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A Master of Science (MSc) in Climate Change, Sustainable Agriculture, and Food Security

Vassilios Makrakis,¹ Nelly Kostoulas-Makrakis,² Manal Hefny,³ Ibrahim Al-Tahat,⁴ Omar Ramzy,⁵ and Ahmed Al-Salaymeh⁶

Introduction

Climate change projections for the Middle East and North African (MENA) region indicate warmer and drier conditions with increased frequency of natural disasters (Karami, 2019; Rajsekhar & Gorelick, 2017; Waha et al., 2017). The population of the Arab countries has nearly tripled since 1970 and is expected to double again by 2050 (United Nations, 2009). Coupled with high rates of urbanization, this will necessitate severe changes in food production and supply (Abou-Hadid, 2014; Jobbins & Henley, 2015; World Food Programme, 2015). For a region that is already facing many social and economic stresses, climate change and food insecurity are likely to exacerbate current problems, leading to large-scale instability (Elasha, 2010; Ministry of Foreign Affairs, 2018; United Nations, 2017).

A thorough review of studies focusing on Egypt and Jordan show shortages of people who have higher skills in niche areas related to the impact of climate change on agricultural sectors and food production

(Al-Bakri et al., 2013; International Labour Organization, 2018). In particular, there is evidence of need for highly specialized scientists in the field of climate change, sustainable agriculture, and food security (CCSAFS).

A needs analysis based on a survey of 305 professionals in the field of CCSAFS showed that the demand for scientists with expertise in the agriculture/food sector is likely to increase in the next decade. More specifically, it showed that there are skill shortages in areas of expertise such as plant and crop breeding, plant physiology and pest management, large animal physiology and health, soil science, and horticulture. There is also a need to bridge the gap between researchers, advisers, and farmers; make climate change-related information more accessible and relevant to the local actors; improve information and knowledge sharing among key stakeholders; give a voice to groups and individuals who are often excluded; and strengthen local empowerment and the ability to self-organize in response to CCSAFS.

In response to these challenges, the development of new and specialized programs that draw on climate change, sustainable agriculture, and food security has been seen as an immediate priority that fits governmental commitments and policies in both Egypt and Jordan. Such policies are also in accordance with these countries' commitment to the UN agenda of SDGs (The Hashemite Kingdom of Jordan, 2015; United Nations Development Programme, 2018).

The initiative for proposing the development of a Master's of Science (MSc) program in CCSAFS originated at the University of Crete where a consortium of eight universities in Egypt and Jordan, two universities in Europe (University of Padova, Italy, and Frederick University, Cyprus), and two NGOs (the SEKEM Foundation in Egypt and the RCE Crete in Greece) were formed. In cooperation with all partners, the University of Crete prepared an application for the development of an MSc Program in CCSAFS in Egypt and Jordan and submitted it to the Capacity Building

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for Higher Education sector under the European Commission Erasmus plus program. The application was accepted and funded for the period 2016-2019.

The impetus for developing the MSc in CCSAFS came primarily from: 1.) the challenge of finding ways for climate change resilience and adaptation to respond to the needs identified for the agricultural sector and food security in the targeted countries; 2.) the declared commitment of the partner institutions in the CCSAFS Consortium; 3.) the need to fill the gap in skills in the field of CCSAFS; and 4.) the absence of any similar MSc Program in the MENA region.

The Program

Design Phase (October 2016–June 2017)

In the design phase, the consortium further elaborated their initial needs analysis through the development and implementation of a mixed-method multi-stakeholder approach (Makrakis & Kostoulas-Makrakis, 2016). This process gave voice to those usually excluded from the curriculum development, for example students, professionals in the field of CCSAFS, and key experts in academia and in the community/industry.

The MSc program in CCSAFS was implemented in Egypt and Jordan and more specifically at Suez Canal University (Egypt) and Jerash University (Jordan) with the support of the CCSAFS Consortium, which was led by the University of Crete (Greece) and the participation of Aswan University, Al Azhar University, and Heliopolis University (Egypt), and the University of Jordan, Jordan University of Science

and Technology, and Mutah University (Jordan). In the CCSAFS Consortium there were also two NGOs: RCE Crete and SDF/SEKEM.

Course curriculum development in Egypt and Jordan is usually a top-down process focusing on the skills of experts in the field and those who are going to implement the curriculum or study program. For the CCSAFS MSc program, a multi-stakeholder curriculum development methodology was adopted to include students, professionals and representatives from the community, and the public and private sectors.

In March 2017, a survey was delivered online to professionals in the field of CCSAFS. In addition, 50 key local experts were interviewed to elicit useful knowledge for designing the MSc curriculum. At the same time 45 members of the teaching staff were trained to be involved in the design, development, and implementation of the MSc in CCSAFS. Feedback from professionals interested in the subject is very important in curriculum design and development. External stakeholders' reflect a wide range of experiences in the field and enhance the participatory approach in course curriculum development, making curricula more relevant to the real needs.

The 305 survey respondents (31% Egyptians and 69% Jordanians) were asked to rate the importance of 27 potential courses which had been formulated on the basis of a thorough review in the relevant literature in the field of CCSAFS. Each respondent used a 5-point Likert-type scale to rate their choices for the titles of the courses listed (where 1 = Strongly Disagree and 5 = Strongly Agree). Table 1 shows that professionals in the field of CCSAFS mostly preferred

courses oriented toward merging climate change, sustainable agriculture, and food security along with courses oriented toward local issues relevant to CCSAFS, especially as core courses (average mean score 4.4 and SD .62).

These results reflect the fact that every society, especially in developing countries, is unique in terms of areas of weakness, opportunities offered, challenges, strengths, and aspirations of their citizens. This was illustrated by the professionals' preferences to localize the MSc curriculum in order to address specific needs and challenges facing their local societies. The results also showed that cross-disciplinary connections, interrelationships, and interactions between different fields of knowledge were mostly preferred for the choice of the courses. The core courses with the lowest ratings were those related to consumer behavior, genomics and genetics, risk analysis, and GIS (Geographic Information Systems), with an average mean score 3.6 and SD 0.65.

The second survey distributed in class was targeted to final-year undergraduate students in the consortium partners' faculties of agriculture. In total, 682 students responded to the survey (49% Egyptians and 51% Jordanians) with a 80% response rate. Students were asked to select and rate the frequency of the pedagogical methods used by their instructors. (See Table 2.) This information was considered very important in identifying gaps and designing capacity building for teaching staff who were adapting their methodologies to be more suitable to the MSc in CCSAFS. Among the instructional methods found to be dominant, lecturing (as expected) was the most prevalent (mean 4.0, SD 1.0), while role play, hands-on-sciences, problem-based

Table 1. Professionals' Responses to the Importance of Prospective Courses in Designing the MSc Program

Prospective Courses to Be Rated	Professionals' Rating Scale					Mean (SD)
	Strongly Disagree %	Disagree %	Neutral %	Agree %	Strongly Agree %	
Small-Scale Farming, Indigenous Knowledge, and Local Food Supply	3	6	27	31	33	3.8 (1.0)
Ethics in Agricultural Production	5	7	17	26	45	4.0 (0.84)
Irrigation Management and Water Resources	1	1	13	25	60	4.4 (1.0)
Integrated Pest Management, Sustainable Agriculture, and Food Security	-	2	11	27	60	4.4 (0.76)
Sustainable and Ethical Livestock Management	3	9	30	29	29	3.7 (1.0)
Climate Change, Sustainable Agriculture, Nutrition, and Health	1	2	14	32	51	4.3 (0.82)
Climate Change, Sustainable Agriculture, and Local Food Security	1	2	14	31	52	4.3 (0.85)
Research Methods and Advanced Statistics Analysis	3	4	24	26	43	4.0 (1.0)
GIS for Agro-Environmental Studies	2	6	32	34	26	3.7 (0.97)
Genetics and Genomics in Sustainable Agriculture	4	11	27	31	27	3.7 (1.0)
Agri-food Supply Chains, Market Awareness and Strategy	3	6	33	33	25	3.7 (0.99)
Food Processing and Preservation	3	9	23	31	34	3.8 (1.0)
Economics of Sustainable Agriculture and Food Security	3	5	22	37	33	3.9 (0.99)
Agro-Ecosystem Services and Sustainability of Farming Practices	4	7	32	36	21	3.6 (1.0)
Sustainable Grassland Systems and Food Security	3	7	33	34	23	3.7 (1.0)
Sustainable Home-Grown Feed, Climate Change, and Food Security	1	5	29	42	23	3.8 (0.88)
Consumer Behavior, Food Security, and Marketing	3	8	32	31	26	3.7 (1.0)
Risk Analysis in the Food Chain	3	6	26	35	30	3.8 (1.0)
Food Quality Control and Community Nutrition	-	7	27	30	36	3.9 (1.0)
Agri-Food Value Chains	3	9	40	25	23	3.5 (1.0)
Social Entrepreneurship in the Organic Food Industry	3	17	37	27	16	3.3 (1.0)
Post-Harvest Supply Chain Management	4	10	31	35	20	3.5 (1.0)
Climate Change Adaptation and Mitigation	1	6	19	32	42	4.0 (0.98)
Climate Change, Poverty, and Food Security	1	5	20	33	41	4.0 (0.96)
Sustainability, Justice, and Food Security	4	12	36	29	19	3.5 (1.0)
Sustainable Management of Soil and Water	1	6	15	30	48	4.2 (0.93)
Sustainable Livestock, Fisheries, and Food Security	3	6	27	27	37	3.9 (1.0)

learning, enabling learning technologies, case studies, field work, and extra-curricular activities were rated between 3.0 to 3.1 and *SD* 1.1.

Students were also asked to rate the importance of certain skills or competences, such as the 10Cs (an extension of the 4Cs model). The 10Cs are also referred to as transversal skills or competences, and include:

communication, collaboration, critical thinking, creativity, critical reflection, critical consciousness, co-responsibility, connectivity, cross-intercultural understanding, and construction of knowledge. Among the 10Cs, creativity and innovation, followed by collaboration and cross-cultural understanding, were rated as the most critical skills to be integrated into the development of the

CCSAFS master course curriculum (average mean 4.5, *SD* 0.56).

The lowest rated courses were those of critical consciousness and critical reflection (average mean 2.8, *SD* 0.52) while the skills/competences of constructing knowledge, co-responsibility, and connectivity were rated in between the two. Similarly, among the learning competences, learning to

Table 2. Assessment of Teaching Methods

Teaching Methods	Never	Rarely	Sometimes	Frequently	Very Frequently	Mean (SD)
Lecture	4	5	18	33	40	4.0 (1.0)
Role play	11	19	35	26	9	3.0 (1.1)
Hands-on-based learning	6	14	33	28	19	3.4 (1.1)
Problem-based learning	9	16	35	28	12	3.1 (1.1)
ICT-supported teaching	15	20	29	22	14	3.0 (1.2)
Case study	9	21	36	24	10	3.0 (1.1)
Extra-curriculum service learning	6	12	34	32	16	3.0 (1.2)
Fieldwork	12	20	33	24	11	3.0 (1.2)
Group/peer learning	9	17	35	27	12	3.2 (1.1)
Guest speakers	20	28	24	19	9	2.7 (1.2)
Inter-multi-disciplinarity	6	13	25	41	15	3.4 (1.1)
Participatory learning	9	18	31	32	10	3.2 (1.1)
Project-based learning	13	24	27	25	11	3.0 (1.2)

know and learning to give and share were highly rated as the most critical skills/competences to be integrated into the development of the CCSAFS master course curriculum (average mean 4.6, *SD* 0.57). The lowest rated was that of learning to live together sustainably (average mean 3.7, *SD* 0.65), while learning to be, learning to do, and learning to transform oneself and society were rated in between the two.

In the design phase, particular emphasis was given to the participation of key external stakeholders in the field of CCSAFS. To this end, a semi-structured interview instrument was developed, combining a predetermined set of open questions which allowed the interviewer the opportunity to ask questions that could explore particular themes or responses in a more detailed way. By definition, a semi-structured interview needs to have some structure, but that structure should be flexible enough to allow more depth in the responses during the interview process.

Three colloquia were organized in three different sites where the invited key experts had the opportunity to discuss the questions and issues raised in the semi-structured instrument of focus-group interviewing. The key experts represented agricultural syndicates, local governorates, companies for seed marketing and agricultural projects, the Agricultural Quarantine Authority, Agricultural Research Centres, the Ministry of Agriculture, and directors of agricultural projects. Participants and course curriculum designers and developers all stated that the exchange of knowledge elicited through the colloquia was very important for the participatory curriculum construction process. Some of the external key experts pointed out that, it was the first time they had received an invitation from an academic institution to discuss and provide an opinion on academic programs. Overall, participants also expressed their eagerness to be part of the process. The interviewees pointed to the need for integrating sustainability in agriculture,

livestock and fisheries, modeling, data analysis software, GIS, disaster management, legislation, reports, and protocols dealing with climate monitoring, mitigation and adaptation policies, socioeconomic impacts of climate change on small communities, and adaptation strategies.

Participatory curriculum development, and more importantly, implementing the developed curriculum necessitate the readiness of both developers and instructors. A preliminary needs and readiness analysis revealed that there were significant gaps in skills of both developers and prospective instructors, for example lack of participatory course curriculum design skills and collaborative and interdisciplinary skills. It is worth pointing out that in both partner countries, in most of the cases, the developers were also the prospective instructors of the master courses. The key gaps identified were: new sustainable agricultural technologies, data analysis software (GIS), research and teaching competence, policy and legislation, farm management, water resources management, management of risk and risk assessment, project development and establishment in the field of agricultural production, economics and business in agriculture, and link knowledge and practice.

In filling these gaps, three National Training Workshops (NTW) were organized and delivered during the period of design and development phases. The main purpose of the NTWs was to provide the needed capacity to both course developers and university teaching staff in order to prepare them for involvement both in the design, development, and implementation of the MSc in CCSAFS courses. The agenda of the workshops included sessions dealing with course curriculum planning,

structuring the CCSAFS curriculum, the CCSAFS validation and accreditation procedures, developing the CCSAFS course syllabi and modules, and administration. Other tasks in the NTWs included discussions on how to utilize the CCSAFS stakeholders' survey results and the survey impact on course curriculum development.

In total, 45 CCSAFS academic staff participated in the NTWs. It is worth pointing out that, although the teaching of the MSc relies on academic staff according to the ministerial laws, provisions have been taken to invite leading practitioners in the field of CCSAFS as guest lecturers. Since the MSc Program was developed collaboratively by eight universities, staff involved and trained from these institutions have had the opportunity to function as instructors and/or co-instructors in a number of courses. Collaborative teaching has been also seen as a strategy in the CCSAFS program.

Development Phase (July 2017-June 2018)

During the development phase, the focus continued on capacity building of the teaching staff in: 1.) participatory curriculum development methods using tools such as DeCoRe plus (Deconstruction-Construction-Reconstruction) methodology (Makrakis 2017); 2.) using student-driven and problem-based learning methodologies; and 3.) establishing the appropriate technical infrastructure supplemented with ICT Labs and eToolkits. Particular attention was given to the curriculum development methodologies such as the DeCoRe plus curriculum development tool and the CARE (Conceptualize-Activate-Reflect-Engage) learning design methodology for developing student-driven learning

activities. There were also sessions on teaching/learning methodologies for SDGs in CCSAFS course curricula in line with problem-based learning methodologies as well as practicing on service learning and community-based learning methodologies.

Capitalizing on the previous analyses and interventions, the MSc in CCSAFS was developed in a way that would be attractive, flexible, and modular so as to make it possible for students to choose among electives and to enable the transferability of knowledge to the real world. In Egypt, students could choose either a research orientation or a professional orientation, an option that reflects the societal needs for more practitioners in the field of CCSAFS rather than more graduates who pursue academic studies and/or research.

During development, particular emphasis was given to transversal skills, especially the 10Cs, which apparently had been missed in the field of CCSAFS (Makrakis, 2017; Makrakis & Kostoulas-Makrakis, 2017). In order to support these additional applied orientations, course materials were drawn from a range of disciplines besides CCSAFS, including applications of GIS and remote sensing, statistics, economics of climate change, sustainability justice, social entrepreneurship, risk analysis, and consumer behavior. Some subjects, such as ethics, gender perspectives, and SDGs, were also addressed by crosscutting within their inclusion in multiple units, rather than creating subject-specific units.

The course curriculum was structured with built-in flexibility to allow students to study either full- or part-time, enabling learning to be combined with other activities. There was also a focus on strengthening the is-

sue of agricultural entrepreneurship and employability by giving students the option of undertaking an extended professional placement or practicum in lieu of the more traditional research dissertation.

The course content is modular (Makrakis & Kostoulas-Makrakis, 2012); each course consists of five to seven modules running from one to three weeks, depending upon the content. Each module contains a title, key concepts, an overview, aims, learning outcomes, units, readings, and activities. A module structure is especially important in the blended learning environments that are the basis for CCSAFS. The consistent structure of the course modules allows students to save time because they know what is expected and what to anticipate. Thus they can more deeply focus on the content and student-driven activities based on the CARE methodology (Kostoulas-Makrakis & Makrakis, 2020).

The MSc in CCSAFS program consists of compulsory and elective courses ranging from five to 10 ECTS each (Tables 3 and 4). To qualify for the MSc in CCSAFS, a total of 120 ECTS (European Credit Transfer and Accumulation System) are needed. Of the 120, 90 ECTS account for the courses in the first three semesters and 30 ECTS are awarded for the thesis during the fourth semester. The ECTS is a tool of the European Higher Education Area for making academic programs and courses more transferable and transparent. This enables higher education students to move between countries that have adopted the ECTS so that their academic qualifications and study credits are recognized within the EU.

During development, there was an attempt to satisfy the demand for

Table 3. MSc in CCSAFS, Suez Canal University, Egypt

Course Code	Course Title	ECTS
Compulsory Courses		
CSAF801	Climate Change: Adaptation and Mitigation	8
CSAF860	Applications of GIS and Remote Sensing	8
CSAF802	Sustainable Management of Soil and Water	8
CSAF880	Statistics and Design and Analysis of Biological Experiments	7
CSAF803	Economics of Climate Change	7
CSAF820	Sustainable Livestock Management	7
CSAF870	Applications of Biotechnology in Sustainable Agriculture	7
CSAF890	Social Entrepreneurship in the Organic Food Industry	7
CSAF875	Sustainable Fisheries and Food Security	7
Elective Courses		
CSAF830	Sustainability Justice of Food Security and Climate Change	5
CSAF835	Small-Scale Farming and Local Knowledge	5
CSAF840	Risk Analysis in Food Chain	5
CSAF845	Precision Farming	5
CSAF850	Consumer Behavior, Marketing, and Food Security	5
CSAF855	Environmental Governance	5

Table 4. MSc in CCSAFS, Jerash University, Jordan

Course Code	Course Title	ECTS
Core Courses		
604 710	Climate Change, Sustainable Agriculture, and Food Security	10
604 712	Climate Change: Adaptation and Mitigation	10
604 718	GIS Applications in Climate Change, Sustainable Agriculture, and Food Security	10
603 719	Sustainable Management of Soil and Water	10
604 716	Economics of Climate Change, Sustainable Agriculture, and Food Security	10
604 714	Research Methods and Advanced Statistics Analysis	10
Elective Courses		
604 726	Sustainability Justice and Food Security	10
604 722	Small-Scale Farming, Indigenous Knowledge, and Local Food Supply	10
604 728	Social Entrepreneurship in the Organic Food Industry	10
604 723	Risk Analysis in the Food Chain	10
604 724	Precision Farming	10
604 720	Consumer Behavior, Food Security, and Marketing	10
604 727	Sustainable and Ethical Livestock Management	10
604 721	Sustainable Fisheries and Food Security	10
604 725	Unsaturated Soil in Arid and Semi-arid Regions	10

inter/multidisciplinary content for the MSc program by combining aspects from the fields of climate change, sustainable agriculture, and food security. The result showed some slight differences in the programs at Suez Canal University in Egypt and Jerash University in Jordan, reflecting country differences.

The distribution of soil in both Egypt and Jordan closely follows the climate and topography. Jordan, in contrast to Egypt, is dry, semi-arid, and arid, characteristics that inevitably have an impact on the range and intensity of desertification. Thus, in the MSc program in Jordan a special course focusing on unsaturated soil in arid and semi-arid regions was included. Another difference in Egypt and Jordan concerns the number of electives and the weight of the courses measured through ECTS. These differences are more of a reflection of preferences of the teams and institutional decision makers involved in the development and accreditation of the MSc programs in each country and less on specific country differences.

Accreditation and Implementation (September 2018-October 2019)

During this phase, the MSc in CCSAFS were validated internally and fully accredited by the corresponding Higher Commissions for Accreditation in Egypt and Jordan. The validation was implemented at two levels—institutional and national. At the institutional level, all syllabi and course modules were peer-reviewed by the key staff participating in the CCSAFS project, especially from the University of Padova, the University of Crete, Frederick University, and an external evaluator. The program was also assessed by the Suez Canal

University and Jerash University Accreditation Committees.

After approval by the university committees, an application was sent to the Higher National Accreditation Committees in the respective countries where each committee reviewed all courses, conducted visits and interviews on the university sites, and finally approved the MSc in CCSAFS in both countries. Upon approval, open calls were sent to invite student applicants. During the pilot and implementation phase, 44 students (29 in Jordan and 15 in Egypt) registered in the accredited MSc program in CCSAFS.

Evaluation Phase (Cutting across All Phases)

Throughout the design, development, and implementation phases, diagnostic, formative, and summative assessments were carried out. Evaluation was approached as an integral part of the planning throughout the process. At the beginning stages, evaluation was handled through the situation analysis, which continued during development through peer reviewing (internally and externally), and ended when accreditation, the pilot, and full implementation were completed. The evaluation methods included: self-assessment, peer assessment, and impact studies to measure the effectiveness of the MSc in CCSAFS curriculum.

Assessment and Discussion

The initial expectations for the incoming students were about 20. Besides attending the courses during the first two semesters, students were placed for practicum in the SEKEM (SDF) Holding, including agricultural and food industries for doing their research and/or undertaking

an extended professional placement. A Centre of Excellence (CoE) focusing on CCSAFS was established at each partner institution. The evaluations showed that the MSc in CCSAFS had a positive impact on students' skills and abilities as well as their self-esteem and confidence. A summary of key results indicated the following:

- Students exhibited good understanding and interpretation of concepts related to the courses implemented.
- Students were able to give clear feedback about their knowledge regarding key concepts in the implemented courses.
- Students valued the courses implemented because of the opportunities offered to merge theory with practice.

To ensure the best possible program for both students and stakeholders, a layered approach was adopted at the student level, the institutional level, and the national/regional/European and international level.

At the Student and Instructors' Levels

The formative assessment showed that the development of the CCSAFS MSc through the participation of students, professionals in the field of CCSAFS, and local key experts from the private and public sectors was very decisive. Students placed for research and/or undertaking an extended professional practice in the SEKEM Foundation and Holding of agricultural and food industries offered feedback at all stages of the project, and their input was used as a resource at each stage. Students were highly satisfied with the practicums for helping them gain relevant knowledge and skills.

Instructors trained for the CCSAFS project reported that their training enabled them able to apply innovative curriculum in their teaching practices, which they could easily transfer to other academic contexts. Staff satisfaction assessments showed that training workshops and training materials were significant predictors of the effectiveness of the training.

In general, the trained staff were equipped with new skills and knowledge in the field of CCSAFS that proved to be very critical throughout the development and implementation of the MSc in CCSAFS. More specifically, the training had a positive influence on curriculum development as instructors applied new skills and methods, such as: participatory or negotiated interdisciplinary curriculum; infusing a blended learning perspective; and problem-based learning. Besides the readiness of the teaching staff to successfully implement the MSc in CCSAFS, the trained staff have become good resources within their institutions, which could potentially lead to the modernization of the partner countries' institutions through quality teaching.

At the Institutional Level

The establishment of a Centre of Excellence (CoE) focusing on CCSAFS at each partner university is expected to play a pivotal role not only in promoting the CCSAFS program, but also in supporting the integration of sustainability concepts in multiple academic fields. In general, the CoE can:

- Enhance academic cooperation within and between academic faculties as well as academic institutions, not only those that participated in the CCSAFS program.

- Raise awareness about the importance of interdisciplinary and cross-disciplinary development of university curricula.
- Address national policies and needs in relation to climate change and sustainable development goals (SDGs).
- Empower academics in developing further the concept of joint academic teaching that was realized through the development and implementation of the CCSAFS course curriculum.
- Promote further the development of the blended learning modalities, especially in the post-Covid-19 era.

At the National/Regional/European and International Level

The CCSAFS project has brought a number of changes. For one, it enhanced the spirit of joining hands in tackling national priorities and societal needs. Aligning the MSc in CCSAFS course curriculum with the ECTS, the partner universities in Egypt and Jordan increased their internationalization profile. Also, bringing together academics from the two partner countries and the three European program countries had a positive impact on cultivating cross-cultural communication skills and competences. In addition, academic cooperation and knowledge transfer contributed to building further inter-institutional cooperation.

There is, however, a need to consider and plan inter-agency coordination mechanisms at university, community, district, national and regional levels to better handle issues on CCSAFS. The planned inter-country student practicum needs to be

put in practice so that it can further promote regional and international cooperation.

Conclusion

The theme treated in this project is quite a niche, both in Europe, the two partner countries, Egypt and Jordan, and the MENA region in general. Indeed, amongst the most pressing needs on the EU and Mediterranean agenda is addressing sustainable agriculture and food security amidst climate change. Globally, various universities either offer a master's degree on climate change and/or a degree that combines agriculture and food security. For example, a degree that is similar to the MSc in CCSAFS is the MSc in Climate Change, Agriculture, and Food Security offered at the National University of Ireland. Another similar MSc program that combines Sustainable Agriculture and Food Security is offered by the Universities of Edinburgh and the Royal Agricultural University, both in the United Kingdom.

The CCSAFS course curriculum development was driven by a transformative pedagogy perspective; it was assumed that knowledge developed through active engagement of key stakeholders would lead to enhanced inter/cross-disciplinary integration and societal relevance. The MSc program was designed to create conditions in which students could apply their knowledge to real-life situations and in which they could feel in charge of what they learn. The program was also designed to allow both instructors and students to actively worked together on themes that reflect local and global issues related to climate change, sustainable agriculture, and food security. It was assumed that

these methods would ultimately foster personal engagement among students, meaningful learning, and knowledge and skills that would be more easily transferred to other circumstances.

The MSc in CCSAFS was built on a modular structure and is envisioned to play a significant role toward the implementation of the UN Agenda for SDGs. The scope of the project was oriented toward a flexible framework for higher education curriculum reform, and harmonization with the European Higher Education area. It is expected to generate and encourage further cooperation among the partners involved, the region, and globally.

Participatory and collaborative curriculum design among the CCSAFS partners in Egypt and Jordan positively affected the development of the interdisciplinary and multidisciplinary master's program. In particular, the academic staff involved did not only develop competences and ownership in developing curricula, but they also learned the processes because they were involved in the co-design of curricula and recognized the impact that such competences have on their professional development.

During this process, it also became clear that professional development through participatory and multidisciplinary collaborative curriculum design influences academic teachers' knowledge and practice with consequential impacts on the implementation of curriculum change. In addition, the active involvement of multidisciplinary academic staff in collaborative curriculum design can improve the harmonization of the

formal and the enacted curriculum. This is consistent with similar previous collaborative curriculum experiences (Voogt et al., 2016). The project also showed that such active involvement can only be effective when the involved staff feel the need to adopt changes in their curriculum design perspectives and teaching practices. Such paradigm shifts become stronger when the involved staff are convinced that their efforts will bring about positive changes.

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