doel van het project is om de duurzaamheid en productiviteit van de kasbouw in de regio te verbeteren, waarbij Complexe Horticole d'Agadir (CHA) als belangrijke partner fungeert. De Nederlandse betrokkenheid omvatte financiering voor een kas onderzoeksfaciliteit en wetenschappelijke samenwerking met Wageningen University & Research (WUR). Vertragingen als gevolg van COVID hebben het projectschema verstoord, maar er is vooruitgang geboekt in onderzoeks-, onderwijs- en outreach-activiteiten. Ondanks vertragingen in de bouw van de kas, is er een basis gelegd voor toekomstige betrokkenheid. Hoewel operationele uitdagingen aanhouden, wordt het project als succesvol beschouwd in het bevorderen van samenwerking en het verbeteren van de vooruitzichten voor de tuinbouwsector in Marokko en de Nederlandse toeleveringsindustrieën.

Abstract

The goal of the project is to enhance the sustainability and productivity of greenhouse horticulture in the region, with the Complexe Horticole d'Agadir (CHA) as the key partner. Dutch involvement included funding for a greenhouse research facility and scientific cooperation with Wageningen University & Research (WUR). Delays due to COVID pushed the project timeline, but progress was made in research, education, and outreach activities. Despite delays in greenhouse construction, groundwork was laid for future involvement. While operational challenges persist, the project is deemed successful in fostering collaboration and improving prospects for the horticultural sector in Morocco and Dutch supply industries.

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Summary

The overall objective of the project is to facilitate the transition of the regional greenhouse horticulture towards a business model that couples increased rural income (higher productivity and value of product) and climate robustness, to a reduced environmental impact (higher water use efficiency and less emissions). That is: both productivity and sustainability of commercial practice must be improved. The Complexe Horticole d'Agadir (CHA) of the Institute Agronomique et Veterinaire Hassan II, was identified as the most suitable partner in facilitating the transition, through a combination of research, education and outreach, focused on transition paths.

The Dutch contribution to the project was financed along two independent lines: a grant (handed directly to the CHA) for the construction of a greenhouse research facility (meant to be the heart of a new Dutch-Moroccan Centre of Excellence in Horticulture, CEH) and a grant to WUR for the scientific cooperation (€ 190 869). In this report we deal exclusively with this second. In fact, the tasks of WUR as defined in the grant were very heavily contingent on the greenhouse research facility to be completed well in advance of the foreseen end of the project. That was unfortunately not the case: as a result of COVID and other factors the construction of the greenhouse was delayed till 2023. Therefore it was agreed to postpone the end of the project to the end of 2023, with new deliverables for the remaining period.

In this report we describe the activities of this final phase, which have been largely successful. In particular we have laid a very solid groundwork for further involvement of WUR and Dutch companies in the Centre of Excellence in Horticulture, both in research and education, as well as outreach/demonstration to local farmers.

We did successfully hold two short courses for students. Appointments were made about more courses and all becoming part of the educational offering of CHA. However, a further delay in getting the greenhouse operational (a head grower has been appointed on Dec 1st, 2023) has prevented the implementation of research/demonstration projects. Nevertheless, since very definite plans have been made about these and also about farmers' involvement, we are in no doubt that the results foreseen will be achieved.

Altogether, we conclude that, thanks to the extremely prolonged timeline, the project has been successful. A very good cooperation has been established between Wageningen and the Complexe Horticole d'Agadir, which will continue well after this project. We should learn the lesson that the initial timeline of the project was extremely unrealistic (even without COVID). Nevertheless, the greenhouse foreseen has been established and will be put into operation as a part of the Complexe very soon. This all will contribute to enhancing the horticultural sector of Morocco, which will be beneficial for the outlook of the Dutch supply industry.

1 Introduction

The overall objective of the project is to facilitate the transition of the regional greenhouse horticulture towards a business model that couples increased rural income (higher productivity and value of product) and climate robustness, to a reduced environmental impact (higher water use efficiency and less emissions) and finally the participation of the Dutch greenhouse supply industry. That is: both productivity and sustainability of commercial practice must be improved. The Complexe Horticole d'Agadir (CHA) of the Institute Agronomique et Veterinaire Hassan II, was identified as the most suitable partner in facilitating the transition, through a combination of research, education and outreach, focused on transition paths.

The Dutch contribution to the project was financed along two independent lines: a grant (handed directly to the CHA) for the construction of a greenhouse research facility (meant to be the heart of a new Dutch-Moroccan Centre of Excellence in Horticulture, CEH) and a grant to WUR for the scientific cooperation (€ 190 869). In this report we deal exclusively with this second. In fact, the tasks of WUR as defined in the grant were very heavily contingent on the greenhouse research facility to be completed well in advance of the foreseen end of the project. That was unfortunately not the case. The (slow) progress of the project has been reported to RVO in the following documents:

1. Inception Report: Memorandum 2017-41, March 2017
2. "Mid-term" report, August 2017
3. Interim Report: Report WPR 1133, December 2021

In the last, it was remarked that as a result of COVID and the fact that it took a long time for the Moroccans to arrange the co-finance for the project, the construction of the greenhouse would be delayed till 2023. For this reason it was agreed to postpone (one final time) the end of the project to the end of 2023, and to re-define the deliverables for the remaining period (RVO letter: MAS1807PTI7U, March 2022) as follows:

1. A joint Moroccan-Dutch 2 year research programme (that is a research-experimental plan for about two years) in which Centre of Excellence in Horticulture (CEH) is instrumental and which addresses the four priorities of the local sector, as previously identified (water, climate, crop and IPM)
2. Two joint research projects (as initial implementation of the research plan and to be defined together with Dutch and Moroccan stakeholders) in which Dutch technology has been instrumental and of which the results have been actively disseminated within the Dutch and Moroccan horticulture sector
3. First edition of at least two thematic short courses (themes to be chosen among the four mentioned above, and held by WUR staff), to be later included in the yearly educational offering of the CHA
4. Participation/seminars at two workshops with wide attendance of local and Dutch stakeholders, particularly from the private sector. One of the outcomes of the seminars should be a refined vision about the future of the CEH and Dutch involvement in it. At least one of the seminars is coupled to a "open day" of the facility.

A very promising result of this new phase of the project has been the signing of a framework agreement between the CEH and Wageningen Research that ensures there will be cooperation (on research, education and training) well after the lifetime of this project. On the other hand, further delays in getting the greenhouse operational (see photo in the next page), have prevented the foreseen research projects getting beyond the planning phase. Nevertheless, detailed plans have been made (and agreed upon) about experiments/demonstrations to be started the next growing season, that is after the summer of 2024.



Current status of the greenhouse: almost finished but just not. Irrigation lines and substrate are not yet there, the head grower has been appointed on Dec, 1st, 2023.

2 Research programme and research projects

Jouke visited the CHA during a workshop in March 2022 (see Annex I), also to lay the groundwork for the cooperation after the [extended] lifetime of this project. The visit was very successful and, indeed, as remarked above, a framework agreement for future cooperation was agreed subsequently.

Cecilia and Jouke visited the center in Agadir in November 2023. They had a two day workshop with the staff and the students of the Complexe Horticole to discuss implementation of the research program and research topics that were agreed upon earlier in the project (see Annex I). The focus was on the topics/projects which could be addressed in the new Center of Excellence in Horticulture, in particular the greenhouse research facility. The newly appointed head grower Richard was also present during these meetings as well as the CEO of the greenhouse builder, HortiXS, see picture here below.



We started with an overview of the main [research] interest of the students and teachers that were present and, not surprisingly, water management came on top. As a basis for the subsequent discussion we used the slide in the next page (results from a project in Saudi Arabia) to provide an insight of what technology can do in terms of water saving.

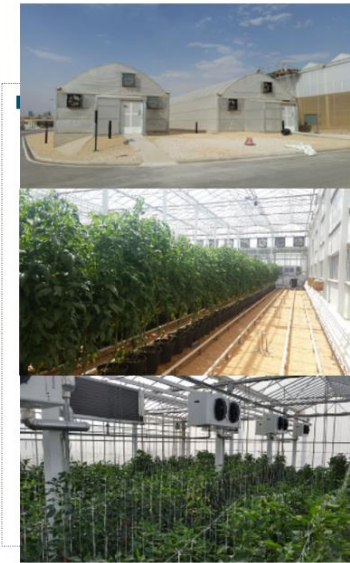
The subsequent discussion identified experiments/projects that will be started as soon as the greenhouse will be operating (spring 2024) and the unavoidable issues will have been solved.

Ideas for initial trials

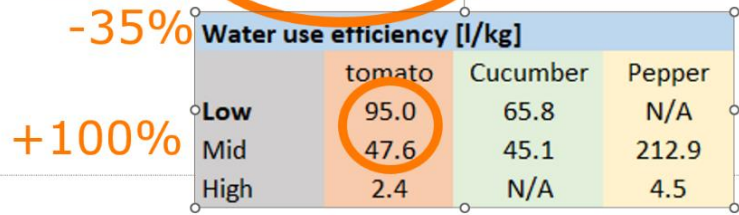
Irrigation efficiency in tomato (details to be worked out later)

- Comparing a traditional Moroccan irrigation schedule with a modern irrigation schedule based on climate and crop data and a comparison with soilless culture with and without recirculating of drainage.
- Aim: a) demonstrating the gain in WUE and NUE (water and nutrient use efficiency, respectively) using more targeted irrigation/fertigation in soil and b) demonstrate the possibilities of growing on soilless systems with and without recycling.

Water saving Middle East



Low tech		Mid Tech			High Tech		
Irrigation	Pad	Irrigation	Drain	Pad	Irrigation	Drain	Condens
1525	3483	1709	-478	2296	1887	-521	-1169
5008		3527			197		



Effect of stem density (and variety) on crop performance

- Interwoven in the above set up (randomized plots in gutters), make plots with different stem densities, according to the seasonal variation in climate (radiation)
- Aim: search for the optimal stem density and LAI in relation to the available light, demonstrate the effect on Light Use Efficiency and yield and fruit quality, in addition saving on planting material by doubling or tripling individual stems



Students with the new head grower in the technical area of the greenhouse.

Ideas for short experiments for students for MSc thesis work (elaboration from idea to test proposal with research questions and hypothesis is part of the thesis):

- Pot trials with cucumber and tomato with different growing media: sand, clay, coir, etc. with different pot heights, where the effect of physical properties and interaction with irrigation can be tested and demonstrated.
- Pot trials with different volumes and pre-treatment to demonstrate the effect of buffer stock fertilization (N, K) on growth, which might in addition can be followed by a next step for a (simple) model for base dressings with fertilisers.
- As above, but with different quality irrigation water (addition of salts) on growth and development, which should lead to a (simple) model for salinity build up.
- Pot experiments with various treatments (media, pH, addition of organic matter) and Boron treatments in the irrigation, in order to find out if the problems of high B in the irrigation water (major problem in region) can be alleviated.

It was agreed that in the future suitable candidates would be identified (for all research lines, if possible), to enrol in a "sandwich" PhD program at Wageningen University, but not exclusively there. Typically a sandwich program consists of an initial period in Wageningen (to identify and write the PhD research), followed by an experimental phase at home (in this case the CEH), to be concluded by another stay of about one year in Wageningen to finalize and write the thesis.

In the future the candidates will be selected among the participants of the Master "Water and Sustainable Horticulture" (see next section). This year three very suitable candidates have been found through an external selection procedure and they will start their PhD trajectory during 2024. Two will be in Wageningen (post-harvest quality and crop protection) and one (water management) at Ben Gurion University (Israel).

3 Education

3.1 Participation in the Master course

During this phase of the project, two thematic short courses were provided by Wageningen, see Annex II and III. The courses were within the two-year Master on Water and Sustainable Horticulture that CHA is providing since September 2022. It is the first English-spoken offering at the CHA and there has been a strong selection to be admitted.

The November workshop also gave the opportunity to evaluate the two courses that have been given and to make appointments about additional topics in the future. Both students and the Master teachers were very positive about the courses given, and it was agreed that - provided by Wageningen - it will become a standard element of the Master. There was discussion in particular about the intensity (a lot of knowledge in one week) and how a future construction (mix of on-line and on-site) could help. In particular, it was agreed that material will be made available on-line well in advance and that it will contain case-studies. It was agreed that company visits (now organised ad-hoc) will be standard elements, helpful to clarify the theory. The form of the final test was also reviewed and slight improvements were agreed upon.

The following "new courses" will be given in the spring 2024

- Design of innovative production systems, combined with
- Innovative plant management practices
- Phenotyping
- Integrated Pest Management

In the same academic year there will be as well a second edition of the courses already given. In addition, every effort will be made to find suitable teacher(s) for a course on farm management.

3.2 Seminars with Dutch stakeholders for the private sector

The transfer of knowledge to the farmers is one of the cornerstones of this project. Due to the many delays, COVID and other issues, in the operation of the demonstration greenhouse facility, there has not been any opportunity for implementation. Nevertheless, a Farmer's training programme has been agreed upon and is one of the elements covered by the framework agreement between WUR and CHA. The training will be given both by WUR scientists and by Dutch companies. The announcement of the training can be found in Annex V. The preparations of this training in terms of outlining the 5 courses to be provided and their content have been done in 2023. The actual trainings will be provided in 2024 since it could not be arranged sooner.

The very first training will start already in January 2024 at the CEH, and it will be given both by WUR scientists and technicians of the company Let's Grow (partly on-line). Working hours: from 4 pm to 8 pm (maximum 4 hours per session per day) with the possibility of working on Saturday a little early (2 pm-6 pm).

January 2024

N	DAY	DATE	Institution	HV	PLACE	TRAINING MODULE	SPEAKER
1	Monday	01/01/2024					
2	Tuesday	02/01/2024					
3	Wednesday	03/01/2024					
4	Thursday	04/01/2024	LetsGrow	4	AGADIR	M40- Data Driven: Bloc 7 - Letsgrow	
5	Friday	05/01/2024	LetsGrow	4			
6	Saturday	06/01/2024	LetsGrow	4			
7	Sunday	07/01/2024					
8	Monday	08/01/2024					
9	Tuesday	09/01/2024					
10	Wednesday	10/01/2024					
11	Thursday	11/01/2024	LetsGrow	4	On ligne	M40- Data Driven: Bloc 7 - Letsgrow	
12	Friday	12/01/2024	WUR	4	AGADIR	M41- Data-driven cultivation : Bloc 7 WUR	Ilias Tsafaras
13	Saturday	13/01/2024	WUR	4			Ilias Tsafaras
14	Sunday	14/01/2024					
15	Monday	15/01/2024					
16	Tuesday	16/01/2024					
17	Wednesday	17/01/2024					
18	Thursday	18/01/2024	LetsGrow	4	On ligne	M40- Data Driven: Bloc 7 - Letsgrow	
19	Friday	19/01/2024	WUR	4	AGADIR	M42- Climate control: Bloc 7 - WUR	Jouke Campen
20	Saturday	20/01/2024	WUR	4			Jouke Campen
21	Sunday	21/01/2024					
22	Monday	22/01/2024					
23	Tuesday	23/01/2024					
24	Wednesday	24/01/2024					
25	Thursday	25/01/2024	LetsGrow	4	On ligne	M40- Data Driven: Bloc 7 - Letsgrow	
26	Friday	26/01/2024	WUR	4	AGADIR	M43- Crop maintenance & integrated pest management: Bloc 7 - WUR	Hessel vd Heide
27	Saturday	27/01/2024	WUR	4			Hessel vd Heide
28	Sunday	28/01/2024					
29	Monday	29/01/2024					
30	Tuesday	30/01/2024					
31	Wednesday	31/01/2024					

February 2024

N	DAY	DATE	Institution	HV	PLACE	TRAINING MODULE	SPEAKER
1	Thursday	01/02/2024	LetsGrow	4	AGADIR	M40- Data Driven: Bloc 7 - Letsgrow	
2	Friday	02/02/2024	LetsGrow	4			
3	Saturday	03/02/2024	LetsGrow	4			
4	Sunday	04/02/2024					
5	Monday	05/02/2024					
6	Tuesday	06/02/2024					
7	Wednesday	07/02/2024					
8	Thursday	08/02/2024	WUR	4	AGADIR	M44-Irrigation & nutrient supply: Bloc 7 - WUR	Wim Voogt
9	Friday	09/02/2024	WUR	4			Wim Voogt
10	Saturday	10/02/2024	WUR	4			Wim Voogt
11	Sunday	11/02/2024					
12	Monday	12/02/2024					
13	Tuesday	13/02/2024					
14	Wednesday	14/02/2024					
15	Thursday	15/02/2024	LetsGrow	4	On ligne	M40- Data Driven: Bloc 7 - Letsgrow	
16	Friday	16/02/2024	LetsGrow	4		M40- Data Driven: Bloc 7 - Letsgrow	
17	Saturday	17/02/2024					

March 2024

N	DAY	DATE	Institution	HV	PLACE	TRAINING MODULE	SPEAKER
1	Friday	01/03/2024	LetsGrow	4	AGADIR	M40- Data Driven: Bloc 7 - Letsgrow	
2	Saturday	02/03/2024	LetsGrow	4			
3	Sunday	03/03/2024					
4	Monday	04/03/2024					
5	Tuesday	05/03/2024					
6	Wednesday	06/03/2024					
7	Thursday	07/03/2024	WUR	4	AGADIR	M45- Harvest & post-harvest management: Bloc 7 - WUR	Rene van Oostwechel
8	Friday	08/03/2024	WUR	4			Rene van Oostwechel
9	Saturday	09/03/2024					
10	Sunday	10/03/2024					
11	Monday	11/03/2024					
12	Tuesday	12/03/2024					
13	Wednesday	13/03/2024					
14	Thursday	14/03/2024	LetsGrow	3	On ligne	M40- Data Driven: Bloc 7 - Letsgrow	
15	Friday	15/03/2024	LetsGrow	3			

4 Conclusions

Reflecting on the agreement at the basis of the final phase of this project we have to conclude that we had been once more too optimistic. The fact that the greenhouse has not been operating until now has made impossible to attain all that seemed reasonable early in 2022. Nevertheless, we think that a lot has been achieved and that we were able to lay the ground work to achieve the original twin scopes of this project:

- improve the productivity of Moroccan greenhouse horticulture
- contribute to making the Dutch greenhouse supply industry instrumental in this process. The Dutch HortiXS constructed the greenhouse and a Dutch head grower is appointed to manage the greenhouse which will result in more products for The Netherlands being implemented for the operation of the greenhouse.

Specifically about the four “deliverables” as listed in the introduction:

1. The research program has been discussed with the staff of the Centre. Appointments have been made about implementation, through the appointment of dedicated PhD candidates. A more detailed outline of the individual topics also was agreed upon.
2. Some topics for initial research projects have been agreed upon as well. Unfortunately the greenhouse has not yet been in operation this year since there was no grower present. The first trials will start in spring 2024.
3. Two short courses for the students have been successfully provided and it has been agreed that short courses from Wageningen scientists will become a recurring item in the educational offering of the Complexe Horticole d’Agadir.
4. We did attend two workshop with the staff of the CHA and few local stakeholders. The delay in the greenhouse operation prevented a successful workshop aimed at farmers. Nevertheless, all appointments have been made to ensure that a first edition of a “farmers’ training” will be held at the beginning of 2024. Teaching practical knowledge where the Demo-research greenhouse will be instrumental will also help in improving marketing outlook for the Dutch greenhouse supply industry.

Thanks to the extremely prolonged timeline the project has been successful. A very good cooperation has been established between Wageningen and the Complexe Horticole d’Agadir, which will continue well after this project. Setting up partnership takes time. During this time also ideas evolve, where they become more realistic and also financially feasible. The center in Agadir managed in the end to obtain proper finances the construct the greenhouse by the Dutch HortiXS. And they also managed to arrange financial means to extend the number of courses provided by Wageningen UR. We should learn the lesson that the initial timeline of the project was extremely unrealistic (even without COVID). Nevertheless, the greenhouse foreseen has been established and will be put into operation as a part of the Complexe very soon. This all will contribute to enhancing the horticultural sector of Morocco, which will be beneficial for the outlook of the Dutch supply industry.

Annex I 1st workshop (March 2022)

Visit report of Jouke Campen to the region of Agadir, Morocco



The picture shows the current (14-03-2022) of the construction of the center. The steel construction is present and well as the glass for the covering of the greenhouse.

AI.1 Centre of Excellence in Horticulture (CEH)

At the Complexe Horticole in Agadir a new centre of Excellence is going to be established.

The aim of the visit of Jouke Campen to the centre was to:

1. See the site where the center of excellence will be established
2. Have a discussion with the staff of the center on the operation of the center
3. Assess the current staff and research facilities already present



Near the centre also a new building is constructed which will host incubator companies. The picture above shows the inside of the new building.

On the 15th of March Jouke met with various professors working at the center on different subjects.

Staff of the centre

Dr. Younnes Elfellah (researcher in the Energy and Farm Machinery Department at IAV Hassan II and his PhD student Reda Errais. They are involved in different subjects:

- Climate control using CFD modelling
- Using of solar heat collection system for heating
- Artificial intelligence based on which they want to control the greenhouse climate.
- Sensors and imaging.
- Applied physics, energy efficiency, IoT, IA, Greenhouses, Automatism, supervision, modalisation, environnement, embedded system

These subjects can be aligned with the research done at the new facility where climate control is one of the topics. Reda Errais seems eager to learn so maybe he can be in the operational staff of the center since he almost finished his PhD. This will be discussed with dr. Farid (director).

Prof. Mohamed Sarehane, Specialist on IPM. He also is involved in work on insects for feeding animals and fertilizer. IPM is also one of the main topic for the center. His group has a quite some students so they can assist in the research as well.

Prof. Achmed Aitoubahou, Specialist in post-harvest and plant physiology.

Prof. Mimoun Mokhtari, Specialist in floriculture.

Meeting with the students of the center

A meeting was organized with the students in which Jouke presented the work done at other centers of excellence around the world, and specially addressed how students contribute to the work.

The students seem to speak well English and are very eager to learn how to do part of the study with Wageningen University. For PhD candidates Jouke explained the admission criteria that are clearly indicated on the website of Wageningen University (www.wur.nl). An exam needs to be done before a PhD can start. As a second phase the PhD candidate needs to write their PhD proposal. If the proposal is approved the PhD candidate can start. For master students the criteria are present which are also outlined on the website.

AI.2 General assessment

Agriculture is a major industry for the region of Agadir. The lack of water is becoming a major issue as rainfall is minimal in the last years (not during Jouke's presence!). For this reason the Moroccan government has established a desalination plant in this region. The plant is now in operation supplying the city of water. Agriculture will also be supplied from this plant. The cost of water will be 5 DH/m³ (0.50 EURO/m³) whereas the actual cost of production is 10 DH/m³. So the water will be subsidized by the government. Yet most growers cannot afford even the subsidized price. Now growers pay around 2.3 DH/m³ which is the cost to pump the water from the well with a depth of 250 meters usually. So the price will be double. The manager of the company Quality Beans (Van Oers United) told that he can only produce cherry tomato and raspberry with this price of water.

So increasing the water use efficiency (more crop per drop) is the only way the agricultural sector can survive in this region. The center of excellence should address this by optimal use of the irrigation water and at the same time increase the productivity.

Dutch companies

Various Dutch companies are active in the region. We visited a farm where Koppert supplies the bumblebees as well as biological control. So for IPM there is a market for the Dutch industry although the competition is also present. Fertigation (nutrient supply and irrigation) is also a field where Dutch industry can contribute. Automated irrigation based on the weather conditions and the status of the crop will be needed to improve the water use efficiency and the production. Dutch industry provides this technology although here as well competition is present.

Requirements for centre of excellence

The founding objectives of the Centre of Excellence in Horticulture Agadir (CEH) are:

- More efficient use of water resources
- Increased productivity, quality and sustainability
- Improved know-how of (present and future) managers and growers
- CEH is expected to become the national reference platform for research and innovation in the issues related to protected horticulture in Morocco
- A showcase demonstration for the transfer of sustainable greenhouse technology to producers of the Region

The research topics which can be identified in this stage and relate to the objectives of the center are:

- Substrate research. Soilless culture with recirculation of drain saves on water and nutrients. A sustainable and economical substrate is demanded. Assessing local materials, like date palm waste, as a substrate material demands research.
- Reuse of drain water. Drain coming from soilless systems needs to be treated before it can be reused as irrigation water. The treatment can be a research topic.
- Climate control. Temperature, relative humidity, light level, CO₂ are all parameters effecting the production. The greenhouse is equipped to evaluate all these parameters.
- Crop management. Crop handling has a major influence on the production.
- Pest and diseases. Already the center has experience on IPM. This knowledge can be enhanced by the research under the conditions which can be set in this greenhouse facility.

AI.3 Possible involvement of Wageningen UR

Different forms of cooperation are possible.

1. Presence in scientific committee

The scientific committee of the center should decide which projects are done in time based on the research agenda and project proposals submitted. The committee will also evaluate the ongoing research. WUR can be part of this committee. The presence can be remotely or at the centre or a combination. If the committee meets 4 times per year, WUR will spend approx. 10 days per year on this involvement (depends on the location, and whether it can be combined with other activities).

2. Involvement in the research

At the centre different experiments will be conducted on the fields of interest. The experiment is done by a local researcher/student who makes an initial project proposal. WUR can support the local researcher in setting up a project proposal which is to be evaluated by the scientific committee. Once granted WUR can assist during the experiment in the field of gathering data, analyzing, reporting. Time spend by WUR is estimated to be 1 day per 2 weeks.

3. Training sessions for the benefit of farmers and horticulture companies in Souss Region

The center aims to do research directly applicable for farmers. The research done at the center should therefore be transferred to the farmers. This can be done by open days and to the point publications. WUR has experience in transferring scientific knowledge to the farmers. This knowledge will be used. Twice a year a farmers day can be organized. 10 days will be the involvement of WUR.

4. Academic training

The WUR scientists are expected to provide training courses in Horticulture to CHA students. These courses should cover the latest development in horticulture sector including: Irrigation and Fertilization, Climate management, crop management, Crop protection and post harvest management. WUR can provide such courses based on the summerschool (<https://www.wur.nl/en/show/Summer-School-Greenhouse-Horticulture.htm>), providing more depth where useful/required. Time needed is two days preparation and one week in Morocco per course.

5. Organization of conferences and congresses

The Center aims to organize 5 international congresses over 5 years (one congress or workshop per year). These events are important to inform the different stakeholders about the programs of the Center of Excellence and disseminate the results of research. WUR can be support in the agenda, the contacts with IHS (International Society of Horticultural Science), forming the scientific committee, general organization. Preparation is estimated 20 days/congress. Before and during the event, 10 days/congress.

6. Doctoral training and research

The scientific research program will be implemented in the form of specific PhD projects with a joint supervision of WUR and the CHA professors. "Sandwich" PhD is suggested as a possible cooperation. A PhD candidate will start his PhD at WUR, and get a PhD title [also] from WUR. Then part of the research will be done in Marocco in the CEH. In the final stage the PhD candidate spends at WUR again. <https://www.wur.nl/en/education-programmes/phd-programme/funding-your-phd/wgs-sandwich-phd-programme.htm>. The number of PhD candidates will determine the budget required. The call for the WGS sandwich PhD programme opens once per year, usually in spring. The calls are published on the above website. The WU sandwich scholarship is a personal grant. The grant of the WGS sandwich PhD programme covers living allowance for a total of 18 months in Wageningen, (partial) travel costs of candidate and WU/local supervisors, visa application costs and use of facilities.

The selection of PhD candidates is crucial. The criteria will be shared by WUR. If no funding from WUR is required, a sandwich PhD can be considered as well, outside the limit of three bourses. The quality requirement is no less. The candidate must prove that she/he has sufficient funding for 18 months in The Netherlands (presently 1305 €/month). Whenever a candidate is enrolled for a WUR Phd (whatever the form) there will be a go/no go evaluation after the first year.

Co-Supervision of candidates for an exclusively Moroccan PhD title can also be done by WUR personnel. For a PhD candidate with WUR, the supervision budget is around 50 k€ over four years. For co-supervision of a CHA PhD candidate it could be about 25 k€ over 3 Years.

7. Operation of the center

The center of excellence demands a staff for the operation of the facility and a research staff. Given the size of the center and the experience with other center of excellence we think the operational staff required consisted of at least 1 manager, 5 engineers and 8 workers (crop handling). The tasks of the engineers will be:

- Technical maintenance of the facility. Keep all the equipment in running condition. Order spare parts.
- Controlling the system (climate control and fertigation control). This settings will be based on the research proposal.
- Crop handling, instructing the workers in all phases of the crop development (sowing, germination, transplanting, pruning, twisting, leaf picking, harvesting etc.)
- Resources supply. Seeds, nutrients, substrates, working equipment, cropping wires, sticks, pest control etc. For every trial a list of resources is provided which is to be order by the operational team.
- Prepare fertilizers and keep the stock solution.
- Find a market for the products including the packaging and delivery.

AI.4 Next steps

In the first year after the establishment of the center the main focus will be on testing and commission the installation and the operational staff. In general it takes at least one year to resolve all the issues which are presented when starting up a new facility. Still in this period already small trials can be done.

In terms of management the following steps should be taken:

- Outline a research agenda for the coming years.
- Formulate joint research projects for the first years which fit into the research agenda
- Set a date and outline for course (academic training)
- Agree on which involvement of WUR in the center

Funding

The research staff and operational staff needs to be hired for the center. A budget should also be allocated for the resources demanded. Wageningen managed to extend the funding of the initial project, which means there is a budget of 65kEURO available till end of 2023 for some activities to be done by Wageningen staff. These activities include the formulation of the research program, assist in two initial research projects, provide one academic training and participate in two workshops.

Annex II Research Agenda

AII.1 Framework

The overall objective of the Centre of Excellence in Horticulture (CEH) is to facilitate the transition of the regional greenhouse horticulture towards a business model that couples increased rural income (higher productivity and value of product) and climate robustness, to a reduced environmental impact (higher water use efficiency and less emissions). That is: both productivity and sustainability of commercial practice must be improved. The CEH can be a main actor in facilitating the transition, through a combination of research, education and outreach, focused on transition paths. The topics relevant at farm level were identified during a workshop with local stakeholders:

1. Water and fert-irrigation management, with the goal of saving water and decreasing leaching
2. Climate management particularly to increase productivity and robustness to climate change
3. Crop protection (integrated pest management) with the goal of residue-free product and reduced pollution
4. Crop management, with the goal of improving quality and productivity.

With new horticultural production systems in Agadir, there is a need for change as well in the ecosystem of supporting firms around the production companies. New/different inputs will be required and different/higher quality fruit and vegetables will be produced. Therefore different/additional markets need to be reached, and supply chains need to be reconfigured, internationally. At the same time there is a need to find new, sustainable business models that allow smallholders to profit, in spite of the modified environment.

The synergistic actions of research, education and demonstration/outreach, is shown in Fig. AII.1.

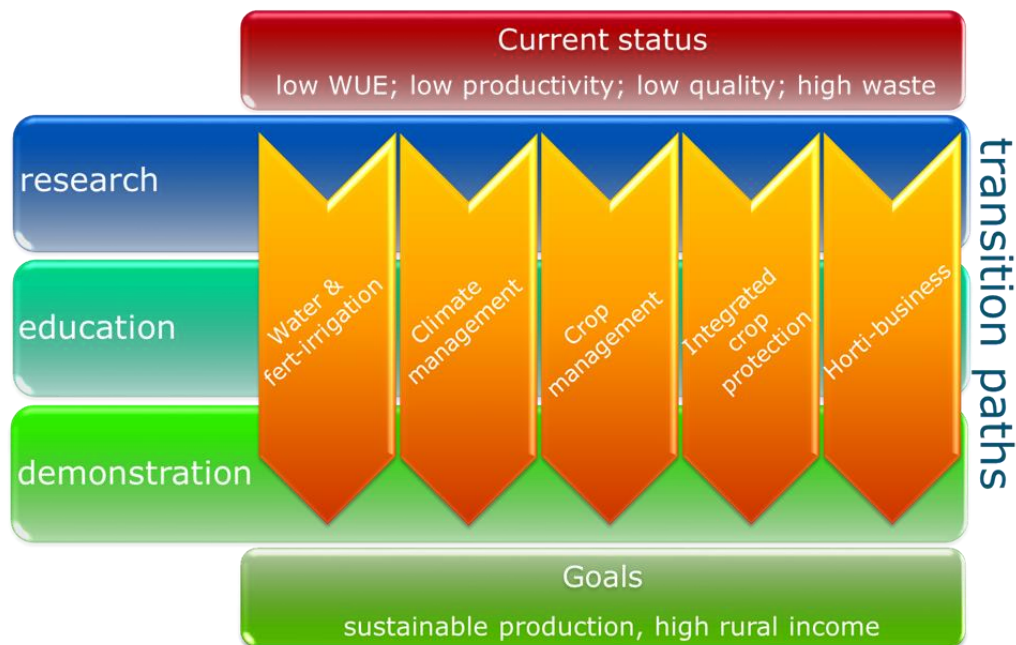


Figure AII.1 Schematic representation of the transition process of Moroccan horticultural production at farm level, showing both the paths along which transformation takes hold, the topic and means involved.

The research should start with major innovations by which large steps in the development of the sector can be taken before going into the more detailed research projects. Fig. AII.2 contains an example of how the development of research could be carried out in time, for selected themes. Identified relevant research projects, are listed in the following sections, split on theme and on level. We expect that to cover a research programme exceeding 5 years. Therefore there is a need to select and prioritize, which could be one of the task of the Scientific Committee of the CEH, in cooperation with local stakeholders.

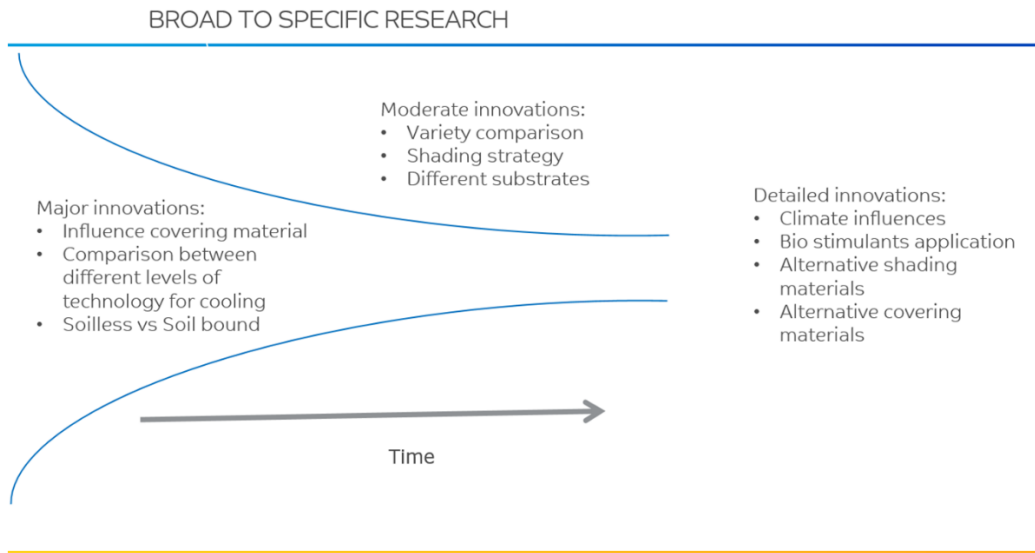


Figure AII.2 Schematic representation of progress in time of research topics. This example relates to climate and irrigation management.

The Centre of Excellence in Horticulture is an ideal combination of education (which is the statutory function of the Complex Horticole d’Agadir, the host of the CEH) with research and outreach, which are facilitated by the new greenhouse facility containing both compartments dedicated to research and compartments more suited to demonstration.

Therefore, the most straightforward implementation of the foreseen research → demonstration → implementation path (and the one that was put forward by the Moroccan side) is to identify projects that are suitable for theses at all levels: that is BSc (traineeship reports), MSc and PhD. Traineeship reports and MSc theses should have a relevant “demonstration” component, that is: results could/should find fast application in current practice, whereas research projects for PhD theses should deal with more strategic/long term themes. In particular, BSc and most MSc thesis projects should be implemented (when applicable) preferably in the Demo compartments of the greenhouse facility and should analyse/evaluate directly applicable technologies for growers as well as advanced technologies and management methods. On the other hand, research projects for PhD theses should deal with more strategic/long term themes, the experiments usually being implemented in the Research compartments of the greenhouse facility, and research results should be suitable for publication in scientific platforms.

In fact, a strong emphasis must be laid on the transition to more sustainable production systems and products at regional scale. This means that sustainability (triple P) in all forms must and will be incorporated in the programme. Besides that, an effective (and fast way) to introduce additional topics in the current educational offering of the CHA is to plan thematic seminars and/or short courses at all three levels, to be held by external experts, that could become a [yearly] recurring feature until a deep revision of the current education programmes has taken place, possibly in cooperation with external parties and stakeholders.

Each item (bullet) in the following sections represents a specific experiment, to be carried out by one or more students, under the daily supervision of a local tutor and the participation of a WUR staff. A PhD programme must be the logical combination of a number of specific topics/experiments, possibly “embedding” MSc theses. We propose that once a topic (or combination of topics) has been selected, the student(s), and the supervisors agree on:

1. Goal and expected outcome of the study
2. Experimental set-up or set-up of desk-study
3. Execution protocol and check-points
4. Method to be applied for the analysis of results
5. Means for publication of results

A document detailing these agreements must be produced prior to the start of the experimental part of the research.

AII.2 Water and fert-irrigation

Irrigation water for the whole region is coming from reservoirs and wells at increasing depth or from a desalination plant at a price deemed non-feasible. There is a need to reduce water use, drastically and fast. This means reduced leaching, which has the additional advantage of reducing pollution caused by leaching of fertilisers.

On a long term, the application of closed loop irrigation (most easy on soilless culture) will become necessary. Besides the accompanying management, automation and disinfection issues, water quality may become the limiting factor, as any salt will accumulate in the closed loop. An additional factor in reducing water use may be the introduction of new crop/and varieties requiring less irrigation.

On a shorter term, “smart” irrigation may reduce water use and emissions. We believe that increasing grower awareness of water use and its consequences will contribute to an overall reduction of water application. Proposed research projects:

Irrigation strategies and soilless cultures	BSc	MSc	PhD
Demonstration	<ul style="list-style-type: none"> • Quantify water use (and water saving) in closed system • Quantify nutrient use and nutrient saving in closed systems • Application of root-zone sampling 	<ul style="list-style-type: none"> • Irrigation scheduling and drain properties • Substrate properties and basic irrigation scheduling (in combination with APEFEL) 	<ul style="list-style-type: none"> • Emissions and environmental evaluation
Research	<ul style="list-style-type: none"> • Implementation of irrigation scheduling • Monitoring emissions 	<ul style="list-style-type: none"> • Management of closed systems (Quality of water and water use) • Growing systems for new crops • Irrigation recipes for new crops 	<ul style="list-style-type: none"> • Effect of two mineral nutrition programs on soilless tomato grown under controlled climate conditions in the greenhouse • Closed systems and bottlenecks to implementation: salinity, water use vs yield and quality

AII.3 Climate management

In order to secure (and increase) rural income, there is the need to increase productivity, quality of produce and robustness to weather and to climate change.

As most income is generated by the winter production for export, the short term goal is to evaluate and demonstrate affordable improvements to the winter climate (energy screens and ventilation management). The longer term goal is to evaluate new crops and effect on productivity and quality of more complex climate management means (carbon dioxide supply, heating and artificial light), to enable an economic and environmental evaluation. A list of possible projects:

Climate management	BSc	MSc	PhD
Demonstration	<ul style="list-style-type: none"> Controlled ventilation Energy screen and night-time temperature Air circulation and leaf temperature Roof cleaning 	<ul style="list-style-type: none"> Energy screen and winter production Temperature with and without controlled ventilation (in combination with APEFEL) 	<ul style="list-style-type: none"> Comparative effect of natural ventilation and shade materials on tomato growth and production under greenhouse
Research	<ul style="list-style-type: none"> Set-points of ventilation Air circulation management 	<ul style="list-style-type: none"> Energy screen and heating Humidity management with screen and air circulation New crops 	<ul style="list-style-type: none"> Combined effect of CO₂ and artificial light on tomato production during the winter period Effects of temperature, light intensity and some agronomic factors on bumblebees activity and tomato production under greenhouse conditions

AII.4 Crop protection

Relevant issues to guarantee farmer income and more sustainable production are: decreasing the incidence of residues, increase resistance to [new] pests, introduction of biological control and prevent emission of chemicals.

Short-term goals are the reduction of application of chemicals and limited introduction of biological crop protection (IPM). On the longer term, widespread application of biological control, introducing several natural antagonists and stimulating by natural means the resilience of the greenhouse environment will become necessary. Proposed research projects:

Crop protection	BSc	MSc	PhD
Demonstration	<ul style="list-style-type: none"> Scouting-based application of chemicals 	<ul style="list-style-type: none"> Blue-print application vs scouting 	<ul style="list-style-type: none"> Advanced blueprint IPM (multiple species per pest) Banker Systems
Research	<ul style="list-style-type: none"> IPM application (single BCA per pest/disease) 	<ul style="list-style-type: none"> Blueprint IPM (interaction multiple species/synergy) 	<ul style="list-style-type: none"> Beneficial fungi and microbial consortia to enhance the defence of tomato plants against biotic (pests and pathogens) and abiotic (reduced water) stress agents Use of aromatic and medicinal plants extracts in IPM strategies to control moth borer (<i>Tuta absoluta</i>) and whiteflies (<i>Bemisia tabaci</i>) Response of pests (<i>T. absoluta</i> and <i>B. tabaci</i>) and their natural enemies (predators and parasitoids) to fertigation treatments

AII.5 Crop management

Much stands to be gained from a knowledgeable crop management, both in terms of productivity and quality. The short term goal is to make growers aware of the value of proven management techniques and methods. The long term goal is to develop crop management techniques that are best suited to the particular local conditions and, possibly, to new crops. Possible initial research projects:

Crop management	BSc	MSc	PhD
Demonstration	<ul style="list-style-type: none"> Truss pruning 	<ul style="list-style-type: none"> Effect of plant density on production of winter crops 	<ul style="list-style-type: none"> Evaluation of different substrates media on soilless tomato growth and production
Research	<ul style="list-style-type: none"> Crop monitoring 	<ul style="list-style-type: none"> Leaf picking and humidity management Management of new crops 	<ul style="list-style-type: none"> Source/sink balance: management of temperature Improving light use efficiency of winter crops

AII.6 Entrepreneurship and Management

With new horticultural production systems in Agadir, there is a need for change as well in the ecosystem of supporting firms around the production companies. New/different inputs will be required and different/higher quality fruit and vegetables will be produced. Therefore different/additional markets need to be reached, and supply chains need to be reconfigured, internationally. While the high-end of horticultural production of fruit and vegetables will change, the large number of small farmers will need to find new business models that allow them to earn a good and stable living while feeding the local population, in spite of the reduced water use levels, and more environmentally sustainable production. For these farmers to reach scale in production and marketing, cooperatives with a proper governance structure are a possible solution: what structure works, and why, in Agadir?

The experience, knowledge and skills built up in Agadir is intended to be leveraged across Northern Africa and the Middle East; international expansion like that needs to find a balance between standardization of model to be exported and catering to local circumstance.

Entrepreneurship and management	BSc	MSc	PhD
Demonstration	<ul style="list-style-type: none"> Changing horticulture business environment 	<ul style="list-style-type: none"> Strategic positioning in a dynamic horticulture business environment 	<ul style="list-style-type: none"> What are the knowledge and skills required to improve competitiveness of sustainable businesses in horticulture
Research	<ul style="list-style-type: none"> Changing Agrifood supply chains 	<ul style="list-style-type: none"> How do different demands on agrifood supply chains impact smallholders' (collective) competitive position? New requirements for horticulture: new products, new markets, new chains, new partners 	<ul style="list-style-type: none"> Internationalizing Agadir commercial-sustainability experience in N-Africa, MME. Intervening on the Agadir ecosystem for enhanced sustainability & competitiveness

Annex III Course on crop and climate management

Teachers: Cecilia Stanghellini, Wageningen UR Glastuinbouw and Ep Heuvelink, Wageningen University - 22 November – 26 November 2022



The course was attended by the 11 first-year students of the Master on Water and Sustainable Agriculture.

NOM & PRÉNOM	BACKGROUND
Aslemani Ahmed	BA in life sciences cellular and molecular biology Diploma of packaging and promotion of agricultural products
Benabouhe Nada	BA technical sciences in applied vital biology Deust in biology chemistry and geology
Fatima Zahra Kasimi	BA in valorization of local products Packaging and valorization of agricultural products
Smına Fadma	B A in environmental modeling and management Diploma of commercial technician in horticultural production
Hanane Ougazdamou	B A in environmental modeling and management Diploma of commercial technician in horticultural production
Soufiane Delaamour	BA in valorization of local products Packaging and valorization of agricultural products
Keltoum Benghrib	Diploma of management of agricultural and agri-fod companies Diploma of commercial technician in horticultural production
Khalid Ait Adda	BA of sciences and techniques plants biotechnology
Said Ben Ali	BA in laboratory sciences and technologies Diploma of bio-industrial engineering
Oumayma El Mahraoui	B A in environmental modeling and management Diploma of commercial technician in horticultural production
Mouad El Kaouri	B A in environmental modeling and management Diploma of commercial technician in horticultural production

Day1—Tuesday 22 Nov 2017			
<i>Introduction to Protected Horticulture</i>			
8:30-10:20	Cecilia Stanghellini	Lecture	Global trends and Critical success factors
10:20-10:40	SMALL BREAK coffee/tea		
10:40-12:30	Cecilia Stanghellini	Lecture	Sun Radiation: spatial and spectral distribution; units of measure of radiation; radiation sources other than the sun
12:30-14:30	LUNCH		
14:30-16:20	Ep Heuvelink	Lecture	Growth and development: from light interception to yield
16:20-16:40	SMALL BREAK coffee/tea		
16:40-17:30	Ep Heuvelink	Lecture	Yield component analysis
17:30-18:30	Heuvelink/Stanghellini	Joint discussion	
Day2—Wednesday 23 Nov 2022			
<i>Light in a greenhouse</i>			
8:30-10:20	Ep Heuvelink	Lecture	Plant growth: the role of light
10:20-10:40	SMALL BREAK coffee/tea		
10:40-12:30	Cecilia Stanghellini	Lecture	Thermal radiation exchanges
12:30-14:30	LUNCH		
14:30-16:20	Cecilia Stanghellini	Lecture	Functions of the greenhouse cover & new developments (transmissivity, diffusion, spectral selection, thermal radiation, heat conductance)
16:20-16:40	SMALL BREAK coffee/tea		
16:40-17:30	Heuvelink/Stanghellini	Exercise	Computer calculations - LUE model
17:30-18:30	Heuvelink/Stanghellini	Joint discussion	
Day3—Thursday 24 Nov 2022			
<i>Temperature management</i>			
8:30-10:20	Cecilia Stanghellini	Lecture	Energy balance and greenhouse temperature: effect of the properties of the cover
	Heuvelink/Stanghellini	Exercise	Effect of energy/shadow screen on greenhouse temperature
10:20-10:40	SMALL BREAK coffee/tea		
10:40-12:30	Ep Heuvelink	Lecture	Plant growth: the role of temperature
12:30-14:30	LUNCH		
14:30-16:20	Cecilia Stanghellini	Lecture	Ventilation and temperature management
16:20-16:40	SMALL BREAK coffee/tea		
16:40-17:30	Heuvelink/Stanghellini	Exercise	Ventilation requirement in given conditions, ventilation vs whitewash
17:30-18:30	Heuvelink/Stanghellini	Joint discussion	
Day4—Friday 25 Nov 2022			
<i>Crop physiology and Crop Management</i>			
8:30-10:20	Ep Heuvelink	Lecture	Plant growth: the role of humidity and CO ₂
10:20-10:40	SMALL BREAK coffee/tea		
10:40-12:30	Ep Heuvelink	Lecture	Biomass partitioning based on relative sink strength
12:30-14:30	LUNCH		
14:30-16:20	Cecilia Stanghellini	Lecture	Carbon dioxide and humidity management
16:20-16:40	SMALL BREAK coffee/tea		
16:40-17:30	Ep Heuvelink	Lecture	Plant growth: the role of drought and salinity
17:30-18:30	Heuvelink/Stanghellini	Joint discussion	
Day5—Saturday 26 Nov 2022			
<i>Lighting and optimal management</i>			
8:30-10:20	Ep Heuvelink	Lecture	Supplementary lighting in greenhouses
10:20-10:40	SMALL BREAK coffee/tea		
10:40-12:30	Cecilia Stanghellini	Lecture	Optimal climate management: economy
12:30-14:30	LUNCH		
14:30-16:20	Cecilia Stanghellini	Lecture	Optimal climate management: sustainability
16:20-16:40	SMALL BREAK coffee/tea		
16:40-18:30	Heuvelink/Stanghellini	Joint discussion and wrap-up	

Photos of the greenhouse research facility in November 2022



Annex IV Course on Soil, Water & Fertilisers

*Docenten: Tommaso Barbagli en Wim Voogt, Wageningen UR Glastuinbouw
6 maart – 10 maart 2023*

Het seminar omvatte 4 ½ lesdagen en werd gegeven in een van de leslokalen van het CHA. Het lesrooster bevatte vier blokken per dag (zie volgende pagina), waarbij er dagelijks minimaal een uur of soms meer was ingeruimd voor groepsopdrachten en zijn er twee excursies gemaakt. Er werd ook een practicum gehouden op het lab over bodemfysica. Elf studenten van de Mastercourse Horticulture waren alle dagdelen aanwezig. Omdat er slechts een vage indruk was van de voorkennis, waren we voorbereid op improvisatie van het lesrooster en de inhoud. Improvisatie bleek echter meer nodig dan verwacht, door langere duur excursies, groepswork maar ook door het lagere kennisniveau.

AIV.1 Inhoud

De cursus werd begonnen met een Kahoot-quiz, met een aantal eenvoudige vragen om wat los te komen en enigszins het niveau te peilen. Dit laatste doel is niet helemaal gehaald, vanwege onbekendheid met dit fenomeen (!), maar gaf wel de nodige onderlinge interactie en droeg bij aan een goede sfeer. De inhoudelijke lessen werden vormgegeven vanuit powerpoint presentaties, waarbij af en toe gerichte vragen werden gesteld aan de studenten. Tijdens het seminar zijn de volgende onderwerpen behandeld: Plantenfysiologie (water- en nutriënten opname en transport); Nutriënten; Fysische, chemische en biologische eigenschappen (bodem en groeimedia); Water (kwaliteit, behandeling, irrigatie); Meststoffen, (chemie, eigenschappen, berekenen van receptuur); Grond- en substraat analyse, aanpassen van receptuur; Management van bemesting.



Niveau

De insteek van het niveau van de stof was afgerond HBO. Dit bleek te hoog gegrepen. Basiskennis van de plant bleek bij de meesten aanwezig, chemie was voor sommigen echt lastig, maar ook fysica. Ook de verschillen tussen de studenten in basiskennis waren groot. Om die reden is de stof gedurende de cursus aangepast en zijn delen niet behandeld of sterk vereenvoudigd.

Interactie met studenten

De verwachtingen over de input, zoals vragen vanuit de studenten waren niet al te hoog. Verrassend genoeg waren er regelmatig vragen, ook tijdens de lessen. Ook de vraagstelling van onze kant aan de studenten tijdens de lessen gaf een bevredigende respons. Het viel ook op dat er tussen de studenten veel op elkaar werd gereageerd over de stof. Daarnaast waren er een aantal die vaak aan het einde van de les of in de pauze een nadere uitleg vroegen.

Day	block	Topic	time	
Monday 6 March 2023	morning session 1	Introduction basic principles of plant nutrition and crop fertilisation Basics of soils and soil physics Organic matter, texture, the soil matrix	08:30	10:30
	break		10:30	10:45
	morning session 2	Water in the soil, water retention lab: group practicum soil and substrate physics / water retention	10:45	12:30
	lunch break		12:30	14:30
	afternoon session 1	Basics of plant physiology Roots, root functions water and nutriënt uptake; transport and distribution	14:30	15:45
	break		15:45	16:00
	afternoon session 2	Special: Ca uptake and distribution group assignment about plant physiology	16:00	17:30
Tuesday 7 March 2023	morning session 1	Recurrence of yesterday lessons Nutrients; their functions and typical aspects Excursion to Grower Atlantis Agri	08:30	09:30
			09:30	15:00
	lunch break		15:00	15:30
	afternoon session 1	Water need of plants/ transpiration Water sources, water quality, Irrigation methods, irrigation scheduling and strategies / management Salinity part 1 group assignement about irrigation and water related issues	15:30	17:30
Wednesday 8 March 2023	morning session 1	Recurrence of yesterday lessons Salinity part II Water treatments Filtration and disinfection water saving	08:30	10:30
	break		09:45	10:00
	morning session 2	Growing media, specific properties: physical, chemical, biological implications for the practical application Soil analysis, Soil fertility management	10:00	12:30
	lunch break		12:30	14:30
		Basics of chemistry: ions, salts, acids, bases, fertilisers Nutrient management ECD and pH	14:30	16:00
	break		15:00	15:30
		excursion to greenhosue facility at CHE	15:30	16:30
	afternoon session 2	Basic principles of fertilisation Group assignment soil - soilless	16:30	17:30
Thursday 9 March 2023	morning session 1	Recurrence of yesterday lessons Nutrient management anions Nutrient management cations	08:30	10:30
	break		10:30	10:45
	morning session 2	Calculation of nutrient solution recipes principles group assignment: calculation of fertiliser recipes	10:45	12:30
	lunch break		12:30	14:30
	afternoon session 1	Nutrients; their functions and typical aspects (micro nutrients) Micro nutrients Special: Iron chelates	14:30	16:00
	break		16:00	16:15
	afternoon session 2	group assignement: fertilisers	16:15	17:30
Friday 10 March 2023	morning session 1	Recurrence of yesterday lessons Fertiliser recommendation and adjustment Calculation of nutrient solution recipes: specific topics	08:30	10:00
	break		10:00	10:15
	morning session 2	Group assignment nutrient recipe calculation: example grower Miscellaneous Wrap up and evalaution	10:15	12:30

Groepswerk

Vier groepjes werden gevormd van 3 (2) studenten. Groepsopdrachten werden dagelijks gegeven gerelateerd aan de stof van die dag. Dit bestond soms uit toepassings- of verdiepingsvragen over de stof en wat berekeningsopdrachten. Het resultaat werd klassikaal besproken, waarbij de groepen elkaars antwoorden konden becommentariëren. Dit leverde vaak levendige discussies op. Men bleek wel veel tijd nodig te hebben om de vragen te beantwoorden.

Practicum

Een practicum is uitgevoerd op het lab om de fysische eigenschappen te demonstreren (bulkdichtheid, waterhoudend vermogen, textuur, enz.) van drie verschillende soorten local soils. De interactie meten tussen studenten was succesvol en gewaardeerd. Wel blijken sommige studenten flink wat moeite te hebben voor simpele algebraïsche berekeningen. Een uitgebreidere sessie met teeltmedia kon helaas niet plaatsvinden, omdat de zending met substraatmaterialen niet was aangekomen.



Excursie

Een excursie is gemaakt naar een kas van Atlantis Agri, ten Zuid van Agadir, (Aït Boutareb), die produceert voor het Franse bedrijf Azura. In totaal 65 ha tomaten, deels in kasgrond deels in kokossubstraat. Dit inhoudelijk zeer succesvol, er was veel interactie met de rondleiders van het bedrijf. Wel moest af en toe de regie genomen worden om de vraagstelling wat gericht naar de cursus te leiden. Organisatorisch kan hier wat verbeterd, met name het tijdsbeslag door het transport.



De tweede excursie naar de in aanbouwfase verkerende kas op het complex van CHA was een doorslaand succes. De studenten keken hun ogen uit naar de moderne kasconstructie en installaties. Opvallend was dat – voor ons basale zaken – als buisrailsysteem, hoge draad, verhoogde goten etc. voor hen volslagen nieuw was. Er werden heel veel (goede) vragen gesteld.



AIV.2 Praktische zaken

Wat was goed:

- Studenten zeer gemotiveerd
- Groepswerk ging betrekkelijk goed en viel in de smaak
- Excursies naar kas en bedrijf waren positief gewaardeerd
- Goed om er met twee personen te zijn
- Personeel en studenten erg vriendelijk en behulpzaam
- Lokaal en faciliteiten goed genoeg
- Lunch in cafetaria op de campus is voldoende en snel
- Studenten handelen adequaat op verzoeken voor ondersteuning

Wat kan beter

- Niet alle studenten op tijd
- Inhoud van het programma te hoog niveau
- Inhoud van het programma te intens:
- Achtergrondinformatie van de student te beperkt (d.w.z. basischemie en algebra)
- Niveau Engels van sommige studenten vrij laag
- Te veel improvisatie op het programma (bezoek teler last minute, doos met media niet geleverd, bodemonsters last minute verzameld, lab beschikbaarheid last minute, nog dia's voor te bereiden/aanpassen, hand-outs en praktische oefening last minute besloten).
- Op tijd verzenden van substraatmateriaal voor demo en practicum
- Bezoek aan de teler kostte te veel tijd (9:00-13:00)
- Hotel (ALMOGGAR) niet adequaat: matig ontbijt, geen bureau op de kamer, geen wifi in de kamer) en vooral Hotel te ver (40 min ochtend, 60 mi middag)
- Ondersteuning tijdens de dag (voorziening koffie /thee, of water)

Aanbevelingen voor een eventueel vervolg:

- De cursisten vooraf van materiaal voorzien om te lezen
- Het programma beperken, vereenvoudigen of de duur verlengen van de cursus
- Organiseer de excursie van tevoren, maak het indien mogelijk dichterbij de campus
- Hotel dichterbij de universiteit, liever geen vakantieresort

voor onszelf:

- Practicum goed voorbereiden, zorgen dat materialen er zijn (tijdig opsturen), instructies op papier zetten evenals uitwerking opgaven.
- Meer uren om de cursus voor te bereiden (50-60 uur in totaal, 40 nu)
- Langer tevoren het materiaal klaarmaken (dia's, practicum, oefening).
- Programma meer structureren
- Inhoud nog eens kritisch bezien: wat is relevant voor Marokko. Grondteelt is nog altijd veruit het belangrijkste teelmedium, maar soiless heeft wel de belangstelling.

Demonstration greenhouse

De kas in aanbouw is een aantal malen bezocht en bekeken. Helaas was er niemand te vinden van de CHA die inhoudelijk iets kon toelichten over de status, noch betrokken was bij de bouw en ontwikkeling of de implementatie. Wel is een naam genoemd van degene die aangesteld is als greenhouse manager, maar is nog niet in dienst (Hazis Rachmani). Meer details waren niet bekend bij de degene die wij gesproken hebben. De kas en de technische ruimtes lijken vrijwel gereed. De kascompartimenten zijn volledig ingericht met kweektafels dan wel goten of alleen gronddoek. Er is geen compartiment direct voor grondteelt. In



een kas zonder goten ligt gronddoek, dit zou dan verwijderd of open gesneden moeten worden. Druppelbevloeiing is ook nog niet geïnstalleerd. Water-, Mest- en Fert-irrigatie installaties staan op hun plaats en lijken waterzijdig allen aangesloten alleen de elektrotechnische aansluitingen zijn kennelijk nog niet klaar. De klimaatcomputer was nog niet aanwezig, wel is de computerruimte met bediening-PC klaar. Overige technische ruimtes, zoals de verwerkingsruimte en personeel moeten van binnen nog afgewerkt. Elektrotechnisch is een en ander nog niet klaar. Apparatuur als buisrailkarren, ontsmettingsluis e.d. zijn aanwezig.

Punt van aandacht: De kas is klaar, maar er is geen ventilatie. Dit betekent dat het de komende weken steeds warmer kan worden in de kas. Dit kan desastreus zijn voor de (kunststof)materialen. Helaas was er niemand bereikbaar met enige verantwoordelijkheid. Inmiddels is dit via de NL contacten aangekaart. Met de studenten is wat gebrainstormd over mogelijke relevante projecten voor onderzoek en demonstratie. Helaas biedt de inrichting van het kascomplex weinig tot geen mogelijkheden voor teeltkundige vergelijkingsproeven met behandelingen rondom irrigatie of bemesting. Voor proeven met teeltmedia is dat beperkt, omdat er geen verschillende irrigatieregimes of aangepaste voedingsoplossingen mogelijk lijken te zijn. Dit zal hooguit voor proeven met een hoog demonstratie -gehalte. De afdelingen met tafels bieden echter wel mogelijkheden voor proeven op kleinere schaal. In het kader van de Mastercourse zouden hier prima experimenten kunnen worden uitgevoerd ter ondersteuning van het onderwijs (Internship, Thesis). Uiteraard zijn ook de grotere kascompartimenten prima geschikt voor internships gericht op crop management.

Foto's van het complex in Maart



Annex V Announcement of the farmer's training

Farm Manager

PROGRAMME

108 H Stratégie et performance financière

1. Management stratégique
2. Environnement macro économique
3. Comptabilité managériale
4. Gestion budgétaire
5. Calcul et analyse des coûts
6. Contrôle de gestion
7. Choix des investissements et de financement
8. Droit fiscal
9. Tableau de bord et indicateurs de performance

144 H Posture managériale & Pratiques RH

1. Développement & efficacité personnelle
 - Développer son intelligence émotionnelle et gagner en confiance
 - Communiquer efficacement et gérer les conflits
 - Organiser son temps et gérer son stress
 - Gérer efficacement les réunions
2. Management & Leadership
 - Manager son équipe au quotidien
 - Développer son leadership et conduire le changement
3. Gestion administrative du personnel
 - Droit du travail
 - Gestion de la rémunération
4. Relations sociales
 - Gestion des relations sociales
 - Gestion des situations de crise

72 H Gestion des opérations

1. Supply Chain Management
 - Gestion de la chaîne logistique
 - Gestion des opérations (stock, entreposage...)
 - Processus de la supply chain
2. Politique d'achats
 - Stratégie achats
 - Choix des fournisseurs
 - Négociation - Achats
 - Achats - Responsables
3. Management de la qualité
4. Méthode de résolution de problèmes

96 H Marketing et développement commercial

1. Stratégie Marketing & Commerciale
2. Marketing digital
3. Techniques de vente et négociation commerciale
4. Globalisation de l'environnement des affaires
5. Réglementation et commerce international
6. Droit des affaires

128 H Technologie en horticulture sous serre et gestion des cultures

1. Contrôle du climat
2. Irrigation et nutrition des plantes
3. Entretien des cultures et lutte intégrée
4. Agriculture pilotée par les données
5. Gestion de la récolte et post-récolte

90 H Entrepreneuriat et innovation digitale

1. Entrepreneuriat et business models
2. Transformation digitale
3. Système d'information
4. Gestion de projets innovants
5. Intelligence artificielle et Big Data
6. Responsabilité sociétale d'une entreprise agricole

88 H Programme de leadership international

1. Comportement de leadership
2. Lean et organisation des flux de travail
3. Management / gestion de la main-d'œuvre
4. Management / gestion des performances
5. Management commercial, marketing et marchés
6. Management stratégique
7. Séance de certification

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SCAN ME

To explore
the potential
of nature to
improve the
quality of life



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