Tuning Africa

Design and Implementation of Degree Programmes in Agricultural Sciences

Kamleshwar Boodhoo (Editor)

Phase II

Design and Implementation of Degree Programmes in Agricultural Sciences

Tuning Africa Project Phase II

Design and Implementation of Degree Programmes in Agricultural Sciences

Kamleshwar Boodhoo (Editor)

Authors:
Kamleshwar Boodhoo, Yemi Akegbejo-Samsons,
Olubunmi Abayomi Omotesho, Ahmed Elamrani,
Taky Hortense Atta Diallo, Mariama Sene, Christopher Mubeteneh Tankou,
Rashid A.M. Hussein, Henri R. Mloza-Banda, Esther Sakyi-Dawson,
Bonaventure Minani, Randriany Jean Baptiste Ramaroson

2018
University of Deusto
Bilbao

The Tuning project is subsidised by the European Commission
This publication reflects only the opinion of its authors. The European Commission may not be held responsible for any use made of the information contained herein.

Editor: Kamleshwar Boodhoo

Authors: Yemi Akegbejo-Samsons, Olubunmi Abayomi Omotesho, Ahmed Elamrani, Taky Hortense Atta Diallo, Mariama Sene, Christopher Mubeteneh Tankou, Rashid A.M. Hussein, Henri R. Mloza-Banda, Esther Sakyi-Dawson, Bonaventure Minani, Randriany Jean Baptiste Ramaroson

Cover design: Fotocomposición IPAR, S.Coop. (Bilbao)

© Deusto University Press
P.O. box 1 - 48080 Bilbao
e-mail: publicaciones@deusto.es

ISBN: 978-84-16982-65-3

Content

Preface

The harmonisation of higher education in Africa is a multidimensional process that promotes the development of an integrated higher education space on the continent of Africa. The objective is to achieve collaboration across borders, sub-regionally and regionally, in curriculum development, educational standards and quality assurance, joint structural convergence, consistency of systems as well as compatibility, recognition and transferability of degrees to facilitate mobility. Harmonisation is necessary for achievement of the African Union vision of integration, peace and prosperity.

Tuning Africa was adopted as a possible instrument to advance the African Union's harmonisation agenda, in collaboration with the EU through the Joint Africa-EU Strategy. Implementing a second phase of Tuning was one of the commitments taken at the 2014 Africa-EU Summit in 2014 in Brussels, as a follow-up to the very successful pilot phase which took place between 2011 and 2013.

At the November 2017 Africa-EU Summit in Abidjan, Heads of State committed to deepening their collaboration and exchange in education, aiming at increasing the employability of young people bearing in mind that investing in youth and future generations in Africa is a prerequisite for building a sustainable future. In this context, further concrete initiatives in the field of higher education which aim to enhance relevance and the quality of education and training will be encouraged.

By contributing to the harmonisation of higher education in Africa, Tuning Africa is complementing Erasmus+, the Intra-Africa academic

mobility programme and the Nyerere scheme; thereby enhancing the mutual recognition of academic qualifications and facilitating exchanges and mobility of students and staff across the continent and with Europe. This is instrumental for acquiring key skills and competences that are important for employability, facilitating collaborative research addressing common challenges, and for ensuring relevant and quality education. The dialogue on credits and a common credit system for Africa is another major deliverable for Africa. All these initiatives are in line with the Continental Education Strategy for Africa as well as Africa's Agenda 2063 which calls for an education and skills revolution.

Tuning Africa has provided a platform for dialogue on quality assurance and the improvement of teaching, learning and assessment in higher education. Bringing together academia and employers, and importantly in this second phase, the active involvement of students, has been crucial. The success of Tuning Africa has been the involvement of a critical mass of universities and stakeholders, the ownership and commitment of all involved, as well as a transparent and credible leadership.

The AUC and EC are grateful to all the African and European experts involved in the production of this book, which is an outcome of the Joint Africa-EU Partnership Harmonisation and Tuning Africa 2 initiative.

African Union Commission and European Commission

Chapter 1

Introduction

Kamleshwar Boodhoo[1]

1.1. Definition of the Agricultural Sciences Area

Agricultural Sciences is a multidisciplinary field that encompasses components of biological, environmental, economic and social sciences that are used in the management of natural resources for the sustainable production of food, fibre and increasingly fuel. Agriculture covers the cultivation of crops and rearing of animals, including their transformation into useful products for human consumption. Agriculture is now increasing concerned with the sustainable management of productive resources for generating economic, social and environmental value (UNESCO, 2008; Acuna *et al.,* 2013; QAA, 2016).

1.2. Importance of Agriculture in Africa

Agriculture plays an important role in the socio-economic development of most African countries. A high percentage of the people of Africa depend on agriculture as a source of livelihood. This sector contributes the highest percentage of the gross domestic product (GDP) of most developing countries. Indeed, agriculture provides about 70 per cent

[1] University of Mauritius, Reduit, Mauritius.

of employment and 30 per cent of the Sub-Saharan gross domestic product (AGRA, 2017; World Bank, 2013a).

Agriculture is also an important foreign exchange earner in the continent. It provides the raw materials for many industrial processes. And yet, though it has the potential to be an agricultural power, a combination of low productivity and an inadequate policy framework make Sub-Saharan Africa (SSA) the world's most food-insecure region (Saghir, 2014). Agricultural production in Africa has not been able to keep pace with modern developments. At present, farmers in Africa often still work with rudimentary tools and employ age-old technologies (Adenle *et al.*, 2017). They have little exposure to modern technological developments and education that can enable a more skilled exploitation and preservation of their natural resources (World Bank, 2013b).

1.3. Types of Degree Programmes in Agricultural Sciences

In Africa, higher education in Agriculture is mostly offered in Faculties or Colleges of Agriculture of many universities, although a few specialised universities are exclusively dedicated to agriculture. Agricultural education is also offered at polytechnics and other higher Colleges of Agriculture where higher diplomas in Agriculture are offered (UNESCO, 2008; World Bank, 2007).

In the participating Universities, higher education courses in agriculture are offered in the first, second and third cycles in these institutions, usually leading to the award of a diploma, bachelor/licence, or master's degree (MSc/MPhil) or a PhD in Agriculture and its related fields. The degree varies in names, lengths and final qualifications. The length of courses varies between 8 and 12 semesters, with 10 being the most common. The duration of the first-cycle programmes varies from 3 to 5 years, while for second-cycle programmes it's varies between 1 and 2 years, while completing the PhD may vary from 3 to 5 years depending on the specific country and university. A typical first cycle programme offers a broad-based training for the first two or three years and may offer specialisation in a particular area of Agriculture (e.g., Animal Production) occurring in the final year of the bachelor's degree programme. In all programmes, there are practical lessons in almost all course units/modules.

Although there are variations in the agricultural degree content of the universities, most of them have several units/modules that are essential

for the training of an agricultural graduate. In some cases, the Faculties dispensing agricultural degrees also run programmes in Fisheries, Food Production and Technology and other related agricultural related areas (e.g. Crop Protection). In some Universities, the programmes are designed to ensure that students undertake a compulsory practical training/placement in either private or public agricultural enterprises/ institutions. The length varies from 3-12 months. In some universities, final-year students undertake a research work under the supervision of an academic staff over 2 semesters.

Usually, a typical degree programme in Agricultural Sciences is designed to develop the knowledge and skills required to manage agricultural enterprises, carry out agricultural research, and provide advisory work and other fields relevant to agriculture. Graduates from Agricultural degree programmes will have a thorough understanding of crop and animal production methods and their underlying scientific, economic and business principles for the production of safe food in a sustainable manner.

1.4. Agricultural Curriculum Reform and Modernisation

Among the challenges facing Africa today is the need for African agricultural graduates and professionals to work effectively with rural farmers, and to bring innovation in agricultural practices based on the skills and competences that they have acquired in their various institutions (World Bank, 2007). It is with this belief that the challenge of food insecurity can be solved if agricultural graduates help them to transform traditional agriculture through development of new methods, processes and systems to address real-issues facing agriculture and agribusinesses; and their sustainability across the continent.

On the African continent, there is a consensus on the need to shift from merely fit-for-purpose to creative models of agricultural higher education that make agriculture attractive to young people while creating impact in rural communities and serving the needs of industry (Salm *et al.*, 2013) Training that presents farming as a lucrative business along the agri-food value chain and attracts young people to engage was identified as a new paradigm in training that African universities need to adopt (Mulder, 2012; Kumar and Kumar, 2014;

Sherrad, 2017). And the statement made by Sherrad (2017) is very fitting to the task the Subject Area Group in Agriculture —referred subsequently as SAG— has set itself. He stressed that:

> Meeting this challenge will require both significant investments in agricultural higher education as well as profound changes in how universities currently train their students… Too often their academic programs are characterized by a reliance on rote learning, an emphasis on theoretical study at the expense of practical experience, a focus on particular disciplines rather than a more holistic, interdisciplinary approach...

One of the aims of the African Union (AU) Strategy for Harmonisation of Higher Education Programmes is to facilitate mutual recognition of academic qualifications and enable intra-African mobility. It also involves designing curriculum development frameworks to enable comparability and equivalence of competence and learning outcomes in African Universities (Hahn and Teferra, 2013). In 2012, the AU embraced the 'Tuning Methodology' as an instrument of choice for achieving these initiatives in higher education (Tuning, 2012). The Tuning approach is a systematic and consultative process that collaboratively engages internal and external stakeholders led by academics to identify, define and develop competence based curriculum and teaching and learning for students (Gonzalez, 2014; Wagenaar, 2014). It is also worth noting that many Francophone African Universities and those in African and Malagasy Council for Higher Education (CAMES) are also implementing reforms to align their curriculum with the LMD system (CAMES, 2007, 2013). Given the importance of agriculture in Africa and the need for well-trained agricultural scientists to meet the new challenges facing the African agriculture, it was identified as a priority subject area for the Tuning Africa Project (Tuning Africa, 2012). The project aimed at developing a competence based agricultural curriculum and its reference points for the generic and subject-specific competences based on the Tuning Methodology. The results on the generic and subject-specific competences and the meta-profile, the consultation with stakeholders, the student workload and the credit system, development of a revised programme, staff development workshops are presented in this report. They are the fruit of the discussions the members of the group had over the Phase I and Phase II of the Tuning Africa Project.

1.5. Core Elements of Agricultural Studies

Agricultural Studies is an integrated discipline that covers a wide range of scientific and applied disciplines such as animal sciences, soil sciences, among others. Table 1 shows the main disciplines and their core domains as reported by the academics in the subject area group (SAG).

Table 1
Agricultural Disciplines and their Core Domains

Discipline	Core Domains
Animal sciences	Animal biology, zoology, physiology, nutrition, animal health, pasture, genetics and breeding, reproduction,
Plant sciences/ crop sciences/ horticulture	Farming systems genetics, physiology, plant nutrition, seed science, breeding, crop protection, botany, and biotechnology
Soil sciences	Soil biology, soil chemistry, soil physics, soil ecology, soil micro- biology, soil mechanics, soil classification
Agricultural extension	Communication, rural sociology, general agriculture, information management, ICT, anthropology
Food science and technology	Biochemistry, food chemistry, microbiology, processing, food engineering, food safety and quality, food machinery, nutrition and toxicology, food laws and standards
Fisheries and aquaculture	Zoology, fish biology hydrobiology, limnology fish nutrition, aquaculture fish pathology and health, fish quality and fisheries management, preservation
Forestry	Botany, zoology, wood engineering, wood science, wildlife management, ethnoforestry, agro-forestry, sylviculture
Agricultural economics / management	Farm management, marketing, agri-business, agric. Development and policy, micro- and macro-economics, econometrics, biometrics
Agricultural engineering	Irrigation, drainage, farm machinery, farm structures, post-harvest technology, GIS
Agricultural biotechnology	Molecular biology, bio-informatics, genomics bio-ethics, micro-biology, diagnostics
Water resources and agrometereology	Hydrology, climatology

1.6. Types of Occupations for Graduates in Agricultural Sciences

There are a wide range of job opportunities in various sectors of the economy in which an African Agricultural Sciences graduate can find employment, as shown in Table 2.

Table 2
Typical Job Opportunities for Agricultural Graduates in Africa

Diploma	Bachelor/ Licence	Master's	Doctorate
• Farm supervisors • Business • Laboratory technicians • Sales Representatives • Civil service	• Agriculturists • Farm managers • Food processors • Extension Agents • Researchers • Teachers/lecturers • Banking • Consultancy • Civil service • Laboratory technicians • Quarantine officers • Environmentalists • Managers in game, wildlife, forestry, fisheries • Farm technologists • Engineers • Business	• Agriculturists • Farm managers • Food processors • Extension Agents • Researchers • Consultancy • Business • Civil service • Marketers • Managers of game, wildlife, forestry, and fisheries	• Researchers • Lecturers • Consultants • Business • Civil service

They usually work in the private sector, Universities, Government Agencies or may be self-employed. The graduates who are employed by the government agencies (e.g. agricultural research and extension stations) usually carry out research, and provide advisory services to farmers, and manage agricultural projects. In the private sector, the graduates usually will be farm supervisors, sales representatives. There are also many graduates in agricultural programmes who may enter other fields such as banking, and information technology. The multitude of occupations which exists within the sector is also mirrored in the International Standard Classification of Occupations (2012), which list over 100 occupations ranging from low educated subsistence farmer to graduates in the agrifood sector. Thus it is clear that due to

the multidisciplinary nature an agricultural degree, the graduates may find employment in a range of sectors of the economy.

1.7. Member Countries of the Tuning Africa Agricultural Sciences Group

The composition of the Agricultural Sciences Subject Area Group covered the five regions of Africa and the participating universities were:

- Benin Republic: Guillaume Lucien Amadji, Professor of Soil Science, former Vice-Dean, Bonaventure Cohovi Ahohuendo, Professor of Plant Pathology, Sub-Dean, Faculty of Agricultural Science, and Joseph Djidjoho Hounhouigan, Professor of Food Science Faculty of Agricultural Science, University of Abomey-Calavi, Benin.

- Benin Republic: Kohounko Dansou Kossu, Professor of Post-Harvest Technology, Dean of Faculty of Agricultural and Environmental Sciences, Catholic University of West Africa, Benin. (Phase II.)

- Burundi: Jean Ndimubandi, Professor of Agricultural Economics and Dean, Faculty of Agricultural Science at the University of Burundi, Burundi.

- Burundi: Bonaventure Minani, Professor Agro-Economist, Dean of Agronomy and Agribusiness Faculty, Ngozi University, Burundi.

- Cameroon: Christopher Mubeteneh Tankou, Associate Professor, Department of Crop Science, Faculty of Agronomy and Agricultural Sciences, University of Dschang, Dschang, Cameroon.

- Côte d'Ivoire: Taky Hortense Atta Diallo, Professor of Plant Pathology and Vice-President (Planning, Programming and External Relations), and Seydou Tiho , Professor of Ecology and Dean of the Natural Sciences Training and Research Unit (UFR-SN), University Nangui Abrogoua (Formerly University of Abobo-Adjame), Abidjan, Côte d'Ivoire.

- Ghana: Samuel Kwame Offei, Professor of Biotechnology, and Pro Vice-Chancellor, and Esther Sakyi-Dawson, Associate Professor of Food Science and Director of Academic Quality Assurance, University of Ghana, Accra, Ghana

- Kenya: Alexander Kigunzu Kahi, Professor of Animal Breeding and Genomics, and Dean, and Abdi Yakub Guliye, Director, Directorate of Quality Assurance; and Associate Professor of Animal Nutrition, Department of Animal Sciences , Faculty of Agriculture, Egerton University, Egerton, Kenya.

- Madagascar: Randrianary Jean Baptiste Ramaroson, Professor of Food Science and Technology and Vice Dean, School of the Higher School of Agronomic Science, Université d'Antananarivo, Antananarivo, Madagascar.

- Mauritius: Kamleshwar Boodhoo, Professor of Tropical Animal Production Faculty of Agriculture, University of Mauritius, Reduit, Mauritius.

- Morocco: Ahmed Elamrani, Professor of Biochemistry and Plant Physiology, Faculty of Science, Department of Biology, Mohammed I University, Oujda, Morocco.

- Nigeria: Yemi Akegbejo-Samsons, Professor of Fisheries and Coastal Resources Management, University of Agriculture, Abeokuta, Nigeria.

- Nigeria: Olubunmi Abayomi Omotesho, Professor of Agricultural Economics; former Dean, Faculty of Agriculture, University of Ilorin, Ilorin, Nigeria.

- Senegal: Mariama Sene, "Docteur d'Etat ès Sciences Naturelles", Lecturer in Zoology, Parasitology and Zoonosis, Faculty of Agronomic Sciences, Aquaculture and Food Technologies, Gaston Berger University, Senegal.

- South Africa: Puffy Soundy, Professor of Horticulture, Tshwane University of Technology, South Africa.

- Sudan: Rashid A. M. Hussein, Professor of Geology, and Vice chancellor, Sudan University of Science and Technology. (Phase II.)

- Swaziland: Henry R. Mloza-Banda, Professor Agricultural Ecologist, University of Swaziland, Swaziland. (Phase II.)

1.8. Conclusion

Agriculture plays a critical role in most African economies as it is a source of livelihood for many people and ensures food security. Agricultural Science is a multidisciplinary and practice-oriented subject area. In most of the participating universities, the agricultural curricula showed broad similarities; although the degree may vary in appellation, length, and credit systems, but they all serve to train agricultural graduates. This overview has provided a good starting point to discuss and develop the reference points for a competence based curriculum in agriculture. In addition, the academics expertise in the different disciplines of agriculture has enriched the discussions in identifying relevant and contemporaneous set of competences. There was a general consensus that there is a need to improve the quality and relevance of the african agricultural education academic programmes.

Chapter 2

Definition of Generic Competences

Yemi Akegbejo-Samsons[1], *Olubunmi Abayomi Omotesho*[2], *Ahmed Elamrani*[3]

- Definition of generic and subject competences: A thematic perspective.
- Brief analysis of the generic and subject-specific competences from the subject area perspective.
- Highlight on some particular aspects considered and/or not considered in the list of competences for Tuning Africa.

2.1. Definition of Competences

One of the tasks in the Tuning Methodology is to collectively define the most relevant competences of the subject area which are deemed to be important. Competences are defined as the cognitive and meta-cognitive skills, knowledge and understanding, interpersonal, intellectual and practical skills and values (ethical,

[1] Federal University of Agriculture, Nigeria.

[2] University of Ilorin, Nigeria.

[3] Université Mohammed Premier, Oujda, Morocco.

cultural, attitudinal, experiential and creative) to be acquired by a learner to earn the degree, certificate or diploma certifying training in the field of study (Wagenaaar, 2014). In Tuning, two types of competences are distinguished: generic (common to any degree course) and subject-specific competences (specific to the field of study) (Villa *et al.*, 2008).

2.2. Developing the Generic Competences for Agricultural Sciences

Generic competences, also known as transferable skills or general academic skills, are competences that a degree holder in any field of study is expected to acquire. Furthermore, Beneitone and Bartolomé (2014) categorised the generic competences into 3 clusters: Instrumental (e.g., capacity for abstract thinking), Interpersonal (e.g., team work) and Systemic (e.g., creativity) competences. A list of the generic competences that were considered relevant for an agricultural graduate in the African region was drawn up by each participating institution based on the following 5 points:

1. From their particular background, how the academics in each Subject Area Group would define their specific area?
2. Which competences are the core contributions of each area to the development and advancement of society?
3. Which are the core elements in a particular subject area or field of knowledge and how may they be determined?
4. Which competences can be considered core for those attaining a qualification in this particular field and at each of the levels?
5. Which competences, although not core, are most needed in the region?

The resulting list was discussed and compared with others in the current literature and those selected by the previous Tuning groups. After a consensual discussion, the list of competences most appropriate for the African region was drawn (Table 3).

Table 3
List of Generic Competences for all African Graduates

1	Ability for conceptual thinking, analysis and synthesis
2	Professionalism, ethical values and commitment to UBUNTU[4]
3	Capacity for critical evaluation and self-awareness
4	Ability to translate knowledge into practice
5	Objective decision making and practical cost-effective problem solving
6	Capacity to use innovative and appropriate technologies
7	Ability to communicate effectively in official /national and local languages
8	Ability to learn to learn and capacity for lifelong learning
9	Flexibility, adaptability and ability to anticipate and respond to new situations
10	Ability for creative and innovative thinking
11	Leadership, management and teamwork skills
12	Communication and interpersonal skills
13	Environmental and economic consciousness
14	Ability to work in an intra- and intercultural and/or international context
15	Ability to work independently
16	Ability to evaluate, review and enhance quality
17	Self confidence, entrepreneurial spirit and skills
18	Commitment to preserve African identity and cultural heritage

2.2.1. *Definition of Generic Competences: a Thematic Perspective*

The abilities and skills that should be developed in the first cycle degree programme can be grouped into numeracy, communications, ICT, interpersonal and teamwork, self-management and professional development skills. The 18 general competences cover a wide range of skills and capabilities in those areas. It includes the capability of

[4] Respect for the well-being and dignity of fellow human beings.

the graduate for independent thinking, creativity and rigor in the application of knowledge and skills in professional situations, and the ability to display independence and integrity when working in complex settings on an individual basis, in teams as well as in cross-disciplinary and intercultural environments. They also describe such skills as being able to select and master appropriate up-to-date methodologies for work and ability to use new technologies and communicate effectively with specialists and non-specialists on scientific and professional issues, using appropriate information and communication tools. A brief analysis of the competences is provided in the next section.

2.2.2. *Brief Analysis of the Generic Competences from an Agricultural Perspective*

G1 Ability for conceptual thinking, analysis and synthesis

This competence corresponds to the ability to apply concepts and relevant knowledge to analyse and solve real life problems in an agricultural system.

G2 Professionalism, ethical values and commitment to UBUNTU

The ability to be in accordance with the norms and law from a legal, moral or human dignity perspective, and to act in compliance with them for sustainable agricultural development and protection of the environment.

G3 Capacity for critical evaluation and self-awareness

This competence corresponds to the ability to use relevant information to evaluate a problem. Self-awareness helps to identify the actions required to act competently in different problem situations in order to make the right decision.

G4 Ability to translate knowledge into practice

This skill corresponds to the ability to use and apply acquired knowledge to solve the real life problems in an agricultural system.

G5 Objective decision making and practical cost effective problem solving

This corresponds to the ability of showing confidence, unbiased initiative and objectivity for taking good responsible decisions in difficult situations and the capacity of proposing adequate cost effective solutions to problems in different fields of agriculture.

G6 Capacity to use innovative and appropriate technologies

Ability to find new agricultural technological developments and to adopt and use them.

G7 Ability to communicate effectively in official /national and local language

This is the ability to be communicate with people (e.g., farmers) in their native language to give information or to effectively express one's own thoughts and feelings.

G8 Ability to learn to learn and capacity for lifelong learning

This competence corresponds to an autonomous learning throughout the one's life and capacities for assimilating, updating and continuous enrichment of agricultural knowledge.

G9 Flexibility, adaptability and ability to anticipate and respond to new situations

Ability to deal with changing priorities in order to respond to new situations with the needed flexibility and anticipation for responding positively to the changing circumstances.

G10 Ability for creative and innovative thinking

The capacity to generate new ideas and approaches that could be applied to solve problems and to cope with new situations in agriculture.

G11 Leadership, management and teamwork skills

Ability to influence people, to bring out the best of themselves in order to achieve desired goals and to effectively work in a team.

G12 Communication and interpersonal skills

This competence means the ability to communicate with individuals and groups in written, graphical and verbal form and to be effective in conveying ideas and technical knowledge in agriculture.

G13 Environmental and economic consciousness

This concerns the awareness of the importance of the balances between agricultural development and the responsibility for the preservation of the environment. Therefore, ability to encourage good agricultural practices, and be respectful of the environment, and promoting sustainable development.

G14 Ability to work in an intra and intercultural and/or international context

This competence underscore, one's abilities to work "effectively and appropriately" when interacting with people who are linguistically and culturally different from oneself", whether at home or in foreign setting.

G15 Ability to work independently

Ability for Working without direct supervision, taking decisions by oneself and execute the better/ right plans in achieving targets in agriculture context."

G16 Ability to evaluate, review and enhance quality

This corresponds to competency in using tools and approaches to evaluate quality and apply improvement strategies (e.g. Good agricultural practices).

G17 Self-confidence, entrepreneurial spirit and skills

This competence refer to the self-determination and self-efficacy based on : The knowledge gained and the cumulative experiences in the field of agriculture, one's technical and professional skills, reasoning and making decision, as fundamental components for the entrepreneurial spirit development.

G18 Commitment to preserve and add value to the African identity and cultural heritage

It means having the same sense of pride in Africa like in one's country, city or home. Contribute for preserving cultural heritage in all part of African's countries in order to reflect Africa's identity and specificity.

2.3. Subject-specific Competences

2.3.1. *Identification of Subject-specific Competences*

Subject-specific competences are the knowledge, skills, abilities and values that individuals who have completed a course of study in a particular subject should possess. In drawing up the subject competences, the academics of the group of Agriculture Sciences deliberated on the competences that they expect a first-degree graduate in Agriculture should possess after completing a programme of study in Agriculture based on the criterion mentioned in section 2.1.1. After discussion, a list of 16 subject-specific competences was drawn up (Table 4).

The 16 subject competences cover a wide range of skills and abilities that should be developed in the undergraduate degree programme and can be grouped into scientific knowledge, problem solving, entrepreneurial skills and creative, research, and professional development skills. The graduates will be able to identify and solve technological problems encountered in agricultural production systems, to evaluate new technologies/trends in agriculture and use them appropriately, to manage an agribusiness enterprise, to undertake research work in the areas of agriculture and related sciences, to make scientific judgements on agricultural issues and to evaluate the consequences of agriculture on the environment, and ensure the sustainable use of natural resources and adopt good agricultural practices. The adoption of such competences will not just improve the employability skills of the graduate but will also equip them with skills to be agribusiness entrepreneurs. A brief analysis of the subject competences is provided in the next section.

Table 4
List of Subject-specific Competences for an African Agricultural Graduate

1	Knowledge and understanding of agricultural production, and basic sciences.
2	Ability to identify problems and apply knowledge to solving day to day agricultural challenges.
3	Ability to evaluate and manage agricultural projects, as well as carry out financial appraisals.
4	Possession of entrepreneurial and creative skills.
5	Ability to design, plan and implement agricultural research.
6	Ability to do business in any part of the world
7	Ability to understand and adapt to new and emerging technologies in agriculture, including ICT.
8	Ability to implement sustainable practices and technologies for the management of natural resources.
9	Ability to think independently and ability to work with minimal supervision in the area of agriculture.
10	Ability to adapt and transfer technology and ability to create new technologies.
11	Ability to know, advise on and implement agricultural policies and regulations.
12	Ability to make sustainable use of water and other natural resources for agricultural use.
13	Ability to understand and work within the organisation, business and community management of the rural sector.
14	Ability to identify pests, pathogens, and weeds associated with crops, animals and their products.
15	Ability to improve quality and safety along the agricultural value chains.
16	Ability to select and manage machinery, implements and equipment for agricultural use in different farming systems.

2.3.2. *Brief Analysis of the Subject-specific Competences from an Agricultural Perspective*

S1 Knowledge and understanding of agricultural production and basic sciences

This is the ability to understand the scientific nature of agricultural production and the connection of production to the basic sciences.

S2 Ability to identify problems and apply knowledge to solving day to day agricultural challenges

This competence is the ability to identify, analyse a problem and try to provide best possible practical solutions to the problems along the agricultural value chain.

S3 Ability to evaluate and manage agricultural projects, as well as carry out financial appraisals

This competence means the ability to assess and to implement agricultural projects. as well as being able to perform financial evaluation and economic analysis.

S4 Possession of entrepreneurial and creative skills

These are the skills to identify, start and run a profitable agribusiness enterprise, (e.g., setting up of a business plan).

S5 Ability to design, plan and implement agricultural research

This is the ability to undertake research at an appropriate level, which means the capacity of conception, planning and implementation of research in agriculture.

S6 Ability to do business in any part of the world

This competence refers to basic skills needed in a dynamic world, they include; problem solving, negotiation, leadership, project management, and networking.

S7 Ability to understand and adapt to new and emerging technologies in agriculture, including ICT

This ability recognises that innovation in agriculture is dynamic and that ICT is very central to the growth of the agricultural enterprise.

S8 Ability to implement sustainable practices and technologies for the management of natural resources

This means recognising that natural resources (soil, water, air) are the backbone of agricultural production and possessing basic scientific and technical skills to ensure their sustainable management.

S9 Ability to think independently and ability to work with minimal supervision in the area of agriculture

This competence refers to developing self-awareness and self-motivating skills, this would encourage agricultural graduates to take initiative rather than be told what to do.

S10 Ability to adapt and transfer technology and ability to create new technologies

This competence refers to the ability of the graduate to adapt and diffuse new technologies to ensure that African agriculture makes the needed progress.

S11 Ability to know, advise on and implement agricultural policies and regulations

This refers to the ability to recognise and disseminate useful and practical information relating to agricultural policies and regulations to improve the industry.

S12 Ability to make sustainable use of water and other natural resources for agricultural use

This competence recognises that water and other natural resources are central to the continued existence of the agricultural industry. Graduates must be able to drive the sustainable use of these resources.

S13 Ability to understand and work within the organisation, business and community management of the rural sector

The ability to recognise that agribusiness is largely a rural sector activity and the realisation that the rural sector has its own unique characteristics.

S14 Ability to identify pests, pathogens, and weeds associated with crops, animals and their products

This competence refers to the ability of the graduate to identify the major challenges that constraint crop, and animal production in Africa.

S15 Ability to improve quality and safety along the agricultural value chains

This ability recognises that more attention should be placed on quality and safety along agricultural vale chains in Africa in order to penetrate foreign markets and earn better incomes.

S16 Ability to select and manage machinery, implements and equipment for agricultural use in different farming systems

This competence focuses on the ability of the graduate to promote mechanisation under varying farming systems to reduce the drudgery associated with small-scale agricultural production and improve efficiency of agricultural production.

2.4. Conclusion

The set of competences that have been developed is expected to equip graduates from Agricultural degrees with a broad spectrum of scientific, practical, technical, research and analytical, and entrepreneurial and managerial skills. And most importantly, a new set of generic competences (e.g., communication skills, leadership, creativity, critical evaluation and self-awareness, among others) that nowadays employers seek have also been developed. Overall, the set of specific and generic competences aim to promote a culture of innovation and creativity and to facilitate the adoption of new technological developments in different sectors of agriculture in order to drive the modernisation of agriculture and to accelerate the

development of agribusinesses and agro-industries in Africa. It will also help the graduates to manage agricultural enterprises to carryout agricultural research, provide advisory work and other relevant field of work related to Agriculture, and to promote the employability of the African Agricultural graduates.

Chapter 3

Consultation and Reflections on the Agricultural Competences

Taky Hortense Atta Diallo[1]

- Analysis of the results of the consultation with regard to generic competences and subject-specific competences.
- Presentation of the analysis of the results of the consultation with regard to subject-specific competences.
- Interpretation of the results.

3.1. Consultation Process

The Agricultural Sciences Subject Area Group carried out an extensive consultation with various stakeholders to validate the generic and subject-specific competences by means of either an online or face-to face interview questionnaire based survey. There were 1,023 respondents comprising 312 academics, 381 students, 204 employers and 306 graduates. The characteristic of each stakeholder as defined by Beneitone (2014) is given as follows: Academics were university lecturers teaching in the area of Agricultural Sciences. Graduates were students who had successfully completed and graduated with a full study programme / university degree,

[1] University Nangui Abrogoua, Ivory Coast.

in Agricultural Sciences. Students were those in the last two years of a first degree in Agricultural Sciences or awaiting graduation. And employers were organisations that had employed graduates or although they have not employed graduates, may have jobs of interest for the graduates. In each category of stakeholders, at least 30 respondents were interviewed.

They rated the degree of importance and ranked the 18 generic and the 16 subject-specific competences and the extent to which these competences are currently being achieved, on a four-point scale in which 1 = "none", 2 = "weak", 3 = "considerable" and 4 = "strong". The rankings (that is the indication of the most important five competences in order of precedence) assigned by all stakeholder groups were analysed and are presented in Table 5.

3.1.1. *Highest Rated Generic Competences*

Regarding the perceived importance of the generic competences, all the stakeholder groups rated the "Ability for conceptual thinking, analysis and synthesis" (No. 1) and the "Ability to translate knowledge into practice (No. 4) in the top four positions. Indeed, the "Ability for conceptual thinking, analysis and synthesis" (No. 1) was rated first by the employers, second by the academics and fourth by the students and the graduates. "Professionalism, ethical values and commitment to UBUNTU (respect for the well-being and dignity of fellow human beings)" (No. 2) was rated in the 4th position by the employers but in a lower position by the academics, the students and the graduates. The same observation can be made with respect to the competence No. 5 "Objective decision making and practical cost effective problem-solving", with the employers rating it 4th while the others rated it lower. All the stakeholders rated the "Ability for creative and innovative thinking" (No. 10) among the first 7. The competence "Leadership, management and teamwork skills" (No. 11) was rated first by the graduates and third by the students. However, the same competence was rated in lower positions by the academics and the employers. The students rated "Self-confidence, entrepreneurial spirit and skills" (No.17) in the second position by whereas for both employers and graduates, it was rated in the third position.

Table 5

Rating of Stakeholders on the Importance (Import) and Level of Achievements (Achieve) and the difference between the rating of the perceived importance and achievement (Gap) for the 18 Generic competences

	General Competences	Academics			Employers			Students			Graduates		
		Import-tance	Achieve	Gap	Import-tance	Achieve	Gap	Import-tance	Achieve	Gap	Import-tance	Achieve	Gap
1	Ability for conceptual thinking, analysis and synthesis	3.67	2.74	0.93	3.74	2.71	1.03	3.50	2.72	0.78	3.59	2.84	0.75
2	Professionalism, Ethical values and commitment to Ubuntu	3.57	2.57	1.00	3.68	2.56	1.12	3.49	2.73	0.76	3.47	2.65	0.82
3	Critical Evaluation and Self Awareness	3.61	2.56	1.05	3.59	2.54	1.05	3.40	2.7	0.70	3.44	2.66	0.78
4	Ability to translate knowledge into practice	3.73	2.74	0.99	3.73	2.63	1.10	3.59	2.68	0.91	3.62	2.73	0.89
5	Objective decision-making, and practical cost effective problem solving	3.55	2.46	1.09	3.68	2.56	1.12	3.38	2.66	0.72	3.53	2.67	0.86
6	Capacity to use innovative and appropriate technologies	3.60	2.48	1.12	3.64	2.58	1.06	3.44	2.46	0.98	3.54	2.59	0.95
7	Ability to communicate effectively in official/national and local languages	3.56	2.81	0.75	3.57	2.76	0.81	3.46	2.88	0.58	3.44	2.82	0.62
8	Ability to learn, to re-learn, and capacity for life-long learning	3.47	2.64	0.83	3.53	2.65	0.88	3.32	2.76	0.56	3.48	2.86	0.62
9	Flexibility, adaptability and ability to anticipate and respond to new situations	3.57	2.49	1.08	3.59	2.53	1.06	3.42	2.65	0.77	3.59	2.67	0.92
10	Ability for creative and Innovative thinking	3.58	2.45	1.13	3.67	2.51	1.16	3.49	2.67	0.82	3.54	2.62	0.92
11	Leadership, Management and Team work skills	3.57	2.61	0.96	3.65	2.71	0.94	3.52	2.84	0.68	3.64	2.79	0.85
12	Communication, interpersonal skills	3.59	2.65	0.94	3.55	2.66	0.89	3.45	2.80	0.65	3.56	2.91	0.65
13	Environmental and Economic consciousness	3.35	2.55	0.80	3.48	2.60	0.88	3.46	2.79	0.67	3.34	2.76	0.58
14	Ability to work in an intra and intercultural and or international context	3.51	2.56	0.95	3.39	2.45	0.94	3.35	2.50	0.85	3.37	2.69	0.68
15	Ability to work independently	3.61	2.74	0.87	3.65	2.72	0.93	3.41	2.86	0.55	3.60	2.97	0.63
16	Ability to evaluate, review and enhance quality	3.57	2.49	1.08	3.62	2.57	1.05	3.35	2.84	0.51	3.52	2.80	0.72
17	Self-confidence, Entrepreneurial spirit and skills	3.57	2.46	1.11	3.69	2.58	1.11	3.56	2.83	0.73	3.60	2.71	0.89
18	Commitment to preserve and to add value to the African identity and cultural heritage	3.14	2.23	0.91	3.01	2.13	0.88	3.21	2.50	0.71	3.06	2.42	0.64

Concerning the level of achievements, regardless of the competence or the stakeholder group, the values given were lower than those of the importance. This indicates that there is room for improvement. The highest rated competences for achievements were the "Ability for conceptual thinking, analysis and synthesis" (No. 1), the "Ability to translate knowledge into practice" (No. 4) and the "Ability to work independently" (No. 15) for the academics. The "Ability to communicate effectively in official/national and local languages" was rated highest by the employers while for the students and the graduates, the most highly rated was the "Ability to work independently".

3.1.2. *Lowest Rated Generic Competences*

On the importance of the competences, with some exceptions, there was closer agreement on the lowest rated competences (rating in places 13 – 18). Indeed, the "Commitment to preserve and to add value to the African identity and cultural heritage" (No.18) was the lowest rated by all the stakeholders. "The ability to work in an intra and intercultural and/or international context" (No. 14) was rated 18th by graduates and students, 17th by employers and 16th by academics. "The ability to evaluate, review and enhance quality" (No.16) was rated 15th by academics, 13th by employers and graduates and 17th by students. "The ability to communicate effectively in official/national and local language" (No. 7) was rated 13th by academics, 15th by employers and 16th by graduates and students. "Environmental and economic consciousness" (No. 13) was rated low by all groups (18th by students and graduates; 17th by employers and 16th by academics).

3.1.3. *Gaps between Perceived Importance and Achievement of the Competences*

The gaps between the rating of the perceived importance and achievement of the eighteen generic competences by the four groups consulted (academics, employers, students and graduates) are also presented in Table 5. The smallest gaps between the perceived importance and level of achievement were registered by the graduates and students' groups compared with the other two stakeholder

groups. For both the academics and the employers, the biggest gap was registered for the "Ability for creative and innovative thinking (No. 10). For the students however, the biggest gap on perceived importance and level of achievement was registered for the "Ability to translate knowledge into practice" (No. 4) whereas for the graduates, it was for the "Capacity to use innovative and appropriate technologies (No. 6)".

The gaps between the rating of the perceived importance and the perceived achievement of the eighteen generic competences by the four groups consulted (academics, employers, students and graduates) are also presented in Table 5.

3.1.4. *Highest Rated Subject-specific Competences*

There is great agreement regarding the top five ratings of the subject-specific competences (Table 6 and Table 7). The academics, students and employers considered "Knowledge and understanding of agricultural production, and basic sciences" as the most important competence, and the "Ability to identify problems and apply knowledge to solving day-to-day agricultural challenges" in the second position while it was the opposite for the graduates.

All four groups were in close agreement regarding the "Ability to design, plan and implement agricultural research". They rated it either third or fourth. Competence (No. 4) "Possession of entrepreneurial and creative skills" was rated third by employers and graduates, fourth by academics and fifth by students. "Ability to evaluate and manage agricultural projects, as well as carry out financial appraisals" (No. 3) was rated fifth by academics, employers and fourth by students.

The perceived level of achievement was lower than the perceived importance for all stakeholders and on all competences (Tables 7). However, while the competence "Have knowledge and understanding of agricultural production and basic sciences" (No. 1) was rated first for achievement by all stakeholders, the competence No. 2 ("Should be able to identify problems and apply knowledge to solving day-to-day agricultural challenges") was rated third by the academics, employers and students. That last competence was rated fourth by the graduates.

Table 6
Stakeholders' Perception of the Subject-specific Competences for Agricultural Graduates

		Academics			Employers			Students			Graduates		
		Impor-tance	Achieve	Gap	Impor-tance	Achieve	Gap	Impor-tance	Achieve	Gap	Impor-tance	Achieve	Gap
1	Have knowledge and understanding of Agricultural production, and basic sciences.	3.80	3.37	0.43	3.82	3.14	0.68	3.67	3.27	0.4	3.72	3.27	0.45
2	Should be able to identify problems and apply knowledge to solving day to day agricultural challenges.	3.75	2.84	0.91	3.73	2.75	0.98	3.60	2.94	0.66	3.71	2.87	0.84
3	Ability to evaluate and manage agricultural projects, as well as carry out financial appraisals.	3.65	2.64	1.01	3.63	2.67	0.96	3.49	2.78	0.71	3.61	2.68	0.93
4	Should possess entrepreneurial and creative skills.	3.61	2.58	1.03	3.59	2.36	1.23	3.48	2.75	0.73	3.53	2.60	0.93
5	Should be able to design, plan and implement agricultural research.	3.71	2.84	0.87	3.67	2.66	1.01	3.52	2.80	0.72	3.68	3.00	0.68
6	Should be able to do business in any part of the world.	3.27	2.31	0.96	3.17	2.21	0.96	3.40	2.58	0.82	3.37	2.48	0.89
7	Ability to understand, and adapt to new and emerging technologies in Agriculture, including ICT.	3.73	2.60	1.13	3.62	2.66	0.96	3.48	2.59	0.89	3.68	2.53	1.15
8	Ability to implement sustainable practices and technologies for the management of natural resources.	3.69	2.69	1.00	3.65	2.57	1.08	3.39	2.68	0.71	3.56	2.73	0.83
9	Have ability for independent thinking and be able to work with minimal supervision in the area of agriculture.	3.61	2.68	0.93	3.65	2.65	1.00	3.38	2.78	0.6	3.50	2.83	0.67
10	Ability to adapt and transfer technology, as well as be able to create new technologies.	3.55	2.63	0.92	3.51	2.36	1.15	3.27	2.33	0.94	3.47	2.54	0.93
11	Ability to know advice and implement agricultural policies, and regulations.	3.47	2.74	0.73	3.53	2.46	1.07	3.36	2.61	0.75	3.49	2.54	0.95
12	To make sustainable use of water and other natural resources for agricultural use.	3.58	2.90	0.68	3.58	2.62	0.96	3.56	2.87	0.69	3.57	2.66	0.91
13	Ability to understand and work within the organization, business and community management of the rural sector.	3.50	2.74	0.76	3.42	2.71	0.71	3.43	2.73	0.70	3.51	2.75	0.76
14	Ability to identify pests, pathogens, and weeds associated with crops, animals and their products.	3.51	2.35	1.16	3.58	2.79	0.79	3.48	3.03	0.45	3.49	2.95	0.54
15	Ability to improve quality and safety along the agricultural value chains.	3.65	2.45	1.20	3.55	2.45	1.10	3.47	2.89	0.58	3.57	2.77	0.80
16	Ability to select and manage machinery, implements and equipment for agricultural use in different farming systems.	3.43	2.21	1.22	3.36	2.36	1.00	3.40	2.56	0.84	3.41	2.46	0.95

3.1.5. *Lowest Rated Subject-specific Competences*

With regards to the competences that all stakeholders (academics, students, graduates and employers) rated as least important, there was a level of agreement. Indeed, all four groups rated three competences among the last six in the table: "Ability to understand and work within the Organisation, business and community management of the rural sector" (No. 13), "Ability to select and manage machinery, implements and equipment for agriculture use in different farming systems" (No. 16) and "Ability to improve quality and safety along the agricultural value chains" (No. 15) (Tables 7 and 8).

There was also a level of agreement on the lowest rated for perceived level of achievements (Table 7). While academics and the graduates rated 16th the "Ability to select machinery, implements and equipment for agricultural use in different farming systems", the employers rated it 13th and the students 13th.

3.1.6. *Gaps between Perceived Importance and Achievement*

The gaps between the ratings with regard to perceived importance and achievement of the 16 subject-specific competences registered by the four groups consulted (academics, employers, students and graduates) are also presented in Table 7. The lowest gap was registered for the medians from all four stakeholder groups on the "Knowledge and understanding of agricultural production, and basic sciences" (No. 1) while the highest gaps were registered for different competences by each of the four stakeholder groups.

The Preference ranking of the Sixteen Agricultural Subject-specific Competences is presented in Table 7.

Table 7
Stakeholders' Ranking of the Agricultural Subject-specific Competences

	Subject-specific Competences	Preference Ranking Positions by Stakeholders			
		Academics	Employers	Students	Graduates
1	Have the Knowledge and understanding of Agricultural production and basic sciences.	1	1	1	2
2	Should be able to identify problems and apply knowledge to solving day-to-day agricultural challenges.	2	2	2	1
3	Ability to evaluate and manage agricultural projects, as well as carry out financial appraisals.	5	5	4	5
4	Should possess entrepreneurial and creative skills.	4	3	5	3
5	Should be able to design, plan and implement agricultural research.	3	4	3	4
6	Should be able to do business in any part of the world.	7	8	7	7
7	Ability to understand, and adapt to new and emerging technologies in Agriculture, including ICT.	8	7	12	9
8	Ability to implement sustainable practices and technologies for the management of natural resources.	9	10	8	11
9	Have the ability for independent thinking and be able to work with minimal supervision in the area of agriculture.	12	14	15	15
10	Ability to adapt and transfer technology, as well as be able to create new technologies.	10	9	6	14
11	Ability to know advice and implement agricultural policies, and regulations.	15	15	9	10
12	To make sustainable use of water and other natural resources for agricultural use.	11	11	14	8

	Subject-specific Competences	Preference Ranking Positions by Stakeholders			
		Academics	Employers	Students	Graduates
13	Ability to understand and work within the organisation, business and community management of the rural sector.	14	12	10	12
14	Ability to identify pests, pathogens, and weeds associated with crops, animals and their products.	16	6	11	13
15	Ability to improve quality and safety along the agricultural value chains.	13	13	16	16
16	Ability to select and manage machinery, implements and equipment for agricultural use in different farming systems.	6	16	13	6

3.2. Relationships between the Responses from Academics, Employers, Students and Graduates

There was a strong correlation between the responses of the academics and the employers regarding the importance of the generic competences (0.90), the achievement (0.85) and the ranking (0.89), as shown in Table 8. The analysis of the subject-specific competences showed a stronger correlation coefficient with regard to importance (0.93), achievement (0.92) and their ranking (0.94). In contrast, the correlation between the assessments of students and academics/employers of the generic competences was lower than that between academics and employers with: 0.71 on importance, 0.53 on achievement and 0.75 on ranking. However, for the subject-specific competences, the correlation for importance was low (0.578) while the correlations for achievement and ranking were 0.793 and 0.881 respectively. The agreement between the rating and the ranking by the groups was very high.

Table 8
Correlation Coefficients for Generic Competences

		Academics	Employers	Students	Graduates
Importance	Academics	1.00			
	Employers	0.90			
	Students	0.71	0.78		
	Graduates	0.90	0.92	0.74	1.00
Achievements	Academics	1.00			
	Employers	0.85	1.00		
	Students	0.53	0.68	1.00	
	Graduates	0.80	0.83	0.74	1.00
Ranking	Academics	1.00			
	Employers	0.89	1.00		
	Students	0.87	0.75	1.00	
	Graduates	0.94	0.92	0.91	1.00

3.3. Reflection on the Consultation

One of the innovative aspects of this survey on the rating of the competences was the involvement of students in addition to academics, employers, and graduates. In other similar studies, the consultation process involved only surveyed chief executive officers and senior managers (Collet *et al.*, 2015) while Vickramasinghe and Perera (2010) did not interview the students. It is therefore postulated that surveys that include students provide a better overview of the competences required and their importance thereof.

In the present study, the high correlation between academics and employers in all aspects indicates the very close cooperation and interaction between these two groups. One explanation could be that students seeking degrees in Agriculture work on placements and write their final theses with their employers, at the farm or in food companies.

The differences in the ratings by graduates and employers could due to the workplace the questionnaire was sent. Graduates of Agricultural

Sciences very often do not find jobs in the field of agriculture. They work in banks, schools, or in government offices. It could be we have missed those groups as all the questionnaires were only sent to employers in the field of agriculture.

There was a bigger gap between students and employers on both the importance and the achievement for the generic competences. Ho (2015) also found a wide gap between students' and employers' perceptions regarding the competences needed in the job market.

The differences between the rankings assigned by the students and graduates could be explained by the fact that students, who are still taking courses or doing their research at the university, may not yet have a full knowledge of the competences needed for their future employment. Additionally, they may not even know what competences they are supposed to develop or are developing while at the university

3.4. Conclusion

This study described the ranking and rating of the importance of the 18 generic and the 16 subject-specific competences, and their level for achievement in the Agricultural Sciences according to four stakeholders groups (academics, employers, graduates and students). There was, with a few exceptions, good consistency in the highest and lowest rated generic and subject-specific competences regarding their importance by the four groups. However, the level of perceived achievement of these competences by the stakeholders was lower than that of the perceived importance. Both generic and subject-specific competences could therefore be used reduce the gaps between all the groups targeted in the study.

Chapter 4

Elaboration of a Meta-profile for Agricultural Science

Mariama Sene[1], *Christopher Mubeteneh Tankou*[2]

- Description of the process followed by the SAG to agree on a Meta-profile.
- Presentation of the Meta-profile as a graphic.
- Explanation of the main components/elements of the Meta-profile and how it is linked to the previous steps (agreement on the generic and subject-specific competences).
- Reflection on the similarities and differences between the Meta-profile and current degree programme profiles at the universities.
- Comparison of Meta-profile at African Institutional and Regional Level with current degree profiles.

[1] Université Gaston Berger, Senegal.

[2] Université de Dschang, Dschang, Cameroon.

4.1. Definition of the Meta-profile

One of the tasks in the Tuning Methodology, after the development of the generic and subject-specific competences, and the consultation with the stakeholders, is to develop a meta-profile. It is a representation of the structure and combinations of generic and subject-specific competences that gives meaning and identity to a subject area (González and Yarosh, 2013; González, 2014). Meta-profiles are mental constructions that cluster the generic and specific competences into definite core and supportive elements and illustrate diagrammatically their interrelationships. Core elements are those indispensable competences that all graduates should acquire while the supporting elements are the other competences that are related to the core elements (Beneitone *et al.,* 2014). Meta-profile enables collective understanding and common comprehension of degree profiles, offers possibilities for recognition, validates the learning experience or academic qualification acquired, and allows development of joint degrees (González, 2014; González and Yarosh, 2013). It also offers a new path to regionalisation and ultimately to globalisation (Knight, 2013).

4.2. Creating the Agricultural Science Meta-profile

In developing the Meta-profile for Agricultural Science, several variables were taken into consideration, firstly the SAG deliberated on which competences should constitute the core and supportive elements of an agricultural study programme from an academic perspective. And secondly, the rankings and rating provided by consultation with the students, graduates, lecturers and employers were used to categorise the competences. Other factors that were taken into consideration were the key occupational jobs for the sector (Chapter 1), the general trends in agricultural development (e.g., mechanisation, development of agribusinesses, intensification of small holder production system, agricultural value chains, among others). After this step, the supporting elements were grouped into 5 clusters: (1) learning process, (2) social values, (3) organisation and communication skills, (4) innovation and (5) technical/technological capacity. In the final step of setting up the Agricultural Meta-profile the core clusters was combined with the supporting clusters to show their interrelationships (Figure 1). The Venn diagram showed that some competences appear more than once in the different clusters (Figure 2). This demonstrates that these competences should not be treated in isolation and should

not be taught in a fragmented manner. For example, the ability to communicate, critical thinking, application of knowledge to real world problems should be integrated across the curriculum. They can be taught in the different modules and there is not a need for separate module for each type of competences.

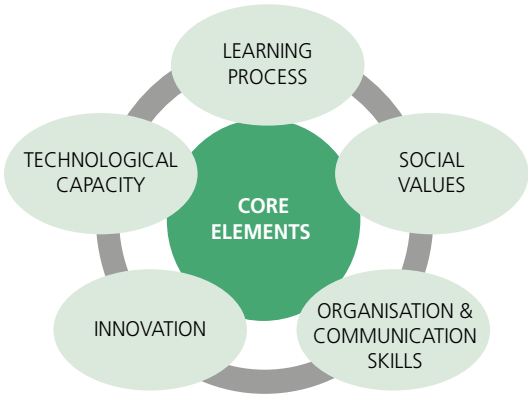

Figure 1a
The core and 5 supporting elements of the Meta-profile for an Agricultural Science Curriculum

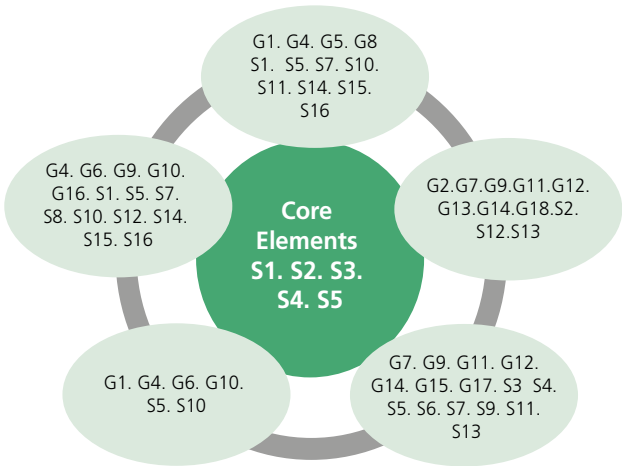

Figure 1b
The core and supporting elements of the Meta-profile for an Agricultural Science Curriculum

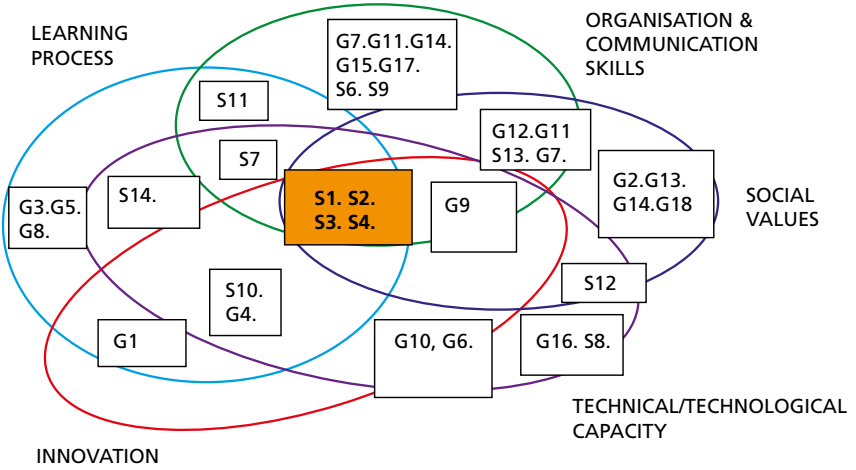

Figure 2
The Venn Diagram showing the interrelationship between the Generic and Subject-specific competences

4.2.1. *Core Competences*

The competences in the core elements for the Agricultural Sciences degree programmes were the most rated by the 4 groups of stakeholders in the consultation process. The core elements are the foundation block and central to any agricultural degree. It covers knowledge of the agricultural system (e.g. crop production, animal production soil science etc.) and ability to identify, solve and manage different challenges in agriculture. Core elements are required to achieve an acceptable level of performance (Leah *et al.*, 2014). The "S" preceding the number designates a subject-specific competence.

S1	Knowledge and understanding of agricultural production, and basic sciences
S2	Ability to identify problems and apply knowledge to solving day-to-day agricultural challenges
S3	Ability to evaluate and manage agricultural projects, as well as carry out financial appraisals
S4	Possession of entrepreneurial and creative skills
S5	Ability to design, plan and implement agricultural research

4.2.2. *Supporting Competences*

The supporting elements were classified into five groups: (1) learning process, (2) social values, (3) organisation and communication skills, (4) innovation and (5) technical/technological capacity. For each supporting element, both generic and subject-specific competences were then assigned. "G" before the number designates a generic competence and S a subject-specific competence (Figure 2).

4.2.2.1. Learning Process Cluster

This cluster concerns the learning processes to acquire knowledge and skills required to translate them into practice (e.g., capacity for solving problems in the field of agriculture) and the competences related it.

G1	Ability for conceptual thinking, analysis and synthesis
G3	Capacity for critical evaluation and self-awareness
G4	Ability to translate knowledge into practice
G5	Objective decision making and practical cost-effective problem solving
G8	Ability to learn to learn and capacity for lifelong learning
S1	Knowledge and understanding of agricultural production, and basic sciences
S5	Ability to design, plan and implement agricultural research
S7	Ability to understand and adapt to new and emerging technologies in agriculture, including ICT
S10	Ability to adapt and transfer technology, and ability to create new technologies
S11	Ability to know, advise on and implement agricultural policies and regulations
S14	Ability to identify pests, pathogens and weeds associated with crops, animals and their products
S15	Ability to improve quality and safety along the agricultural value chains
S16	Ability to select and manage machinery, implements and equipment for agricultural use in different farming systems

4.2.2.2. Social Values Cluster

This cluster relates to the ability of the Graduates to develop strong work ethics, be able to fit across social and cultural diversity, capacity to work in multi-disciplinary teams, and to contribute to preservation of the environment, among others.

G2	Professionalism, ethical values and commitment to UBUNTU (respect for the well-being and dignity of fellow human beings)
G7	Ability to communicate effectively in official/national and local languages
G9	Flexibility, adaptability and ability to anticipate and respond to new situations
G11	Leadership, management and teamwork skills
G12	Communication and interpersonal skills
G13	Environmental and economic consciousness
G14	Ability to work in an intra- and intercultural and /or international context
G18	Commitment to preserve African identity and cultural heritage
S2	Ability to identify problems and apply knowledge to solving day-to-day agricultural challenges
S12	Ability to make sustainable use of water and other natural resources for agricultural use
S13	Ability to understand and work within the organisation, business and community management of the rural sector

4.2.2.3. Innovation Cluster

This cluster relates to the capacity to promote a culture of innovation and creativity and to facilitate the adoption of new technological developments. It also relates to the ability to conduct innovative and results oriented research.

These are competences that indicate the ideal patterns needed for exceptional performance. Changing environmental and market conditions continually force enterprises and service providers to offer their customers new and modified products and services in order to remain competitive. The competences identified to prepare graduates in this respect include:

G1	Ability for conceptual thinking, analysis and synthesis
G4	Ability to translate knowledge into practice
G6	Capacity to use innovative and appropriate technologies
G10	Ability for creative and innovative thinking
S5	Ability to design, plan and implement agricultural research
S10	Ability to adapt and transfer technology, and ability to create new technologies

4.2.2.4. Organisation and Communication Skills Cluster

This cluster incudes the capacity to achieve good communication skills using modern ICT tools under different settings, develop autonomy in professional life, and capacity to organise plan work both at an individual and team level.

Organisation and communication are vital skills both for managers and business owners as well as employees. Interacting with others is a large portion of many industries and having the necessary skills to interact with others is essential no matter the type of business. In order to fulfil these expectations, graduates need the following competences:

G7	Ability to communicate effectively in official/national and the local languages
G9	Flexibility, adaptability and ability to anticipate and respond to new situations
G11	Leadership, management and teamwork skills
G12	Communication and interpersonal skills
G14	Ability to work in an intra- and intercultural and/or international context
G15	Ability to work independently
G17	Self-confidence, entrepreneurial spirit and skills
S3	Ability to evaluate and manage agricultural projects, as well as carry out financial appraisals
S4	Possession of entrepreneurial and creative skills
S5	Ability to design, plan and implement agricultural research
S6	Ability to do business in any part of the world
S7	Ability to understand and adapt to new and emerging technologies in agriculture, including ICT

S9	Ability to think independently and ability to work with minimal supervision in the area of agriculture
S11	Ability to know, advise on and implement agricultural policies and regulations
S13	Ability to understand and work within the organisation, business and community management of the rural sector

4.2.2.5. Technical/Technological Capacity Cluster

This cluster is defined as the ability to develop skills to be able to translate knowledge into practice, adapt and evaluate new technologies, and to be innovative in bringing changes in the agricultural sector. In order to achieve these expectations, graduates need to acquire the following competences:

G4	Ability to translate knowledge into practice
G6	Capacity to use innovative and appropriate technologies
G9	Flexibility, adaptability and ability to anticipate and respond to new situations
G10	Ability for creative and innovative thinking
G16	Ability to evaluate, review and enhance quality
S1	Knowledge and understanding of agricultural production and basic sciences
S5	Ability to design, plan and implement agricultural research
S7	Ability to understand and adapt to new and emerging technologies in agriculture, including ICT
S8	Ability to implement sustainable practices and technologies for the management of natural resources
S10	Ability to adapt and transfer technology, and ability to create new technologies
S12	Ability to make sustainable use of water and other natural resources for agricultural use
S14	Ability to identify pests, pathogens, and weeds associated with crops, animals and their products
S15	Ability to improve quality and safety along the agricultural value chains
S16	Ability to select and manage machinery implements and equipments for agricultural use in different farming systems

4.3. Comparison of Meta-profiles at African Institutional and Regional Level with Current Degree Profiles

A reflection on the similarities and differences between the Meta-profile and current degree programme profiles at the participating universities are provided below.

The Agriculture Meta-profile was compared and contrasted with the current degree profile of each participating institution and the Agronomy meta-profile in Latin America, Agronomy (Tuning, 2014b). This process allowed the academics to reflect on the similarities, differences and missing elements at both institutional and regional levels.

The core elements (S1, S2, S3, S4 and S5) were covered in all of the Agricultural Sciences programmes of the participating universities. In a few cases, it was suggested to increase the number of competences, in the core elements, such as S12 Ability to make sustainable use of water and other natural resources for agricultural use and S15 - Ability to improve quality and safety along the agricultural value chains. This is understandable as more and more emphasis is now being placed on food safety and sustainable use of natural resources in many agricultural production systems. In some instances, some subject-specific competencies identified by the group are not currently covered in the programmes of some of the institutions. For example, in the curriculum of University Gaston Berger's Animal Productions Bachelor degree does not fully cover the Agriculture specific competence S16 "Ability to select and manage machinery, implements and equipment for agricultural use in different farming systems".

All the generic competences were considered relevant and important for a first cycle degree programme in Agricultural Sciences at the SAG universities but not all competences (e.g., leadership, innovative thinking, communicate in local language, among others) were covered as the emphasis is mostly on teaching and assessing the technical and scientific aspects. In some cases, although the students are provided with opportunities to develop their communication skills, IT skills, ability to work independently, they are not explicitly assessed. The generic competence G2 Professionalism, ethical values and commitment to UBUNTU was lacking in all Universities degree profile. There is thus a need for more efforts to define the essence of UBUNTU and its resultant benefits to staff and students. Another generic skill that was missing

in many Universities programme of studies was the ability to speak the native language. This skill was judged important as fluency in the native language build more trusty partnerships and transmission of knowledge, especially when the graduates work with farmers in rural areas.

Members of the Agriculture team were concerned about courses with large classes, as it may not be easy to impart all the competencies, and appropriate teaching and learning methods for some competences (e.g., S4 Possesses entrepreneurial and creative skills, G10 Self-confidence, entrepreneurial spirit and skills). However, some members of the SAG indicated that in their programmes, students undertake practical training in industries and enterprises for periods ranging from three to twelve months. Such opportunities will allow the student to gain competences in both the generic and subject-specific competences (Armoogum *et al.*, 2016).

In most institutions, students undertake a research based dissertation in their final year. When writing a final thesis, the student develops to some extent competences in their ability to write in a scientific language, acquires more in-depth knowledge, ability to search for relevant information, ability to apply knowledge gained, ability to analyse, summarise and communicate results, among other competences.

The meta-profile was compared with the Latin America Agronomy SAG. Although there was a difference the structure of the meta-profile (i.e differences in the clusters), it was found that there was both similarity (80%) and differences (20%) in the generic and subject-specific competences, despite they were phrased in a different manner. They developed 20 subject competences compared to 16 for our group. For example, two competences, that was not explicit in our subject competences, S18 ability to develop projects for crop genetic improvement and propagation methods to maximise production and S20 ability to develop and implement strategies for post-harvest handling of agricultural products. The differences were mainly attributed to differing agricultural systems, socio economic development in the respective regions.

4.4. Conclusion

The relationship established between the competences as core elements and supportive elements in the Meta-profile made it easy

to visualise the key elements for an effective undergraduate degree programme in Agricultural Science in the African context. There was a general consensus on the validity and relevance of the metaprofile. It will be a useful guide for developing new/revised agricultural and related subjects (e.g. crop protection, agricultural engineering) curriculum. Its successful implementation will equip graduates with skills that employers are looking for (e.g. entrepreneurship, creativity, problem solving, and numeracy and ICT skills) and generate more productive and employable graduates that can bring changes in the African agricultural production systems.

Chapter 5

Elaboration of Programme of Study

Rashid A.M. Hussein[1], *Henri R. Mloza-Banda*[2]

5.1. Introduction

Two master degree programmes one in Agricultural Engineering and Crop Protection were submitted at one of the Tuning meetings for review by the group and the revised programmes are presented hereunder. It provides an overview of the degree profile, how it is more student-centred with a course outline, and learning outcomes, and indications of the generic and subject-specific competences to be achieved. In reviewing the programmes, the following elements were considered: the generic and subject-specific competences, description of the job opportunities, linking of the competences with the agreed meta-profile, dfinition of the competences, defining the programme learning outcomes, the learning and assessment strategy for achieving the competences and the course units and its consistency with the competences ad learning outcomes.

[1] Sudan University of Science and Technology, Khartoum, Sudan.

[2] University of Swaziland, Faculty of Agriculture, Swaziland.

5.2. Degree Profile-Master in Agricultural Engineering

5.2.1. *Purpose*

The purpose of this Master of Science (MSc) degree in Agricultural Engineering developed by the Sudan University is to face the major changes in the Agricultural Engineering sector, and to address the issues of sustainable development. It's a two year programme with 15 core modules. It is closely related to the fields of agricultural science, agribusiness, agroforestry, animal science and husbandry. The holder of the degree will be able to understand the scientific, social and economic realities of the modern agricultural engineering industry and will have the required scientific knowledge and practical training in an international context.

5.2.2. *Disciplines and Subject Areas*

Agricultural Engineering is multidisciplinary subject area which involves the application of engineering principles in the production, processing, handling and storage of food, fiber and materials of biological origin. It includes subjects such as Design, Manufacture and Operation of agricultural systems. Agricultural engineering is application of Mechanical Systems for the execution of cultural practices and provision of services for crop and animal production, irrigation and drainage of agricultural lands, soil and water conservation, agro-processing, housing for animals and plants and control of their environment and delivery and storage of agricultural products, and agricultural waste management.

5.2.3. *Employability and Further Education*

The career pathway could lead the holder of the degree to work in a laboratory, research station, forest or farm. Employment sectors include agricultural engineering industries agriculture and agri-business sector, agricultural construction projects, agricultural equipment industries, livestock and cropping industries, environmental sector, government policy and regulations sector, agricultural services and consultation sector, corporations and small farming businesses, teaching and research sector. The holder of the degree will be well-placed to research and develop solutions to conserve the world's agro-resources

and natural resources and will be prepared for international careers in the sectors of agriculture, agricultural engineering, and environment. This programme prepares the students to embark on further research degrees, such as PhD.

5.3. Programme Competences

5.3.1. *Subject-specific Competences*

- Acquire and apply knowledge and skills of the basic and applied sciences of Agricultural Engineering.
- Ability to identify, evaluate and implement the most appropriate technologies for the context in hand.
- Use practical and safe techniques, to test, install and repair agricultural equipment within a laboratory setting and in the field.
- Plan, execute, operate, maintain, inspect and monitor Agricultural Engineering projects and systems and repair Agricultural Engineering systems.
- Conduct work and research in the field.
- Use scientific principles method and the application of experimental techniques to solve specific problems.
- Provide Agricultural Engineering solutions to societal problems for sustainable development.
- Use information technologies, software and tools for Agricultural Engineering.
- Conceive, analise, design and manufacture mechanical products and systems.
- Analise GPS and weather data and using computer modeling.
- Evaluate the environmental and socio-economic impact of agro-mechanical projects.

- Employ quality control techniques in managing materials, products, resources and services.
- Integrate legal, economic and financial aspects in decision-making in Agricultural Engineering projects.
- Select, mobilize and administrate material resources, tools and equipment cost-effectively.
- Conduct life cycle assessment for products and systems and employ quality control techniques in managing materials, products, resources and services.
- Employ Agricultural Engineering skills to transform local natural resources into products or services through value addition.

5.3.2. *Generic Competence*

- Communicate both orally and through the written word in Arabic and English languages.
- Interact with multidisciplinary groups towards developing integrated solutions.
- Work autonomously and apply knowledge in practical situations to identify, and resolve problems.
- Work in a team in a constructive manner under various work conditions.
- Evaluate and maintain the quality of work.
- Use information and communications technologies.
- Commit to tasks and responsibilities.
- Adapt to new situations and cope under pressure.
- Act with social responsibility and civic awareness.
- Work in an international context.

5.4. Programme Learning Outcomes

The intended learning outcomes (ILOs) of the programme of Agricultural Engineering are divided into four categories, namely: knowledge and understanding, intellectual skills, practical skills and transferable skills.

On successful completion of the programme, students should be able to:

- Explain the scientific, social and economic principles of modern agricultural engineering industry.
- Devise and evaluate effective solutions to Agricultural Engineering problems.
- Design and execute a research project in the various areas of agricultural engineering (e.g., irrigated and rain fed agriculture).
- To formulate and resolve a complex agricultural engineering problem.
- To design appropriate, sustainable and innovative solutions through a systematic approach.
- To design, construct, operate new equipment and system for agricultural production.
- To design and implement a multidisciplinary project.
- To communicate and interact in a professional manner, in Arabic and English.
- To act critically and responsibly by taking account of sustainable development issues.
- Demonstrate self-confidence, entrepreneur skills and financial management capabilities.

5.5. Learning and Teaching Approaches

Throughout the degree programme, various teaching methods such as lectures, use of audio/visual, demonstrations, active learning (Q&A and

focus group discussions) and activities such as surveys, case studies will be used to achieve the learning outcomes. In addition to the hands-on laboratory sessions and field experience, a research project and dissertation should be completed, applying all the formal knowledge to a real world agricultural engineering problem. Whether this is on sustainable agricultural production, the environmental impact of intensive agriculture or water allocation, the project will provide insight into and preparation for the profession of an Agricultural Engineer.

5.6. Assessment Methods

There are four major assessment situations: Tutorial assignments and participation (10%), Laboratory group projects report (35%), Mid-term test (15%), Final examination (40%). Examination and laboratory report are numerically marked and grades awarded accordingly.

5.7. Programme Structure

The structure of Agricultural Engineering MSc. Programme is based on provision of basic knowledge and data needed by the various disciplines of Agricultural Engineering (machinery, irrigation, processing of agricultural product, and rural development) in Year 1 Semester 1, and the design concept simulation, application of computer to case studies in Semester 2 of Year 1. The candidate capabilities and practical skills shall be developed to implement operate, and manage agricultural engineering projects in Year 2.

Year 1 Semester 1

Course ID	Course Name	Hrs/Wk	Credit
GMAE611	Structure Engineering and Crop Environment	2	2
GMAE612	Bio – energy Technology	2	2
GMAE613	Design of Irrigation Systems	2	2
GMAE614	Advanced Farm Power	2	2
GMAE615	Experimental Design and Research Methods	2	2
GMAE616	System Analysis in Agricultural Engineering	2	2

Year 1 Semester 2

Course ID	Course Name	Hrs/Wk	Credit
GMAE621	Functional Analysis and Testing of Agricultural Machinery	3	3
GMAE622	Water Resources and Dry Land Farming Systems	3	3
GMAE623	Agricultural Processing Engineering	2	2
GMAE624	Applied Hydraulic Structures	2	2
625GMAE	Design of Agricultural Machinery	2	2

Year 2 Semester 1-2

Course ID	Course Name	Hrs/Wk	Credit
GMAE631	Feasibility Studies and Project Planning	2	3
GMAE632	Evaluation and Management of Irrigation Systems	2	2
GMAE633	Agricultural Machinery Management	2	2
GMAE634	Water Harvesting Techniques	2	2
GPRJ635	Research Project	—	3

5.8. Consistency of the Programme with Competences

The consistency of the programme with the generic and subject-specific competences was briefly checked via a matrix as shown in Table 9 and Table 10. Although, an in-depth analysis was not done, it can be seen that most competences, related to knowledge, skills, attitudes abilities, attitudes and ethical values, among others are covered across the various course units.

Table 9
Matrix of Consistency of Subject-specific Competences with the Course Units

Course Units/ Learning Outcome	Subject-specific Competences								
	Demonstrate Engineering. knowledge base	Develop Research skills	Skills: techniques, technology practice	Mathematics; describe define, simulate system	Develop theoretical concepts and models	Analyse interactions elements and forces	Decision making skills and design abilty	Professional practice, critical and evaluative ability	Develop strategies, solve problems
GMAE611	X			X	X				
GMAE612	X			X	X				
GMAE613	X			X	X				
GMAE614	X			X	X				
GMAE615	X			X	X				
GMAE616	X			X	X				
GMAE621			X	X		X			X
GMAE622			X	X		X			X
GMAE623			X	X		X			X
GMAE624			X	X		X			X
GMAE625			X	X		X			X
GMAE631		X	X				X	X	X
GMAE632		X	X				X	X	X
GMAE633		X	X				X	X	X
GMAE634		X	X				X	X	X
GPRJ635		X	X				X	X	X

Table 10
Matrix of Consistency of Generic Competences with the Course Units

Competence Course Units	Generic Competence								
	Research ability	Team work and tasks resposibility	Resources and time management ability	Problem solving	Creativity: generate original, quality ideas	Communication and critical skills	Communication skills	Ethics and quality concern	Project planning capacity
GMAE611				X		X	X		
GMAE612				X		X	X		
GMAE613				X		X	X		
GMAE614				X		X	X		
GMAE615				X		X	X		
GMAE616				X		X	X		
GMAE621	X	X	X	X	X	X			
GMAE622	X	X	X	X	X	X			
GMAE623	X	X	X	X	X	X			
GMAE624	X	X	X	X	X	X			
GMAE625	X	X	X	X	X	X			
GMAE631	X	X	X		X		X	X	X
GMAE632	X	X	X		X		X	X	X
GMAE633	X	X	X		X		X	X	X
GMAE634	X	X	X		X		X	X	X
GPRJ635	X	X	X		X		X	X	X

5.9. Programme of Study: Master in Crop Protection

5.9.1. *Overview*

The two-year MSc programme in Crop Protection was proposed by the Department of Crop Production, University of Swaziland. The programme addresses issues of crop health within sustainable crop production systems in Sub-Saharan Africa. It is a taught, research and practice oriented programme of study with an international and multidisciplinary focus leading to three specialisations in either Pathology, or Entomology or Weed Science. The qualification shall thus be designated depending on the specialisation, as for example, MSc. in Crop Protection (Pathology).

5.9.2. *Length of the Programme*

It's a two year for a full-time student and four years for a part-time student. The student shall be required to take and pass a minimum of 42-48 credits in order to graduate. These credits are distributed as follows: 30-36 credits for course work and 12 credits for thesis research work.

5.9.3. *Sectors of Employment / Occupation*

The MSc programme in Crop Protection will offer them a variety of job opportunities in: Agrochemical industry, Agricultural research institutions, Universities, International organisations and institutes, Consulting companies, Public administration and advisory boards, Public and private research centers, Governmental agencies, Crop protection advisors, and Crop protection consultants. The programme will allow graduates to register for admission to related third cycle (Ph.D.) qualifications in Crop Protection, Plant Pathology, Entomology, or Weed Science.

5.10. Programme Competences

5.10.1. *Subject-specific competences*

The graduates of this programme will be able to:

- Describe the science related to insects, pathogens and weeds and their effects in crop production and agrosystem.
- Assess insect pest, diseases and weed diagnostics.
- Identify, analyse and develop holistic solutions to problems related to Crop Protection.
- Generate, demonstrate and promote valuable technologies related to Crop Protection.
- Consult farmers, extension experts, investors and policy makers in formulating appropriate Crop Protection packages and agricultural policies, respectively.
- Create, design, implement and manage their own agricultural enterprises as well as advice farmers and other entrepreneurs.
- Play leading role in integrating multidisciplinary knowledge and skill in the process of enhancing agricultural productivity and ensuring national food security.
- Engage in teaching and training activities at various levels in the field of Crop Protection.
- Engage in research projects aimed at entomology, pathology and weed science and management.

5.10.2. *Generic Competences*

- Ability for conceptual thinking, analysis and synthesis.
- Ability to apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments related to their field of study.

- Capacity for critical evaluation, self-awareness and self-limitations.
- Ability to gather and interpret relevant data to inform judgments that include reflection on relevant social, scientific or ethical issues in crop protection.
- Ability to gather knowledge, advice and implement agricultural policies and regulations in crop protection.
- Capacity for self-confidence, entrepreneurial spirit and skills to enable them to translate knowledge into practice and engage objective decision-making and practical cost-effective problem solving.
- Ability to communicate conclusions clearly to specialist and non-specialist audiences.
- Ability to integrate knowledge and handle complexity, and formulate judgment with incomplete or limited information.
- Ability to reflect on social and ethical responsibilities linked to the application of their knowledge and judgment.
- Capacity to use their learning skills for study in a manner that may be largely self-directed or autonomous.
- Ability to learn how to learn and capacity for lifelong learning in an intra- and intercultural and/or international context.
- Be competent candidates in further national and international training opportunities.
- Ability that inculcates familiarity with local and national norms and standards as well as international standards governing pesticide science such as those issued by national standards institutions and ISO.

5.11. Programme Learning Outcomes

The learning outcomes of the programme are divided into four categories, namely: knowledge and understanding, intellectual skills, professional and academic, practical and transferable skills.

At the end of the programme the graduate will be able to

- Demonstrate knowledge into scientific theories, methodologies and concepts within crop protection.
- Diagnose weeds, insect pests and diseases of crops.
- Elaborate and implement environment friendly plant protection approaches.
- Describe, formulate and communicate crop protection-related issues.
- Select suitable control measures for integrated pest management.
- Offer advisory services in all matters related to crop and environmental protection.
- Elaborate a personal opinion on professional issues and defend it during discussion with specialist and non-specialists audience.
- Apply and evaluate different methodologies relevant to crop protection.
- Utilise research results to develop evidence-based crop protection activities.
- Show personal integrity and act within ethics of legal frameworks.
- Demonstrate ability and willingness to function in a multi-disciplinary setting.
- Participate and conduct development work/ projects relevant to crop protection.

5.12. Learning and Teaching Methods

Different types of learning and teaching activity are defined below taking into account the complexity of the study programme and the number of credits of the modules. The main teaching methods are: lecture; practical and laboratory work; practical classes; tutorials; seminars; research seminars; workshops, case studies and problem

solving class; exploratory, educational, work-based and other types of practice, e.g., placement/internship/ traineeship, independent work, fieldwork, and thesis research project work. The crop protection study programme will cooperate with research institutions and the agrochemical industry at different levels (internship, lectures and practical courses) and provide the opportunity to focus on the topics and tools applicable and on demand for research in national and international crop protection.

Practical experience is critical for Crop Protection students and shall be gained through professional practice or practical classes, which can take different shapes, for example: demonstrations, multiphase individual or group laboratory and field practical training, design, implementation and documentation of field collections, preparing and presenting a technical report, design, implementation and documentation of thesis research projects.

Writing a final thesis is the final stage of study. A thesis research project shall offer the opportunity to link academic training with experience in interdisciplinary team work in a professional environment at the university or in a private company or research institution.

5.13. Assessment Methods

A number of assessment methods can be distinguished: formation assessment, generalising assessment and cumulative assessment. The University of Swaziland stipulates that all taught courses shall be assessed by a combination of continuous assessment and formal examination. Further, each Faculty prescribes weighting of marks from cumulative assessment and final examination. The Faculty of Agriculture and Consumer Sciences recommends a 50:50 weighting with the cumulative assessment consisting at least three pieces of work two of which must be written tests.

5.14. Programme Structure

The structure of the programme utilises Core and Elective units. Core courses for Semester I of the programme consists of units or courses that are specified as co-requisites, i.e. courses required to be taken as a unit by all students irrespective of their specialisations. Students

will then meet their total course credit requirements (30-36) by taking specified subject-specific core courses in their areas of specialisations and from elective courses. An illustration of the MSc with specialization in Entomology is given below.

Core Courses		Hours per Week		
Course Code	Course Title	Contact Hours		Credit Hours
		Lecture	Practical	Cr
Semester 1				
CPT601	Biometrics	3L	0P	3.0
CPT603	Biotechnology in Crop Protection	2L	2P	3.3
CPT605	Host-Plant Resistance	2L	2P	3.3
CPT607	Pesticide Chemistry, Toxicology and Applications	2L	2P	3.3
Total		9L	6P	12.9
Semester 2				
CPT602	Insect Evolution and Diversity	2L	2P	3.3
CPT604	Insect Physiology and Ecology	2L	2P	3.3
CPT606	Biocontrol and Biodiversity	2L	2P	3.3
CPT690	Seminar	0L	2L	1.3
		6L	8P	11.2
	Total Core Course Credits			24.1
CPT699	Master's Thesis			12.0
	Total Credits (Core + Thesis)			36.1

5.15. Conclusion

Both programmes of studies have been reviewed by peers in the Agricultural Science group. In most cases, it was fairly straightforward to draw up the list of competences for each programme of study. Likewise there was no difficulty for choosing the appropriate teaching, learning and assessment methods, albeit some of them were not

student-centred, to achieve the learning outcomes. However, it was not possible to assess whether the combination of the teaching methods and assessment tools were of the right mix so as not to overload the students and achieve the learning outcomes. Another challenge was to define the programme learning outcomes. But both programmes give the students a better understanding of what competences they should acquire and could offer to their future employers. For academic staff, it will help them for a better alignment of their teaching methodology with the expected learning outcomes. However it is worthy to mention that it should not be construed as the final degree programme as both can be further improved.

Chapter 6

Reflection on Staff Development

Henri R. Mloza-Banda[1], *K. Boodhoo*[2]

6.1. Overview

One of the objectives of The Tuning Africa II Project seeks to enable the development of an agreed system of credits to support the higher education harmonisation strategy of the African Union, and to strengthen institutional capability in the area of curriculum reform in terms of design, teaching, learning and assessment based on competences and intended learning outcomes. The Tuning Africa Project has developed reference points for an Agricultural Science curriculum on the basis of agreed competences and learning outcomes for a first cycle degree programme. For its successful implementation, it is imperative that an effective academic staff development is put in place to buttress the competence-based curriculum being developed.

Staff development refers to the programmes and activities planned and implemented by managers and staff members for the development of competences (knowledge, skills and attitudes/values) needed by individual staff members with a view to organisational effectiveness and quality of professional life (Seyoum, 2012; Partington and

[1] University of Swaziland, Faculty of Agriculture, Swaziland.

[2] University of Mauritius, Faculty of Agriculture, Mauritius.

Stainton, 2003). In the context of the Tuning Africa Project, the staff development programmes was intended to facilitate academics to effect a paradigm shift from being a 'teacher-centred/content-oriented' (where lectures are the dominant teaching method) to 'student-centred/learning-oriented' modes of curriculum development, delivery and assessment.

6.2. Mapping of University-Supported Academic Staff Development

A wide range of learning and development activities are often provided to enhance the knowledge and skills of all staff in order to meet the priorities of the university, schools /departments and individuals. They range from those facilitated by academic and management committees or units to those incidental initiatives identified by and for staff at local, regional or international levels. In order to map staff development opportunities, a simple needs consultation was undertaken to identify current staff development programmes at each institution, as well as to identify their future training needs.

6.2.1. *Current Academic Staff Development Programmes*

From the consultation, it was found that most member Universities, the organisation of staff development, is dispensed by academic staff development centers. In some cases all new academics recruits are requested to follow a module on Learning Theories, Teaching and Assessment methods and on Writing up lesson plans. In some cases, universities fund conferences/seminars/workshops related to academic staff development skills. In many instances, there are ongoing in-service seminars for academic staff on basic teaching skills, on the use of educational technology to improve the quality of teaching and student learning and assessment and evaluation. However, in one case, it was mentioned that presently there are no strategies for staff development.

6.2.2. *Identification of Staff Development Needs*

A wide range of areas for staff development workshops at the SAG members' respective institutions were identified (Table 11). The topics

identified show that by and large, the emphasis for staff development is mainly on teaching and learning and assessment methods.

Table 11
Topics identified for staff development workshops

Topics for Staff Development Workshops
• Development and Importance of generic competences
• Use of Innovative teaching methods to enhance student learning
• Calculation of Student workload in credit system
• Writing up learning outcomes for course units/module
• Matching competences and learning outcomes
• Improving assessment methods for a competence based curriculum
• Use of Technology in Teaching
• Development of Blended Learning Strategies
• Development of Online Course Materials
• Development of a competence-based curriculum and instruction
• Use of Open Educational Resources
• Student-centred methods of teaching

6.3. Proposals for Staff Development Programmes

Several workshops were proposed by the academic staff. These workshops were specifically tailored to their respective subject areas, institutional and national needs. The breakdown of the proposed staff development programmes is shown in Table 12. The workshop proposals were mounted according to the template developed by Tuning. Each proposal was reviewed by two reviewers according to a checklist to check the consistency and whether the proposal matches all the proposed learning outcomes and activities. The aim of these workshops was to target a wider audience of academic staff so that a competence-based approach can be embedded widely in the universities. These topics were delivered in face to face workshops. It is, however expected that their conversion to an online version will permit more academics to be trained.

Table 12
Topics identified for staff development workshops

Title of Workshops
• Evaluation and integration of pedagogical approaches in the implementation of a real system of mutualisation of training
• Importance of generic competences in curriculum development
• Innovative methods of teaching to enhance student learning
• Writing intended learning outcomes and start of sequences
• Student workload in a credit system
• Writing learning outcomes for course units/module
• Entrepreneurial culture during placements outside the university
• Capacity building workshop on improving the assessment of learners' (students') competences in the three major agricultural resources management courses
• Capacity building workshop on enhancing the assessment of student competences in agricultural course
• Development of an African standard for Agricultural Engineering Education

6.4. Tuning on-line Courses on Competence-based Curriculum

The Tuning Project provided participants and staff at their respective universities two on-line courses: the first was on competence-based curriculum development and instruction while the second was on assessment methods. The main objective was to reorient educators' conceptions of learning and teaching and to familiarise more academics from the member institutions with the components of a competence based curriculum, its teaching methods and assessment.

The Tuning Project dissociated its approach from that described by Ho *et al.* (2001) where elsewhere staff development effort works on the assumption that providing tertiary educators with prescribed skills and teaching recipes will change their teaching practices and thus improve their students' learning outcomes. Ho *et al.* (2001) cited contrary experiences where such methods are pursued. The Tuning on-line courses on competence-based curriculum, instruction and assessment were instead based on educators' conceptions of learning and teaching to explain limitations of their teaching skills developed from years of

classroom experience as students and subsequently as teachers (Moon, 2001; Brown, 2004).

Specifically, the on-line courses engaged participants in four persuasive elements described by Ho *et al.* (2001): a self-awareness process whereby participants underwent a self-reflection and clarify personal conceptions; a confrontation process in which participants were brought to realise possible inadequacies in their existing conceptions and/or teaching practices and thus create an awareness for the need to change; an exposure to alternative conceptions to provide a direction and a model for improvement; and a commitment building process to encourage participants engage in changes and development.

Participants commended this on-line support courses as it gave them a better focus on competence teaching, learning and assessment methods. This strategy enabled sustained interaction among academic staff and helped other staff to embrace the Tuning Methodology and allowed the inclusion of a greater number of staff in the Tuning Africa Project.

6.5. Reflection on Design of Staff Development Workshops

Workshops on (i) curriculum development, (ii) assessment, (iii) student workload and credits and (iv) intended learning outcomes were organised. They helped participants to gain a better understanding of the expectations for staff development workshops to be organised at their respective countries. Further, it enabled them to improve their knowledge and skills in designing meaningful workshops. The multiple perspectives of views/discussions among the group members, and the good back up provided by the facilitators, contributed greatly to these outcomes. However, many research works have shown that the success of introducing new pedagogical tools, after their training, to enhance learning of students depends on several factors such as resources, teacher knowledge and skills, teacher attitudes and beliefs and time constraints and other priorities (Kim *et al.*, 2013; Maskit, 2013; Banks, 2016). Hence these factors need to be taken into consideration when designing the staff development workshops for successful implementation.

Institutions participating in Tuning however need to evaluate staff development efforts, i.e., some assessment of the programme's impact on participating staff, the organisation, and students. For meaningful and enduring improvement, Guskey and Sparks (1991) suggested that

evaluation of programmes should include participant outcomes (the knowledge, skills, and/or attitudes of staff), organisation outcomes (changes in institutional culture or in role responsibilities), and student outcomes (learning gains or affective and behavioural outcomes). Guskey and Sparks (1991) observed that while staff development is essential for anyone directly involved with students and whose actions directly influence their learning, in itself, it would not likely bring about significant improvement if students and the organisation do not change as well. Indeed, the Group expressed concern about the willingness of students to respond positively to changes in the teaching methods and learning processes for the programmes' content. It was the general impression that such student response could be negative, creating a disincentive to adopt these changes.

6.6. Conclusion

Academic staff development remains a prerequisite for the universities' ability to ensure delivery of competence-based curricula, and maintain and develop a respectable market position in higher education. The African Universities were encouraged to embrace an approach to staff improvement in which teachers' prior conceptions of teaching are modified and changed to one of facilitating student learning, including curricula development that are based on tenets of student-centred strategies and approaches. A wide range of topics have been identified as needing training purposes such understanding of the theoretical bases for the curriculum reform, and ways of implementing it through teaching, learning and assessment of student learning. The Tuning workshops held during the meetings and the online courses have brought immediate results through increased knowledge and skills of faculty staff to update their teaching methods and embrace a competence-based approach for curriculum development. It is expected that through the staff development workshops, a wider audience of academic staff will become familiar with the Tuning Methodology and its related areas.

Chapter 7

Student Workload and Credit System

Esther Sakyi-Dawson[1], *Bonaventure Minani*[2], *Randriany Jean Baptiste Ramaroson*[3]

- Relevance of a continental credit system.
- Issues affecting its adoption related to the Agricultural Sciences SAG.
- Main issues arising from the workload consultation for the SAG.

7.1. Definition of the Student Academic Workload

The Tuning Africa Project aimed at defining a credit reference system for Africa which would reflect the real effort in terms of the time, measured in hours that students devote to the curricular activities of their degree programme, whether they are those performed with support from academic staff/lecturers and tutors or those performed independently as individuals or in groups (Tuning, 2014a).

One of the main elements of curriculum design is the student workload (Kember, 2004; EC 2015). In Tuning Methodology, emphasis is given

[1] University of Ghana, Ghana.

[2] Université de Ngozi, Burundi.

[3] Antananarivo University, Madgascar.

to the time spent by students in independent studies along with hours of classroom activities, laboratories, workshops, internships, among others, to achieve the defined learning outcomes of a course unit/module. This time is needed for the student to construct their own meanings to transform this information into knowledge and mobilise and contextualise their learning (Alarcón *et al.*, 2013). In this context, student workload is defined as the average time required to successfully complete all planned learning activities (e.g. attending lectures, private study, examinations) in and out of class to achieve the specified learning outcomes of module/a course unit in a study programme and is thus not solely related to formal teaching hours (González and Wagenaar, 2008).

In this context, a survey was carried out to estimate the total hours of work needed by a student to pass a unit/course/module from the point of view of both the academics and students, and to compare the two estimates.

7.2. Components of the Learning Activities

The teaching and learning of an applied science like Agricultural Science consists of learning facts and figures, rules, laws formulae, problem solving, understanding of basic scientific principles of concepts and explanation of concepts and observed phenomena. Students in agriculture have a strong practical component where they familiarise themselves with various laboratory tools/equipment (e.g., use of chromatography), farms tools /equipment (e.g., use of sprayers, calibration of irrigation machines) and crop and animal husbandry practice (e.g., candling of eggs) (UNESCO, 2008). It is therefore crucial for the teacher to use appropriate pedagogy to achieve the learning outcomes.

The following face-to-face learning activities were identified by the SAG as those that constitute the contact learning processes for an agricultural degree: lectures, laboratory practicals, dissertations, field work/visits/on-line discussion, internships/industrial experience, continuous assessments (e.g. class tests) and formal examinations. More information on the teaching methods for agriculture can be found in Module 10 of the UNESCO booklet (UNESCO, 2008). The non-face-to-face activities were as follows: reading textbooks, preparing and developing assignments, fieldwork, and laboratory work,

private study, preparing and developing written assignments, online activities and studying for assessment purposes.

7.3. Calculation of Student Workload

In a preliminary exercise, the group discussed the learning activities that are involved in 2 modules in an agricultural curriculum to estimate the real student workload, which is shown in Table 13.

Table 13
Estimated hours for Learning Activities for 2 typical modules in Agricultural studies

	Learning Activities and Assessment	Agricultural Economics	Animal Production
		Time dedicated to the Activities in Hours	Time dedicated to the Activities in Hours
I	Lecture	3 hrs.	2 hrs.
II	Practical / On farm activities	0	2 hrs.
III	Field Work/farm Visits/ Excursions	0	1
IV	Seminars/Oral Presentations	1	1
V	Industrial Experience/ Internship	0	0
VI	Reading Assignments and Tutorials	1	30 min
VII	Test/Assessment/ Examination	25 min	25 min
VIII	Writing Assignments	1	30 min
IX	On-line discussions	0	1 hr.
XXI	Independent Research	1	30 min
	Preparation for test : Exam/ Assessment	75 min	75 min
	Total Per Week	8 hrs. 40 min	10 hrs. 10 min
	Total Per Semester	120 hours	165 hours

In addition to this preliminary estimation of student workload, a largescale questionnaire based survey was carried out to calculate

the time students devoted to their different subjects throughout one semester, both from the learner's and academic's perspective, in the 13 countries represented in the SAG. The questionnaires were administered both to the students (n = 623) and academics (n = 66) teaching the subjects. The questionnaire included questions on: the duration of contact sessions, the time devoted to independent work activities and workload planning. A semester was chosen that was neither at the beginning nor the end of the programme, such as the fifth or sixth semester. The average number of weeks per semester was assumed to be 15 weeks. Given that the length of undergraduate degree programs were not the same across the continent, it was found best to conduct the survey using courses taught in the 1st Semester of the year before the graduation, namely the 5th Semester for 4 year programmes or the 1st semester of the 2nd year (Semester 3) for 3 year programmes. For 5 year programmes, the 8th semester was used. The results of the survey are shown in Table 14.

7.4. Estimation of Student Workload for an Agricultural Graduate

From Table 13, it was noted that students spent between 120-165 hours for the 2 modules.The number of modules taken by a student normally ranged from five to eight per week and students spent about 8-10 hours per day (equivalent 40-50 hours per week) in learning activities. A typical semester will last 15 weeks. Thus according to this preliminary study, it can be grossly estimated that the student workload over a period of one academic year spans from 1,200-1,750 hours. These preliminary data also have demonstrated that students on this programme of study could be overloaded. On the other hand, the Tuning Africa Policy Advisory Group (TAPAG), established by Tuning Africa Project Phase 2, which has analysed the survey among all universities participating in the Agricultural Science group, has shown that an average student workload over a period of one year spans from 1,350 to 1,800 hours of study. In a similar survey in Latin America Universities, it ranged from 1,200-1,400 hours while the annual student workload for Agricultural Sciences stood at 1,300 hours (Alarcón *et al.*, 2013).

Table 14 provides a summary of the survey conducted by members of the Agricultural Sciences Subject Area Group in their respective Universities. The results are an average of responses for all the courses/ subjects/modules taken to fulfil the requirements for the programme during a particular semester and not for individual courses.

Table 14
Responses obtained from Academics and Students on face-to-face contact and student independent work in hours

Questions	Responses	
	Academics	Students
Time spent in studying (hours)		
Total contact hours to study for the programme modules in the semester	231	346
Total number of hours of Independent work done during the semester per unit/course/module for the programme	342	488
Total Contact hours and Independent Work (Hours)	573	834
Average number of hours spent for specific forms of independent work engaged in during the semester per course/unit/module		
• Reading texts or literature (hours)	93.5	117.00
• Unsupervised Fieldwork/site visits	34.0	22.5
• Unsupervised lab work	29.50	23.0
• Preparation and execution of written assignments	48.0	68.0
• Working with internet sources (internet searches)	54.0	42.0
• Preparation for interim assessments and final exams	75.0	211.00
• Other (including preparation for scheduled classes)	9.0	5.0
Hours needed by an average student to complete *all* the requirements of programme in a *semester* (contact hours plus independent work)	445.00	654.00
Hours per week of study an average student (both contact hours and independent work) requires to complete all the requirements of each unit/course/module in the programme	45.17	62.13
Workload planning		
% of lecturers who in planning the workload for their unit/course/module, take into consideration the hours they expect students to spend on independent work	54.55	—
% of lecturers who take into consideration student's expectations and evaluation when planning the workload for their unit/course/module	48.96	—
% of students who are aware of the number of hours they are expected to spend on independent work	—	55.52
% of students who indicated that their lecturers guided them at the beginning of the unit/course /module on the necessary workload expected for each part of the independent work they are to engage in	—	34.99

Source: Bartolomé, 2016.

The total number of hours envisaged by a lecturer (academic) that a student should spend on independent work and contact hours (573 hours) is less than the sum of contact hours and independent work hours taken individually (834 hours). This means that academics are giving more work to the students than they think that they should give. This is happening because as per the results of the survey, just about 55% of academics planned the expected workload for their course in relation to the whole programme when designing their syllabus. In general students are also not guided about the number of hours they are expected to need to devote to independent work for a course or for the programme. Less than 40% indicated that they were given some guidance and less than 60% are actually aware of the number of hours they are expected to spend on independent work. This means some may be spending more time than necessary whilst others may not be spending enough time.

A point worth noting is that a disproportionately high amount of the time is being spent on preparing for tests and exams by students (211 hours) compared to the time academics think students should be spending on this type of independent work (75 hours). This is a reflection of the over-dependence on exams as a means of assessing student learning.

Students stated that on average they devoted a total of 62 hours during the semester to complete all the requirements of each unit/ course/module in the programme, whereas lecturers stated that students should spend an average of 45 hours for that purpose. The average number of weeks per semester was 15 weeks, which works out at an average of 12 hours per week according to student data, and 9 hours according to lecturers. Usually, the number of courses taken by a student ranged from 5 to 8 per week. Clearly this shows that the students may be overloaded when taking all the modules together. In Latin America, the average for Agricultural Sciences was estimated at 51 hours (Alarcón *et al.,* 2013) which fall in between the estimated hours in this study (45-62 hours).

However, some research has shown that long hours of student work are not necessarily excessive workload if the course is well designed (Kember and Leung, 2006). However, it is important to stress that the estimation is not the actual time that any particular student needs to spend learning. The actual time will differ from student to student. Indeed there are numerous studies that have shown that not all

learners spent the same amount of time for the same module. Also, it must be taken into account that there are many factors affecting the workload of individual students such as teaching methods, module content student capability and pedagogical resources (González and Wagenaar, 2006). This may explain the wide variation in student workload recorded in Table 13. But nevertheless, the results of the survey have provided a good indication of the student workload in an agricultural degree programme in Africa.

7.5. Comparison of Contact Hours v/s Independent Work

The survey also sought to find out the perspective of both academics and students about the proportion of time students spend attending lectures, laboratory sessions and doing other supervised work (contact hours) compared to the time they spend on independent work. The results are represented graphically in Figure 3.

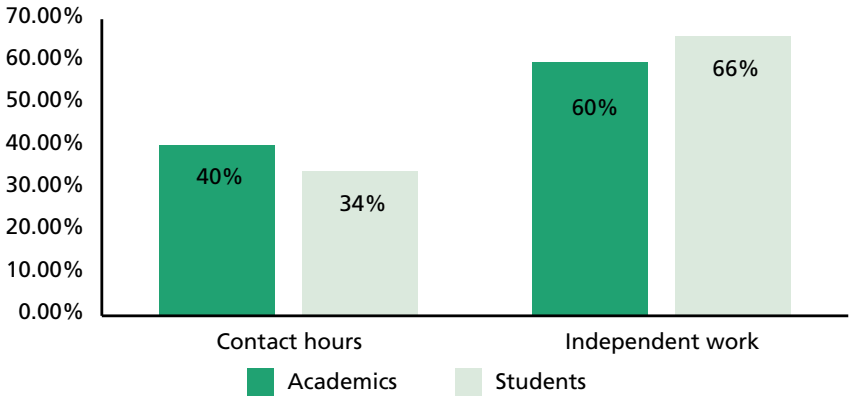

Figure 3
Response of Academics and Students about the average proportion of time spent on Contact Hours v/s Independent Work in the Agricultural Sciences

In general students rated the proportion of time spent on independent work higher than the academics did. This is because the system of learning is still largely teacher-focused rather than being learner-focused. The other activities such as presentations, assignments and

visits are usually not included in the calculations and thus the true number of hours spent for learning is grossly underestimated by the academics. But on the average both academics and students thought that for a programme in the Agricultural Sciences, contact hours (i.e. lectures, labs, supervised field work etc.) constituted approximately 40% of the study time with independent work constituting approximately 60%. This is acceptable and must be maintained. There may be slight differences from course to course but the contact hours should never be more than hours spent on independent work.

Academics responsible for planning a study programme are expected to develop a good understanding of what the workload for a particular programme/unit/module may entail and relate this workload to the learning outcomes to be achieved. However, the system of consulting students in order to calculate their work-load is not common in many African higher education systems. In some francophone African countries, where the LMD system exists, student workload is considered to be composed of 60% time spent with the teacher and 40% time spent for independent work. The results from the survey have revealed that the opposite may actually be occurring because approximately 60% of learning time is devoted to independent work.

7.6. Relevance of a Continental Credit System

Issues affecting its adoption that are related to the Agricultural Sciences.

7.6.1. *Definition of Credit*

A credit is normally a value assigned to a programme of study. The concept of 'credit' refers to the amount of learning contained in a qualification or part of a qualification (SAQA, 2014).The value can be calculated in various ways. For example, in the UK credit is based on defined learning outcomes (based on the amount and depth of learning undertaken) while in North America it is based on contact hours (the number of hours of instruction that students receive). In Europe, the European Credit Transfer and Accumulation System (ECTS) is the system used by many universities. It is a system that has also attracted a great deal of attention globally (EC, 2015). It is a

learner-centred credit system that promote student mobility, facilitate recognition of degrees and allows accumulation and transfer of credits among institutions in many european countries (EC, 2015). It is a measure of the workload required by a typical learner to acquire competences defined by the learning outcomes. It makes study programmes easy to read and compare for all students, local and foreign, and therefore facilitates mobility and academic recognition.

7.6.2. *Continental Credit System*

A continental credit system must be learner-centred for purposes of credit accumulation and transfer, and based on the principle of transparency in learning, teaching and evaluation processes. It must aim to facilitate the planning, implementation and evaluation of study programs and student mobility by recongising learning outcomes, certifications and learning periods (CEDEFOP, 2010).

One of the challenges facing African higher educational system is the difficulty for students to be able to transfer part or all of their study credits from one institution to another in order to continue their education (Woldegiorgis and Doevenspeck, 2015). For example, in the Agriculture Group, the total number of credits, for the award of various bachelor programme of studies of 3 years, varies between 100-180 credits, despite the universities may be offering the same degree. This is because the concept of credit has different meaning, ways of calculation, and different applications from region to region and from country to country. There is at present no reliable tool for measuring student achievement in a transparent way and there is no defined system which allows for adequate recognition of student workload/ credits between institutions and between countries. It is therefore hoped that the development of an African credit system will pave the way for making comparability and transferability of period of studies in the continent possible (Woldegiorgis and Doevenspeck, 2015).

There is thus a need to recognise and understand the different types of credit and transfer systems being used in different parts of Africa, as presently, little information is available. A study was therefore carried out to find out the different types of credit systems in some African universities.

7.6.3. *The Credit System in Africa*[4]

For the Agricultural Sciences, most of the participating countries have a credit system though the definitions and duration of study may vary from country to country.

In North Africa, all the five countries participating in this study are committed to the LMD programmes, and a Credit system is used in their higher education institutions. However, not all the Universities in the five countries employ the Credit system. Some universities are still using the old British system.

In southern Africa, only Angola has no Credit system. All the other 8 countries have one form of Credit system or another. All universities in Madagascar, Mauritius, Namibia and South Africa practice the Credit system. As in the case of the North African countries, not all universities in Botswana, Lesotho, Malawi, Mozambique and Swaziland currently operate the Credit system.

In East Africa, the Credit system started with Kenya in 1968 and the latest country to adopt the system was Burundi in 2012. It is only in Somalia that the Credit system does not exist in East Africa. Some of the countries, such as Djibouti, have not been able to apply the Credit system to their medical programmes.

In West Africa, the Credit system started in 1968 in Nigeria and developed widely in the 1990s in other countries such as Ghana. In some countries programmes in Medicine are exempted from the credit system.

In Central Africa, the Credit system started in Cameroon in 2007 and has just been introduced to Zimbabwe in 2016. The Democratic Republic of Congo (DRC) has no Credit system. Most universities in Cameroon operate the LMD while not all universities in DRC and Zimbabwe operate the Credit system. LMD is at Pilot phase in the University of Lumumbashi (DRC). In Zimbabwe, 15 Universities have committed to change from the Course Unit System to the Credit system.

[4] Extracts from the TAPAG report, Tuning Africa 5th Meeting, Belgium, Brussels, Nov 2017.

7.6.4. *Definition and Measurement of Credit in Various Regions*

The ways in which credits are defined or measured across the continent can be categorised under 3 major types. These are summarised as follows:

i. Teacher contact hours with the learners.

   - 1 credit unit is equivalent to one hour of lectures/tutorials or 2-4 hours of practicals/field work per week for the duration of the study period in the semester.

ii. Teacher contact hours with the learners plus hours for independent work

   - 1 credit unit is equivalent to 15 hours Lectures + 10 hours of independent work.

iii. Notional Hours which includes contact time, structured learning, workplace learning, assessment, and self-study

   - 1 credit = 10 notional hours.

7.7. Proposal for Number of Credits for an Agricultural Degree Programme

In this section, a credit-based system for a degree in Agricultural Sciences is being proposed. Based on the estimated yearly average total student workload of 1,350-1,800 hours, and that the semester is on average 15 weeks, the student workload would turn out to be ranging from 450-600 hours per semester. There was some variation in the number of credits necessary to complete a year of an undergraduate programme. This varied from 36 to 60 with the majority requiring 60 credits per year, meaning that for a bachelor degree of 3 years, 180 credits would be required. The general trend is that 60 credits are equivalent to the workload of a full time student during one academic year (TAPAG, 2017), one credit in an agricultural degree would be equivalent to 20 to 25 hours of work. This is higher than the current hours presently being allocated in some participating Universities. This is due to the fact that in the newly estimated student workload both

formal and independent work hours spent by the students have been considered. However, given that Agricultural Sciences is a practical oriented subject and entails several laboratory work, field visits, on field experimentation, among other activities, the 20 to 25 hours may be on the low side. It would be reasonably fair to suggest that one credit should be about 30 hours.

7.8. Conclusion

There were significant gap between the students and academics on student workload, independent work hours and planning of student workload. A credit does not have the same value and are not calculated in the same way in the participating countries. The Anglophone and Francophone Universities in Africa credit systems differ and the workload per credit varies among institutions. There is currently no credit transfer system as such among institutions in Africa. The general trend is that 60 credits are equivalent to the workload of full-time student during one academic year. In a majority of countries across the continent the use of teacher contact hours to define the credit is prevalent, except for the countries practicing the Licence-Master-Doctorat (LMD) system. This survey has provided a gross estimate of the average workload of an agricultural student and shown that students in most African universities were indeed overloaded.

It was noted that in most African universities, except for the countries practicing the Licence-Master-Doctorat (LMD) system, the work-load of the students is therefore largely measured in terms of the teaching load of the lecturer. This is because the system of learning is still largely teacher-focused rather than being learner-focused. The other activities such as presentations, assignments and visits are usually not included in the calculations and thus the true number of hours spent for learning is grossly underestimated.

In a majority of countries across the continent, the use of teacher contact hours to define the credit is prevalent. A credit does not have the same value in all the countries and regions. The Anglophone and Francophone credit systems differ and the workload per credit varies among institutions. There is currently no credit transfer system among institutions in Africa. The general trend is that 60 credits are equivalent to the workload of full-time student during one academic year.

This study on the African student workload in Agricultural Sciences is meaningful as it has provided a basis for the definition and implementation of a harmonised reference credit system for the region. This will ease student mobility across institutions and make comparability and transferability of period of studies in the continent possible. This credit transfer system should take into consideration the competences that are required at each level in an Agricultural Science programme. Basing the transfer system on the competences gained at a specific level will make it easier for students to transfer part or all of their credits in order to continue their education in another institution.

Chapter 8

General Conclusions and Recommendations

The Tuning Africa Project has afforded agricultural academics from 13 countries representing the five regions of Africa the time to meet and deliberate on the skills and competences that African Agricultural Science graduates are expected to acquire. 18 generic and 16 subject-specific competences were identified as necessary for a graduate to be able to demonstrate on completion of a first level or cycle degree in Agriculture. A Meta-profile for Agricultural Sciences was developed as that any university in Africa could use to evaluate its Agricultural undergraduate programmes. The relationships established between the competences identified as core elements and as supportive elements in the Meta-profile can constitute an indispensable guide for effective curriculum development. This clearly is useful to the students by having a better understanding of what skills they should acquire and could offer to their future employers. For staff, it would help them to better align their teaching methods with the learning outcomes and devise appropriate assessment.

The relationship established between the competences identified as core elements and as supportive elements in the Meta-profile can constitute an indispensable guide for effective curriculum development which can facilitate staff and student mobility within the region and ensure an effective training in Agriculture in the African region. This conclusion is further supported by the fact that all the participating universities found no significant contrasts between the proposed Meta-profile and their programmes of studies.

The working group recommends that agricultural institutions should regularly evaluate their curricula to ensure that they are achieving the expected competences. It is hoped that the results of the work carried out by the Agricultural Science Subject Area team, within the context of the Tuning Africa Project, will help to produce better curricular proposals for educating Agricultural professionals for Africa. Competences described by Tuning Africa should be used as reference points by programme developers but they are not meant to be interpreted as prescriptive. In other words, our findings allow flexibility and autonomy in programme development to be preserved, while a common language for formulating programme aims and objectives is made available.

There is a need to involve yet more academics through staff development activities that enable them to examine the tuning approach in direct relation to their own needs and circumstances. As yet, it is mostly a teacher-centred pedagogy that is being used. On average, it was shown that students in most African universities surveyed were overloaded and the extra hours of work are not being accounted for in their total student workload. The workload of the students is largely measured in terms of the teaching load of the lecturer. It is therefore necessary to devise a harmonised credit system that gives due recognition to the total student workload.

However, there are a few challenges which could affect the effective adoption of a competence-based curriculum. In order to effectively adopt all the competences, there will be the need for substantial investment to improve infrastructure, laboratories and equipment, to adopt teaching aids, to create good learning environment and to provide well equipped library among others. Large student numbers may pose a difficulty in having effective interaction with the students to be able inculcate all the skills in the student.

Another area where there would need for improvement is that teachers will need re-tooling/re-training to be more effective in their teaching methods. The style lecturer-centred instruction should be replaced with more student-centred teaching methods to ensure that the generic and subject-specific competences are imparted and properly assessed. It is suggested that right from the beginning newly recruited staff should be trained in student centred pedagogies and assessment methods based on learning outcomes.

Although the academics have been given opportunities to revise or develop new curriculum based on the developed competence framework, attended the staff development workshops developed and the Tuning Online courses on competence based TLA, it is felt that the task of breaking down the competences into meaningful learning outcomes is still a challenge for many academics of the Universities represented in the SAG. It is recognised that the skills and knowledge to write those learning outcomes, develop newer teaching methods and to devise the appropriate assessment techniques requires expertise and experience.

Overall, Tuning Africa has paved the way for African Universities to adopt a learning outcome-based approach to curriculum development. The adoption of the competences and removal of some obstacles will surely bring up a new breed of Agricultural Science graduates on the African continent.

References

Acuna, T., Kelder, J.A., Lane, P., Hannan, G. (2013). Developing Threshold Learning Outcomes for Agricultural Science. International Journal of Innovation in Science and Mathematics Education 21(5), 54-66, 2013.

Adenle, A. A., Azadi, H., Manning, L. (2017). The era of sustainable agricultural development in Africa: Understanding the benefits and constraints. Food Reviews International 1-23.

AGRA (2016). Africa Agriculture Status Report: Progress towards Agricultural Transformation. Nairobi, Kenya: Alliance for a Green Revolution for Africa (AGRA).

Alarcón, F, Beneitone, P, de Armas, R, Kieling, S, Suñé, L and Venero, D (2013) Student Workload and Degree Profiles: the experience of CLAR credit in Latin America. Tuning Journal for Higher Education (1).

Armoogum, N.Y, Ramasawmy, B and Driver, M.F.D (2016). The need to enhance the employability competences (knowledge, skills, autonomy, and attitudes) of undergraduates in Agriculture. Evidence from students' perceptions and employers' expectations. Tuning Journal for Higher Education, 4 (1) Available at http://www.tuningjournal.org/article/view/1207

Villa, A., González, J., Auzmendi, E., Bezanilla, M.J.and Laka, J.P. (2008): Competences in teaching and learning process. In "Tuning Educational Structures in Europe, Universities Contribution to the Bologna Process, an Introduction" (ed. González, J and Wagenaar, R). University of Deusto, Bilbao, Spain.

Banks, J. (2016). Promoting Change: Professional Development to Support Pedagogic Change in Sessional Teaching Staff. Procedia - Social and Behavioral Sciences 228, 112-117. https://doi.org/10.1016/j.sbspro.2016.07.017

Bartolomé, E (2016) Student Workload survey analysis, Paper presented at Third General Meeting, Tuning Africa II, Accra, Ghana, 17 October 2016.

Beneitone, P (2014). Generic Competences and the Consultation Process. In Tuning and Harmonisation of Higher Education: The African Experience (Onana, C.A., Oyewole, O.B.,Teferra, D., Beneitone, P., González, J. and Wagenaar, R. (eds.). University of Deusto, Bilbao, Spain. Retrieved at http://tuningacademy.org/wp-content/uploads/2014/05/Tuning-Africa-2014-English.pdf

Beneitone, P, González, J. and Wagnenaar, R (2014). Meta-profiles and profiles. A new approach to qualifications in Latin America. University of Deusto Press, Bilbao. Retrieved at https://tinyurl.com/y9lo3dhx

Beneitone, P. and Bartolomé, E. (2014). Global generic competences with local ownership: a comparative study from the perspective of graduates in four world regions. Tuning Journal for Higher Education 1, 303-334.

Beneitone, P and El-Gohary A (2017). Student Competencies and Curriculum: Tools for Regionalisation. In Regionalization of African Higher Education: Progress and Prospects (Knight, J. and Woldegiorgis, E.T. (Eds.) African higher education: developments and perspectives Series, Sense Publishers, Netherlands.

Brown, S. (2004). Assessment for Learning. Learning and Teaching in Higher Education, http:// www2.glos.ac.uk/offload/tli/lets/lathe/issue1/articles/brown.pdf (Accessed 23 June 2017).

CAMES (2007). Proposition de référentiel au format LMD l'équivalence et la reconnaissance. Retrieved at http://www.lecames.org/diplome_cames/files/refentiel_LMD.pdf

CAMES (2013). Guide pour le reconnaissance et l'équivalence des diplômes. Retrieved at http://www.lecames.org/diplome_cames/files/GuideCames_dossierRecEqDiplomes-2.pdf

CEDEFOP (2010). Linking credit systems and qualifications frameworks. An international comparative analysis. European Centre for the Development of Vocational Training, European Union,

Luxembourg. Retrieved at http://www.cedefop.europa.eu/en/publications-and-resources/publications/5505

Collet, C., Hine, D. and du Plessis, K. (2015). Employability skills: perspectives from a knowledge-intensive industry. Education + Training, Vol. 57 Issue: 5, pp.532-559, https://doi.org/10.1108/ET-07-2014-0076

EC (European Commission) (2015). ECTS Users' guide. European credit transfer and accumulation system and the diploma supplement. Retrieved from https://publications.europa.eu/en/publication-detail/-/publication/da7467e6-8450-11e5-b8b7-01aa75ed71a1/language-en

González, J. (2014). "Tuning definitions" in Tuning and Harmonisation of Higher Education: The African Experience (Onana, C.A., Oyewole, O.B., Teferra, D., Beneitone, P., González, J. and Wagenaar, R. (eds.). University of Deusto, Bilbao. Retrieved at http://tuningacademy.org/wp-content/uploads/2014/05/Tuning-Africa-2014-English.pdf

González, J., & Wagenaar, R. (2006). Student workload, teaching methods and learning outcomes: The Tuning Approach. In Wagenaar, R. and González, J. (Eds.), Tuning Educational Structures in Europe. Universities' Contribution to the Bologna Process. An Introduction, Bilbao and Groningen: University of Deusto Press.

González, J and Yarosh, M. (2013). Building Degree Profiles. The Tuning Approach Tuning Journal for Higher Education, 1.

González, J and Beneitone, B (2014) The meta-profiles for the different areas and their role in developing qualification profiles. In Meta-profiles and profiles: A new approach to qualifications in Latin America, Pablo Beneitone, Julia González & Robert Wagenaar (Eds), Bilbao, University of Deusto Press.

Guskey, T. R. and Sparks, D. (1991). What to Consider When Evaluating Staff Development. Educational, School, and Counseling Psychology Faculty Publications, 19. http://uknowledge.uky.edu/edp_facpub/19 (Accessed 23 June 2017).

Hahn, K. and Teferra, D. (2013). Tuning as instrument of systematic higher education reform and quality enhancement: The African Experience. Tuning Journal for Higher Education 1:127-163.

Ho, A. Watkins, D. and Kelly, M. (2001). The conceptual change approach to improving teaching and learning: An evaluation of a Hong Kong staff development programme. Higher Education 42: 143–169.

Ho, H-F. (2015). Matching University Graduates' Competences with Employers' Needs in Taiwan. International Education Studies 8 (4).

International Labour Office (2012). International Standard Classification of Occupations, ISCO-08, Geneva, ILO.

Hooper,L., Begg,M.D., Sullivan,L.M. (2014). Integrating Competencies and Learning Outcomes in Core Courses for the MPH. Public Health Rep. 129 (4), 376-381.

Kember, D. (2004). Interpreting student workload and the factors which shape students' perceptions of their workload. Studies in Higher Education, 29 (2), 165-184.

Kember, D., & Leung, D. Y. P. (2006). Characterising a teaching and learning environment conducive to making demands on students while not making their workload excessive. Studies in Higher Education, 31(2), 185-198.

Kim, C.M, Kim, C.J, Spector, J.M and DeMeester, K. (2013). Teacher belief and technology integration. Teaching and Teacher Education, 29, 76-85.

Knight, J., 2013. A model for the regionalization of higher education: The role and contribution of tuning. Tuning Journal for Higher Education 1, 105–125.

Kumar, A., and Kumar, V.A.. (2014). Pedagogy in Higher Education of Agriculture. Procedia - Social and Behavioural Sciences, ERPA International Congress on Education, ERPA Congress 2014, 6-8 June 2014, Istanbul, Turkey.

Maskit, D. (2013). Teacher's attitudes towards pedagogical changes during various stages of professional development. Teaching and Teacher Education, 27(5), 851-860.

Moon, J. (2001). Reflection in Higher Education Learning. Personal Development Planning (PDP) Working Paper 4. Learning and Teaching Support Network Generic Centre. University of Exeter. U. K. http://www.sussex.ac.uk/education/.../jenny-moon-workshop---reflection-in-higher-education.pdf Accessed 23 June 2017.

Mulder, M. (2012). Competence-based education and training – about frequently asked questions. Journal of Agricultural Education & Extension 18(4), 319-327.

Oyewole, O.B. (2016). The State of the Art of Credit in African Higher Education System. Presentation at Tuning Africa, Phase II Meeting, Accra, Ghana, Oct 2016.

Partington, P. and Stainton, C. (2003). Managing Staff Development (Managing Universities and Colleges: Guides to Good Practice). Buckingham: Open University Press, U.K.

Quality Assurance Agency for Higher Education's (QAA) (2016) Subject Benchmark Statement Agriculture, Horticulture, Forestry, Food Nutrition and Consumer Sciences:Draft for consultation. Retrieved at http://www.qaa.ac.uk/en/Publications/Documents/SBS-Agriculture-horticulture-forestry-food-nutrition-and-consumer-sciences-consultation-16.pdf

Saghir, J., (2014). Global challenges in agriculture and the World Bank's response in Africa. Food and Energy Security 3, 61–68. https://doi.org/10.1002/fes3.43

Salm, M., Baltissen,G.,Hawkins,R., Sol,J., Ludemann,R., van Eerdewijk, A., Wongtschowski, M., Enserink, D. and Roefs, M. (2014). The need for Institutional Change in capacity development of tertiary agricultural education organisations; Report from CDI-ICRA-KIT Writeshop, October 2013. Centre for Development Innovation, Wageningen UR (University & Research centre), Wageningen.

Seyoum, Y. (2012). Staff Development as an Imperative Avenue in Ensuring Quality: The Experience of Adama University," Education Research International, doi:10.1155/2012/624241

Sherrad, D. (2017). Higher Education for Agricultural Transformation. Retrieved https://blog.ruforum.org/2017/12/07/higher-education-for-agricultural-transformation/

South African Qualification Framework (SAQA) (2014). Policy for credit accumulation and transfer within the national qualification framework.

Teferra, D. (2012) Harmonization and Tuning: Integrating the African Higher Education Space. Retrieved at https://www.insidehighered.com/blogs/harmonization-and-tuning-integrating-african-higher-education-space

TAPAG (2017). A proposal to establish African Credit Transfer Systems Paper presented at Fifth General Meeting, Tuning Africa II, Bruxelles, Belgium, 13-15 November 2017.

Tuning Africa (2012). Retrieved at http://tuningafrica.org/en/what-is-tuning-africa

Tuning (2014a). Retrieved at http://tuningafrica.org/en/what-is-tuning-africa

Tuning (2014b). Higher Education in Latin America: Reflections and perspectives on Agronomy (Jovita Antonieta Miranda Barrios (ed.). University of Deusto Press, Bibao, Spain. Retrieved at https://tinyurl.com/y9y7n96x

UNESCO (2008). Module 10 Teaching and Learning Agriculture. In "Guide to effective teaching and learning in higher education in Africa" (eds. Juma Shabani and Peter A. Okebukola), UNESCO, Bamako Office.

Wagenaar, R. (2014). Competences and learning outcomes: a panacea for understanding the (new) role of Higher Education? Tuning Journal for Higher Education 1 (2), 279-302.

Wickramasinghe V. and Perera L., (2010) "Graduates', university lecturers' and employers' perceptions towards employability skills", Education + Training, 52 (3). https://doi.org/10.1108/00400911011037355

Woldegiorgis, E.T. and Doevenspeck, M., (2015). Current Trends, Challenges and Prospects of Student Mobility in the African Higher Education Landscape. International Journal of Higher Education 4 (2).

Woldegiorgis, E.T (2017). Regionalization of Higher Education in Africa: The Operationalization of the African Union Higher Education Harmonization Strategy. LIT Verlag Münster.

World Bank (2007) Cultivating Knowledge and Skills to Grow African Agriculture A Synthesis of an Institutional, Regional, and International Review. Retrieved from http://siteresources.worldbank.org/INTARD/Resources/AET_Final_web.pdf

World Bank (2013a). Unlocking Africa's Agricultural Potential. Washington, DC: World Bank. World Bank, Natural Resources Institute . Washington, DC.

World Bank (2013b). Growing Africa: Unlocking the potential of agribusiness. Washington, DC: The World Bank.

Annex

Contributors to the Publication

Name	Phase	University	Country
Kohounko Dansou **KOSSOU**	II	Université Catholique de l'Afrique de l'Ouest , UCAO-UUC	Benin
Bonaventure Cohovi **AHOHUENDO**	I&II	Université d'Abomey-Calavi	Benin
Guillaume Lucien **AMADJI**	I	Université d'Abomey-Calavi	Benin
Djidjoho Joseph **HOUNHOUIGAN**	I&II	Université d'Abomey-Calavi	Benin
Jean **NDIMUBANDI**	I	Université du Burundi	Burundi
Bonaventure **MINANI**	II	Université de Ngozi	Burundi
Christopher Mubeteneh **TANKOU**	I&II	Université de Dschang	Cameroon
Samuel Kwame **OFFEI**	I&II	University of Ghana	Ghana
Esther Odofoley **SAKYI-DAWSON**	I&II	University of Ghana	Ghana
Taky Hortense **ATTA EPSE DIALLO**	I&II	Université Nangui Abrogoua	Ivory Coast
Seydou **TIHO**	I&II	Université Nangui Abrogoua	Ivory Coast
Abdi Yakub **GULIYE**	I&II	Egerton University	Kenya
Alexander Kigunzu **KAHI**	I	Egerton University	Kenya
Randrianary Jean Baptiste **RAMAROSON**	I&II	Université d'Antananarivo	Madagascar
Kamleshwar **BOODHOO**	I&II	University of Mauritius	Mauritius
Ahmed **ELAMRANI**	I&II	Université Mohammed Premier	Morocco

Name	Phase	University	Country
Yemi **AKEGBEJO-SAMSONS**	I&II	Federal University of Agriculture	Nigeria
Olusola Bandele **OYEWOLE PROF**	I&II	Federal University of Agriculture	Nigeria
Olubunmi Abayomi **OMOTESHO**	I&II	University of Ilorin	Nigeria
Mariama **SENE EPSE WADE**	I&II	Université Gaston Berger de Saint-Louis	Senegal
Puffy **SOUNDY**	i	Tshwane University of Technology	South Africa
Rashid Ahmed Mohamed **HUSSEIN**	II	Sudan University of Science and Technology	Sudan
Henry Raphael **MLOZA-BANDA**	II	University of Swaziland	Swaziland

For more information about Tuning

International Tuning Academy
Universidad de Deusto
Avda. de las Universidades, 24 (48007 Bilbao)
Tel. +34 944 13 90 95
Spain
dita@deusto.es

European Commission

AFRICAN UNION

Deusto
University of Deusto